Community Medicine

29th lecture:

Environmental Health and Hazards

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Objectives:

1. Concepts of environment and health
2. Environmental hazards
3. Control of environmental hazards
4. Mass gathering and health
5. Principals of occupational health

Health is

"a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"

Public health

is "the science and art of preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations, public and private, communities and individuals."

Environmental Health

1.1. Environment: In general, environment refers to the surroundings of an object

Pollution: Pollution is the introduction of pollutants or contaminants into a natural environment that causes instability, disorder, harm or discomfort to the ecosystem i.e. physical systems or living organisms.

Environment doesn't equal echo system.

Pollution can take the form of chemical substances or energy, such as noise, heat, or light. Pollutants, the elements of pollution, can be foreign substances or energies, or naturally occurring; When naturally occurring, they are considered Pollutants when they exceed natural levels.
e.g.: adding salt to sea-water is not considered pollution. However, adding the same amount of salt to well's water is.

*pollution is wider than contamination. In other words, contamination is a special case of pollution.

1.3. Environmental health

- Environment is the area surrounding a place.
- Environmental health is the branch of public health that is concerned with all aspects of the natural and built environment that may affect human health.
- Environmental health: Those aspects of the human health and disease that are determined by factors in the environment
- It also refers to the theory and practice of assessing and controlling factors in the environment that can potentially affect health.
- Almost all communicable diseases have an environmental element.
- An example of an environmental disease is skin cancer caused by UV light.

1.4. Concepts of Environment and health

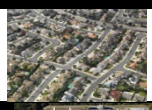
- **Air quality, including both ambient outdoor air and indoor air quality, which also comprises concerns about environmental tobacco smoke .**


- **Climate change and its effects on health.**

- **Disaster preparedness and response. (e.g. tsunami)**

- **Food safety: including in agriculture, transportation, food processing, wholesale and retail distribution and sale**

- **Hazardous materials management, including hazardous waste management, contaminated site remediation, the prevention of leaks from underground storage tanks and the prevention of hazardous materials releases to the environment and responses to emergency situations resulting from such releases.**
- **Housing, including substandard housing reduction**
- **Childhood lead poisoning prevention.**
- **Land use planning, including smart growth**



- **Liquid waste disposal, including city wastewater treatment plants and on-site waste water disposal systems, such as septic tank systems and chemical toilets.**

- **Medical waste management and disposal.**

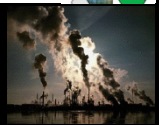
- **Noise pollution control.**

- **Occupational health and industrial hygiene.**
- **Radiological health, including exposure to ionizing radiation from X-rays or radioactive isotopes.**
- **Recreational water illness prevention, including from swimming pools, spas and ocean and freshwater bathing places.**

- **Safe drinking water.**

- **Solid waste management, including landfills, recycling facilities, composting and solid waste transfer stations**

- **Toxic chemical exposure whether in consumer products, housing, workplaces, air, water or soil.**



- **Vector control, including the control of mosquitoes, rodents, flies, cockroaches and other animals that may transmit pathogens.**

EXAMPLE I: Air quality

A). Primary pollutants include:

- Nitrogen oxides(NOx) - especially nitrogen Carbon monoxide - is a colorless, odorless, non-irritating but very poisonous gas
- Carbon dioxide(CO2) - a colorless, odorless, non-toxic greenhouse gas associated with ocean acidification, emitted from sources such as combustion, cement production, and respiration
- Particulate matter(PM) - Particulates, alternatively referred to as particulate matter (PM) or fine particles, are tiny particles of solid or liquid suspended in a gas.

- (Small/fine particles are more susceptible to be trapped/suspended in the air than the large ones)
- What is the ideal air temperature for the human body? 22° C
- What is the relative humidity in Riyadh? 10%
- What is the relative humidity in Jeddah and Dammam? Up to 85%
- What is the ideal relative humidity for the human body? 60%

- Toxic metals, such as lead, cadmium and copper.
- Chlorofluorocarbons(CFCs) - harmful to the ozone layer emitted from products currently banned from use.
- Ammonia(NH3)- emitted from agricultural (farming) processes.

Notes:

- The direct effect of greenhouse is global warming.
- Ozone layer is formed by ultraviolet rays, yet, it protects the earth from UV light. However, chlorofluorocarbons prevent ozone (O_3) from forming causing ozone hole.
- So the cause of the green house effect is O_2 while the cause of the ozone hole is chlorofluorocarbon.
- Odorless gases are more dangerous than the ones with special smell, because when they exist you won't notice them.

B). Secondary pollutants:

Are not emitted directly. Rather, they form in the air when primary pollutants react or interact.
Include:

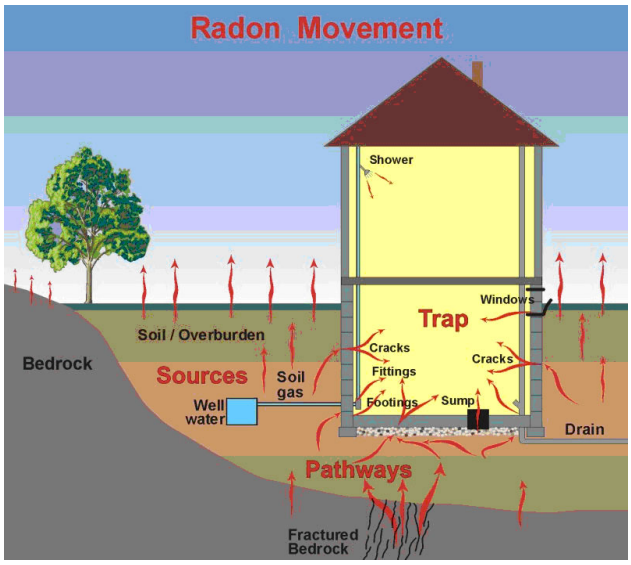
- Particulate matter formed from gaseous primary pollutants and compounds in photochemical smog.
- Ground level ozone (O3) formed from NOx and VOCs. Ozone (O3) is a key constituent of the troposphere.

Second-hand smoke:

Second-hand smoke is tobacco smoke, which affects persons other than the 'active' smoker.

Radon:

Radon is an invisible, radioactive atomic gas that results from the radioactive decay of radium, which may be found in rock formations beneath buildings or in certain building materials themselves.



Radon is probably the most pervasive serious hazard for indoor air in the United States and Europe, probably responsible for tens of thousands of deaths from lung cancer each year.

Moulds And Other Allergens:

These biological chemicals can arise from a host of means, but there are two common classes:

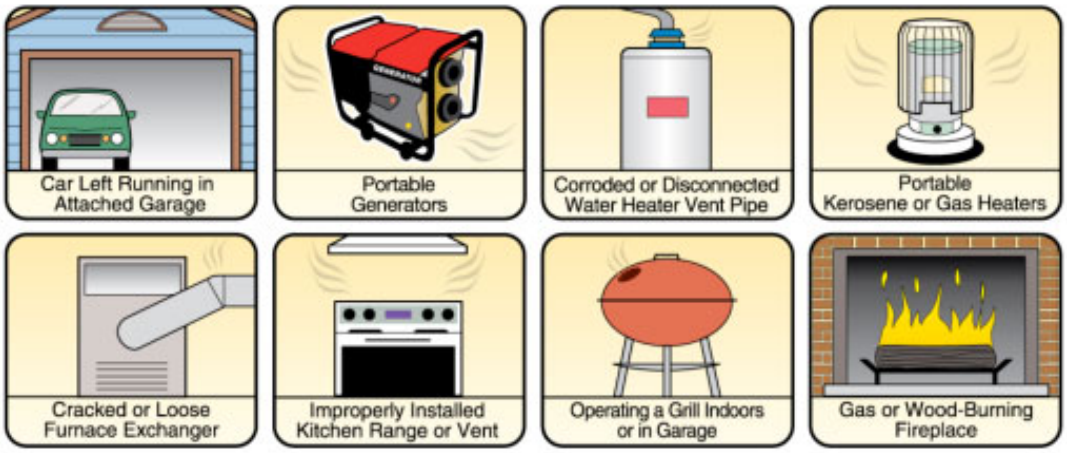
(a) Moisture induced growth of mold colonies and
(b) Natural released into the air such as animal dander and plant pollen.

There are some varieties of mould that contain toxic compounds (**mycotoxins**).

Mould on the walls

CARBON MONOXIDE:

A colourless, **odourless** gas that is a byproduct of incomplete combustion of fossil fuels. Common sources of carbon monoxide are tobacco smoke, space heaters using fossil fuels, defective central heating furnaces and automobile exhaust.



Carbon Monoxide in our daily life

VOLATILE ORGANIC COMPOUNDS:

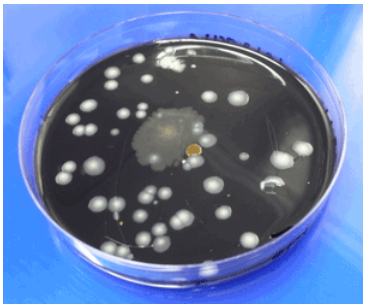
Concentrations of many VOCs are consistently higher indoors **(up to ten times higher)** than outdoors.

Examples include: paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions.

LEGIONELLA:

Legionellosis or Legionnaire's Disease is caused by a waterborne bacterium Legionella that grows best in slow-moving or still, warm water.
The primary route of exposure is through the creation of an aerosol effect, most commonly from evaporative cooling towers or showerheads.

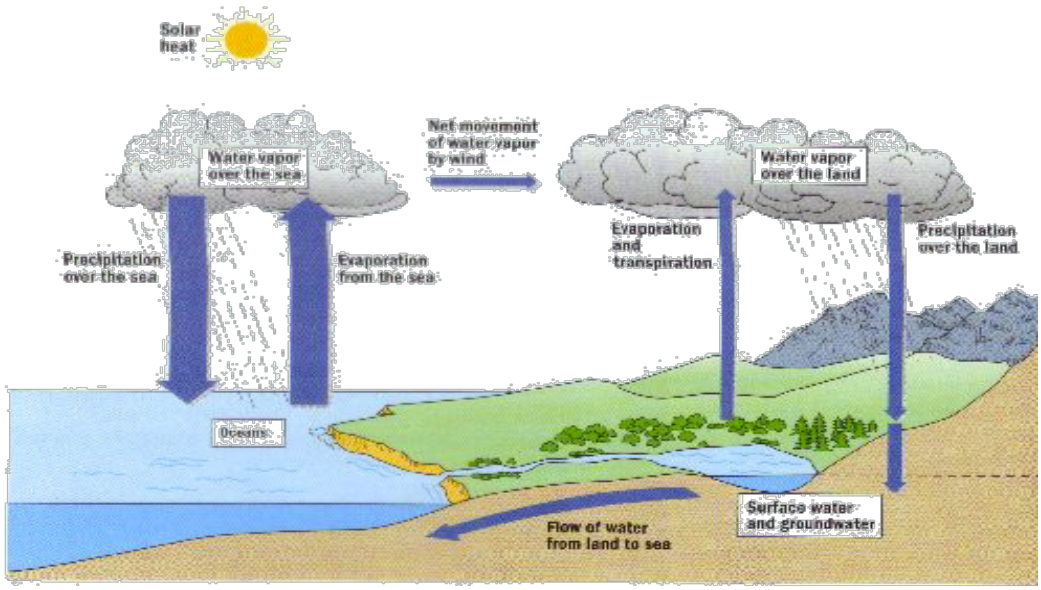
Legionella testing typically involves collecting water samples and surface swabs from evaporative cooling basins, shower heads, and other locations where warm water collects



ASBESTOS FIBRES:

Asbestos is found in older homes and buildings, but it is most dangerous in schools and industrial settings

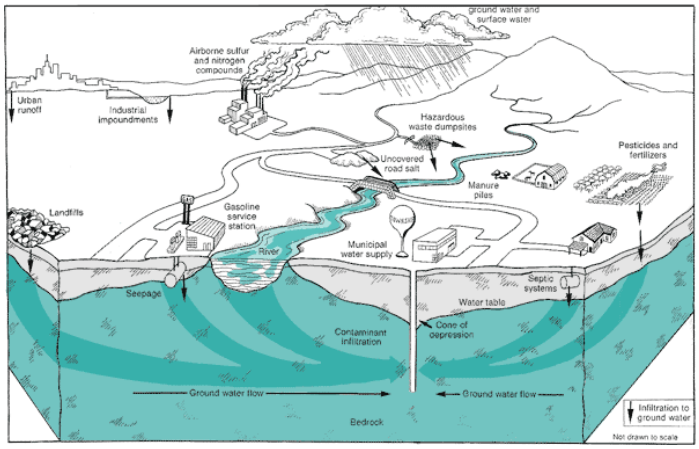
EXAMPLE II: WATER:

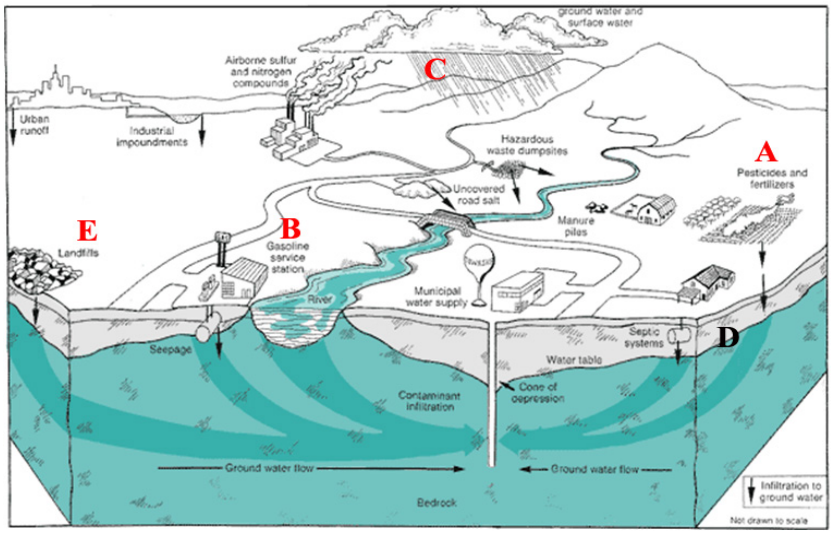


- Evaporation and Transpiration
- Condensation and Precipitation
- Runoff and infiltration
- Streams
- Groundwater – held in aquifers

Sources of Pollution & Causes of Contamination

- Improper Waste Disposal
- Improper Well Construction
- Poor Site Selection
- Wells Not Properly Abandoned
- Improper Waste Storage
- Lack of Information on Hazardous Sites or Activities





Question (34): According to the figure above, surface water and groundwater can be polluted by different sources. Letter "A" on the figure can be considered as one of the following:

a) Fertilizer and pesticides pollutant.
b) Leak of fuel to the groundwater.
c) Acid rain.
d) Groundwater contamination with domestic wastewater.
e) Groundwater contamination with leakage of solid waste hazardous materials.

Water Disinfection:

1. Chlorination. using chlorine
2. Ozonization. using ozone
3. Bromination. using bromine.
4. Iodination. using iodine.
5. Exposure to Ultra Violet Rays using UV Rays.
6. Heating. By boiling
7. Addition of lime. using lime.
8. Exposure to Ultra Sonic Waves.

Chlorination is the most common method for ease of control and low cost in addition to its effectively.

- Ozonization is safer than chlorination when disinfecting water, even though chlorination is most common.

- Basics you need to know and memorize:

- These units are equal to each other: **Mg/L** = **part/million** (part per million or ppm) = **g/m**
- Chlorine amount needed to disinfect any water: 0.5-1 mg/L
- Chlorine amount needed to disinfect a swimming pool: **2mg/L = 2g/m = 2 ppm**

Question: We have a swimming pool with the following dimensions:
(Length: 10m, Width: 5m, Depth: 1m)

- What is the swimming pool's volume? 10x5x1=**50m**
- How many grams do we need to disinfect this swimming pool? 50x2=**100 g pure chlorine**!

* Got it? Now focus on the following please! *

If we have a bottle of chlorine with a concentration of 25%, how many grams of this bottle do we need?
400! Why? Because the bottle's concentration is not 100%, it is 25%

Applying Chlorination in rural areas:

This could be carried out with any powder or solution containing Cl_2 (Chlorine) as:

a. Chlorinated lime = Bleaching powder, 25-35% Cl_2
b. HTH = High-test hypochlorite powder, 70-75% CI_2.
c. Sodium hypochlorite solution, 15% Cl_2

High-test hypochlorite powder (used in swimming pools)

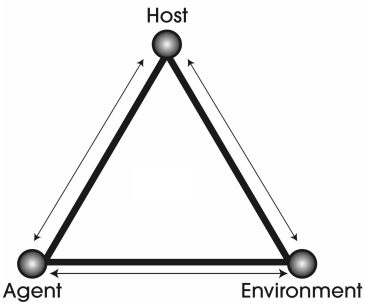
Ex. Water quantity	**= 100 m^3/day.**
Residual Cl_2 required	**= 0.5 ppm**
Cl_2 demand	**= 0.6 ppm**
Cl_2 dose	**= 1.1 ppm**

So every 1 m^3 needs 1.1 gm CI_2
100 m^3 need 100 x 1.1 = 110 gm Cl_2/day
for one month 110 x 30 = 3300 gm Cl_2
Every 1 gm of HTH contains 0.75 gm CI_2

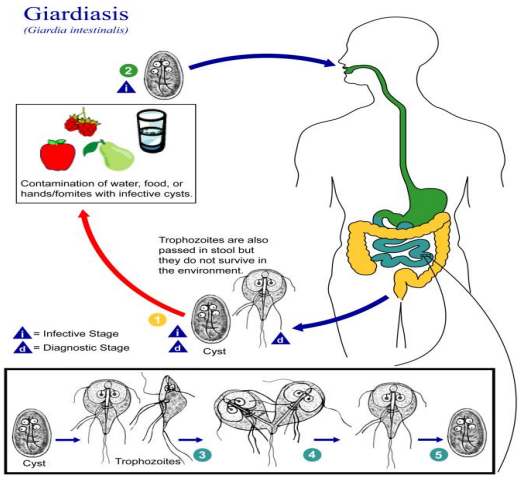
$$\textbf{So amount of HTH needed} = \frac{100 \times 1.1 \times 30}{0.75} = 4400 \text{ gm HTH / month}$$

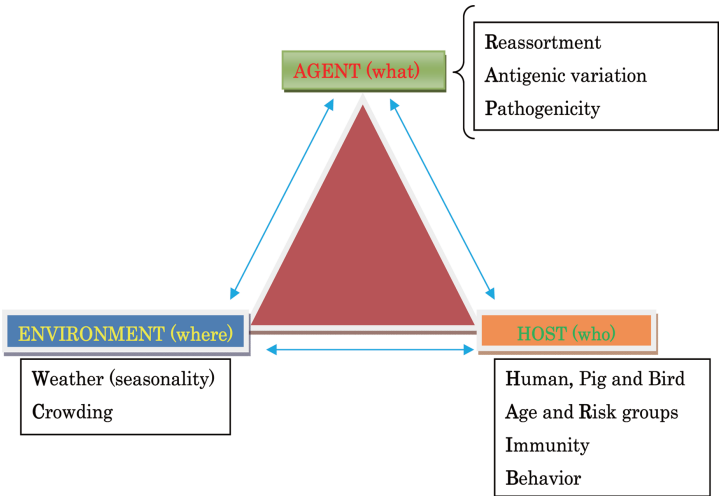
$$= 4.4 \text{ Kg HTH / month}$$

1.5. Epidemiologic Triangle



- Host, agent, and environment are needed to complete the Epidemiologic Triangle.

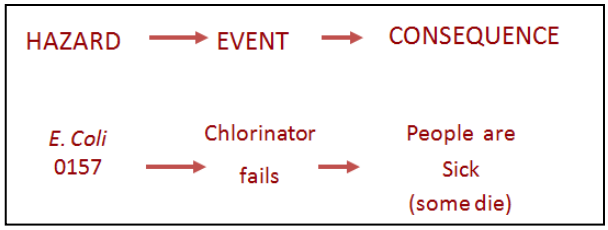




- Pandemic (H1N1) 2009 Virus Viewed from an Epidemiological Triangle Model

Risk Assessment

Potential for risk:



For each event:

- How severe would the public health consequences be? [Severity]
- How likely is the event to happen? [Frequency]

Importance = Severity X Frequency

Risk scoring matrix:

Likelihood	Severity of Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	2	2	3	3	4
Likely	1	2	2	3	3
Possible	-	1	2	3	3
Unlikely	-	-	1	2	3
Rare	-	-	1	2	2