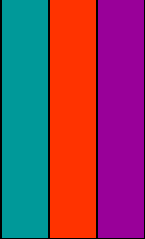




Preview: epidemiology and innate defense



Q1: What's epidemiology?

Q2: How does the pathogen transmitted?

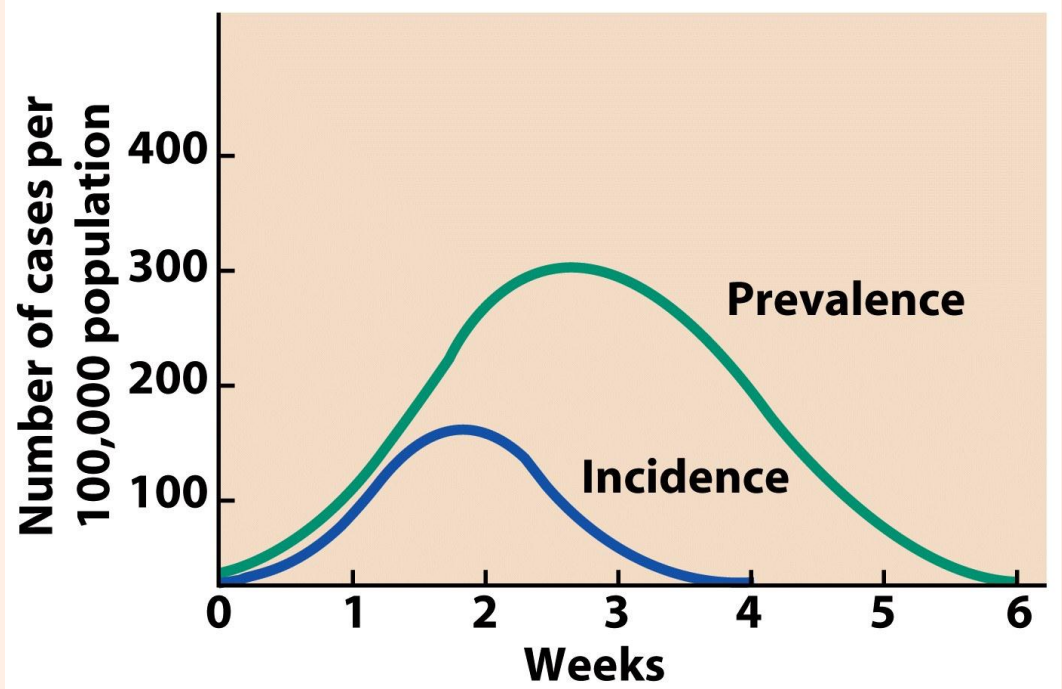
Q3: What's innate defense?

Epidemiology

the study of the **frequency** and **distribution** of disease in order to identify its cause, source, and route of transmission.

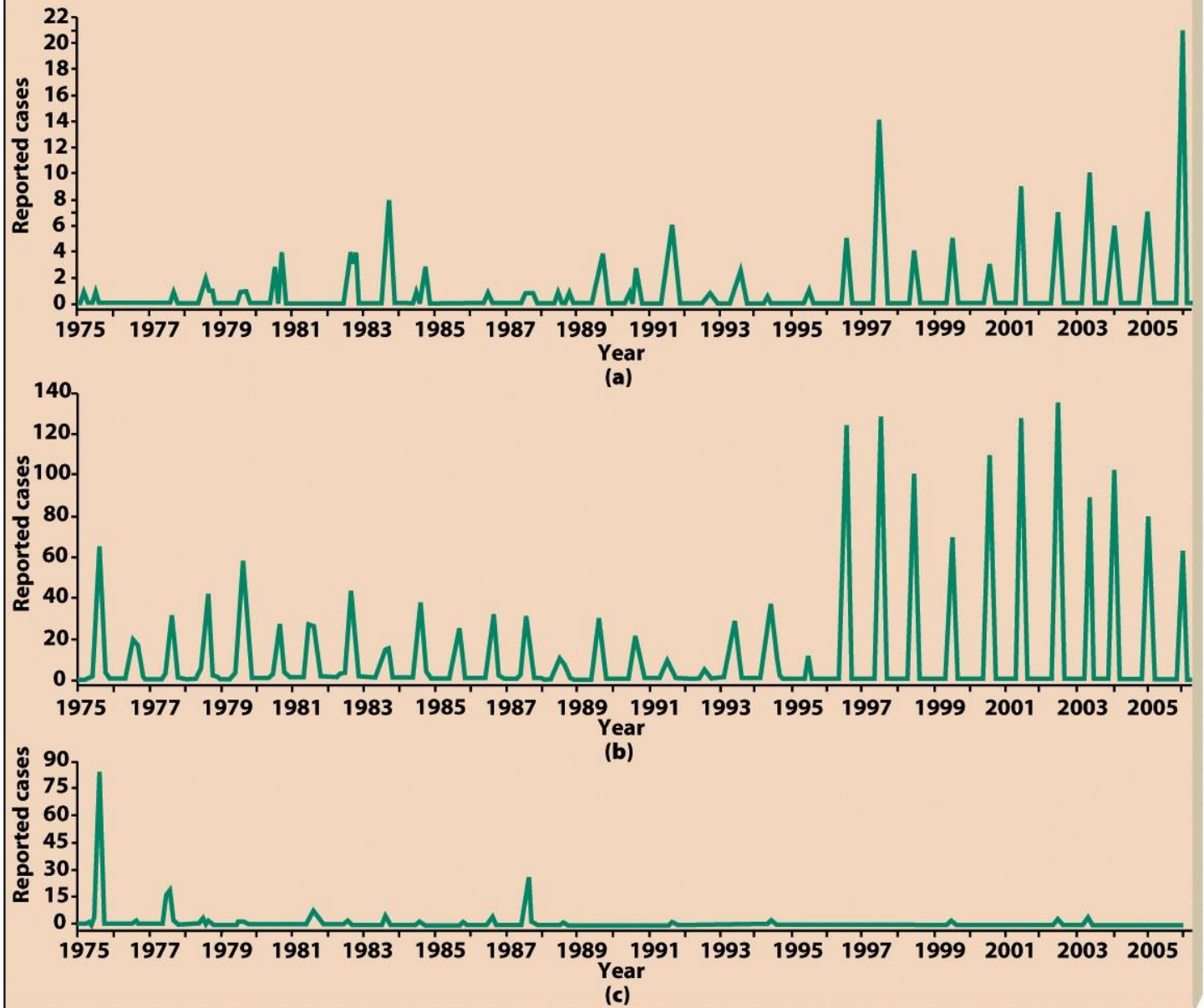
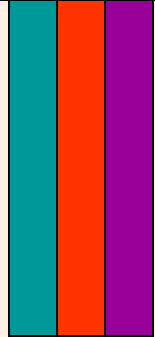
- What is Epidemiology?
- Etiology

the study of the causation.



Incidence reflects number of new cases per specific time period
Prevalence reflects total number of existing cases

Incidence Types





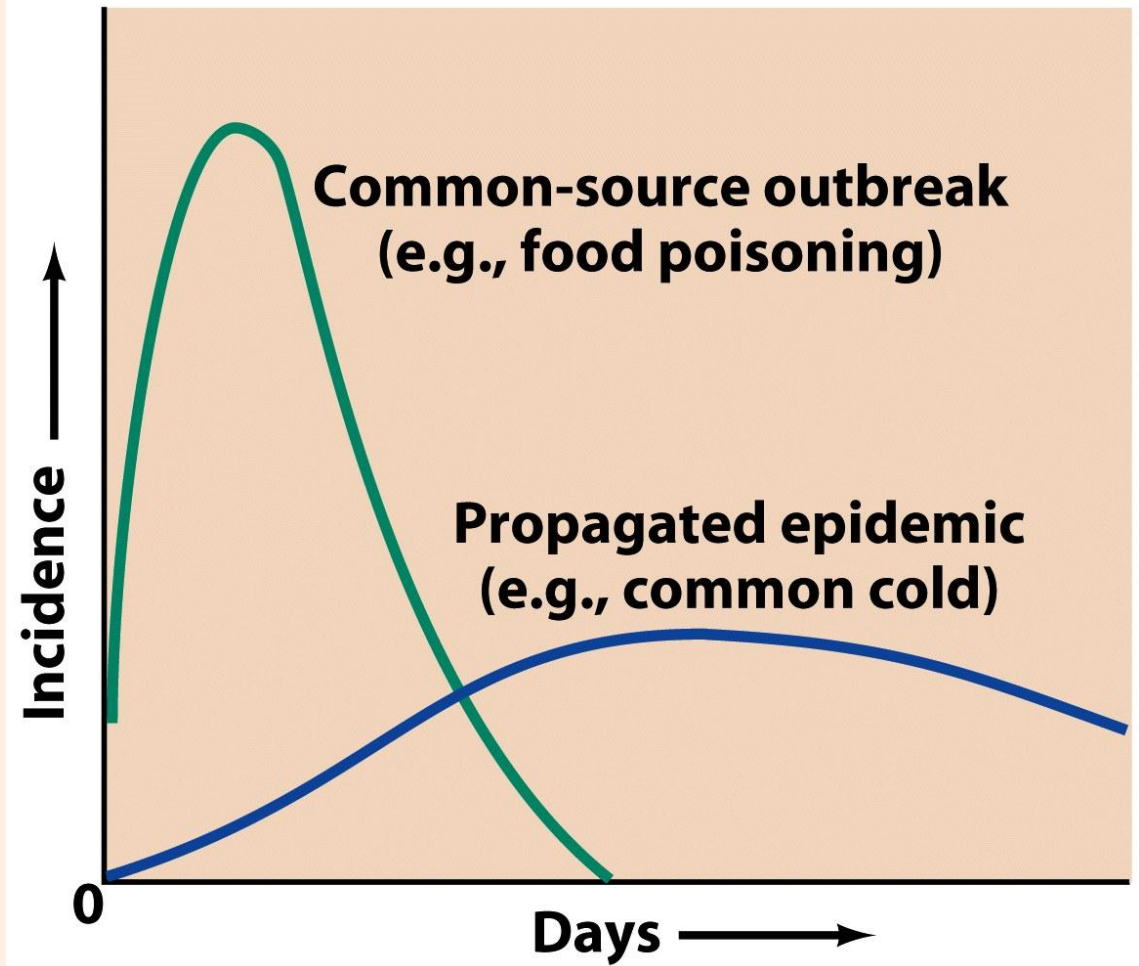
■ Rate of disease in population

- **Morbidity rate** is number of cases of illness divided by population at risk
- **Mortality rate** reflects population that dies from disease
- **Incidence** reflects number of new cases per specific time period
- **Prevalence** reflects total number of existing cases
- Diseases that are constantly present are **endemic**
- Unusually large number of cases in a population constitutes an **epidemic**
 - When epidemics spread worldwide they are termed pandemic
- **Outbreak** refers to a cluster of cases in a brief time affecting a specific population

Disease Spread

■ Common Source Outbreak

■ Propagated Epidemic





■ Non-communicable

- Disease that does not spread from one host to another
- Disease is often caused by individual's own normal flora or from an environmental reservoir

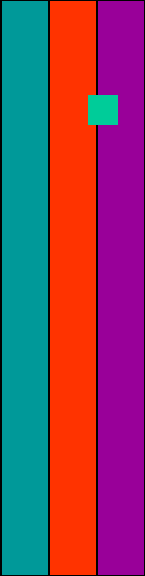


■ Communicable disease

- Disease transmitted from one host to another

■ In order for disease to spread, a chain of events must occur

- Pathogen must have suitable environment in which to live
 - Natural habitat is termed **reservoir**
- Pathogen must leave reservoir to be transmitted to susceptible host
 - Organism leaves animal reservoir through **portal** of exit



■ Human reservoirs

- Infected humans most significant reservoirs
 - Primarily of communicable diseases
 - In some cases humans are only reservoir
 - In this case disease is easier to control
- Human reservoirs as
 - Symptomatic infections
 - Obvious source of infectious agents
 - Ideally infected individuals understand the importance of precautions such as hand washing to inhibit transmission
 - Asymptomatic carriers
 - Individual harbors pathogen with no ill effects
 - They may shed organisms intermittently for long periods of time
 - Some have asymptomatic infection
 - » More likely to move about spreading pathogen

Principles of Epidemiology

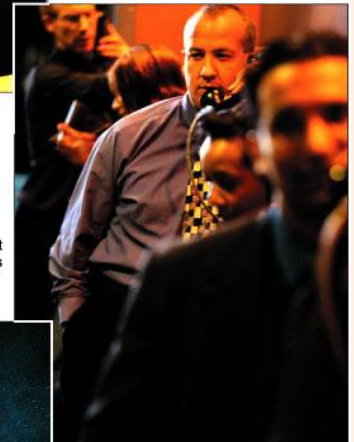
- **Reservoirs of infectious disease**
 - Reservoir of pathogen affects extent and distribution of disease
 - Recognizing reservoir can help protect population from disease
 - Reservoirs can be
 - Human
 - Non-human animal
 - Environmental

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Transmission



Direct contact



Indirect contact through surfaces



Vectors



Airborne

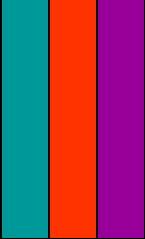


Food/water

(b)



Principles of Epidemiology

- 
- **Non-human animal reservoirs**
 - Source of some pathogens
 - Disease transmitted by non-human animal reservoirs are termed **zoonotic**
 - Disease often more severe in humans than in normal animal
 - Infection in humans is accidental

Principles of Epidemiology

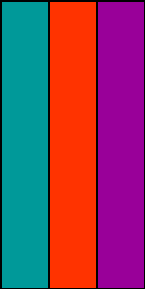
Environmental reservoirs

- Some pathogens have environmental reservoirs, which can include
 - Water
 - Soil
- These pathogens difficult or nearly impossible to eliminate





Principles of Epidemiology

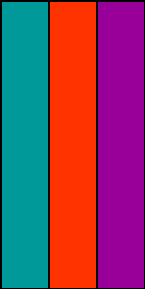


■ Portals of exit

- Microbes must leave one host in order to be transmitted to another
 - Organisms inhabiting intestinal tract are shed in feces
 - Organisms inhabiting respiratory tract are expelled in respiratory droplets of saliva
 - Organisms of the skin are shed with skin cells as they slough off



Principles of Epidemiology

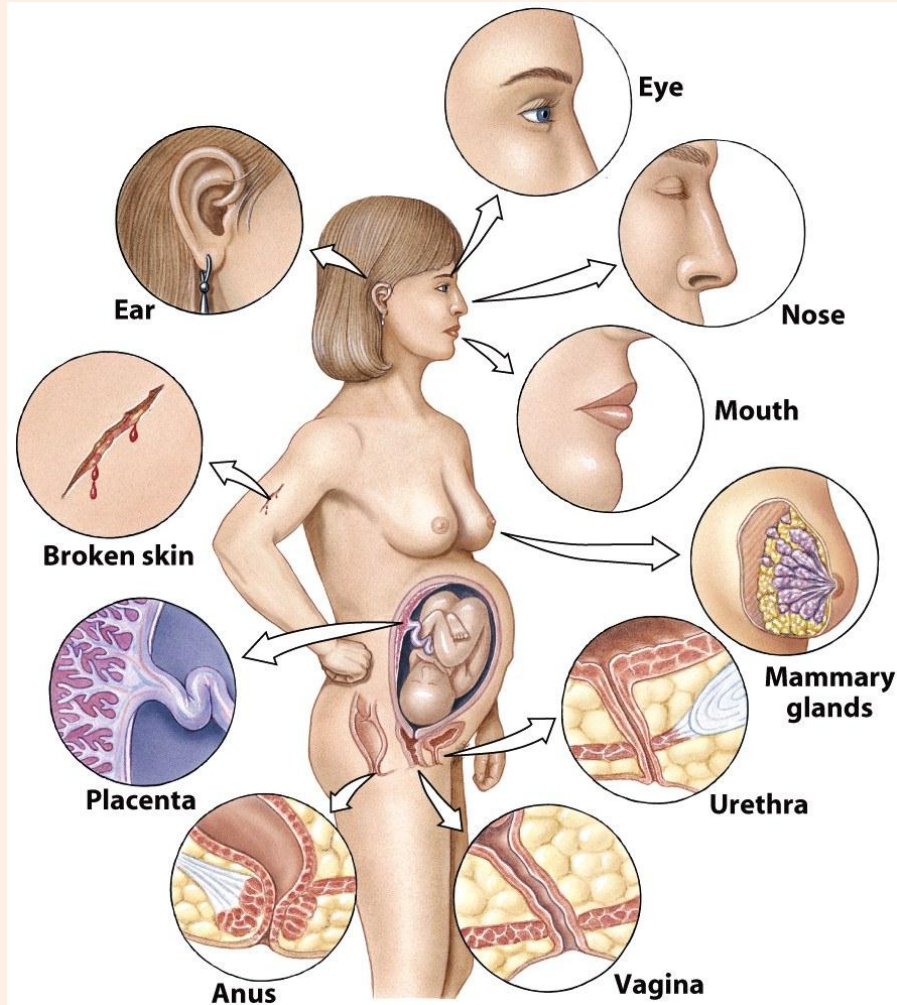


■ Transmission

- Successful pathogen must be passed from reservoir to next susceptible host
- Transmission of pathogen via contact with food, water, or living agent is termed **horizontal transmission**
- Transmission via transfer of pathogen from mother to fetus or child through breast feeding is termed **vertical transmission**

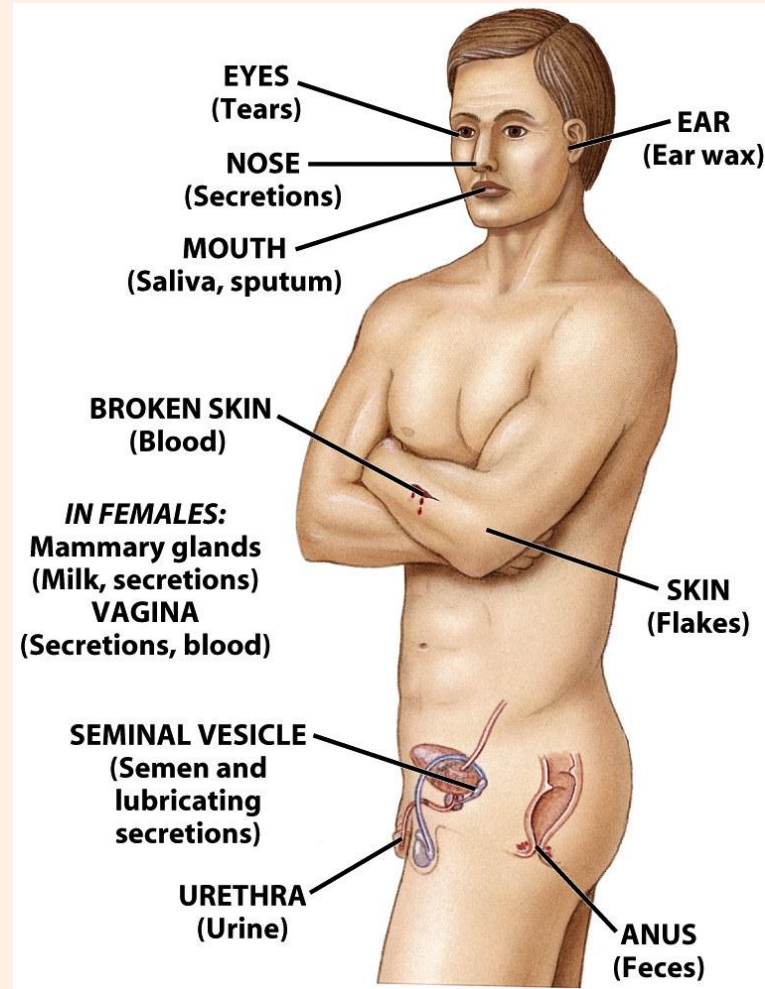
Microbe Spread

■ Portals of Entry



Microbe Spread

■ Portals of Exit

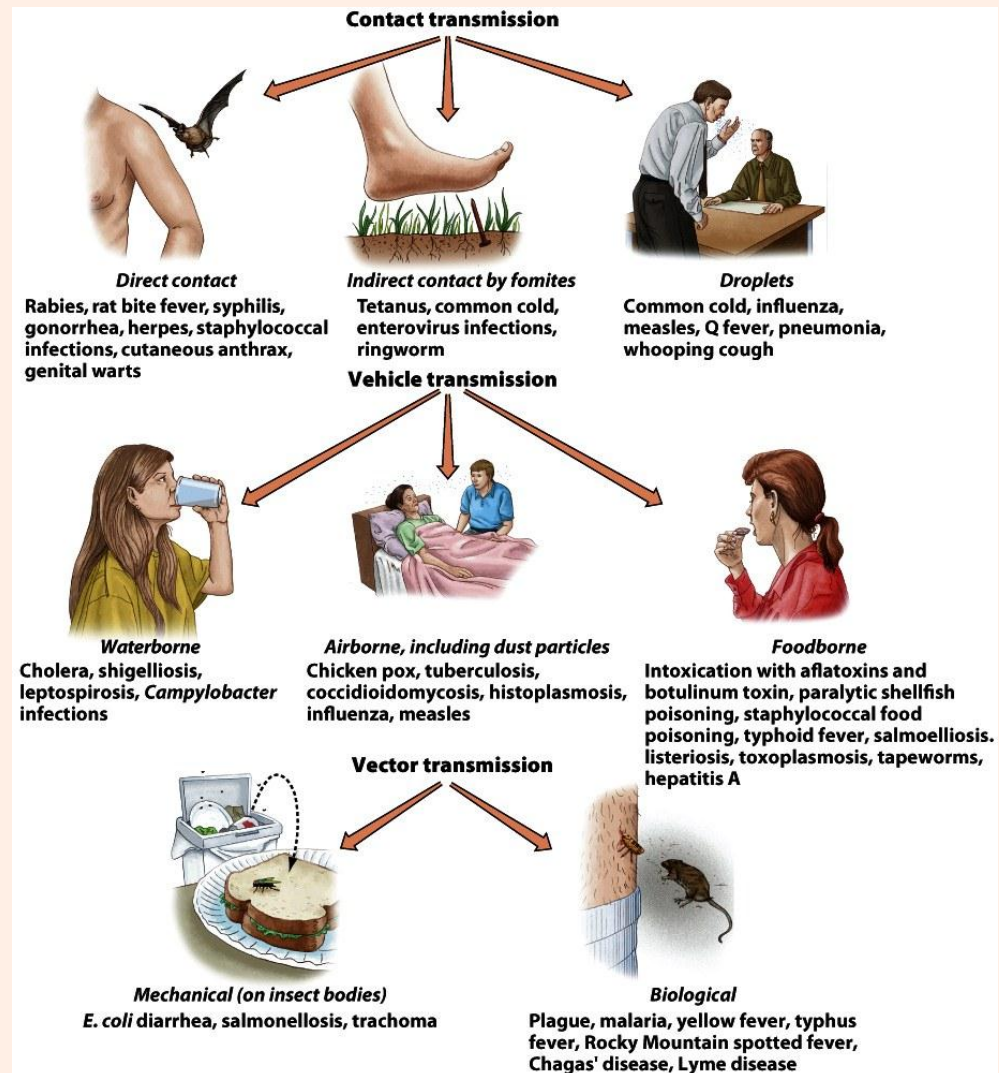


Modes of Disease Transmission

■ Contact

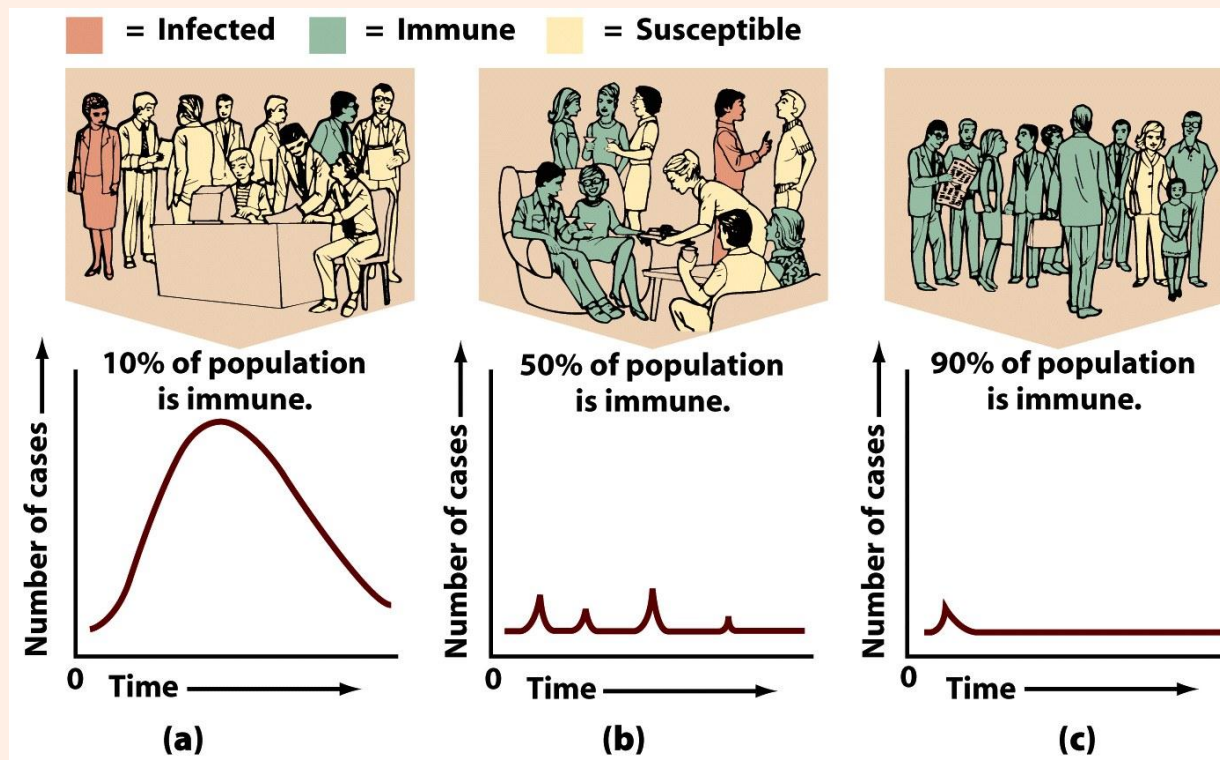
■ Vehicles

■ Vectors



Problems in Disease Transmission

- Disease Cycles
- Herd Immunity



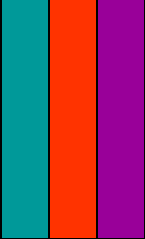
Controlling Disease Transmission

■ Biosafety





Public Health Organizations

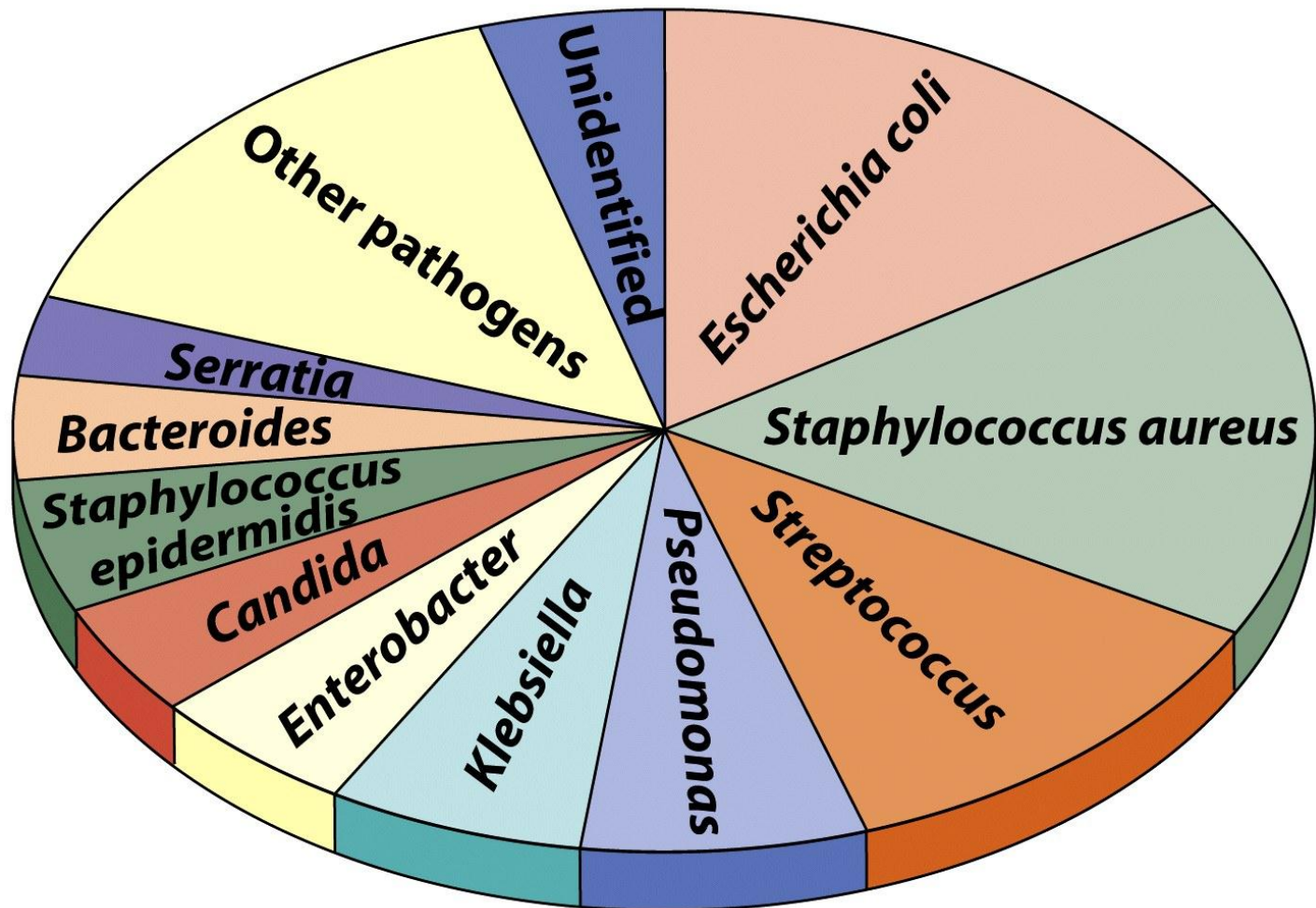
- 
- Center for Disease Control (CDC)
 - World Health Organization (WHO)

Nationally Notifiable Infectious Diseases

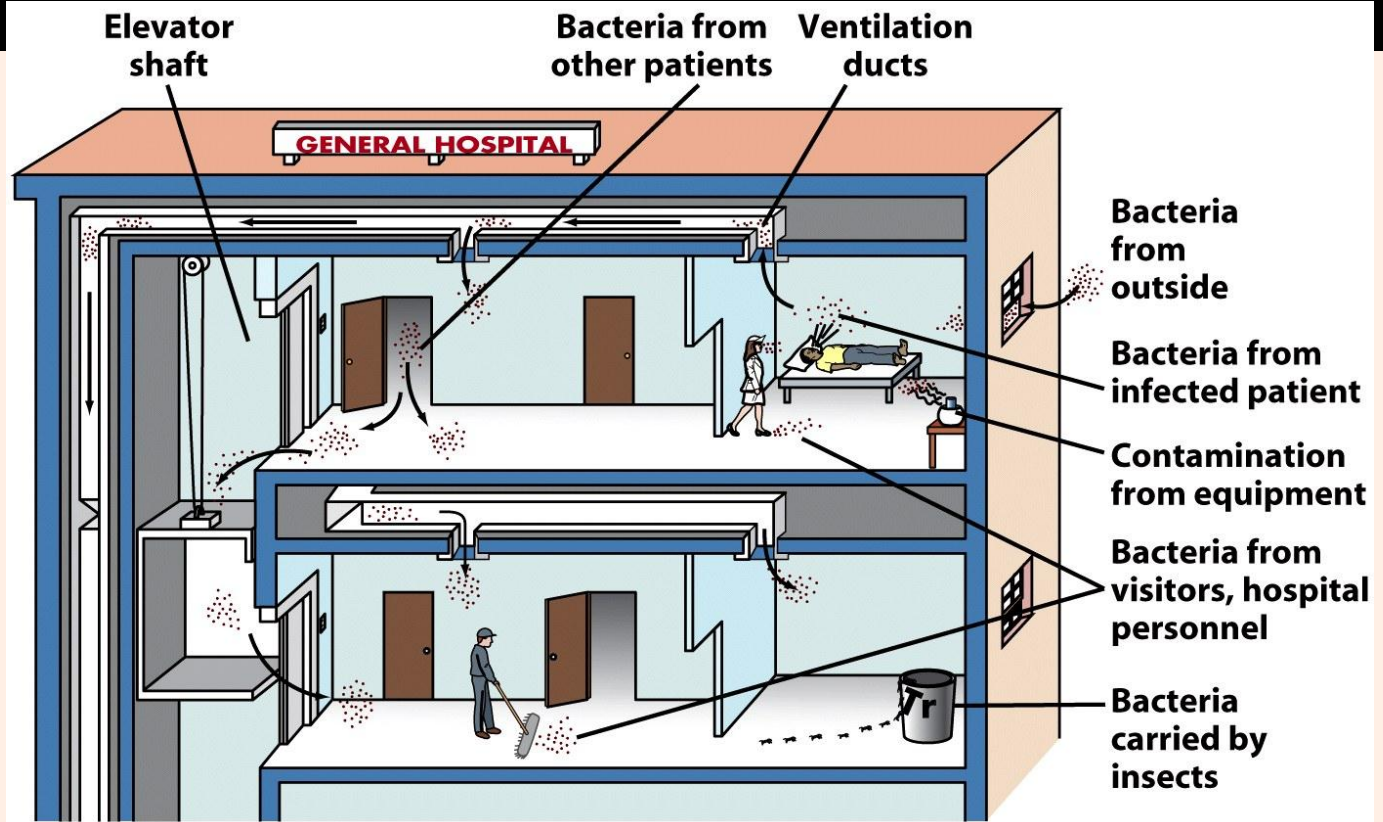
any disease that is required by law to be reported to government authorities.

Nosocomial Infections

■ Sources



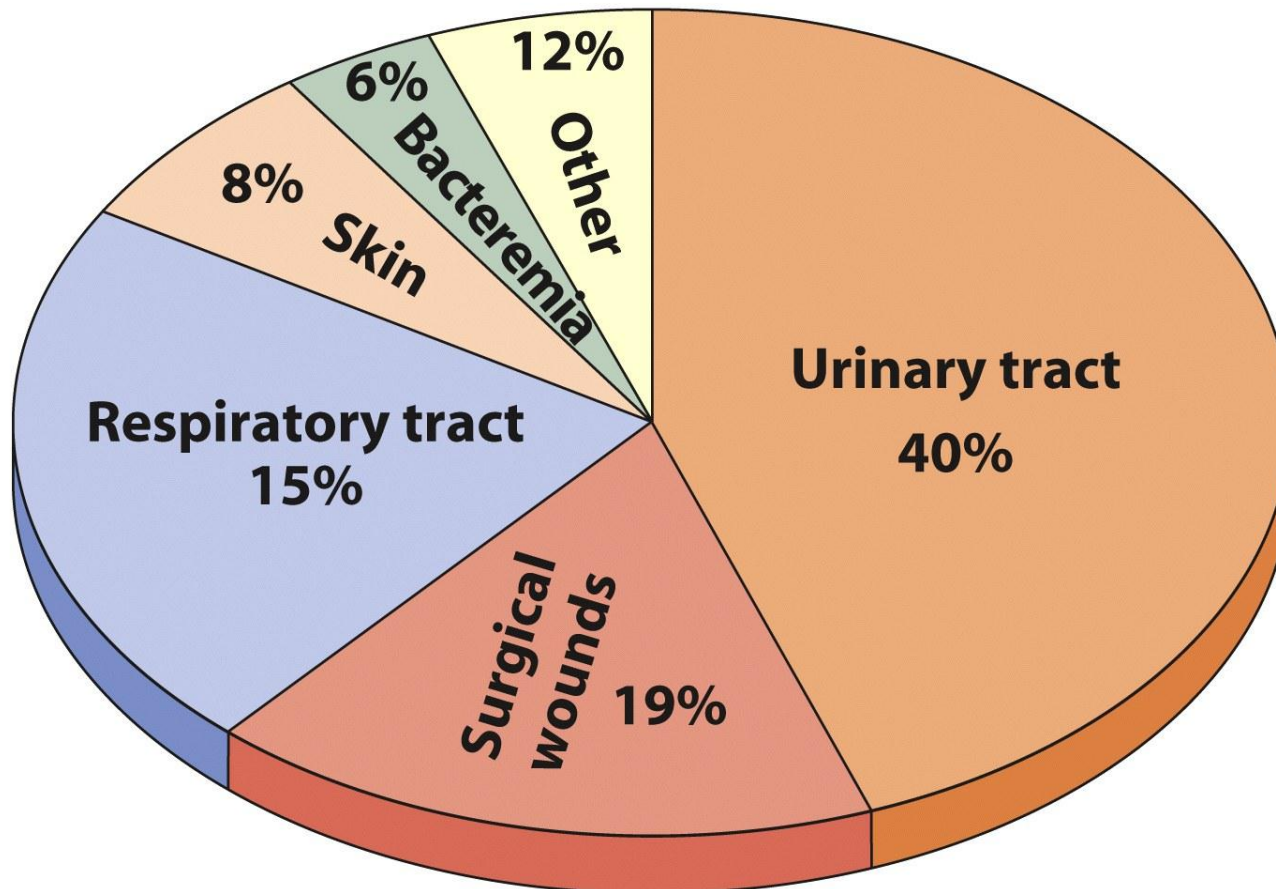
Nosocomial Infection Risks



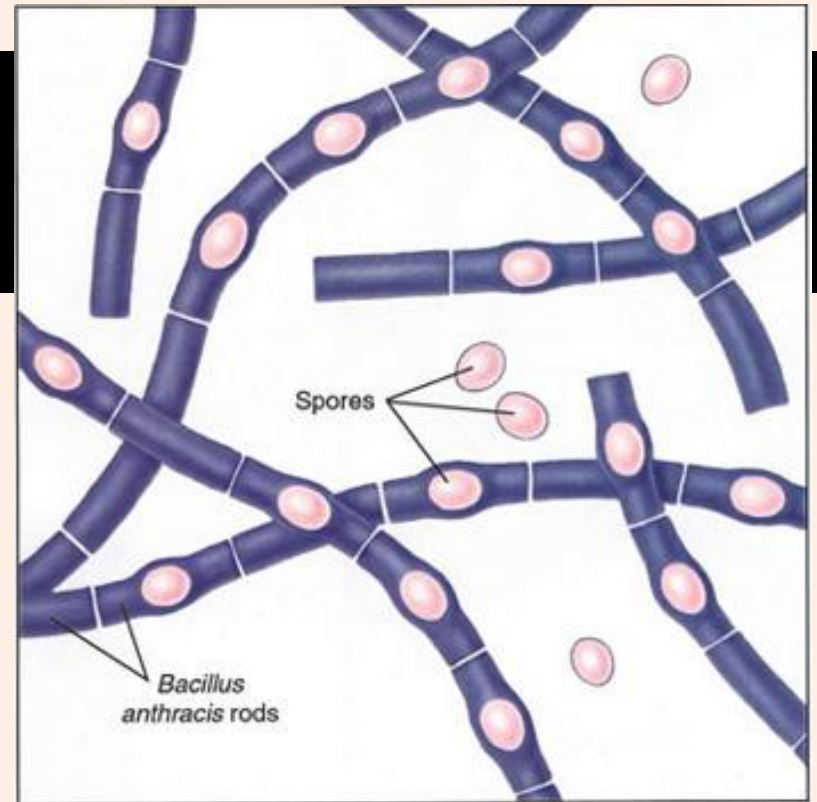
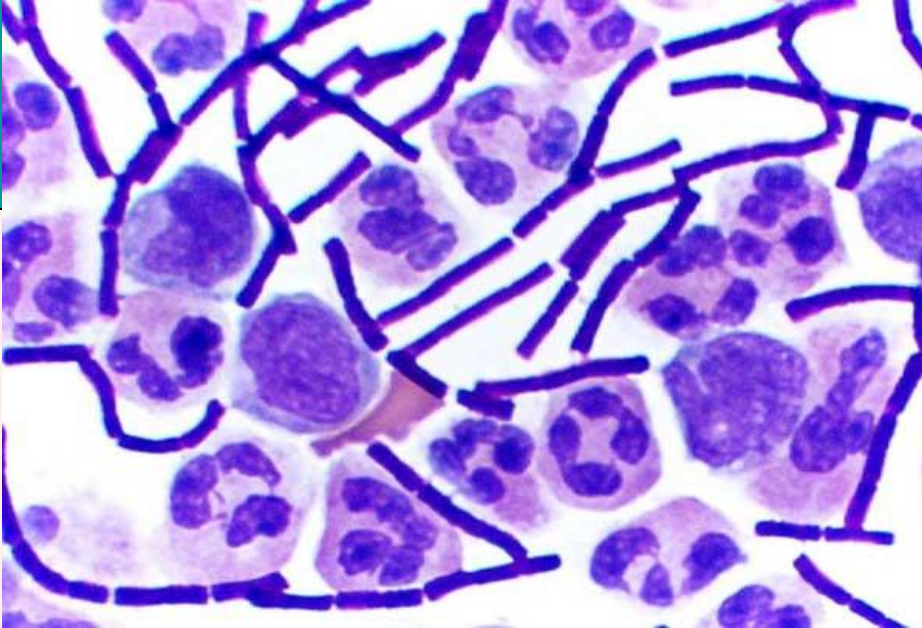
- **Susceptibility**
- **Transmission**
- **Universal Precautions**

Risks

- Equipment/Procedures
- Sites of Infection



Bioterrorism



<http://txtwriter.com/Backgrounders/Bioterrorism/bioterror5.html>

Bacillus anthracis in **Cerebrospinal fluid (CSF)** sample. 98 known species

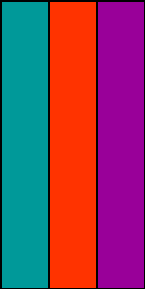
Portal of entry: Pulmonary, Gastrointestinal (gastroenteric)
and Cutaneous (skin)

Radiation risks

- Radiation is a form of energy
- Average dose: 360 mRem
- Radiation causes ionizations in the molecules of living cells.
- Risk threshold: 100 Rem

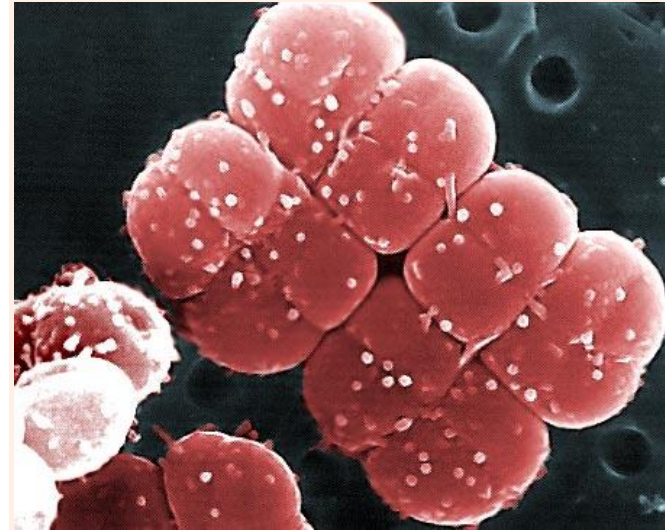
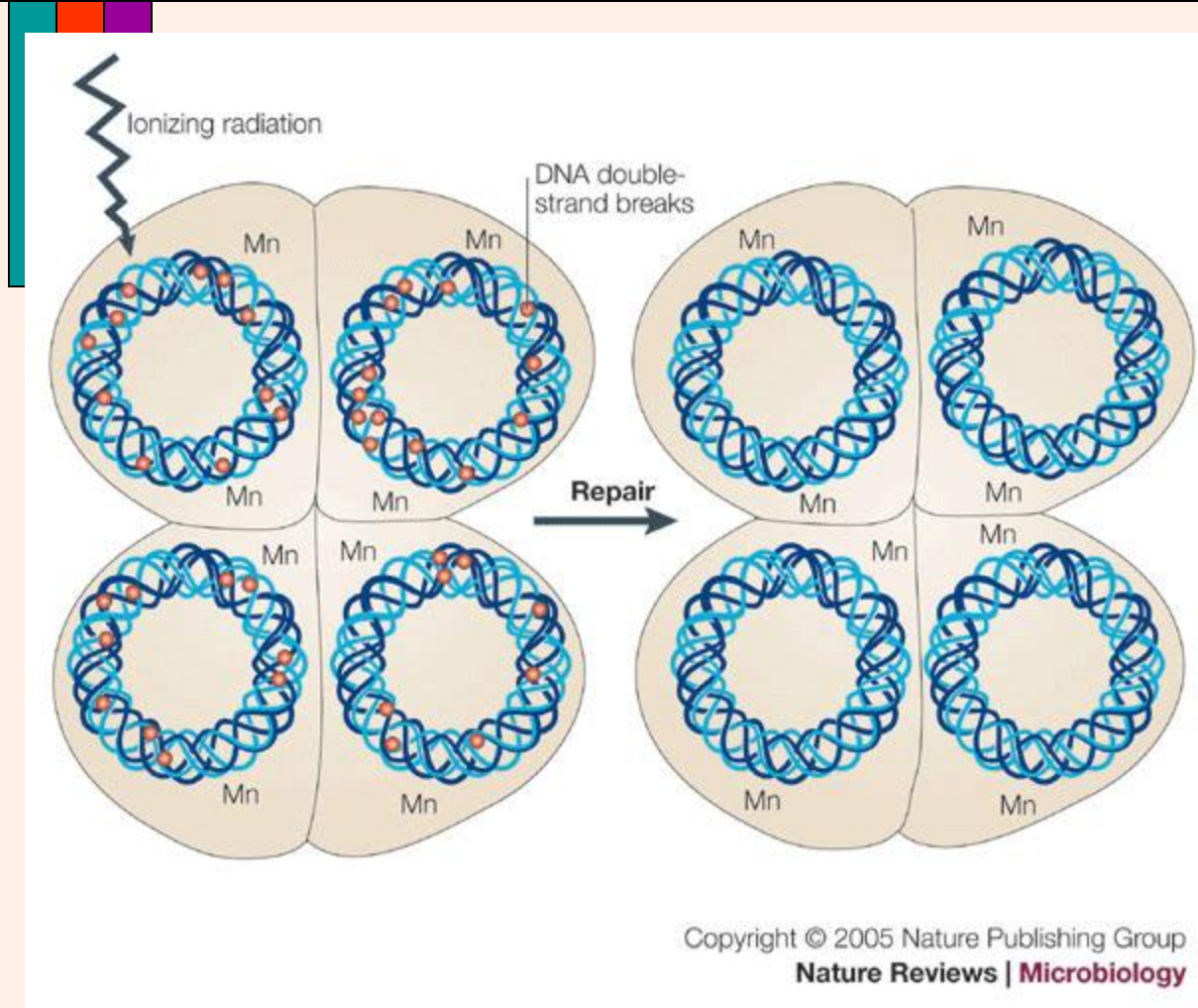
Health Risk	Est. life exp. lost
Smoking 20 cigs a day	6 yrs
Overweight (15%)	2 yrs
Alcohol (US Ave)	1 yr
All Accidents	207 days
All Natural Hazards	7 days
Occupational dose (300 mrem/yr)	15 days
Occupational dose (1 rem/yr)	51 days

Radiation risks



Procedure	Effective Dose (mrem)	Risk of Fatal Cancer	Equivalent to Number of Cigarettes Smoked	Equivalent to Number of Highway Miles Driven
Chest Radiograph	3.2	1.3×10^{-6}	9	23
Skull Exam	15	6×10^{-6}	44	104
Barium Enema	54	2×10^{-5}	148	357
Bone Scan	440	1.8×10^{-4}	1300	3200

Radiation resistant bacteria: *Deinococcus radiodurans*

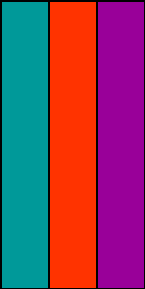


In class quiz: What's incidence? Give an example.





Microbial detection



Morphological methods

Chemical methods

Molecular methods

Microbial detection

Morphological methods

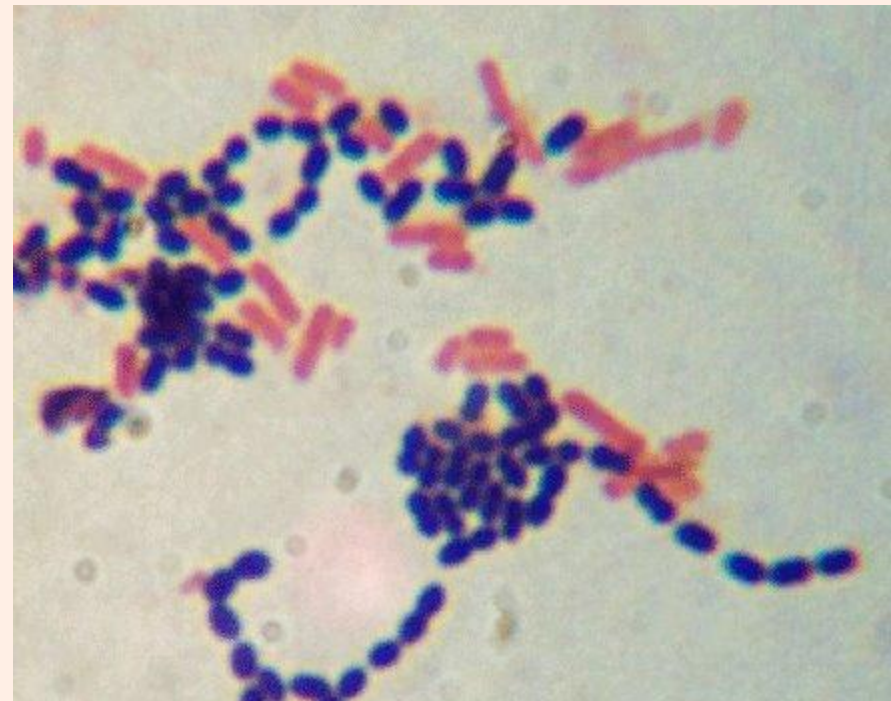
Culture--

Staining:

Gram staining

Endospore staining

Acid fast staining



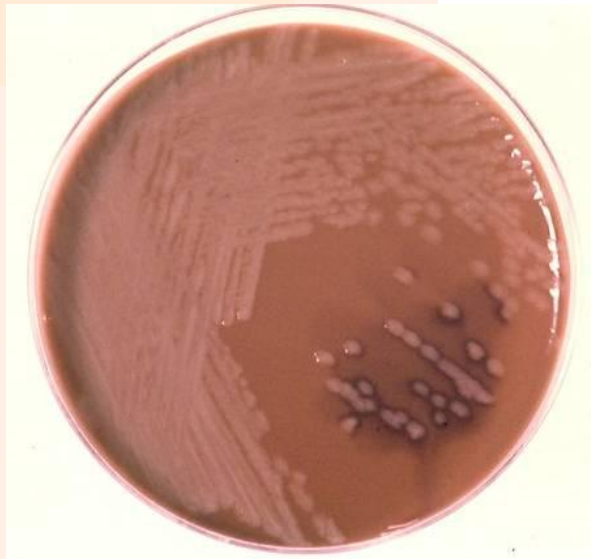
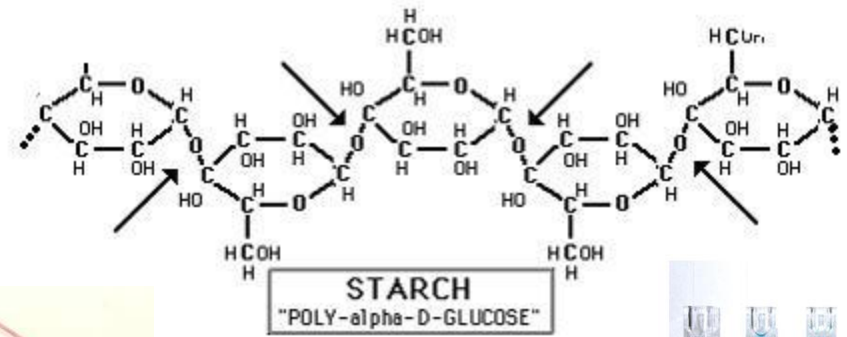
Limitation:

The majority of Microbes can't be cultured

Microbial detection

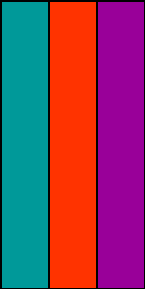
Chemical methods

Enzymes detection:
Amylase,
oxidase etc.





Microbial detection



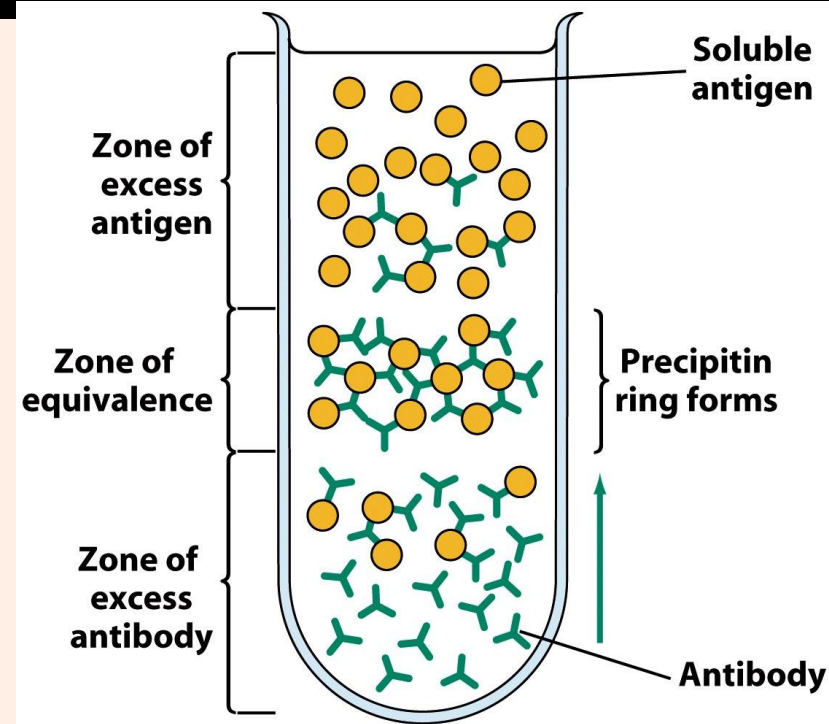
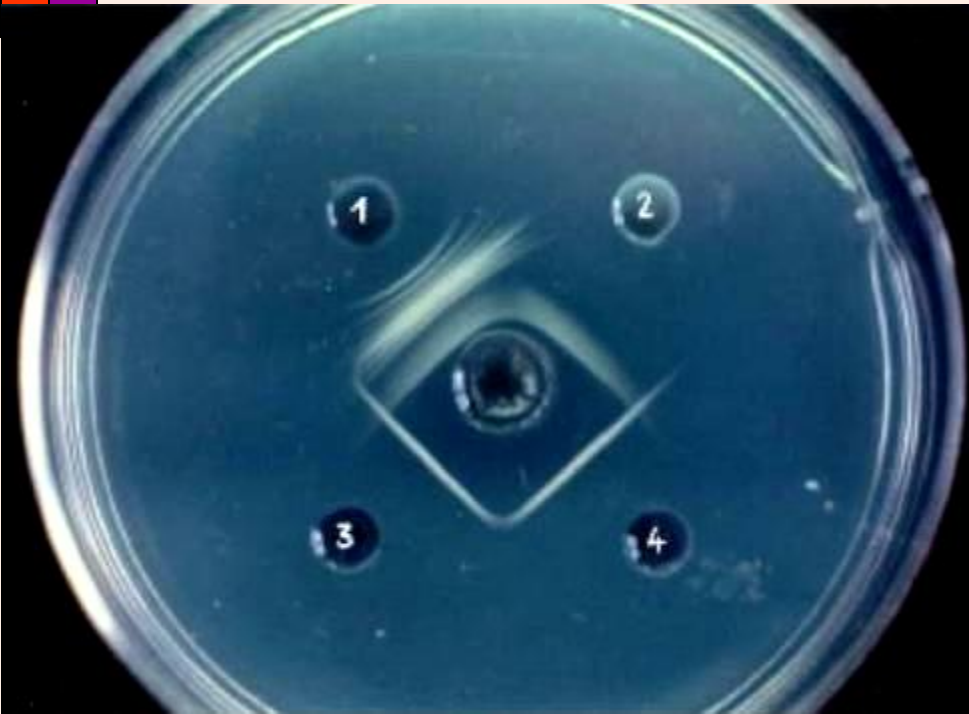
Molecular methods

Protein: ELISA

DNA: PCR, array

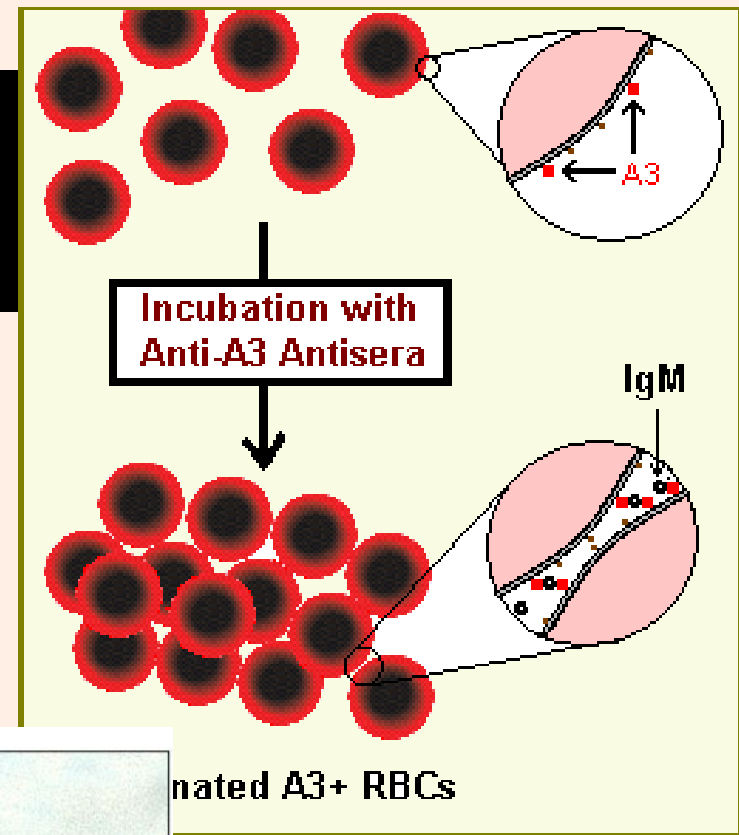
Precipitation Tests

- Precipitation
- Immunodiffusion

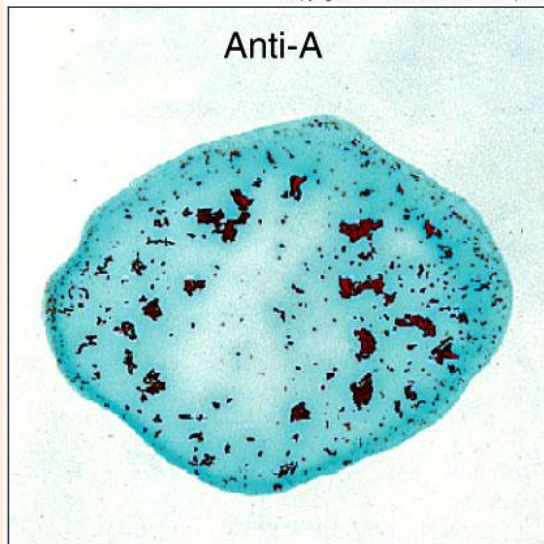


Agglutination Tests

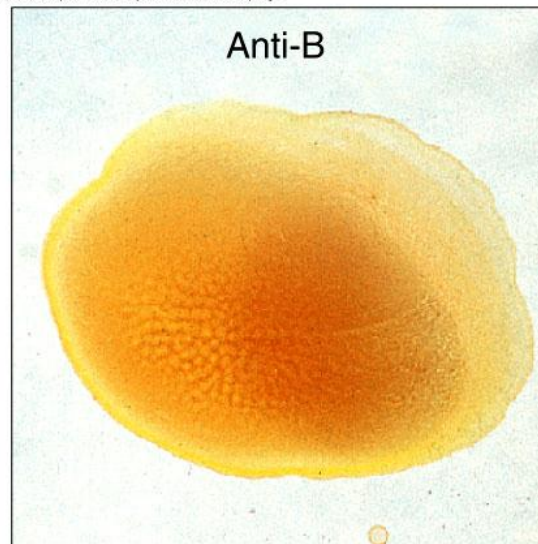
- Agglutination
- Hemagglutination



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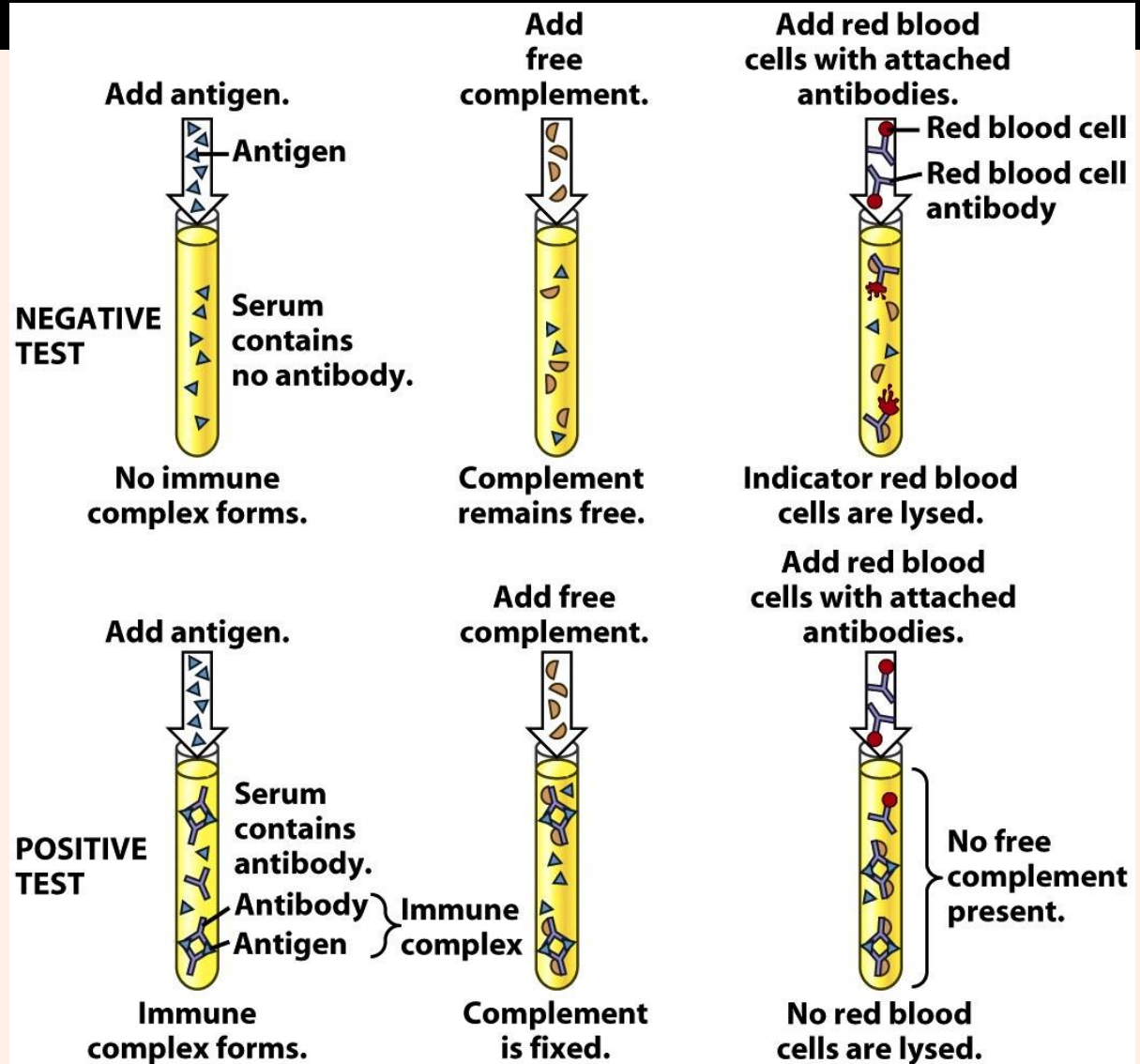
(a)



(b)

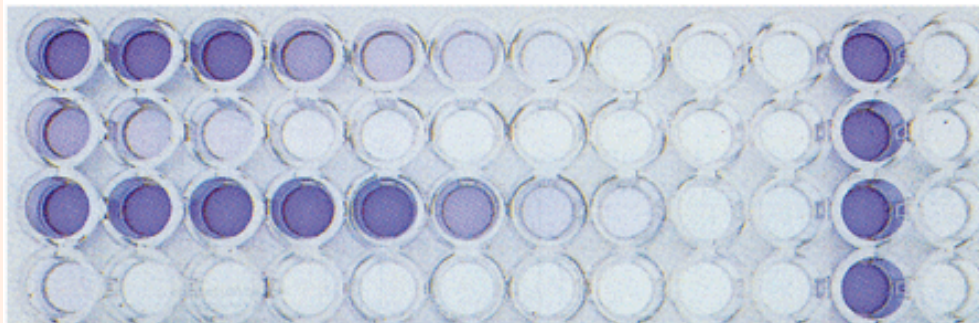
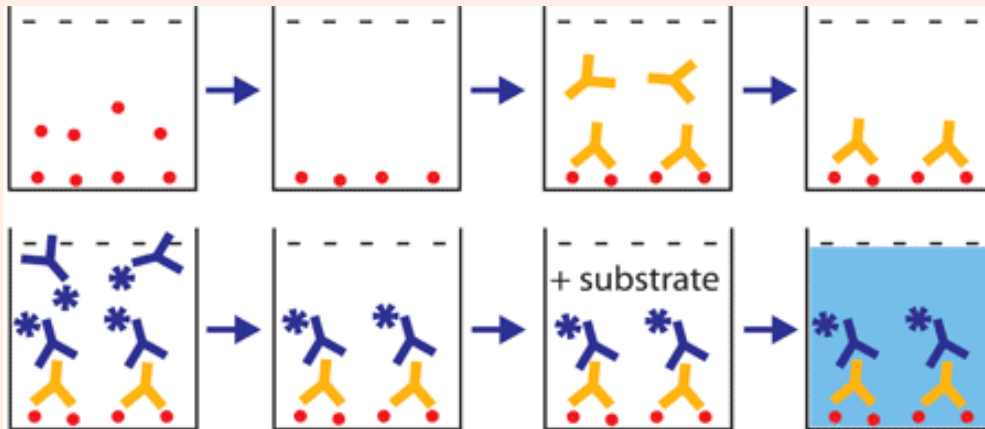
Complement Fixation

Ab/Ag complex competition



■ ELISA: Enzyme-Linked Immunosorbant Assay

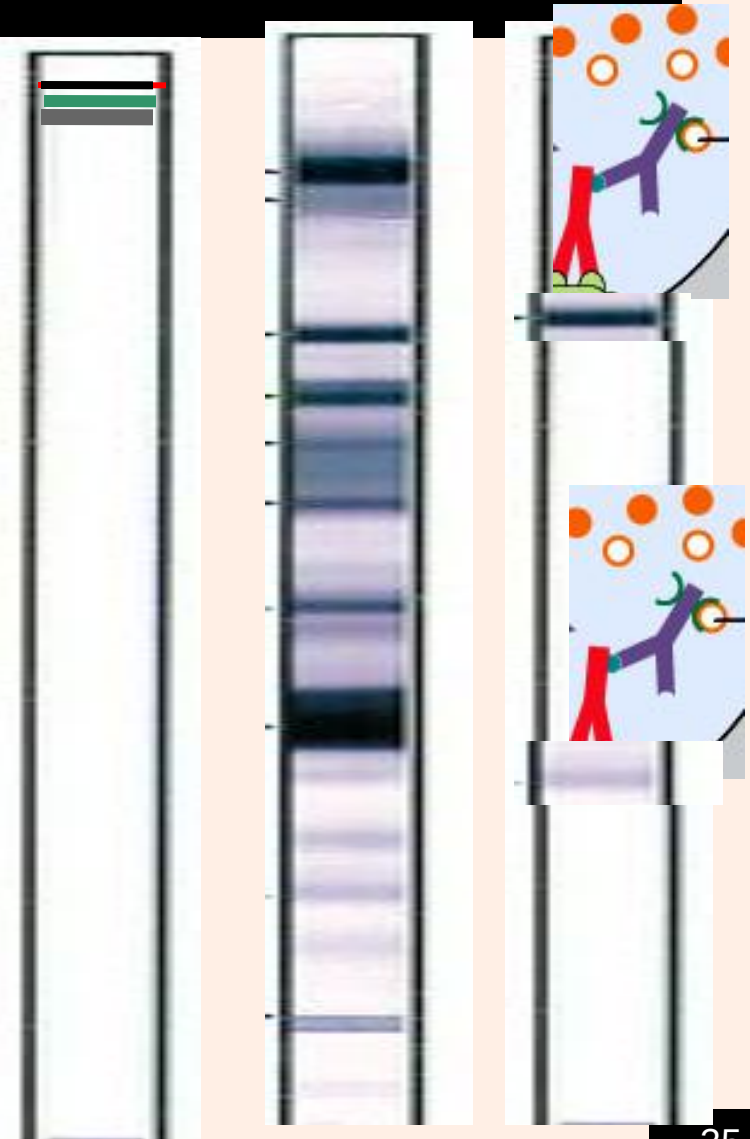
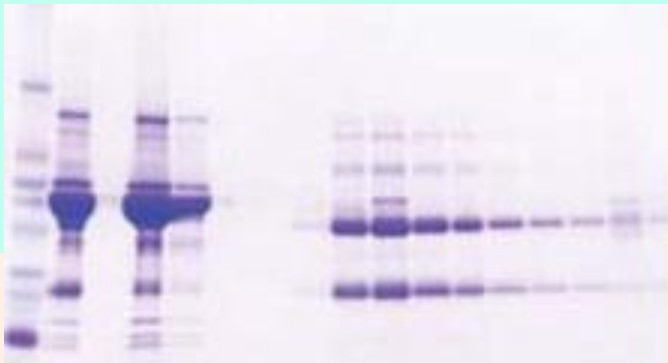
- Direct ELISA
 - Looks for specific antigen
 - Specimen placed in wells of microtiter plate
 - » Wells treated with antibody for antigen
- Indirect ELISA
 - Looks for antibody in patient serum
 - Human IgG
 - Wells of plate treated with known antigen



Using Labeled Antibodies to Detect Interactions

■ Western blotting

- Technique used to detect antigenic proteins
- Proteins are separated by size before reacting with antibody
 - Proteins separated by special gel electrophoresis
 - SDS PAGE
- Makes it possible to establish which proteins are recognized by antibodies

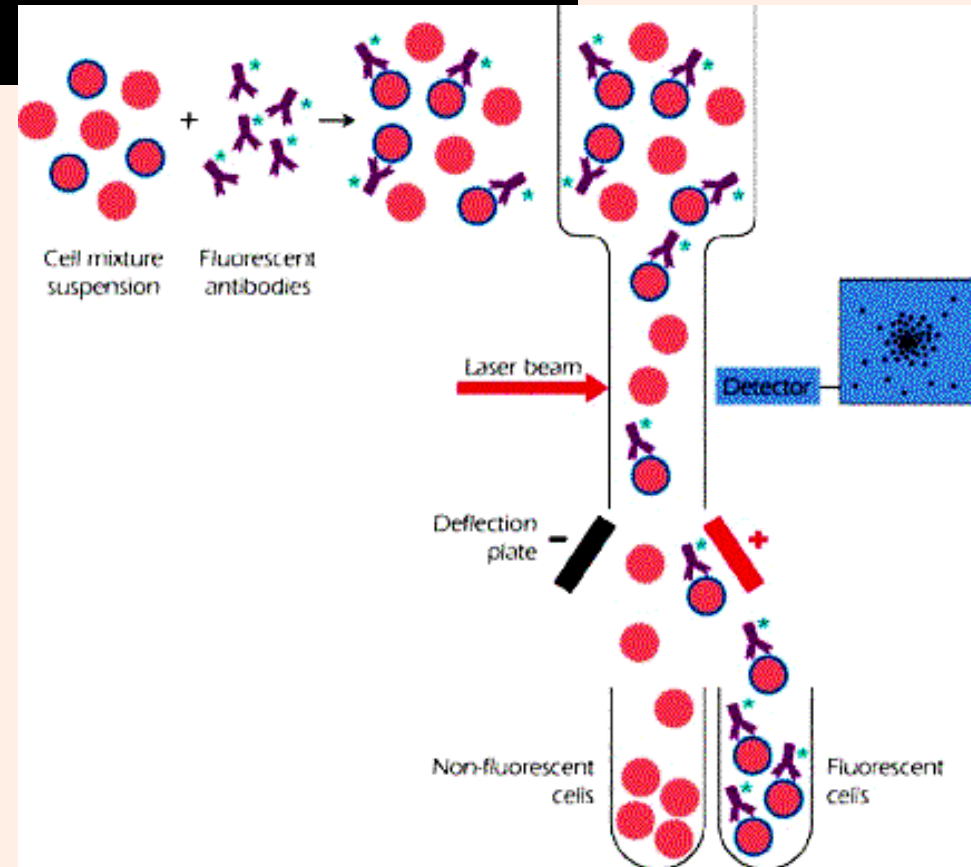


Using Labeled Antibodies to Detect Interactions

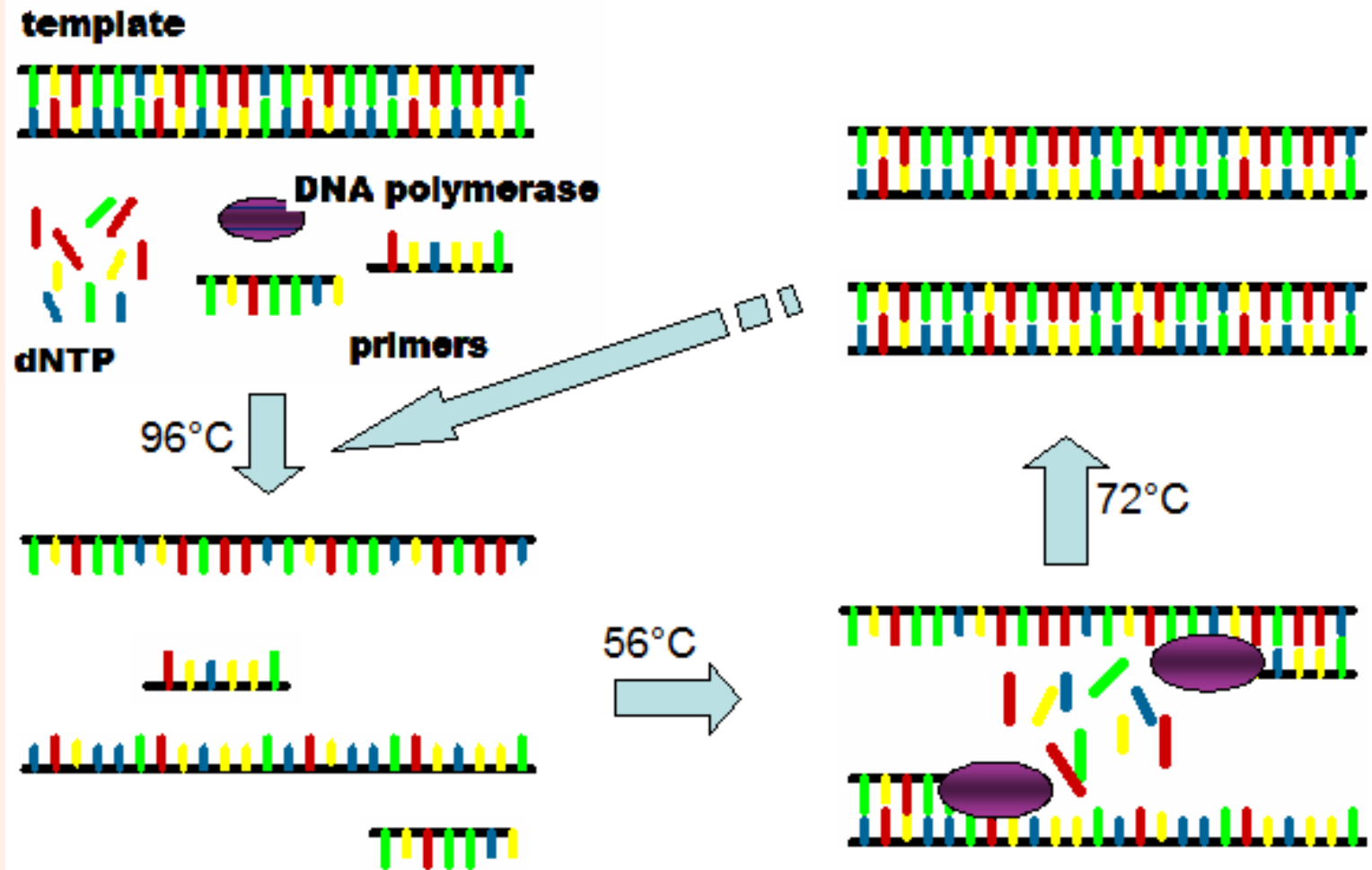


■ Fluorescence Activated Cell Sorter (FACS)

- Special version of flow cytometry counts cells labeled with fluorescent antibodies
- Used to count subsets of T cells
 - CD4 and CD8 cells especially
 - Antibodies are attached to the CD4 and CD8 markers
 - Cells with fluorescently labeled markers are counted

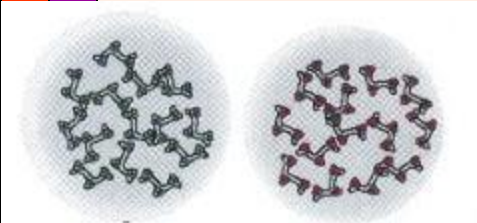


Polymerase chain reaction (PCR)

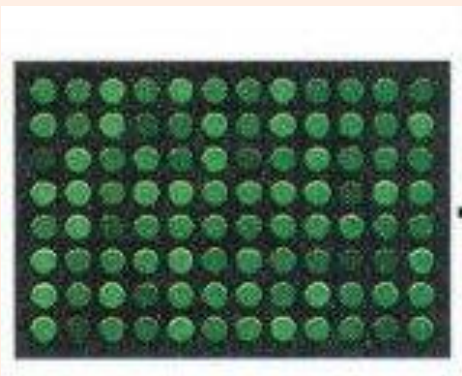


PCR: <http://www.youtube.com/watch?v=NloxUFSdwe4&feature=related>

Microarray



Special gene from different species



Blot on special chip

Hybridize with unknown microbe DNA

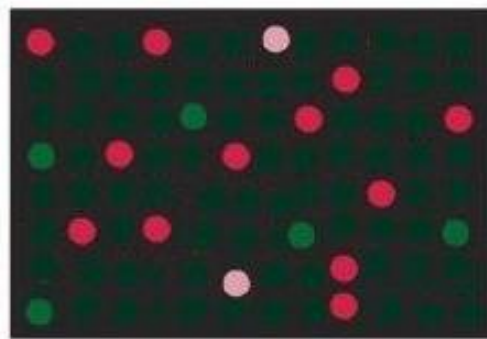


Figure out what it is