

# Introduction

Tuesday, March 16, 2010  
10:09 AM

The REHS/RS examination consists of a total of 250 multiple-choice questions. The exam is split into two parts of 125 questions each. Candidates are given a total of four (4) hours to complete the entire exam or two (2) hours for each part with a short 15-minute break in between.

The following is a description of the 15 topic areas and the percent of each that occur on the exam:

## **I. GENERAL ENVIRONMENTAL HEALTH**

14% (35 questions)

- A. Conduct Environmental Health Investigations, Inspections, and Audits
- B. Conduct Epidemiological Investigations
- C. Collect Samples and Specimens for Lab Analysis
- D. Perform Routine Field Tests and Measurements
- E. Plan Land Use
- F. Review Construction Plans
- G. Environmental Microbiology
- H. Contamination Control

## **II. FOOD PROTECTION**

14% (35 questions)

- A. Inspection and Investigation of Food Establishments
- B. Food Safety, Protection, Quality and Storage
- C. Temporary Events with Food Service
- D. Transportation of Food

## **III. WASTEWATER**

8% (20 questions)

- A. Conduct Investigations of Wastewater Management Systems

## **IV. SOLID AND HAZARDOUS WASTE**

4% (10 questions)

- A. Knowledge of Waste Management Systems
- B. Conduct Waste Management Investigations
- C. Public Education

## **V. POTABLE WATER**

8% (20 questions)

- A. Conduct Sanitary Surveys of Potential or Existing Water Systems and Watersheds

## **VI. INSTITUTIONS AND LICENSED ESTABLISHMENTS 12% (30 questions)**

- A. Understand the Health Hazards and Sanitation Problems of Institutions
- B. Conduct Epidemiological Investigations of Institutions
- C. Conduct Investigations of Facilities, Institutions and Licensed Establishments

## **VII. VECTORS, PESTS AND POISONOUS PLANTS**

6% (15 questions)

- A. Develop Controls for Vectors, Pests, and Poisonous Plants

**VIII. SWIMMING POOLS AND RECREATIONAL FACILITIES**

**8% (20 questions)**

- A. Inspect Swimming Pools, Hot Tubs, and Spas
- B. Inspect Natural Recreation Areas and Facilities
- C. Amusement Parks and Temporary Mass Gatherings

**IX. STATUTES, REGULATIONS, AND STANDARDS**

**6% (15 questions)**

- A. Knowledge of Source and Nature of Legal Authority
- B. Knowledge of Law Concerning Inspections (search warrants, right of entry, seizures, etc.)
- C. Knowledge of Lawfulness of Agency Administrative Actions
- D. Evaluate Compliance with Appropriate Federal Laws
- E. Knowledge of Standards (ISO, UL, NSF, etc.)

**X. HOUSING**

**6% (15 questions)**

- A. Conduct Investigations of Public and Private Housing
- B. Conduct Investigations of Mobile Home and Recreational Vehicle Parks

**XI. HAZARDOUS MATERIALS**

**2% (5 questions)**

- A. Conduct Investigations of Hazardous Materials

**XII. RADIATION PROTECTION**

**2% (5 questions)**

- A. Conduct Investigations of Radiation Hazards

**XIII. OCCUPATIONAL SAFETY AND HEALTH**

**2% (5 questions)**

- A. Conduct Investigations of Work Sites

**XIV. AIR QUALITY AND NOISE**

**2% (5 questions)**

- A. Assess Ambient Air Quality
- B. Survey Noise Control

**XV. DISASTER SANITATION AND EMERGENCY PLANNING**

**6% (15 questions)**

- A. Prepare in Advance for Disasters
- B. Assist with Management of Disaster Situations
- C. Assist with Post-Disaster Management

**TOTAL**

**100% (250 questions)**

## Vectors and Pests

Wednesday, March 17, 2010  
9:15 AM

### **VECTORS and PESTS**

#### **Learning Objectives**

- Be familiar with definitions used in class
- Know the various vectors and specific diseases they transmit
- Be familiar with pesticides, types and their uses
- Know rodent species, signs, and diseases transmitted
- Be able to discuss various control and surveillance technologies
- Know the hazardous plants and illnesses they cause

## **Definitions**

- Disease – A condition of abnormal functioning typically manifested by distinguishing signs and symptoms
- Endemic – Constant presence of a disease in a given geographic area
- Epidemic – Occurrence of a given illness in a region or community that is in excess of expectancy
- Pandemic – Worldwide occurrence of a given illness in excess of expectancy in humans
- Zoonosis – Infection or infectious disease transmitted from animals to humans
- Panzootic – Worldwide occurrence of a given illness in excess of expectancy in animals

## **Definitions (cont)**

- Fomite – Inanimate object capable of harboring disease agents allowing their transmission
- Vector – any LIVING creature that can transmit a disease agent to another creature
- Transmission – any mechanism that can spread a disease agent from the source (reservoir) to a living creature
- Direct transmission – transfer of the disease agent directly into the human body
- Indirect transmission –
  - Vehicle borne – via fomites, water, food, blood, etc
  - Vector borne – living creature transmits disease agent to another living creature
  - Airborne – disease agents are spread as aerosols

### **Mosquitoes of Significance**



Anopheles Mosquito

- Malaria mosquito
- Night Biter
- Lays single eggs on water
- Overwintering stage – Adult female

### **Mosquitoes of Significance**



Aedes Mosquito

- Tree-hole mosquito
- Day Biter
- Lays single eggs on soil or in a container
- Overwintering stage – Eggs

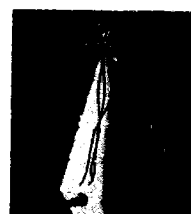
## Mosquitoes of Significance



Culex Mosquito

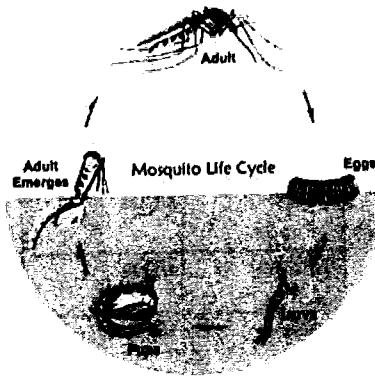
- House mosquito
- Lays egg raft on still water
- Overwintering stage – Adult female

## Mosquitoes of Significance



Can you distinguish between the three?

## Mosquito Life Cycle



<http://www.winnipeg.ca/cms/hugline/images/Mosquito-Life-Cycle.gif>

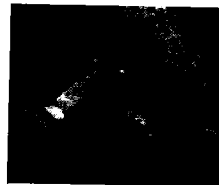
## MOSQUITOES AND DISEASES

DISEASE	VECTOR	AGENT
Malaria	Anopheles	P. Falciparum P. Vivax PROTOZOAN
Dengue (Breakbone fever)	Aedes	Flavivirus VIRUS
Yellow Fever	Aedes	Flavivirus VIRUS
West Nile Virus	Culex	Flavivirus VIRUS
Rift Valley Fever	Aedes (commonly)	Phelebovirus VIRUS
Filariasis	Several Species	Nematode

## **MOSQUITOES AND DISEASES**

DISEASE	VECTOR	AGENT
St. Louis Encephalitis	Culex	Virus
Western Equine Encephalitis	Culex	Virus
Japanese Encephalitis	Culex	Virus
LaCross Encephalitis	Aedes	Virus
Eastern Equine Encephalitis	Aedes Culex	Virus

## **Mosquito Disease Transmission**



- Mosquito is not a flying needle - does not inject blood only saliva
- If a mosquito feeds on an infected host, does not mean it will transmit the disease
- Infectious agent must infect the salivary glands

**HIV is NOT transmitted via mosquitoes**



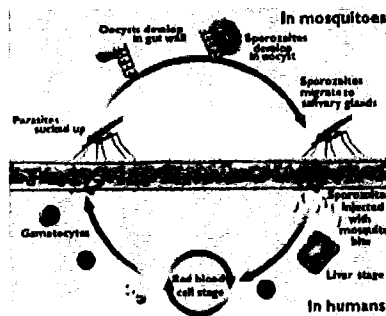
## Malaria

- Mosquito borne **PROTOZOAN** disease
- Reservoir – Humans
- Transmission - Infected female **ANOPHELES** (night biter) mosquito
- Plasmodium Vivax<sup>1</sup>
  - Most prominent strain
  - Rarely fatal
- Plasmodium Falciparum<sup>2</sup>
  - Least prominent strain
  - Most severe – untreated case fatality 10-40% or higher
  - Can be drug resistant



## Malaria

### Malaria Transmission Cycle (7-10 days)



[http://www.firstscience.com/home/images/stories/articles/malaria\\_lifecycle2.gif](http://www.firstscience.com/home/images/stories/articles/malaria_lifecycle2.gif)

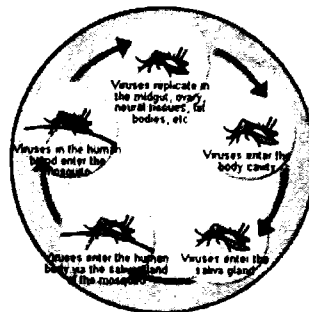
## Dengue Fever



- Mosquito borne **VIRAL** disease – Flavivirus
- Reservoir – Primarily humans (monkeys too)
- Transmission – Infected female **Aedes** (day biter) mosquito
- Mosquito is most common in cities (breed in old tires, flower pots, etc)
- Starts suddenly with a high fever, rash, severe headache, pain behind the eyes, and muscle and joint pain - “**breakbone fever.**”
- No medical treatment – prevention is best
- In the United States, approximately 100 cases of dengue are reported each year in travelers returning from tropical areas.
- Locally-acquired dengue has been reported three times since 1980 in southern Texas (1980, 1986, and 1995).

## Dengue Fever

### Dengue Transmission Cycle



[http://activity.ntsec.gov.tw/lifeworld/english/content/images/en\\_dis\\_c10.jpg](http://activity.ntsec.gov.tw/lifeworld/english/content/images/en_dis_c10.jpg)

## Yellow Fever

- Mosquito borne **VIRAL** disease – Flavivirus
- Reservoir – Primarily humans (animals including monkeys)
- Transmission – Infected female **Aedes** (day biter) mosquito
- Mosquito is most common in cities (breed in old tires, flower pots, etc)
- Most cases experience only high fever, chills, headache, muscle aches, vomiting, and a backache then recover.
- Few cases go into toxic state of shock, bleeding, and kidney and liver failure. Liver failure leads to Jaundice – yellow skin
- 20-50% of patients who enter the toxic phase die
- No medical treatment



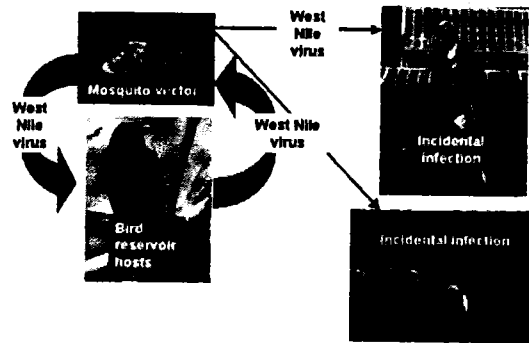
## West Nile Virus

- Mosquito borne **VIRAL** disease – Flavivirus
- Reservoir – Primarily crows and blue jays (317 other birds) – humans and other mammals are "dead-end" or incidental hosts
- Transmission – Infected female **Culex** mosquito
- Most cases experience only mild flu-like symptoms before fully recovering
- In a small number of cases, particularly among the elderly, the disease is much more serious causing encephalitis, even death
- < 1% are infected and < 1% of individuals who are bitten by infected mosquito develop severe symptoms.
- In every state but AK and HI
- No medical treatment



## West Nile Virus

### West Nile Virus Transmission Cycle



<http://www.cdc.gov/ncidod/dvbid/westnile/cycle.htm>

## Rift Valley Fever

- Mosquito borne **VIRAL** disease – Phelebovirus
- Reservoir – Sheep, cattle, goats, monkeys, rodents
- Transmission – *Aedes* (most commonly), indirect transmission through handling of animal tissues
- Most cases experience a sudden onset of flu-like fever, muscle pain, joint pain and headache
- Rarely the illness progresses to hemorrhagic fever, encephalitis, or ocular disease.
- Approximately 1% of humans that become infected with RVF die of the disease.
- No medical treatment

## Filariasis

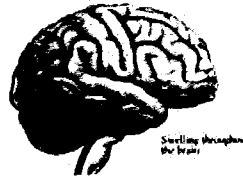
- Mosquito borne **NEMATODE** disease –W. Bancrofti
- Reservoir – Humans
- Transmission – Several mosquito species
- Most infections are asymptomatic, but the living adult worm causes progressive lymphatic vessel dilation and dysfunction
- No vaccine available
- The drug of choice for treatment of travelers with Filariasis is diethylcarbamazine (DEC).



[http://www.who.int/csr/don/20060814\\_01.jpg](http://www.who.int/csr/don/20060814_01.jpg)

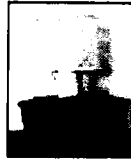
## Mosquito Borne Encephalitis

- Mosquito borne **VIRAL** disease
- Reservoir – birds, pheasants, rodents, bats, reptiles
- Transmission – Varies depending upon disease
  - St Louis – Culex
  - Western Equine – Culex
  - Japanese – Culex
  - West Nile – Culex
  - LaCrosse – Aedes
  - Eastern Equine – Aedes and Culex
- Symptoms range from mild flu-like illness to inflammation of the brain, coma and death.



## Mosquito Surveillance

Groin trap



Used to catch Culex when laying eggs

Highly sensitive  
Panic (larvae) captured by water (larvae)  
Small amount of water (larvae)

Dipper



Used to capture larvae

NJ Light Trap



Most common – mosquitoes are attracted to a light and are captured

## Mosquito Controls

- Physical Control

- Best method
- Drill holes in old tires, drain standing water, etc



- Biological Control

- BTI - parasitic bacteria that feed on larvae
- Gambusia - mosquito eating fish

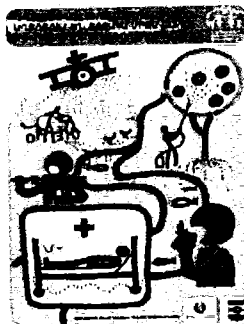


- Chemical Control

- Larvicide – Best method for active mosquito control
- Adulticide – Best method for control of disease

## Pesticides

- FIFRA
  - Federal Insecticide, Fungicide and Rodenticide act
  - Regulates all of the above
- FQPA
  - Food quality protection act - 1996
  - Replaced the Delaney clause
  - Reassessment of all tolerances of all food use pesticides (concerned with residue)
- USEPA and State Department are the regulator agencies



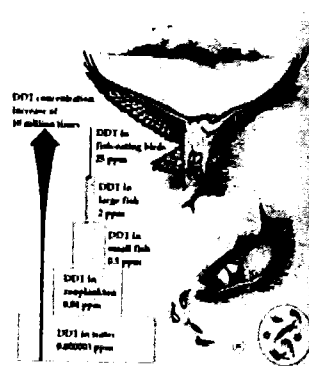
## Pesticides

- Organophosphates
  - Malathion
  - Diazinon
  - Most dangerous
- Carbamates
  - Bendiocarb (Ficam)
  - Carbaryl (Sevin)
  - Moderate hazard
- Pyrethroids
  - Resmethrin
  - Permethrin
  - Least hazardous



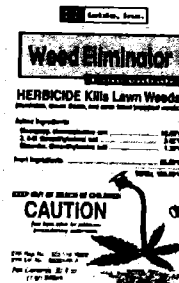
## Pesticides

- Inorganics
  - Boric acid
  - Silica Aerogel
- Chlorinated Hydrocarbons
  - Lindane (banned in 2006)
  - DDT (banned in 1971)
  - Aldrin
- Insect Growth Regulators
  - Precor
  - Gencor



## Pesticides

- Labels
  - Contain:
    - USEPA establishment number
    - USEPA registration number
  - General use labels
    - Most pesticides
    - Can be applied by anyone
  - Restricted use (on label)
    - Applied by licensed applicator
    - Must keep record

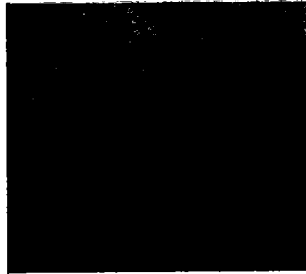


**RESTRICTED USE PESTICIDE**  
DUE TO TOXICITY TO HUMAN AND ENVIRONMENT  
For retail sale to and use only by Certified Applicators or persons under their direct supervision and only in those states licensed by the Certified Applicator's certification.

**IS A LEGAL DOCUMENT AND THE MOST IMPORTANT PART OF PESTICIDE APPLICATION**



### Ticks of Significance



Deer Tick

- Ixodes scapularis
- Black-legged tick
- Feeds on
  - White footed mouse
  - White tail deer
  - Other mammals
  - Birds
- Smaller than most ticks
- Slow feeders
- Transmits Lyme Disease (primarily in the east)

### Ticks of Significance



Lone Star Tick

- Amblyomma Americanum
- Female = white spot
- Males = white spots around perimeter of body
- Feeds on:
  - Small birds
  - Rodents
  - Deer
  - Cattle
- Transmits Rocky Mountain Spotted Fever and Tularemia

## Ticks of Significance



American Dog Tick

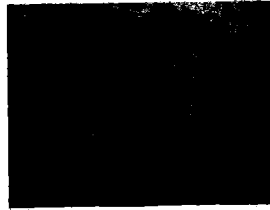
- *Dermacentor variabilis*
- Wood tick
- Feeds on
  - rodents
  - opossums
  - raccoons
  - deer
  - cattle
- Transmits Rocky Mountain Spotted Fever and Tularemia

## TICKS AND DISEASES

DISEASE	VECTOR	AGENT
RMSF	American Dog Tick (wood tick) PRIMARY	<i>Rickettsia rickettsii</i> BACTERIA
Lyme Disease	Deer tick (blacklegged tick)	<i>Borrelia burgdorferi</i> BACTERIA
Tularemia (Rabbit Fever)	Dog (wood) tick Lone Star tick	<i>Francisella tularensis</i> BACTERIA

## **ROCKY MOUNTAIN SPOTTED FEVER**

- Tick borne BACTERIAL disease – *Rickettsia rickettsii*
- Reservoir – Ticks, dogs, rodents
- Transmission – Bites from dog (wood) tick – 4-6 hours of attachment, infected tick feces in skin breaks or mucous membranes
- Sudden fever, rash and joint pain
- 13-25 % untreated case fatality
- Death uncommon if treated
- One attack offers immunity
- No person to person transmission



## **LYME DISEASE**

- Tick borne BACTERIAL disease – *Borrelia Burgdorferi* which is a SPIROCHETE (resembles a coiled spring)
- Reservoir – Rodents and Ixodid ticks
- Transmission – Bites from deer (blacklegged) tick – 24 hours of attachment
- Characterized by fatigue, fever, stiff neck, and headache
- Joint pain and swelling will recur for years
- Often presents as a bulls eye, but hard to diagnose
- No person to person transmission



## **TULAREMIA (Rabbit Fever)**

- Tick borne BACTERIAL disease – *francisella tularensis*
- Reservoir – Wild animals, especially rabbits
- Transmission – Bites from dog (wood) tick or lone star tick, consuming infected meat or water, inhaling infected dust
- Two types develop
  - Type A – highly virulent, 5-15% case mortality
  - Type B – less virulent, few deaths even without treatment
- Often confused with plague and tuberculosis (buboes and respiratory distress)
- Category A Bioterrorism Agent
- No person to person transmission

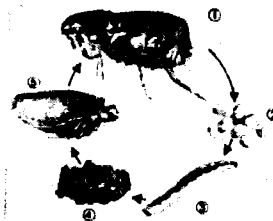


## **Fleas**



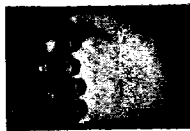
- Associated with pets, wild animals, and rodents
- Adults feed on blood
- Cat flea most common
- Human flea more rare in US

- Larvae feed on detritus (in carpet)
- Pupae can survive for months
- Controls:
  - Treatment of pets by vet
  - Cleaning/vacuum carpet
  - Use of Precor (controls larvae)



## FLEAS AND DISEASES

DISEASE	RESERVOIR	AGENT
Bubonic Plague	Rodents, Gnd squirrel (X cheopis flea)	Yersinia Pestis BACTERIA
Pneumonic Plague	P2P inhalation	
Murine Typhus	Rats/Mice (Rat flea)	Rickettsia typhi BACTERIA



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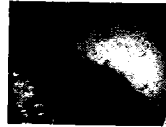
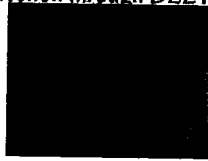
## Mites

- Some are microscopic
- Related to ticks (same class and subclass)
- Live in soil, water, on plants and animals

DISEASE	RESERVOIR	AGENT
Scrub Typhus ( <u>Tsutsugamushi</u> disease)	Mite larvae (chiggers)	Rickettsia tsutsugamushi BACTERIAL
Scabies ( <u>Acariasis</u> )	Mite	Sarcoptes scabiei PARASITIC INFESTATION

### **Scrub Typhus** **( Tsutsugamushi disease)**

- Mite borne BACTERIAL disease – *Orientia tsutsugamushi*
- Reservoir – Larval trombiculid mites
- Transmission – Bites from larval mites; nymph/adults do not feed on vertebrates
- Acute febrile disease with skin ulcer, headache, and sweating
- Characterized by ulcer where mite was attached
- No person to person transmission
- Protection through DEET, repellants, and PPE



### **Scabies (Acariasis)**

- Mite borne parasitic infestation – *Sarcoptes scabiei*
- Reservoir – Humans
- Transmission:
  - Skin to skin
  - Undergarments if recently removed
- Characterized by papules, vesicles, or linear burrows containing mites and their eggs usually on finger web or belt line
- Mites burrow into skin in 2.5 minutes
- Incubation is 2-6 weeks before itching starts
- Treatment with topical permethrin or lindane and laundering of all bedding, clothes etc to kill mites and eggs



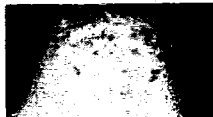
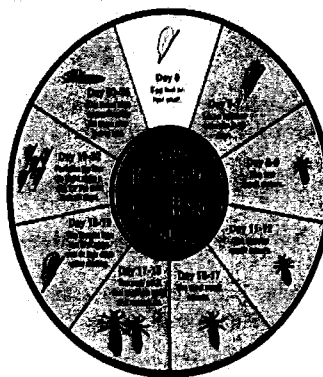
## Lice

- Only 3 types of lice of concern
  - *Pediculus humanus capitis* (head louse)
  - *Pediculus humanus corporis* (body louse, clothes louse)
  - *Phthirus pubis* ("crab" louse, pubic louse)
- Body louse only louse known to transmit disease
- Lice do not fly or hop
- Person to person contact is most common transmission, pets do not play a role in transmission of human lice



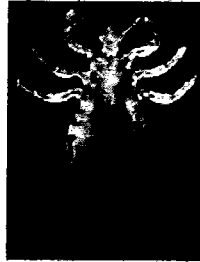
## Head Lice

- Transmitted by direct contact or via fomites
- Feed solely on blood
  - Intense itching
- Glue eggs to hair (nits)
- Can live 2-4 days without a host
- Shampoo, vacuum, wash
- Not known to transmit disease



## **Body Lice**

- Adult body lice are 2.3-3.6 mm in length
- Live and lay eggs on clothing; move to the skin to feed
- Body lice are known to transmit
  - epidemic LOUSE BORNE typhus
  - trench fever
  - epidemic relapsing fever
- Vagabond's disease
- Same treatment as head lice



## **Crab Lice**

- Adult pubic lice are 1.1-1.8 mm in length
- Typically are found attached to hair in the pubic area
- Sometimes are found on eyebrows, eyelashes, beard, mustache, chest, and armpits
- Usually spread through sexual contact.
- **Not known to transmit disease**
- Pubic lice on the head (eyelashes or eyebrows) of a child may be an indication of sexual exposure or abuse.
- Same treatment as head lice





## Bed Bugs

- *Cimex lectularius* – common bed bug
- Associated with humans
- Feed on blood
- No known disease transmission
- Attracted to CO<sub>2</sub> and warmth, not waste
- Many other species associated with bats and birds



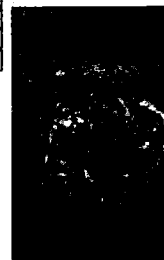
## Filth Flies

- House fly and others
- Direct and indirect mechanical transmission of pathogens

amoebic dysentery	hepatitis	<i>Shigella</i>
anthrax	intestinal worms	<i>Streptococcus</i>
cholera	leprosy	trachoma
diphtheria	polio	tuberculosis
<i>Escherichia coli</i>	rotavirus	typhoid fever
Eyeworms	<i>Salmonella</i>	yaws

[www.afpub.org/pubs/tmrs/TG30/TG30.htm](http://www.afpub.org/pubs/tmrs/TG30/TG30.htm)

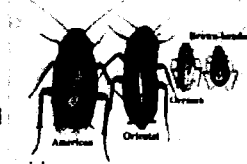
- Myiasis
  - Screw worms in cattle
  - Blow flies in nursing homes
- Accidental Myiasis – swallow fly eggs
  - larvae feast on weak organs



<http://www.pathexo.fr>

## Cockroaches

- German – Mostly found in kitchens
- Brown banded – Hot dry areas
- American – Basements and steam tunnel
- Oriental (water bug) - Basements and humid areas
- Wood roach – Near woods, attracted to light
- Transmission of disease possible through mechanical means
  - No specific disease linked to cockroach
- Control
  - Sanitation – Eliminate cardboard (breeding area)
  - Sticky traps
  - Insecticides or bait



## Rodents

### • Roof Rat (Black, Ship, Alex Fruit)

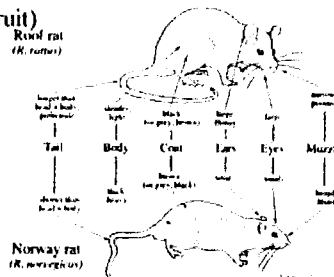
- Rattus rattus
- Pointed nose
- Long tail
- Likes to climb

### • Norway Rat (Brown, Sewer)

- Rattus norvegicus
- Blunt nose
- Short tail

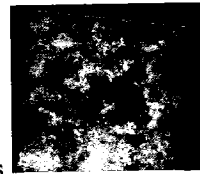
### • House Mouse

- Mus musculus
- Small head/feet
- Tail longer than body
- Most common mammal



## Rodents

- Signs
  - Droppings
    - Rat – 50 per day
    - Mouse – 150 per day
  - Runways and tracks
  - Burrows
  - Gnawing
  - Urine
    - Smell
    - Fluoresces under UV light
- Control
  - Sanitation – primary method
  - Exclusion – primary method
  - Snap traps – effective for small numbers
  - Rodenticides – large populations



## RODENTS AND DISEASES

DISEASE	MODE	AGENT
Rat Bite Fever (Haverhill Fever)	Rat Bite – teeth and gum of rat Rat Urine	Streptobacillus moniliformis BACTERIA
Salmonellosis	Fecal Cont	Salmonella BACTERIA
Murine Typhus (endemic typhus)	Flea (X cheopis)	Rickettsia typhi BACTERIA
Bubonic Plague	Flea	Yersinia Pestis BACTERIA
Leptospirosis (Wells Disease)	Rodent urine Food/Water	Leptospira Spirochetes BACTERIA
Hanta Virus	Deer/White Footed mouse urine	Sin Nombre VIRUS

## Rodent Control

- Rodenticides

- Single dose (toxicants)

- Bromethalin (Rampage®, Vengeance ®)
    - Cholecalciferol (Quintox ®)
    - Zinc phosphide (Ridall ®)



- Multi dose (anti coagulants)

- Brodifacoum (Havoc ®)
    - Brodifolone (Boot Hill ®)
    - Chlorophacinone (J.T. Eaton AC Formula 90)
    - Diphacinone (Ramik ®)
    - Pindone (Pinval ®)
    - Warfarin (D-Con ®)



**RABBIT**  
Pindone Oat Ball

## Bats/Pigeons and Disease

DISEASE	RESERVOIR	AGENT
Rabies	Several species including Bats	Rabies VIRUS
Histoplasmosis	Bat and pigeon droppings	Histoplasma capsulatum FUNGUS
Cryptococcosis	Pigeon droppings	Cryptococcus neoformans FUNGUS
Psittacosis	Birds in parrot family	Chlamydia psittaci BACTERIAL

### **Miscellaneous Disease Culprits**

DISEASE	RESERVIOR/ TRANSMISSION	AGENT
African Trypanosomiasis (African sleeping sickness)	Humans TSE TSE FLY	Trypanosoma brucei PROTOZOAN
American Trypanosomiasis (Chagas Disease)	Humans/animals Cone Nosed Kissing Bug	Trypanosoma Cruzi PROTOZOAN
Onchocerciasis (River Blindness)	Humans BLACKFLY	Onchocerca Volvulus NEMATODE
Raccoon Roundworm (Baylisascaris )	Raccoons/rodent Consump of eggs	Baylisascaris ssp. ROUNDWORM

### **Poisonous Plants and Disease**

DISEASE	TRANSMISSION	AGENT
Ergotism	Contaminated grains (bread)	Ergot Parasitic Fungus
Favism	Vicia Faba Bean	Vicia Faba Pollen and Bean Toxin
Water-Hemlock Poisoning	Water Hemlock	Cicutoxin Toxin
Snakeroot Poisoning	Milk from cows that ate snakeroot	Trematol Toxin

## **Questions**

**?**

## **The Occupational Safety and Health Administration (OSHA)**

### **Learning Objectives**

- Be familiar with definitions used in class
- Know OSHA standards and to whom they apply
- Be familiar with agencies who protect the worker
- Be familiar with the workplace hazards discussed in class
- Know the types of controls and specific ones discussed in class
- Calculate the WBGT index given required variables
- Know the NFPA diamond and what each color/number means

## Occupational Safety and Health Administration (OSHA)

- Established in 1970 by OSH Act – Department of Labor
- Created to reduce injuries, illness, and death on the job by creating workplace safety regulations
  - Enforceable by law, OSHA is the enforcement agency
  - Applicable to:
    - Private sector employers/employees in all states
    - Federal agencies – Must create program that is as stringent
    - USPS – 2000 – States declined to include them, Federally covered
  - OSHA Regulations do not cover:
    - Public workers (state and local employees)
      - Covered under state plan
      - If no state plan, not covered
    - Military personnel
- Developed PELs and the HAZCOM standard

## OSHA (Cont)

- Permissible Exposure Limits (PELs)
  - Time weighted average (TWA) – Average concentration for a normal 8 hour workday and 40 hour workweek that must not be exceeded – many PELs are 8 hour TWAs
  - Short term exposure limit (STEL) – Concentration allowed over a 15 minute period
    - 4 times/day, 1hr between
    - Cannot exceed PEL TWA
  - Ceiling (C) – Concentration that should not be exceeded during any part of the workday
- Hazardous Communication Standard
  - Workplace chemicals evaluated and communicated to workers
  - Container labeling, MSDS, employee training



## Other Agencies Who Protect Workers

- NIOSH

- National institute for occupational safety and health
- Created by OSH act of 1970
- Research and education only
- Recommends exposure standards
  - Recommended Exposure Limits (RELs)
  - Not enforceable
- Part of the Health and Human Services and a division of the CDC

- ACGIH

- American conference of governmental industrial hygienists
- Independent professional association
- Recommends exposure standards - No enforcement
  - Threshold limit values (TLVs)
  - Biological Exposure Indices (BEIs)

## Workplace Hazards

- Asbestos --

- Chrysotile - white - small particles, least toxic
- Tremolite - blue - needle like, more toxic
- Crocidolite - blue - needle like, most toxic
- Occupational exposure is the #1 risk
  - Used as fire retardant, roofing material, floor tiles
  - Brake pads, insulation
  - Remediation = \$\$\$\$\$\$
- Mesothelioma - rare lung cancer of the lung lining
- Asbestosis - chronic inflammatory lung disease - smoking increases severity
- Lung cancer - risk magnified with smoking

OSHA says workers will not smoke in work areas where occupationally exposed to asbestos

## Workplace Hazards

### • Radon

- Odorless, colorless gas that emits alpha particles by natural decay of uranium in soil and building materials
- Radon Act 51 set the natural outdoor concentration of .4pCi/L as the target for indoor levels - 2/3 homes in US exceed level
- OSHA Max Permissible Concentration (MPC) - 100pCi/L, amount that a worker can be exposed to in 40 hours in a 7 day period
- OSHA sampling method - Electret-passive environmental radon monitor

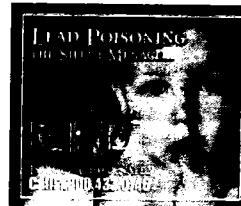
**Smoking increases the risk of cancer**



## Workplace Hazards

### • Metals

- Lead Pb
  - Heavy metal that accumulates in bone and teeth
  - Affects CNS, kidneys and learning in children
  - Soil and paint
- Cadmium Cd
  - Chemical element that accumulates in the liver and kidneys
  - Irritation of resp tract, reduced pulmonary function and cancer
  - Batteries, pigments, and plastics
- Mercury Hg
  - Heavy metal that affects kidneys and CNS
  - Poisoning has been misidentified as ergotism - 1951 France
  - Currently few anthropogenic sources except burning coal



## Workplace Hazards

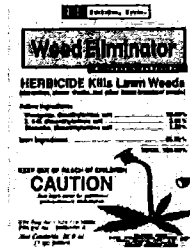
- Pesticides

- Organophates – parathion, diazanon, malathion
- Carbamates – Baygon, Sevin, Ficam
- Chlorinated hydrocarbons – DDT, aldrin, lindane, chlordane
- Pyrethroids – Resmethrin, permethrin
- Inorganics – Boric acid, silica aerogel
- Fungicides – Hg – France
- Rodenticides – Warfarin (anti-coagulant), Bromethalin (toxicant)
- Fumigants – Methyl Bromide, Ethylene oxide, hydrogen cyanide
- Food Quality Protection Act - 1996
  - Replaced Delaney Clause – banned pesticide even for neg risks
  - Reassessment of all food use pesticides
    - Tolerances at which no harm will occur from aggregate exposures
    - Incorporates a 10 fold safety factor for children

## Workplace Hazards

- Pesticides (cont)

- Labels contain:
  - USEPA establishment number
  - USEPA registration number
- General use labels
  - Most pesticides
  - Can be applied by anyone
- Restricted use (on label)
  - Applied by licensed applicator
  - Must keep record



**RESTRICTED USE PESTICIDE**  
 DUE TO TOXICITY TO NONTARGET ORGANISMS  
 For retail sale to and use only by Certified Applicators or  
 persons under their direct supervision and only for those uses  
 allowed by the Certified Applicator's certification.

**IS A LEGAL DOCUMENT AND THE MOST IMPORTANT  
 PART OF PESTICIDE APPLICATION**

## Workplace Hazards

- Herbicides

- Chlorophenoxy - broadleaf weed control often mixed with fertilizer
- 2,4 D and 2, 4, 5 T mecoprop
- Causes skin, eyes and respiratory irritation
- Can depigment skin
- Causes diarrhea, vomiting - toxic to liver and kidneys

- Volatile Organic Compounds (VOCs)

- Organic chemicals that have a high vapor pressure and easily form vapors at normal temperature and pressure
- Solvents, paints, gasoline, etc
- Causes irritation, headaches, nausea
- OSHA benzene PEL = .75 ppm, Action level = .5 ppm



## Workplace Hazards

- Carbon Monoxide CO

- Colorless, odorless gas
- Competes with O<sub>2</sub> for binding hemoglobin sites
- Causes fatigue, headache, cherry red coloring, and death by asphyxiation
- One of the 6 criteria air pollutants



- Heat Stress

- Heat cramps - mild form, fluid replacement required
- Heat exhaustion - moist skin, headache, vomiting
- Heat stroke - body 105F+, hot dry skin - medical emergency



## OSHA Hazard Controls

- Engineering, Administrative, and PPE
- If the employer determines there are hazards present which require the use of PPE, the employer will:
  - Select the PPE necessary and pay for it
  - Communicate selection to each employee
  - Select PPE that properly fits each individual
  - Provide training on when, where, and how to use it
- Level A – Highest level of respiratory/skin/eye protection
- Level B – Max respiratory protection, skin/eye less than A
- Level C – Less respiratory/skin/eye protection than B
- Level D – No respiratory protection/low skin protection



## OSHA Hazard Controls

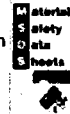
- Respiratory protection
  - Qualitative field check – simple positive and neg pressure
  - Qualitative FIT test- irritant smoke, banana oil, saccharin
  - Quantitative FIT test
    - Uses condensation nuclei count to compare outside air concentrations to inside mask (leak)
    - Yields a FIT factor for each individual to a SPECIFIC mask
  - N, P, R and 95, 99, and 100 respirators
    - N = not resistant to oil
    - P = oil proof
    - 95 – 100 = filtration efficiency at removing particles .3 um and up
- Hard hats
  - A – object and 2200 volts
  - B – objects and 20000 volts
  - C – objects but not volts
  - Type 1 is top impact protection, Type 2 adds side protection

## OSHA Hazard Controls

- Wet bulb globe temperature index and work/rest cycle chart
  - Uses wet bulb thermometer, dry bulb, and a black bulb
  - $.7 \text{ Wet} + .2 \text{ Black} + .1 \text{ Dry} = \text{WBGT Index}$  OR



- MSDS
  - Located where all employees can access
  - Provide hazards, storage, spill and other important information
  - No specific format - Can use OSHA form 174 as a guide



## OSHA Hazard Controls



## **Questions**

**?**

# HAZMAT

Wednesday, March 17, 2010  
9:17 AM

3/17/2010

## Hazardous Materials

### Learning Objectives

- Be familiar with definitions used in class
- Know the 9 classes of HAZMAT for transport
- Know the various agencies who respond to HAZMAT incidents
- Know EPCRA and how it applies to HAZMAT incidents
- Know the various levels of PPE



### Definitions

- LD50 lethal dose– amount of a material, given all at once which causes death of 50% of an animal test group
- LD50 effective does – minimal dose that produces the desired effect of a drug or symptom of a pollutant
- LC50 – lethal concentration of a chemical in air; in environmental studies can also mean the concentration in water
- TSCA – Toxic Substances Control Act of 1976, regulates chems entering the US including PCBs and CFCs – 4 titles: control of toxic substances, asbestos hazard emergency response act, indoor radon abatement act, and lead based paint exposure reduction act

### Definitions

- ATSDR
  - Agency for Toxic Substance and Disease Registry
  - Under Department of Health and Human Services
  - Advisory non-regulatory public health agency
  - Identifies communities exposed to hazardous substances
  - Maintains a toxicology profile of over 302 chemicals
- NRC
  - National Response Center
  - Single point contact for all pollution and HAZMAT incident reporting
  - Is the communications center for the National Response Team which is chaired by the EPA
  - Center is manned 24/7/365

## Hazardous Material for Transport

A substance that has been determined by the Secretary of Transportation to be capable of posing an unreasonable threat to the health, safety or property when transported in commerce.

Not necessarily a hazardous waste

## Hazardous Material for Transport

- Dept of Transportation, Title 49 of the CFR
- HAZMAT divided into classes which are further divided into subdivisions:
  - Class 1 explosives
  - Class 2 Gases
  - Class 3 Flammable Liquids
  - Class 4 Flammable solids, spontaneously combustible materials
  - Class 5 Oxidizers and organic peroxides
  - Class 6 Poisonous and etiologic materials
  - Class 7 Radioactive materials
  - Class 8 Corrosives
  - Class 9 Miscellaneous hazards
- Must label material and placard vehicle for transport

## Hazardous Material for Transport

- Hazmat placards/labels



- Must notify NRC if a release occurs that exceeds a reportable quantity (RQ)

## Emergency Response to HAZMAT

- Federal Emergency Management Agency (FEMA)
  - Lead agency for nationwide emergency management
- National Response Teams
  - Consists of reps from 14 federal agencies with major env, trans, emergency management, worker safety and PH responsibilities.
  - Not response driven, nationwide planning and preparedness
- Regional Response Teams
  - Consists of reps from federal agencies and a rep from each state within a federal region
  - Provide advice and recommendations

## Emergency Response to HAZMAT

- **Emergency Planning and Community Right to Know Act (EPCRA)**
  - Federal law that applies emergency management process to hazardous materials
  - Consists of 4 areas:
    - Prevention/Mitigation
    - Preparedness
    - Response
    - Recovery
  - EPA is responsible at the federal level – state responsible for state emergency response commissions (SERCs) and local emergency planning committees (LEPCs)
- Facilities that handle materials identified as extremely hazardous in quantities exceeding federal threshold planning quantities must submit inventory info SERC and LEPC within 60 days of arrival so they can start planning

## Emergency Response to HAZMAT

- **Level A – Highest level of respiratory/skin/eye protection**
  - Gas/vapor tight and chemical splash resistant suit
  - Full face respirator with SCBA or SAR with escape unit
  - Used when hazard is unknown or IDLH
- **Level B – Max respiratory protection, skin/eye less than A**
  - Chemical splash resistant suit
  - Full face respirator with SCBA or SAR with escape unit
  - Used when vapors/gas are not a threat
- **Level C – Less respiratory/skin/eye protection than B**
  - Chemical splash resistant suit with APR
  - Used when no skin hazard and conc and type of cont are KNOWN
- **Level D – No respiratory protection/low skin protection**

3/17/2010

## Questions

?

# Noise

Wednesday, March 17, 2010  
9:17 AM

3/17/2010

## Noise

### Learning Objectives

- Be familiar with definitions used in class
- Know how to add sound sources
- Know the 3 types of hearing loss
- Know the occupational exposure limits for noise

### Noise Abatement Regulations

- Noise control act of 1972 and the quiet communities act of 1978 are both in effect but have been unfunded since 1982
- Aviation safety and noise abatement act of 1979 required FAA to develop noise maps and a method of measuring airplane noise pollution
- Federal Highway Admin – 67dBA near sensitive areas and 72dBA for commercial land use
- EPA and DOT max noise of 90dBA for interstate trucks and buses at 35 + mph and 86dBA under 35 mph
  - New trucks over 10K lbs = 83dBA

Noise Regulation enforcement is up to the states and local jurisdictions

### Sound Basics

- Sound is a result of a source causing a vibrational wave in the air and is described by
  - Amplitude (loudness)
  - Frequency (pitch)
  - Time pattern
- Travels through gas, liquid and solid but not a vacuum
- Loses energy as it travels

### Sound Basics

- Noise – unwanted sound
- Noise pollution – noise that has characteristics and duration injurious to public health and welfare or unreasonably interferes with the comfortable enjoyment of life and property
- Decibel – dimensionless unit that expresses the intensity of sound
- Noise level – measurement by an approved sound level meter
  - dBA, dBC, dBD

### Sound Basics

- dBA
  - attempt to measure the way the human ear hears loudness (amplitude) in normal situations
- dBC
  - attempt to measure the way the human ear hears loudness (amplitude) in noisy situations
- dBD
  - attempt to measure and compare the effect of airplane noise on the human ear

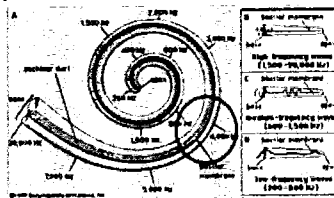


## Sound Basics

- Sone – measure of a perceived loudness by an observer
- Phon – loudness of a 1kHz tone at 40dB – 40 phons = 1 sone
- Sabin – a measure of the sound absorption ability of a surface

## Hearing Loss

- Temporary Threshold Shift (TTS)
  - temporary loss of sensitivity or acuity
  - recover ~12 hours after leaving source
  - repeated exposure can lead to permanent shift
- Permanent Threshold Shift (PTS)
  - Destruction of sensory cells in inner ear
    - hair cells
    - nerve fibers
  - 4K Hz Notch
    - human voice
    - audiogram



## Hearing Loss

- Standard Threshold Shift (STS)
  - Average change of  $\geq 10$  dB at 2,3, and 4 k Hz
    - Requires monitoring
    - Notification in writing
  - Average change of  $\geq 25$  dB at 2,3, and 4 k Hz
    - Reportable event
    - OSHA Form 300

### RECORDABILITY GUIDELINES OSHA 29 CFR 1904.10 (2002)

Has an annual audiogram recorded an STS (average 10dB or more shift relative to baseline audiogram at 2000, 3000, & 4000 Hz - age corrected per Appendix F) in one or both ears according to the provisions of the hearing conservation amendment to the OSHA noise standard (29 CFR 1910.94)?	Yes
In the employee's actual hearing 25dB or greater above audiometric zero (average at 2000, 3000, & 4000 Hz) in the same ear as the STS? (for age correction permitted)	Yes
Is the hearing loss work-related?	Yes
Record on OSHA 300 Log within 30 days of test (Check "Hearing Loss" column - MCH)	Yes
Do not record	

## Noise Limits

- OSHA Action level
  - 8 hour TWA of 85 decibels – medical surv required
- OSHA PEL – 90dBA – requires controls
- OSHA 115 dBA continuous steady state noise
- OSHA 140 dBA impact noise
- OSHA doubling (exchange) rate = 5dB
  - when noise increases by 5dB, max exposure cut in  $\frac{1}{2}$
  - noise of 95dBA only allowed for 4 hours
- NIOSH – 85 dBA REL – 3dB doubling rate

**EPA says 70dBA is safe for 24 hours exposure**

## Combining Sound Sources

- Modified Decibel Addition

Diff in decibels	ADD	Decibels to highest level
0-1		3
2-4		2
5-9		1
10 or more		0

- $90 \text{ dB} + 90 \text{ dB} = 93 \text{ dB}$
- $100 \text{ dB} + 90 \text{ dB} = 100.4 \text{ dB}$

**Combining two identical sources ALWAYS adds 3 dB**

## Combining 3 or More Sound Sources

Diff in decibels	ADD	Decibels to highest level
0-1		3
2-4		2
5-9		1
10 or more		0

- 90 dB, 90 dB, and 90 dB
  - 90 to 90 = 0 ---- add 3 (from chart) to highest
  - 93 to 90 = 3 ---- add 2 to highest
  - 95 dB

**Combining 3 identical sounds will always result in 5 dB gain (actually 4.8 dB according to formula)**

**Questions**

**?**

## Food Protection

Wednesday, March 17, 2010  
9:18 AM

### **FOOD PROTECTION**

#### **Learning Objectives**

- Be familiar with definitions used in class
- Know various foodborne allergens, bacteria, viruses, parasites, and toxins as well as the illnesses they are associated with
- Know the difference between foodborne infection and intoxication
- Know how to conduct a foodborne illness investigation
- Be familiar with the HACCP process
- Know the employee health, work practice, structural, food procurement/storage, and food preparation controls discussed in the 2005 FDA Food Code

## **Definitions**

- Critical Control Point – point or procedure in a food system where loss of control may result in a health risk
- Food – raw, cooked or processed edible substance, ice, beverage, or ingredient used for human consumption including CHEWING GUM
- Food Establishment – operation that stores, preps, packs, serves, vends or otherwise provides food for HUMAN consumption (restaurant, market, vending location, caterer, etc) which gives food directly to consumer or indirectly through a delivery service (includes home delivery of groceries)
  - Includes trans vehicle and central prep facility that supplies a vending location UNLESS the vending or feeding location is permitted
  - Includes mobile, stationary, temp, and perm facilities regardless of where food is consumed and regardless of cost of food

## **Definitions**

- Not a Food Establishment
  - Offers only prepacked foods that are not potentially hazardous
  - Offers whole, uncut fruits and vegetables
  - Food processing plant
  - Kitchen in private home
    - Cannot provide potentially hazardous foods to consumers
    - Can provide non pot hazardous foods at functions if allowed by law
      - Sign stating prepared in a non regulated/inspected home kitchen
    - Location above goods are sold is not a food establishment
  - Kitchen in private home functioning as a daycare
  - Private home that receives catered or home delivered food

## **Definitions**

### **• Major Food Allergens**

- Milk
- Eggs
- Fish
  - Bass
  - Flounder
  - Cod
- Shellfish
  - Crab
  - Lobster
  - Shrimp
- Tree nuts
  - Almonds
  - Pecans
  - Walnuts
- Peanuts
- Soybeans
- Wheat
- Ingredients that contain protein from any of these

## **Definitions**

- Potentially hazardous food – Food that requires time/temperature control for safety (TCS) to limit pathogenic microorganism growth or toxic formation
- Ratite – flightless bird such as an emu, ostrich, or rhea
- Spoilage – Damage to organoleptic (smell, see, touch taste) qualities of food
- Sanitary – Free of HARMFUL levels of disease causing organisms
- TCS – Time/temperature control for safety – is equivalent to PHF
- Unsanitary – Contains HARMFUL levels of disease causing organisms

## **Potentially Hazardous Foods**

• Food that requires time/temperature control for safety (TCS) to limit pathogenic microorganism growth or toxic formation

• Includes:

- Raw or treated animal food
- Heat treated plant food
- Raw seed sprouts
- Cut melons
- Cut tomatoes or mixtures\*

• Excludes:

- Air cooled hard boiled egg with intact shell
- Pasteurized intact raw shell egg
- Food in unopened hermetically sealed container
- Product assessment showing pathogens don't grow
- Are excluded due to Aw or pH or interaction of both\*

## **Potentially Hazardous Foods**

**Table A. Interaction of pH and  $A_w$  for control of spores in food heat-treated to destroy vegetative cells and subsequently PACKAGED**

$A_w$ values	pH values		
	4.6 or less	> 4.6 - 5.6	> 5.6
$\leq 0.92$	non-PHF/non-TCS FOOD**	non-PHF/non-TCS FOOD	non-PHF/non-TCS FOOD
> 0.92 - .95	non-PHF/non-TCS FOOD	non-PHF/non-TCS FOOD	PA***
> 0.95	non-PHF/non-TCS FOOD	PA	PA

\* PHF means POTENTIALLY HAZARDOUS FOOD

\*\* TCS FOOD means TIME/TEMPERATURE CONTROL FOR SAFETY FOOD

\*\*\* PA means Product Assessment required



## Potentially Hazardous Foods

**Table B. Interaction of pH and  $A_w$  for control of vegetative cells and spores in food not heat-treated or heat-treated but not packaged**

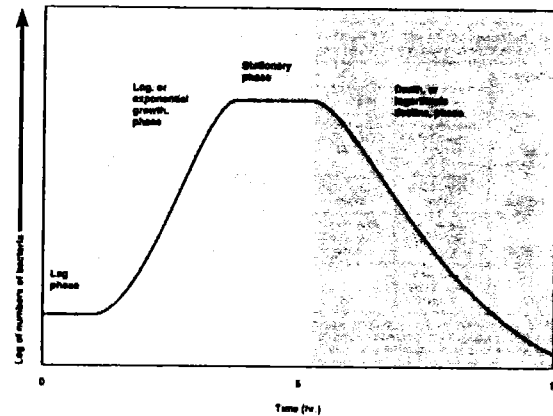
$A_w$ values	pH values			
	< 4.2	4.2 - 4.6	> 4.6 - 5.0	> 5.0
< 0.88	non-PHF/ non-TCS food**	non-PHF/ non-TCS food	non-PHF/ non-TCS food	non-PHF/ non-TCS food
0.88 - 0.90	non-PHF/ non-TCS food	non-PHF/ non-TCS food	non-PHF/ non-TCS food	PA***
> 0.90 - 0.92	non-PHF/ non-TCS food	non-PHF/ non-TCS food	PA	PA
> 0.92	non-PHF/ non-TCS food	PA	PA	PA

\* PHF means POTENTIALLY HAZARDOUS FOOD  
 \*\* TCS FOOD means TIME/TEMPERATURE CONTROL FOR SAFETY FOOD  
 \*\*\* PA means Product Assessment required

## Potentially Hazardous Foods

<b>F</b>	Food	High in protein
<b>A</b>	Acidity	4.6~7.5
<b>T</b>	Time	2 hour, 4 hour etc
<b>T</b>	Temperature	41-135 F
<b>O</b>	Oxygen	Aerobic vs Anaerobic
<b>M</b>	Moisture	.85~.97

## Potentially Hazardous Foods



## Foodborne Health Hazards

- Bacteria
  - Thermophilic (optimal growth ~50-70 C)
  - Mesophilic (optimal growth ~37 C)
  - Psychrotrophs (optimal growth ~ 15 C)
- Viruses
  - Most heat resistant
  - Do not multiply in food
- Parasites
  - Helminths (Nematode)
  - Protozoa
- Toxins
  - Bacteria produced
  - Fungi produced
  - Naturally occurring

## **Food Borne Illnesses**

- Infection:
  - Live bacterial cells are ingested
  - Cells grow in the digestive tract and cause symptoms – Slower onset
- Intoxication:
  - Food that contains a toxin produced by bacteria – Not produced in the body
  - Toxin causes symptoms – Fast onset
- Toxin Mediated Infection:
  - Live bacterial cells are ingested which then produce toxins in the body
  - Toxin causes symptoms - Mid onset

## **Food Borne Bacteria Infections**

<b>BACTERIA</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Brucella spp.	Infection (5-21 days)	<b>Brucella (undulant fever)</b> Raw cow or goats milk
Campylobacter jejuni	Infection (2-5 days)	<b>Campylobacter Enteritis</b> Raw milk, water, beef, poultry pork
Listeria monocytogens	Infection (3-21 days)	<b>Listeriosis</b> Raw milk, cont milk products, soil
Salmonella Typhi	Infection (1-2 wks)	<b>Typhoid Fever</b> Fecal-oral, cont water, oysters, vegetables grown in night soil
Salmonella Typhimurium	Infection (12-24 hrs)	<b>Salmonellosis</b> Poultry, eggs, sliced fruits/veg, milk, fecally through food and water

### **Food Borne Bacteria Infections**

<b>BACTERIA</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Shigella Sonnei and Flexneri	Infection (1-7 days)	<b>Shigellosis (Bacillary Dysentery)</b> Cont water, vegetables, salads
Vibrio Cholera	Infection (hrs-days)	<b>Cholera</b> Cont water, raw foods, shellfish
Vibrio Vulnificus	Infection (16 hrs)	<b>Vibrio Vulnificus Gastroenteritis</b> Seafood, mainly oysters
Yersinia Enterocolitica	Infection (2-3 days)	<b>Yersiniosis</b> Raw milk, pork, beef, lamb

### **Food Borne Bacteria Infections**

<b>ILLNESS</b>	Brucella (Undulant fever, Bangs Disease, Malta Fever)
<b>BACTERIA</b>	Brucella ssp.
<b>VEHICLE</b>	Raw cow or goats milk
<b>SYMPTOMS</b>	Irregular fever, sweating, chills, joint and muscle pain
<b>ONSET</b>	5-21 days

### **Food Borne Bacteria Infections**

ILLNESS	Campylobacter Enteritis (Infectious diarrhea, bacterial diarrhea)
BACTERIA	Campylobacter Jejuni
VEHICLE	Raw milk, water, beef, poultry, pork
SYMPTOMS	Watery diarrhea, abdominal pain, fever, chills, nausea, vomiting, blood in stool
ONSET	2-5 days

### **Food Borne Bacteria Infections**

ILLNESS	Listeriosis (Listeria Infection)
BACTERIA	Listeria Monocytogens
VEHICLE	Raw milk, contaminated milk products, soil (unwashed vegetables)
SYMPTOMS	Fever, headache, nausea, vomiting, meningeal symptoms
ONSET	3-21 days

### **Food Borne Bacteria Infections**

ILLNESS	Typhoid Fever (enteric fever, bilious fever, yellow jack)
BACTERIA	Salmonella Typhi
VEHICLE	Fecal oral, contaminated water and shellfish, P2P, veggies grown in night soil
SYMPTOMS	Sustained high fever, headache, malaise, anorexia, splenomegaly, a rash of flat, rose-colored spots
ONSET	1-2 weeks

NOT SALMONELLOSIS!!!!

### **Food Borne Bacteria Infections**

ILLNESS	Salmonellosis (non-typhoidal salmonella, salmonella infection)
BACTERIA	Salmonella Typhimurium
VEHICLE	Poultry, eggs, milk and milk products, contaminated water, pigs, turtles, iguanas
SYMPTOMS	Abdominal pain, diarrhea, chills, fever, vomiting, nausea
ONSET	12-24 hours

NOT TYPHOID FEVER

### **Food Borne Bacteria Infections**

ILLNESS	Shigellosis (Bacillary Dysentery)
BACTERIA	Shigella Sonnei and Flexneri
VEHICLE	Fecal oral, contaminated food/water, P2P, milk, anything washed with cont water
SYMPTOMS	Acute onset with diarrhea, fever, bloody stool
ONSET	1-7 days

### **Food Borne Bacteria Infections**

ILLNESS	Cholera (asiatic cholera, epidemic cholera)
BACTERIA	Vibrio Cholera
VEHICLE	Contaminated water, shellfish, raw foods, fecally contaminated from infected humans
SYMPTOMS	Acute diarrhea (so severe rehydration required), rapid pulse, dry skin, abdominal cramps, nausea, and vomiting.
ONSET	Hours to days

### **Food Borne Bacteria Infections**

ILLNESS	Vibrio Vulnificus Gastroenteritis
BACTERIA	Vibrio Vulnificus
VEHICLE	Seafood, mainly oysters
SYMPTOMS	Fever, chills, vomiting, nausea, diarrhea
ONSET	16 hours

### **Food Borne Bacteria Infections**

ILLNESS	Yersiniosis
BACTERIA	Yersinia Enterocolitica (Not Yersinia Pestis which carries Bubonic Plague)
VEHICLE	Raw milk, pork, beef, lamb, cont water, P2P
SYMPTOMS	fever, abdominal pain, and bloody diarrhea – confused with appendix attack
ONSET	2-3 days



## **Food Borne Bacteria Intoxications**

<b>BACTERIA</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Bacillus Cereus	Intoxication (6-16 hrs)	<b>Bacillus Cereus Food Poisoning</b> Rice products, starchy food SPORE FORMER
Clostridium Botulinum	Intoxication (12-36 hrs)	<b>Botulism Food Poisoning</b> Improperly processed canned food SPORE FORMER
Staphylococcus Aureus	Intoxication (2-4 hrs)	<b>Staphylococcus Food Poisoning</b> Humans, custards, meats, reheats TOXIN STABLE AT BOIL

## **Food Borne Bacteria Intoxications**

<b>ILLNESS</b>	<b>Bacillus Cereus Food Poisoning (Diarrhea and Vomiting types)</b>
<b>BACTERIA</b>	Bacillus Cereus
<b>VEHICLE</b>	Rice products, starchy foods, spores found in a variety of cereals
<b>SYMPTOMS</b>	Diarrheal – cramps, diarrhea, slight vomit Vomiting – vomiting, some diarrhea
<b>ONSET</b>	6-16 hours

### **Food Borne Bacteria Intoxications**

ILLNESS	Botulism Food Poisoning
BACTERIA	Clostridium Botulinum SPORE FORMER
VEHICLE	Low-acid, improperly canned foods, temperature abused vegetables, meats, sausage, fish
SYMPTOMS	Nausea, vomiting, diarrhea, fatigue, headache, dry mouth, double vision, muscle paralysis, respiratory failure
ONSET	Hours to days

### **Food Borne Bacteria Intoxications**

ILLNESS	Staphylococcus Food Poisoning
BACTERIA	Staphylococcus Aureus – produces enterotoxin
VEHICLE	Custard or cream-filled baked goods, ham, poultry, eggs, potato salad, cream sauces, sandwich fillings
SYMPTOMS	Severe vomiting, diarrhea, abdominal cramping
ONSET	2-4 hours

### **Food Borne Bacteria Toxin-Mediated Infections**

BACTERIA	ILLNESS	DISEASE/VEHICLE
Clostridium Perfringens	Toxin Mediated Infection (12-36 hrs)	Clostridium Perfringens Poisoning Cooked meat, gravy, beans, stews SPORE FORMER
Escherichia Coli Shiga Toxin Producing	Toxin Mediated Infection (2-4 days)	Enterohemorrhagic (EHEC) 0157H7 Raw ground beef, raw milk/juice, sprouts

### **Food Borne Bacteria Toxin-Mediated Infections**

ILLNESS	Clostridium Perfringens Poisoning (C. welchii food poisoning, Pigbel)
BACTERIA	Clostridium Perfringens SPORE FORMER
VEHICLE	Cooked meat, gravy, beans, stews
SYMPTOMS	Diarrhea, abdominal cramps, headache, chills
ONSET	12 – 36 hours

### **Food Borne Bacteria Toxin-Mediated Infections**

ILLNESS	Enterohemorrhagic (EHEC, ecoli 0157H7)
BACTERIA	Ecoli 0157H7
VEHICLE	Raw and undercooked ground beef, raw milk, alfalfa sprouts, unpasteurized fruit juices, dry-cured salami, lettuce, game meat, and cheese curds. P2P, water
SYMPTOMS	Diarrhea ranging from mild to severe with blood, abdominal pain, HUS
ONSET	2 – 4 days

### **Food Borne Viral Infections**

VIRUS	ILLNESS	DISEASE/VEHICLE
Hepatitis A Virus	Infection (30-35 days)	Infectious Hepatitis Water, ice, milk, oysters, clams, P2P
Norwalk Like Viruses	Infection (1-2 days)	Viral Gastroenteritis Water, ice, shellfish – fecal oral Most common enteric disease in US CHLORINE RESISTANT
Rotavirus	Infection (1-2 days)	Human Rotavirus (HRV) Fecal-oral, cont food/water, fomites

### **Food Borne Viral Infections**

ILLNESS	Infectious Hepatitis (Type A Hepatitis, Catarrhal jaundice, Epidemic hepatitis)
VIRUS	Hepatitis A Virus
VEHICLE	Water, ice, milk, oysters, clams, P2P
SYMPTOMS	Mild fever, general weakness, nausea, abdominal pain; can develop into jaundice, P2P, fecal oral
ONSET	Up to a month

### **Food Borne Viral Infections**

ILLNESS	Viral Gastroenteritis
VIRUS	Norwalk virus group (Norwalk like virus NLV, Small round structured virus SRSV)
VEHICLE	Water, ice, shellfish – fecal oral
SYMPTOMS	Nausea, vomiting, diarrhea, abdominal cramps
ONSET	1 – 2 days

### **Food Borne Viral Infections**

<b>ILLNESS</b>	Human Rotavirus (HRV, Sporadic viral gastroenteritis, severe viral gastroenteritis of infants and children, rotaviral enteritis)
<b>VIRUS</b>	Rotavirus
<b>VEHICLE</b>	Fecal-oral route; person-to-person; contact with respiratory secretions, contaminated water, food or other surfaces; contact with fomites
<b>SYMPTOMS</b>	Mild to moderate fever and vomiting, followed by the onset of watery stools
<b>ONSET</b>	1-2 days

### **Food Borne Parasitic Infections**

<b>PARASITE</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Ascaris Lumbricoides	Infection (2 months)	Ascariasis Food/water cont with man/ape feces
Anisakis Worm	Infection (7-14 days)	Anisakiasis Marine fish (cod, haddock, fluke) SUSHI
Cryptosporidium Parvum	Infection (1-10 days)	Cryptosporidiosis (Diarrheal disease) Cont food/water, P2P
Cyclospora Cayetanensis	Infection (1-14 days)	Diarrheal disease Cont food/water, Fresh produce

### **Food Borne Parasitic Infections**

PARASITE	ILLNESS	DISEASE/VEHICLE
Entamoeba Histolytica	Infection (1-4 weeks)	Amoebiasis Cont food/water, P2P
Giardia Lamblia	Infection (1-2 weeks)	Giardiasis Cont food/water
Toxoplasma Gondii	Infection (5-23 days)	Toxoplasmosis Cat feces, poorly cooked lamb, pork or venison
Trichinella Spiralis	Infection (9 days)	Trichinosis Undercooked pork, bear and boar meat

### **Food Borne Parasitic Infections**

ILLNESS	Ascariasis (Round worm infection, Ascariidiasis)
PARASITE	Ascaris Lumbricoides (large intestinal worm of humans)
VEHICLE	Food/water cont with man/ape feces
SYMPTOMS	Live worm passed via stool, anus, nose or mouth, weight loss, bowel obstructions
ONSET	2 months

### **Food Borne Parasitic Infections**

ILLNESS	Anisikiasis
PARASITE	Anisakis Worm
VEHICLE	Marine fish (cod, haddock, fluke) SUSHI
SYMPTOMS	Abdominal pain, cramps, vomiting – mimics appendicitis
ONSET	Gastric symptoms develop within hours, other symptoms in 1-2 weeks

### **Food Borne Parasitic Infections**

ILLNESS	Cryptosporidiosis (Diarrheal disease)
PARASITE	Cryptosporidium Parvum SPORE FORMER
VEHICLE	Fecally contaminated food/water, P2P – dogs, cats, and cattle
SYMPTOMS	Anorexia, vomiting, profuse watery diarrhea
ONSET	1 – 10 days



### **Food Borne Parasitic Infections**

ILLNESS	Diarrheal disease
PARASITE	Cyclospora Cayetanensis SPORE FORMER
VEHICLE	Cont food/water, Fresh fruits and vegetables
SYMPTOMS	Watery diarrhea, anorexia, nausea, cramps, weight loss – fever is rare
ONSET	1-14 days

### **Food Borne Parasitic Infections**

ILLNESS	Amoebiasis (Amebiasis)
PARASITE	Entamoeba Histolytica SPORE FORMER
VEHICLE	Fecally cont food/water, P2P
SYMPTOMS	Anorexia, cramps, blood and mucous in stool
ONSET	1 – 4 weeks

### **Food Borne Parasitic Infections**

ILLNESS	Giardiasis (Beaver Fever)
PARASITE	Giardia Lamblia CYSTS
VEHICLE	Cont food/water, beavers, muskrats, P2P
SYMPTOMS	Asymptomatic, acute self-limiting diarrhea, or chronic diarrhea with weight loss
ONSET	1 – 2 weeks

### **Food Borne Parasitic Infections**

ILLNESS	Toxoplasmosis
PARASITE	Toxoplasma Gondii
VEHICLE	Cat feces, poorly cooked lamb, pork or venison
SYMPTOMS	Weakness, swollen lymph nodes, resembles mononucleosis
ONSET	5 – 23 days

### **Food Borne Parasitic Infections**

ILLNESS	Trichinosis (Tricheniasis, trichinellosis)
PARASITE	Trichinella Spiralis
VEHICLE	Undercooked pork, bear and boar meat
SYMPTOMS	Muscle soreness, diarrhea, swelling of eyelids and fever
ONSET	9 days

### **Food Borne Toxins**

TOXIN	ILLNESS	DISEASE/VEHICLE
Ciguatoxin	Intoxication (6 hours)	<b>Ciguatera Poisoning</b> Marine fin fish- grouper, snapper
Saxitoxins	Intoxication (2-24 hrs)	<b>Paralytic Shellfish Poisoning</b> Clams, mussels, oysters, crabs
	Intoxication (1-3 hrs)	<b>Neurotoxic Shellfish Poisoning</b> Clams, mussels, oysters, crabs
	Intoxication (2-24 hrs)	<b>Amnesic Shellfish Poisoning</b> Clams, mussels, oysters, crabs
Histamine	Intoxication (0-2 hrs)	<b>Scromboid Poisoning</b> Tuna, mackerel not properly refrigerated when caught
Aflatoxin	Intoxication (varies)	<b>Aflatoxicosis</b> Tree nuts, peanuts and other oil seeds

### **Food Borne Toxins**

ILLNESS	Ciguatera Poisoning
TOXIN	Ciguatoxin
VEHICLE	Marine fin fish- grouper, snapper
SYMPTOMS	Abdominal pain, nausea, vomiting, diarrhea
ONSET	6 hours

### **Food Borne Toxin**

ILLNESS	Paralytic Shellfish Poisoning
TOXIN	Saxitoxins
VEHICLE	Clams, mussels, oysters, crabs
SYMPTOMS	Numbness, headache, dizziness, nausea, and muscular incoordination. In cases of severe poisoning, muscle paralysis and respiratory failure occur, and in these cases death may occur in 2 to 25 hours.
ONSET	2 -24 hours

### **Food Borne Toxins**

ILLNESS	Scrombold Poisoning
TOXIN	Histamine
VEHICLE	Tuna, mackerel not properly refrigerated when caught
SYMPTOMS	Rash, diarrhea, flushing, sweating, headache, and vomiting. Burning or swelling of the mouth, abdominal pain, or a metallic taste may also occur.
ONSET	0 – 2 hours

### **Food Borne Toxins**

ILLNESS	Aflatoxicosis
TOXIN	Aflatoxin
VEHICLE	Tree nuts, peanuts and other oil seeds
SYMPTOMS	Edema of the lower extremities, abdominal pain, and vomiting. Targets liver
ONSET	Varies

## **Food Borne Investigations**

The following steps need to be taken in all epidemiologic investigations:

1. Confirm the existence of an epidemic or an outbreak.
2. Confirm the diagnosis.
3. Determine the number of cases.
4. Orient the data in terms of time, person and place.
5. Develop a hypothesis.
6. Compare the hypothesis with the established facts.
7. Execute control and preventive measures.
8. Write a written report.

- **Most often diagnosed – Salmonella**
- **Highest rate of infection – Campylobacter**
- **Most common enteric disease – Norwalk**

## **Food Borne Investigations**

- **Attack rate** - The number of people at risk who are sick divided by the total number of people at risk X 100%

	Sick	Well	Total	Attack Rate
At Risk	A	B	A + B	$A/(A+B)*100$

- **Food-specific attack rate** - Number of people who ate a certain food and are sick divided by the total number who ate that food X 100%

	Sick	Well	Total	Attack Rate
Sushi	20	6	26	70%
No Sushi	22	14	36	61%

## Food Borne Investigations

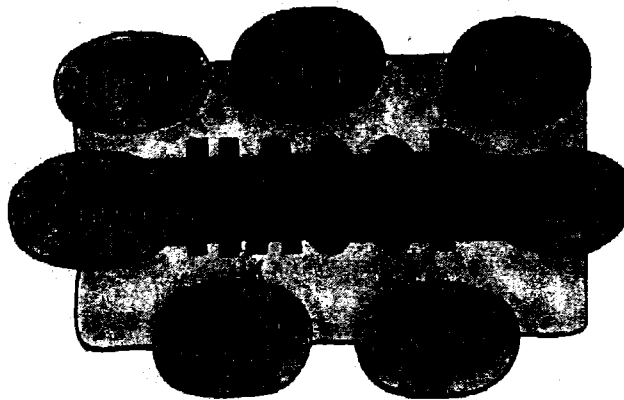
- Food-specific attack rate ratio - attack rate of those who ate specific food/attack rate for those who didn't eat specific food

	Sick	Well	Total	Attack Rate
Sushi	20	6	26	70%
No Sushi	22	14	36	61%

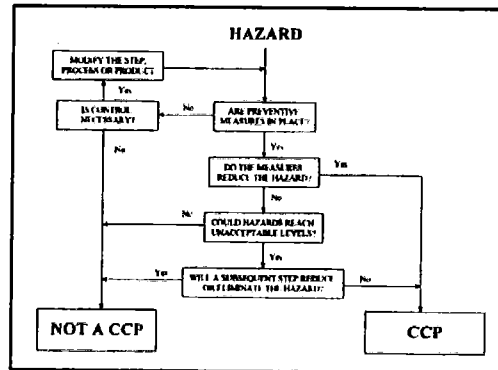
- Ratio of 1 = no increased risk of getting sick by eating sushi
- Ratio > 1 = increased risk of getting sick by eating sushi
- Ratio < 1 = decreased risk of getting sick by eating sushi
- Judgment call
  - >3 = strong association
  - 1.7 - 3 = moderate association
  - 1.3-1.7 = weak association
  - .9 - 1.3 = no association

70% / 61% = 1.15  
No Association

## Hazard Analysis Critical Control Points



## HACCP



## Controlling the Hazard

- Employee Health Controls
- Work Practice Controls
- Structural Controls
- Food Procurement/Storage Controls
- Food Preparation Controls



### **Employee Health Controls**

- Must report the following to supervisor:
  - Vomiting
  - Diarrhea
  - Jaundice
  - Sore throat with fever
  - Lesion with pus
    - On hand or wrist (imper membrane and glove)
    - Exposed portion of arm (impermeable membrane)
    - Other body parts (bandage)
- Must report the following clinical diagnoses:
  - Norovirus
  - Hep A virus
  - Shigella ssp.
  - EHEC
  - Salmonella Typhi

### **Employee Health Controls**

- Employees must report the following:
  - Diagnosis of Salmonella Typhi in past 3 months
  - Previous exposure or involvement or living in the same house of a confirmed disease outbreak diagnosed with:
    - Norvirus in last 48 hours
    - EHEC within the past 3 days
    - Salmonella typhi in past 14 days
    - Hep A in past 30 days
- Employer must report the following to Regulators:
  - Jaundice
  - Norovirus
  - Hep A
  - Salmonella Typhi
  - Shigella ssp
  - EHEC

## **Employee Health Controls**

- Immediately Dangerous to Life and Health Situations
  - Discontinue operations and report to regulators
  - No need to discontinue ops in areas unaffected by IDLH
  - Approval required to resume operations



## **Work Practice Controls**

- Hands and arm washing(20 second procedure)
  - Rinse under clean, running water in a sink designated for hand washing – not in food prep or ware washing
  - Apply soap
  - Rub vigorously for 10-15 seconds
    - fingernails
    - friction
  - Rinse with 100-108 F water
  - Thoroughly dry with paper, roll, or air
  - Hand antiseptics-only after cleaned using procedure
- If approved, when food exposure is limited and hand washing sinks are not conveniently available (mobile temp food establishments or vending machine locations, EMPLOYEES MAY USE CHEMICALLY TREATED TOWELETTES.

### **Work Practice Controls**

- **Fingernails**
  - Trimmed and filed
  - No rough edges with cleanable surfaces
  - **NO FINGERNAIL POLISH OR FAKE NAILS**, unless wearing intact gloves in good repair while working with food
- **Jewelry**
  - No jewelry on hands or arms
  - Includes medical information
  - **EXCEPTION:** Plain ring such as wedding band
  - No mention of nose, eye or tongue jewelry
- **Hair Restraints**
  - Employees will wear hat, net, beard restraints, and clothing that covers body hair
  - **EXCEPTION:** Servers of beverages, wrapped foods, hostess and wait staff

### **Work Practice Controls**

- **Eating, Drinking, or Use of Tobacco**
  - No eating, drinking, or use of ANY form of tobacco in any area where contamination of food, clean equip, utensils, linen, unwrapped single service and single use items or other items needing protection could occur.
  - **EXCEPTION:** Employee may drink from a closed closed container if handled such that it does not contaminate:
    - Hands
    - Container
    - Any items listed above
  - Prohibited from working with exposed food, clean equip, utensils, linens, and unwrapped single service and single use items if experiencing discharges from the nose, eye, or mouth.

### **Structural Controls**

- Water Quality
  - Non public water system must be tested at least annually
  - Water pressure will be provided to all fixtures and equipment except:
    - Water supplied to a temporary food establishment
    - Water supplied in response to a temporary interruption of a water supply
  - Non drinking water
    - Used only if approved
    - Only used for nonculinary purposes
      - Fire protection
      - Irrigation

### **Structural Controls**

- Hand washing sink
  - Provide water of at least 100 F
  - Self closing faucet must provide 15 sec of continuous flow
  - Convenient access for employees
  - In or adjacent to toilet rooms
- Min of 1 service sink or curbed cleaning facility for mops, etc
- At least 1 toilet and not fewer than required by law
- Plumbing will stop the backflow of contaminants into the water supply system at each point of use at the food establishment
  - Air gap
  - Backflow prevention device

### **Structural Controls**

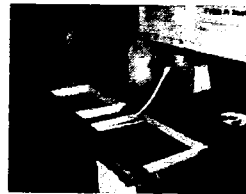
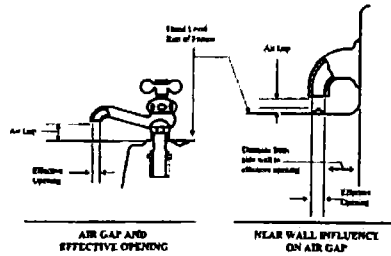
- Manual Ware Washing Sink
    - Three compartment- wash, rinse, sanitize
      - Wash water – 110F or by soap directions
      - Sanitize water – 171F or higher
    - Heated by integral heating device
    - Must have rack to allow complete immersion of utensils
    - Only used to
      - Wash dishes/utensils
      - Wash wiping cloths
      - Wash produce
      - Thaw food if sanitized before and after each use
- NO HANDWASHING ALLOWED**

### **Structural Controls**

- Mechanical Ware Washing
  - Wash solution in spray type, Hot Sanitization
    - Stationary rack, single temp 165F
    - Stationary rack, dual temp 150F
    - Single tank conveyor, dual temp 160F
    - Multitank conveyor, multitemp 150F
  - Hot water Sanitization Rinse may not exceed 194F as it enters the manifold or be less than
    - Stationary, single temp 165F
    - All others 180F
    - MUST ACHIEVE SURFACE TEMP OF 160F
  - Wash solution in spray type, Chem Sanitization – 120F

## Structural Controls

- Air Gap – air space between the water supply inlet and flood level rim of the fixture or equipment. Must be at least twice the diameter of the supply inlet and may not be less than 1 inch



## Structural Controls

- Backflow prevention devices –

- Reduced Pressure Principle Assembly (RP)

- Two independently acting check valves separated by a reduced pressure zone.
- Installed as a unit between two shut off valves



- Double Check Valve Assembly (DCVA)

- Two internally loaded check valves, force-loaded
- If one check valve fails to close, other prevents backflow



- Atmospheric Vacuum Breaker (AVB)

- Can't be used under constant pressure
- Only back siphonage, not back pressure



## **Structural Controls**

- Backflow prevention devices –
  - Pressure Vacuum Breaker (PVBA) – similar to AVB
  - Hose Connection Vacuum Breaker (HCVB) - vents when turned off preventing back siphonage, not pressure
  - Dual Check Valve (DuC) - 2 independent check valves – prevents both back siphonage and pressure



## **Structural Controls**

- Insect Control
  - Designed to retain insect in the device
  - Not over food prep area
  - Screens not required if flying insects not present
- Lighting
  - At least 108 lux (10 ft candles) at 30 inches above floor in walk-in refrigerators and dry food storage areas
  - At least 215 lux (20 ft candles) at consumer self-serve and inside reach in equipment and at 30 inches above floor in handwashing, warewashing, and toilet rooms
  - At least 540 lux (50 ft candles) on areas where employees work with food with utensils or equipment
- Waste receptacles will be covered if inside and not in continuous use or after filled and outside with tight fitting lids

## **Food Procurement/Storage Controls**

- Food prepared in private home may not be offered for consumption in a food establishment
- Fish must be commercially and legally caught and approved for sale
- Wild game must be slaughtered and processed under a routine inspection program
- Wild mushrooms
  - Individually inspected by an approved mushroom expert
  - Cultivated wild and regulated mushrooms and wild mushrooms packaged in a food processing plant are exempt

## **Food Procurement/Storage Controls**

- Raw Shucked Shellfish
  - Labeled with name, address, certification #, and:
    - Sell by date if less than ½ gallon or
    - Date shucked if more than ½ gallon
  - If no label – Hold, seize, and destroy
- Shellstock
  - Label with harvester id, date and location of harvest, type and quantity of each
  - Label must be kept for 90 after container is empty
  - Must record the date the last shellstock was sold
- Treated juice – obtained from processor with a HACCP or obtained pasteurized or treated to obtain 5 log reduction in pathogens or bear a warning label



## **Food Procurement/Storage Controls**

- Storage in ice or water
  - Fine for sealed-packaged food, whole raw fruits or veggies, and tofu
  - Raw chicken and fish received on ice may remain
  - Unpacked food may NOT be stored in direct contact with undrained ice
- At least 6 inches off the floor (unless still in case)
- On floor if pressurized beverage container, cased food in waterproof container (bottles/cans), or milk containers in plastic crates

## **Food Preparation Controls**

- Chlorine Sanitization (10 seconds and 7 seconds)

Min Conc	Minimum Temperature	
Mg/L	pH 10 or less	pH 8 or less
25	120F	120F
50	100F	75F
100	55F	55F

- Iodine Sanitization (30 seconds)
  - Min temp of 75F with pH of 5 or less
  - 12.5 mg/L to 25 mg/L
- Quaternary Ammonium (30 seconds)
  - Min temp of 75F – follow directions for concentration
  - Water must be less than 500 mg/L hardness

### **Food Preparation Controls**

- Cleaning Equipment and Utensils
  - Each time change from raw food to ready to eat foods
  - Between uses with raw fruits/veggies to PHFs
  - Before using or storing a thermometer
  - When changing from type of raw animal food: beef, fish, lab, pork, poultry except if in succession each requiring a higher cooking temperature
    - Raw fish to cutting raw poultry
    - Raw steak to cutting raw poultry
  - Every 4 hours EXCEPT if under refrigeration

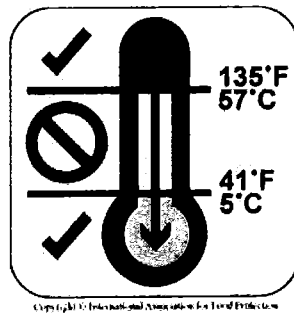
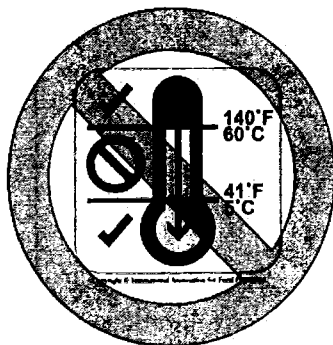
### **Food Preparation Controls**

- Consumer Use Utensils (pre-set)
  - Protected by contamination by
    - Wrapping
    - Covering
    - Inversion (upside down as in a buffet line)
  - Extra utensils
    - Removed when consumer is seated
    - Cleaned and sanitized before further use if not removed
- Utensils shall be free of lead or contain less than:

## Food Preparation Controls

- Storing utensils used during food prep
  - In a PHF/TCS
    - In food with handles protruding from top
    - On clean portion of food prep table
    - In **RUNNING** water
    - In water > 135F
  - In non PHF/TCS
    - In clean protected location (ice scoops)
    - On top of the food with handles protruding from top

## Food Preparation Controls



### **Food Preparation Controls**

145 F for 15 seconds

- Eggs broken and prepared for immediate service
- Fish, meat and game animals raised for food except
  - Ratites
  - Injected meats
  - Eggs not served as specified above
  - Comminuted (ground)

### **Food Preparation Controls**

155 F for 15 seconds

- Comminuted fish, meat and game animals raised for food
- Ratites
- Injected meats
- Raw eggs not prepared for immediate service

OR

- 145 F for 3 minutes
- 150 F for 1 minute
- 158 for 1 second

### **Food Preparation Controls**

165 F for 15 seconds

- Poultry
- Baluts
- Wild game that is not commercially raised
- Stuffed fish, meat, pasta, poultry, ratites
- Stuffing containing any of the above

### **Food Preparation Controls**

MICROWAVE

- Rotated and stirred midway during cooking
- Covered to retain surface moisture
- Heated to at least 165 F in all parts of food
- Allowed to stand covered for 2 minutes to attain equilibrium

## **Food Preparation Controls**

### **ROASTS**

- < 10 pound whole beef, corned beef, pork and cured pork roasts must be cooked in a preheated oven:
  - 350 F Still dry oven
  - 325 F Convection oven
  - 250 F High humidity oven
- > 10 pound whole beef, corned beef, pork and cured pork roasts must be cooked in a preheated oven to 250 F.
- All parts must reach the following temperature:
  - 130 F for 112 minutes
  - 133 F for 56 minutes
  - 135 F for 36 minutes
  - 140 F for 12 minutes
  - 145 F for 4 minutes
  - 158 F for 0 seconds

## **Food Preparation Controls**

### **STEAKS**

- Raw or undercooked whole muscle intact beef steak may be served if:
  - Not to a highly susceptible population
  - Steak is labeled as whole muscle intact beef
  - Cooked on top and bottom to surface temp of 145 F or above and a color change is achieved on all surfaces
- Otherwise cooked to 145 F for 15 seconds

## **Food Preparation Controls**

### **RAW FOOD**

• Eggs, fish, shellfish, steak tartare or partially cooked food other than whole muscle intact beef steaks may be served if:

- Not to highly susceptible population
- Consumer is informed that it should be cooked – disclosure and reminder
- Regulatory agency grants a variance based on a HACCP plan that:
  - Is submitted by the permit holder and approved
  - Documents scientific data that shows a lesser time/temperature results in safe food
  - Verifies training and equipment meet the variance



## **Food Preparation Controls**

### **RAW FOOD (SUSHI)**

- Raw or partially cooked fish shall be frozen and stored:
  - -4 F or below for 7 days before serving
  - -31 F for 15 hours before serving
  - -31 F until solid then stored at -4 F for 24 hours
- Does not apply to tuna, molluscan shellfish, and aquacultured fish such as salmon – can be served without freezing
- Record of freezing temperature and time must be kept for 90 days
- If frozen by supplier, written statement by supplier stating time/temp is required
- Aquaculture records must be kept for 90 days

## **Food Preparation Controls**

### **REHEATING**

- Immediate service – Cooked and refrigerated food that is prepared in response to an order (roast beef au jus) can be served at any temp
- Hot Holding
  - Reheated so that all parts of the food reach 165 F for 15 sec
  - Microwave 165 F, rotated, stirred and covered to stand 2 min
  - Commercial ready to eat foods – 135 F
  - Must reheat rapidly to 165 F within 2 hours

## **Food Preparation Controls**

### **THAWING**

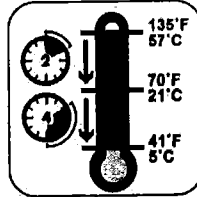
- Under refrigeration – Food must be <41 F (Slacking)
- As part of cooking process
- Completely submerging in running water
  - 70 F or colder
  - Enough velocity to agitate loose particles
- Use any procedure if ready to eat and prepared for immediate service
- Thawing foods will not exceed 41 F for more than 4 hours
  - includes prep time
  - includes time required to cool back down to 41 F



## **Food Preparation Controls**

### **COOLING**

- Cooked PHFS shall be cooled:
  - 135 F to 70 F in 2 hours AND
  - 135 F to 41 in 6 hours
- Ambient temperature prepared foods shall be cooled to 41 F within 4 hours
- Raw eggs shall be kept at 45 F
- Milk and molluscan fish received above 41 F as allowed by law shall be cooled to 41 F in 4 hours



## **Food Preparation Controls**

### **READY TO EAT PHFS**

- On premises preparation/open and hold cold foods
  - Must be marked if held longer than 1 day
  - Date that must be consumed, sold, or discarded
    - Prep day is day 1
    - Stored at 41 F can be kept for 7 days
    - Stored at 45 F can be kept for 4 days
  - Manufacturer's use by date cannot be exceeded
- Commercially prepared, packaged and inspected foods exempt
  - Deli salads – ham, seafood, egg, etc
  - Hard cheese – <39% moisture, cheddar, parm, romano
  - Semi-soft cheese – 39-50% moisture, blue, edam, gouda
  - Cultured dairy – yogurt, sour cream
  - Preserved fish – pickled herring, salted cod

## **Food Preparation Controls**

### **4 HR TIME NOT TEMP RULE**

- For a working supply of PHF before cooking or a ready to eat PHF displayed or held for immediate service
  - Marked for a 4 hour max
  - Initial temp of 41 F or 135 F
  - Cooked, served, or discarded after 4 hours
  - Not for highly susceptible populations

### **6 HR TIME NOT TEMP RULE**

- Cold food only with initial temp of 41 F or less
- Marked with start and stop time
- Discarded if food exceeds 70 F or if not cooked or served within 6 hours

## **Food Preparation Controls**

### **SPECIALIZED PROCESSING**

- Food establishment must obtain a variance for:
  - Smoking food to preserve rather than for flavor
  - Curing food
  - Using additives (vinegar) to preserve food or to render it a non-PHF
  - Reduced Oxygen Packaging (ROP)
  - Operating a molluscan shellfish life-support display tank that are offered for human consumption
  - Custom processing animals that are for personal use
  - Sprouting seeds or beans

## **Food Preparation Controls**

- Reduced Oxygen Packaging:
  - Unless you have a variance, must provide 2 barriers to control C. Botulinum and Listeria Monocytogenes
  - Food must have a HACCP that identifies the food packaged, maintains 41 F or less, and meets one of the following:
    - Aw of .91 or less
    - pH of 4.6 or less
    - Meat or poultry product cured at a USDA plant
    - Food product with a high level of competing microorganisms such as raw meat or poultry

## **Food Preparation Controls**

- Reduced Oxygen Packaging (Cont):
  - HACCP
    - Labeling
      - Must state maintain at 41 F or lower
      - Discard within 14 days of packaging
    - Procedures to prohibit bare hand contact
    - Designated area for minimizing cross contamination and untrained personnel
    - Sanitizing and cleaning procedures
    - ROP operation, equipment, etc training

**NO ROP FOR FISH, EXCEPT FOR FISH THAT IS FROZEN BEFORE, DURING, AND AFTER PACKAGING**

## **Food Preparation Controls**

- Reduced Oxygen Packaging (Cont):
  - No variance needed for Sous-Vide and Cook-Chill ROP if:
    - HACCP in place
    - Prepared and consumed on premises
    - Cooked properly
    - Packaged before cooking or immediately after cooking (before drops below 135 F)
  - Cooled to 41F in the package (2 hrs 70F, 6 hrs 41F) then:
    - Cooled to 34F w/in 48 hrs and maint at 34 F
      - 30 Day shelf-life
    - Cooled to 34F w/in 48 hrs and maint at 41 F
      - 72 hour shelf-life
    - Held frozen – No shelf-life restriction
  - Must be held in electronic and monitored (2/day) units-records of heating and cooling kept for 6 months

## **Food Preparation Controls**

- Reduced Oxygen Packaging (Cont):
  - Cheese can be packaged without a variance if:
    - No ingredients are added in the food establishment
    - HACCP plan
    - Labeled with a use by date that does not exceed 30 days or the manufactures sell by or use by date (whichever is first)
    - Discarded if is not sold or consumed within 90 days of packaging

## **Food Preparation Controls**

- Labeling Packaged Food
  - Common name of food, list of ingredients in descending order by wt, declaration of contents, distributor info AND
    - Name of each major allergen
    - Salmonoid fish containing canthaxanthin must be labeled as such
  - Bulk unpackaged foods (bakery) that are portioned to consumer specs DO NOT need labeling if:
    - No health or nutrient claims
    - No state or local laws requiring label
    - Made by the seller and regulated

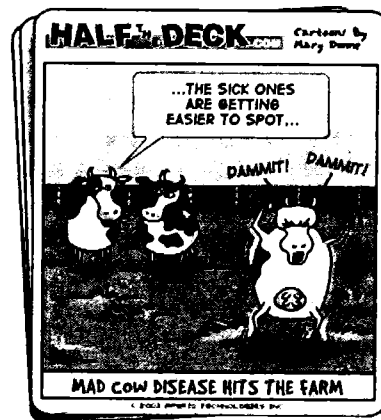
## **Food Preparation Controls**

- Raw milk diseases
  - Salmonella typhimurium
  - Campylobacter jejuni
  - Listeria monocytogens
  - Staphylococcus aureus
  - Streptococcus agalactiae
  - Mycobacterium tuberculosis
  - Yersinia enterocolitica
  - Coxiella burnetii (Q fever)
  - Brucellosis abortis
- Pasteurization - process of heating liquids for the purpose of destroying bacteria, protozoa, molds, and yeasts
  - Does not eliminate
    - Staphylococci toxins
    - Anthrax spores
    - Pesticides

## **Food Preparation Controls**

- Testing for Milk
  - Temperature at 40 F
  - Antibiotics - *Bacillus stearothermophilus* disk, Charm Test, Delvo Test
  - Bacteria count - Standard Plate Count
  - Complete pasteurization - Phosphatase Test
    - Negative test is good
    - All positives must be investigated
  - Water dilution - Cryoscope Test
  - Mastitis - Modified white test, catalase test
- If milk has been irradiated, it must be labeled as a food additive

## **Bovine Spongiform Encephalitis**



## **Questions**

**?**

## Statutes, Regs, and Stds

Wednesday, March 17, 2010  
10:43 AM

3/17/2010

### Statutes, Regulations and Standards

### **Learning Objectives**

- Be familiar with definitions used in class
- Know the authority for public health law and its applications
- Know the Home Rule and how it applies to public health
- Know licensing authority and requirements
- Be able to discuss why public health inspections do not violate 4<sup>th</sup> amendment rights
- Know when a search warrant is needed and how to obtain one
- Be familiar with the administrative tasks in an inspection
- Know about the rights of a pervasively regulated industry
- Be able to discuss Judicial Relief in terms of operation and property



### Definitions

- Abate – to put an end to; demolish; to do away with; nullify; make void
- Arraignment – the appearance of the defendant before the Court to answer the allegations made against him and to enter his plea
- Discovery – process of obtaining facts or document from a party to an action which are in his exclusive knowledge or possession
- In Rem – the power a court may exercise over property. Jurisdiction in rem assumes the property or status is the primary object of the action rather than personal liabilities associated with the property
- Eminent domain – government's right to a property, owner is entitled to compensation

### Definitions

- Malfeasance – doing something a person should not do, or official misconduct
- Misfeasance – doing wrongfully and injuriously an act with might otherwise be done in a lawful manner
- Nonfeasance – Not doing what should be done
- Sovereign Immunity – government immune from any liability for negligence
- Temporary Restraining Order (TRO) – the first of several steps in which the government requests the imposition of immediate restraint of the defendants, usually 10 days then the defendant either consents to a decree of permanent injunction or a hearing may be held on the preliminary injunction

## The Role of Law in Public Health

- Constitutional Law
  - based on the Constitution
  - US and State
- Statutory Law
  - legislatively based
  - Fed and state law and local ordinances
- Regulatory Law
  - administratively based
  - created by agencies to implement policies set by legislation
- Common Law
  - judicially based
  - prior court decisions

## Authority for Public Health Law

- Police power – right of the state to take coercive action against individuals for the benefit of society

- Protection of property
  - ± Use of property in general (zoning)
  - ± Building regulations
- ± Regulation of billboards, signs, and other structures or devices for advertising purposes
- ± Prevention of and protection against fire
  - ± Keeping and use of animals
  - ± Prohibition of nuisances in general
- ± Restriction of smoke and offensive or noxious odors
- ± Removal and disposition of garbage, refuse, and filth
  - ± Removal of dead animals
- ± Regulation of occupations and employment

### Authority for Public Health Law

- Home Rule

- *The right to local self-government including the powers to regulate for the protection of the public health, safety, morals, and welfare; to license; to tax; and to incur debt*

- States authorize local governmental entities to exercise governmental authority on the local level

- direct delegation of authority (no choice)
    - local authority option

### Limits on Governmental Power

- Federal laws must be based on the Constitution

- State and local laws are based upon police power and the Constitution

- Laws may be challenged if they interfere with civil rights or civil liberties

- Rights are granted and defined by statute or common law and belong to every citizen
  - Liberties are guaranteed by the first 10 amendments of the Constitution, the Bill of Rights

### **Individual Rights vs Public Safety**

- Individual rights may be abridged to protect public safety
  - Cannot yell “fire” in a movie theater (1<sup>st</sup> amendment)
  - Supreme Court upheld “parade permits” as legal against the right to assemble based on the overwhelming public safety and good order (1<sup>st</sup> amendment)
  - Supreme Court loosened the requirement for warrants for searches and inspections for public safety (4<sup>th</sup> amendment)

### **5<sup>th</sup> Amendment: Self Incrimination**

- May refuse to answer official questions if the answers could be used as evidence against them in a criminal prosecution
- Self incrimination may be an issue with records and reports required in PH and safety enforcements if they could lead to prosecution
- Can be circumvented by making it a criminal offense to fail to maintain and report such records but forbidding use of their content for criminal prosecution

### 5<sup>th</sup> Amendment: Due Process

- No person shall be deprived of life, liberty, or property without due process of law
- Basic components
  - Notice – laws must be clearly written and understood
  - Opportunity to be heard
    - challenge an agency's decision
    - challenge the action BEFORE the license is revoked (exception IDLH)
- Equal protection under the law – NOT equal treatment in all instances

### Licensing

- Licensing Statutes make it illegal to practice particular occupations or operate specified businesses and facilities without a license
- Establish requirement for obtaining a license
- Limit who can engage in a practice or regulate the use of official designations (MD, RS, etc)
- Licenses impose operational standards on businesses that affect public health
- Authority to license is based on POLICE POWER

### **Licensing (cont)**

- Licensure constitutes a limitation both on a persons liberty of action and on the use of a persons property
- Courts consistently consider a license a legal right that therefore deserves adherence to specified procedural safeguards
- License requirements must not impose undue or unreasonable burdens

### **Licensing (cont)**

- Licensees give up certain Constitutional Guarantees
  - allows governmental intrusion in the form of investigation and monitoring
  - Loosens but does not eliminate the warrant requirements when conducting an inspection
  - licensees relinquish much of the protection from self incrimination that the ordinary citizen could expect

### **H&S Inspections**

- A visitation or survey to determine whether or not conditions deleterious to health exist
  - Unlike police searches, they are not conducted with the particular aim of finding evidence for criminal prosecution
- Health and safety inspections are the core function of public health agencies
- Supreme Court defined the legal rights surrounding H&S inspections differently than legal rights regarding police searches

### **H&S Inspections**

- **4<sup>th</sup> amendment protects the expectation of privacy**
  - **Police cannot search without probable cause**
- PH inspections are often random and unannounced
- Had to balance the need for H&S inspections with 4<sup>th</sup> amendment requirements

## H&S Inspections

- Dealt with by Supreme Court by
  - Dispensed of the requirement for specific probable cause for routine public health inspections
  - Developed less stringent administrative warrant requirements to be used for H&S inspections
    - to obtain a warrant from a judge a PHO need only establish that an inspection is to be conducted pursuant to a pre-existing neutral administrative plan or scheme – e.g. refusal to allow you to conduct a H&S inspection

## H&S Inspections

- Warrant not required unless a refusal or partial refusal is encountered or anticipated
- No inspection can be conducted unless it is authorized by a valid statute
  - person must be authorized to conduct
  - search limited to the enforcement of the law that authorized it
- Unannounced inspections are better for catching violations
- Announced inspections assure that personnel and records are on site



## H&S Inspections

- Lawful entry
  - administrative inspections must be conducted pursuant to an administrative search warrant unless consent has been given to conduct the search
    - Has consent been given to inspect
    - Did the person have authority to give consent
    - Was consent given voluntarily
  - warrant less inspections must be conducted within the limits of the law

## H&S Inspections

- Consent to inspect refused
  - gently try to persuade to allow inspection
  - if still denied, leave promptly and inform supervisor
  - create a careful and detailed record, noting whom you spoke with and what was said
  - NEVER THREATEN LEGAL ACTION
    - Courts uphold that threats to take legal action or to obtain a search warrant are coercive; any consent following such threats will not be considered voluntarily given

## H&S Inspections

- Administrative Warrant Procedures

- show evidence to the judge that an administrative warrant is required
- inspection cannot be discriminatory, abusive or corrupt
- may have to testify that a warrant is needed
- time limitations
  - 24 hrs to several weeks

## H&S Inspections

- Entry Protocol

- during normal business hours
- use main door
- ask for the PIC
- present your credentials
- fully describe the purpose and nature of your business
- ASK PERMISSION TO INSPECT
- Document procedures in your notes

## H&S Inspections

- Inspector Demeanor

- conduct yourself as a courteous, neutral, and credible representative of the public and its government
- be intent upon discharging your responsibilities pursuant to public mandate
- avoid the appearance of bias, hostility, arrogance or contempt
- need not be apologetic, weak, indecisive or timid about carrying out your duties

## H&S Inspections

- Field Note Documents

- Admissible in court if:
  - Bound book
  - Numbered pages
  - Date
  - Time
  - Initials

## H&S Inspections

- Pervasively Regulated Industries

- industries that have a long, establish history of being inspected can be inspected without consent

- meat packing plants
    - gun shops
    - liquor stores
    - food warehouses

- no reasonable expectation of privacy exists due to extensive history of government oversight

## H&S Inspections

- Open field and plain view entry

- observations made by inspectors that can be seen by anyone in a lawful position or place to make such observations

- can enter the facility based upon this if

- IDLH
    - in hot pursuit of the perpetrator

## H&S Inspections

- Permission withdrawn during an inspection
  - follow procedures outlined in procedures for denial of inspection
  - any information gathered up to that point is valid and admissible in court
- You may NOT expand your inspection to include things not covered under your authority found during your inspection
  - Take notes (after leaving)
  - Refer to proper channels for investigation

## H&S Inspections

- Exit Phase
  - provide the PIC with an exit interview
  - if you have issued orders or tickets, determination of violations may require legal interpretations or additional information and at the very least are subject to due process

## **H&S Inspections**

- Re inspection
  - No such thing- is a search
  - Limited to only the areas that you are there to view for compliance and order
  - Exception – IDLH
- Strive to solve problems through compliance and enforcement

## **IDLH Situations**

Situation that presents imminent and controlling urgency, before which of necessity all private rights must give way

- Must consider
  - Can situation be dealt with voluntarily
  - Is there time to obtain Judicial Relief

## **Judicial Relief**

### **• Temporary Restraining Order (TRO)**

- an order of the court forbidding a party to carry out a threatened act or continue an act in progress until a hearing is held
- TRO purpose – prevent a situation from deteriorating further during the time it takes the parties to litigate the matter
- obtained through an abbreviated court proceeding

## **Judicial Relief (cont)**

### **• Temporary Restraining Order (TRO)**

- significant probability that irreparable harm will result if the injunctive relief is not granted
- the agency is likely to succeed when the case goes to trial
- public protection outweighs the rights of the private parties involved
- is based solely upon testimony of the agency
- in effect for brief period- usually 10 days

### **Judicial Relief (cont)**

- **Preliminary Injunction**

- issued after the TRO is issued and a full hearing takes place

- **Permanent Injunction**

- issued after a full trial takes place

### **Judicial Relief (cont)**

- **Property**

- **Embargo**

- tag with " Warning, all persons not to remove, sell or otherwise dispose of the product until permission is granted by the agency or a court"

- **Seizure**

- public health authority takes possession of the goods

Civil court proceeding will determine whether the goods will be destroyed or returned to the owner



## Questions

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# Air Quality

Wednesday, March 17, 2010  
10:43 AM

3/17/2010

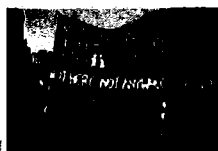
## Air Quality

### Learning Objectives

- Be familiar with definitions used in class
- Know the historical incidents leading to noise and air legislation
- Understand the Clean Air Act and implications
- Know the origination, effects, sampling, monitoring and control of criteria pollutants
- Be familiar with indoor air quality issues and legislation

## Air Pollution

The presence of solids, liquids, or gases in the OUTDOOR air in amounts that are injurious or detrimental to humans, animals, plants or property or that unreasonably interfere with the comfortable enjoyment of life and property.



## Historic Perspective

- Donora, Pa 1948
  - Particulates and oxides of sulfur
  - 20 deaths and sickness in 6000
  - Presumably from industry, but not proven
- London, 1952 Killer Fog
  - Particulates and oxides of sulfur
  - 4000 deaths and increased illness
  - Presumably from household coal burning, but not proven
  - So thick that buses could not run without lantern guides in front
- Bhopal, India 1985
  - Methyl isocyanate leak from pesticide factory
  - 2-5K deaths, 8000 disabled, 200K injured

### Clean Air Act Amendment 1990

- Sets limits on how much pollution can be in the air anywhere in the US
- State and local air pollution agencies take the lead in carrying out the Clean Air Act
- State implementation Plan (SIP) is a collection of the regs, programs, and policies that a state will use to clean up polluted areas
- Primary Standard
  - Protect public health, esp of sensitive people (kids, elderly and asthmatics)
- Secondary Standard
  - Protect public welfare, vegetation, buildings and animals

### MACT

- Maximum achievable control technology
- Standards will be based upon the best demonstrated control technology or practices within the regulated industry
- Companies that voluntarily reduce emissions according to certain conditions can get a 6 year extension from meeting MACT requirements
- 2006 - Regulations controlling air emissions from cement kilns and incinerators using MACT

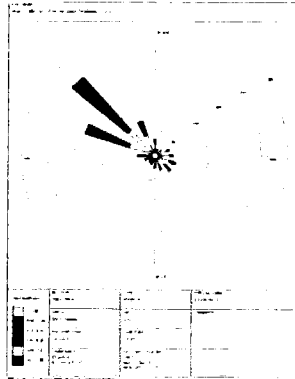
### Non-attainment Areas

- Non-attainment = Not in compliance
- 5 classifications for Ozone non-attainment areas
  - Marginal
  - Moderate
  - Serious
  - Severe
  - Extreme
- 2 classifications for Carbon Monoxide and PM
  - Moderate
  - Serious

### Attainment Areas

- Zone within which the level of a pollutant is considered to meet NAAQS. These standards are per pollutant. It is possible to be in attainment for one and not another.
- Some attainment areas are affected by transport of pollutants from nonattainment areas that cause them to suffer an increase in classification.
- Transport is determined by a wind rose.

## Wind Rose



Divided into 16 wind directions. Each direction is divided into wind speeds. As the % of time the wind blows from a particular direction get larger, the portion of the bar representing the wind speed gets larger in both length and width.

## Cap and Trade

- 2K utilities are required to reduce their SO<sub>2</sub> emissions
- Sulfur dioxide emissions from power plants are capped to 10 M tons per year. Amount is considered to be 1/2 of the total US annual emissions of sulfur dioxide
- Law allows utilities to trade allowances within their systems and/or buy or sell allowances to and from other affected sources.

### Air Toxics

- Hazardous air pollutants that are known or suspect to cause serious health effects or severe environmental effects
  - Carcinogens, mutagens and reproductive toxics
- List of 188 toxic air pollutants of which emissions must be reduced
- Sources
  - Major – emits 10 tons/year of any 1 toxic or 25 tons/year of a combination
  - Area source – smaller source such as a dry cleaner

### Criteria Pollutants

- NO<sub>x</sub> – motor vehicles, industry
- SO<sub>x</sub> – coal fired power plants, industry
- Ground level O<sub>3</sub> – motor vehicles
- CO – motor vehicles
- Particulate Matter – paper industry, construction, burning
  - PM<sub>10</sub>
  - PM<sub>2.5</sub>
- Lead – smelting, steel works, blast furnaces

Particle pollution and ground level ozone are the most widespread health threats

## SOx and NOx

- Acid Rain
  - Sulfur dioxide and nitrogen oxide emissions react with H<sub>2</sub>O in air and return as precipitation
- Mostly from burning of fossil fuels
- Damages lakes, forests and buildings
- 110 fossil fuel power plants (major polluters) are required to reduce emissions

Reduction can be accomplished through energy conservation, cleaner technology, and the cap and trade program



## Ozone

- Ground level ozone (O<sub>3</sub>) is bad ozone
  - main ingredient in smog
  - harmful to lungs and plants
- Stratospheric ozone is good ozone
  - filters out harmful UV rays
  - is destroyed by
    - chlorofluorocarbons (CFCs)
    - hydrochlorofluorocarbons (HCFCs)
    - Halons
    - Methyl Bromide - remember what this is??
    - Methyl chloroform



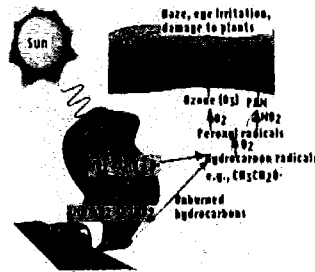
## Pollutant Effects

- Peroxyacyl Nitrates (PAN)
  - loss of chlorophyll in plants
  - silvering or bronzing of the underside of leaves

- Ground Level Ozone
  - plant bleaching
  - plant growth suppression
  - tip burns on leaves

- Animals are primarily effected by ingesting plants contaminated by air pollutants

- Photochemical Smog



## Ground ozone controls

- Automobiles account for almost 1/3 of the emissions of the ozone precursors VOCs & NOx and up to 90% of CO emissions in urban areas.

- Tighter pollution standards for automobiles
- Cleaner burning gasoline
- Clean fuel car pilot program in California – mandates LEV production
- Clean fleets – 26 metropolitan areas the country will have to adopt a program limiting emissions from centrally fueled fleets of 10 or more vehicles

### Ground Ozone Controls

- Montreal Protocol of 1987
- Phase out CFC production and use of O3 depleting substances (ODS) by 1996
- Warning labels on essential ODS
- Prohibit non essential ODS
- 1992 amendment scheduled phase out of HCFCs
  - 2010 manufacture only for existing equipment
  - 2020 manufacturing prohibition

If all countries stop producing ODS, O3 layer in stratosphere should return to normal by 2050

### Ground Ozone Controls (cont)

- Refrigerants cannot be vented into the atmosphere
- Required to be recovered, recycled and reclaimed
- No requirement to repair leaks
- After 2020, only recycled R-22 will be available
- No requirement to change type of refrigerant in existing units even if being repaired

**Technicians are required to be Section 608 Certified**

### Particulate Matter

- PM10 mostly deposited in the nose and pharynx and expelled from the body – problem for sensitive population
- PM2.5 are small enough to reach the inner lung and interfere with oxygen exchange – can lead to heart or lung disease, heart attacks, bronchitis, and asthma attacks
- Burning fuel is a major source of PM2.5
  - woodstoves
  - diesel trucks/buses
  - coal fired power plants
  - Natural sources = volcanoes, dust, forest fires

### Particulate Matter Controls

- Settling Chamber
  - Low pressure drop for large particles  $>50\text{ }\mu\text{m}$
- Cyclone (Venturi)
  - Low pressure drop + high flow rate  $10\text{--}200\text{ }\mu\text{m}$
- Filters
  - Multiple bags or cloths in parallel (Baghouse filter)
- Wet Collectors
  - High pressure drop, high gas volume  $\geq 1\text{ }\mu\text{m}$
- Electrostatic Precipitator
  - Very high flow rate, very efficient for all sizes

### GAS and VAPOR Controls

- Wet scrubbers or spray towers
- Granular bead beds
  - chemical or physical absorption
- Incinerators for combustible vapors
- Thermal afterburners
  - for incinerators – use energy to burn unburned fuel
- Catalytic converters
  - motor vehicle exhaust
  - honeycombed platinum, palladium or rhodium which burn products of incomplete combustion

### Pollution Sampling

- Particulates – Impactors, filters
- Gases – Impingers
- Gases/vapors – Adsorbent tubes, Tedlar bags
- Mold/Bacteria – Agar plates



### Principles of Collection

- Sampling is collecting
- Measure amount of air – use a calibrated pump
- Impaction – centrifuge like action to precipitate different size particles (also uses inertia like in minivol)
- Filtration – different hole sizes in media to sort particles
- Adsorption – gases and vapors chemically adhere to surface
- Solution – gases bubbled through a solution as in an impinger

Amount of pollutant collected is expressed in terms of how much air was drawn – e.g. 5 mg/m<sup>3</sup>

### Pollution Monitoring

- Periodically checking contaminant concentrations
  - Sequential samples
  - Direct reading instrument
    - PID - photoionization detector
    - FID – flame ionization detector
    - Electrochemical cells
- Most meters measure a change in electrical resistance or current generated by the ion
- Advantage = speed NOT quality

### Pollution Analysis

- Metals
  - Atomic Absorption (AA)
  - Ion coupled plasma (ICP)
- Asbestos
  - Polarized light microscopy (PLM) for bulk samples
  - Phase contrast microscopy (PMC) and transmission electron microscopy (TEM) for filters
- Gases and vapors
  - Gas chromatography (GC)
  - Mass Spectrometry (MS)
  - Combination of both

### Indoor Air Quality

- Not regulated
- Concerns
  - Molds - mycotoxins
  - Radon – decay of uranium
  - Carbon monoxide – burning process
  - Formaldehyde – carpet, wood
  - Cigarette Smoke
- 1994 OSHA proposed a rule for IAQ
- 2001 OSHA withdrew the proposed rule

**Questions**

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## Housing/Institutions

Wednesday, March 17, 2010  
10:55 AM

### **Housing and Institutions**

#### **Learning Objectives**

- Be familiar with terms used in class
- Know what makes a dwelling substandard
- Know the effects of substandard housing
- Be familiar with ways to combat obsolescence
- Be able to explain the two appraisal methods
- Know the minimum standards for plumbing, IAQ, ventilation



## Housing

- Individuals have a right to a decent home and suitable living environment
  - Clean air
  - pure water and food
  - adequate shelter
  - unpolluted land
  - freedom from excessive noise and odors
  - adequate recreational and neighborhood facilities
  - convenient community services
- Substandard Housing is a reality, particularly in urban areas
  - >1.51 persons per room
  - no private bath (or is dilapidated)
  - no running water

## Housing Problem

- Rapid growth of population in the suburbs
  - Desirable housing increasingly difficult to find and costly
  - Inadequate public transportation to work forcing some people to move close to work – creates less desirable housing effect
- Obsolescence
  - Property is no longer suitable for the purpose in which it was first used for
  - e.g. slum around central business area
    - people who want peace and quiet move away
    - landlord forced to lower rent – creates less desirable housing
    - area becomes **BLIGHTED** – no growth and building deterioration

### **Housing Problem (cont)**

- Returns on ownership of property decreases
  - property is often sold or abandoned
  - only minimum repairs are made
  - tax payments are delays
  - neighborhood further degrades
- Effects
  - Intestinal disease 100% higher with no private toilet
  - Meningococcus rate 5.5% higher
  - TB rate 8 times higher
  - Infant death rate 5 times higher
  - Life expectancy 6.7 years less

### **Housing Solutions**

- Housing Ordinances
  - Must be diligently enforced
  - Should require owners to reinvest a reasonable part of income - AT THE FIRST SIGN OF DETERIORATION
  - Prevent deterioration and "milking" of properties
  - Eliminate the need of the community to acquire and destroy properties (eyesore, fire, health hazards)
- In Rem proceedings for failure to pay taxes
  - Shorten foreclosure window from 5 to 2 years
  - Property still has value and can be repaired

## **Housing Appraisal**

- American Public Health Association (APHA) Method
  - Developed by the Committee on the Hygiene of Housing 1944 to measure the quality of the **dwellings** and the **environment** they are located in
  - Eliminates individual opinion when evaluating housing to arrive at a numerical value
    - Starts at 600 (the theoretical worst possible score)
    - Subtract for each area that meets standards
    - 0 indicates all standards are met (perfect score)
    - Practical worst score = 300, median = 75
  - Dwellings evaluated based of facilities, vacancies, and occupancy

## **Housing Appraisal**

- American Public Health Association (APHA) Method (cont)
  - Basic deficiencies
    - Shared toilet with another dwelling or is not an approved type
    - Water source not approved
    - No electric lighting
    - $\frac{1}{4}$  of rooms lacking heater
    - $>1.5$  persons per room
    - # occupants  $> 2$  times # of bedrooms +2
    - less than 40ft<sup>2</sup> of sleeping area/person

**Score of  $>120$  classifies the dwelling as unfit,  $>80$  environmental score is unfit – Combo of  $>200$  unfit**

## **Housing Appraisal**

- Neighborhood Environmental Evaluation and Decision System (NEEDS)

- Developed by the US Public Health Service
- 5 stage system
- **Uses fewer variables than APHA**
- Rapid survey technique

Adapted for electronic data processing to reduce the lapse time between data collection, analysis, planning, and implementation

## **Minimum Standards**

- Housing and Health APHA-CDC Recommended Minimum Housing Standards

- Listing of basic standards that should apply to all existing, altered, and newly constructed housing
  - Sanitation
  - Inspections: powers and duties
  - Fire safety and personal security
  - Lighting and ventilation
  - Heating
  - Space requirements
- Prepared for local adoption
- Should be exceeded

## **Minimum Standards**

- Plumbing
  - National Plumbing Code
  - Uniform Plumbing Code
  - Standard Plumbing Code (Southern Code)
- All prohibit the use of lead for water distro and the use of tin-lead (50:50) and (60:40) for joining copper pipes
- Define water supply fixture units (wsfu) (usually 7.5 gpm)
- Define drainage fixture units (dfu)
- Specify # fixtures required
- Specify backflow prevention
  - Air gap – 1" for .5" faucet, 1.5" for .75" faucet, 1" or < faucet = double the diameter for air gap (e.g. 2" airgap for 1" faucet)

## **Minimum Standards**

- Indoor Air Quality
  - Most urban dwellers spend 80-90 % of time indoors
  - 3 problems – inadequate ventilation (52%), contamination from inside building (17%), contamination from outside (11%), microbiological (5%), contamination from building fabrics (3%), unknown (12%)
  - American Society of Heating, Refrigerating and Air Conditioning Engineer Standards (ASHRAE)
    - Asbestos - .2 fiber/ml
    - CO – 9 ppm for 8 hrs, 35 ppm for 1 hr
    - Formaldehyde - .1 ppm
    - Radon - .01 working level

### **Minimum Standards**

- Indoor Air Quality (cont)
  - 1/3 of recirculated air should be fresh air
  - Recommended supply of 15 – 20 ft<sup>3</sup>/min
  - Toilets and Bathrooms
    - Mechanical exhaust of 5 airchanges/hour
    - Fans NOT activated by light switch or door switch
    - Recirculation not permitted
  - Air Change
    - divide volume of air entering room by volume of room
    - e.g. 100ft<sup>3</sup>/ min enters a 1000ft<sup>3</sup> room
      - $(100 \text{ ft}^3/\text{min} \times 60 \text{ sec}/\text{min})/1000\text{ft}^3 = 6 \text{ AC}$

### **Minimum Standards**

- Indoor Air Quality (cont)
  - NIOSH on control of respiratory illness
    - relative humidity below 70% in occupied space
    - 20 ft<sup>3</sup>/ min in smoking areas (remember ASHRAE 15-20 ft<sup>3</sup>/min)
- Venting
  - Flue or vent must extend 3' above flat roofs or 2' above the highest part of peaked roof ridges
  - Standards by the National Fire Protection Association (NFPA)
- Mobile homes – minimum of 10' between homes

### **Housing Program Enforcement**

- Prepare and distribute housing operating manual
- Complete inspections on all premises occupied as living units
- Letter to owner – deficiencies and recommendations
- Re-inspection letter giving **30 days** to make progress
- Issue of summons when measures have failed (if authorized)
- Notification to welfare dept (substandard housing= no\$)
- Notification to property stakeholders of existing conditions
- Low interest loans to make repairs
- Tax foreclosure proceedings within two years (in rem)

Procedure consists of education and persuasion with legal action  
being a last resort

### **Institutions and Licensed Establishments**

## **Learning Objectives**

- Be familiar with the terms used in class
- List ways to combat nosocomial infections in the hospital and nursing home setting
- Know the 4 biosafety levels and what they are used for
- Know the 3 types of biosafety cabinets and their application
- Know the provisions for the following institutions: hospitals, schools, day care centers, correctional facilities
- Know the provisions for the following licensed establishments: tattoo parlors, barber shops

## **Institutions**

- A complete property with building, facilities, and services having asocial, education, or religious purpose. Includes

- Schools
- Colleges and universities
- Hospitals
- Nursing homes
- Day care centers
- Detention facilities

**Possibility of transmission of illness associated with air, water, food and contact are increased**



## **Institutions**

- Hospitals and Nursing Homes
  - 5% of hospital patients incur nosocomial infections
    - Teaching hospitals have highest rate while non teaching hospitals have the lowest rate
    - Can be avoided by
      - Hand washing, air handling and sterilization
      - Laundry/Linen handling
        - Wash at 160-167 F for 25 minutes
        - Correct Cl dilution and drying temperature (170 F) more important than wash temp
  - Only 15 % hospital was is infectious
  - Blood borne pathogens regulated by Dept of Labor (OSHA)

## **Institutions**

- Hospitals and Nursing Homes (cont)
  - Biosafety level 1 – agents are identified and characterized as agents not known to cause disease in health human adults – minimal potential hazard
  - Biosafety level 2 – agents are of moderate potential hazard and include many of the food and waterborne agents such as salmonella, shigella, and campylobacter
  - Biosafety level 3 – agents are indigenous or exotic that may cause serious or potentially lethal disease by inhalation – tuberculosis and hantavirus
  - Biosafety level 4 – agents are dangerous and exotic agents which pose a high risk of infection and life threatening disease as a result of aerosol exposure

## **Institutions**

- Hospitals and Nursing Homes (cont)
  - Biosafety Cabinets
    - Class I – low risk agents, not for handling materials vulnerable to airborne contamination – HEPA exhaust
    - Class II – (type A & B) suitable for volatiles and radionuclides – exhausted via HEPA to outside
    - Class III – maximum protection, required is BSL 3 or 4 facilities – glovebox – double HEPA then incineration
  - Test upon setup, relocation, and ANNUALLY

## **Institutions**

- Schools
  - 1 drinking fountain for 75 children
  - 1 washbasin for 30 students
  - Toilet
    - 1 for every 35-45 girls
    - 1 for every 30-40 boys
  - Lighting provisions
  - 68-72 F in classrooms
  - Ventilation 10-30 ft<sup>3</sup> per person

## **Institutions**

- Day Care
  - Temperature and Humidity
    - Winter 65-75 F, 30-60% RH
    - Summer 68-82 F, 30-60% RH
  - Exits must be at least 36" wide
  - Windows – open max of 6" if children under 6 are present
  - Electrical Safety
    - Safety covers on outlets
    - GFCI on outlets by water source (tested every 3 years)
  - Infant walkers are prohibited
  - Sleeping areas
    - Cribs, pads, cots etc must be at least 3' apart
    - Cannot be placed on floor colder than 65F

## **Institutions**

- Day Care (cont)
  - No bunk beds for children under 6
  - 1 hand washing sink/2 changing tables
  - Swings shall have clearance of 6 feet
  - Indoor play space
    - 2-12 years old 40ft<sup>2</sup>
    - < 2 years 35ft<sup>2</sup>

## **Institutions**

- Day Care (cont)
  - Outdoor play area required or within 1/8 of mile from center
    - 75ft<sup>2</sup>/child >2 years old
    - 50ft<sup>2</sup>/child 18-24 months old
    - 33ft<sup>2</sup>/infant
  - Fencing or hedge 4' high required
  - Rooftop fence >6' high with rooftop fire escape
- Equipment – designed not to trap child's head
  - Rings must be smaller than 4" or larger than 9"
  - Openings 4 5/8 to 9 1/8 inches prohibited
  - Opening 3/8 – 1 inch prohibited

## **Institutions**

- Day Care (cont)
  - Sandboxes drained and covered when not in use
  - Soil tested for lead
    - Initially and every two years after (if on exteriors)
    - Not to exceed 400 ppm
    - 10ug/dl is action level in children
  - Water testing every 3 years (chem and bact)

## **Institutions**

- Day Care (cont)
  - Separate area for isolating sick children
    - Meningococcal disease – Rx administered with consent
    - Strep A – 24 hours exclusion post TX
    - Non febrile cold – no exclusion or isolation
    - Oral herpes – excluded until secretions controlled
    - Chicken pox – excluded until sores have dried
    - Diarrhea – exclude children with diapers
    - Scabies – exclude
    - Head lice – exclude
    - Ring worm – do not exclude if being treated

## **Institutions**

- Correctional Facilities
  - Amount of unencumbered space per inmate confined to cell for 10+ hours
    - 35ft<sup>2</sup>
    - One wall 7' or longer
    - Bed (12" off floor), plumbing fixtures, desk and locker
  - Dayrooms must have 12ft<sup>2</sup> of glass to outdoors
  - Noise – max 70 dBA day, 45 dBA night
  - 15ft<sup>3</sup> outside air or recirculated filtered air/occupant
  - Temperature and humidity = appropriate

## **Institutions**

- Correctional Facilities (cont)
  - Clean clothing
    - 3 sets/week
    - Not washed in wash basin
  - Clean linen
    - Weekly
    - 2 sheets, pillow, pillow case, mattress, blankets
  - Bathing
    - 3 showers per week
    - Thermostatically controlled 100-120F
    - Soap, toothbrush, toothpaste, comb, toilet paper
    - Haircuts to comply with applicable health requirements

## **Institutions**

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### **Licensed Facilities**

- Tattoo Parlor
  - Must follow the universal body fluid precautions – CDC
  - 30 ft candles of light for tattoo area, 10 ft candles in other areas
  - Equipment sterilization
    - Autoclave only – dry heat not acceptable
    - 15lbs psi for 35 minutes at 250F
    - tested monthly using bacillus stearothermophilus spores-destroyed at 15 min at 121 C
  - Artist or patron can't have infectious disease in communicable stage
  - Must keep records of patrons, including signed consent

### **Licensed Facilities**

- Barber Shop
  - Require annual renewal of certificate
  - Equipment will be cleaned and disinfected after each use
    - Quaternary ammonia, alcohol, lube sanitizer, bleach, autoclave, and others
    - Boil for 5 minutes
  - Sanitary napkin around neck to prevent skin contact with cape
  - Barbers and patrons excluded for communicable diseases that may be spread via hair cut
  - Non porous floors and removal of hair to covered receptacle after each patron

## Questions

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## Solid and Haz Waste

Wednesday, March 17, 2010  
10:45 AM

### **Solid and Hazardous Waste**

#### **Learning Objectives**

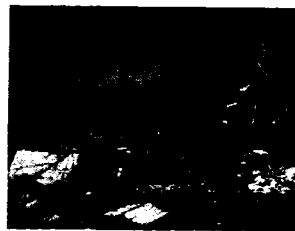
- Be familiar with definitions used in class
- Be able to discuss Love Canal and its aftermath
- Know the 4 components of ISWM in detail
- Know the collection frequencies for MSW
- Be able to discuss RCRA and CERCLA in the context pertaining to solid and hazardous waste
- Given chemical characteristics, determine if a waste is hazardous
- Discuss waste destruction, treatment, and control technologies

## Definitions

- Garbage – Putrescible (organic materials prone to degrade rapidly, giving rise to obnoxious odors) waste
  - Animal and vegetable waste from processing, handling, storage, cooking, or serving of FOOD
  - Originates mostly from restaurants, kitchens, grocery stores
- Solid Waste
  - Includes garbage, waste treatment sludge, mining waste, refuse, industrial waste, etc – CAN BE SOLID, LIQUID OR A CONTAINED GAS
  - Not based on state of material, only how was disposed of
    - abandoned, recycled, inherently waste like, certain military munitions
  - Excludes domestic sewage, agricultural manure, crop residues that could be used as a fertilizer, NPDES point source pollution, and nuclear waste
  - Largest source is paper
- Municipal Solid Waste – portion of solid waste that is generated by households and commercial establishments

## Open Dumps

- Illegal disposal of waste (banned in the US)
- Still used worldwide
- Breeding ground for pests, pollutes air, soil, and water
- Costs thousands of dollars to remediate – Love Canal



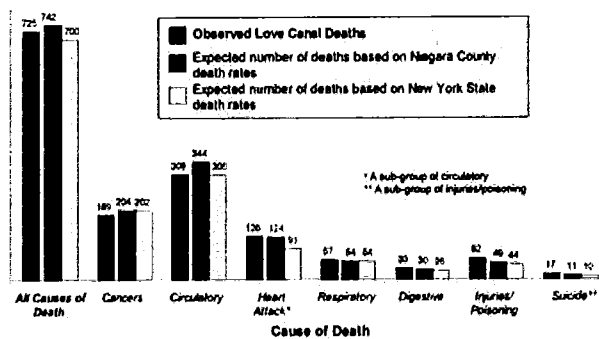
## Love Canal

- 1920 canal started being used as an open dump by the town
- 1942 Hooker Chemicals and Plastics purchased site
- 1942 – 1953 Hooker disposes of nearly 22K tons of chemical waste into canal and covers
- 1953 – Hooker sells site to Niagara Falls School Board - \$1.00
- 1955 – 1960 – 99<sup>th</sup> St. School and town constructed on and around site
- 1975 - 1976 – Heavy rainfall forces water table to rise causing portions of dump to subside bringing deteriorated drums to surface
- 1978 – Declared as a threat to human health, site fenced off
- 1978 – 99<sup>th</sup> St. School closed, government purchases homes with emergency federal funding



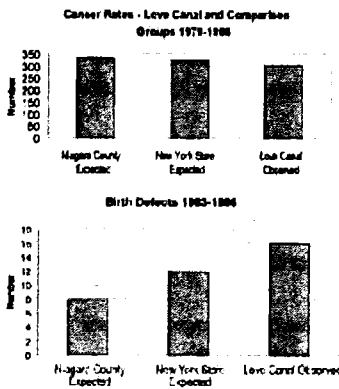
## Love Canal

Figure 2: Observed vs. "Expected" Deaths in Love Canal Group (1978 - 1996)



[http://www.health.state.ny.us/environmental/investigations/love\\_canal/mortality\\_community\\_report.htm](http://www.health.state.ny.us/environmental/investigations/love_canal/mortality_community_report.htm)

## Love Canal



[http://www.health.state.ny.us/environmental/investigations/love\\_canal/fall\\_2006.htm](http://www.health.state.ny.us/environmental/investigations/love_canal/fall_2006.htm)

## Integrated Solid Waste Management

- The selection and application of suitable techniques, technologies, and management programs to achieve specific waste management goals
  - Source reduction
    - Reducing the volume or toxicity of waste generated
  - Recycling and composting
    - Recycling returns raw materials to the market by separating reusable products from the rest of the waste stream
    - Composting is the controlled decay of organic matter in a warm, moist environment by the action of bacteria, fungi, and other organisms
  - Combustion(waste to energy)
    - Reduce the volume of waste up to nine fold
    - Ash can be used as a building material
  - Landfills
    - NOT an open dump – controlled method of solid waste disposal
    - Only management technique that is both necessary and sufficient

## **Source Reduction**

- Should be the first step in integrated solid waste management.
- Eliminate toxic chemicals from processes
- Substitute less toxic chemicals
- Example –
  - Bottle bill – designed to decrease the amount of roadside trash in the form of beverage containers
  - Deposits are paid to stores on specified beverages
  - When container is returned, deposit is refunded
  - Decreased the amount of roadside trash

## **Recycling and Composting**

- Resource Recovery = Recycling
  - 90% of MSW is theoretically recoverable
  - 50 - 60 % is achievable
  - 35% national goal
- 95% energy savings from recycling aluminum cans
- Crushed recycled glass melts at lower temperature – saves energy
  - Lots of material available
  - Costs a lot to recycle
- Most material recovery operations are losing propositions and are subsidized
- 3 methods of composting
  - Windrow – long piles, turned every other day to keep aerobic (odor control)
  - Aerated static pile – pile with oxygen provided via mechanical means
  - In vessel method – enclosed container with mechanically controlled environmental factors



## Combustion

- 4 common types of Incinerators
  - Mass fired combustors – minimal processing before burning – potential for haz mat to enter – Large - energy content extremely variable
  - Refuse derived fuel (RDF) fired combustors – organic matter shredded or cubed – waste entering more controlled – Smaller – high energy
  - Modular combustion units – small capacities of waste – volume reduction of 80 -90 % and energy recovery of 55%
  - On site commercial and industrial incinerators – limited by pollution control requirements – many being replaced or redesigned to comply
- Incineration requires
  - Time – drive out the moisture
  - Temperature – must reach ignition point
    - Min temp 1500 – 1800 F (lower than 1500F produces dioxins and furans)
    - 2500 F typical for steam generation and energy recovery
    - Hospital waste – 1800 – 2000 F
  - Turbulence (including sufficient oxygen) – mix of gases formed with enough oxygen to burn the combustible matter and particulates
  - Inorganics are typically not destroyed

## Landfills

- 3 Common designs
  - Trench
    - level ground to moderate slope
    - trench is dug and filled
  - Area or Ramp
    - flat and rolling terrain
    - ramp is constructed and waste is spread over an area and covered
    - fill comes from off site
  - Valley fill
    - in valleys and ravines
    - Walls of ravines are used for fill
- Must be designed to contain the liquid that percolates through the landfill (leachate) and minimize the release of pollutants (including odors and gas) from the landfill (RCRA subtitle D)
  - Liners
  - Leachate collection
  - Gas monitoring



## Landfill Design

- **Liners – designed to prevent groundwater contamination**
  - Single liner – one liner consisting of compacted soil or geomembrane
  - Composite liner (subtitle D or MSW) – single liner of compacted soil and geomembrane in intimate contact
  - Double liner (subtitle C or Haz Waste) – system with low permeability barrier layers with a leachate collection system and a leak detection system. The upper and lower components are either compacted soil, geomembrane, or composite.
- **Leachate collection**
  - High permeability layer designed to direct, collect and transmit leachate from the liner
    - Geomembrane – impermeable layer of clay or dirt which limits the movement of liquid
    - Geonet – impermeable synthetic material that provides a path for liquids
    - Geotextile – PERMEABLE synthetic material that acts as a filter for liquids

## Landfill Design

- **Leachate collection (cont)**
  - Required on all subtitle C (haz waste) landfills
  - Managed by
    - Onsite WWTP
    - Pipeline
    - Recirculate – accelerates biodegradation of waste
    - Evaporate
    - Evacuate to off site treatment facility
- **Gas collection**
  - Methane and carbon dioxide principle gases produced (anaerobic)
    - Greenhouse implications
    - Explosive (methane 5 – 15% LEL)
  - Potential energy source – heating and electricity
  - Source combustion – flames coming out of capped landfills



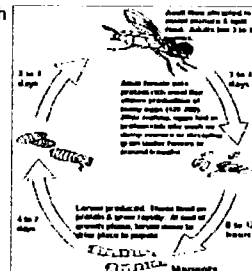
## Landfill Design

- Minimum of 100ft from any surface water
- Fill must be at least 100ft from property line
- Located at least 6 miles from airport
- Minimum of 4 monitoring wells at a new facility, min of 3 down gradient for a small site
- Liner must be at least 5 feet from ground water
- Cover material and drainage based on 25 year storm and a 24 hour, 25 year storm
- Final cover of 2 ft, including impervious barrier and gas venting layer along with upper grass cover crop
- Final vegetation must be established within 4 months

## Landfill Operation

- Access must be controlled
- Need at least 2 personnel present when open, 1 must be supervisor
- Solid waste spread max of 2 ft layers and **compacted daily**
- Min 6 inches of cover at end of day
- Leachate must be monitored annually and for 30 years after site closes
  - Fly can migrate 5 ft in uncompacted trash and only 6 inches in compacted trash

- Reasons for daily cover and compacting



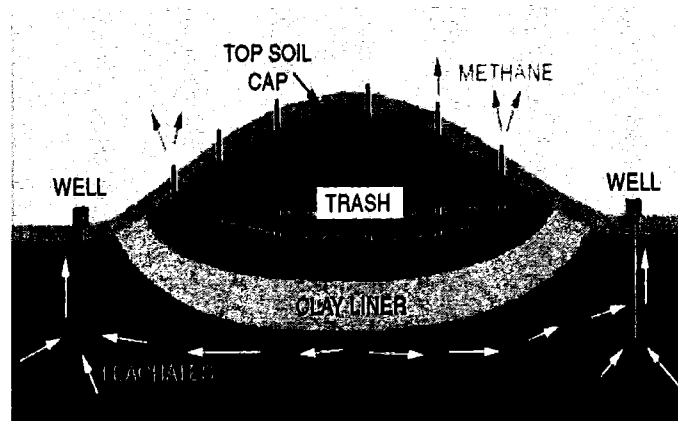


## Landfill Closure

- Final Cap must be placed on landfill
  - Vegetative cover
  - Min 6 inches of topsoil
  - Min 18 inches of infiltration cover
  - = 24 inch final cap
  - Slope at 4 degrees for run off
  - Monitor leachate for 30 years
- Financial assurance for 30 years post closure
- Once completed can be used for
  - Green space
  - Recreational areas
  - Agriculture
  - No permanent buildings can be erected



## Landfill Closure



## **Municipal Solid Waste Collection**

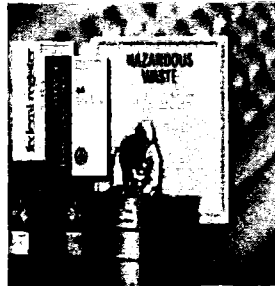
- **Frequency**
  - Average amount of waste collected per area is dependent on season, education, rural/urban, and SES status
  - Ghettos typically generate more waste
  - Residential waste
    - Twice a week in warm weather
    - Once a week during other months
  - Hotels and Restaurants
    - Daily except on Sunday
  - Bulky waste
    - Every 3 months
- **Collection Systems**
  - Hauled Container Systems (HCS) – removal of waste from sources where the generation rate is high – large containers
  - Stationary Container Systems (SCS) – containers remain at source of generation – trash cans

## **Hazardous Waste**

## **Resource Conservation and Recovery Act**

### **1976**

- Goals
  - PROTECT human health and environment through effective waste management
  - CONSERVE materials and energy resources through waste recycling and recovery
  - REDUCE or eliminate waste generation as expeditiously as possible



## **Resource Conservation and Recovery Act**

### **1976**

- Provides "Cradle to Grave" tracking and management of hazardous waste
- Defines and governs treatment, storage and disposal (TSD) facilities
- Defines 4 programs
  - Subtitle C – hazardous waste
  - Subtitle D – solid waste
  - Subtitle I – underground storage tanks
  - Subtitle J – Medical waste



## **Resource Conservation and Recovery Act**

### **1976**

- Subtitle C – Hazardous Waste
  - Regulates commercial business as well as federal, state, and local government facilities that generate, transport, treat, store, or dispose of hazardous waste.
  - Ensures proper management of hazardous waste from the moment it is generated until its disposal or destruction – Cradle to Grave
  - EPA or a state hazardous waste agency enforces the hazardous waste laws
  - Defines ten methods of hazardous waste management
    - i. containers
    - j. tanks
    - K. surface impoundments
    - L. waste piles
    - M. land treatment
    - N. land fills
    - o. incinerators
    - p. thermal treatment
    - q. chem. phy, bio treatment
    - r. underground injection

## **Hazardous Waste**

- Under RCRA, hazardous waste is a **solid waste** or combination of solid wastes that because of its quantity, concentration, or physical, chemical or infectious characteristics may
  - Cause of significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness
  - OR
  - Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of or otherwise managed
- Can be chemical, biological, flammable, explosive, and radioactive substances
- Can be solid, liquid, sludge, or contained gas
- Must meet definition of solid waste first

### Hazardous Waste

- Listed Hazardous Wastes - Determined hazardous by EPA
  - F List – **Generic** process waste from non specific sources
    - Spent solvents – cannot be used again without reprocessing
    - All spent solvent mixtures containing a total of 10% or more of one of the solvent listed in F list
  - K List – Process waste from very **specific industries**
    - Notable - Pesticides, Primary lead, Primary zinc, vet pharmaceuticals
  - P List – **Acutely hazardous UNUSED** chemicals
    - Discarded commercial chemical products
    - Spill residue or cleanup of P listed chemicals
  - U List – **Non-acutely hazardous UNUSED** chemicals
    - Discarded commercial chemical products
    - Spill residue or cleanup of U listed chemicals

### Hazardous Waste

- 4 Characteristics
  - Ignitability
    - Liquids with flashpoint <140F
    - Non liquids that cause fire and burn persistently
    - DOT ignitable compressed gas or DOT oxidizers
  - Corrosivity
    - Liquid with pH <= 2 or >= 12.5
    - Liquids that corrode steel at a rate greater than 6.35 mm/yr at 130F
  - Reactivity
    - React violently or form toxic gases with air/water/heat
    - Normally unstable, capable of explosive reaction
  - Toxicity
    - When analyzed using the Toxicity Characteristic Leaching Procedure (TCLP) produces leachate containing 1 or more constituent concentrations at or exceeding threshold values

### **Hazardous Waste**

- Non hazardous waste + Listed hazardous waste = Hazardous waste
- Non hazardous waste + characteristic hazardous waste = non hazardous waste if does not exhibit any characteristic
  - $\text{HNO}_3 + \text{CaCO}_3$  = non hazardous if pH is between 2 and 12.5
- Any solid waste derived from the treatment, storage, or disposal of a hazardous waste and still exhibits the same characteristics of the hazardous waste is still hazardous waste

### **Hazardous Waste**

- Conditionally Exempt Small Quantity Generator (CESQG)
  - Generates less than 100 kg/month
- Small Quantity Generator (SQG)
  - Generates 100 – 1000 kg/month
- Large Quantity Generator (LQG)
  - Generates more than 1000 kg/month OR
  - Accumulates more than 1 kg of acute toxins/month

### **Hazardous Waste**

- Transportation off site requires a hazardous waste manifest which continuously tracks the waste from the time it leaves the generator unit it reaches the waste management facility that will store, treat or dispose of the waste.
- Form 8700-22
- Treatment technologies
  - Biological methods
  - Physicochemical processes
  - Stabilization and solidification
  - Thermal destruction
  - See page 884 Salvato

### **Universal Hazardous Waste**

- Widely used and generated wastes
  - Small dry batteries
  - Agriculture pesticides
  - Thermostats containing mercury
  - Paints, latex and oil
  - Lamps – fluorescent, neon, mercury vapor, metal halide, high pressure sodium, high intensity discharge
- Small Quantity Generator – less than 5000kg/year
- Large Quantity Generator – 5000 kg or more/year

## Hazardous Waste

- Notatable exclusions from the definition

- Sewer discharges
- Wastewater discharges
- Irrigation water
- High level radioactive waste
- Mining waste
- Non terne plated used oil filters
- Arsenically treated wood products
- **HOUSEHOLD HAZARDOUS WASTE**



## Hazardous Waste

- The Annotated Code of Maryland, Environment Article § 9-1801, defines Household Hazardous Waste (HHW) is any waste material, including garbage or trash, derived from a household that would be listed as hazardous waste under the Resource Conservation and Recovery Act but for the fact that the waste is derived from a household. Household hazardous waste may include: agricultural chemicals, cleaning agents and solvents, paint, pesticides, and preservatives.
- Maryland does not regulate HHW as hazardous waste and Federal law allows for the disposal of HHW in household trash. However, due to the potential of HHW to cause physical injury, contaminate septic tanks or wastewater treatment systems, and present hazards to children and pets, **MDE recommends the proper recycling/disposal of HHW materials at local HHW collection programs.**
- <http://www.mde.state.md.us/Programs/LandPrograms/Recycling/Education/hhw.asp>



### **Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)**

- AKA Superfund – regulates leachate and other releases of hazardous substances from abandoned hazardous waste sites operating prior to Nov 1980 and business that produce 220 – 2000 lbs hazardous waste/month.
- Requires the person who generated or transported the waste to cleanup or Feds use Superfund \$ to clean up
- Administered by EPA's office of solid waste and emergency response (OSWER)
- Was amended by superfund amendments and reauthorization act (SARA) of 1986
- <http://www.atsdr.cdc.gov/cercla/>
- <http://www.epa.gov/superfund/sites/npl/npl.htm>

### **Hazardous Waste Cleanup**

- Exothermic Incineration
  - Requires oxygen
  - Thermal destruction using Time, Temp, and Turbulence
- Endothermic Pyrolysis
  - Absence of oxygen
  - Hydrocarbons are converted to a gas or liquid that is combusted without oxygen
- In Situ Vitrification
  - Uses electric current to melt soil at extremely high temps (makes glass)
  - Organics are destroyed, inorganics are incorporated into glass
  - Product is a chemically stable, leach resistant crystalline material

### **Hazardous Waste Cleanup**

- In Situ Vitrification (cont)
  - Cant be used with buried pipes or drums
  - Heating can cause migration of contaminants
  - Off gases and high voltage present safety concerns
  - Reduces the mobility of radionuclides, not their radioactivity
  - Most effective for near surface contamination (less than 10m)
  - VERY EXPENSIVE
- Ex Situ Vitrification
  - Accomplished inside of a chamber
  - Effluent gases must be treated
  - Cannot be used for debris larger than 60mm in diameter
  - Pure chemicals, oxidizers, explosives, and compressed gas cylinders are prohibited
  - DOE has a transportable one for use at several sites

### **Hazardous Waste Cleanup**

- Plasma Arc/Gas Technology
  - Converts biomass to a superfuel which is burned to create energy
  - Slag bi-product used in building materials
- Chemical Solidification/Stabilization
  - Addition of chemicals to contaminated soil to limit the waste's solubility and mobility
  - In situ or ex situ
- Capping
  - Contaminated soil or material to be left in place
  - The chemicals do not migrate
  - Groundwater monitoring common to detect migration
  - Design life 20 – 100 years

### **Hazardous Waste Cleanup**

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### **Questions**

?

## Potable Water

Wednesday, March 17, 2010  
10:46 AM

### Potable Water

### Learning Objectives

- Be familiar with definitions used in class
- Know the sources of water and how they are obtained
- Know the guidelines for construction of a new well
- Discuss the Safe Drinking Water Act
- Be familiar with the acute and chronic health effects and causes associated with consumption of water
- Be familiar with ways to make water potable
- Understand how to collect a water sample to analyze for microorganisms or chemical contamination

## **Definitions**

- **Public Water System (PWS)**
  - A system that serves water for human consumption that has at least 15 service connections or serves at least 25 people, 60 days/year
- **Community Water System (CWS)**
  - PWS that serves 25 people year round
  - Municipal water systems, mobile home park, etc
- **Non Community Water System (NCWS)**
  - PWS that do not have a permanent resident population
    - Non Transient NCWS
      - PWS that serves 25 people at least 6 months/year – churches, schools
    - Transient NCWS
      - PWS that have their own water supply and serve a transient population (25) at least 60 days/year – hotels, commercial campgrounds

## **Definitions**

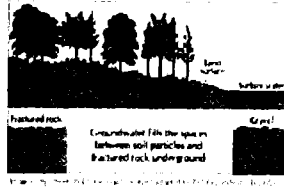
15 connections and  $\geq$  25 people?

Are the 25 permanent residents?

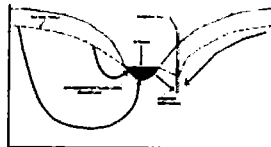
Serve a transient community at least 60 days/year?

## Sources of Water

- Surface Water
  - 70% of earth's surface
  - 97% of surface water is ocean water



- Ground Water
  - 1/2 of US depends upon groundwater for drinking
  - 33M served by individual wells that are NOT protected or regulated by Safe Drinking Water Act
- Ground water under the direct influence of surface water

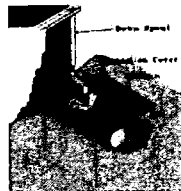
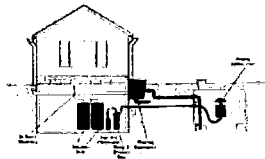


## Sources of Water

- Surface Water
  - Lakes
    - Eutrophic – Old lake, enriched in nutrients, low dissolved O<sub>2</sub>, lots of aquatic life and algae
    - Mesotrophic – Intermediate level of nutrients, clarity, algae – balanced lake
    - Oligotrophic – Young lake, clear, high dissolved O<sub>2</sub>, low nutrients, few plants, deep water supports large trout
  - Streams
    - Zone of degradation – immediately downstream from cont source, low DO, fish kills
    - Zone of decomposition – farther downstream from cont source, DO almost zero, no fish, foul odors
    - Zone of recovery – gradual reversal, DO increases, less odors, then fish gradually appear

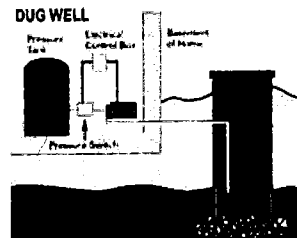
## Sources of Water

- Surface Water (cont)
  - Cisterns
    - Watertight tank that collects and stores roof rainwater runoff
    - Used where groundwater or surface water sources are inadequate
    - Rainwater
      - Contains roof dirt and air pollutants
      - Requires treatment for pathogens (5 ppm chlorination)
      - May contain cadmium and zinc from galvanized roofing materials
    - Human consumption or not???



## Sources of Water

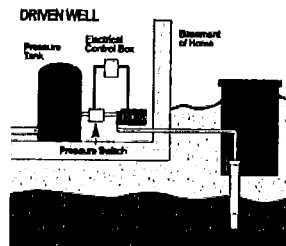
- Dug Well - most potential for contamination
  - Shallow ~ 10-35 ft deep
  - Watertight casing material – concrete cap
  - Sealed in cement grout or bentonite clay
  - Mounded for runoff



- Pump
  - Suction style
  - Not in well hole
  - In house (best)
  - In adjacent pit (if necessary)

## Sources of Water

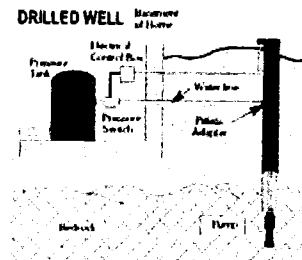
- Driven Well – mod cont risk
  - ~30 – 100 ft deep
  - Water from saturated zone
  - 2" - 4" pipe



- Pump
  - At top of well in pit below frost line
  - In house
- Concrete capped well and pit

## Sources of Water

- Drilled Well – low cont risk
  - ~100 - 400 ft deep
  - 6" well casing extends into bedrock
  - Casing 1 – 2 ft above ground
  - Casing capped
  - Submersible pump





## **Sources of Water**

- Soil Formations for Wells
  - Sedimentary – weathered or eroded rocks and decomposed organic material. Sand, gravel, peat, shale and sandstone
    - Good source of water volume
  - Igneous – formed by cooling and hardening of molten rock. Granite, diorite
    - Poor source of water volume
  - Metamorphic – heat and pressure treated sedimentary and igneous rock
    - Poor source of water volume
  - Karst Areas – fast moving underground water through porous limestone that forms caves, sinkholes etc

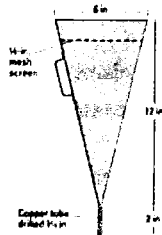
## **Sources of Water**

- New wells
  - At least 50 ft from septic tank
  - At least 100ft from septic field
  - At least 100 ft from septic distribution box
  - Petroleum tanks = 100ft
  - Manure stacks 250 ft
  - Privy or outhouse
    - Sanitary pit – 100ft
    - Watertight vault – 50 ft



## **Sources of Water**

- Marsh funnels and cones
  - Marsh funnel measures the viscosity of drilling quality of mud
  - Marsh cone measures the viscosity of cement and grout used for filling the well casing



## **The Problem**

- Over 2.5 billion live without access to clean, safe water
- Global estimates are that about 1.7 million people die every year from diarrheal diseases
  - 90% are children under 5, mostly in developing countries
  - 80 % of deaths due to unsanitary water and poor hygiene
- Unsanitary water is related to 75% of all morbidity in the developing world
- Every 15 seconds, a child under 5 years of age dies of water related illness

## **Safe Drinking Water Act**

- 1914, U.S. Public Health Service set drinking water quality standards, but these were merely voluntary for public systems
- 1970, the PHS released results of its Community Water Supply Study (CWSS) and new articles appear painting bad picture
  - Potential cancer-causing chemicals in New Orleans' and Pittsburgh's drinking water and lead from pipes in Boston
  - Bacteriological contamination in smaller, more rural communities
- 1974, SDWA signed by President Ford
  - Required establishment of National Primary Drinking Water Standards
  - State Primacy – EPA can award states, territories and indian tribes primary enforcement for public water systems – can be taken away
- 1986, SDWA amended to include 83 more contaminants and required EPA to list 25 new contaminants every 3 years
- 1996, SDWA amended to repeal the 25 contaminants/3yrs and focused on regulating based upon risk assessments

## **Safe Drinking Water Act**

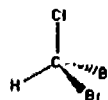
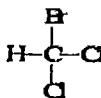
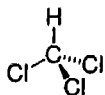
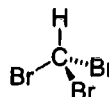
- Established National Primary Drinking Water Standards
  - Enforceable health based standards
    - Protect public health by limiting the levels of 87 contaminants in drinking water
    - MCL – Maximum Contaminant Level – highest level of contaminant allowed in drinking water
  - Apply to all PUBLIC water systems
  - Based upon "One in a million chance" of probably having health affected based upon
    - Drinking TWO liters per day
    - At maximum concentration level (MCL)
    - For 70-80 years

## Safe Drinking Water Act

- Notable standards under the Act (cont)
  - Total trihalomethanes
  - Chemical Rules (phases 1, 2, 2b, and 3)
  - Surface water treatment rule (SWTR)
  - Total coliform rule
  - Lead and copper rule
  - Stage 1 D/DBP rule
  - Interim enhanced SWTR
  - Radionuclides
  - Arsenic
  - Filter backwash recycling rule
- Prevent ACUTE health risks from microbiological contaminants and nitrates
- Prevent CHRONIC health risks from Volatile organic compounds (VOCs) Inorganic compounds (IOCs), Synthetic organic compounds (SOCs) and Radionuclides
- National Secondary Drinking Water Standards
  - Recommendations on 15 constituents
  - Cosmetic or aesthetic based
  - States may adopt and make them enforceable

## Safe Drinking Water Act

- Total Trihalomethanes Standard
  - By product of chlorine or bromine disinfection
    - Trichloromethane (chloroform)  $\text{CHCl}_3$
    - Dibromochloromethane  $\text{CHClBr}_2$
    - Bromodichloromethane  $\text{CHCl}_2\text{Br}$
    - Tribromomethane (bromoform)  $\text{CHBr}_3$
  - Cancer Group B carcinogens (cause cancer in lab animals)
  - Can affect the liver, kidneys, and CNS
  - 80 ug/L Standard is for TOTAL THMs



## **Safe Drinking Water Act**

- Chemical Rules (phases 1, 2, 2b, and 5)
  - Regulations cover 69 drinking water contaminants most of which are carcinogens
    - MCL
    - Testing Requirements
    - Treatments
  - Generally apply to CWSs and NTNCWSs
  - 3 types of contaminants
    - VOCs
    - SOCs
    - IOCs

## **Safe Drinking Water Act**

- Surface Water Treatment Rule - 1989
  - Applies to systems that use surface water including ground water under direct influence (GWUDI)
  - Establishes treatment techniques for Giardia, viruses, legionella, and turbidity
    - Requires disinfection and usually filtration
  - Establishes monitoring requirements for turbidity and disinfectant residual
- Total Coliform Rule - 1989
  - Requires systems to sample for coliform in the distribution system
  - Presence of coliform indicates treatment failure or deterioration of the distribution system
  - No more than 5% samples positive per month, zero positive ecoli
  - Applies to all public water systems

## **Safe Drinking Water Act**

- Lead and Copper Rule - 1991
  - Applies to CWSs and NTNCWSs
  - Requires monitoring at customer's tap
    - Lead action level 15 ppb
    - Copper action level 1.3 ppm
  - If lead or copper exceed the action level in 10% or more of customers sampled
    - Treat source water
    - Add corrosion control
    - Establish public education system
    - Replace lead service lines

## **Safe Drinking Water Act**

- Stage 1 Disinfectants and Disinfection Byproducts Rule - 1998
  - Update to the 1979 regulations for total trihalomethanes
  - established maximum residual disinfectant levels (MRDLs) for chlorine, chloramine and chlorine dioxide
  - Established maximum contaminant levels (MCLs) for total trihalomethanes, haloacetic acids, chlorite and bromate
  - Required water systems that use surface water or ground water under the direct influence of surface water to remove specified percentages of organic materials that may react with disinfectants to form DBPs
- Interim Enhanced Surface Drinking Water Treatment Rule - 1998
  - Most provisions apply to surface and GWUDI serving >10,000 people
  - Strengthened surface water treatment to prevent micro contamination
    - MCLG of zero for cryptosporidium
    - Filtered systems must physically remove 99% (2-log) of *Cryptosporidium*
    - More stringent turbidity standards

## **Safe Drinking Water Act**

- Interim Enhanced Surface Drinking Water Treatment Rule – 1998 (Cont)
  - Turbidity
    - Measurement of water clarity caused by suspended solids
      - Nephelometric turbidity units (NTUs)
        - Measures light scattered by suspended particles
        - Primary EPA method
      - Formazin Turbidity units (FTUs)
      - JTU - Jackson Turbidity Unit – old method using candle
    - MCL
      - Shall not exceed .5 NTUs in 95% of monthly samples
      - Shall never exceed 1 NTU

## **Safe Drinking Water Act**

- Radionuclide Rule – 2000
  - Applies to CWSs
  - Set new standard for Uranium at 30 ug/L
  - Increased monitoring to every entry point in a distribution system
- Arsenic Rule – 2001
  - New standard set to 10 ppb (old was 50 ppb)
  - EPA wanted 5 ppb, **national debate** and cost/health benefits analysis led to 10 ppb
  - Causes skin damage, circulatory system problems, and increased cancer risk
- Filter Backwash Recycling Rule – 2001
  - Required filter backwash to be send back through the treatment process properly
  - Aimed at reducing the risk associated with disinfection resistant pathogens, such as *Cryptosporidium*

## **Safe Drinking Water Act**

- **Prevention of Acute Health Effects**
  - Viruses
  - Bacteria
  - Protozoa
  - Helminths
  - Nitrate
- **Disinfection treatment technology**
  - Cryptosporidium 99%
  - Giardia lablia 99.9%
  - Viruses 99.99%
  - 100% removal not required under SDWA

## **Acute Effects - Water Borne Viruses**

<b>VIRUS</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Hepatitis A Virus	Infection (30-35 days)	<b>Infectious Hepatitis</b> Water, ice, milk, oysters, clams, P2P
Norwalk Like Viruses	Infection (1-2 days)	<b>Viral Gastroenteritis</b> Water, ice, shellfish – fecal oral Most common enteric disease in US CHLORINE RESISTANT
Rotavirus	Infection (1-2 days)	<b>Human Rotavirus (HRV)</b> Fecal-oral, cont food/water, fomites



### **Acute Effects - Water Borne Viruses**

ILLNESS	Human Rotavirus (HRV, Sporadic viral gastroenteritis, severe viral gastroenteritis of infants and children, rotaviral enteritis)
VIRUS	Rotavirus
VEHICLE	Fecal-oral route; person-to-person; contact with respiratory secretions, contaminated water, food or other surfaces; contact with fomites
SYMPTOMS	Mild to moderate fever and vomiting, followed by the onset of watery stools
ONSET	1-2 days

### **Acute Effects - Water Borne Viruses**

ILLNESS	Viral Gastroenteritis
VIRUS	Norwalk virus group (Norwalk like virus NLV, Small round structured virus SRSV)
VEHICLE	Water, ice, shellfish – fecal oral CHLORINE RESISTANT
SYMPTOMS	Nausea, vomiting, diarrhea, abdominal cramps
ONSET	1 – 2 days

### **Acute Effects - Water Borne Viruses**

ILLNESS	<b>Infectious Hepatitis</b> (Type A Hepatitis, Catarrhal jaundice, Epidemic hepatitis)
VIRUS	Hepatitis A Virus
VEHICLE	Water, ice, milk, oysters, clams, P2P
SYMPTOMS	Mild fever, general weakness, nausea, abdominal pain; can develop into jaundice, P2P, fecal oral
ONSET	Up to a month

### **Acute Effects - Water Borne Viruses**

- Treatment
  - 86 - 100 % removal through coagulation and flocculation
    - water treatment processes that combine or coagulate small particles into larger particles, which settle out of the water as sediment
  - 92 - 100 % removal through stabilization ponds
    - Holding ponds where waste is stabilized and pathogens reduced through the action of bacteria and algae
  - 99 - 100% removal through chlorination
  - 100% removal through ozone

### **Acute Effects-Waterborne Bacteria**

<b>BACTERIA</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Campylobacter jejuni	Infection (2-5 days)	<b>Campylobacter Enteritis</b> Raw milk, water, beef, poultry pork
Pseudomonas aeruginosa	Dermatitis (1-10 days)	Swimmers Itch Heated contaminated water
Salmonella Typhi	Infection (1-2 wks)	<b>Typhoid Fever</b> Fecal-oral, cont water, oysters, vegetables grown in night soil
Salmonella Typhimurium	Infection (12-24 hrs)	<b>Salmonellosis</b> Poultry, eggs, sliced fruits/veg, milk, fecally through food and water

### **Acute Effects-Waterborne Bacteria**

<b>BACTERIA</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Escherichia Coli <b>Shiga Toxin Producing</b>	Toxin Mediated Infection (2-4 days)	<b>Enterohemorrhagic (EHEC) 0157H7</b> Raw ground beef, raw milk/juice, sprouts, water
Shigella Sonnei and Flexneri	Infection (1-7 days)	<b>Shigellosis (Bacillary Dysentery)</b> Cont water, vegetables, salads
Legionella pneumophila	Infection	<b>Legionnaires Disease</b> Heated water, droplets only
Vibrio Cholera	Infection (hrs-days)	<b>Cholera</b> Cont water, raw foods, shellfish

### **Acute Effects-Waterborne Bacteria**

ILLNESS	Campylobacter Enteritis (Infectious diarrhea, bacterial diarrhea)
BACTERIA	Campylobacter Jejuni
VEHICLE	Raw milk, water, beef, poultry, pork
SYMPTOMS	Watery diarrhea, abdominal pain, fever, chills, nausea, vomiting, blood in stool
ONSET	2-5 days

### **Acute Effects-Waterborne Bacteria**

ILLNESS	Swimmer's itch, swimmer's ear, rash, dermatitis, UTIs
BACTERIA	Pseudomonas aeruginosa
VEHICLE	Hot tubs, geothermal pools – is thermophilic
SYMPTOMS	See Above
ONSET	1 – 10 days

### **Acute Effects-Waterborne Bacteria**

ILLNESS	Typhoid Fever (enteric fever, bilious fever, yellow jack)
BACTERIA	Salmonella Typhi
VEHICLE	Fecal oral, contaminated water and shellfish, P2P, veggies grown in night soil
SYMPTOMS	Sustained high fever, headache, malaise, anorexia, splenomegaly, a rash of flat, rose-colored spots
ONSET	1-2 weeks

NOT SALMONELLOSIS!!!!

### **Acute Effects-Waterborne Bacteria**

ILLNESS	Salmonellosis (non-typhoidal salmonella, salmonella infection)
BACTERIA	Salmonella Typhimurium
VEHICLE	Poultry, eggs, milk and milk products, contaminated water, pigs, turtles, iguanas
SYMPTOMS	Abdominal pain, diarrhea, chills, fever, vomiting, nausea
ONSET	12-24 hours

NOT TYPHOID FEVER

### **Acute Effects-Waterborne Bacteria**

ILLNESS	Enterohemorrhagic (EHEC, ecoli 0157H7)
BACTERIA	Ecoli 0157H7
VEHICLE	Raw and undercooked ground beef, raw milk, alfalfa sprouts, unpasteurized fruit juices, dry-cured salami, lettuce, game meat, and cheese curds. P2P, water
SYMPTOMS	Diarrhea ranging from mild to severe with blood, abdominal pain, HUS
ONSET	2 – 4 days

### **Acute Effects-Waterborne Bacteria**

ILLNESS	Shigellosis (Bacillary Dysentery)
BACTERIA	Shigella Sonnei and Flexneri
VEHICLE	Fecal oral, contaminated food/water, P2P, milk, anything washed with cont water
SYMPTOMS	Acute onset with diarrhea, fever, bloody stool
ONSET	1-7 days

### **Acute Effects-Waterborne Bacteria**

ILLNESS	Legionnaires disease (Pontiac fever too – same but less effects)
BACTERIA	Legionella pneumophila
VEHICLE	Hot tubs, cooling towers, warm ponds INHALED DROPS ONLY, no P2P
SYMPTOMS	Pneumonia like – 40% fatal
ONSET	2 – 10 days

### **Acute Effects-Waterborne Bacteria**

ILLNESS	Cholera (asiatic cholera, epidemic cholera)
BACTERIA	Vibrio Cholera
VEHICLE	Contaminated water, shellfish, raw foods, fecally contaminated from infected humans
SYMPTOMS	Acute diarrhea (so severe rehydration required), rapid pulse, dry skin, abdominal cramps, nausea, and vomiting.
ONSET	Hours to days

### **Acute Effects-Waterborne Protozoa**

PARASITE	ILLNESS	DISEASE/VEHICLE
<i>Naegleria fowleri</i>	Infection (3-7 days)	<b>Primary Amoebic Meningoencephalitis (PAM)</b>
<i>Cryptosporidium Parvum</i>	Infection (1-10 days)	<b>Cryptosporidiosis (Diarrheal disease)</b> Cont food/water, P2P
<i>Cyclospora Cayetanensis</i>	Infection (1-14 days)	<b>Diarrheal disease</b> Cont food/water, Fresh produce

### **Acute Effects-Waterborne Protozoa**

PARASITE	ILLNESS	DISEASE/VEHICLE
<i>Entamoeba Histolytica</i>	Infection (1-4 weeks)	<b>Amoebiasis</b> Cont food/water, P2P
<i>Giardia Lambia</i>	Infection (1-2 weeks)	<b>Giardiasis</b> Cont food/water
<i>Toxoplasma Gondii</i>	Infection (5-23 days)	<b>Toxoplasmosis</b> Cat feces, poorly cooked lamb, pork or venison



### **Acute Effects-Waterborne Protozoa**

ILLNESS	Primary Amoebic Meningoencephalitis (PAM)
PARASITE	Naegleria fowleri
VEHICLE	Warm stagnant water, swimming pools, Through NASAL passage only
SYMPTOMS	Headache, nausea, vomiting, encephalitis
ONSET	3 – 7 days, death in 14 days from respiratory failure – 200 cases, 97% mortality

### **Acute Effects-Waterborne Protozoa**

ILLNESS	Cryptosporidiosis (Diarrheal disease)
PARASITE	Cryptosporidium Parvum SPORE FORMER
VEHICLE	Fecally contaminated food/water, P2P – dogs, cats, and cattle
SYMPTOMS	Anorexia, vomiting, profuse watery diarrhea
ONSET	1 – 10 days

### **Acute Effects-Waterborne Protozoa**

ILLNESS	Diarrheal disease
PARASITE	Cyclospora Cayetanensis SPORE FORMER
VEHICLE	Cont food/water, Fresh fruits and vegetables
SYMPTOMS	Watery diarrhea, anorexia, nausea, cramps, weight loss – fever is rare
ONSET	1-14 days

### **Acute Effects-Waterborne Protozoa**

ILLNESS	Amoebiasis (Amebiasis)
PARASITE	Entamoeba Histolytica SPORE FORMER
VEHICLE	Fecally cont food/water, P2P
SYMPTOMS	Anorexia, cramps, blood and mucous in stool
ONSET	1 – 4 weeks

### **Acute Effects-Waterborne Protozoa**

ILLNESS	Giardiasis (Beaver Fever)
PARASITE	Giardia Lambia CYSTS
VEHICLE	Cont food/water, beavers, muskrats, P2P
SYMPTOMS	Asymptomatic, acute self-limiting diarrhea, or chronic diarrhea with weight loss
ONSET	1 – 2 weeks

### **Acute Effects-Waterborne Protozoa**

ILLNESS	Toxoplasmosis
PARASITE	Toxoplasma Gondii
VEHICLE	Cat feces, poorly cooked lamb, pork or venison
SYMPTOMS	Weakness, swollen lymph nodes, resembles mononucleosis
ONSET	5 – 23 days

### **Acute Effects-Waterborne Helminths**

PARASITE	ILLNESS	DISEASE/VEHICLE
Ascaris Lumbricoides	Infection	<b>Ascariasis</b> Food/water cont with man/ape feces
Schistosoma ssp.	Infection	Swimmers Itch
Schistosoma Mansoni	Infection	Schistosomiasis, Snail Fever
Dracunculus medinensis	Infection	<b>Dracunculiasis, Guinea worm disease (GWD) or Medina Worm</b>

### **Acute Effects-Waterborne Helminths**

ILLNESS	<b>Ascariasis</b> (Round worm infection, Ascaridiasis)
PARASITE	Ascaris Lumbricoides (large intestinal worm of humans)
VEHICLE	Food/water cont with man/ape feces
SYMPTOMS	Live worm passed via stool, anus, nose or mouth, weight loss, bowel obstructions
ONSET	2 months

### **Acute Effects-Waterborne Helminths**

ILLNESS	Swimmers Itch, Schistosome dermatitis
PARASITE	Schistosoma ssp
VEHICLE	Egg infected migratory fowl feces in water, egg enters snail and develops
SYMPTOMS	Dermatitis
ONSET	Hours to days TREAT WASTE WITH COPPER SULFATE TO ELIMINATE SNAIL HOST

### **Acute Effects-Waterborne Helminths**

ILLNESS	Schistosomiasis, Snail fever
PARASITE	Schistosoma Mansoni (blood)
VEHICLE	Trematode (blood fluke)
SYMPTOMS	Pain, cough, diarrhea
ONSET	weeks

## **Acute Effects-Waterborne Helminths**

ILLNESS	<b>Dracunculiasis, Guinea worm disease (GWD) or Medina Worm</b>
PARASITE	Dracunculus medinensis - CYST
VEHICLE	Ingestion of larvae from stagnant fresh water – only human reservoir
SYMPTOMS	Blister and burning sensation
ONSET	months



## **Acute Effects-Nitrate**

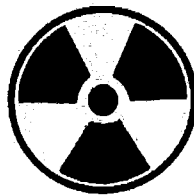
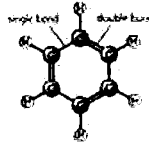
- Relatively non toxic
- MCL 10 ppm
- Infants under 6 months have a higher pH in the intestinal tract which allows for bacteria to convert nitrate from food/water to nitrite
  - Nitrite attacks the heme of hemoglobin resulting in the inability for it to carry oxygen
  - Results in Blue Baby syndrom or Methemoglobinemia
    - Treatment is Methylene blue
- Treatment – distillation, RO, ion exchange
- **BOILING NOT EFFECTIVE** – concentrates nitrates
  - Boil water, mix with baby formula = blue baby



## Safe Drinking Water Act

- Prevention of Chronic Health Effects

- VOCs
- IOCs
- SOCs
- Radionuclides

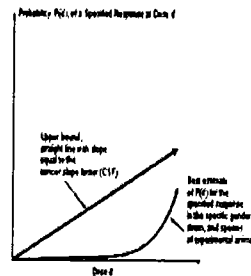


## Chronic Effects

- VOCs
  - Vaporize at room temperature
  - Benzene = .005 ppm MCL, increased cancer risk
  - Toluene = 1 ppm MCL, kidney and liver damage
- IOCs
  - Lead – action level .015 ppm, increase cancer risk, childhood delayed mental development
  - Cadmium – .005 ppm MCL, kidney damage
  - Fluoride (in excess) – mottled teeth (fluorosis)
    - 4 ppm action level
    - 40% ages 12-19 have fluorosis
  - Arsenic – .01 ppm MCL, skin damage, circulatory problems

## Chronic Effects

- SOCs
  - Atrazine – pesticide
    - Weight loss
    - Retinal damage
    - Increase cancer risk
  - Alachlor – pesticide
    - Eye, liver, and SPLEEN damage
    - Anemia
    - Increase cancer risk
- Radionuclides
  - Alpha is the major preventable cancer concern
    - Action level = 300 pCi/L
  - Uranium poisoning linked to kidney toxicity
  - MCLG = 0



## Safe Drinking Water Act

- Aesthetics
  - Secondary drinking water standards
    - 15 non enforceable guidelines
    - Odor
      - Hydrogen sulfide rotten egg odor – aeration remedies
      - Chlorine, chloramines and other biproducts
        - Activated carbon filter remedies
    - Taste
      - Fe and Mn give metallic taste – aeration remedies
    - Hardness
      - Concentration of Ca and Mg
    - Aluminum, Chloride, Color, Copper, corrosivity, fluoride, foaming agents, pH, silver, sulfate, TDS and zinc too



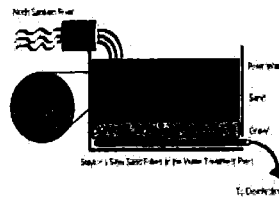
## Safe Drinking Water Act

- Aesthetics (cont)
  - **Crenothrix**
    - Nuisance microorganism
    - Causes sever fouling or plugging of pipes, fixtures, pumps, tec
    - Reddish orange slimy deposits
    - Adds iron flavor to water
    - Often source of slugs of foul water
- Staining of clothing and water fixtures
  - Fe – orange – brown
  - Mn – black or gray
  - Hydrogen sulfide (when Fe is present) – black



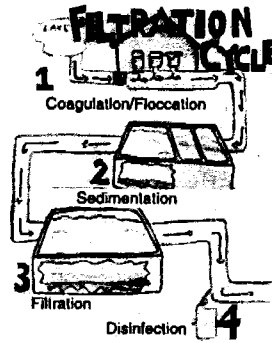
## Early Water Treatment

- Disinfection
  - Chlorination
- Slow sand filtration
  - Large filter beds with slow filtration rate, no chemical coagulation
- Rapid sand filtration
  - Smaller filter beds with more rapid filtration rate, some chemical coagulation



## Modern Water Treatment

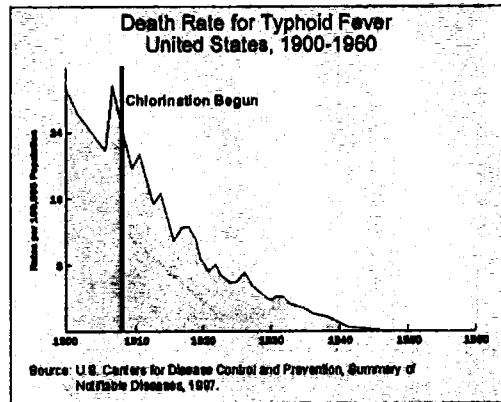
- Coagulation
- Flocculation
- Sedimentation
- Filtration
  - Conventional
  - Direct
  - Slow sand
  - Diatomaceous earth
- Disinfection



## Modern Water Treatment

- **Coagulation**
  - Finely dispersed solids (colloids) are suspended in water by repelling electrical charges
  - Coagulation changes the charge to cause an attraction to form larger particles (flocs)
    - Aluminum sulfate (black alum), sodium aluminate, pulverized limestone, clays
- **Flocculation**
  - Adding chemical polymers to bridge flocs to form larger flocs
- **Sedimentation**
  - Water is sent to a sedimentation basin, where flocs settle to the bottom and are removed
- **Filtration**
  - Direct - Water is sent directly through a filter system to clearwell
  - Conventional - Water is sent to sedimentation basin then filter then clearwell

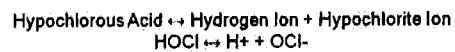
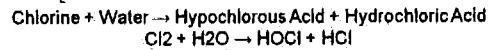
## Modern Water Treatment



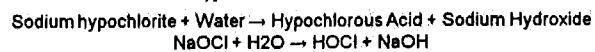
## Modern Water Treatment

- **Disinfection**

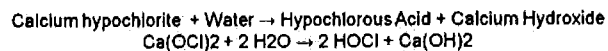
- Chlorine gas



- Chlorine bleach – Sodium hypochlorite

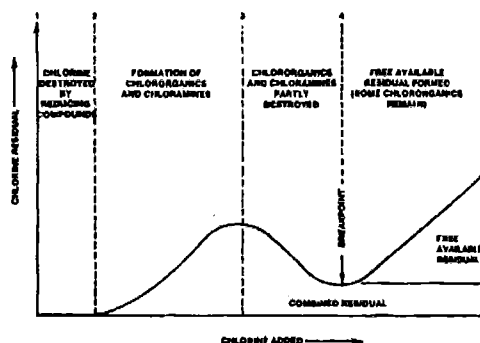


- HTH – Calcium hypochlorite



## Modern Water Treatment

- Breakpoint Chlorination

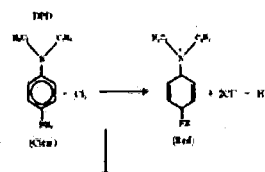


## Modern Water Treatment

- Well disinfection
  - Mix 2 quarts bleach with 10 gallons water
  - Pour into well and run pump
  - Open all faucets
  - Close each faucet as you smell chlorine
  - Shut off pump
  - Mix 1 quart bleach with 10 gallons of water
  - Pour into well and let sit for 12-24 hours
  - Run pump by hosing chlorine water between the casing and drop pipe for 30 minutes

## Chlorine Residual Testing

- DPD is the preferred field test
  - N, N – diethyl-p-phenylenediamine
  - Colorimetric



- SNORT
  - Stabilized neutral orthotolidine
  - Colorimetric

- FACTS
  - Free available chlorine test
  - Colorimetric



## Water Testing

- Organisms
  - Sterile bottle with clean hands
  - Take aerator off faucet
  - Turn on water for 5 minutes
  - Fill bottle leaving 1" headspace
  - If chlorinated, use sodium thiosulfate
  - Examine in 4-6 hours – goal = zero coliform



- Chemicals
  - First draw sample (immediately after turning on)
  - Fill to the top of container

## **Questions**

**?**

## Swimming and Rec Water

Wednesday, March 17, 2010  
10:47 AM

### **Swimming and Recreational Water**

#### **Learning Objectives**

- Be familiar with definitions used in class
- Be familiar with waterborne bacteria, viruses, helminths and fungi and the diseases they cause
- Know the standards for pools, hot tubs, and beaches
- Be familiar with the various types of water disinfection
- Perform turnover rate, pH, and volume calculations
- Know actions to perform in the event of an accidental pool discharge

## **Waterborne Bacteria**

<b>BACTERIA</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Campylobacter jejuni	Infection (2-5 days)	<b>Campylobacter Enteritis</b> Raw milk, water, beef, poultry pork
Pseudomonas aeruginosa	Dermatitis (1-10 days)	<b>Swimmers Itch</b> Heated contaminated water
Salmonella Typhi	Infection (1-2 wks)	<b>Typhoid Fever</b> Fecal-oral, cont water, oysters, vegetables grown in night soil
Mycobacterium marinum	Infection 2-4 weeks	<b>Fish-tank Granuloma</b> Fish bites or pokes, water

## **Waterborne Bacteria**

<b>BACTERIA</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Escherichia Coli <b>Shiga Toxin Producing</b>	Toxin Mediated Infection (2-4 days)	<b>Enterohemorrhagic (EHEC) 0157H7</b> Raw ground beef, raw milk/juice, sprouts, water
Shigella Sonnei and Flexneri	Infection (1-7 days)	<b>Shigellosis (Bacillary Dysentery)</b> Cont water, vegetables, salads
Legionella pneumophila	Infection	<b>Legionnaires Disease</b> Heated water, droplets only
Chlamydia trachomatis	Infection 5-12 days	<b>Trachoma</b> Secretions from eyes, nose, throat
Leptospira ssp	Infection (2-20 days)	<b>Weils disease, Leptospirosis</b> Urine of infected animal, rats, swine



### **Waterborne Bacteria**

ILLNESS	Campylobacter Enteritis (Infectious diarrhea, bacterial diarrhea)
BACTERIA	Campylobacter Jejuni
VEHICLE	Raw milk, water, beef, poultry, pork
SYMPTOMS	Watery diarrhea, abdominal pain, fever, chills, nausea, vomiting, blood in stool
ONSET	2-5 days

### **Waterborne Bacteria**

ILLNESS	Swimmer's itch, swimmer's ear, rash, dermatitis, UTIs
BACTERIA	Pseudomonas aeruginosa
VEHICLE	Hot tubs, geothermal pools – is thermophillic
SYMPTOMS	See Above
ONSET	1 – 10 days

## **Waterborne Bacteria**

ILLNESS	Typhoid Fever (enteric fever, bilious fever, yellow jack)
BACTERIA	Salmonella Typhi
VEHICLE	Fecal oral, contaminated water and shellfish, P2P, veggies grown in night soil
SYMPTOMS	Sustained high fever, headache, malaise, anorexia, splenomegaly, a rash of flat, rose-colored spots
ONSET	1-2 weeks

NOT SALMONELLOSIS!!!!

## **Food Borne Bacteria Infections**

ILLNESS	Salmonellosis (non-typhoidal salmonella, salmonella infection)
BACTERIA	Salmonella Typhimurium
VEHICLE	Poultry, eggs, milk and milk products, contaminated water, pigs, turtles, iguanas
SYMPTOMS	Abdominal pain, diarrhea, chills, fever, vomiting, nausea
ONSET	12-24 hours

NOT TYPHOID FEVER

### **Waterborne Bacteria**

ILLNESS	<b>Fish-tank Granuloma</b>
BACTERIA	<i>Mycobacterium marinum</i>
VEHICLE	Contaminated water, fish bites, pokes from fins
SYMPTOMS	1-2.5 cm lesions on the elbows, knees and feet in swimming pool-related cases, and on the hands and fingers in aquarium owners
ONSET	2-4 weeks

### **Waterborne Bacteria**

ILLNESS	<b>Enterohemorrhagic (EHEC, <i>ecoli</i> 0157H7)</b>
BACTERIA	<i>Ecoli</i> 0157H7
VEHICLE	Raw and undercooked ground beef, raw milk, alfalfa sprouts, unpasteurized fruit juices, dry-cured salami, lettuce, game meat, and cheese curds. P2P, water
SYMPTOMS	Diarrhea ranging from mild to severe with blood, abdominal pain, HUS
ONSET	2 – 4 days

### **Waterborne Bacteria**

ILLNESS	Shigellosis (Bacillary Dysentery)
BACTERIA	Shigella Sonnei and Flexneri
VEHICLE	Fecal oral, contaminated food/water, P2P, milk, anything washed with cont water
SYMPTOMS	Acute onset with diarrhea, fever, bloody stool
ONSET	1-7 days

### **Waterborne Bacteria**

ILLNESS	Legionnaires disease (Pontiac fever too – same but less effects)
BACTERIA	Legionella pneumonphilia
VEHICLE	Hot tubs, cooling towers, warm ponds INHALED DROPS ONLY, no P2P
SYMPTOMS	Pneumonia like – 40% fatal
ONSET	2 – 10 days

## **Waterborne Bacteria**

ILLNESS	Trachoma
BACTERIA	Chlamydia trachomatis
VEHICLE	P2P, direct contact with eye, nose, throat secretions or fomites (towels, etc)
SYMPTOMS	Eye irritation, white lumps on upper eye lid, distortion of eyelid causing follicles to touch it
ONSET	5-12 days



## **Waterborne Bacteria**

ILLNESS	Cholera (asiatic cholera, epidemic cholera)
BACTERIA	Vibrio Cholera
VEHICLE	Contaminated water, shellfish, raw foods, fecally contaminated from infected humans
SYMPTOMS	Acute diarrhea (so severe rehydration required), rapid pulse, dry skin, abdominal cramps, nausea, and vomiting.
ONSET	Hours to days

## **Water Borne Viruses**

<b>VIRUS</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Hepatitis A Virus	Infection (30-35 days)	<b>Infectious Hepatitis</b> Water, ice, milk, oysters, clams, P2P
Norwalk Like Viruses	Infection (1-2 days)	<b>Viral Gastroenteritis</b> Water, ice, shellfish – fecal oral Most common enteric disease in US <b>CHLORINE RESISTANT</b>
Rotavirus	Infection (1-2 days)	<b>Human Rotavirus (HRV)</b> Fecal-oral, cont food/water, fomites

## **Water Borne Viruses**

<b>ILLNESS</b>	Human Rotavirus (HRV, Sporadic viral gastroenteritis, severe viral gastroenteritis of infants and children, rotaviral enteritis)
<b>VIRUS</b>	Rotavirus
<b>VEHICLE</b>	Fecal-oral route; person-to-person; contact with respiratory secretions, contaminated water, food or other surfaces; contact with fomites
<b>SYMPTOMS</b>	Mild to moderate fever and vomiting, followed by the onset of watery stools
<b>ONSET</b>	1-2 days

### **Water Borne Viruses**

ILLNESS	Viral Gastroenteritis
VIRUS	Norwalk virus group (Norwalk like virus NLV, Small round structured virus SRSV)
VEHICLE	Water, ice, shellfish – fecal oral
SYMPTOMS	Nausea, vomiting, diarrhea, abdominal cramps
ONSET	1 – 2 days

### **Water Borne Viruses**

ILLNESS	Infectious Hepatitis (Type A Hepatitis, Catarrhal jaundice, Epidemic hepatitis)
VIRUS	Hepatitis A Virus
VEHICLE	Water, ice, milk, oysters, clams, P2P
SYMPTOMS	Mild fever, general weakness, nausea, abdominal pain; can develop into jaundice, P2P, fecal oral
ONSET	Up to a month

## **Waterborne Protozoa**

<b>PARASITE</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Naegleria fowleri	Infection (3-7 days)	Primary Amoebic Meningoencephalitis (PAM)
Cryptosporidium Parvum	Infection (1-10 days)	<b>Cryptosporidiosis</b> (Diarrheal disease) Cont food/water, P2P
Cyclospora Cayetanensis	Infection (1-14 days)	<b>Diarrheal disease</b> Cont food/water, Fresh produce

## **Waterborne Protozoa**

<b>PARASITE</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Entamoeba Histolytica	Infection (1-4 weeks)	<b>Amoebiasis</b> Cont food/water, P2P
Giardia Lamblia	Infection (1-2 weeks)	<b>Giardiasis</b> Cont food/water
Toxoplasma Gondii	Infection (5-23 days)	<b>Toxoplasmosis</b> Cat feces, poorly cooked lamb, pork or venison



### **Waterborne Protozoa**

ILLNESS	Primary Amoebic Meningoencephalitis (PAM)
PARASITE	Naegleria fowleri
VEHICLE	Warm stagnant water, swimming pools, Through NASAL passage only
SYMPTOMS	Headache, nausea, vomiting, encephalitis
ONSET	3 – 7 days, death in 14 days from respiratory failure – 200 cases, 97% mortality

### **Waterborne Protozoa**

ILLNESS	Cryptosporidiosis (Diarrheal disease)
PARASITE	Cryptosporidium Parvum SPORE FORMER
VEHICLE	Fecally contaminated food/water, P2P – dogs, cats, and cattle
SYMPTOMS	Anorexia, vomiting, profuse watery diarrhea
ONSET	1 – 10 days

### **Waterborne Protozoa**

ILLNESS	Diarrheal disease
PARASITE	Cyclospora Cayetanensis SPORE FORMER
VEHICLE	Cont food/water, Fresh fruits and vegetables
SYMPTOMS	Watery diarrhea, anorexia, nausea, cramps, weight loss – fever is rare
ONSET	1-14 days

### **Waterborne Protozoa**

ILLNESS	Amoebiasis (Amebiasis)
PARASITE	Entamoeba Histolytica SPORE FORMER
VEHICLE	Fecally cont food/water, P2P
SYMPTOMS	Anorexia, cramps, blood and mucous in stool
ONSET	1 – 4 weeks

### **Waterborne Protozoa**

ILLNESS	Giardiasis (Beaver Fever)
PARASITE	Giardia Lambia CYSTS
VEHICLE	Cont food/water, beavers, muskrats, P2P
SYMPTOMS	Asymptomatic, acute self-limiting diarrhea, or chronic diarrhea with weight loss
ONSET	1 – 2 weeks

### **Waterborne Protozoa**

ILLNESS	Toxoplasmosis
PARASITE	Toxoplasma Gondii
VEHICLE	Cat feces, poorly cooked lamb, pork or venison
SYMPTOMS	Weakness, swollen lymph nodes, resembles mononucleosis
ONSET	5 – 23 days

## **Waterborne Helminths**

PARASITE	ILLNESS	DISEASE/VEHICLE
Ascaris Lumbricoides	Infection (2 months)	<b>Ascariasis</b> Food/water cont with man/ape feces
Schistosoma ssp.	Infection	Swimmers Itch
Schistosoma Mansoni	Infection	Schistosomiasis, Snail Fever
Dracunculus medinensis	Infection	<b>Dracunculiasis, Guinea worm disease (GWD) or Medina Worm</b>

## **Waterborne Helminths**

ILLNESS	<b>Ascariasis</b> (Round worm infection, Ascaridiasis)
PARASITE	Ascaris Lumbricoides (large intestinal worm of humans)
VEHICLE	Food/water cont with man/ape feces
SYMPTOMS	Live worm passed via stool, anus, nose or mouth, weight loss, bowel obstructions
ONSET	2 months

### **Waterborne Helminths**


ILLNESS	Swimmers Itch, Schistosome dermatitis
PARASITE	Schistosoma ssp
VEHICLE	Egg infected migratory fowl feces in water, egg enters snail and develops
SYMPTOMS	Dermatitis
ONSET	Hours to days TREAT WASTE WITH COPPER SULFATE TO ELIMINATE SNAIL HOST

### **Waterborne Helminths**

ILLNESS	Schistosomiasis, Snail fever
PARASITE	Schistosoma Mansoni (blood)
VEHICLE	Trematode (blood fluke)
SYMPTOMS	Pain, cough, diarrhea
ONSET	weeks


## **Waterborne Helminths**

ILLNESS	<b>Dracunculiasis, Guinea worm disease (GWD) or Medina Worm</b>
PARASITE	Dracunculus medinensis - CYST
VEHICLE	Ingestion of larvae from stagnant fresh water – only human reservoir
SYMPTOMS	Blister and burning sensation
ONSET	months



## **Waterborne Fungi**

ILLNESS	<b>Ringworm or Tinea</b>
PARASITE	Trichophyton tinea ssp
VEHICLE	P2P via skin contact or fomites; shower or pool surfaces
SYMPTOMS	Reddish raised or bumpy patch of skin that that gives the appearance of a ring
ONSET	days



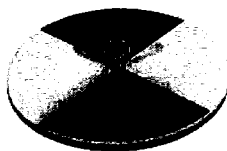
## **Spa and Hot Tubs**

- 10ft<sup>2</sup> per user
- 100-102 F Max
- pH 7.5
- Turnover rate 30 min
- Free Cl residual: 3-5 ppm



## **Swimming Pools**

- Free available chlorine: 1-3 ppm
- pH 7.2-7.6
- Alkalinity 50 – 150 mg/l
- Coliform – max of 15% can be positive over 30 day period (minimum of 5 samples)
- Staphylococcus ssp- not more than 50 cfu/ml
- Clarity – 6" secchi disk clear to pool bottom
- Turbidity - .5 NTU max
- 78-82 F
- Never <85F



## **Swimming Pools**

- Life saving equipment/2000 ft<sup>2</sup> water surface
  - 12 – 15 ft shepherd's hook
  - Coast Guard approved 18" float ring, 50' line
  - Spine board
  - First aid kit
  - Signage
  - Telephone
- Minimum 4' high fence
  - Self closing gate
  - Latch > 40" off ground



## **Swimming Pools**

- Turnover Rates
  - Public pool – every 6-8 hours
  - Private pool – every 12 hrs
  - Wading pool – every 1-2 hrs
  - Public spa – every 30 minutes
  - 5 turnovers = 100% of water molecules

**Turnover = Pool capacity (gallons)/flow (gpm) \* 1/60 (min/hr)**

### **Pool capacity**

- Rectangle pool – length\*width\*avr depth\*7.5 = gallons
- Round pool –  $3.14r^2$  \* avr depth \* 7.5 = gallons



## **Swimming Pools**

- pH
  - Measure of the activity of dissolved hydrogen ions.
    - Low pH = high concentration of  $H^+$
    - High pH = low concentration of  $H^+$
  - Pure water = pH 7
  - $pH = -\log[H^+]$
  - Below 7 or above 8 = eye irritation and metal corrosion
  - $>8$  greatly reduces the effect of chlorination
  - To raise pH – add sodium carbonate ( $Na_2CO_3$  or soda ash)
  - To lower pH – add sodium bisulphate ( $NaHSO_4$ ) or HCl

## **Swimming Pools**

- Alkalinity
  - Measure of the acid reducing capacity available in the water
  - Not a measure of pH
  - Maintain 50 – 150 mg/l
- Total dissolved solids (TDS)
  - Measures all materials dissolved in water
  - Above 1500 ppm reduces Cl efficiency and clouds water
  - Must dilute!!!!

## **Swimming Pools**

- Filters
  - Sand
    - Rapid sand pressure filter – older large pools
    - High rate sand filter – finer sand than rapid
    - Vacuum sand filter – large open tanks, requires lots of space
  - Diatomaceous earth
    - Fossilized diatoms (single celled plants)
      - Light, porous, honeycomb structure
      - Lots of surface area (more than sand)
      - Cheap, natural, stable

## **Swimming Pools**

- Algae control
  - Superchlorination
  - $\text{CuSO}_4$
  - Algaecides
- Scale control (build up of calcium carbonate)
  - Langelier saturation index
    - Calculation that takes pH, temp, Ca, and alkalinity into account
    - Positive = will cause scaling –  $\text{CaCO}_3$  will precipitate
    - Negative = will not scale – water dissolve  $\text{CaCO}_3$
    - Ideal = 0

## Swimming Pools

- Shocking (Superchlorination or nonchlorine)
  - 1-3 ppm recommended chlorine does mitigate all bacteriological risks
  - Pools require regular shocking to remain safe
  - Pools - every 2 weeks or every week when heated
- Superchlorination
  - **When Combine Chlorine – FAC > .2 mg/l**
  - Bring the water to 10X the value of (CC – FAC)
  - Should get you to the breakpoint
    - Point where all Cl added results in FAC
  - Read product – tells the FAC needed for shocking

## Swimming Pools

- Shocking (cont)
  - Nonchlorine
    - Bromination
    - Same formula as chlorination
    - Use **Potassium monopersulfate**
  - Clean filter and backwash before
  - Do not allow bathers to re enter until
    - Chlorine 1 - 3 ppm
    - Bromine 3 – 5 ppm



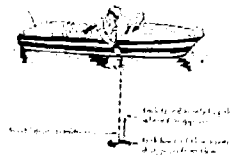
## Swimming Pools

- Accidental discharges
  - Formed stool
    - Evacuate bathers and remove fecal matter
    - Raise FAC to 2 ppm for 30 minute contact time
    - Establish a fecal accident log
  - Diarrhea
    - Evacuate bathers and remove fecal matter
    - Raise FAC to 20 ppm for 12.75 hrs contact time
    - Establish a fecal accident log
  - Vomit – follow fecal accident protocol
  - Blood spill – no public health reason to close the pool if pool was > 1ppm FAC



## Public Beaches

- EPA RECOMMENDED Standards
  - Fecal coliform
    - Not less than 5 samples over 30 days
    - Not to exceed a log mean of 200/100ml
    - Not more than 10% of total samples during any 30 day period shall exceed 400/100ml
  - pH 6.5-8.3
  - Samples collected every 300ft in 2 ft of water
  - 8" Secchi disk used for clarity
    - Visible at 4 ft



## **Disinfection**

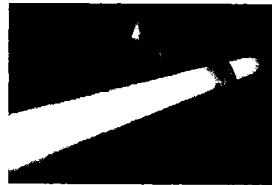
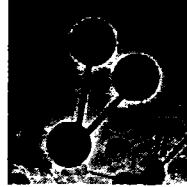
- Chlorine
  - Most popular and inexpensive
  - Continuous feed into public pools
  - DPD test kit (diethyl-p-phenylenediamine)
  - Cyanuric acid to stabilize Cl from UV
  - Free available chlorine (FAC)
    - 1-3 ppm @ pH 7.2-7.5 for pools
    - 3-5 ppm @ pH 7.5-7.6 for hot tubs
  - Chloramine is a poor sanitizer
    - Urine in pool or hot tub

## **Disinfection**

- Bromine
  - More expensive than chlorine
  - Bromamine is better sanitizer than chloramine
  - Bromine residual
    - 3-5 ppm in swimming pools
    - 4-6 ppm in hot tubs
  - Lowers the pH of water
  - Easily destroyed by UV
    - Cyanuric acid does not stabilize bromine

## Disinfection

- Ozone ( $O_3$ )
  - 3000 times faster than chlorine
  - Very volatile – no residual
  - Must be produced on site
  - No disinfection by products
- Ultra Violet (UV)
  - Short life – no residual
  - Need to produce on site
  - No disinfection by products



## Questions

?

# Wastewater

Wednesday, March 17, 2010  
10:48 AM

## Wastewater

### Learning Objectives

- Be familiar with definitions used in class
- Know how a septic system works
- Describe the key components of a septic system
- Explain the things to consider when building a waste water treatment system
- Know how to determine soil permeability
- Know the isolation distances associated with an onsite waste water treatment system
- Know reasons for septic system failure
- Know the organisms and diseases associated with sewage

## **Definitions**

- Biochemical Oxygen Demand (BOD) – The difference between the initial dissolved O<sub>2</sub> in a water sample and the dissolved O<sub>2</sub> in duplicate samples after a stated period of time (usually 5 days = BOD 5). Is the best single measurement of wastewater or polluted water.
- Chemical Oxygen Demand (COD) – Measure of the amount of O<sub>2</sub> chemically consumed by the oxidation of organic and oxidizable inorganic materials in a water sample. Good for industrial wastes.
- COD and BOD do not necessarily measure the same types of oxygen consumption.
  - COD does not measure the oxygen-consuming potential associated with certain dissolved organic compounds such as acetate. However, acetate can be metabolized by microorganisms and would therefore be detected in an assay of BOD.
  - The oxygen-consuming potential of cellulose is not measured during BOD assay, but it is measured during a COD test.

## **Definitions**

- Domestic Sewage – used water from a home or community from toilet, bath, laundry, lavatory and kitchen sink waste.
  - Strength reported in BOD<sub>5</sub>, COD, and suspended solids (SS)
  - Black water – from toilet
  - Grey water – all other domestic waste water
- Privy – excreta disposed without aid of water – outhouse
- National Pollutant Discharge and Elimination System (NPDES) – system from issuing permits for the discharge of treated sanitary, industrial and commercial waste under the 1972 federal water pollution control act. Specifies treatment and expected outcome of effluent to protect water quality.

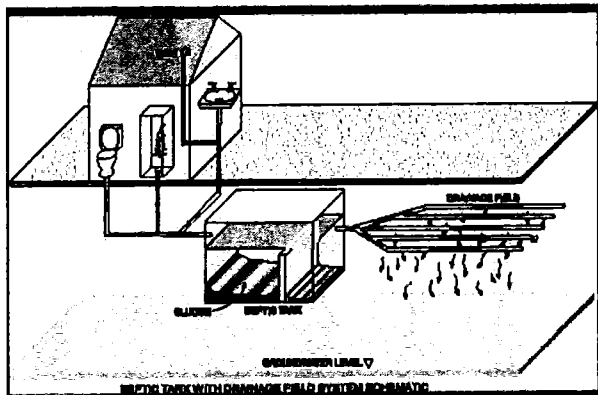


## **Definitions**

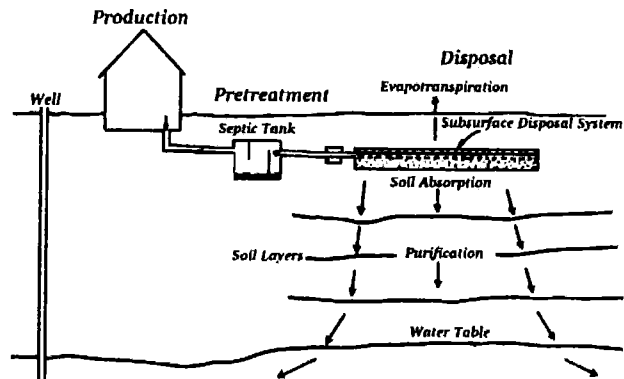
- Combined sewer – storm water and domestic sewage are combined in the same pipe
- Separate sewer system – storm water and domestic sewage are collected separately
- Suspended solids (SS) solids that are visible and in suspension in water. Test is retention on the asbestos mat in a Gooch crucible and represents the food that bacteria eat.



## **Onsite Wastewater System**



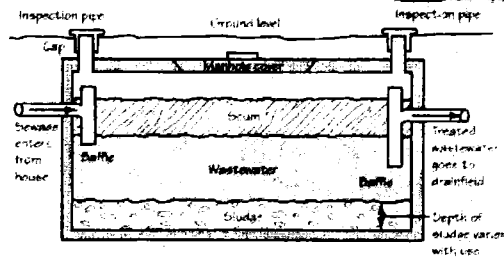
## Onsite Wastewater System



## Septic Tank

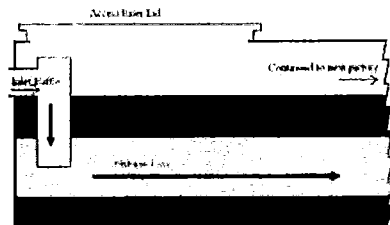


- Primary functions
  - Remove solids
  - Biological (anaerobic) treatment
  - Sludge and Scum Storage



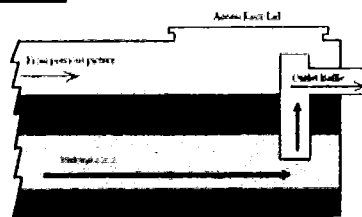
Results in conditioned product that can be percolated into subsoil

## Septic Tank

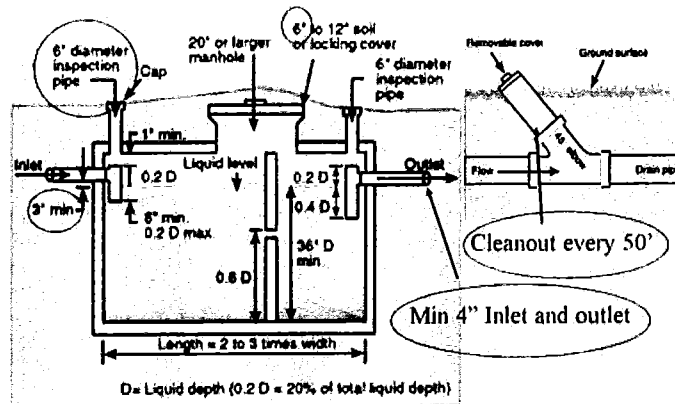


- Inlet Baffle
- Directs flow
- Minimizes turbulence

- Outlet Baffle
- Clear zone guarantee
- Holds scum (FOG) in tank
- Can house an effluent screen

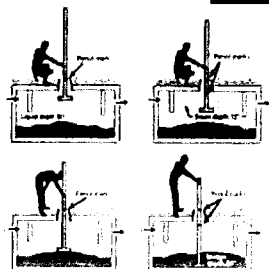


## Septic Tank

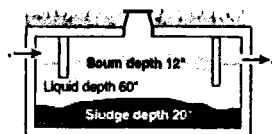


<http://extension.missouri.edu>

## Septic Tank

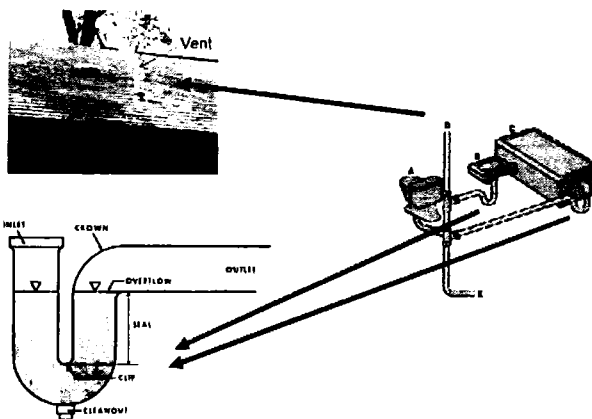


- Pump System if
  - Scum < 3" from outlet
  - Scum > 12"
  - Sludge < 12" from outlet
  - Scum + sludge > 1/2 liquid depth



<http://extension.missouri.edu>

## Septic Tank



## Septic Tanks

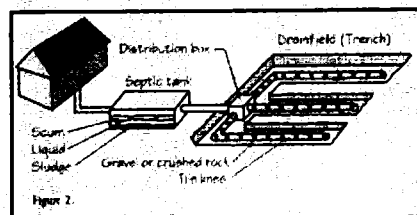
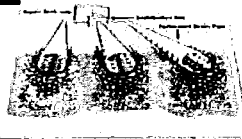
Minimum distance in feet from:	Sewage tanks	Drain fields
Private water supply well	50	100
Public water supply well	300	300
Cistern	25	25
Spring	50	100
Stream or open ditch	25	25
Property lines	10	100
Building foundation	5	15
Basement	15	25
Swimming pool	15	15
Water line under pressure	10	10

## Drain Fields



### Purpose

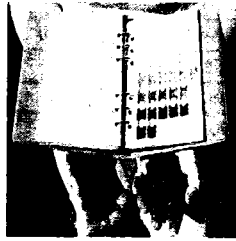
- Dispose of effluent from septic tank
- Distribute so can be treated by soil before reaching groundwater



Schematic of a Drainfield

## Design: Soil Permeability

- Yellow, brown or red
  - Air and therefore water passes through
- Blue or grey
  - Saturated for extended periods
- Mottled brown or red
  - Fluctuating seasonal high water table
  - Unsuitable for subsurface absorption of wastewater
- Measured using Munsell Color Chart



## Design: Soil Permeability

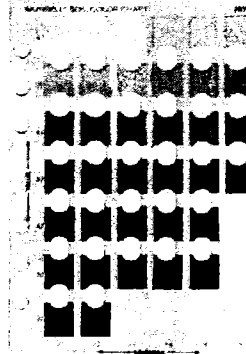
The Munsell color book is used to document color in a standard notation.

**Hue:** Dominant spectral color. Value found in the top right-hand corner of each page.

**Value:** The degree of light/dark of a color in relation to a neutral gray scale. Values along the left-hand side of each page.

**Chroma:** Strength of hue. Values along the bottom of each page.

The 10YR page of the Munsell color book.

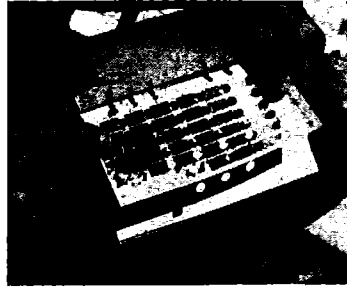


<http://www.munsellcolor.com>

## Design: Soil Permeability

### Soil Classification

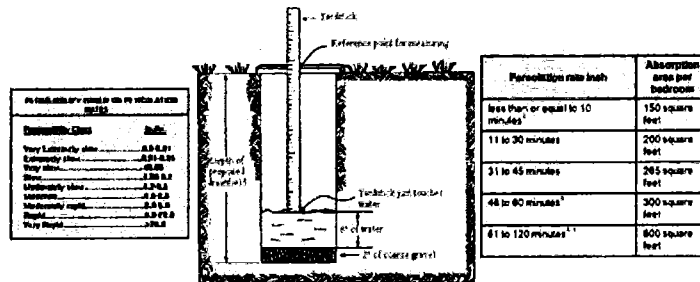
- Munsell color
- Structure
- Texture
- Content



Classification yields a permeability estimate and an estimated application rate – Can also use the percolation test

## Design: Soil Permeability

### Percolation Test



A measure of the relatively constant rate at which clear water maintained  
At a relatively constant depth (6") will seep out a standard sized hole

## **Design: Site Geography**

- Slope
  - Gradient, complexity, length and aspect
- Lot Size
  - Gravel vs non gravel drainfield etc
  - Isolation distances
- Vegetation
- Limiting layer
  - Seasonal high water table OR
  - Soil layer with a very low percolation rate

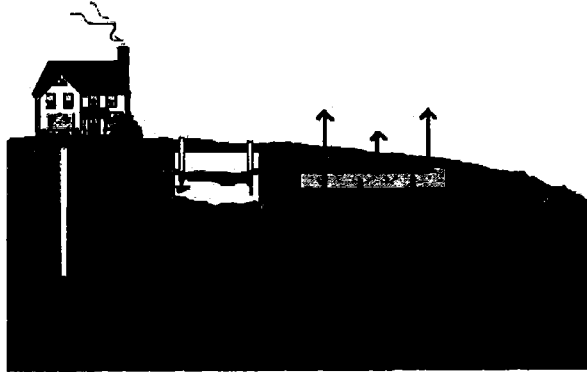


## **Design: Summary**

- Expected flow determines tank capacity
  - # of bedrooms
- Flow and application rate determine seepage area
  - # of bedrooms, percolation test, soil characterization
- Depth to limiting layer, isolation distances, lot size determine
  - Where a system can be placed
  - If a system can be installed
- Waste strength determines type of pretreatment
  - Septic tank - slower
  - Aerobic treatment plant (ATP) - faster

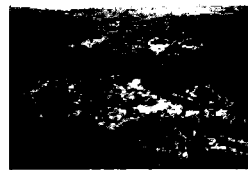


## The Completed System



## System Failure

- Poor design
- Hydraulic overload
  - Seasonal high water
  - Excessive water use
  - Leaking fixtures
- System Abuse
  - Excessive cleaning chemicals
  - Flushing non digestibles
- System damage
  - Missing or damaged baffles
  - Soil compaction in drain field
- Improper connections
  - Roof gutters
  - Footing drains
  - Sub pumps
- Uneven settlement
  - Tank
  - Connecting pipes
  - Distribution box



## **System Failure: Hazards**

- ALWAYS assume that sewage contains pathogenic organisms
  - Can survive in soil from days to years
  - Main indicator is Escherichia coli
- No process other than disinfection can remove all pathogens
- Pathogens of concern are bacteria, viruses, helminthes, and protozoa

## **Sewage Borne Bacteria**

BACTERIA	ILLNESS	DISEASE/VEHICLE
Campylobacter jejuni	Infection (2-5 days)	<b>Campylobacter Enteritis</b> Raw milk, water, beef, poultry pork
Pseudomonas aeruginosa	Dermatitis (1-10 days)	<b>Swimmers Itch</b> Heated contaminated water
Salmonella Typhi	Infection (1-2 wks)	<b>Typhoid Fever</b> Fecal-oral, cont water, oysters, vegetables grown in night soil
Salmonella Typhimurium	Infection (12-24 hrs)	<b>Salmonellosis</b> Poultry, eggs, sliced fruits/veg, milk, fecally through food and water

## **Sewage Borne Bacteria**

<b>BACTERIA</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Mycobacterium marinum	Infection 2-4 weeks	<b>Fish-tank Granuloma</b> Fish bites or pokes, water
Yersinia Enterocolitica	Infection (2-3 days)	<b>Yersiniosis</b> Raw milk, pork, beef, lamb
Vibrio Cholera	Infection (hrs-days)	<b>Cholera</b> Cont water, raw foods, shellfish
Escherichia Coli <b>Shiga Toxin Producing</b>	Toxin Mediated Infection (2-4 days)	<b>Enterohemorrhagic (EHEC) 0157H7</b> Raw ground beef, raw milk/juice, sprouts, water

## **Sewage Borne Bacteria**

<b>BACTERIA</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Shigella Sonnei and Flexneri	Infection (1-7 days)	<b>Shigellosis (Bacillary Dysentery)</b> Cont water, vegetables, salads
Legionella pneumophilia	Infection	<b>Legionairres Disease</b> Heated water, droplets only
Chlamydia trachomatis	Infection 5-12 days	<b>Trachoma</b> Secretions from eyes, nose, throat
Leptospira ssp	Infection (2-20 days)	Wells disease, Leptospirosis Urine of infected animal, rats, swine

### **Sewage Borne Bacteria**

ILLNESS	Campylobacter Enteritis (Infectious diarrhea, bacterial diarrhea)
BACTERIA	Campylobacter Jejuni
VEHICLE	Raw milk, water, beef, poultry, pork
SYMPTOMS	Watery diarrhea, abdominal pain, fever, chills, nausea, vomiting, blood in stool
ONSET	2-5 days

### **Sewage Borne Bacteria**

ILLNESS	Swimmer's itch, swimmer's ear, rash, dermatitis, UTIs
BACTERIA	Pseudomonas aeruginosa
VEHICLE	Hot tubs, geothermal pools – is thermophillic
SYMPTOMS	See Above
ONSET	1 – 10 days

### **Sewage Borne Bacteria**

ILLNESS	Typhoid Fever (enteric fever, bilious fever, yellow jack)
BACTERIA	Salmonella Typhi
VEHICLE	Fecal oral, contaminated water and shellfish, P2P, veggies grown in night soil
SYMPTOMS	Sustained high fever, headache, malaise, anorexia, splenomegaly, a rash of flat, rose-colored spots
ONSET	1-2 weeks

NOT SALMONELLOSIS!!!!

### **Sewage Borne Bacteria**

ILLNESS	Salmonellosis (non-typhoidal salmonella, salmonella infection)
BACTERIA	Salmonella Typhimurium
VEHICLE	Poultry, eggs, milk and milk products, contaminated water, pigs, turtles, iguanas
SYMPTOMS	Abdominal pain, diarrhea, chills, fever, vomiting, nausea
ONSET	12-24 hours

NOT TYPHOID FEVER

### **Sewage Borne Bacteria**

ILLNESS	Fish-tank Granuloma
BACTERIA	Mycobacterium marinum
VEHICLE	Contaminated water, fish bites, pokes from fins
SYMPTOMS	1-2.5 cm lesions on the elbows, knees and feet in swimming pool-related cases, and on the hands and fingers in aquarium owners
ONSET	2-4 weeks

### **Sewage Borne Bacteria**

ILLNESS	Yersiniosis
BACTERIA	Yersinia Enterocolitica (Not Yersinia Pestis which carries Bubonic Plague)
VEHICLE	Raw milk, pork, beef, lamb, cont water, P2P
SYMPTOMS	fever, abdominal pain, and bloody diarrhea – confused with appendix attack
ONSET	2-3 days

### **Sewage Borne Bacteria**

ILLNESS	Cholera (asiatic cholera, epidemic cholera)
BACTERIA	Vibrio Cholera
VEHICLE	Contaminated water, shellfish, raw foods, fecally contaminated from infected humans
SYMPTOMS	Acute diarrhea (so severe rehydration required), rapid pulse, dry skin, abdominal cramps, nausea, and vomiting.
ONSET	Hours to days

### **Sewage Borne Bacteria**

ILLNESS	Enterohemorrhagic (EHEC, ecoli 0157H7)
BACTERIA	Ecoli 0157H7
VEHICLE	Raw and undercooked ground beef, raw milk, alfalfa sprouts, unpasteurized fruit juices, dry-cured salami, lettuce, game meat, and cheese curds. P2P, water
SYMPTOMS	Diarrhea ranging from mild to severe with blood, abdominal pain, HUS
ONSET	2 – 4 days

### **Sewage Borne Bacteria**

ILLNESS	Shigellosis (Bacillary Dysentery)
BACTERIA	Shigella Sonnei and Flexneri
VEHICLE	Fecal oral, contaminated food/water, P2P, milk, anything washed with cont water
SYMPTOMS	Acute onset with diarrhea, fever, bloody stool
ONSET	1-7 days

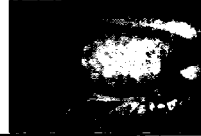
### **Sewage Borne Bacteria**

ILLNESS	Legionnaires disease (Pontiac fever too – same but less effects)
BACTERIA	Legionella pneumoniphilia
VEHICLE	Hot tubs, cooling towers, warm ponds INHALED DROPS ONLY, no P2P
SYMPTOMS	Pneumonia like – 40% fatal
ONSET	2 – 10 days



### **Sewage Borne Bacteria**

ILLNESS	Trachoma
BACTERIA	Chlamydia trachomatis
VEHICLE	P2P, direct contact with eye, nose, throat secretions or fomites (towels, etc)
SYMPTOMS	Eye irritation, white lumps on upper eye lid, distortion of eyelid causing follicles to touch it
ONSET	5-12 days



### **Sewage Borne Bacteria**

ILLNESS	Leptospirosis, Weil's disease, Canefield fever
BACTERIA	Leptospira ssp
VEHICLE	Ingestion or contact with cont food and water Urine of infected animal, rats, swine
SYMPTOMS	Flu like symptoms followed by liver and kidney damage - jaundice
ONSET	2 - 20 days

### **Sewage Borne Viruses**

<b>VIRUS</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Hepatitis A Virus	Infection (30-35 days)	<b>Infectious Hepatitis</b> Water, ice, milk, oysters, clams, P2P
Norwalk Like Viruses	Infection (1-2 days)	<b>Viral Gastroenteritis</b> Water, ice, shellfish – fecal oral Most common enteric disease in US <b>CHLORINE RESISTANT</b>
Rotavirus	Infection (1-2 days)	<b>Human Rotavirus (HRV)</b> Fecal-oral, cont food/water, fomites

### **Sewage Borne Viruses**

<b>VIRUS</b>	<b>ILLNESS</b>	<b>DISEASE/VEHICLE</b>
Human Adenovirus (HAdV)	Infection (days – weeks)	<b>Acute respiratory disease (ARD), conjunctivitis</b> P2P, fecal –oral, waterborne
Poliovirus	Infection 1-3 weeks	<b>Poliomyelitis, Paralytic poliomyelitis (Polio)</b> P2P, fecal-oral, waterborne

### **Sewage Borne Viruses**

ILLNESS	Human Rotavirus (HRV, Sporadic viral gastroenteritis, severe viral gastroenteritis of infants and children, rotaviral enteritis)
VIRUS	Rotavirus
VEHICLE	Fecal-oral route; person-to-person; contact with respiratory secretions, contaminated water, food or other surfaces; contact with fomites
SYMPTOMS	Mild to moderate fever and vomiting, followed by the onset of watery stools
ONSET	1-2 days

### **Sewage Borne Viruses**

ILLNESS	Viral Gastroenteritis
VIRUS	Norwalk virus group (Norwalk like virus NLV, Small round structured virus SRSV)
VEHICLE	Water, ice, shellfish – fecal oral
SYMPTOMS	Nausea, vomiting, diarrhea, abdominal cramps
ONSET	1 – 2 days

### **Sewage Borne Viruses**

ILLNESS	<b>Infectious Hepatitis</b> (Type A Hepatitis, Catarrhal jaundice, Epidemic hepatitis)
VIRUS	Hepatitis A Virus
VEHICLE	Water, ice, milk, oysters, clams, P2P
SYMPTOMS	Mild fever, general weakness, nausea, abdominal pain; can develop into jaundice, P2P, fecal oral
ONSET	Up to a month

### **Sewage Borne Viruses**

ILLNESS	<b>Human Adenovirus (HAdV)</b>
VIRUS	<b>Adenovirus</b>
VEHICLE	P2P, fecal-oral, waterborne
SYMPTOMS	Respiratory distress, gastroenteritis, conjunctivitis, cystitis, and rash illness.
ONSET	Days to weeks

## **Sewage Borne Viruses**

ILLNESS	Poliomyelitis, Paralytic poliomyelitis, polio
VIRUS	Poliovirus
VEHICLE	P2P, fecal-oral, waterborne
SYMPTOMS	<b>acute flaccid paralysis (AFP)</b> sudden onset of weakness or paralysis and reduced muscle tone
ONSET	1 – 3 weeks

## **Sewage Borne Protozoa**

PARASITE	ILLNESS	DISEASE/VEHICLE
Entamoeba Histolytica	Infection (1-4 weeks)	<b>Amoebiasis</b> Cont food/water, P2P
Giardia Lamblia	Infection (1-2 weeks)	<b>Giardiasis</b> Cont food/water
Balantidium coli	Infection (Several days)	<b>Balantidiasis</b> Cont food/water

### **Sewage Borne Protozoa**

ILLNESS	<b>Amoebiasis</b> (Amebiasis)
PARASITE	Entamoeba Histolytica SPORE FORMER
VEHICLE	Fecally cont food/water, P2P
SYMPTOMS	Anorexia, cramps, blood and mucous in stool
ONSET	1 – 4 weeks

### **Sewage Borne Protozoa**

ILLNESS	<b>Giardiasis</b> (Beaver Fever)
PARASITE	Giardia Lambia CYSTS
VEHICLE	Cont food/water, beavers, muskrats, P2P
SYMPTOMS	Assymptomatic, acute self-limiting diarrhea, or chronic diarrhea with weight loss
ONSET	1 – 2 weeks

### **Sewage Borne Protozoa**

ILLNESS	<b>Balantidiasis</b>
PARASITE	Balantidium coli CYSTS
VEHICLE	Cont food/water
SYMPTOMS	Diarrhea and dysentery, ameobiasis like symptoms
ONSET	Several days

### **Sewage Borne Helminths**

PARASITE	ILLNESS	DISEASE/VEHICLE
Ascaris Lumbricoides	Infection (2 months)	<b>Ascariasis</b> Food/water cont with man/ape feces
Dracunculus medinensis	Infection	<b>Dracunculiasis, Guinea worm disease (GWD), Medina Worm</b>
Taeniasis Saginata (cows) Taeniasis Solium (pigs)	Infection (5-12 weeks)	<b>Taeniasis</b> Raw meat, water
Trichuris trichiura (human whipworm)	Infection (several days)	<b>Trichuriasis</b> Soil, water and infected food

### **Sewage Borne Helminths**

ILLNESS	<b>Ascariasis</b> (Round worm infection, Ascariidiasis)
PARASITE	Ascaris Lumbricoides (large intestinal worm of humans)
VEHICLE	Food/water cont with man/ape feces
SYMPTOMS	Live worm passed via stool, anus, nose or mouth, weight loss, bowel obstructions
ONSET	2 months

### **Sewage Borne Helminths**

ILLNESS	<b>Dracunculiasis, Guinea worm disease (GWD) or Medina Worm</b>
PARASITE	Dracunculus medinensis - CYST
VEHICLE	Ingestion of larvae from stagnant fresh water – only human reservoir
SYMPTOMS	Blister and burning sensation
ONSET	months





### **Sewage Borne Helminths**

ILLNESS	Taeniasis (beef and pork tapeworm)
PARASITE	Taenia saginata (cows), taenia solium (pigs) CYST FORMER
VEHICLE	Contaminated food and water
SYMPTOMS	Mostly asymptomatic, nausea, hunger pains, stomach aches,
ONSET	5 – 12 weeks

### **Sewage Borne Helminths**

ILLNESS	Trichuriasis
PARASITE	Trichuris trichiura (human whipworm)
VEHICLE	Contaminated soil, food and water
SYMPTOMS	Mostly asymptomatic, bloody stool, colonic obstruction, mimics inflammatory bowel disease
ONSET	Several days

## **Sewage Borne Fungi**

ILLNESS	Ringworm or Tinea
PARASITE	Trichophyton tinea ssp
VEHICLE	P2P via skin contact or fomites; shower or pool surfaces
SYMPTOMS	Reddish raised or bumpy patch of skin that that gives the appearance of a ring
ONSET	days



## **Questions**

?

# Radiation

Wednesday, March 17, 2010  
10:49 AM

## Radiation

### Learning Objectives

- Be familiar with definitions used in class
- Know the sources for the various types of radiation discussed in class
- Be able to discuss characteristics as well as protection from alpha, beta, gamma, and x rays
- Know radiation units
- Know about radon and its cancer causing effects
- Be able to discuss EPA carcinogenicity categories and give examples
- Know how radon enters a home and how to protect against it

## **Definitions**

- Ionizing radiation
  - Radiation capable of producing ions when interacting with matter
    - X rays, Alpha, Beta, Gamma, Cosmic rays
- Nonionizing radiation
  - Radiation that does not have enough energy to remove an electron from an atom or molecule
    - UV light, Visible light, Infrared radiation, microwaves, radio and TV, power transmission

## **Ionizing Radiation**

- 4 types of Ionizing radiation
  - Alpha particles
  - Beta particles
  - Gamma photons
  - X ray photons

## **Ionizing Radiation**

- Alpha Particles
  - Large in Mass (+2)
  - Effects are short range (stopped by paper)
  - Hazardous - Inhalation and ingestion
  - Not part of the electromagnetic spectrum – has mass
- Beta Particles
  - Relatively small mass and charge (-1)
  - Fast moving (stopped by thin metal or plastic)
  - Hazardous – inhalation, ingestion, skin burns
  - Not part of the electromagnetic spectrum –has mass

## **Ionizing Radiation**

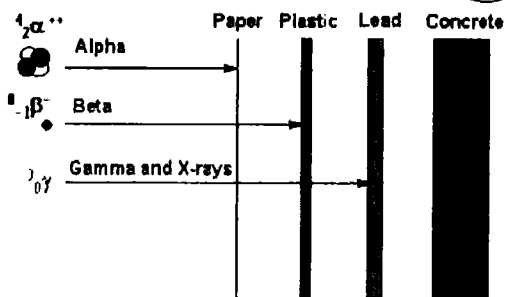
- Gamma Photons
  - Pure energy
  - Ionizing radiation at the high frequency end of spectrum
  - NO MASS
  - Very penetrating – external and internal radiation hazard
  - Travels at the speed of light
  - No charge
  - **PRIMARY PROTECTION**
    - Time
    - Distance
    - Shielding

## Ionizing Radiation

- X Ray Photons
  - Similar to gamma
  - Penetrates less than gamma
- **PRIMARY PROTECTION**
  - Time
  - Distance
  - Shielding

## Ionizing Radiation

Penetrating Distances



## **Ionizing Radiation**

- Radiation Damage - 4 things can happen
  - 1 – Pass through cell without causing damage
  - 2 – Damage the cell, but cell repairs itself
  - 3 – Damage the cell so repairs and replicates a damaged form
  - 4 – Kills the cell
- Somatic effects appear in exposed person
  - Damage to cells that are NOT reproductive cells
  - Occur immediately or over years
- Genetic effects can effect future generations
  - Reproductive cells
  - Can be inherited

## **Carcinogenicity Categories**

- Class A – Human Carcinogen
  - **RADON, Tobacco smoke Po210**
- Class B1 – Probable human carcinogen
  - Limited evidence but not conclusive
  - **UVA, UVB**
- Class B2 – Probable human carcinogen
  - Inadequate cause and effect evidence
  - **UVA, UVB**
- Class C – Possible human carcinogen
- Class D – Not classifiable as a human carcinogen
- Class E – Evidence of non carcinogenicity

## **Regulating Radiation**

- Nuclear Regulatory Commission
  - Nuclear Power Plants and Fuels
- Department of Energy
  - Military
  - Argon National Lab, Fermi, Oak Ridge
- EPA
  - Naturally occurring
  - Radon RECOMMENDATIONS

## **Regulating Radiation**

- pCi/L
  - A picocurie is a trillionth of a curie and represents about one radioactive particle disintegration every 27 seconds
- Becquerel per meter<sup>3</sup> (Bq/m<sup>3</sup>)
  - One becquerel per meter<sup>3</sup> is one disintegration per second within a cubic meter
- Absorbed dose - Gray (Gy) formerly Rad
  - Amount of energy absorbed
- Equivalent Dose - Sievert (Sv) formerly REM
  - Makes different sources of radiation equivalent
  - Measures biological effect
- Roentgen (R) -
  - Equivalent dose of ionizing radiation received by tissues and organs - takes in a quality factor for dangerous radiation



## **Regulating Radiation**

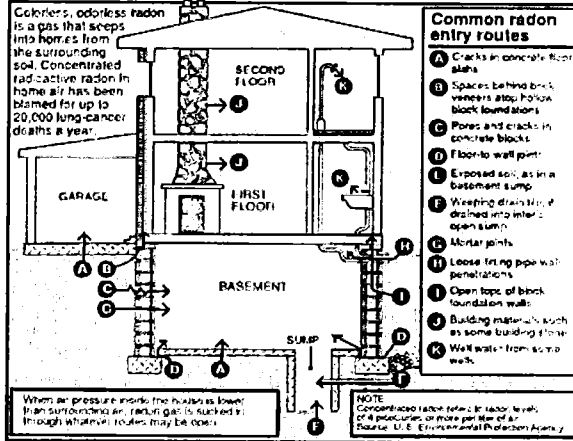
- Radon – ALPHA EMITTER
  - All manmade Class A carcinogens are regulated
  - Radon regulated in mines since 1950s
  - Not regulated in homes because is not manmade
  - Standard of exposure
    - 4.0 pCi/l
    - Equates to 28 deaths per million per year
    - OSHA = 100 pCi/l

## **Radon**

- Radon 222 is the decay product of radium 226.
- Radium 226 is the decay product of Uranium 228.
- Uranium is ubiquitous in the earth's crust making Radium 226 and Radon 222 in almost all rock, soil, and water
- Colorless, odorless, tasteless
- Leaks into basements of houses, office, schools via
  - Foundation cracks
  - Sump pump wells
  - Drains
  - Well water

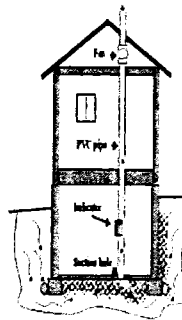
## Radon

### How Radon Enters Homes



## Radon

- Protection
  - Test your house, work, school etc
    - Seal and Vent
      - Sub slab depressurization
      - Discharge above the highest eave
  - Post mitigation re test
    - Test location after work is complete
    - Test every two years



## Questions

?

# Emergency and Disaster Response

Wednesday, March 17, 2010  
10:53 AM

## Emergency and Disaster Response

### **Learning Objectives**

- Be familiar with terms used in class
- Know the different emergency action levels
- Be familiar with the basic requirements of an emergency action plan
- Be familiar with the basic requirements of an emergency response plan
- Know the personnel involved in an emergency response including responsibilities and training requirements

## Emergency Response

- 29 CFR 1910.120, Hazardous waste operations and emergency response standard (HAZWOPER)
  - Effective 1990
  - Mandates emergency response and preparedness programs for industry
    - interface activities with off site agencies
    - prompt notification in event of emergency
  - Designed for emergency response
  - Requires lots of equipment
  - Requires lots of training
  - Requires lots of practice

## Emergency Response

- 29 CFR 1910.120, Hazardous waste operations and emergency response standard (HAZWOPER) (cont)
  - Initially very confusing
    - Many went overboard trying to comply
      - Standard PPE replaced with level A
      - Full decon in place of common sense chemical hygiene
    - Prompted training requirements
      - 40 HAZWOPER course
      - 8 hour annual refresher
      - Drills and respirator training

## Emergency Response

"Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release are, or by maintenance personnel are **NOT** considered to be emergency responses within the scope of this standard"

Not intended for small  
incidental spills

## Emergency Response

- What constitutes an emergency?

- Size of spill
- Location
- Substance spilled
- Hazards of the material

Each case will be different and must be  
evaluated

## Emergency Response

- Emergency Action Levels (EAL)
  - Level 1- Alert
    - Lowest emergency level which is associated with an unusual event that is under control or can easily be brought under control by plant personnel
  - Level 2 – Site Emergency
    - Intermediate level associated with fires, explosions, or toxic releases that affect more than the immediate area but are not expected to spread off site.
  - Level 3 – General Emergency
    - Critical level that implies spread or potential for spreading beyond plant boundaries. Outside population is or could be affected.

## Emergency Response

- Emergency Action Plan (EAP)
  - Procedures for reporting a fire or other emergency
  - Procedures for emergency evacuation
  - Procedures to be followed by employees who remain to operate critical plant operations before evacuation
  - Procedures to account for all employees after evacuation
  - Procedures to be followed by employees performing rescue or medical duties
  - Training
  - Review of the plan by all

## Emergency Response

- General Response Plan Components

- Personnel

- Emergency Director
    - Response Operations Coordinator
    - First Responders
    - HAZMAT Technicians
    - HAZMAT Specialist
    - Incident Commander

## Emergency Response

- General Response Plan Components (cont)

- Functions

- Communications – to and from response personnel
    - Fire and rescue teams
    - HAZMAT team
    - Process/Utilities-shut down utilities
    - Engineering/Technical Assistance-process related emerg equip
    - Environmental and field survey-migration of chemicals
    - Medical
    - Security
    - Off site liason-coord between onsite and external response teams
    - Public affairs
    - Resource/supplies



## Emergency Response

- Emergency Director (Site Emergency Coordinator)
  - Overall supervision of the protective action recommended to public, employees, and environment
  - Typically the plant manager
- Response Operations Coordinator
  - Operates out of the EOC and:
    - assists emergency director in emergency activities
    - makes strategies on mitigation of consequences
    - maintains commo with on scene commander
    - requests additional personnel and equipment

## Emergency Response

- Emergency Response Personnel
  - First Responder – 8 hrs of training
    - Operational Level
    - Respond in defensive fashion
    - Do not stop the release
    - Contain only!!!
  - HazMat Technician – 24 hrs of training
    - Operational level
    - Respond in Offensive fashion
    - Contain and.....
    - Plug, patch or stop release

## Emergency Response

- **Emergency Response Personnel (cont)**
  - HazMat Specialist – 24 hrs of training
    - Parallel HazMat Technician duties
    - More direct knowledge of specific chemical
    - Liaison with external agencies
  - Incident Commander – 24 hrs of training
    - **Must have at minimum 8 hrs of first responder training**
    - Highest ranking officer at the scene who operates out of command post (as close to scene as possible)
    - Direction and coordination of all field operations
    - Assessment of severity of the incident
    - Recommendation of on site protective actions
    - Implementation of responsive action at the scene
    - Coordination of actions with the emergency preparedness coordinator

## Emergency Response

- **HAZMAT Teams require**
  - medical surveillance
    - baseline, annual, symptoms, termination
  - PPE
  - Training
  - Direct reading instruments (PID, FID, etc)
  - Showers on site if site active for more than 6 months

### **Misc Disaster Response**

- **Disaster evacuation of homes**
  - Shut off all water and gas
  - Shut off electricity for appliances
- **Emergency Shelter**
  - First consideration is protection from flooding, elements and other risks of survivors
  - Require 30 ft<sup>2</sup>/person

### **Misc Disaster Response**

- **Water Supply**
  - 3-6 gallons of potable water/day
    - boil 1-2 minutes
    - bleach (double if water is colored)
      - 6 drops/gallon +20 minutes contact time
      - 1 pint/1000 gallons +30 minutes contact time
    - iodine – 8 drops/qt + 30 min contact time
- **Nuclear Disaster**
  - Notify public within 10 miles in 15 minutes
  - Test response plan every 2 years

## **Questions**

**?**

## HW Vector and Pests

Tuesday, March 16, 2010  
10:28 AM

### Vectors, Pests, and Poisonous Plants

1. The most widespread cockroach pest in restaurants is:
  - a. American Cockroach
  - b. Australian
  - c. German
  - d. Oriental
2. Roaches may be capable of spreading
  - a. Malaria
  - b. Rocky Mt. Spotted Fever
  - c. Rabies
  - d. Salmonellosis
3. The most important aspect in controlling roaches is:
  - a. Use of a strong pesticide
  - b. Maintaining good general sanitation
  - c. Collection of garbage on a regular basis
  - d. Hiring a competent exterminator
4. Flies generally spread disease by:
  - a. cyclo-development transmission
  - b. propagative transmission
  - c. fecal contamination
  - d. mechanical transmission
5. Mosquitoes have been known to spread
  - a. Typhus fever
  - b. encephalitis
  - c. shigellosis
  - d. salmonella
6. The mosquito genus responsible for the transmission of malaria is:
  - a. culex
  - b. aedes
  - c. plasmodium
  - d. anopheles
7. Which of the following is not ordinarily considered to be transmitted by an insect:
  - a. malaria
  - b. tetanus
  - c. typhus fever
  - d. yellow fever

8. The insect infestation on humans known as pediculosis is caused by
  - a. fleas
  - b. mites
  - c. ticks
  - d. lice
9. The most prevalent arthropod-borne disease transmitted to humans in the US today is:
  - a. rabies
  - b. plague
  - c. malaria
  - d. lyme disease
10. Scabies is an infectious disease of the skin caused by:
  - a. bedbugs
  - b. mites
  - c. chiggers
  - d. lice
11. Which is not considered a single dose rodenticide?
  - a. ANTU
  - b. Strychnine
  - c. Red squill
  - d. Warfarin
12. Which is an anti-coagulant type poison for rodents?
  - a. ANTU
  - b. Strychnine
  - c. Red squill
  - d. Warfarin
13. When is the best time to bat-proof a barn?
  - a. late spring
  - b. early summer
  - c. late fall
  - d. doesn't matter
14. Which of the following is caused by a virus?
  - a. encephalitis
  - b. malaria
  - c. Q fever
  - d. Tetanus
15. Which of the following is caused by a parasite?
  - a. encephalitis
  - b. malaria
  - c. Q fever
  - d. Tetanus

16. Which of the following is caused by bacteria?
- Yellow fever
  - Filariasis
  - Tularemia
  - Dengue
17. Which of the following diseases are rats NOT an intermediate host in?
- amoebic dysentery
  - endemic typhus
  - plague
  - weils disease
18. In rodent control, the primary method of producing permanent results is?
- fumigating
  - poisoning
  - proofing
  - trapping
19. Which of the following is ordinarily not used as a fumigant?
- ethylene oxide
  - hydrogen cyanide
  - methyl bromide
  - phosphorus pentoxide
20. The most effective measures for mosquito control are dependent upon the
- elimination of breeding places
  - trapping of adult insects
  - use of new types of insecticides to destroy adult insects
  - use of new repellents
21. Which of the following is not ordinarily transmitted by an insect?
- malaria
  - tetanus
  - typhus fever
  - yellow fever
22. The variety of rat most common in the US in urban environments is?
- black rat
  - brown rat
  - roof rat
  - white rat
23. Which would be a plant derived organic pesticide?
- arsenic
  - chlorine
  - rotenone
  - boron

24. What is the inherent capacity of a pesticide to produce injury or death?
- a. antagonistic effect
  - b. synergistic effect
  - c. toxicity
  - d. hazard effect
25. Lasso is the trademark name for?
- a. aerolein
  - b. atrazine
  - c. alachlor
  - d. dulron
26. Under which conditions would a pesticide operator wear a respirator?
- a. exposed to small amounts of toxics for a short time
  - b. exposed to large amounts of toxics for a short time
  - c. exposed to small amounts of toxics for a long time
  - d. all of the above
27. The establishment number can be found on a pesticide container and it indicates?
- a. the inspector for EPA who approved it
  - b. the factory that produced it
  - c. location where the product was purchased
  - d. non of the above
28. Which disease is tickborne?
- a. murine typhus
  - b. scabies
  - c. Q fever
  - d. All of the above
29. Chagas disease is also known as?
- a. brucellosis
  - b. trypanosomiasis
  - c. undulant fever
  - d. dengue fever
30. What is the most important step in the use of pesticides?
- a. use the right pesticide for the job
  - b. wear proper PPE
  - c. use the pesticide downwind
  - d. read the label
31. All are anti-coagulant type rodenticides except?
- a. PMP
  - b. Surflan
  - c. Warfarin
  - d. Fumarin



32. What etiologic agent for malaria is most fatal to man?
- a. plasmodium ovale
  - b. plasmodium malariae
  - c. plasmodium vivax
  - d. plasmodium falciparum
33. In recent years, the largest number of US rabies cases were associated with
- a. skunks
  - b. bats
  - c. dogs
  - d. raccoons
34. The term endemic means?
- a. sporadic occurrence of an illness
  - b. constant presence of an illness
  - c. all illnesses present at any one time
  - d. an unusually large number of persons with the same illness
35. The interval between the exposure to an infectious agent and appearance of symptoms is?
- a. lag time
  - b. susceptible period
  - c. incubation period
  - d. primary period
36. A disease transmitted by bird droppings is?
- a. dengue fever
  - b. psittacosis
  - c. tularemia
  - d. Haverhill fever
37. An infected organism which does not exhibit symptoms during the spread of an illness is?
- a. reservoir
  - b. parasite
  - c. host
  - d. carrier
38. Rocky MT spotted fever is spread by?
- a. flies
  - b. spiders
  - c. cockroaches
  - d. ticks

39. Mycotoxins are chemicals produced by
- bacteria
  - vertebrates
  - viruses
  - fungi
40. The study of the occurrence, frequency, and distribution of disease is?
- entomology
  - biology
  - endocrinology
  - epidemiology
41. The world-wide occurrence of a given illness in excess of expectancy in humans is?
- panzootic
  - epidemic
  - pandemic
  - zoonotic
42. Which of the following is a night biter?
- culex
  - aedes
  - anopheles
  - cobra
43. Which of the following lays eggs on a raft in still water?
- blackfly
  - aedes
  - anopheles
  - culex
44. Mosquitoes transmit all of the following but?
- protozoa
  - bacteria
  - viruses
  - nematodes
45. Filariasis is caused by?
- virus
  - nematode
  - bacteria
  - protozoa
  - e.
46. Breakbone fever is spread by?
- sand fly
  - culex
  - German cockroach
  - aedes

47. Humans are considered dead-end hosts in transmission of?
- a. malaria
  - b. yellow fever
  - c. dengue
  - d. west Nile fever
48. Rift valley fever is caused by?
- a. bacteria
  - b. virus
  - c. nematode
  - d. protozoa
49. Which of the following spreads filariasis?
- a. flavavirus
  - b. w. bancrofti
  - c. phlebovirus
  - d. plasmodium ova
50. Which of the following regulates the use of pesticides?
- a. FDA
  - b. USDA
  - c. OSHA
  - d. USEPA
51. Which of the following is not a chlorinated hydrocarbon pesticide?
- a. lindane
  - b. aldrin
  - c. ddt
  - d. malathion
52. Which of the following is a pyrethroid?
- a. Diazinon
  - b. Carbaryl
  - c. Permethrin
  - d. DDT
53. Lyme disease is transmitted by?
- a. lone star tick
  - b. deer tick
  - c. dog tick
  - d. mite
54. Ticks transmit all of the following but?
- a. viruses
  - b. bacteria
  - c. protozoa
  - d. nematodes

55. Tick must stay attached for how many hours before lyme disease can be transmitted?
- a. immediately
  - b. 1-6 hours
  - c. 6-12 hours
  - d. 12 – 23 hours
  - e. >23 hours
56. Rabbit fever is caused by?
- a. bed bugs
  - b. chiggers
  - c. wood tick
  - d. deer tick
57. Bubonic plague is caused by?
- a. rickettsia typhi
  - b. yersinia pestis
  - c. scarcoptes scabiei
  - d. rickettsia tsutsugamushi
58. Acariasis is also known as?
- a. Chagas disease
  - b. Weils disease
  - c. Scabies
  - d. Undulant fever
59. African sleeping sickness is caused by?
- a. aedes
  - b. cone nosed kissing bug
  - c. tse tse fly
  - d. culex
60. Onchocerciasis is otherwise known as?
- a. Baylisascaris
  - b. Tsutsugamushi disease
  - c. Pediculosis
  - d. River blindness

## HW OSHA and HAZMAT

Tuesday, March 16, 2010  
10:29 AM

### OSHA and HAZMAT

1. The minimum temperature at which vapor concentration of a liquid is high enough to propagate a flame is?
  - a. fire point
  - b. flammability coefficient
  - c. flash point
  - d. flammability point
2. OSHA contains all of the following except?
  - a. definitions of procedures for promulgating rules
  - b. conducts compliance investigations
  - c. recommends industrial hygiene and safety equipment
  - d. reviews record keeping procedures
3. Which does not describe a TLV?
  - a. data comes from animal studies
  - b. data comes from human studies
  - c. concentration that most workers will have adverse effects
  - d. concentration that most workers will not have adverse effects
4. Max concentration that workers can be exposed to for up to 15 minutes without suffering irritation, chronic tissue damage, or narcosis is?
  - a. TLV-C
  - b. TLV-SC
  - c. TLV-STEL
  - d. TLV-TWA
5. Which statement is false?
  - a. Right to inspect includes the right to inspect employee medical records
  - b. an appeal system has been set up for OSHA actions
  - c. Criminal penalties can be invoked for certain violations
  - d. OSHA has established a priority inspection schedule
6. Which is an engineering control?
  - a. isolation
  - b. ventilation
  - c. PPE
  - d. training
7. Results of research done by NIOSH
  - a. becomes standard in two years
  - b. serves as recommendations for future standards
  - c. can be enforced immediately upon publishing by the CDC
  - d. are only applicable to private sector and those covered by a state plan
8. Who authorized TSCA of 1976?

- a. Sec of Commerce
  - b. EPA
  - c. FDA
  - d. Dept of Labor
9. Heat illness characterized by moist, clammy skin and normal oral temp is?
- a. heat exposure
  - b. heat exhaustion
  - c. heat stroke
  - d. heat cramps
10. What is the most common route of entry for parathion?
- a. ingestion
  - b. absorption
  - c. injection
  - d. inhalation
11. The Delaney Clause states
- a. the action level of pesticides shall be 50% the PEL
  - b. no carcinogens shall be added to food
  - c. pesticides must consider aggregate effects
  - d. residual pesticides are considered on a threshold basis
12. The Clean Air Act is enforced by?
- a. EPA
  - b. Dept of Labor
  - c. Dept of Interior
  - d. FDA
13. Smoking causes increased risk associated with each of the following except when exposed to asbestos?
- a. Lung cancer
  - b. Asbestosis
  - c. Baggiosis
  - d. Mesothelioma
14. Which is not a function of NIOSH?
- a. enforces regulations pertaining to occupational exposures
  - b. conducts research on health effects
  - c. develops criteria for dealing with toxics
  - d. conducts research and assistance programs for improving protection of workers
15. TLVs are published by?
- a. Dept of Labor
  - b. OSHA
  - c. ACGIH
  - d. NIOSH

16. Which occupational exposure typically reaches the bloodstream more slowly?
  - a. inhalation
  - b. ingestion
  - c. absorption through skin
  - d. absorption through eyes
17. Which contaminant will not damage the lung, but still causes harm?
  - a. NH<sub>3</sub>
  - b. SO<sub>2</sub>
  - c. CO
  - d. Phosgene
18. What describes the capacity to produce bodily harm?
  - a. toxicity
  - b. hazard
  - c. toxemia
  - d. irritant
19. A mechanical respirator would not be useful in filtering?
  - a. nuisance dust
  - b. asbestos
  - c. CO
  - d. all of the above
20. The particulates of significance in the occupational setting are?
  - a. all liquids or solid particles that may be inhaled
  - b. liquid particles that can be inhaled
  - c. solid particles that can be inhaled
  - d. particles larger than 100  $\mu$ m
21. The method for protection against occupational disease is?
  - a. personal control
  - b. environmental control
  - c. medical control
  - d. all of the above
22. The best safeguard against occupational dermatitis is?
  - a. process control
  - b. good housekeeping
  - c. personal cleanliness
  - d. local exhaust ventilation
23. One of the most common occupational disease is?
  - a. occupational dermatoses
  - b. silicosis
  - c. cancer
  - d. TB

24. What is the term for an estimate of an oral dose that produces a lethal effect on half of an animal population?
- LC50
  - LD50
  - EC50
  - ED50
25. Which respiratory device provides the best protection?
- positive pressure respirator with a full face piece
  - negative pressure respirator with a full face piece
  - full face canister respirator
  - half face respirator
26. No person should be allowed to work in a trench or pit in sandy clay soil with unsupported banks higher than?
- 2 ft
  - 3 ft
  - 4 ft
  - 5 ft
27. An employer removes workers who have reached the upper permissible level of exposure to a hazardous environment. What type of control is this?
- educational
  - PPE
  - administrative
  - engineering
28. A negative pressure fit test is done by?
- placing a palm over the intake filter and inhaling
  - placing a palm over the exhaust and inhaling
  - placing a palm over the exhaust and exhaling
  - is conducted by a machine and yields a FIT factor
29. A flashpoint above 200 F would be depicted as?
- 4 in the red section of the NFPA diamond
  - 1 in the white section of the NFPA diamond
  - 4 in the white section of the NFPA diamond
  - 1 in the red section of the NFPA diamond
30. The thermometer reads 90F, the wet bulb reads 80 and the black globe reads 90. What is the WBGT index?
- 87
  - 84
  - 86
  - 83
31. The following is true about the MSDS except?
- must be accessible by all



- b. must conform with OSHA form 174
  - c. provides information about spill response
  - d. provides health hazard information
32. An N95 respirator is?
- a. NIOSH respirator that removes 3um particles at 95% efficiency
  - b. oil resistant respirator that removes 3 um particles at 95% efficiency
  - c. removes 3um particles at 95% efficiency but is not resistant to oil
  - d. removes 3 um particles at 95% efficiency but is oil proof
33. A type C hard hat will protect you from
- a. 2200 volts
  - b. 200 volts
  - c. 20000 volts
  - d. monkey wrench falling on your head
34. You should use an APR only if
- a. in a fully encapsulated suit
  - b. if the contaminant is known and it protects against it
  - c. in emergency situations
  - d. in level B
35. A full face respirator with encapsulated suit with SCBA or SAR should be used
- a. during all HAZMAT responses
  - b. if the contaminant is known and it protects against it
  - c. in emergency situations
  - d. when contaminant is unknown or at IDLH
36. The last resort control is always
- a. PPE
  - b. administrative
  - c. education
  - d. engineering
37. Heat stroke is
- a. characterized by a body temp of greater than 102F
  - b. not an issue in the workplace
  - c. a mild form of heat stress
  - d. a medical emergency
38. Which of the following is false about benzene?
- a. It is a known carcinogen
  - b. Is used in rubber, solvents, and detergents
  - c. PEL is .75ppm with an action level of .5
  - d. Is not considered a VOC due to low vapor pressure
39. Which of the following does not work by inhibition of cholinesterase?
- a. parathion

- b. malathion
  - c. aldrin
  - d. diazanon
40. Minemata Bay, Japan was the site of
- a. Cadmium accumulation in fish causing Cd poisoning in 1200 people
  - b. Chromium accumulation in fish causing Cr poisoning in 1200 people
  - c. Methyl mercury accumulation in fish causing HG poisoning in 1200 people
  - d. Hg poisoning in grain causing poisoning in humans
41. The most hazardous form of asbestos is
- a. chrysotile
  - b. tremolite
  - c. crocidolite
  - d. asbestolite
42. Chrysotile is
- a. most hazardous asbestos
  - b. white
  - c. blue
  - d. needle like
43. OSHA regulations apply to all of the following except
- a. private sector employees
  - b. federal agencies
  - c. postal service
  - d. military personnel and local employees not under a state plan
44. Dermal exposure to cement and mortar mix can expose a worker to chromium, causing
- a. jaundice
  - b. loss of skin pigmentation
  - c. chrome holes
  - d. mesothelioma
45. All of the following are fumigants but
- a. methyl bromide
  - b. warfarin
  - c. ethylene oxide
  - d. hydrogen cyanide
46. What agency has the responsibility for safe transport of haaroudous materials?
- a. EPA
  - b. DOT
  - c. Dept of energy
  - d. CPSC
47. What regulation covers the dumping of materials into the ocean?

- a. The marine protection research and sanctuaries act
  - b. EPCRA
  - c. RCRA
  - d. Safe waterways act
48. For first responders, which is listed correctly in order of importance?
- a. responder safety, env safety, public safety, property safety
  - b. public safety, responder safety, property safety, env safety
  - c. responder safety, public safety, env safety, property safety
  - d. property safety, public safety, responder safety, env safety
49. The DOT response guidebook can be used to
- a. determine compliance with DOT regs
  - b. create worker safety documents
  - c. identify the specific or general classifications of HAZMAT
  - d. characterize hazardous materials for disposal
50. Green pages of the DOT response guide lists
- a. EPA hazardous material personnel
  - b. hazardous materials in alphabetical order
  - c. initial isolation distances and protective actions
  - d. hazardous materials in ID order
51. Level D provide the following
- a. highest level of protection
  - b. APR with splash resistant suit
  - c. SAR with fully encapsulated suit
  - d. no respiratory protection
52. EPCRA requires all of the following except
- a. establishment of a state emergency response commission SERC
  - b. disclosure of all chemicals used at a facility
  - c. Notification to the NRC if there is a release
  - d. Provide toxic release data to the TRI
53. The following are areas of emergency planning under EPCRA but
- a. Recovery
  - b. Damage assessment
  - c. Preparedness
  - d. Prevention
54. \_\_\_\_\_ is the lead agency for nationwide emergency management
- a. FEMA
  - b. NRT
  - c. RRT
  - d. NRC
55. There are \_\_\_\_\_ classes of hazardous materials for transport

- a. 7
  - b. 8
  - c. 9
  - d. 10
56. A vehicle transporting HAZMAT requires
- a. certification by the DOT
  - b. placarding on 2 sides
  - c. placarding on sides and ends
  - d. none of the above
57. Transportation of HAZMAT is covered by
- a. OSHA regulations
  - b. 49 CFR
  - c. 21 CFR
  - d. State regulations
58. Class 3 HAZMAT is
- a. oxidizer
  - b. explosive
  - c. radioactive
  - d. flammable
59. A facility that handles extremely hazardous materials in excess of threshold quantities must
- a. develop a local emergency planning committee LEPC
  - b. submit inventory to SERC and LEPC within 90 days
  - c. report inventory to SERC and LEPC within 60 days
  - d. provide information to fire department only if requested
60. ATSDR is owned by
- a. Dept of health and human services
  - b. Dept of transportation
  - c. Sec of interior
  - d. EPA

## **AIR QUALITY AND NOISE & STATUTES AND REGULATIONS**

1. Conduction, convection, and radiation are three ways in which
  - a. water loss from impounded water occurs
  - b. heat loss from the surface of a body of water occurs
  - c. atmospheric pollutants are measured
  - d. industrial x-rays are evaluated
2. An atmospheric condition where a layer of cool air is trapped by a layer of warm air so that the cool air cannot rise is called
  - a. an episode
  - b. masking
  - c. eutrophication
  - d. inversion
3. The control of sulfur dioxide gas by absorbing it in water in a plate tower or wet scrubber would result in the production of a liquid waste that is
  - a. acid
  - b. highly turbid
  - c. innocuous
  - d. basic
4. Which of the following gases is least toxic to humans
  - a. nitric oxide
  - b. sulfur dioxide
  - c. carbon dioxide
  - d. carbon monoxide
5. A correct statement concerning the relationship of PM size and development of occupational lung disease is that smaller particles
  - a. are more injurious as more of these particles are deposited in the lungs and seem to be less readily removed
  - b. are less injurious as more of these particles are deposited in the lungs, but are easily removed
  - c. more injurious as less of these particles are deposited in the lungs and seem to be less readily removed
  - d. less injurious as fewer particles are deposited in the lungs and seem to be more readily removed
6. The most serious consequence of exposure to inorganic lead is injury to
  - a. digestive tract
  - b. CNS
  - c. respiratory system
  - d. circulatory system
7. An organic chemical is characterized by

- a. carbon and nitrogen bonding
  - b. oxygen and hydrogen bonding
  - c. carbon and hydrogen bonding
  - d. hydrogen and nitrogen bonding
8. All of the following are particulates except
- a. smoke
  - b. gas
  - c. fumes
  - d. dust
9. Fumes are
- a. gas
  - b. metallic oxides
  - c. vapors from liquids
  - d. smoke
10. The presence of solid, liquid or gases in amounts injurious to man, plants, animals and property is caused by
- a. the tax man
  - b. environmental decay
  - c. terricide
  - d. air pollution
11. Most combustible materials are made of
- a. carbon
  - b. oxygen
  - c. hydrocarbons
  - d. carbon dioxide
12. A major air pollution episode that occurred in 1948 is
- a. Meuse Valley, Belgium
  - b. Donora, PA
  - c. Ponza Rica, Mexico
  - d. New York, NY
13. The major air pollutant by weight is
- a. PM
  - b. hydrocarbons
  - c. carbon monoxide
  - d. ozone
14. The Ringlemann units, in the process of being phased out, are measures of
- a. smoke emissions
  - b. sulfur fumes
  - c. ozone concentrations
  - d. auto emissions

15. The major mechanism for the removal of large particulates from the atmosphere is
  - a. filtration
  - b. sedimentation
  - c. rainfall
  - d. diffusion
16. The natural source of ozone and nitrogen dioxide is
  - a. ashes
  - b. lightening
  - c. volcanoes
  - d. gases from forest fires
17. The natural source of SO<sub>x</sub> is
  - a. ashes
  - b. lightening
  - c. volcanoes
  - d. gases from forest fires
18. The major significance of topography in air pollution is
  - a. its direct effect on concentration of pollutants
  - b. its application to land use
  - c. its effect on meteorology
  - d. its applicability to zoning
19. Fuel combustion at stationary sources is the largest source of
  - a. SO<sub>x</sub>
  - b. CO
  - c. hydrocarbons
  - d. nitrogen dioxide
20. Cascade impactors are instruments used to sample
  - a. sedimentation
  - b. nitrogen compounds
  - c. hydrocarbons
  - d. particulates
21. An effective cleansing process of most pollutants in the atmosphere is accomplished by
  - a. sedimentation
  - b. precipitation
  - c. filtration
  - d. diffusion
22. Which of the following is a series of filters used to control PM
  - a. Settling chamber
  - b. Wet collector
  - c. Baghouse
  - d. Electrostatic precipitator

22. The Venturi filter uses
- a. a series of filters or cloths in parallel
  - b. high pressure drop, high gas volume
  - c. low pressure drop and high flow rate
  - d. cyclonic movement of water
23. NAAQS include all of the following except
- a. Pb
  - b. CO<sub>2</sub>
  - c. PM
  - d. O<sub>3</sub>
24. The % of oxygen in the air of a properly ventilated room is about
- a. 5%
  - b. 10%
  - c. 15%
  - d. 20%
25. Electrostatic precipitators are effective in the removal of
- a. vapors
  - b. PM
  - c. gases
  - d. organic compounds
26. Automobiles are the leading source of
- a. CO
  - b. SO<sub>x</sub>
  - c. PM
  - d. fluorocarbons
27. When servicing a refrigeration unit, a technician must
- a. properly vent the refrigerant into a fume hood
  - b. convert the system to R134a if using R22
  - c. wear cold shielding gloves to prevent frostbite
  - d. obtain section 608 certification
28. In what part of the atmosphere are photochemical oxidants formed
- a. lithosphere
  - b. stratosphere
  - c. troposphere
  - d. hydrosphere
29. Scrubbers are wet collectors used to remove particulates that form as a
- a. dust, aerosol, or fog
  - b. mist, solid, or vapor
  - c. fog, mist or dust
  - d. fume, dust, or mist



30. The particle most likely to reach the inner lung is
- 10  $\mu\text{m}$
  - 7  $\mu\text{m}$
  - 2  $\mu\text{m}$
  - none of the above
31. The distance that a sound wave travels in one cycle or period is
- sound intensity
  - wavelength
  - sound pressure
  - frequency
32. The most common type of noise instrument used for initial inspection is
- octave band analyzer
  - noise dosimeter
  - sound level meter
  - sound analyzer
33. The \_\_\_\_ of a sound wave is the energy transferred per unit time through a unit area normal to the direction of propagation
- sound pressure
  - frequency
  - intensity
  - speed
34. The first federal standard for occupational exposure to noise were issued by
- DOT
  - FAA
  - DHUD
  - DOL
35. Which frequency weighing approximates the ears response characteristics during normal situations
- A
  - B
  - C
  - D
36. Malleus, incus, and stapes are located
- outer ear
  - inner ear
  - middle ear
  - ear lobe
37. As you double the distance from a noise source, noise is reduced by how many decibels
- 1

- b. 3
  - c. 6
  - d. 9
38. Sound absorption is measured in
- a. watts
  - b. hz
  - c. sabins
  - d. phons
39. The OSHA PEL for noise is
- a. 85 dB
  - b. 90 dB
  - c. 88 dB
  - d. 83 dB
40. Combining 3 – 100 dB sound sources will result in
- a. 100 dB
  - b. 103 dB
  - c. 105 dB
  - d. 107 dB
41. Combining 2 – 70 dB sound sources will result in
- a. 70 dB
  - b. 72 dB
  - c. 73 dB
  - d. 75 dB
42. The legal authority to conduct a routine inspection is
- a. stated in the constitution
  - b. inherent in a health agency
  - c. granted by judicial decree
  - d. delegated by the legislature
43. When a business refuses to consent to an inspection, the most appropriate action is
- a. close down the business until it is inspected
  - b. return later with a warrant
  - c. request the objector to state in writing why he didn't consent
  - d. proceed with the inspection
44. In individuals right to be treated with a least a minimum of decency and fairness by the government is guaranteed by
- a. state of rights
  - b. home rule
  - c. equal protection
  - d. due process

45. In planning an inspection, it is important to follow explicit procedure in the ordinance because
- a. it is the most efficient process
  - b. is required by due process
  - c. is required by the home rule
  - d. is it required by OSHA
46. At a trial, the technical person called as a witness should
- a. answer all questions truthfully and directly
  - b. refer to notes given by the prosecuting attorney
  - c. volunteer as much information as possible
  - d. refuse to answer questions that he feels are inappropriate
47. Hearsay is best defined as
- a. evidence excluded from the privilege against self incrimination
  - b. repetition in court of what someone else has said
  - c. a statement of the right to remain silent
  - d. a presumptive inference drawn from known facts
48. Which of the following is generally most useful as legal evidence
- a. chronological summary of events
  - b. original field notes
  - c. photocopy of office records and correspondence
  - d. published report
49. A correct statement about police power is that it
- a. is largely reserved for fed gov by the constitution
  - b. refers to the alleged abuse of persons arrested
  - c. cannot be used except by officially appointed police officials
  - d. in plenary and inherent attribute of sovereign governments
50. Which of the following would most strongly justify an emergency inspection
- a. sudden appearance of several cases of salmonellosis in the community
  - b. the presence of food contaminated with strychnine
  - c. a customer complaint about an establishment
  - d. the owners refusal to permit an inspection
51. According to the Freedom of Information Act, all of the following information must be made available to the public except
- a. application for federal licensing
  - b. medical records of personnel
  - c. decisions affecting agency policies
  - d. records of routine inspections
52. A warrant to conduct a routine inspection of a private dwelling should only be obtained
- a. after working hours
  - b. after consent has been denied

- c. where surprise is important
  - d. in an emergency
53. An inspectors choice of embargo, seizure, or condemnation should be based upon
- a. political power of the owner
  - b. the inspectors preference
  - c. statutory authority and immediacy of risk
  - d. cost of items and epidemiologic history
54. Following an inspection and prior to leaving the site, you should
- a. inform the local health department
  - b. check bacteria counts
  - c. notify your agency that the inspection is complete
  - d. meet with management to discuss the significance of findings
55. The legal term "caveat emptor" means
- a. do not enter
  - b. let the buyer beware
  - c. illegal entry prohibited
  - d. property condemned
56. The doing of an authorized act in an unauthorized manner is
- a. misdemeanor
  - b. malfeasance
  - c. misfeasance
  - d. nonfeasance
57. If a health inspector fails to close a restaurant know to have imminent health dangers this is
- a. misdemeanor
  - b. malfeasance
  - c. misfeasance
  - d. nonfeasance
58. What amendment covers unreasonable searches
- a. 1<sup>st</sup>
  - b. 4<sup>th</sup>
  - c. 5<sup>th</sup>
  - d. 10<sup>th</sup>
59. A warrant is required for
- a. pervasively regulated industries
  - b. when observations can be made in plain view
  - c. when entry is denied for routine inspections
  - d. when IDLH conditions exist
60. Which of the following is not a characteristic of a license or permit?
- a. operates through the administrative lifting of a legislative prohibition

- b. may be subject to certain specified conditions
- c. allows the regulator to control the licensees activities by consent
- d. is a voluntary device which every citizen can carry on his or her occupation

## HW Housing/Emerg & Disaster Response

Tuesday, March 16, 2010  
10:37 AM

### **Housing, Institutions & Licensed Establishment, and Emergency Disaster Response**

1. What is the ASHRAE recommended minimal thermal standard for dwellings at 40% humidity and air circulation of 45 fpm?
  - a. 57F
  - b. 60F
  - c. 68F
  - d. 76F
2. The distance from the end of a 2" diameter water supply pipe and the sink should be
  - a. .5"
  - b. 1"
  - c. 2"
  - d. 4"
3. Condensation, corrosion and mildew occur when the RH exceeds
  - a. 20%
  - b. 40%
  - c. 60%
  - d. 10%
4. Nosocomial infections are a problem in
  - a. daycare centers
  - b. hospitals
  - c. health spas
  - d. food establishments
5. Hospital laundry should be washed
  - a. 146- 150 F
  - b. 160 – 167 F
  - c. 180 – 200 F
  - d. in cold water only
6. A biohazard is
  - a. any material that negatively impacts a biological organism
  - b. any virus that causes a fatal disease
  - c. a material of biological composition that is a threat to humans
  - d. a chemical that is a treat to humans and the environment
7. Bloodborne pathogens are regulated by
  - a. DOL
  - b. CDC
  - c. FDA
  - d. HHS
8. Muerto Canyon virus is mainly carried by

- a. deer
  - b. sheep
  - c. mice
  - d. gophers
9. Universal precautions refer to
- a. respiratory protection in hospitals
  - b. infection control program regulating handling of blood and certain body fluids
  - c. personal/env protection procedures used when handling chemical waste
  - d. precautions to be used when collecting samples for potential litigation
10. The biosafety containment level suitable for work involving agents of moderate potential hazard to personnel and the environment
- a. 1
  - b. 2
  - c. 3
  - d. 4
11. The four biosafety containment levels consist of a combination of
- a. lab practices, safety equipment and facilities
  - b. lab techniques, research protocols, and safety equip
  - c. research protocols, safety training and lab practices
  - d. lab facilities, safety training, research protocols
12. The protection of personnel and immediate lab environment from exposure to infectious agents by good micro techniques and safety equip is called
- a. primary containment
  - b. secondary containment
  - c. tertiary containment
  - d. pentiary containment
13. According the Universal Precautions, which is considered infectious
- a. all blood from human sources
  - b. certain body fluids
  - c. body contact
  - d. a and b
14. Wearing contact lenses is an area that has the potential to expose workers to body fluids requires
- a. special cleaning and disinfection procedures if cleaned in work area
  - b. they may not be cleaned in the work area
  - c. no special process
  - d. none of the above
15. Contaminated needles must be
- a. recapped after use
  - b. cut to ensure they are not used again
  - c. washed in hot soapy water prior to reuse

- d. none of the above
- 16. Broken glassware found in contamination risk areas must be
  - a. disinfected with carbolic acid with 5 minute contact time prior to picking up
  - b. must be left until decon team arrives
  - c. must be picked up by mechanical means
  - d. none of the above
- 17. Hep B vaccinations for employees that work in contamination risk jobs and areas
  - a. must be offered at no cost
  - b. must be made available to employees at cost
  - c. are not important
  - d. none of the above
- 18. The most important factor in hospital laundry is
  - a. water temp of 160-167 F
  - b. type of contamination
  - c. chlorine dilution and drying temp 170F
  - d. using the correct cycle
- 19. An agent that may cause serious or potential lethal disease by inhalation requires
  - a. BSL 1
  - b. BSL 2
  - c. BSL 3
  - d. can be contained in both 2 and 3
- 20. BSL 4 containment requires the following
  - a. Class 1 cabinet
  - b. Class 2A cabinet
  - c. Class 2B cabinet
  - d. Class 3 cabinet
- 21. A class 3 cabinet can be
  - a. vented into ductwork following HEPA
  - b. vented outside following double HEPA
  - c. requires only incineration
  - d. requires double HEPA and incineration before venting
- 22. Females should have 1 toilet for every \_\_\_\_\_ female students
  - a. 30-40
  - b. 35-45
  - c. 40-50
  - d. 25-35
- 23. Exits in a day care center must be
  - a. smaller than 36" to prevent trapping
  - b. larger than 24"
  - c. 36" or larger



- d. none of the above
- 24. Children under 6
  - a. cannot sleep in a bunkbed
  - b. require a maximum window opening of 6"
  - c. need a minimum of 3' between cots or sleep mats
  - d. all of the above
- 25. Outdoor play area in a day care can
  - a. be adjoined to property
  - b. greater than 1/8 mile away
  - c. are not required
  - d. must have a 3' fence or hedge around it
- 26. Pb at a day care's play area
  - a. must be tested for monthly
  - b. Shall not exceed 400ppm
  - c. requires action at 1ug/dl in a child
  - d. both b and c
- 27. Each inmate in a correctional facility is entitled to
  - a. 35ft<sup>2</sup> living space
  - b. 35ft<sup>3</sup> outside air or recirculated filtered air
  - c. 35 dBA max noise at night
  - d. 35C temperature
- 28. The max noise in a correctional facility is
  - a. 35 dBA night, 70 dBA day
  - b. 45 dBA night, 60 dBA day
  - c. 45 dBA night, 70 dBA day
  - d. appropriate levels
- 29. Inmates are entitled to
  - a. wash laundry in a wash basin
  - b. 3 sets of clothing/week
  - c. 1 set of clothing/week
  - d. soap, toothbrush, toothpaste and straightedge razor
- 30. Tattoo equipment must be \_\_\_\_\_ before reuse
  - a. disinfected using bleach
  - b. disinfected using UV
  - c. cleaned with soap and water
  - d. autoclaved
- 31. Proper temperature for autoclaving equipment is
  - a. 205F for 35 minutes
  - b. 225F for 35 minutes
  - c. 250F for 35 minutes

- d. 275F for 15 minutes
- 32. Autoclaves must be tested
  - a. daily
  - b. weekly
  - c. monthly
  - d. annually
- 33. Testing of an autoclave involves
  - a. destruction of psychotrophs
  - b. destruction of bacillus anthracis spores
  - c. destruction of bacillus stearothermophilus spores
  - d. testing temperatures using a calibrated thermometer
- 34. Barber shops
  - a. require an autoclave
  - b. must place a reusable napkin around patrons neck under the cape
  - c. must renew their license every two years
  - d. must exclude patrons with communicable diseases that could be spread in shop
- 35. Which of the following cover the HAZWOPER standard?
  - a. 49CFR1910
  - b. 29CFR120.1910
  - c. 49CFR1910.120
  - d. 29CFR1910.120
- 36. HAZWOPER involves all of the following except
  - a. PPE
  - b. Thorough medical record review
  - c. Training
  - d. Drills and practice
- 37. What are the training requirements for HAZWOPER certification
  - a. 40 hour HAZWOPER course
  - b. 40 hour hazardous cargo course
  - c. 8 hour refresher course
  - d. both a and c
- 38. A petroleum spill occurs at the plant which is contained by plant personnel. What type of EAL is this?
  - a. level 1
  - b. level 2
  - c. level 3
  - d. level 4
- 39. A spill is expected to spread beyond the borders of the plant and could pose a hazard to the immediate population. What kind of EAL is this?
  - a. level 1

- b. level 2
  - c. level 3
  - d. level 4
40. What are the actions that can be taken in response to an emergency?
- a. local plant response
  - b. no response
  - c. HAZWOPER response
  - d. all of the above
41. Plan that spells out procedures for employees in the event of an emergency is?
- a. Spill response plan
  - b. Emergency action plan
  - c. Chemical hygiene plan
  - d. HAZWOPER plan
42. Which of the following is the most senior officer on the ground at a HAZMAT response?
- a. Emergency director
  - b. Incident commander
  - c. Response coordinator
  - d. FEMA director
43. Which organization has the responsibility of national disaster response?
- a. FEMA
  - b. Red Cross
  - c. Doctors without Borders
  - d. WHO
44. The HAZMAT Technician requires?
- a. 24 hours of training
  - b. knowledge of direct reading instruments
  - c. equipment to plug, patch or stop leaks
  - d. all of the above
45. The first responder requires?
- a. basic HAZCOM training
  - b. 2 hour MSDS training
  - c. 8 hour operations level training
  - d. 24 hour operations level training
46. The blue pages of the emergency response guidebook are
- a. Chemical by ID #
  - b. Chemical by alphabetical order
  - c. Emergency response
  - d. Isolation distances

47. The term that describes when a property is no longer suitable for the purpose it was intended for is?
- a. obsolescence
  - b. blighted
  - c. in rem
  - d. condemned
48. A common problem associated with substandard housing is
- a. decrease in intestinal diseases
  - b. blighting of neighborhoods
  - c. several thousands of dollars in owner repairs
  - d. less than 1.5 people per room
49. Which of the following is a minor deficiency according to the APHA?
- a. central heating inadequate
  - b. water supply is located outside
  - c. no windows to the outside
  - d. only one exit
50. A minimum of \_\_\_\_\_ ft<sup>2</sup> of sleeping area per person is required under the APHA method.
- a. 10
  - b. 20
  - c. 40
  - d. 60
51. The end of a waste pipe should terminate at least \_\_\_\_\_ " above the rim of a sink or receptacle directly connected to the drainage system.
- a. 2
  - b. 4
  - c. 5
  - d. 6
52. Vent gases combined with high moisture inside a chimney can form
- a. a glass like glaze
  - b. hydrochloric acid
  - c. sodium chloride
  - d. sulfuric acid
52. Flue or vent must extend \_\_\_\_\_ above the highest part of a peaked roof
- a. 1 ft
  - b. 2 ft
  - c. 3 ft
  - d. 6 inches
53. The action level of lead in children is
- a. 10 ug/dl
  - b. 10 ug/ml

- c. 100 g/dl
  - d. 10 g/ml
54. Which of the follow is the primary cause of poor IAQ?
- a. inadequate ventilation
  - b. contaminated outside air
  - c. radon
  - d. mold
55. Radon can be reduced using
- a. humidifier
  - b. electrostatic precipitator
  - c. ionizer
  - d. none of the above
56. Which of the following are not typically members of the infection control committee?
- a. hospital CEO
  - b. environmental control officer
  - c. infection control nurse
  - d. physician representative
57. Which of the following is the most frequent disease transmission route in a day care
- a. respiratory
  - b. fecal oral
  - c. intimate contact
  - d. all of the above
58. International agencies who respond to emergency situations include
- a. WHO
  - b. CDC
  - c. WSO
  - d. none of the above
59. Workers that work at uncontrolled hazardous waste sites require minimum of \_\_\_\_ hours of training
- a. 8
  - b. 24
  - c. 32
  - d. 40
60. Which of the following is not required in an emergency response plan at a hazardous waste site?
- a. PPE and emergency equipment
  - b. emergency medial treatment and first aid
  - c. EPA library telephone number
  - d. pre emergency planning

## HW Solid & Haz Waste

Tuesday, March 16, 2010  
10:33 AM

### SOLID AND HAZARDOUS WASTE

1. Hazardous waste is governed by the
  - a. Clean Water Act
  - b. Occupational Safety and Health Act
  - c. Resource Conservation and Recovery Act
  - d. Food and Drug Act
2. Hazardous waste includes
  - a. chemical
  - b. biological
  - c. flammable
  - d. all of the above
3. By definition, RCRA hazardous wastes are \_\_\_\_\_ waste
  - a. solid
  - b. natural
  - c. gray
  - d. none of the above
4. Hazardous waste may be in a \_\_\_\_\_ form
  - a. solid
  - b. liquid
  - c. gas
  - d. all of the above
5. Which of the following is not a characteristic of hazardous waste?
  - a. ignitability
  - b. corrosivity
  - c. reactivity
  - d. combustibility
6. Which of the following is not included in hazardous waste regulations?
  - a. domestic sewage
  - b. flammable liquids
  - c. corrosive liquids
  - d. none of the above
7. Toxicity is determined by a laboratory using
  - a. EPA method 012
  - b. toxicity characteristic leaching procedure
  - c. EPA method 016
  - d. landfill toxicity leaching procedure
8. Hazardous waste include
  - a. industrial discharges permitted under the FWPCA
  - b. agricultural wastes

- c. permitted irrigational waters
  - d. none of the above
9. The regulatory level for benzene under the RCRA toxicity characteristic rule is
- a. .5 mg/l
  - b. 100 mg/kg
  - c. .2 mg/l
  - d. 24 mg/l
10. The regulatory level for total cresol under the RCRA toxicity characteristic rule is
- a. 600 mg/l
  - b. 400 mg/l
  - c. 200 mg/l
  - d. 100 mg/l
11. Information and advice on what to do with a hazardous waste when spilled in a transportation accident is available 24 hours a day from
- a. RCRA hotline
  - b. CHEMTREC
  - c. EPA administrator
  - d. none of the above
12. In 1984, RCRA was amended to require \_\_\_\_\_, or the equivalent at hazardous waste landfills
- a. double liners
  - b. auxiliary incinerators
  - c. methane collection systems
  - d. all of the above
13. Land disposal by hazardous waste regulations includes
- a. incineration
  - b. waste pile
  - c. sewer disposal
  - d. fuel blending
14. Domestic wastewater which passes through a sewer system into a POTW is not considered to be a
- a. solid waste
  - b. hazardous waste
  - c. sewer waste
  - d. both a and b
15. Toxic priority pollutants include
- a. arsenic
  - b. cadmium
  - c. vinyl chloride
  - d. all of the above

16. Waste generated by the construction industry include
  - a. ignitable paint waste
  - b. spent solvents
  - c. acids and bases
  - d. all of the above
17. Hazardous wastes generated by vehicle maintenance shops include
  - a. heavy metal paint waste
  - b. ignitable waste
  - c. spent solvents
  - d. all of the above
18. The goal for hazardous waste management should be
  - a. zero discharge
  - b. <2% discharge
  - c. <5% discharge
  - d. none of the above
19. Which of the following is not an option for hazardous waste minimization
  - a. treatment
  - b. waste reduction at point of generation
  - c. process modification
  - d. increased production
20. High temperature incinerator systems are mostly suitable to destroy
  - a. waste water
  - b. organic compounds
  - c. inorganic compounds
  - d. domestic sewage
21. Examples of thermal destruction processes in addition to incineration are
  - a. cement kiln
  - b. chemical treatment
  - c. separation
  - d. none of the above
22. Which of the following is not a type of hazardous waste incinerator
  - a. rotary kiln
  - b. fixed hearth
  - c. fluidized
  - d. fuel blender
23. Heating of air, gas, or gas mixture up to 9032F for the thermal destruction of hazardous waste describes
  - a. plasma technology
  - b. rotary kiln incineration
  - c. fuel blending
  - d. all of the above



24. The disposal of equipment and other materials containing PCBs
- a. is nearly finished
  - b. is unregulated
  - c. will continue for years
  - d. is not necessary
25. The EPA requires that dioxin-bearing wastes be \_\_\_\_ destroyed or reduced before disposal in a secure hazardous waste landfill
- a. 99.99%
  - b. 95 %
  - c. 99.9999%
  - d. .05%
26. Sources of dioxin include
- a. wood preserved with PCBs
  - b. paper mill bleached pulp and sludge
  - c. bleach paper products
  - d. all of the above
27. Neutralization and detoxification are feasible with most of the organophosphate and carbamate insecticides, but not with
- a. chlorinated hydrocarbons
  - b. acids
  - c. bases
  - d. all of the above
28. The EPA requires that toxic waste incinerators achieve a destruction and removal rate of \_\_\_\_ before the material is landfilled
- a. 99.99%
  - b. 95%
  - c. 98%
  - d. 15%
29. It can be assumed that all hazardous waste landfill liners
- a. are designed for all hazardous material
  - b. will eventually leak
  - c. will not leak
  - d. both a and b
30. What is the largest source of municipal solid waste in the US
- a. vegetable waste
  - b. aluminum
  - c. paper
  - d. scrap metal
31. Four foundations of integrated solid waste management are
- a. landfills, recycling, burn pits, source reduction

- b. open dumps, composting, incinerators, source reduction
  - c. landfills, recycling, combustion, source reduction
  - d. landfills, composting, combustion, source magnification
32. Which of the following are methods of composting
- a. In situ
  - b. windrow
  - c. non aerated static pile
  - d. both a and b
33. Which of the following is false
- a. compost is a poor fertilizer
  - b. temperature must be maintained at 130F for 3 days to destroy pathogens
  - c. compost is must be aerated
  - d. composting can result in undesirable health effects
34. Mass fired combustors are
- a. compact units
  - b. used to incinerate pretreated waste
  - c. have a steady energy output
  - d. require minimal waste processing before incineration
35. Incineration requires
- a. time, temperature, turbulence
  - b. Min temperature of 1200F
  - c. destruction of inorganic material
  - d. both a and b
36. What type of landfill would be recommended on flat terrain
- a. Trench
  - b. Dump
  - c. Valley
  - d. all of the above
37. RCRA subtitle D covers
- a. hazardous waste
  - b. municipal solid waste
  - c. TSCA
  - d. none of the above
38. For best results when composting
- a. maintain pH of 8.5 - 10
  - b. maintain moisture content of 50-60%
  - c. maintain anaerobic conditions
  - d. all of the above
39. Landfills must be designed with
- a. double liner

- b. leachate collection systems
  - c. hydrogen sulfide monitoring system
  - d. both a and b
40. Leachate should be \_\_\_\_\_ to accelerate degradation of waste
- a. vented
  - b. recirculated
  - c. treated
  - d. collected
41. Landfilling of Subtitle C waste requires
- a. composite liner
  - b. single liner
  - c. double liner
  - d. geotextile liner
42. A geonet is
- a. impermeable layer of clay or dirt
  - b. permeable layer of clay or dirt
  - c. permeable synthetic material
  - d. impermeable synthetic material
43. Landfills must be
- a. minimum of 100 ft from any ground water
  - b. at least 5 ft from surface water
  - c. have a minimum of 24" of cover when capped
  - d. all of the above
44. Landfills require a minimum of \_\_\_\_\_ personnel on site during hours of operation
- a. 1
  - b. 2
  - c. 3
  - d. 4
45. A minimum of \_\_\_\_\_ cover must be placed over landfill daily
- a. 3"
  - b. 6"
  - c. 12"
  - d. 24"
46. A fly can migrate \_\_\_\_\_ in trash
- a. 5 ft in uncompacted trash
  - b. 6" in compacted trash
  - c. to lay eggs
  - d. all of the above
47. Residential trash should be collected at least
- a. twice a week in warm months

- b. once a week in warm months
  - c. twice a week in cold months
  - d. always twice a week (both a and c)
48. A trash can is an example of a
- a. HCS
  - b. STD
  - c. IED
  - d. SCS
49. Which of the following is incorrect
- a. subtitle c = hazardous waste
  - b. subtitle d = solid waste
  - c. subtitle i = underground pipelines
  - d. subtitle j = medical waste
50. An acutely hazardous substance that is unused and discarded is
- a. F list waste
  - b. K list waste
  - c. P list waste
  - d. U list waste
51. A chemist diluted 10ml of lab grade benzene in 50ml of in an experiment. What type of waste is this?
- a. F list
  - b. K list
  - c. P list
  - d. U list
52. Which of the following makes a substance a hazardous material
- a. flashpoint <140F
  - b. pH from 1.5-12
  - c. TCLP yields concentrations in excess of thresholds
  - d. both b and c
53. A hazardous waste small quantity generator produces
- a. less than 100 kg/month
  - b. 100 – 1000 kg/month
  - c. more than 1000 kg/month
  - d. accumulates more than 1 kg of acute toxins/month
54. Hazardous waste requires
- a. cradle to grave tracking
  - b. transportation manifest
  - c. vehicle placarding
  - d. all of the above
55. Dry batteries used in your home

- a. must be disposed of as universal waste
  - b. must be recycled
  - c. are excluded under RCRA
  - d. should be composted
56. Which of the following wastes is regulated at a residence under RCRA
- a. arsenically treated lumber
  - b. paint
  - c. aerosol cans
  - d. terne plated oil filters
57. Who administers CERCLA
- a. OSHA
  - b. OSWER
  - c. SARA
  - d. DOL
58. In situ vitrification
- a. creates a glass like substance to encapsulate contaminants
  - b. is effective in areas with buried pipes
  - c. is best suited for near surface contamination
  - d. both a and c
59. Hazardous waste treatment methods include
- a. biological methods
  - b. phytoremediation
  - c. deep well injection
  - d. all of the above
60. During daily compaction at a landfill, layers should be spread and compacted
- a. 6-12" thick
  - b. 12 - 24" thick
  - c. 24 - 36" thick
  - d. greater than 36" thick

## HW Potable Water

Tuesday, March 16, 2010  
10:34 AM

### POTABLE WATER

1. Which of the following is not a sedimentary formation?
  - a. limestone
  - b. peat
  - c. olivine
  - d. loess
2. Rocks such as serpentine, slate, soapstone, and marble belong to which class
  - a. igneous
  - b. sedimentary
  - c. metamorphic
  - d. limestone
3. Which soil has the greatest % porosity
  - a. silt
  - b. uniform sand
  - c. gravel
  - d. sandstone
4. Which is included in the sanitary survey of groundwater supplies
  - a. aquifer drainage area and local geology
  - b. nature of soil, rock, strata, and local geology
  - c. land use and habitation, sources of pollution, and local geology
  - d. all of the above
5. What chemical is used to dechlorinate water when testing for bacteriological agents
  - a. sodium sulfate
  - b. sodium thiosulfate
  - c. sodium bisulfate
  - d. sodium bisulfite
6. What is the purpose of using a forward sweeping motion when sampling surface water
  - a. allows equal mixing of the sample
  - b. prohibits contamination from hands
  - c. prohibits collection of trash in the water
  - d. creates a current that will collect visible contaminants for ID
7. Which bacterial group is indicative of fecal contamination
  - a. pseudomonas
  - b. coliform
  - c. salmonella
  - d. all of the above
8. Which soil condition is most favorable for removal of viruses
  - a. sand over gravel
  - b. fine loamy sand over coarse sand and gravel

- c. gravel over semi porous clay
  - d. coarse sand and gravel over fine sand or clay
9. What water constituent has been associate with staining clothes and plumbing dark brown or black
- a. Zn
  - b. Mn
  - c. Ag
  - d. Ca
10. Methylene Blue Active Substance (MBAS) is a test to identify
- a. hardness of water
  - b. iron in water
  - c. presence of detergents containing phosphates
  - d. presence of coliform bacteria
11. Which two elements cause the most hardness
- a. Zn and Mg
  - b. Na and Mg
  - c. Ca and Mg
  - d. Ca and Na
12. Which chlorine test is least desirable
- a. SNORT
  - b. Methyl orange
  - c. Amperometric procedure
  - d. DPD
13. Which would not be used as a coagulant
- a. black alum
  - b. chlorinated copperas
  - c. ferric chloride
  - d. sodium hypochlorite
14. Which of the following is not known as an iron bacteria
- a. crenothrix
  - b. gallionella
  - c. leptothrix
  - d. giardia lamblia
15. Which statement is most correct
- a. facultative bacteria live in aerobic conditions only
  - b. facultative bacteria live in anaerobic conditions only
  - c. facultative bacteria live in either aerobic or anaerobic conditions
  - d. facultative bacteria produce their own oxygen
16. Which increases the mobility of contaminants
- a. acidic soil conditions

- b. lack of organic material
- c. lack of Fe, Mg, Ca
- d. all of the above

17. The measure of the amount of water held by a rock or soil in pores or voids as % of total volume

- a. permeability
- b. specific retention
- c. porosity
- d. specific gravity

18. What is the primary organism identified in the fecal coliform test

- a. fecal streptococci
- b. enterobacter aerogenes
- c. salmonella typhosa
- d. Escherichia coli

19. Which is not a measure of turbidity

- a. nephelometric unit
- b. siple turbidity unit
- c. formazin turbidity unit
- d. Jackson turbidity unit

20. The final product in the oxidation of ammonia yields

- a. zinc
- b. lead
- c. nitrate
- d. nitrogen

21. Which contaminant is associated with methemoglobinemia

- a. zinc
- b. copper
- c. lead
- d. nitrate

22. Which statement concerning ozone is incorrect?

- a. ozone residuals can last several hours
- b. ozone is a faster disinfectant than chlorine
- c. ozone is more expensive than chlorine
- d. all statements are correct

23. Regulations governing drinking water additives is the responsibility of

- a. FDA
- b. EPA
- c. Dept of Labor
- d. PHS

24. Which conditions indicate organic stream pollution



- a. water has foul odor and is turbid
  - b. fish counts decrease or disappear
  - c. increase in worms and snails
  - d. all of the above
25. Lakes that are clean, high in DO, and receive few nutrients are
- a. oligotrophic
  - b. mesotrophic
  - c. euphoric
  - d. eutrophic
26. Which organisms are most resistant to unfavorable environmental conditions and indicate past or possibly intermittent pollution?
- a. Fecal streptococci
  - b. Escherichia coli
  - c. aerobacter aerogenes
  - d. Clostridium sporulates
27. Algae will cause all of the conditions except
- a. reduced water clarity
  - b. increased chlorine consumption
  - c. rapid fall in pH
  - d. slimy growth
28. The presence of typhoid fever caused by a public water supply could be traced to
- a. fecal contamination
  - b. excessive water aeration
  - c. pus from skin lesions
  - d. rotting animal and fish remains
29. Microbial pollution travels only a short distance through
- a. solution channels in limestone
  - b. fissured rock
  - c. dried out, cracked clay
  - d. sandy loam or clay
30. Infectious Hepatitis A is caused by
- a. bacteria
  - b. protozoa
  - c. rickettsia
  - d. virus
31. The pH of a solution in which the hydrogen ion concentration is equal to  $1 \times 10^{-8}$  moles per liter is
- a. 2
  - b. 4
  - c. 6
  - d. 8

32. A substance commonly used as a coagulant in water treatment is
- aluminum sulfate
  - calcium sulfate
  - potassium chloride
  - sodium phosphate
33. A sample of water for bacterial analysis is usually packed in ice if cannot be analyzed immediately to retard changes in
- amount of DO in the sample
  - mineral content
  - number of bacteria
  - pH
34. The disinfecting ability of chlorine is affected most by
- BOD
  - temperature
  - hydrogen ion concentration
  - DO
35. Alkalinity exists in 3 forms, which is not one of the forms
- bicarbonate
  - hydroxide
  - carbonate
  - hypochlorite
36. Which of the following compounds would not contribute to water hardness
- calcium sulfate
  - magnesium sulfate
  - calcium chloride
  - sodium chloride
37. Improperly located wells which allow fecal pollution of the water supply could result in
- botulism, leptospirosis, typhus fever, malaris
  - brucellosis, strep infections, cholera, yellow fever
  - salmonellosis, shigellosis, cholera, hepatitis
  - relapsing fever, histoplasmosis, psittacosis
38. Viral Hep B is most often associated with
- contaminated dairy products
  - uncooked shellfish
  - administration of blood products
  - fecal contamination of water
39. Historically in the US, the impetus for water treatment came from the need to control
- infectious Hep
  - TB

- c. typhus fever
  - d. typhoid fever
40. Communicable diseases such as typhoid fever, cholera, shigellosis, and infectious hepatitis are most commonly transmitted by
- a. vector borne
  - b. respiratory
  - c. direct contact
  - d. fecal oral
41. Aeration is advantageous in the treatment of water containing
- a. phosphorus and manganese
  - b. dissolved iron and manganese
  - c. magnesium and iron
  - d. phosphorus and iron
42. Masonary reservoirs of rural water supplies are called
- a. leaching pits
  - b. cisterns
  - c. sedimentation ponds
  - d. seepage pits
43. The liquid form of chlorine used for emergency disinfection of water is
- a. calcium hypochlorite
  - b. sodium hypochlorite
  - c. bromium hypochlorite
  - d. potassium hypochlorite
44. They type of subsurface formation in which groundwater contamination is likely to travel the farthest is
- a. clay
  - b. granite
  - c. fragmented limestone
  - d. gravel
45. The presence of coliform in water indicates
- a. the presence of pathogens
  - b. the presence of fecal viruses
  - c. the possible presence of pathogens
  - d. the presence of sewage
46. Activated carbon is used to
- a. increase turbidity
  - b. kill bacteria
  - c. control taste and odors
  - d. keep the chlorine in suspension
47. A cross connection is

- a. a connection between two approved water supplies
- b. a plumbing device
- c. connection which permits the flow of non potable water in to an approved source
- d. a connection in which hot and cold water lines are crossed allowing leaching of lead

48. According to the SDWA, the minimum number of water samples required for bacteriological analysis for a PWS depends upon

- a. chlorine residual
- b. population served
- c. area of raw water supply
- d. amount of water treated

49. The type of filter recommended for small communities is

- a. rapid sand
- b. pressure
- c. diatomaceous earth
- d. slow sand

50. One of the most common reasons for contamination of wells drilled through rock, clay or hardpan is

- a. seepage of pollutants through the soil
- b. failure to seal well casing properly
- c. porosity of the rock
- d. use of inferior quality well casings

51. Aeration is a natural process or mechanical process which

- a. increases the contact between air and water
- b. improves the physical and chemical characteristics of water
- c. both
- d. neither

52. The main function of a sand filter is to remove

- a. tastes and odors
- b. suspended solids
- c. dissolved materials
- d. bacteria

53. Ozone is effective against

- a. amoebic cysts
- b. bacteria and phenols
- c. viruses
- d. all

54. 30 ppm chlorine in drinking water is

- a. just right
- b. too low

- c. would not kill ecoli
  - d. excessive
55. A well must be placed \_\_\_\_\_ feet from a septic field or distribution box
- a. 50
  - b. 100
  - c. 200
  - d. 250
56. Marsh funnels are used to
- a. measure the drilling quality of mud
  - b. measure the viscosity of cement and well casing grout
  - c. measure the porosity of mud
  - d. to take water samples from swampy areas
57. Trihalomethanes are
- a. formed as a chlorination byproduct
  - b. group b carcinogens
  - c. cause liver and kidney damage
  - d. all of the above
58. When sampling for chemical from your home tap, always
- a. let your faucet run for 5 minutes
  - b. leave a 1" air gap
  - c. treat with sodium thiosulfate
  - d. all of the above
59. If lead or copper exceed the action level in \_\_\_\_\_ % or more of customers sampled, the water is in violation of the SDWA
- a. 2
  - b. 5
  - c. 10
  - d. 15
60. Which of the following is not chlorine resistant
- a. NLV
  - b. Cryptosporidium parvum
  - c. Entamoeba histolytica
  - d. Salmonella typhimurium

### Swimming Pools and Recreation Areas

1. Which of the following would not be as likely to be contracted bathing at a beach
  - a. leptospirosis
  - b. middle ear infection
  - c. spinal meningitis
  - d. all of the above
2. What public health factor is of primary importance in determining the sanitary quality of recreational waters?
  - a. heavy metals
  - b. coliform
  - c. human waste
  - d. solid waste
3. The causative agent *Naegleria fowleri* has been linked to which of the following
  - a. bacterial meningitis
  - b. Primary amoebic meningoencephalitis
  - c. cholera
  - d. diphtheria
4. Which organism would probably survive in a hot tub
  - a. e coli
  - b. vibrio cholera
  - c. entamoeba histolytica
  - d. pseudomonas aeruginosa
5. A secchi disk is used to determine
  - a. pH
  - b. clarity
  - c. coliform contamination
  - d. heavy metals
6. A chemical used to adjust pool alkalinity is
  - a. chlorine
  - b. calcium chloride
  - c. sodium bicarbonate
  - d. copper sulfate
7. Which pH would cause the least eye irritation
  - a. 6.8
  - b. 7.5
  - c. 8.2
  - d. 7
8. What is the primary reason the pH of a pool should stay less than 8
  - a. skin irritation

- b. decrease the amount of active chlorine
  - c. promotes the growth of coliform
  - d. attacks concrete walls
9. The factor used to determine the bromine residual using the chlorine test (DPD) is
    - a. multiply chlorine residual by 2.3
    - b. multiply chlorine residual by 4
    - c. divide chlorine residual by 2.3
    - d. divide chlorine residual by 4
  10. The chemical quality of a pool is generally measured by which 2 tests
    - a. pH and alkalinity
    - b. alkalinity and TDS
    - c. pH and chlorine residual
    - d. alkalinity and chlorine residual
  11. Which raises the pH of pool water
    - a. chlorine
    - b. alum
    - c. sodium carbonate
    - d. all of the above
  12. What compound is the principal scale former
    - a. calcium carbonate
    - b. potassium carbonate
    - c. magnesium sulfate
    - d. sodium carbonate
  13. The preferred treatment for algae control is
    - a. copper sulfate
    - b. superchlorination
    - c. quaternary ammonium
    - d. drain and scrub pool
  14. The best method to eliminate swimmers itch is
    - a. apply antibiotics to the water
    - b. break the life chain of the schistosome
    - c. raise the pH to destroy the snails
    - d. destroy all aquatic vegetation so the cercariae cant mature
  15. Which of the following is a method by which recreation waters may be contaminated
    - a. infected people
    - b. surface runoff
    - c. normal water flora
    - d. all
  16. Swimming pool water that is brownish black in color may be due to
    - a. H<sub>2</sub>S

- b. Mg
- c. Mn
- d. Fe

17. The best method to reduce diving accidents is to
- a. shorten the distance between the board and water
  - b. slope the bottom of the pool
  - c. use a safety factor ratio for depth of water to height of board
  - d. develop diving training and education programs

18. Muriatic acid is a weak solution of
- a. nitric acid
  - b. sulfuric acid
  - c. acetic acid
  - d. hydrochloric acid

19. In which situation would you most likely find PAM
- a. river or pond
  - b. geothermal pool
  - c. reservoir
  - d. Atlantic ocean

20. Some studies indicate that swimmers have a higher over all illness rate than non swimmers
- a. regardless of bathing water quality
  - b. due to poor regulatory practice
  - c. if they are over 50 years old
  - d. if they swim only in pools

21. The treatment system of a pool is typically recommended to be installed in which of the following flow arrangements
- a. skimmer or gutter line, main drain line, adjustment valves, disinfectant feeder, hair strainer, pump, filter, pH feeder pump, adjustable inlets
  - b. skimmer or gutter line, main drain line, adjustment valves, hair strainers, pump, filter, pH feeder pump, adjustable inlets
  - c. skimmer or gutter line, main drain line, adjustment valves, pH feeder pump, hair strainer, pump, filter, disinfectant feeder, adjustable inlets
  - d. skimmer or gutter line, main drain line, adjustment valves, hair strainer, filter aid pump, filters, disinfectant feeder, pH feeder, adjustment valves

22. Swimming pool water turbidity should not exceed \_\_\_\_\_ NTUs
- a. .5
  - b. 5
  - c. .15
  - d. 15

23. A public pool filtration system should filter the entire volume of water every
- a. 2-3 hours



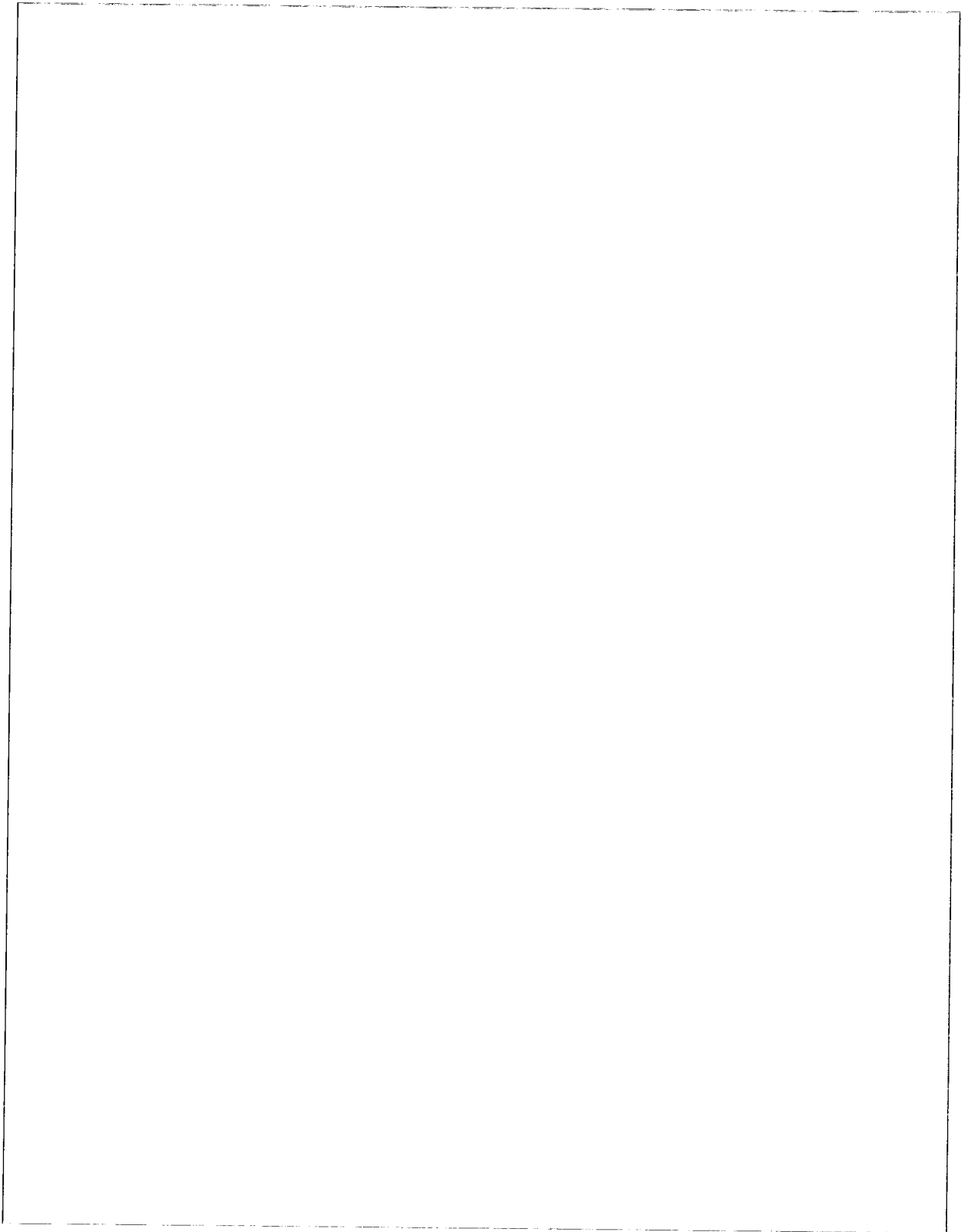
- b. 6-8 hours
  - c. 10-12 hours
  - d. 30 minutes
24. The gutters or skimmers should receive a minimum of what percent of total pool water due to the large quantity of organisms and material that float
- a. 95
  - b. 40
  - c. 60
  - d. 30
25. The acidity-alkalinity balance affects eye irritation, water coagulation, and the
- a. effectiveness of chlorine
  - b. ambient water temperature
  - c. effectiveness of the skimmers
  - d. evaporation rate
26. To mix acid and water, always add
- a. water to acid
  - b. acid to water
  - c. soda ash to acid
  - d. stir while pouring water into acid
27. When bleach is added to water
- a. one disinfecting compound is formed
  - b. two disinfecting compounds are formed
  - c. HCl is considered the primary product
  - d. Ozone is produced
28. Water in wading pools should be recirculated a minimum of every
- a. 60 minutes
  - b. 90 minutes
  - c. 120 minutes
  - d. 180 minutes
29. The preferred method for controlling sewage from watercrafts is
- a. on board holding tanks
  - b. overboard discharges
  - c. incinerator toilets
  - d. composting toilets
30. The molecular state of hypochlorous acid is the desired product from chlorination of pool water. This product
- a. increases as pH rises
  - b. decreases with as pH decreases
  - c. ionizes as pH decreases
  - d. is at 62% at pH of 7.2

31. The main drain should have a grate that is \_\_\_\_\_ the area of the discharge pipe to prevent dangerous suction effects
- four times
  - five times
  - six times
  - two times
32. \_\_\_\_\_ is associated with swimmers ear and appears in hot tubs frequently
- Mycobacterium marinum*
  - Chlamydia trachomatis*
  - Leptospira* spp
  - Pseudomonas aeruginosa*
33. \_\_\_\_\_ species are one of the most common pathogens in recreational water and can cause Scarlet fever
- Staphylococcal
  - Streptococcal
  - Shigella*
  - Pseudomonas*
34. Fish ich is a disease that
- otherwise known as fish tank granuloma
  - common to aquarium operators
  - both a and b
  - none of the above
35. *Mycobacterium marinum* is associated with
- fish ich
  - fish tank granuloma
  - swimmers itch
  - typhoid fever
36. Legionnaires disease is spread via
- P2P
  - consuming contaminated water
  - through open sores or wounds
  - inhaled droplets
37. Trachoma
- can be spread via fomites
  - is caused by *Chlamydia trachomatis*
  - can result in blindness
  - all of the above
38. \_\_\_\_\_ is the most common cause of gastroenteritis in children
- HRV
  - Salmonella*
  - Infectious HepA

- d. amoebiasis
39. \_\_\_\_\_ is the most common enteric disease in the US
- a. Salmonella
  - b. Viral gastroenteritis
  - c. amoebiasis
  - d. giardiasis
40. Schistosome dermatitis outbreaks in recreational waters can be controlled through
- a. use of ozone
  - b. use of copper oxide
  - c. use of copper sulfate
  - d. use of snails
41. Tinea is caused by
- a. bacteria
  - b. protozoa
  - c. helminth
  - d. fungus
42. Ozone disinfection is
- a. slower than chlorine
  - b. often used in conjunction with chlorine
  - c. effective at providing a residual
  - d. capable of producing THMs
43. Cyanuric acid is used to
- a. disinfect water
  - b. stabilize chlorine in water
  - c. stabilize bromine in water
  - d. stabilize ozone in water
44. Bromine residuals are \_\_\_\_\_ than chlorine residuals
- a. lower
  - b. higher
  - c. equal
  - d. more stable
45. Pools should be chlorinated to
- a. 1-3 ppm
  - b. 3-5 ppm
  - c. 4-6 ppm
  - d. none of the above
46. The DPD test for a hot tub returned at chlorine residual of 3.1 ppm, the operator should
- a. add calcium hypochlorite
  - b. add sodium bisulfate

- c. add sodium carbonate
  - d. no action required
47. 5 samples were taken from a public beach for coliform analysis resulting in 250/100ml, 150/100ml, 50/100ml, 75/100 ml, and 425/100ml. It is recommended that
- a. beach stay open
  - b. beach be closed due to exceeding mean average coliform standard
  - c. beach be closed due to exceeding the 10% coliform rule
  - d. examine epi, social, economical and psychological factors before acting
48. A pool should be immediately evacuated for
- a. blood spill
  - b. vomit due to ingested water
  - c. formed stool
  - d. chlorine residual of .9
49. Shocking a pool is done through
- a. superchlorination
  - b. bromination
  - c. electrical current
  - d. a and b
50. Chlorination of 1 ppm prevents which of the following
- a. pseudomonas aeruginosa
  - b. entamoeba histolytica
  - c. giardia lamblia
  - d. none of the above
51. Your pool DPD kit tells you that you have .7 mg/l combine chlorine and 1 mg/l of FAC. What action should be taken?
- a. nothing, FAC is in acceptable range of 1-3 ppm
  - b. bring the water to 3 ppm Cl and follow product label
  - c. bring the water to .3 ppm Cl and follow product label
  - d. evacuate the pool
52. You notice excessive scaling on your pool. You predict
- a. high langlier index
  - b. low langlier index
  - c. langlier index of 0
  - d. none of the above
53. Your pool has an  $H^+$  concentration of  $10^{-6}$ . You should
- a. add sodium bisulfate
  - b. add sodium carbonate
  - c. add calcium hypochlorite
  - d. do nothing
54. A hot tub should be turned over every

- a. 6-8 hours
  - b. 12 hours
  - c. 1-2 hours
  - d. 30 minutes
55. A hot tub should not exceed
- a. 100 F
  - b. 101 F
  - c. 102 F
  - d. 103 F
56. A pool measures 40 ft X 20 X 5 feet. How many gallons of water are in the pool?
- a. 30000 gallons
  - b. 4000 gallons
  - c. 40000 gallons
  - d. 3000 gallons
57. A wading pool 20 X 20 X 1.3 ft pool wants to set their pump to operate at 1 turnover/2 hours. What rate in gallons per minute should it be set at
- a. 5 gallons per minute
  - b. 1950 gallons per minute
  - c. 33 gallons per minute
  - d. 65 gallons per minute
58. A pool fence should be
- a. at least 4 feet high
  - b. have a self closing gate
  - c. latch at least 40" off the ground
  - d. all of the above
59. Chloramines are
- a. excellent sanitizers
  - b. result from urine in chlorinate pool
  - c. a form of combined bromine
  - d. both a and b
60. pH should not exceed 8 in a pool because
- a. decreases desired disinfection product
  - b. causes eye irritation
  - c. can corrode pool equipment
  - d. all of the above



## HW Wastewater/Radiation

Tuesday, March 16, 2010  
10:35 AM

### Wastewater and Radiation

1. Biochemical oxygen demand measures
  - a. rate of oxygen uptake by micro-organisms in a sample of water at a temperature
  - b. rate at which  $O_2$  oxidizes organic and inorganic materials over 5 days
  - c. the same parameters as chemical oxygen demand
  - d. none of the above
2. The best single measure for waste water is
  - a. COD
  - b. BOD
  - c. PPE
  - d. ATP
3. Black water contains
  - a. waste water from sinks and showers
  - b. waste water from hot tubs
  - c. waste water from toilets
  - d. all of the above
4. \_\_\_\_\_ specifies the treatment outcome required for wastewater.
  - a. OSHA
  - b. POTW
  - c. NPDES
  - d. SDWA
5. Suspended solids in wastewater are measured using
  - a. Gooch crucible
  - b. Turbidimeter
  - c. Marsh cone
  - d. titrations
6. The primary function of a septic tank is
  - a. pretreatment of waste
  - b. removal of SS
  - c. storage of FOG
  - d. all of the above
7. A septic tank has three distinct levels, which level is desirable to exit the septic tank
  - a. Scum
  - b. FOG
  - c. Clear zone
  - d. Sludge
8. Septic tanks should be large enough to

- a. hold 1000 gallons of sewage
  - b. hold 3 bedrooms of sewage
  - c. hold 1-2 days of sewage
  - d. hold 2-4 days of sewage
9. The inlet baffle insures
- a. turbulence does not upset microorganisms or solids
  - b. that liquid from the clear zone enter drain field
  - c. FOG does not leave the tank
  - d. all of the above
10. The inlet of a septic tank should be
- a. 3" higher than the outlet
  - b. 4" higher than the outlet
  - c. 3" higher than the sludge
  - d. 4" higher than the clear zone
11. A cleanout must be placed
- a. every 5 feet
  - b. whenever the pipe turns sharper than 45 degrees
  - c. every 50 feet
  - d. both b and c
12. A septic tank is buried 12" underground, what must be done to bring it into compliance
- a. install a riser to bring the manhole within 6" of surface
  - b. lift the tank to bring manhole within 8" of surface
  - c. nothing, it meets EPA guidelines
  - d. locate it above ground, USTs are not allowed to be buried
13. What is the minimum diameter of the inlet and outlet of a septic tank
- a. 2"
  - b. 3"
  - c. 4"
  - d. 6"
14. A stick is lowered into a septic tank until resistance is felt and is marked on the stick. It is then pushed until no resistance is felt and raised back up until resistance is felt again and marked on the stick. What does this represent?
- a. measuring the clear zone
  - b. measuring the sludge
  - c. measuring the FOG
  - d. measuring the liquid
15. A tank should be pumped
- a. only if you smell odors
  - b. only after it backs up
  - c. if scum is greater than 10"



- d. if sludge + scum > ½ clear zone
- 16. A p trap is used to
  - a. decrease turbulence into the septic system
  - b. prevent sewage gas from entering home
  - c. prevent SS from entering the septic system
  - d. vent sewage gas from home
- 17. A newly constructed home smells of sewage, what is the first action you should take
  - a. have your septic tank pumped
  - b. call the contractor to fix your system
  - c. check the slope of your drain field
  - d. pour water into the floor drain of your home
- 18. Your gravel drain field has to be 100 feet long due to the flow of your system. You note that after installing it, it will come within 75 feet of your neighbors well. What should you do?
  - a. relocate your system
  - b. nothing, the isolation from the well is acceptable
  - c. consider using a gravel less system
  - d. sue your neighbor for locating his well too close to your property
- 19. A septic tank must be
  - a. 10 feet from the property line
  - b. 50 feet from a well
  - c. 50 feet from a spring
  - d. all of the above
- 20. The purpose of a drain field is to
  - a. evenly distribute effluent from the tank into the soil
  - b. promote microbial action within the pipes
  - c. allow for overflow conditions of the septic tank
  - d. a place to pump out your septic tank
- 21. Effluent is considered purified when
  - a. it exits the septic tank
  - b. when it exits the drain field
  - c. when it reaches the water table
  - d. when nitrogen, SS, organic/inorganic matls, and bact/viruses are reduced
- 22. Yellow soil indicates
  - a. area of saturation
  - b. fluctuating water table
  - c. presence of air in soil
  - d. presence of sewage
- 23. Grey soil indicates
  - a. area of saturation

- b. fluctuating water table
  - c. presence of air in soil
  - d. presence of sewage
24. Mottled brown or red soil indicates
- a. area of saturation
  - b. fluctuating water table
  - c. presence of air in soil
  - d. presence of sewage
25. The munsell chart measures
- a. saturation of soil
  - b. color of soil
  - c. percolation of soil
  - d. permeability of soil
26. Soil permeability can be measured using
- a. Gooch crucible
  - b. BOD5
  - c. March funnel
  - d. Percolation test
27. The percolation test is complete when
- a. time of water dropping 1" is equal in 3 measurements
  - b. time of water dropping 1" is within 10% in 3 measurements
  - c. after completing 3 measurements and averaging results
  - d. after saturating for 4 hours and timing the water from 6" to 5" one time
28. The limiting layer can is
- a. can effect performance of the septic system
  - b. is the seasonal high water table
  - c. can be defined as an area of very low permeability
  - d. all of the above
29. Vegetation is important is locating your drain field because
- a. tree roots and cause system failure
  - b. plants on the surface will be come contaminated
  - c. it will be a great place to locate a garden
  - d. transpiration through plants is the primary means of purification
30. The area of seepage is determined by
- a. limiting layer
  - b. soil quality and number of bedrooms
  - c. strength of the waste
  - d. all of the above
31. An aerobic treatment plant is
- a. slower than septic tank

- b. faster than septic tank
  - c. not commonly used at a residence
  - d. both b and c
- 32. Hot tubs and roof gutter should
  - a. drain into the homes black water
  - b. drain into the homes grey water
  - c. drain above the drain field
  - d. should not be drained into the septic system
- 33. Large amounts of cleaning chemicals should not be poured in the sink because
  - a. they are regulated by the EPA and should be disposed of as a hazardous waste
  - b. they will cause suspended solids to clog the effluent filter
  - c. they could kill microorganisms in your septic tank
  - d. they will corrode your metal septic tank
- 34. A dug well is more susceptible to contamination from septic systems because
  - a. septic tanks naturally release sewage that contaminates the water table
  - b. effluent can contaminate high water tables before being properly treated
  - c. isolation distances do not apply to dug wells
  - d. septic tanks are only required to be 10 feet away from a dug well
- 35. The primary indicator organism for fecal contamination of a water supply is
  - a. Salmonella Typhi
  - b. Salmonella Typhimurium
  - c. Escherichia Coli
  - d. Vibrio Cholera
- 36. Typhoid fever is caused by
  - a. virus
  - b. bacteria
  - c. helminth
  - d. protozoa
- 37. Salmonellosis is caused by
  - a. Salmonella Typhi
  - b. Salmonella Typhimurium
  - c. Escherichia Coli
  - d. Vibrio Cholera
- 38. Yersinosis is caused by
  - a. Yersinia Pestis
  - b. Yersinia Enterocolitica
  - c. Yersina Major
  - d. none of the above
- 39. Leptospirosis is a disease that is an occupation hazard to

- a. sewer workers
  - b. slaughter house workers
  - c. veterinarians
  - d. all of the above
40. HRV is the most common cause of enteritis in the world and is caused by
- a. bacteria
  - b. virus
  - c. helminth
  - d. protozoa
41. Which of the following was first recognized in military recruit and can cause ARD
- a. HAdV
  - b. HRV
  - c. NLV
  - d. leptospirosis
42. Poliomyelitis
- a. is eradicated from the world
  - b. can cause AFP
  - c. is caused by the polio bacteria
  - d. both b and c
43. *Balantidium coli*
- a. is a primary indicator of fecal coliform
  - b. can cause EHEC
  - c. can remain for years in the soil as a cyst
  - d. causes Balantidium fever
44. Cystercercosis would mostly likely be caused by
- a. ingestion of taenia solium eggs
  - b. ingestion of balantidium cysts
  - c. ingestion of cyclospora cysts
  - d. ingestion of taenia. saginata eggs
45. The human whipworm or *Trichuris trichiura*
- a. has been used to treat Crohns disease
  - b. causes Trichuriasis
  - c. is normally detectible in stool exams
  - d. all of the above
46. Which of the following is a source of ionizing radiation
- a. microwaves
  - b. UV rays
  - c. cosmic rays
  - d. alpha rays
47. Ionizing radiation

- a. is low energy and is ionized
  - b. is high energy and removes electrons from material
  - c. is composed of ions
  - d. moves at the speed of light
48. Radon is a source of
- a. alpha radiation
  - b. beta radiation
  - c. gamma radiation
  - d. x ray
49. Cobalt 60 is an example of a \_\_\_\_\_ emitter
- a. alpha radiation
  - b. beta radiation
  - c. gamma radiation
  - d. x ray
50. A piece of paper can stop
- a. alpha radiation
  - b. beta radiation
  - c. gamma radiation
  - d. x ray
51. Primary protection from radiation hazards includes
- a. time, distance, shielding
  - b. dilution of source
  - c. decay
  - d. PPE
52. Somatic effects do not effect the
- a. reproductive cells
  - b. dna
  - c. skin
  - d. organs
53. Radon is considered \_\_\_\_\_ human carcinogen
- a. Class A
  - b. Class B
  - c. Class C
  - d. Class E
54. Permethrin is considered a \_\_\_\_\_ human carcinogen
- a. Class A
  - b. Class B
  - c. Class C
  - d. Class E
55. Tobacco smoke, which contains Po 210 is considered

- a. Class A
- b. Class B
- c. Class C
- d. Class E

56. The follow organization governs naturally occurring radiation

- a. EPA
- b. NRC
- c. DOE
- d. naturally occurring radiation is not a concern

57. The sievert (formerly the REM) measures

- a. absorbed dose
- b. equivalent dose
- c. decay rate
- d. none of the above

58. The EPA Radon standard of exposure is

- a. 4 pCi/l
- b. 40 pCi/l
- c. .4 pCi/l
- d. none of the above

59. The OSHA Radon standard of exposure is

- a. 10 pCi/L
- b. .1 pCi/L
- c. 100 pCi/L
- d. none of the above

60. Radon can be remove from a house by

- a. filtration systems
- b. venting above highest peak in house
- c. ionizer
- d. both b and c

## KEY Vector and Pests

Tuesday, March 16, 2010  
12:33 PM

### Vectors, Pests, and Poisonous Plants

1. The most widespread cockroach pest in restaurants is:
  - a. American Cockroach
  - b. Australian
  - c. **German**
  - d. Oriental
2. Roaches may be capable of spreading
  - a. Malaria
  - b. Rocky Mt. Spotted Fever
  - c. Rabies
  - d. **Salmonellosis**
3. The most important aspect in controlling roaches is:
  - a. Use of a strong pesticide
  - b. **Maintaining good general sanitation**
  - c. Collection of garbage on a regular basis
  - d. Hiring a competent exterminator
4. Flies generally spread disease by:
  - a. cyclo-development transmission
  - b. propagative transmission
  - c. fecal contamination
  - d. **mechanical transmission**
5. Mosquitoes have been known to spread
  - a. Typhus fever
  - b. **encephalitis**
  - c. shigellosis
  - d. salmonella
6. The mosquito genus responsible for the transmission of malaria is:
  - a. culex
  - b. aedes
  - c. plasmodium
  - d. **anopheles**
7. Which of the following is not ordinarily considered to be transmitted by an insect:
  - a. malaria
  - b. **tetanus**
  - c. typhus fever
  - d. yellow fever

8. The insect infestation on humans known as pediculosis is caused by
- a. fleas
  - b. mites
  - c. ticks
  - d. lice**
9. The most prevalent arthropod-borne disease transmitted to humans in the US today is:
- a. rabies
  - b. plague
  - c. malaria
  - d. lyme disease**
10. Scabies is an infectious disease of the skin caused by:
- a. bedbugs
  - b. mites**
  - c. chiggers
  - d. lice
11. Which is not considered a single dose rodenticide?
- a. ANTU
  - b. Strychnine
  - c. Red squill
  - d. Warfarin**
12. Which is an anti-coagulant type poison for rodents?
- a. ANTU
  - b. Strychnine
  - c. Red squill
  - d. Warfarin**
13. When is the best time to bat-proof a barn?
- a. late spring
  - b. early summer
  - c. late fall**
  - d. doesn't matter
14. Which of the following is caused by a virus?
- a. encephalitis**
  - b. malaria
  - c. Q fever
  - d. Tetanus
15. Which of the following is caused by a parasite?
- a. encephalitis
  - b. malaria**
  - c. Q fever
  - d. Tetanus



16. Which of the following is caused by bacteria?
- a. Yellow fever
  - b. Filariasis
  - c. **Tularemia**
  - d. Dengue
17. Which of the following diseases are rats NOT an intermediate host in?
- a. **amoebic dysentery**
  - b. endemic typhus
  - c. plague
  - d. weils disease
18. In rodent control, the primary method of producing permanent results is?
- a. fumigating
  - b. poisoning
  - c. **proofing**
  - d. trapping
19. Which of the following is ordinarily not used as a fumigant?
- a. ethylene oxide
  - b. hydrogen cyanide
  - c. methyl bromide
  - d. **phosphorus pentoxide**
20. The most effective measures for mosquito control are dependent upon the
- a. **elimination of breeding places**
  - b. trapping of adult insects
  - c. use of new types of insecticides to destroy adult insects
  - d. use of new repellents
21. Which of the following is not ordinarily transmitted by an insect?
- a. malaria
  - b. **tetanus**
  - c. typhus fever
  - d. yellow fever
22. The variety of rat most common in the US in urban environments is?
- a. black rat
  - b. **brown rat**
  - c. roof rat
  - d. white rat
23. Which would be a plant derived organic pesticide?
- a. arsenic
  - b. chlorine
  - c. **rotenone**
  - d. boron

24. What is the inherent capacity of a pesticide to produce injury or death?
- a. antagonistic effect
  - b. synergistic effect
  - c. **toxicity**
  - d. hazard effect
25. Lasso is the trademark name for?
- a. aerolein
  - b. atrazine
  - c. **alachlor**
  - d. dulron
26. Under which conditions would a pesticide operator wear a respirator?
- a. exposed to small amounts of toxics for a short time
  - b. exposed to large amounts of toxics for a short time
  - c. exposed to small amounts of toxics for a long time
  - d. **all of the above**
27. The establishment number can be found on a pesticide container and it indicates?
- a. the inspector for EPA who approved it
  - b. **the factory that produced it**
  - c. location where the product was purchased
  - d. non of the above
28. Which disease is tickborne?
- a. murine typhus
  - b. scabies
  - c. **Q fever**
  - d. All of the above
29. Chagas disease is also known as?
- a. brucellosis
  - b. **trypanosomiasis**
  - c. undulant fever
  - d. dengue fever
30. What is the most important step in the use of pesticides?
- a. use the right pesticide for the job
  - b. wear proper PPE
  - c. use the pesticide downwind
  - d. **read the label**
31. All are anti-coagulant type rodenticides except?
- a. PMP
  - b. **Surflan**
  - c. Warfarin
  - d. Fumarin

32. What etiologic agent for malaria is most fatal to man?
- a. plasmodium ovale
  - b. plasmodium malariae
  - c. plasmodium vivax
  - d. **plasmodium falciparum**
33. In recent years, the largest number of US rabies cases were associated with
- a. skunks
  - b. **bats**
  - c. dogs
  - d. raccoons
34. The term endemic means?
- a. sporadic occurrence of an illness
  - b. **constant presence of an illness**
  - c. all illnesses present at any one time
  - d. an unusually large number of persons with the same illness
35. The interval between the exposure to an infectious agent and appearance of symptoms is?
- a. lag time
  - b. susceptible period
  - c. **incubation period**
  - d. primary period
36. A disease transmitted by bird droppings is?
- a. dengue fever
  - b. **psittacosis**
  - c. tularemia
  - d. Haverhill fever
37. An infected organism which does not exhibit symptoms during the spread of an illness is?
- a. reservoir
  - b. parasite
  - c. host
  - d. **carrier**
38. Rocky MT spotted fever is spread by?
- a. flies
  - b. spiders
  - c. cockroaches
  - d. **ticks**

39. Mycotoxins are chemicals produced by
- a. bacteria
  - b. vertebrates
  - c. viruses
  - d. **fungi**
40. The study of the occurrence, frequency, and distribution of disease is?
- a. entomology
  - b. biology
  - c. endocrinology
  - d. **epidemiology**
41. The world-wide occurrence of a given illness in excess of expectancy in humans is?
- a. panzootic
  - b. epidemic
  - c. **pandemic**
  - d. zoonotic
42. Which of the following is a night biter?
- a. culex
  - b. aedes
  - c. **anopheles**
  - d. cobra
43. Which of the following lays eggs on a raft in still water?
- a. blackfly
  - b. aedes
  - c. anopheles
  - d. **culex**
44. Mosquitoes transmit all of the following but?
- a. protozoa
  - b. **bacteria**
  - c. viruses
  - d. nematodes
45. Filariasis is caused by?
- a. virus
  - b. **nematode**
  - c. bacteria
  - d. protozoa
  - e.
46. Breakbone fever is spread by?
- a. sand fly
  - b. culex
  - c. German cockroach
  - d. **aedes**

47. Humans are considered dead-end hosts in transmission of?
- a. malaria
  - b. yellow fever
  - c. dengue
  - d. west Nile fever
48. Rift valley fever is caused by?
- a. bacteria
  - b. virus
  - c. nematode
  - d. protozoa
49. Which of the following spreads filariasis?
- a. flavavirus
  - b. w. bancrofti
  - c. phlebovirus
  - d. plasmodium ova
50. Which of the following regulates the use of pesticides?
- a. FDA
  - b. USDA
  - c. OSHA
  - d. USEPA
51. Which of the following is not a chlorinated hydrocarbon pesticide?
- a. lindane
  - b. aldrin
  - c. ddt
  - d. malathion
52. Which of the following is a pyrethroid?
- a. Diazinon
  - b. Carbaryl
  - c. Permethrin
  - d. DDT
53. Lyme disease is transmitted by?
- a. lone star tick
  - b. deer tick
  - c. dog tick
  - d. mite
54. Ticks transmit all of the following but?
- a. viruses
  - b. bacteria
  - c. protozoa
  - d. nematodes

55. Tick must stay attached for how many hours before lyme disease can be transmitted?
- a. immediately
  - b. 1-6 hours
  - c. 6-12 hours
  - d. 12 – 23 hours
  - e. **>23 hours**
56. Rabbit fever is caused by?
- a. bed bugs
  - b. chiggers
  - c. **wood tick**
  - d. deer tick
57. Bubonic plague is caused by?
- a. rickettsia typhi
  - b. **yersinia pestis**
  - c. scarcoptes scabiei
  - d. rickettsia tsutsugamushi
58. Acariasis is also known as?
- a. Chagas disease
  - b. Weils disease
  - c. **Scabies**
  - d. Undulant fever
59. African sleeping sickness is caused by?
- a. aedes
  - b. cone nosed kissing bug
  - c. **tse tse fly**
  - d. culex
60. Onchocerciasis is otherwise known as?
- a. Baylisascaris
  - b. Tsutsugamushi disease
  - c. Pediculosis
  - d. **River blindness**

## KEY OSHA and HAZMAT

Tuesday, March 16, 2010  
12:34 PM

### OSHA and HAZMAT

1. The minimum temperature at which vapor concentration of a liquid is high enough to propagate a flame is?
  - a. fire point
  - b. flammability coefficient
  - c. **flash point**
  - d. flammability point
2. OSHA contains all of the following except?
  - a. definitions of procedures for promulgating rules
  - b. conducts compliance investigations
  - c. **recommends industrial hygiene and safety equipment**
  - d. reviews record keeping procedures
3. Which does not describe a TLV?
  - a. data comes from animal studies
  - b. data comes from human studies
  - c. **concentration that most workers will have adverse effects**
  - d. concentration that most workers will not have adverse effects
4. Max concentration that workers can be exposed to for up to 15 minutes without suffering irritation, chronic tissue damage, or narcosis is?
  - a. TLV-C
  - b. TLV-SC
  - c. **TLV-STEL**
  - d. TLV-TWA
5. Which statement is false?
  - a. **Right to inspect includes the right to inspect employee medical records**
  - b. an appeal system has been set up for OSHA actions
  - c. Criminal penalties can be invoked for certain violations
  - d. OSHA has established a priority inspection schedule
6. Which is an engineering control?
  - a. isolation
  - b. **ventilation**
  - c. PPE
  - d. training
7. Results of research done by NIOSH
  - a. becomes standard in two years
  - b. **serves as recommendations for future standards**
  - c. can be enforced immediately upon publishing by the CDC
  - d. are only applicable to private sector and those covered by a state plan
8. Who authorized TSCA of 1976?

- a. Sec of Commerce
  - b. EPA**
  - c. FDA
  - d. Dept of Labor
9. Heat illness characterized by moist, clammy skin and normal oral temp is?
- a. heat exposure
  - b. heat exhaustion**
  - c. heat stroke
  - d. heat cramps
10. What is the most common route of entry for parathion?
- a. ingestion
  - b. absorption**
  - c. injection
  - d. inhalation
11. The Delaney Clause states
- a. the action level of pesticides shall be 50% the PEL
  - b. no carcinogens shall be added to food**
  - c. pesticides must consider aggregate effects
  - d. residual pesticides are considered on a threshold basis
12. The Clean Air Act is enforced by?
- a. EPA**
  - b. Dept of Labor
  - c. Dept of Interior
  - d. FDA
13. Smoking causes increased risk associated with each of the following except when exposed to asbestos?
- a. Lung cancer
  - b. Asbestosis
  - c. Bursitis
  - d. Mesothelioma**
14. Which is not a function of NIOSH?
- a. enforces regulations pertaining to occupational exposures**
  - b. conducts research on health effects
  - c. develops criteria for dealing with toxics
  - d. conducts research and assistance programs for improving protection of workers
15. TLVs are published by?
- a. Dept of Labor
  - b. OSHA
  - c. ACGIH**
  - d. NIOSH



16. Which occupational exposure typically reaches the bloodstream more slowly?
- a. inhalation
  - b. ingestion**
  - c. absorption through skin
  - d. absorption through eyes
17. Which contaminant will not damage the lung, but still causes harm?
- a. NH<sub>3</sub>
  - b. SO<sub>2</sub>
  - c. CO**
  - d. Phosgene
18. What describes the capacity to produce bodily harm?
- a. toxicity**
  - b. hazard
  - c. toxemia
  - d. irritant
19. A mechanical respirator would not be useful in filtering?
- a. nuisance dust
  - b. asbestos
  - c. CO**
  - d. all of the above
20. The particulates of significance in the occupational setting are?
- a. all liquids or solid particles that may be inhaled**
  - b. liquid particles that can be inhaled
  - c. solid particles that can be inhaled
  - d. particles larger than 100  $\mu$ m
21. The method for protection against occupational disease is?
- a. personal control
  - b. environmental control
  - c. medical control
  - d. all of the above**
22. The best safeguard against occupational dermatitis is?
- a. process control**
  - b. good housekeeping
  - c. personal cleanliness
  - d. local exhaust ventilation
23. One of the most common occupational disease is?
- a. occupational dermatoses**
  - b. silicosis
  - c. cancer
  - d. TB

24. What is the term for an estimate of an oral dose that produces a lethal effect on half of an animal population?
- a. LC50
  - b. LD50**
  - c. EC50
  - d. ED50
25. Which respiratory device provides the best protection?
- a. positive pressure respirator with a full face piece**
  - b. negative pressure respirator with a full face piece
  - c. full face canister respirator
  - d. half face respirator
26. No person should be allowed to work in a trench or pit in sandy clay soil with unsupported banks higher than?
- a. 2 ft
  - b. 3 ft
  - c. 4 ft
  - d. 5 ft**
27. An employer removes workers who have reached the upper permissible level of exposure to a hazardous environment. What type of control is this?
- a. educational
  - b. PPE
  - c. administrative**
  - d. engineering
28. A negative pressure fit test is done by?
- a. placing a palm over the intake filter and inhaling**
  - b. placing a palm over the exhaust and inhaling
  - c. placing a palm over the exhaust and exhaling
  - d. is conducted by a machine and yields a FIT factor
29. A flashpoint above 200 F would be depicted as?
- a. 4 in the red section of the NFPA diamond
  - b. 1 in the white section of the NFPA diamond
  - c. 4 in the white section of the NFPA diamond
  - d. 1 in the red section of the NFPA diamond**
30. The thermometer reads 90F, the wet bulb reads 80 and the black globe reads 90. What is the WBGT index?
- a. 87
  - b. 84
  - c. 86
  - d. 83**
31. The following is true about the MSDS except?
- a. must be accessible by all

- b. must conform with OSHA form 174**
  - c. provides information about spill response
  - d. provides health hazard information
- 32. An N95 respirator is?
  - a. NIOSH respirator that removes 3um particles at 95% efficiency
  - b. oil resistant respirator that removes 3 um particles at 95% efficiency
  - c. removes 3um particles at 95% efficiency but is not resistant to oil**
  - d. removes 3 um particles at 95% efficiency but is oil proof
- 33. A type C hard hat will protect you from
  - a. 2200 volts
  - b. 200 volts
  - c. 20000 volts
  - d. monkey wrench falling on your head**
- 34. You should use an APR only if
  - a. in a fully encapsulated suit
  - b. if the contaminant is known and it protects against it**
  - c. in emergency situations
  - d. in level B
- 35. A full face respirator with encapsulated suit with SCBA or SAR should be used
  - a. during all HAZMAT responses
  - b. if the contaminant is known and it protects against it
  - c. in emergency situations
  - d. when contaminant is unknown or at IDLH**
- 36. The last resort control is always
  - a. PPE**
  - b. administrative
  - c. education
  - d. engineering
- 37. Heat stroke is
  - a. characterized by a body temp of greater than 102F
  - b. not an issue in the workplace
  - c. a mild form of heat stress
  - d. a medical emergency**
- 38. Which of the following is false about benzene?
  - a. It is a known carcinogen
  - b. Is used in rubber, solvents, and detergents
  - c. PEL is .75ppm with an action level of .5
  - d. Is not considered a VOC due to low vapor pressure**
- 39. Which of the following does not work by inhibition of cholinesterase?
  - a. parathion

- b. malathion
- c. aldrin**
- d. diazanon

40. Minemata Bay, Japan was the site of
- a. Cadmium accumulation in fish causing Cd poisoning in 1200 people
  - b. Chromium accumulation in fish causing Cr poisoning in 1200 people
  - c. Methyl mercury accumulation in fish causing HG poisoning in 1200 people**
  - d. Hg poisoning in grain causing poisoning in humans
41. The most hazardous form of asbestos is
- a. chrysotile
  - b. tremolite
  - c. crocidolite**
  - d. asbestolite
42. Chrysotile is
- a. most hazardous asbestos
  - b. white**
  - c. blue
  - d. needle like
43. OSHA regulations apply to all of the following except
- a. private sector employees
  - b. federal agencies
  - c. postal service
  - d. military personnel and local employees not under a state plan**
44. Dermal exposure to cement and mortar mix can expose a worker to chromium, causing
- a. jaundice
  - b. loss of skin pigmentation
  - c. chrome holes**
  - d. mesothelioma
45. All of the following are fumigants but
- a. methyl bromide
  - b. warfarin**
  - c. ethylene oxide
  - d. hydrogen cyanide
46. What agency has the responsibility for safe transport of hazardous materials?
- a. EPA
  - b. DOT**
  - c. Dept of energy
  - d. CPSC
47. What regulation covers the dumping of materials into the ocean?

- a. **The marine protection research and sanctuaries act**
  - b. EPCRA
  - c. RCRA
  - d. Safe waterways act
48. For first responders, which is listed correctly in order of importance?
- a. responder safety, env safety, public safety, property safety
  - b. public safety, responder safety, property safety, env safety
  - c. **responder safety, public safety, env safety, property safety**
  - d. property safety, public safety, responder safety, env safety
49. The DOT response guidebook can be used to
- a. determine compliance with DOT regs
  - b. create worker safety documents
  - c. **identify the specific or general classifications of HAZMAT**
  - d. characterize hazardous materials for disposal
50. Green pages of the DOT response guide lists
- a. EPA hazardous material personnel
  - b. hazardous materials in alphabetical order
  - c. **initial isolation distances and protective actions**
  - d. hazardous materials in ID order
51. Level D provide the following
- a. highest level of protection
  - b. APR with splash resistant suit
  - c. SAR with fully encapsulated suit
  - d. **no respiratory protection**
52. EPCRA requires all of the following except
- a. establishment of a state emergency response commission SERC
  - b. **disclosure of all chemicals used at a facility**
  - c. Notification to the NRC if there is a release
  - d. Provide toxic release data to the TRI
53. The following are areas of emergency planning under EPCRA but
- a. Recovery
  - b. **Damage assessment**
  - c. Preparedness
  - d. Prevention
54. \_\_\_\_\_ is the lead agency for nationwide emergency management
- a. **FEMA**
  - b. NRT
  - c. RRT
  - d. NRC
55. There are \_\_\_\_\_ classes of hazardous materials for transport

- a. 7
- b. 8
- c. **9**
- d. 10

56. A vehicle transporting HAZMAT requires
- a. certification by the DOT
  - b. placarding on 2 sides
  - c. **placarding on sides and ends**
  - d. none of the above

57. Transportation of HAZMAT is covered by
- a. OSHA regulations
  - b. **49 CFR**
  - c. 21 CFR
  - d. State regulations

58. Class 3 HAZMAT is
- a. oxidizer
  - b. explosive
  - c. radioactive
  - d. **flammable**

59. A facility that handles extremely hazardous materials in excess of threshold quantities must
- a. develop a local emergency planning committee LEPC
  - b. submit inventory to SERC and LEPC within 90 days
  - c. **report inventory to SERC and LEPC within 60 days**
  - d. provide information to fire department only if requested

60. ATSDR is owned by
- a. **Dept of health and human services**
  - b. Dept of transportation
  - c. Sec of interior
  - d. EPA

## AIR QUALITY AND NOISE & STATUTES AND REGULATIONS

1. Conduction, convection, and radiation are three ways in which
  - a. water loss from impounded water occurs
  - b. heat loss from the surface of a body of water occurs**
  - c. atmospheric pollutants are measured
  - d. industrial x-rays are evaluated
2. An atmospheric condition where a layer of cool air is trapped by a layer of warm air so that the cool air cannot rise is called
  - a. an episode
  - b. masking
  - c. eutrophication
  - d. inversion**
3. The control of sulfur dioxide gas by absorbing it in water in a plate tower or wet scrubber would result in the production of a liquid waste that is
  - a. acid**
  - b. highly turbid
  - c. innocuous
  - d. basic
4. Which of the following gases is least toxic to humans
  - a. nitric oxide
  - b. sulfur dioxide
  - c. carbon dioxide**
  - d. carbon monoxide
5. A correct statement concerning the relationship of PM size and development of occupational lung disease is that smaller particles
  - a. are more injurious as more of these particles are deposited in the lungs and seem to be less readily removed**
  - b. are less injurious as more of these particles are deposited in the lungs, but are easily removed
  - c. more injurious as less of these particles are deposited in the lungs and seem to be less readily removed
  - d. less injurious as fewer particles are deposited in the lungs and seem to be more readily removed
6. The most serious consequence of exposure to inorganic lead is injury to
  - a. digestive tract
  - b. CNS**
  - c. respiratory system
  - d. circulatory system
7. An organic chemical is characterized by

- a. carbon and nitrogen bonding
  - b. oxygen and hydrogen bonding
  - c. carbon and hydrogen bonding**
  - d. hydrogen and nitrogen bonding
8. All of the following are particulates except
- a. smoke
  - b. gas**
  - c. fumes
  - d. dust
9. Fumes are
- a. gas
  - b. metallic oxides**
  - c. vapors from liquids
  - d. smoke
10. The presence of solid, liquid or gases in amounts injurious to man, plants, animals and property is caused by
- a. the tax man
  - b. environmental decay
  - c. terricide
  - d. air pollution**
11. Most combustible materials are made of
- a. carbon
  - b. oxygen
  - c. hydrocarbons**
  - d. carbon dioxide
12. A major air pollution episode that occurred in 1948 is
- a. Meuse Valley, Belgium
  - b. Donora, PA**
  - c. Ponza Rica, Mexico
  - d. New York, NY
13. The major air pollutant by weight is
- a. PM
  - b. hydrocarbons
  - c. carbon monoxide**
  - d. ozone
14. The Ringlemann units, in the process of being phased out, are measures of
- a. smoke emissions**
  - b. sulfur fumes
  - c. ozone concentrations
  - d. auto emissions



15. The major mechanism for the removal of large particulates from the atmosphere is
- a. filtration
  - b. sedimentation
  - c. **rainfall**
  - d. diffusion
16. The natural source of ozone and nitrogen dioxide is
- a. ashes
  - b. **lightening**
  - c. volcanoes
  - d. gases from forest fires
17. The natural source of SO<sub>x</sub> is
- a. ashes
  - b. lightening
  - c. **volcanoes**
  - d. gases from forest fires
18. The major significance of topography in air pollution is
- a. its direct effect on concentration of pollutants
  - b. its application to land use
  - c. **its effect on meteorology**
  - d. its applicability to zoning
19. Fuel combustion at stationary sources is the largest source of
- a. **SO<sub>x</sub>**
  - b. CO
  - c. hydrocarbons
  - d. nitrogen dioxide
20. Cascade impactors are instruments used to sample
- a. sedimentation
  - b. nitrogen compounds
  - c. hydrocarbons
  - d. **particulates**
21. An effective cleansing process of most pollutants in the atmosphere is accomplished by
- a. sedimentation
  - b. **precipitation**
  - c. filtration
  - d. diffusion
22. Which of the following is a series of filters used to control PM
- a. Settling chamber
  - b. Wet collector
  - c. **Baghouse**
  - d. Electrostatic precipitator

22. The Venturi filter uses
- a. a series of filters or cloths in parallel
  - b. high pressure drop, high gas volume
  - c. **low pressure drop and high flow rate**
  - d. cyclonic movement of water
23. NAAQS include all of the following except
- a. Pb
  - b. **CO<sub>2</sub>**
  - c. PM
  - d. O<sub>3</sub>
24. The % of oxygen in the air of a properly ventilated room is about
- a. 5%
  - b. 10%
  - c. 15%
  - d. **20%**
25. Electrostatic precipitators are effective in the removal of
- a. vapors
  - b. **PM**
  - c. gases
  - d. organic compounds
26. Automobiles are the leading source of
- a. **CO**
  - b. SO<sub>x</sub>
  - c. PM
  - d. fluorocarbons
27. When servicing a refrigeration unit, a technician must
- a. properly vent the refrigerant into a fume hood
  - b. convert the system to R134a if using R22
  - c. wear cold shielding gloves to prevent frostbite
  - d. **obtain section 608 certification**
28. In what part of the atmosphere are photochemical oxidants formed
- a. lithosphere
  - b. stratosphere
  - c. **troposphere**
  - d. hydrosphere
29. Scrubbers are wet collectors used to remove particulate matter that forms as a
- a. dust, aerosol, or fog
  - b. mist, solid, or vapor
  - c. **fog, mist or dust**
  - d. fume, dust, or mist

30. The particle most likely to reach the inner lung is
- a. 10  $\mu\text{m}$
  - b. 7  $\mu\text{m}$
  - c. **2  $\mu\text{m}$**
  - d. none of the above
31. The distance that a sound wave travels in one cycle or period is
- a. sound intensity
  - b. **wavelength**
  - c. sound pressure
  - d. frequency
32. The most common type of noise instrument used for initial inspection is
- a. octave band analyzer
  - b. noise dosimeter
  - c. **sound level meter**
  - d. sound analyzer
33. The \_\_\_\_\_ of a sound wave is the energy transferred per unit time through a unit area normal to the direction of propagation
- a. sound pressure
  - b. frequency
  - c. **intensity**
  - d. speed
34. The first federal standard for occupational exposure to noise were issued by
- a. DOT
  - b. FAA
  - c. DHUD
  - d. **DOL**
35. Which frequency weighing approximates the ears response characteristics during normal situations
- a. **A**
  - b. B
  - c. C
  - d. D
36. Malleus, incus, and stapes are located
- a. outer ear
  - b. inner ear
  - c. **middle ear**
  - d. ear lobe
37. As you double the distance from a noise source, noise is reduced by how many decibels
- a. 1

- b. 3
- c. 6**
- d. 9

38. Sound absorption is measured in

- a. watts
- b. hz
- c. sabins**
- d. phons

39. The OSHA PEL for noise is

- a. 85 dB
- b. 90 dB**
- c. 88 dB
- d. 83 dB

40. Combining 3 – 100 dB sound sources will result in

- a. 100 dB
- b. 103 dB
- c. 105 dB**
- d. 107 dB

41. Combining 2 – 70 dB sound sources will result in

- a. 70 dB
- b. 72 dB
- c. 73 dB**
- d. 75 dB

42. The legal authority to conduct a routine inspection is

- a. stated in the constitution
- b. inherent in a health agency
- c. granted by judicial decree
- d. delegated by the legislature**

43. When a business refuses to consent to an inspection, the most appropriate action is

- a. close down the business until it is inspected
- b. return later with a warrant**
- c. request the objector to state in writing why he didn't consent
- d. proceed with the inspection

44. In individuals right to be treated with a least a minimum of decency and fairness by the government is guaranteed by

- a. state of rights
- b. home rule
- c. equal protection
- d. due process**

45. In planning an inspection, it is important to follow explicit procedure in the ordinance because
- a. it is the most efficient process
  - b. is required by due process**
  - c. is required by the home rule
  - d. is it required by OSHA
46. At a trial, the technical person called as a witness should
- a. answer all questions truthfully and directly**
  - b. refer to notes given by the prosecuting attorney
  - c. volunteer as much information as possible
  - d. refuse to answer questions that he feels are inappropriate
47. Hearsay is best defined as
- a. evidence excluded from the privilege against self incrimination
  - b. repetition in court of what someone else has said**
  - c. a statement of the right to remain silent
  - d. a presumptive inference drawn from known facts
48. Which of the following is generally most useful as legal evidence
- a. chronological summary of events
  - b. original field notes**
  - c. photocopy of office records and correspondence
  - d. published report
49. A correct statement about police power is that it
- a. is largely reserved for fed gov by the constitution
  - b. refers to the alleged abuse of persons arrested
  - c. cannot be used except by officially appointed police officials
  - d. in plenary and inherent attribute of sovereign governments**
50. Which of the following would most strongly justify an emergency inspection
- a. sudden appearance of several cases of salmonellosis in the community
  - b. the presence of food contaminated with strychnine**
  - c. a customer complaint about an establishment
  - d. the owners refusal to permit an inspection
51. According to the Freedom of Information Act, all of the following information must be made available to the public except
- a. application for federal licensing
  - b. medical records of personnel**
  - c. decisions affecting agency policies
  - d. records of routine inspections
52. A warrant to conduct a routine inspection of a private dwelling should only be obtained
- a. after working hours
  - b. after consent has been denied**

- c. where surprise is important
  - d. in an emergency
53. An inspectors choice of embargo, seizure, or condemnation should be based upon
- a. political power of the owner
  - b. the inspectors preference
  - c. statutory authority and immediacy of risk**
  - d. cost of items and epidemiologic history
54. Following an inspection and prior to leaving the site, you should
- a. inform the local health department
  - b. check bacteria counts
  - c. notify your agency that the inspection is complete
  - d. meet with management to discuss the significance of findings**
55. The legal term "caveat emptor" means
- a. do not enter
  - b. let the buyer beware**
  - c. illegal entry prohibited
  - d. property condemned
56. The doing of an authorized act in an unauthorized manner is
- a. misdemeanor
  - b. malfeasance
  - c. misfeasance**
  - d. nonfeasance
57. If a health inspector fails to close a restaurant know to have imminent health dangers this is
- a. misdemeanor
  - b. malfeasance
  - c. misfeasance
  - d. nonfeasance**
58. What amendment covers unreasonable searches
- a. 1<sup>st</sup>
  - b. 4<sup>th</sup>**
  - c. 5<sup>th</sup>
  - d. 10<sup>th</sup>
59. A warrant is required for
- a. pervasively regulated industries
  - b. when observations can be made in plain view
  - c. when entry is denied for routine inspections**
  - d. when IDLH conditions exist
60. Which of the following is not a characteristic of a license or permit?
- a. operates through the administrative lifting of a legislative prohibition

- b. may be subject to certain specified conditions
- c. allows the regulator to control the licensees activities by consent
- d. is a voluntary device which every citizen can carry on his or her occupation

## KEY Housing/Emer & Disaster Resp

Tuesday, March 16, 2010  
12:35 PM

### Housing, Institutions & Licensed Establishment, and Emergency Disaster Response

1. What is the ASHRAE recommended minimal thermal standard for dwellings at 40% humidity and air circulation of 45 fpm?
  - a. 57F
  - b. 60F
  - c. 68F
  - d. **76F**
2. The distance from the end of a 2" diameter water supply pipe and the sink should be
  - a. .5"
  - b. 1"
  - c. 2"
  - d. **4"**
3. Condensation, corrosion and mildew occur when the RH exceeds
  - a. 20%
  - b. 40%
  - c. **60%**
  - d. 10%
4. Nosocomial infections are a problem in
  - a. daycare centers
  - b. **hospitals**
  - c. health spas
  - d. food establishments
5. Hospital laundry should be washed
  - a. 146- 150 F
  - b. **160 – 167 F**
  - c. 180 – 200 F
  - d. in cold water only
6. A biohazard is
  - a. any material that negatively impacts a biological organism
  - b. any virus that causes a fatal disease
  - c. **a material of biological composition that is a threat to humans**
  - d. a chemical that is a treat to humans and the environment
7. Bloodborne pathogens are regulated by
  - a. **DOL**
  - b. CDC
  - c. FDA
  - d. HHS
8. Muerto Canyon virus is mainly carried by



- a. deer
  - b. sheep
  - c. mice
  - d. gophers
9. Universal precautions refer to
- a. respiratory protection in hospitals
  - b. **infection control program regulating handling of blood and certain body fluids**
  - c. personal/env protection procedures used when handling chemical waste
  - d. precautions to be used when collecting samples for potential litigation
10. The biosafety containment level suitable for work involving agents of moderate potential hazard to personnel and the environment
- a. 1
  - b. **2**
  - c. 3
  - d. 4
11. The four biosafety containment levels consist of a combination of
- a. **lab practices, safety equipment and facilities**
  - b. lab techniques, research protocols, and safety equip
  - c. research protocols, safety training and lab practices
  - d. lab facilities, safety training, research protocols
12. The protection of personnel and immediate lab environment from exposure to infectious agents by good micro techniques and safety equip is called
- a. **primary containment**
  - b. secondary containment
  - c. tertiary containment
  - d. pentiary containment
13. According the Universal Precautions, which is considered infectious
- a. all blood from human sources
  - b. certain body fluids
  - c. body contact
  - d. **a and b**
14. Wearing contact lenses is an area that has the potential to expose workers to body fluids requires
- a. special cleaning and disinfection procedures if cleaned in work area
  - b. **they may not be cleaned in the work area**
  - c. no special process
  - d. none of the above
15. Contaminated needles must be
- a. recapped after use
  - b. cut to ensure they are not used again

- c. washed in hot soapy water prior to reuse
  - d. none of the above**
16. Broken glassware found in contamination risk areas must be
- a. disinfected with carbolic acid with 5 minute contact time prior to picking up
  - b. must be left until decon team arrives
  - c. must be picked up by mechanical means**
  - d. none of the above
17. Hep B vaccinations for employees that work in contamination risk jobs and areas
- a. must be offered at no cost**
  - b. must be made available to employees at cost
  - c. are not important
  - d. none of the above
18. The most important factor in hospital laundry is
- a. water temp of 160-167 F
  - b. type of contamination
  - c. chlorine dilution and drying temp 170F**
  - d. using the correct cycle
19. An agent that may cause serious or potential lethal disease by inhalation requires
- a. BSL 1
  - b. BSL 2
  - c. BSL 3**
  - d. can be contained in both 2 and 3
20. BSL 4 containment requires the following
- a. Class 1 cabinet
  - b. Class 2A cabinet
  - c. Class 2B cabinet
  - d. Class 3 cabinet**
21. A class 3 cabinet can be
- a. vented into ductwork following HEPA
  - b. vented outside following double HEPA
  - c. requires only incineration
  - d. requires double HEPA and incineration before venting**
22. Females should have 1 toilet for every \_\_\_\_\_ female students
- a. 30-40
  - b. 35-45**
  - c. 40-50
  - d. 25-35
23. Exits in a day care center must be
- a. smaller than 36" to prevent trapping
  - b. larger than 24"

- c. **36" or larger**
  - d. none of the above
24. Children under 6
- a. cannot sleep in a bunkbed
  - b. require a maximum window opening of 6"
  - c. need a minimum of 3' between cots or sleep mats
  - d. **all of the above**
25. Outdoor play area in a day care can
- a. **be adjoined to property**
  - b. greater than 1/8 mile away
  - c. are not required
  - d. must have a 3' fence or hedge around it
26. Pb at a day care's play area
- a. must be tested for monthly
  - b. **Shall not exceed 400ppm**
  - c. requires action at 1ug/dl in a child
  - d. both b and c
27. Each inmate in a correctional facility is entitled to
- a. **35ft<sup>2</sup> living space**
  - b. 35ft<sup>3</sup> outside air or recirculated filtered air
  - c. 35 dBA max noise at night
  - d. 35C temperature
28. The max noise in a correctional facility is
- a. 35 dBA night, 70 dBA day
  - b. 45 dBA night, 60 dBA day
  - c. **45 dBA night, 70 dBA day**
  - d. appropriate levels
29. Inmates are entitled to
- a. wash laundry in a wash basin
  - b. **3 sets of clothing/week**
  - c. 1 set of clothing/week
  - d. soap, toothbrush, toothpaste and straightedge razor
30. Tattoo equipment must be \_\_\_\_\_ before reuse
- a. disinfected using bleach
  - b. disinfected using UV
  - c. cleaned with soap and water
  - d. **autoclaved**
31. Proper temperature for autoclaving equipment is
- a. 205F for 35 minutes
  - b. 225F for 35 minutes

- c. 250F for 35 minutes
  - d. 275F for 15 minutes
- 32. Autoclaves must be tested
  - a. daily
  - b. weekly
  - c. **monthly**
  - d. annually
- 33. Testing of an autoclave involves
  - a. destruction of psychotrophs
  - b. destruction of bacillus anthracis spores
  - c. **destruction of bacillus stearothermophilus spores**
  - d. testing temperatures using a calibrated thermometer
- 34. Barber shops
  - a. require an autoclave
  - b. must place a reusable napkin around patrons neck under the cape
  - c. must renew their license every two years
  - d. **must exclude patrons with communicable diseases that could be spread in shop**
- 35. Which of the following cover the HAZWOPER standard?
  - a. 49CFR1910
  - b. 29CFR120.1910
  - c. 49CFR1910.120
  - d. **29CFR1910.120**
- 36. HAZWOPER involves all of the following except
  - a. PPE
  - b. **Thorough medical record review**
  - c. Training
  - d. Drills and practice
- 37. What are the training requirements for HAZWOPER certification
  - a. 40 hour HAZWOPER course
  - b. 40 hour hazardous cargo course
  - c. 8 hour refresher course
  - d. **both a and c**
- 38. A petroleum spill occurs at the plant which is contained by plant personnel. What type of EAL is this?
  - a. **level 1**
  - b. level 2
  - c. level 3
  - d. level 4

39. A spill is expected to spread beyond the borders of the plant and could pose a hazard to the immediate population. What kind of EAL is this?
- a. level 1
  - b. level 2
  - c. level 3**
  - d. level 4
40. What are the actions that can be taken in response to an emergency?
- a. local plant response
  - b. no response
  - c. HAZWOPER response
  - d. all of the above**
41. Plan that spells out procedures for employees in the event of an emergency is?
- a. Spill response plan
  - b. Emergency action plan**
  - c. Chemical hygiene plan
  - d. HAZWOPER plan
42. Which of the following is the most senior officer on the ground at a HAZMAT response?
- a. Emergency director
  - b. Incident commander**
  - c. Response coordinator
  - d. FEMA director
43. Which organization has the responsibility of national disaster response?
- a. FEMA**
  - b. Red Cross
  - c. Doctors without Borders
  - d. WHO
44. The HAZMAT Technician requires?
- a. 24 hours of training
  - b. knowledge of direct reading instruments
  - c. equipment to plug, patch or stop leaks
  - d. all of the above**
45. The first responder requires?
- a. basic HAZCOM training
  - b. 2 hour MSDS training
  - c. 8 hour operations level training**
  - d. 24 hour operations level training
46. The blue pages of the emergency response guidebook are
- a. Chemical by ID #
  - b. Chemical by alphabetical order**
  - c. Emergency response

d. Isolation distances

47. The term that describes when a property is no longer suitable for the purpose it was intended for is?

- a. **obsolescence**
- b. blighted
- c. in rem
- d. condemned

48. A common problem associated with substandard housing is

- a. decrease in intestinal diseases
- b. **blighting of neighborhoods**
- c. several thousands of dollars in owner repairs
- d. less than 1.5 people per room

49. Which of the following is a minor deficiency according to the APHA?

- a. **central heating inadequate**
- b. water supply is located outside
- c. no windows to the outside
- d. only one exit

50. A minimum of \_\_\_\_\_ ft<sup>2</sup> of sleeping area per person is required under the APHA method.

- a. 10
- b. 20
- c. **40**
- d. 60

51. The end of a waste pipe should terminate at least \_\_\_\_\_ " above the rim of a sink or receptacle directly connected to the drainage system.

- a. **2**
- b. 4
- c. 5
- d. 6

52. Vent gases combined with high moisture inside a chimney can form

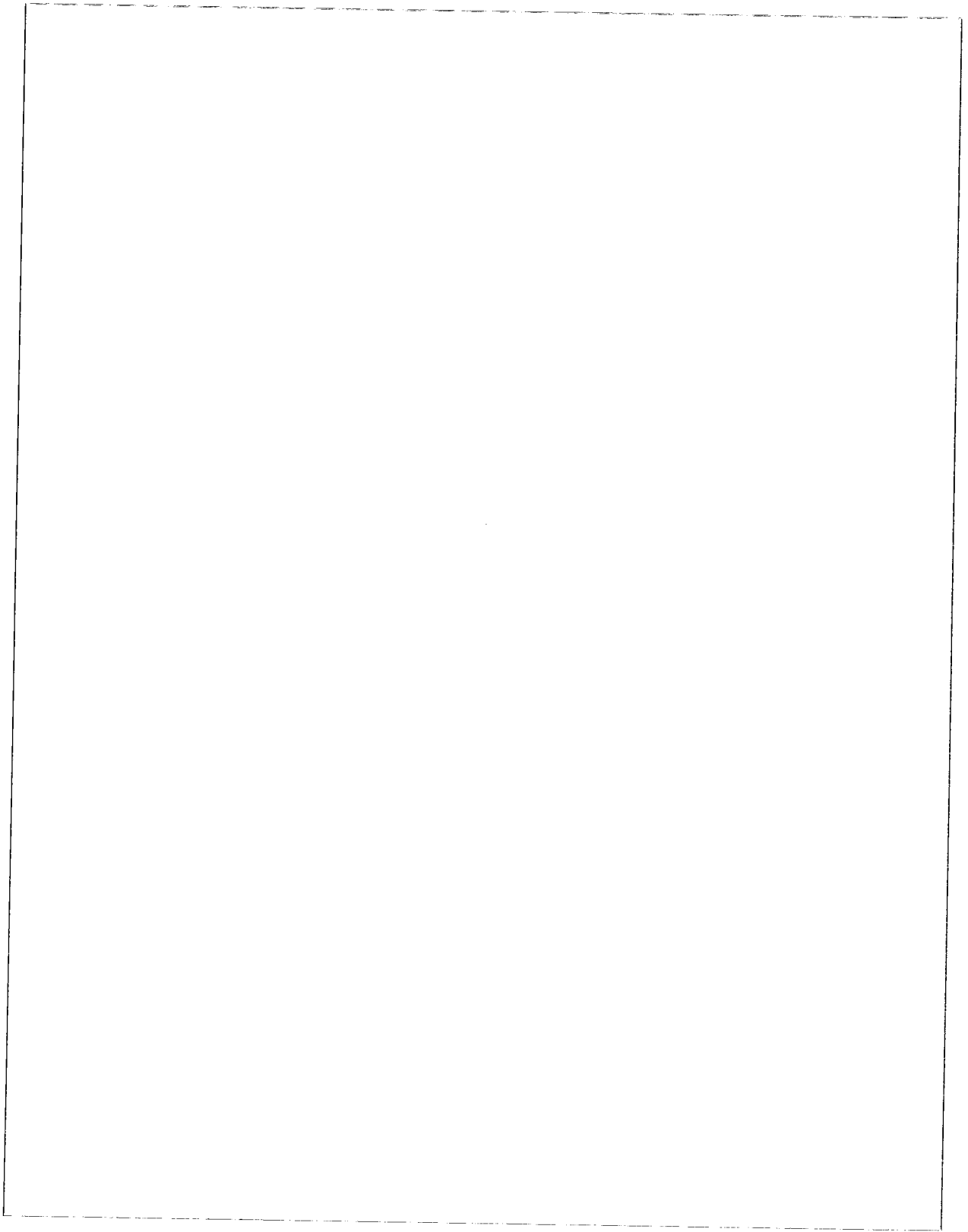
- a. a glass like glaze
- b. hydrochloric acid
- c. sodium chloride
- d. **sulfuric acid**

52. Flue or vent must extend \_\_\_\_\_ above the highest part of a peaked roof

- a. 1 ft
- b. **2 ft**
- c. 3 ft
- d. 6 inches

53. The action level of lead in children is

- a. **10 ug/dl**
  - b. 10 ug/ml
  - c. 100 g/dl
  - d. 10 g/ml
54. Which of the follow is the primary cause of poor IAQ?
- a. **inadequate ventilation**
  - b. contaminated outside air
  - c. radon
  - d. mold
55. Radon can be reduced using
- a. humidifier
  - b. electrostatic precipitator
  - c. ionizer
  - d. **none of the above**
56. Which of the following are not typically members of the infection control committee?
- a. **hospital CEO**
  - b. environmental control officer
  - c. infection control nurse
  - d. physician representative
57. Which of the following is the most frequent disease transmission route in a day care
- a. respiratory
  - b. **fecal oral**
  - c. intimate contact
  - d. all of the above
58. International agencies who respond to emergency situations include
- a. **WHO**
  - b. CDC
  - c. WSO
  - d. none of the above
59. Workers that work at uncontrolled hazardous waste sites require minimum of \_\_\_\_ hours of training
- a. 8
  - b. 24
  - c. 32
  - d. **40**
60. Which of the following is not required in an emergency response plan at a hazardous waste site?
- a. PPE and emergency equipment
  - b. emergency medial treatment and first aid
  - c. **EPA library telephone number**
  - d. pre emergency planning





## KEY Solid & Haz Waste

Tuesday, March 16, 2010  
12:37 PM

### SOLID AND HAZARDOUS WASTE

1. Hazardous waste is governed by the
  - a. Clean Water Act
  - b. Occupational Safety and Health Act
  - c. **Resource Conservation and Recovery Act**
  - d. Food and Drug Act
2. Hazardous waste includes
  - a. chemical
  - b. biological
  - c. flammable
  - d. **all of the above**
3. By definition, RCRA hazardous wastes are \_\_\_\_\_ waste
  - a. **solid**
  - b. natural
  - c. gray
  - d. none of the above
4. Hazardous waste may be in a \_\_\_\_\_ form
  - a. solid
  - b. liquid
  - c. gas
  - d. **all of the above**
5. Which of the following is not a characteristic of hazardous waste?
  - a. ignitability
  - b. corrosivity
  - c. reactivity
  - d. **combustibility**
6. Which of the following is not included in hazardous waste regulations?
  - a. **domestic sewage**
  - b. flammable liquids
  - c. corrosive liquids
  - d. none of the above
7. Toxicity is determined by a laboratory using
  - a. EPA method 012
  - b. **toxicity characteristic leaching procedure**
  - c. EPA method 016
  - d. landfill toxicity leaching procedure
8. Hazardous waste include
  - a. industrial discharges permitted under the FWPCA
  - b. agricultural wastes

- c. permitted irrigational waters
- d. none of the above

9. The regulatory level for benzene under the RCRA toxicity characteristic rule is
- a. .5 mg/l
  - b. 100 mg/kg
  - c. .2 mg/l
  - d. 24 mg/l

10. The regulatory level for total cresol under the RCRA toxicity characteristic rule is
- a. 600 mg/l
  - b. 400 mg/l
  - c. 200 mg/l
  - d. 100 mg/l

11. Information and advice on what to do with a hazardous waste when spilled in a transportation accident is available 24 hours a day from
- a. RCRA hotline
  - b. CHEMTREC
  - c. EPA administrator
  - d. none of the above

12. In 1984, RCRA was amended to require \_\_\_\_\_, or the equivalent at hazardous waste landfills
- a. double liners
  - b. auxiliary incinerators
  - c. methane collection systems
  - d. all of the above

13. Land disposal by hazardous waste regulations includes
- a. incineration
  - b. waste pile
  - c. sewer disposal
  - d. fuel blending

14. Domestic wastewater which passes through a sewer system into a POTW is not considered to be a
- a. solid waste
  - b. hazardous waste
  - c. sewer waste
  - d. both a and b

15. Toxic priority pollutants include
- a. arsenic
  - b. cadmium
  - c. vinyl chloride
  - d. all of the above

16. Waste generated by the construction industry include
- a. ignitable paint waste
  - b. spent solvents
  - c. acids and bases
  - d. **all of the above**
17. Hazardous wastes generated by vehicle maintenance shops include
- a. heavy metal paint waste
  - b. ignitable waste
  - c. spent solvents
  - d. **all of the above**
18. The goal for hazardous waste management should be
- a. **zero discharge**
  - b. <2% discharge
  - c. <5% discharge
  - d. none of the above
19. Which of the following is not an option for hazardous waste minimization
- a. treatment
  - b. waste reduction at point of generation
  - c. process modification
  - d. **increased production**
20. High temperature incinerator systems are mostly suitable to destroy
- a. waste water
  - b. **organic compounds**
  - c. inorganic compounds
  - d. domestic sewage
21. Examples of thermal destruction processes in addition to incineration are
- a. **cement kiln**
  - b. chemical treatment
  - c. separation
  - d. none of the above
22. Which of the following is not a type of hazardous waste incinerator
- a. rotary kiln
  - b. fixed hearth
  - c. fluidized
  - d. **fuel blender**
23. Heating of air, gas, or gas mixture up to 9032F for the thermal destruction of hazardous waste describes
- a. **plasma technology**
  - b. rotary kiln incineration
  - c. fuel blending
  - d. all of the above

24. The disposal of equipment and other materials containing PCBs
- a. is nearly finished
  - b. is unregulated
  - c. **will continue for years**
  - d. is not necessary
25. The EPA requires that dioxin-bearing wastes be \_\_\_\_ destroyed or reduced before disposal in a secure hazardous waste landfill
- a. 99.99%
  - b. 95 %
  - c. **99.9999%**
  - d. .05%
26. Sources of dioxin include
- a. wood preserved with PCBs
  - b. paper mill bleached pulp and sludge
  - c. bleach paper products
  - d. **all of the above**
27. Neutralization and detoxification are feasible with most of the organophosphate and carbamate insecticides, but not with
- a. **chlorinated hydrocarbons**
  - b. acids
  - c. bases
  - d. all of the above
28. The EPA requires that toxic waste incinerators achieve a destruction and removal rate of \_\_\_\_ before the material is landfilled
- a. **99.99%**
  - b. 95%
  - c. 98%
  - d. 15%
29. It can be assumed that all hazardous waste landfill liners
- a. are designed for all hazardous material
  - b. will eventually leak
  - c. will not leak
  - d. **both a and b**
30. What is the largest source of municipal solid waste in the US
- a. vegetable waste
  - b. aluminum
  - c. **paper**
  - d. scrap metal
31. Four foundations of integrated solid waste management are
- a. landfills, recycling, burn pits, source reduction

- b. open dumps, composting, incinerators, source reduction
  - c. **landfills, recycling, combustion, source reduction**
  - d. landfills, composting, combustion, source magnification
32. Which of the following are methods of composting
- a. In situ
  - b. **windrow**
  - c. non aerated static pile
  - d. both a and b
33. Which of the following is false
- a. compost is a poor fertilizer
  - b. **temperature must be maintained at 130F for 3 days to destroy pathogens**
  - c. compost is must be aerated
  - d. composting can result in undesirable health effects
34. Mass fired combustors are
- a. compact units
  - b. used to incinerate pretreated waste
  - c. have a steady energy output
  - d. **require minimal waste processing before incineration**
35. Incineration requires
- a. **time, temperature, turbulence**
  - b. Min temperature of 1200F
  - c. destruction of inorganic material
  - d. both a and b
36. What type of landfill would be recommended on flat terrain
- a. **Trench**
  - b. Dump
  - c. Valley
  - d. all of the above
37. RCRA subtitle D covers
- a. hazardous waste
  - b. **municipal solid waste**
  - c. TSCA
  - d. none of the above
38. For best results when composting
- a. maintain pH of 8.5 - 10
  - b. **maintain moisture content of 50-60%**
  - c. maintain anaerobic conditions
  - d. all of the above
39. Landfills must be designed with
- a. double liner

- b. **leachate collection systems**
- c. hydrogen sulfide monitoring system
- d. both a and b

40. Leachate should be \_\_\_\_\_ to accelerate degradation of waste
- a. vented
  - b. **recirculated**
  - c. treated
  - d. collected
41. Landfilling of Subtitle C waste requires
- a. composite liner
  - b. single liner
  - c. **double liner**
  - d. geotextile liner
42. A geonet is
- a. impermeable layer of clay or dirt
  - b. permeable layer of clay or dirt
  - c. permeable synthetic material
  - d. **impermeable synthetic material**
43. Landfills must be
- a. minimum of 100 ft from any ground water
  - b. at least 5 ft from surface water
  - c. **have a minimum of 24" of cover when capped**
  - d. all of the above
44. Landfills require a minimum of \_\_\_\_\_ personnel on site during hours of operation
- a. 1
  - b. **2**
  - c. 3
  - d. 4
45. A minimum of \_\_\_\_\_ cover must be placed over landfill daily
- a. 3"
  - b. **6"**
  - c. 12"
  - d. 24"
46. A fly can migrate \_\_\_\_\_ in trash
- a. 5 ft in uncompacted trash
  - b. 6" in compacted trash
  - c. to lay eggs
  - d. **all of the above**
47. Residential trash should be collected at least
- a. **twice a week in warm months**

- b. once a week in warm months
  - c. twice a week in cold months
  - d. always twice a week (both a and c)
48. A trash can is an example of a
- a. HCS
  - b. STD
  - c. IED
  - d. SCS
49. Which of the following is incorrect
- a. subtitle c = hazardous waste
  - b. subtitle d = solid waste
  - c. **subtitle i = underground pipelines**
  - d. subtitle j = medical waste
50. An acutely hazardous substance that is unused and discarded is
- a. F list waste
  - b. K list waste
  - c. **P list waste**
  - d. U list waste
51. A chemist diluted 10ml of lab grade benzene in 50ml of in an experiment. What type of waste is this?
- a. **F list**
  - b. K list
  - c. P list
  - d. U list
52. Which of the following makes a substance a hazardous material
- a. flashpoint <140F
  - b. pH from 1.5-12
  - c. **TCLP yields concentrations in excess of thresholds**
  - d. both b and c
53. A hazardous waste small quantity generator produces
- a. less than 100 kg/month
  - b. **100 – 1000 kg/month**
  - c. more than 1000 kg/month
  - d. accumulates more than 1 kg of acute toxins/month
54. Hazardous waste requires
- a. cradle to grave tracking
  - b. transportation manifest
  - c. vehicle placarding
  - d. **all of the above**
55. Dry batteries used in your home

- a. must be disposed of as universal waste
- b. must be recycled
- c. **are excluded under RCRA**
- d. should be composted

56. Which of the following wastes is regulated at a residence under RCRA
- a. arsenically treated lumber
  - b. paint
  - c. aerosol cans
  - d. **terne plated oil filters**

57. Who administers CERCLA
- a. OSHA
  - b. **OSWER**
  - c. SARA
  - d. DOL

58. In situ vitrification
- a. creates a glass like substance to encapsulate contaminants
  - b. is effective in areas with buried pipes
  - c. is best suited for near surface contamination
  - d. **both a and c**

59. Hazardous waste treatment methods include
- a. biological methods
  - b. phytoremediation
  - c. deep well injection
  - d. **all of the above**

60. During daily compaction at a landfill, layers should be spread and compacted
- a. 6-12" thick
  - b. **12 - 24" thick**
  - c. 24 - 36" thick
  - d. greater than 36" thick



## KEY Potable Water

Tuesday, March 16, 2010  
12:37 PM

### POTABLE WATER

1. Which of the following is not a sedimentary formation?
  - a. limestone
  - b. peat
  - c. **olivine**
  - d. loess
2. Rocks such as serpentine, slate, soapstone, and marble belong to which class
  - a. igneous
  - b. sedimentary
  - c. **metamorphic**
  - d. limestone
3. Which soil has the greatest % porosity
  - a. **silt**
  - b. uniform sand
  - c. gravel
  - d. sandstone
4. Which is included in the sanitary survey of groundwater supplies
  - a. aquifer drainage area and local geology
  - b. nature of soil, rock, strata, and local geology
  - c. land use and habitation, sources of pollution, and local geology
  - d. **all of the above**
5. What chemical is used to dechlorinate water when testing for bacteriological agents
  - a. sodium sulfate
  - b. **sodium thiosulfate**
  - c. sodium bisulfate
  - d. sodium bisulfite
6. What is the purpose of using a forward sweeping motion when sampling surface water
  - a. allows equal mixing of the sample
  - b. **prohibits contamination from hands**
  - c. prohibits collection of trash in the water
  - d. creates a current that will collect visible contaminants for ID
7. Which bacterial group is indicative of fecal contamination
  - a. pseudomonas
  - b. **coliform**
  - c. salmonella
  - d. all of the above
8. Which soil condition is most favorable for removal of viruses
  - a. sand over gravel
  - b. **fine loamy sand over coarse sand and gravel**

- c. gravel over semi porous clay
  - d. coarse sand and gravel over fine sand or clay
9. What water constituent has been associate with staining clothes and plumbing dark brown or black
- a. Zn
  - b. Mn**
  - c. Ag
  - d. Ca
10. Methylene Blue Active Substance (MBAS) is a test to identify
- a. hardness of water
  - b. iron in water
  - c. presence of detergents containing phosphates**
  - d. presence of coliform bacteria
11. Which two elements cause the most hardness
- a. Zn and Mg
  - b. Na and Mg
  - c. Ca and Mg**
  - d. Ca and Na
12. Which chlorine test is least desirable
- a. SNORT
  - b. Methyl orange**
  - c. Amperometric procedure
  - d. DPD
13. Which would not be used as a coagulant
- a. black alum
  - b. chlorinated copperas
  - c. ferric chloride
  - d. sodium hypochlorite**
14. Which of the following is not known as an iron bacteria
- a. crenothrix
  - b. gallionella
  - c. leptothrix
  - d. giardia lamblia**
15. Which statement is most correct
- a. facultative bacteria live in aerobic conditions only
  - b. facultative bacteria live in anaerobic conditions only
  - c. facultative bacteria live in either aerobic or anaerobic conditions**
  - d. facultative bacteria produce their own oxygen
16. Which increases the mobility of contaminants
- a. acidic soil conditions

- b. lack of organic material
- c. lack of Fe, Mg, Ca
- d. all of the above**

17. The measure of the amount of water held by a rock or soil in pores or voids as % of total volume

- a. permeability
- b. specific retention
- c. porosity**
- d. specific gravity

18. What is the primary organism identified in the fecal coliform test

- a. fecal streptococci
- b. enterobacter aerogenes
- c. salmonella typhosa
- d. Escherichia coli**

19. Which is not a measure of turbidity

- a. nephelometric unit
- b. siple turbidity unit**
- c. formazin turbidity unit
- d. Jackson turbidity unit

20. The final product in the oxidation of ammonia yields

- a. zinc
- b. lead
- c. nitrate**
- d. nitrogen

21. Which contaminant is associated with methemoglobinemia

- a. zinc
- b. copper
- c. lead
- d. nitrate**

22. Which statement concerning ozone is incorrect?

- a. ozone residuals can last several hours**
- b. ozone is a faster disinfectant than chlorine
- c. ozone is more expensive than chlorine
- d. all statements are correct

23. Regulations governing drinking water additives is the responsibility of

- a. FDA
- b. EPA**
- c. Dept of Labor
- d. PHS

24. Which conditions indicate organic stream pollution

- a. water has foul odor and is turbid
  - b. fish counts decrease or disappear
  - c. increase in worms and snails
  - d. **all of the above**
25. Lakes that are clean, high in DO, and receive few nutrients are
- a. **oligotrophic**
  - b. mesotrophic
  - c. euphoric
  - d. eutrophic
26. Which organisms are most resistant to unfavorable environmental conditions and indicate past or possibly intermittent pollution?
- a. Fecal streptococci
  - b. Escherichia coli
  - c. aerobacter aerogenes
  - d. **Clostridium sporulates**
27. Algae will cause all of the conditions except
- a. reduced water clarity
  - b. increased chlorine consumption
  - c. **rapid fall in pH**
  - d. slimy growth
28. The presence of typhoid fever caused by a public water supply could be traced to
- a. **fecal contamination**
  - b. excessive water aeration
  - c. pus from skin lesions
  - d. rotting animal and fish remains
29. Microbial pollution travels only a short distance through
- a. solution channels in limestone
  - b. fissured rock
  - c. dried out, cracked clay
  - d. **sandy loam or clay**
30. Infectious Hepatitis A is caused by
- a. bacteria
  - b. protozoa
  - c. rickettsia
  - d. **virus**
31. The pH of a solution in which the hydrogen ion concentration is equal to  $1 \times 10^{-8}$  moles per liter is
- a. 2
  - b. 4
  - c. 6
  - d. **8**

32. A substance commonly used as a coagulant in water treatment is
- a. **aluminum sulfate**
  - b. calcium sulfate
  - c. potassium chloride
  - d. sodium phosphate
33. A sample of water for bacterial analysis is usually packed in ice if cannot be analyzed immediately to retard changes in
- a. amount of DO in the sample
  - b. mineral content
  - c. **number of bacteria**
  - d. pH
34. The disinfecting ability of chlorine is affected most by
- a. BOD
  - b. temperature
  - c. **hydrogen ion concentration**
  - d. DO
35. Alkalinity exists in 3 forms, which is not one of the forms
- a. bicarbonate
  - b. hydroxide
  - c. carbonate
  - d. **hypochlorite**
36. Which of the following compounds would not contribute to water hardness
- a. calcium sulfate
  - b. magnesium sulfate
  - c. calcium chloride
  - d. **sodium chloride**
37. Improperly located wells which allow fecal pollution of the water supply could result in
- a. botulism, leptospirosis, typhus fever, malaris
  - b. brucellosis, strep infections, cholera, yellow fever
  - c. **salmonellosis, shigellosis, cholera, hepatitis**
  - d. relapsing fever, histoplasmosis, psittacosis
38. Viral Hep B is most often associated with
- a. contaminated dairy products
  - b. uncooked shellfish
  - c. **administration of blood products**
  - d. fecal contamination of water
39. Historically in the US, the impetus for water treatment came from the need to control
- a. infectious Hep
  - b. TB

- c. typhus fever
- d. typhoid fever**

40. Communicable diseases such as typhoid fever, cholera, shigellosis, and infectious hepatitis are most commonly transmitted by
- a. vector borne
  - b. respiratory
  - c. direct contact
  - d. fecal oral**
41. Aeration is advantageous in the treatment of water containing
- a. phosphorus and manganese
  - b. dissolved iron and manganese**
  - c. magnesium and iron
  - d. phosphorus and iron
42. Masonary reservoirs of rural water supplies are called
- a. leaching pits
  - b. cisterns**
  - c. sedimentation ponds
  - d. seepage pits
43. The liquid form of chlorine used for emergency disinfection of water is
- a. calcium hypochlorite
  - b. sodium hypochlorite**
  - c. bromium hypochlorite
  - d. potassium hypochlorite
44. They type of subsurface formation in which groundwater contamination is likely to travel the farthest is
- a. clay
  - b. granite
  - c. fragmented limestone**
  - d. gravel
45. The presence of coliform in water indicates
- a. the presence of pathogens
  - b. the presence of fecal viruses
  - c. the possible presence of pathogens**
  - d. the presence of sewage
46. Activated carbon is used to
- a. increase turbidity
  - b. kill bacteria
  - c. control taste and odors**
  - d. keep the chlorine in suspension
47. A cross connection is

- a. a connection between two approved water supplies
- b. a plumbing device
- c. **connection which permits the flow of non potable water in to an approved source**
- d. a connection in which hot and cold water lines are crossed allowing leaching of lead

48. According to the SDWA, the minimum number of water samples required for bacteriological analysis for a PWS depends upon

- a. chlorine residual
- b. **population served**
- c. area of raw water supply
- d. amount of water treated

49. The type of filter recommended for small communities is

- a. rapid sand
- b. pressure
- c. diatomaceous earth
- d. **slow sand**

50. One of the most common reasons for contamination of wells drilled through rock, clay or hardpan is

- a. seepage of pollutants through the soil
- b. **failure to seal well casing properly**
- c. porosity of the rock
- d. use of inferior quality well casings

51. Aeration is a natural process or mechanical process which

- a. increases the contact between air and water
- b. improves the physical and chemical characteristics of water
- c. **both**
- d. neither

52. The main function of a sand filter is to remove

- a. tastes and odors
- b. **suspended solids**
- c. dissolved materials
- d. bacteria

53. Ozone is effective against

- a. amoebic cysts
- b. bacteria and phenols
- c. viruses
- d. **all**

54. 30 ppm chlorine in drinking water is

- a. just right
- b. too low

- c. would not kill ecoli
- d. excessive

55. A well must be placed \_\_\_\_\_ feet from a septic field or distribution box
- a. 50
  - b. **100**
  - c. 200
  - d. 250
56. Marsh funnels are used to
- a. **measure the drilling quality of mud**
  - b. measure the viscosity of cement and well casing grout
  - c. measure the porosity of mud
  - d. to take water samples from swampy areas
57. Trihalomethanes are
- a. formed as a chlorination byproduct
  - b. group b carcinogens
  - c. cause liver and kidney damage
  - d. **all of the above**
58. When sampling for chemical from your home tap, always
- a. let your faucet run for 5 minutes
  - b. **leave a 1" air gap**
  - c. treat with sodium thiosulfate
  - d. all of the above
59. If lead or copper exceed the action level in \_\_\_\_\_ % or more of customers sampled, the water is in violation of the SDWA
- a. 2
  - b. 5
  - c. **10**
  - d. 15
60. Which of the following is not chlorine resistant
- a. NLV
  - b. Cryptosporidium parvum
  - c. Entamoeba histolytica
  - d. **Salmonella typhimurium**



## KEY Swimming and Rec Fac

Tuesday, March 16, 2010  
12:38 PM

### Swimming Pools and Recreation Areas

1. Which of the following would not be as likely to be contracted bathing at a beach
  - a. leptospirosis
  - b. middle ear infection
  - c. **spinal meningitis**
  - d. all of the above
2. What public health factor is of primary importance in determining the sanitary quality of recreational waters?
  - a. heavy metals
  - b. **coliform**
  - c. human waste
  - d. solid waste
3. The causative agent *Naegleria fowleri* has been linked to which of the following
  - a. bacterial meningitis
  - b. **Primary amoebic meningoencephalitis**
  - c. cholera
  - d. diphtheria
4. Which organism would probably survive in a hot tub
  - a. e coli
  - b. vibrio cholera
  - c. entamoeba histolytica
  - d. **pseudomonas aeruginosa**
5. A secchi disk is used to determine
  - a. pH
  - b. **clarity**
  - c. coliform contamination
  - d. heavy metals
6. A chemical used to adjust pool alkalinity is
  - a. chlorine
  - b. calcium chloride
  - c. **sodium bicarbonate**
  - d. copper sulfate
7. Which pH would cause the least eye irritation (\*\* Answer is NOT 7\*\*\*)
  - a. 6.8
  - b. **7.5**
  - c. 8.2
  - d. 7
8. What is the primary reason the pH of a pool should stay less than 8
  - a. skin irritation

- b. **decrease the amount of active chlorine**
  - c. promotes the growth of coliform
  - d. attacks concrete walls
9. The factor used to determine the bromine residual using the chlorine test (DPD) is
- a. **multiply chlorine residual by 2.3**
  - b. multiply chlorine residual by 4
  - c. divide chlorine residual by 2.3
  - d. divide chlorine residual by 4
10. The chemical quality of a pool is generally measured by which 2 tests
- a. **pH and alkalinity**
  - b. alkalinity and TDS
  - c. pH and chlorine residual
  - d. alkalinity and chlorine residual
11. Which raises the pH of pool water
- a. chlorine
  - b. alum
  - c. **sodium carbonate**
  - d. all of the above
12. What compound is the principal scale former
- a. **calcium carbonate**
  - b. potassium carbonate
  - c. magnesium sulfate
  - d. sodium carbonate
13. The preferred treatment for algae control is
- a. copper sulfate
  - b. **superchlorination**
  - c. quaternary ammonium
  - d. drain and scrub pool
14. The best method to eliminate swimmers itch is
- a. apply antibiotics to the water
  - b. **break the life chain of the schistosome**
  - c. raise the pH to destroy the snails
  - d. destroy all aquatic vegetation so the cercariae cant mature
15. Which of the following is a method by which recreation waters may be contaminated
- a. infected people
  - b. surface runoff
  - c. normal water flora
  - d. **all**
16. Swimming pool water that is brownish black in color may be due to
- a. **H<sub>2</sub>S**

- b. Mg
- c. Mn**
- d. Fe

17. The best method to reduce diving accidents is to
  - a. shorten the distance between the board and water
  - b. slope the bottom of the pool
  - c. use a safety factor ratio for depth of water to height of board
  - d. develop diving training and education programs**
18. Muriatic acid is a weak solution of
  - a. nitric acid
  - b. sulfuric acid
  - c. acetic acid
  - d. hydrochloric acid**
19. In which situation would you most likely find PAM
  - a. river or pond
  - b. geothermal pool**
  - c. reservoir
  - d. Atlantic ocean
20. Some studies indicate that swimmers have a higher over all illness rate than non swimmers
  - a. regardless of bathing water quality**
  - b. due to poor regulatory practice
  - c. if they are over 50 years old
  - d. if they swim only in pools
21. The treatment system of a pool is typically recommended to be installed in which of the following flow arrangements
  - a. skimmer or gutter line, main drain line, adjustment valves, disinfectant feeder, hair strainer, pump, filter, pH feeder pump, adjustable inlets
  - b. skimmer or gutter line, main drain line, adjustment valves, hair strainers, pump, filter, pH feeder pump, adjustable inlets
  - c. skimmer or gutter line, main drain line, adjustment valves, pH feeder pump, hair strainer, pump, filter, disinfectant feeder, adjustable inlets
  - d. skimmer or gutter line, main drain line, adjustment valves, hair strainer, filter aid pump, filters, disinfectant feeder, pH feeder, adjustment valves**
22. Swimming pool water turbidity should not exceed \_\_\_\_\_ NTUs
  - a. .5**
  - b. 5
  - c. .15
  - d. 15
23. A public pool filtration system should filter the entire volume of water every
  - a. 2-3 hours

- b. 6-8 hours
  - c. 10-12 hours
  - d. 30 minutes
24. The gutters or skimmers should receive a minimum of what percent of total pool water due to the large quantity of organisms and material that float
- a. 95
  - b. 40
  - c. 60
  - d. 30
25. The acidity-alkalinity balance affects eye irritation, water coagulation, and the
- a. **effectiveness of chlorine**
  - b. ambient water temperature
  - c. effectiveness of the skimmers
  - d. evaporation rate
26. To mix acid and water, always add
- a. water to acid
  - b. **acid to water**
  - c. soda ash to acid
  - d. stir while pouring water into acid
27. When bleach is added to water
- a. one disinfecting compound is formed
  - b. **two disinfecting compounds are formed**
  - c. HCl is considered the primary product
  - d. Ozone is produced
28. Water in wading pools should be recirculated a minimum every
- a. 60 minutes
  - b. 90 minutes
  - c. **120 minutes**
  - d. 180 minutes
29. The preferred method for controlling sewage from watercrafts is
- a. **on board holding tanks**
  - b. overboard discharges
  - c. incinerator toilets
  - d. composting toilets
30. The molecular state of hypochlorous acid is the desired product from chlorination of pool water. This product
- a. increases as pH rises
  - b. decreases with as pH decreases
  - c. ionizes as pH decreases
  - d. **is at 62% at pH of 7.2**

31. The main drain should have a grate that is \_\_\_\_\_ the area of the discharge pipe to prevent dangerous suction effects
- a. **four times**
  - b. five times
  - c. six times
  - d. two times
32. \_\_\_\_\_ is associated with swimmers ear and appears in hot tubs frequently
- a. *Mycobacterium marinum*
  - b. *Chlamydia trachomatis*
  - c. *leptosira ssp*
  - d. ***pseudomonas aeruginosa***
33. \_\_\_\_\_ species are one of the most common pathogens in recreational water and can cause Scarlet fever
- a. Staphococcal
  - b. **Streptococcal**
  - c. Shigella
  - d. pseudomonas
34. Fish ich is a disease that
- a. otherwise known as fish tank granuloma
  - b. common to aquarium operators
  - c. both a and b
  - d. **none of the above**
35. *Mycobacterium marinum* is associated with
- a. fish ich
  - b. **fish tank granuloma**
  - c. swimmers itch
  - d. typhoid fever
36. Legionnaires disease is spread via
- a. P2P
  - b. consuming contaminated water
  - c. through open sores or wounds
  - d. **inhaled droplets**
37. Trachoma
- a. can be spread via fomites
  - b. is caused by *Chlamydia trachomatis*
  - c. can result in blindness
  - d. **all of the above**
38. \_\_\_\_\_ is the most common cause of gastroenteritis in children
- a. **HRV**
  - b. Salmonella
  - c. Infectious HepA

d. amoebiasis

39. \_\_\_\_\_ is the most common enteric disease in the US
- a. Salmonella
  - b. Viral gastroenteritis**
  - c. amoebiasis
  - d. giardiasis
40. Schistosome dermatitis outbreaks in recreational waters can be controlled through
- a. use of ozone
  - b. use of copper oxide
  - c. use of copper sulfate**
  - d. use of snails
41. Tinea is caused by
- a. bacteria
  - b. protozoa
  - c. helminth
  - d. fungus**
42. Ozone disinfection is
- a. slower than chlorine
  - b. often used in conjunction with chlorine**
  - c. effective at providing a residual
  - d. capable of producing THMs
43. Cyanuric acid is used to
- a. disinfect water
  - b. stabilize chlorine in water**
  - c. stabilize bromine in water
  - d. stabilize ozone in water
44. Bromine residuals are \_\_\_\_\_ than chlorine residuals
- a. lower
  - b. higher**
  - c. equal
  - d. more stable
45. Pools should be chlorinated to
- a. 1-3 ppm**
  - b. 3-5 ppm
  - c. 4-6 ppm
  - d. none of the above
46. The DPD test for a hot tub returned at chlorine residual of 3.1 ppm, the operator should
- a. add calcium hypochlorite
  - b. add sodium bisulfate**

- c. add sodium carbonate
- d. no action required**

47. 5 samples were taken from a public beach for coliform analysis resulting in 250/100ml, 150/100ml, 50/100ml, 75/100 ml, and 425/100ml. It is recommended that

- a. beach stay open
- b. beach be closed due to exceeding mean average coliform standard
- c. beach be closed due to exceeding the 10% coliform rule**
- d. examine epi, social, economical and psychological factors before acting

48. A pool should be immediately evacuated for

- a. blood spill
- b. vomit due to ingested water
- c. formed stool**
- d. chlorine residual of .9

49. Shocking a pool is done through

- a. superchlorination
- b. bromination
- c. electrical current
- d. a and b**

50. Chlorination of 1 ppm prevents which of the following

- a. pseudomonas aeruginosa
- b. entamoeba histolytica
- c. giardia lamblia
- d. none of the above**

51. Your pool DPD kit tells you that you have .7 mg/l combine chlorine and 1 mg/l of FAC. What action should be taken?

- a. nothing, FAC is in acceptable range of 1-3 ppm**
- b. bring the water to 3 ppm Cl and follow product label
- c. bring the water to .3 ppm Cl and follow product label
- d. evacuate the pool

52. You notice excessive scaling on your pool. You predict

- a. high langlier index**
- b. low langlier index
- c. langlier index of 0
- d. none of the above

53. Your pool has an H<sup>+</sup> concentration of 1<sup>-6</sup>. You should

- a. add sodium bisulfate
- b. add sodium carbonate**
- c. add calcium hypochlorite
- d. do nothing

54. A hot tub should be turned over every

- a. 6-8 hours
- b. 12 hours
- c. 1-2 hours
- d. 30 minutes**

55. A hot tub should not exceed

- a. 100 F
- b. 101 F
- c. 102 F**
- d. 103 F

56. A pool measures 40 ft X 20 X 5 feet. How many gallons of water are in the pool?

- a. 30000 gallons**
- b. 4000 gallons
- c. 40000 gallons
- d. 3000 gallons

57. A wading pool 20 X 20 X 1.3 ft pool wants to set their pump to operate at 1 turnover/2 hours. What rate in gallons per minute should it be set at

- a. 5 gallons per minute
- b. 1950 gallons per minute
- c. 33 gallons per minute**
- d. 65 gallons per minute

58. A pool fence should be

- a. at least 4 feet high
- b. have a self closing gate
- c. latch at least 40" off the ground
- d. all of the above**

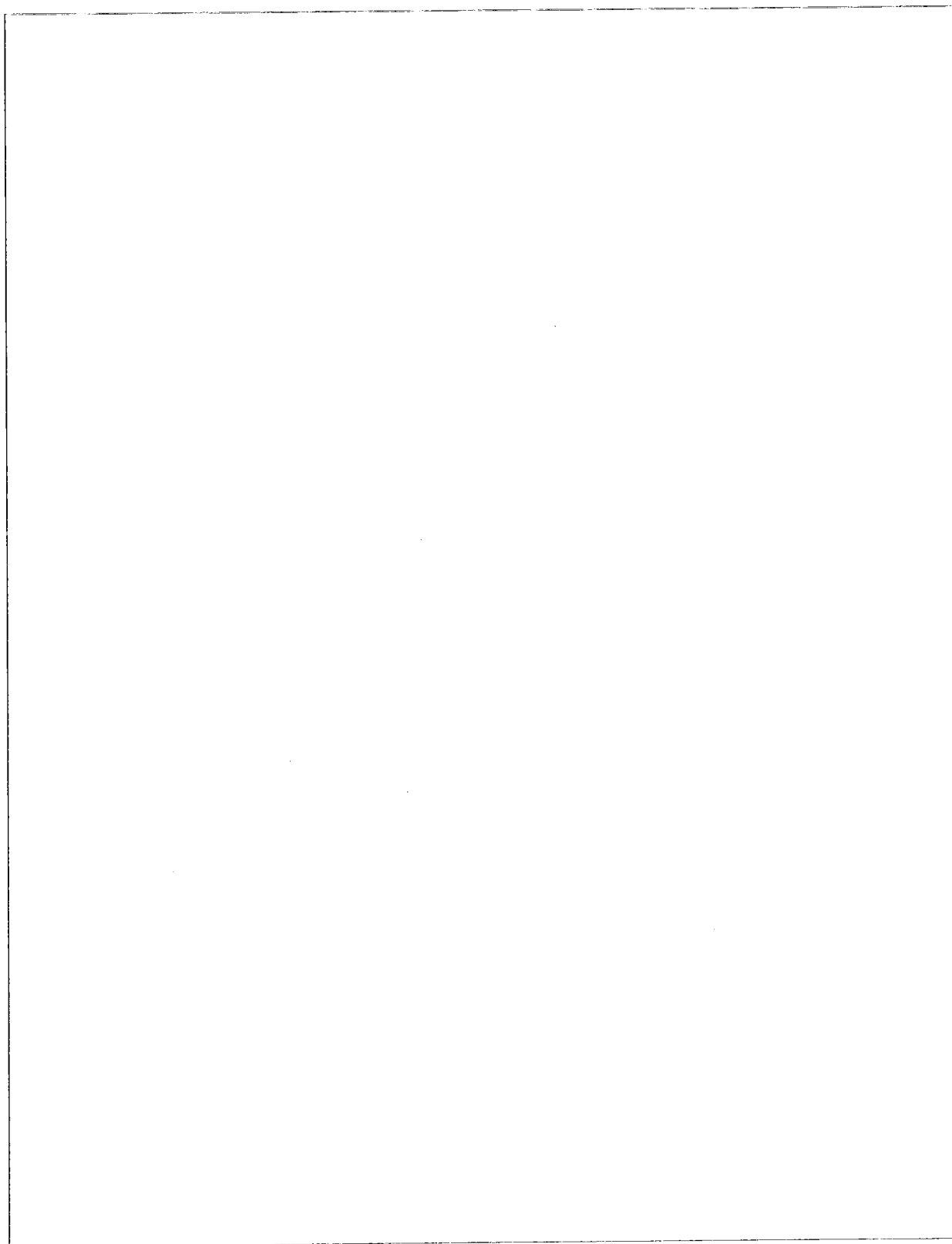
59. Chloramines are

- a. excellent sanitizers
- b. result from urine in chlorinate pool**
- c. a form of combined bromine
- d. both a and b

60. pH should not exceed 8 in a pool because

- a. decreases desired disinfection product
- b. causes eye irritation
- c. can corrode pool equipment
- d. all of the above**





## KEY Wastewater/Radiation

Tuesday, March 16, 2010  
12:39 PM

### Wastewater and Radiation

1. Biochemical oxygen demand measures
  - a. rate of oxygen uptake by micro-organisms in a sample of water at a temperature
  - b. rate at which O<sub>2</sub> oxidizes organic and inorganic materials over 5 days
  - c. the same parameters as chemical oxygen demand
  - d. none of the above
2. The best single measure for waste water is
  - a. COD
  - b. **BOD**
  - c. PPE
  - d. ATP
3. Black water contains
  - a. waste water from sinks and showers
  - b. waste water from hot tubs
  - c. **waste water from toilets**
  - d. all of the above
4. \_\_\_\_\_ specifies the treatment outcome required for wastewater.
  - a. OSHA
  - b. POTW
  - c. **NPDES**
  - d. SDWA
5. Suspended solids in wastewater are measured using
  - a. **Gooch crucible**
  - b. Turbidimeter
  - c. Marsh cone
  - d. titrations
6. The primary function of a septic tank is
  - a. pretreatment of waste
  - b. removal of SS
  - c. storage of FOG
  - d. **all of the above**
7. A septic tank has three distinct levels, which level is desirable to exit the septic tank
  - a. Scum
  - b. FOG
  - c. **Clear zone**
  - d. Sludge
8. Septic tanks should be large enough to

- a. hold 1000 gallons of sewage
  - b. hold 3 bedrooms of sewage
  - c. hold 1-2 days of sewage**
  - d. hold 2-4 days of sewage
9. The inlet baffle insures
- a. turbulence does not upset microorganisms or solids**
  - b. that liquid from the clear zone enter drain field
  - c. FOG does not leave the tank
  - d. all of the above
10. The inlet of a septic tank should be
- a. 3" higher than the outlet**
  - b. 4" higher than the outlet
  - c. 3" higher than the sludge
  - d. 4" higher than the clear zone
11. A cleanout must be placed
- a. every 5 feet
  - b. whenever the pipe turns sharper than 45 degrees
  - c. every 50 feet
  - d. both b and c**
12. A septic tank is buried 12" underground, what must be done to bring it into compliance
- a. install a riser to bring the manhole within 6" of surface**
  - b. lift the tank to bring manhole within 8" of surface
  - c. nothing, it meets EPA guidelines
  - d. locate it above ground, USTs are not allowed to be buried
13. What is the minimum diameter of the inlet and outlet of a septic tank
- a. 2"
  - b. 3"
  - c. 4"**
  - d. 6"
14. A stick is lowered into a septic tank until resistance is felt and is marked on the stick. It is then pushed until no resistance is felt and raised back up until resistance is felt again and marked on the stick. What does this represent?
- a. measuring the clear zone
  - b. measuring the sludge
  - c. measuring the FOG**
  - d. measuring the liquid
15. A tank should be pumped
- a. only if you smell odors
  - b. only after it backs up
  - c. if scum is greater than 10"

**d. if sludge + scum > ½ clear zone**

16. A p trap is used to
- a. decrease turbulence into the septic system
  - b. prevent sewage gas from entering home**
  - c. prevent SS from entering the septic system
  - d. vent sewage gas from home
17. A newly constructed home smells of sewage, what is the first action you should take
- a. have your septic tank pumped
  - b. call the contractor to fix your system
  - c. check the slope of your drain field
  - d. pour water into the floor drain of your home**
18. Your gravel drain field has to be 100 feet long due to the flow of your system. You note that after installing it, it will come within 75 feet of your neighbors well. What should you do?
- a. relocate your system
  - b. nothing, the isolation from the well is acceptable
  - c. consider using a gravel less system**
  - d. sue your neighbor for locating his well too close to your property
19. A septic tank must be
- a. 10 feet from the property line
  - b. 50 feet from a well
  - c. 50 feet from a spring
  - d. all of the above**
20. The purpose of a drain field is to
- a. evenly distribute effluent from the tank into the soil**
  - b. promote microbial action within the pipes
  - c. allow for overflow conditions of the septic tank
  - d. a place to pump out your septic tank
21. Effluent is considered purified when
- a. it exits the septic tank
  - b. when it exits the drain field
  - c. when it reaches the water table
  - d. when nitrogen, SS, organic/inorganic matls, and bact/viruses are reduced**
22. Yellow soil indicates
- a. area of saturation
  - b. fluctuating water table
  - c. presence of air in soil**
  - d. presence of sewage
23. Grey soil indicates
- a. area of saturation**

- b. fluctuating water table
  - c. presence of air in soil
  - d. presence of sewage
- 24. Mottled brown or red soil indicates
  - a. area of saturation
  - b. fluctuating water table**
  - c. presence of air in soil
  - d. presence of sewage
- 25. The munsell chart measures
  - a. saturation of soil
  - b. color of soil**
  - c. percolation of soil
  - d. permeability of soil
- 26. Soil permeability can be measured using
  - a. Gooch crucible
  - b. BOD5
  - c. March funnel
  - d. Percolation test**
- 27. The percolation test is complete when
  - a. time of water dropping 1" is equal in 3 measurements
  - b. time of water dropping 1" is within 10% in 3 measurements**
  - c. after completing 3 measurements and averaging results
  - d. after saturating for 4 hours and timing the water from 6" to 5" one time
- 28. The limiting layer can is
  - a. can effect performance of the septic system
  - b. is the seasonal high water table
  - c. can be defined as an area of very low permeability
  - d. all of the above**
- 29. Vegetation is important is locating your drain field because
  - a. tree roots and cause system failure**
  - b. plants on the surface will be come contaminated
  - c. it will be a great place to locate a garden
  - d. transpiration through plants is the primary means of purification
- 30. The area of seepage is determined by
  - a. limiting layer
  - b. soil quality and number of bedrooms**
  - c. strength of the waste
  - d. all of the above
- 31. An aerobic treatment plant is
  - a. slower than septic tank

- b. faster than septic tank
  - c. not commonly used at a residence
  - d. **both b and c**
32. Hot tubs and roof gutter should
- a. drain into the homes black water
  - b. drain into the homes grey water
  - c. drain above the drain field
  - d. **should not be drained into the septic system**
33. Large amounts of cleaning chemicals should not be poured in the sink because
- a. they are regulated by the EPA and should be disposed of as a hazardous waste
  - b. they will cause suspended solids to clog the effluent filter
  - c. **they could kill microorganisms in your septic tank**
  - d. they will corrode your metal septic tank
34. A dug well is more susceptible to contamination from septic systems because
- a. septic tanks naturally release sewage that contaminates the water table
  - b. **effluent can contaminate high water tables before being properly treated**
  - c. isolation distances do not apply to dug wells
  - d. septic tanks are only required to be 10 feet away from a dug well
35. The primary indicator organism for fecal contamination of a water supply is
- a. Salmonella Typhi
  - b. Salmonella Typhimurium
  - c. **Escherichia Coli**
  - d. Vibrio Cholera
36. Typhoid fever is caused by
- a. virus
  - b. **bacteria**
  - c. helminth
  - d. protozoa
37. Salmonellosis is caused by
- a. Salmonella Typhi
  - b. **Salmonella Typhimurium**
  - c. Escherichia Coli
  - d. Vibrio Cholera
38. Yersinosis is caused by
- a. Yersinia Pestis
  - b. **Yersinia Enterocolitica**
  - c. Yersina Major
  - d. none of the above
39. Leptospirosis is a disease that is an occupation hazard to

- a. sewer workers
  - b. slaughter house workers
  - c. veterinarians
  - d. all of the above
40. HRV is the most common cause of enteritis in the world and is caused by
- a. bacteria
  - b. virus
  - c. helminth
  - d. protozoa
41. Which of the following was first recognized in military recruit and can cause ARD
- a. HAdV
  - b. HRV
  - c. NLV
  - d. leptospirosis
42. Poliomyelitis
- a. is eradicated from the world
  - b. can cause AFP
  - c. is caused by the polio bacteria
  - d. both b and c
43. Balantidium coli
- a. is a primary indicator of fecal coliform
  - b. can cause EHEC
  - c. can remain for years in the soil as a cyst
  - d. causes Balantidium fever
44. Cystercercosis would mostly likely be caused by
- a. ingestion of taenia solium eggs
  - b. ingestion of balantidium cysts
  - c. ingestion of cyclospora cysts
  - d. ingestion of taenia. saginata eggs
45. The human whipworm or Trichuris trichiura
- a. has been used to treat Crohns disease
  - b. causes Trichuriasis
  - c. is normally detectible in stool exams
  - d. all of the above
46. Which of the following is a source of ionizing radiation
- a. microwaves
  - b. UV rays
  - c. cosmic rays
  - d. alpha rays
47. Ionizing radiation

- a. is low energy and is ionized
- b. is high energy and removes electrons from material**
- c. is composed of ions
- d. moves at the speed of light

48. Radon is a source of

- a. alpha radiation**
- b. beta radiation
- c. gamma radiation
- d. x ray

49. Cobalt 60 is an example of a \_\_\_\_\_ emitter

- a. alpha radiation
- b. beta radiation
- c. gamma radiation**
- d. x ray

50. A piece of paper can stop

- a. alpha radiation**
- b. beta radiation
- c. gamma radiation
- d. x ray

51. Primary protection from radiation hazards includes

- a. time, distance, shielding**
- b. dilution of source
- c. decay
- d. PPE

52. Somatic effects do not effect the

- a. reproductive cells**
- b. dna
- c. skin
- d. organs

53. Radon is considered \_\_\_\_\_ human carcinogen

- a. Class A**
- b. Class B
- c. Class C
- d. Class E

54. Permethrin is considered a \_\_\_\_\_ human carcinogen

- a. Class A
- b. Class B
- c. Class C**
- d. Class E

55. Tobacco smoke, which contains Po 210 is considered



- a. Class A
- b. Class B
- c. Class C
- d. Class E

56. The follow organization governs naturally occurring radiation

- a. **EPA**
- b. NRC
- c. DOE
- d. naturally occurring radiation is not a concern

57. The sievert (formerly the REM) measures

- a. absorbed dose
- b. **equivalent dose**
- c. decay rate
- d. none of the above

58. The EPA Radon standard of exposure is

- a. **4 pCi/l**
- b. 40 pCi/l
- c. .4 pCi/l
- d. none of the above

59. The OSHA Radon standard of exposure is

- a. 10 pCi/L
- b. .1 pCi/L
- c. **100 pCi/L**
- d. none of the above

60. Radon can be remove from a house by

- a. filtration systems
- b. **venting above highest peak in house**
- c. ionizer
- d. both b and c

