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## Chapter 6: Fighting Disease

### Lesson 1: Infectious Disease

#### How Do Pathogens Cause Disease?

Ancient times, people had different ideas about what caused disease.

- Evil spirits
- Swamp air
- Imbalance of four body fluids: blood, phlegm, black bile, and yellow bile

#### Louis Pasteur and Microorganisms 1860s -- French scientist -- Louis Pasteur -- discovered the cause of some diseases

- **MICROORGANISMS**: living things too small to see without a microscope.
    - Pasteur thought microorganisms were causing disease in animals and people.
    - Investigated with silkworms and found microorganisms inside silkworms with disease.
- \*Pasteur's work led to understanding of what causes most infectious disease -- MICROORGANISMS!



#### Joseph Lister--British surgeon

Before 20th century, surgery very dangerous --If people survived surgery, usually died of infection

- Surgeons used dirty tools and did not wash hands.
- Sheets on hospital beds rarely washed.

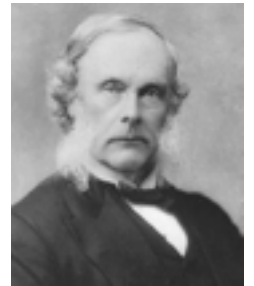
Lister's hypothesis: microorganisms cause infections that follow surgery.

His Experiment:

- Washed hands and tools before surgery with carbolic acid (chemical that kills microorganism)
- Also sprayed patients with acid before surgery.
- After surgery, covered wounds with bandages dipped in carbolic acid.

Results:

- Before new methods --> 45% of surgery patients died from infection
- After new methods --> 15 % of surgery patients died



#### Robert Koch

1880s & 1880s -- German physician -- showed that SPECIFIC microorganism causes each disease.

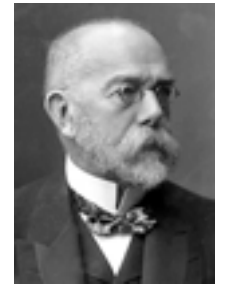
Example: microorganism that causes strep cannot cause chickenpox

- Used mice for his experiment (see Fig 2 pg 173)

**PATHOGENS**: organisms that cause disease.

Infectious disease: a disease caused by a pathogen.

\* When you have an infectious disease, pathogens are causing harm

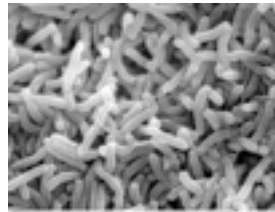


#### What Pathogens Cause Infectious Disease and How Are They Spread?

Four Major Types of Human Pathogens

1) **BACTERIA**: one-celled microorganisms

- Cause many diseases (ear infections, food poisoning, tetanus, strep throat, ect)
  - Some damage body cells directly
  - Some bacteria damage cells indirectly by using toxins: a poison



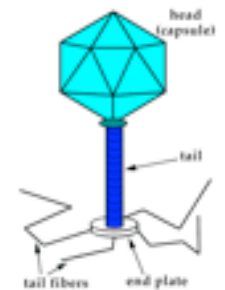
2) **VIRUSES**: tiny, nonliving particles that are much smaller than bacteria.

- Reproduce ONLY inside living cells --> causes damage/destroys the cell when new virus particles are released.
  - New particles infect other cells

- Viruses cause many diseases --> Cold and flu -- over 200 cold viruses alone!

3) **FUNGI**: like mold & yeast -- can cause infectious diseases

- Grow best in warm, dark, moist areas of the body.

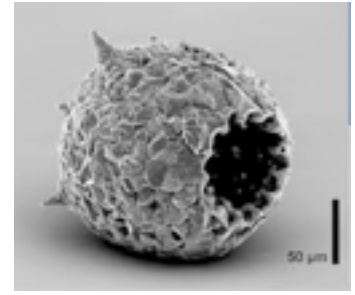


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- Examples: Athlete's foot and ringworm

4) **PROTISTS**: one-celled microorganisms that can cause disease (larger than bacteria, but still tiny)

- Example: Protist that causes malaria -- common tropical disease



## How Pathogens Are Spread

1) Infected People -- Pathogens often pass from person to person through direct and indirect contact

- Direct: Kissing, shaking hands

- Indirect: Person with a cold sneezes

2) Soil, Food, and Water -- Some pathogens occur naturally in environment

- **BOTULISM**: severe form of food poisoning that lives in soil

- Cholera and dysentery: spread through contaminated food or water

3) Contaminated Objects -- some pathogens can survive for time outside a person's body

- Example: Using objects that an infected person touched.

4) Infected Animals -- Infected animal bites a person

- Rabies, Malaria, Lyme Disease



## Lesson 2: The Body's Defenses

### What Is The Body's First Line of Defense?

- First line defense includes skin, breathing passages, mouth, and stomach -- barriers

- Trap and kill most pathogens that you come into contact with.

**Skin** -- pathogens on skin exposed to destructive chemicals in oil and sweat.

- Pathogens fall off with dead skin cells

- Most only get through skin via cuts

**Breathing Passages** -- defend against pathogens that you inhale.

- Hairs, mucus and cilia trap pathogens.

- Sneeze and cough to force pathogens out of body.

**Mouth and Stomach** -- Food contains pathogens that are mostly destroyed by saliva and stomach acid.

### What Are the Inflammatory and Immune Response

- Sometimes first line fails, so body needs to use second and third lines of defense.

**INFLAMMATORY RESPONSE**: your body's second line of defense that releases fluid and white blood cells from blood vessels to fight pathogens in nearby tissues.

- Involves WBCs, inflammation and sometimes fever

1) White Blood Cells

- Type of blood cell involved in inflammatory response called phagocyte: white blood cell that engulfs pathogens and destroys them by breaking them down.

2) Inflammation

- Capillaries in the area with the pathogen get wider and increase blood flow to the area.

- Fluid and phagocytes leak out of enlarged capillaries and affected area becomes red and swollen

3) Fever

- Helps body fight infection because some pathogens do not grow or reproduce well at higher temps

**IMMUNE RESPONSE**: your body's third line of defense that is controlled by the immune system.

- Cells of immune system can differentiate between kinds of pathogens -- create targeted defense

- **LYMPHOCYTES**: white blood cells that distinguish between different kinds of pathogens -- 2 major kinds

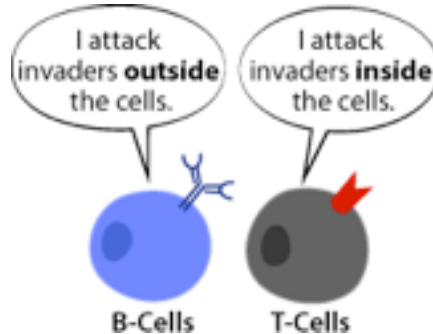
1) **T CELLS**: a lymphocyte that identifies pathogens and distinguishes one pathogen from another.

- Each kind of T cell recognizes different kind of pathogen.

- Antigen: molecules that the immune system recognizes either as part of your body or as coming from outside your body.

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- Each pathogen has its own pathogen with its own chemical structure. (Fig 4, p 183)
- 2) **B CELLS**: lymphocytes that produce proteins that help destroy pathogens.
  - Antibodies: the proteins produced by B Cells
  - Each kind of B cell produces ONLY 1 kind of antibody and each has DIFFERENT structure.
    - Antigen and antibody fit together like puzzle pieces
    - Mark pathogens for destruction



## Lesson 3: HIV and AIDS

### How Does HIV Affect the Body?

**AIDS**: (acquired immunodeficiency syndrome) a disease caused by a virus that attacks the immune system.

- Caused by **HIV virus**: human immunodeficiency virus
  - Only virus known to attack human immune system directly and kill T cells
  - Can be infected for years before becoming sick
  - First case in US 1981- Worldwide epidemic!

### HIV and AIDS

- When first infected -- usually no symptoms -- can still spread virus
- HIV begins to destroy T cells -- body begins to lose ability to fight disease

### Infections

- People with AIDS get diseases that healthy people do not get normally.
- Many people survive numerous attacks of infections, but eventually immune system dies.

### How Is HIV Spread and Treated?

- Can only reproduce inside cells, BUT can survive outside the body for a short time in fluids
  - Fluids include blood and reproductive system fluids
- Spread when body fluids from infected person come into body fluids of an uninfected person.
- No cure for AIDS, but there are drugs that delay the development of AIDS and extend life expectancy.

## Lesson 4: Infectious Disease and Your Health

### How Can You Become Immune?

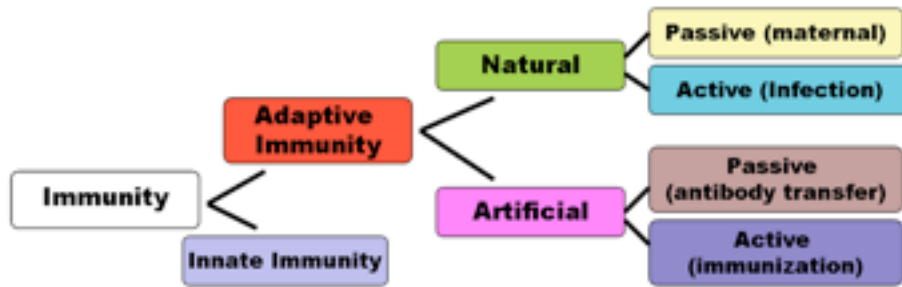
**IMMUNITY**: the body's ability to destroy pathogens before they can cause disease.

- 2 Kinds: Active and Passive

- 1) **ACTIVE IMMUNITY**: Body has produced the antibodies that fight pathogens and can produce them quickly if their system is invaded.
  - Active immunity can last many years - life.
  - Example: Chickenpox -- Once infected with chickenpox, will not become sick with them again.
- Immune Response: Some T cells and B cells keep memory of pathogen's antigen so that if pathogen invades again, they recognize it and start fighting the pathogen.
- **VACCINATION**: the process by which harmless antigens are put into a person's body to produce active immunity.
  - vaccine: substance used in vaccination that is usually a weakened or killed pathogen that trigger the immune response into action.
    - T Cells and B cells recognize and respond, creating memory cells

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- 2) **PASSIVE IMMUNITY**: Results when antibodies are given to a person and usually lasts no more than a few months.
- Example: Newborn has some antibodies that are passed from mother's blood to baby's blood during pregnancy and protect baby for ~ 6 months.



## How Can Infectious Disease Be Treated and Prevented?

### Bacterial Disease

Often treated with antibiotic: a chemical that kills the bacteria or slows the growth without harming body cells.

- Made naturally by some bacteria and fungi, but also made in factories
- **ANTIBIOTIC RESISTANCE**: results when some bacteria are able to withstand the effects of antibiotics.
- Example: Antibiotic Resistant Tuberculosis (TB)

### Viral Diseases

Medicines for cold and flu do not kill virus because they are not alive, but reduce symptoms so you feel better.

### Prevention

Avoid Contact with infected people, wash hands, eat balanced diet, and exercise

## Lesson 5: Noninfectious Disease

### How Do Allergies, Asthma, and Diabetes Affect the Body?

Noninfectious diseases: diseases that are not caused by pathogens.

- Cannot be transmitted from person to person
- Cardiovascular disease and cancer (#1 & 2 killers in US) are noninfectious diseases
- Allergies, asthma and diabetes are chronic (reappear frequently over time) noninfectious diseases



### Allergies

**ALLERGY**: a reaction caused when the immune system is overly sensitive to a foreign substance -- something not normally found in the body.

Allergen: any substance that causes an allergy

- Include pollen, dust, molds, some foods, pet dander, and medicines (and many more!)
- Get in body when you inhale them, eat them, or touch them.
- Signal body to produce histamine: a chemical that is responsible for the symptoms of an allergy (rash, sneezing, ect)
- Treated with antihistamines: drugs that interfere with histamine action.

### Asthma

**ASTHMA**: a disease in which the airways in the lungs narrow significantly causing wheezing, coughing and shortness of breath. (Fig 1, p 199)

- Can be triggered by allergies, stress, heavy exercise, tobacco smoke, air pollution, strong odors, ect.
- More than 20 million Americans have asthma.
- Person having asthma attack needs medicine, like inhaler.



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## **Diabetes**

1 function of pancreas is to make insulin: a substance that enables the body cells to take glucose from the blood and use it for energy.

**DIABETES:** the pancreas produces too little insulin OR body cells do not use insulin properly.

- Diabetics have high levels of glucose in blood but not enough in body cells
- 2 forms of diabetes

1) Type 1 Diabetes: often begins in childhood, pancreas produces little or no insulin and need insulin injections.

2) Type 2 Diabetes: usually develops in adults, body cells stop responding normally to insulin or pancreas stops making enough insulin.

## **What Is Cancer and How Can It Be Treated?**

Cancer is a disease in which cells multiply uncontrollably and destroy healthy tissue.

- Form **TUMORS:** masses of abnormal cells.
  - Invade and destroy healthy tissue around them.
  - Can spread to other parts of the body via blood or lymph
- Different factors may cause cancer.
  - Inherited characteristics
  - Carcinogens: factors in the environment that can cause cancer (cigarette smoke)
- Surgery, radiation and drugs used to treat cancer.
- Prevention
  - Avoid Carcinogens
  - Eat a healthy diet
  - Get regular checkups