Chapter 3 - The Immune System

"You’ve become run down from working too much. Try sneezing on your boss."
What are germs?

• We all have heard that washing your hands helps stop the spread of germs...

• What are “germs” exactly?
  - Germs are disease-causing invaders or organisms, also called pathogens.

• These pathogens enter the body and can cause disease if not attacked by the immune system.
Some pathogens being analyzed under a microscope
Bacterial and viral pathogens
Water-bourne pathogens can pose serious health-risks for people. Outbreaks caused by bacteria (samonella, E-coli) and viruses (Hepatitis A) in drinking water have happened in Canada.
An Elm tree with Dutch Elm’s Disease caused by a pathogen. The tree will eventually die.
Infectious Diseases

• Infectious disease can be transmitted in a variety of ways.

• In each case, the pathogen (disease causing organism) finds away to get into the body.

  • What are some ways?
    - Direct contact (shaking hands)
    - Indirect contact (sneezing)
    - Through water and food that is infected
    - Animal bites (ex: rabies virus)
Did You Know?

• Way back in the day, surgeons didn’t use sterilized operating tools and they didn’t usually wash their hands before operating!

• As a result, most people died after having surgery (due to infectious disease).
So Why Aren’t We Sick All the Time?

• Because we have a built-in system to help fight pathogens
  - Immune System

• The immune system has 2 lines of defense
  • 1 - Skin and lining of internal organs
  • 2 - Immune response (attacks invader)
First Line Of Defense - Skin

• Why do we have skin???
  - For protection
• Your skin acts as a barrier to keep pathogens OUT of the body.
• Our skin also contains sweat and oils that help prevent pathogen growth because they are slightly acidic.
First Line Of Defense - Skin

Lining inside the body also helps protect us against pathogens!

- **Stomach lining**
  - Secretes *gastric juice* (acidic!) that destroys pathogens that enter the stomach

- **Nose lining**
  - *Cilia* and *mucus* prevent pathogens from entering the respiratory system
Second Line Of Defense

• If pathogens get by the first line of defense... the body must DESTROY the invader!
• Your body launches an **immune response**.
  
  - If your body recognizes a cell as an invader (not one of your own cells), it attacks it.

**2 Types:**
(1) **Innate immune response**
(2) **Acquired immune response**
2 Types of Immune Response

• 1. **Innate immune response**
  - All living things can mount this type of response
  - We are born with it (innate)
  - It is *quick* and non-*specific*
    - The body attacks anything that it recognizes as an invader

*How does it work???
2 Types of Immune Response

1. Innate immune response

- A flow of fluid, cells and dissolved substances from the blood go to the site of infection.
- This causes a fever.
- This also causes swelling and redness in the area (known as inflammation).
- There is an increase of white blood cells (called phagocytes).
Phagocytes (cell-eaters!)

**What are they?**
- Type of white blood cell
- Recall: white blood cells fight infection
- They roam around the body looking for invaders and when they find them...
  - They swallow them!
2 Types of Immune Response

• 1. Acquired immune response
  - Very specific immune response
  - Acquired immune response takes longer than innate response (up to \textit{a week}).
  - An attack is launched on a specific invader
    - Pathogen or antigen

• \textit{What is an antigen?}
  - A non-living particle that your body recognizes as an invader (ex: virus, sliver...
Acquired Immune Response

- There are 2 ways your body can mount an acquired immune response.
  - Both ways involve white blood cells called **B cells and T cells**
Acquired Immune Response

• #1 - Antigen in body (B cells in action)

  - B cells recognize specific antigens
  - Produce antibodies to fight the antigens
  - Antibodies ATTACH to antigen or pathogen
  - Antibodies either
    • Mark the antigen/pathogen to be destroyed or
    • prevent it from entering body cell
Antibodies attaching to antigen
Acquired Immune Response

• #2 - Antigen inside body cell (T cells in action)
  - White blood cell recognize antigen/pathogen
  - Signals for T cells to be produced
  - Helper T cells recognize presence of antigen/pathogen and activates B cells
  - B cells produce antibodies
  - Antibodies destroy antigen/pathogen
Attack of the Invaders!

Imagine your body is like an old Medieval fort...
Attack of the Invaders!

Recognition

White blood cells spot the invader....

Alert Helper T cells!

An invader...
Attack of the Invaders!

Round up the troops, we have an invader...

Helper T cells signal B cells.

10-4 Roger that.
Attack of the Invaders!

B cells MOBILIZE the forces.....(antibodies)
Attack of the Invaders!

Antibodies (army) destroy pathogens (invader)....
Acquired Immune Response

• What is immunity?

- After an attack, some antibodies remain in the body.
- These antibodies protect against future infection of the same antigen/pathogen.
- This protection is called immunity!
Immunity

- When your body remembers which antibodies to use for a pathogen it has encountered before...
  - This is called "active immunity"

The B cells that remember and produce the antibodies are called memory B cells
T cells

- There is another type of T cell (other than helper T cells)
- A second type is called killer T cells
  - These T cells can directly destroy antigens or pathogens

Killer T cells kill a cancer cell
Acquired Immune Response

• Let’s sum it up...

4 Main Steps:
1) Recognition
2) Mobilization
   (B cells make antibodies)
3) Disposal
   (antibodies destroy invader)
4) Immunity
   (left over antibodies for future)