Regents Biology

North Salem High School

MISSION: *Engage students to continuously learn, question, define and solve problems through critical and creative thinking.*

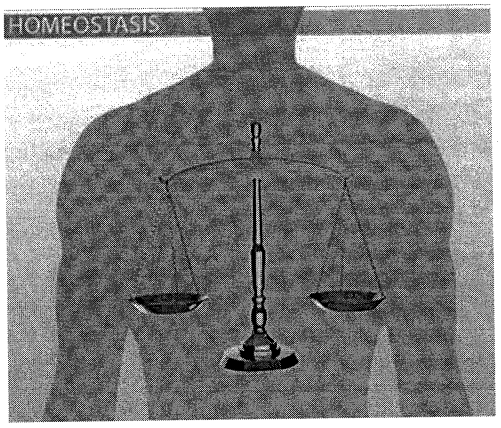
*** Class Notes ***

(pp. 201-213, 313-328)

Homeostasis

*The **maintenance of a STABLE, INTERNAL environment.***

Homeostasis *- The **maintenance of a STABLE, INTERNAL environment** or any self-regulating process by which biological systems tend to maintain stability while adjusting to conditions that are optimal for survival. If homeostasis is successful,* life *continues; if unsuccessful, disease or death occurs.*



Let's get to work!

If you have any problems – please sign up for extra help after school.

Mr. Collea

Room W-19

HOMEOSTASIS

The ability of an organism to maintain a stable internal *environment.*

I. HOMEOSTASIS AND THE IMMUNE SYSTEM

(To protect)

- Homeostasis in an organism is constantly threatened. Failure to respond effectively can result in disease or death. Viruses, bacteria, and other disease-causing microorganisms called pathogens ("disease" "to generate") may infect plants and animals and interfere with normal life functions.
- It is the job of the immune system to protect the body from these foreign invaders to the body known as antigens ("antibodies" "to generate").

"good" "bad"

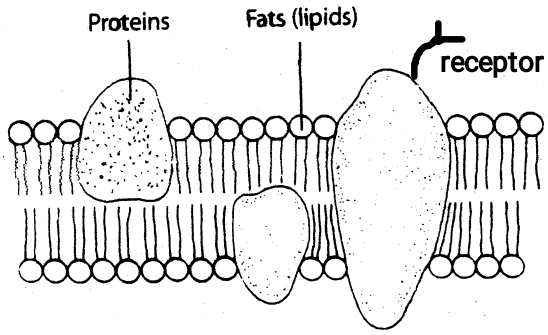
BUT HOW DOES THE BODY RECOGNIZE FRIEND FROM FOE?

A. CYTOLOGY REVIEW

1. The Cell Membrane

- The protein molecules found on surface of **ALL** cell membranes act as a kind of QR code for that cell or microorganism.

Fluid-Mosaic Model



- The white blood cells of the immune system have the incredible ability of recognizing which cell membrane protein molecules (**receptors**) are friend (**good**) and which are foe (**bad**).

B. CELLS OF THE IMMUNE SYSTEM

TYPE OF CELLS	FUNCTION
"phagocytosis" "cell" PHAGOCYTES (Video)	White blood cells that surround and ENGULF (eat) foreign invaders by phagocytosis.
"large" "phagocytosis" MACROPHAGES	LARGE phagocytes that surround and ENGULF (eat) foreign invaders by phagocytosis.
T-CELLS (Thymus)	Capable of recognizing and engulfing SPECIFIC pathogens.
B-CELLS	Produce special PROTEIN molecules that destroy SPECIFIC pathogens called antibodies.

(Video: Flu Attack)

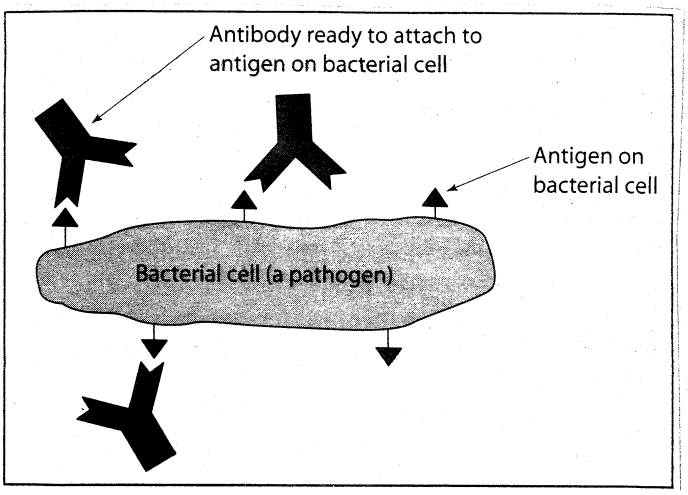
"antibody" "generate"

C. ANTIGEN-ANTIBODY REACTION

- The bodies natural response when an ___antigen___ enters the body is to engineer ___specific___ protein molecules called ___antibodies___ to destroy them.
- The ___antigen___ - ___antibodies___ reaction functions much like an ___enzyme___ - ___substrate___ complex, except in this case, the antibody is designed to destroy antigen.
- The structure of the ___antibody___ is designed to recognize and fit the receptors found on the cell membranes of various ___pathogens___ (**disease-causing microorganisms**).

ANTIGEN-ANTIBODY REACTION
Y-shaped antibodies are engineered to match the shape of a SPECIFIC protein receptor or antigen found on the cell membrane surface of pathogens (disease-causing microorganisms)

(Animation: Antigen and Antibodies)



D. WAYS OF ACQUIRING IMMUNITY

(1) Active Immunity (Video)

- When a person ***ACTIVELY*** forms antibodies by coming into contact with the disease-causing microorganism OR by receiving a vaccination
- Active immunity usually lasts forever because the body is somehow able to "remember" **ALL** the antigens you come into contact with by producing special immune cells called memory cells.

EXAMPLES: 1. Chicken Pox Virus

2. COVID-19 vaccination

(2) Passive Immunity

- A temporary form of immunity produced by the introduction of antibodies into a person from another organism

EXAMPLES: 1. mother —(antibodies / breast milk)→ newborn baby

2. Anti-Venoms

1. Tetanus Shot

E. IMMUNE DISORDERS

(1) Allergies - An over reaction of the immune system to an antigen that is not normally harmful.

(2) Autoimmune Diseases - ("self") When cells of the immune system fail to recognize one's own body cells as "self" and destroy them.

Auto-Immune Disorders

Name	Part of the Body Destroyed
Juvenile Diabetes	Insulin-producing cell in the pancreas.
Rheumatoid Arthritis	The space in between bones (joints).
Multiple Sclerosis	Nerve Cells (neurons).
[redacted]-Immune Deficiency Syndrome (AIDS)	T4 Lymphocytes (white blood cells) - T Cells

(Acquired) (Human Immunodeficiency Virus)

This video is found on EdPuzzle

The Universe Within - The Immune System

1. Where is Rob Taylor's favorite place to climb? (00:50)

   Tuckerman's Ravine, NH

2. What is the body's first line of defense against foreign invaders? (4:18)

   The skin

3. Which cells are the first to arrive on the scene of an infection? (4:52)

   Phagocytes

4. What do phagocytes do? (5:15)

   Engulf pathogens whole via phagocytosis.

5. Do the phagocytes appear to be engulfing the asbestos fibers? WHY? (5:40)

   No, because it is synthetic (man-made)

6. Where are most of the cells of the immune and circulatory systems produced? (6:10)

   The Bone Marrow

7. Bursting phagocytes produce puss. (9:10)

8. Giant phagocytes are called macrophages. (9:25)

9. Amputate means to cut off. (10:40)

10. Where do T-Cells mature? (12:00)

    Thymus

11. What do B-cells produce? (11:35)

    Antibodies

12. What did Rob Taylor do again in 1985? (17:05)

    Finish climbing Mount Kilimanjaro.

I. HOMEOSTASIS AND THE ENDOCRINE SYSTEM

- The glands that make up the endocrine system produce hormones that act as chemical messengers in the communication between different organs of the body.
- ALL hormones travel from their point of origin, through blood vessels to their target tissue.

A. *SOME HORMONAL RESPONSES IN THE BODY* (Review)

(1) The hormone FSH produced in the brain travels through the blood vessels on its way to the ovary where it stimulates the maturation of a follicle.

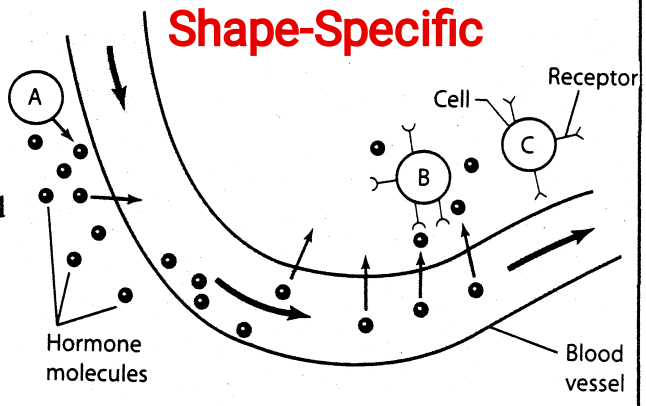
(2) The hormone LH produced in the brain travels through the blood vessels on its way to the ovary where it stimulates the release of an egg from the ovary in the process of ovulation.

(3) The hormone estrogen produced in the ovary travels through the blood vessels on its way to the uterus where it stimulates the thickening of the uterine lining.

(4) The hormone testosterone produced in the testies travels through the blood vessels on its way to the larynx where it stimulates the thickening of the vocal cords resulting in the deepening of a teenage boys voice.

HOW DO HORMONES RECOGNIZE THEIR TARGET TISSUE?

RECEPTOR MOLECULES:
Like *enzymes* and *antibodies*, **hormones** are protein molecules composed of *amino acids* linked together by *peptide bonds* in a SPECIFIC sequence. The function of any protein molecules is determined by its structure and the structure of a protein is determined by your DNA. Distinct receptor molecules on the membranes of certain cells can only detect SPECIFIC hormones that will stimulate that cell to respond. In this case, only cells with B receptors will respond to the hormones produced by endocrine gland A.



B. THE REGULATION OF GLUCOSE IN THE BODY

- Glucose is a carbohydrate / sugar (*ends in OSE*) that is used as a source of immediate energy by the body.

- Glucose is converted into ATP by the process of cellular respiration which takes place in the mitochondria of ALL cells.

- The chemical *equation* for cellular respiration is:

[Raw Materials] [Products]

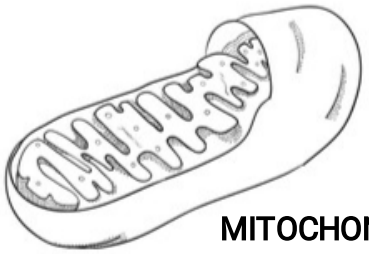
$C_6H_{12}O_6 + O_2 \longrightarrow CO_2 + H_2O + ATP$

(glucose) (oxygen) (carbon dioxide) (water) (ENERGY)

- The concentration of glucose in the blood is regulated by the hormones insulin and glucagon which are both produced in the pancreas.

- When the concentration of glucose in the blood is **HIGH** (*like immediately after a meal*), the hormone insulin is secreted by the pancreas and removes this glucose from the blood by allowing it to be taken in by the cells of the body.

GLUCOSE (Blood Sugar) —Insulin (*allows glucose to enter the mitochondria*)→



MITOCHONDRIA

- When the concentration of glucose in the blood is **LOW** (*like hours after a meal*), the hormone glucagon is secreted by the pancreas and travels via the blood stream to the liver where it converts glycogen into glucose.

(polysaccharide) *GLYCOGEN* —(Glucagon)→ (monosaccharide) *GLUCOSE*

- One form of the disease diabetes results when a person is unable to make their own insulin. Diabetics must constantly monitor the amount of glucose in their blood to make sure it is not too high or too low.

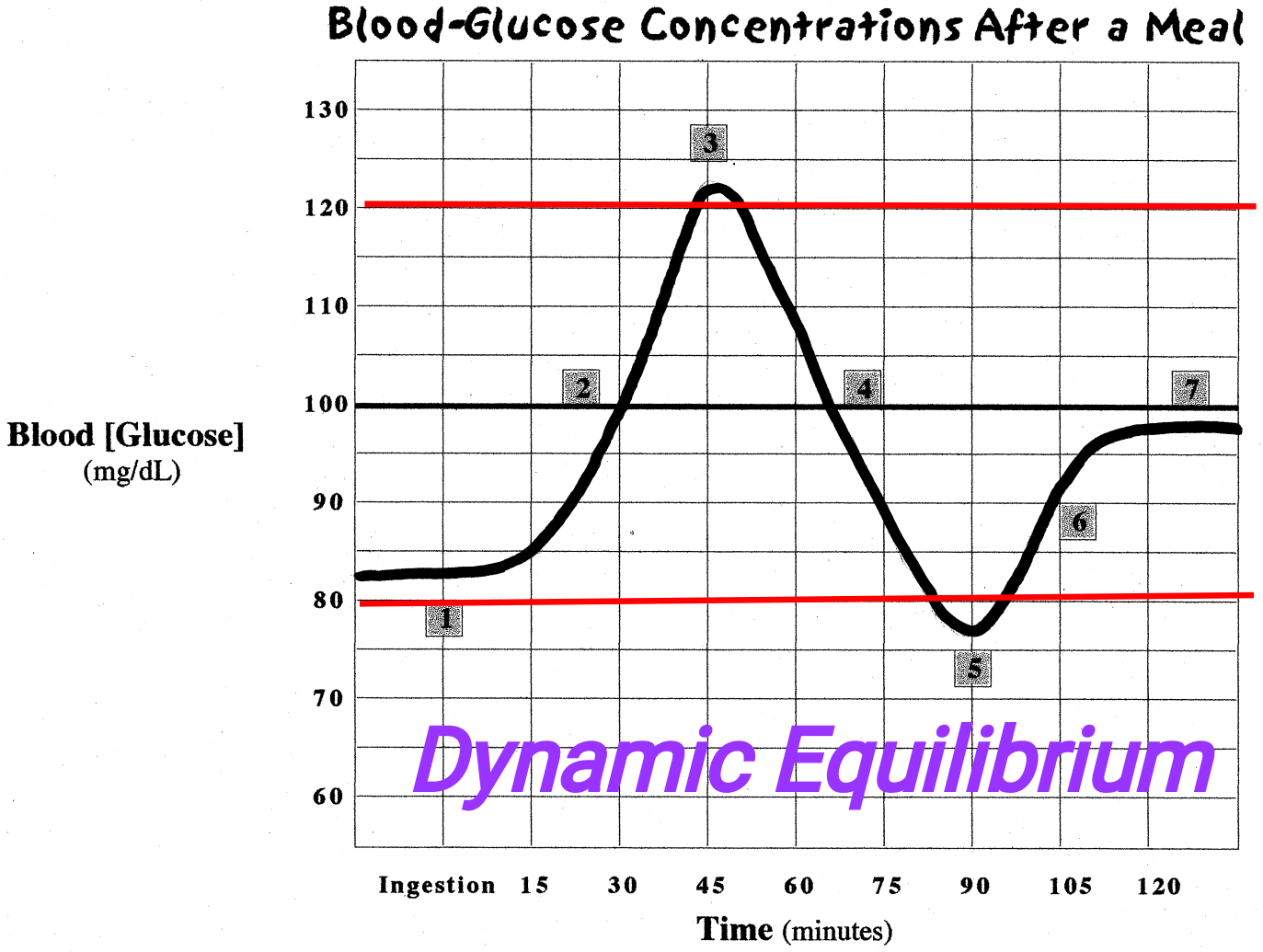
If the amount of glucose in the blood is low (Hypoglycemia), the daibetic must take in glucose.
If the amount of glucose in the blood is high (Hyperglycemia), the daibetic must inject insulin.

C. *GLUCOSE GRAPH* (Animation: What is HOMEOSTASIS?)

- The body's ability to maintain a stable concentration of glucose in the blood is an excellent example of HOMEOSTASIS.
- The *normal* amount of glucose in the blood is between 80-120 mg/dL

(**mg/dL** = milligrams per deciliter)

(Animation: Insulin and Glucagon)



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1. **INGESTION** - food is taken into the body.
2. Glucose concentration in the blood **INCREASES** as carbohydrate digestion and absorption continues.
3. Glucose concentration in the blood reaches its peak, the **PANCREAS** secretes the hormone **INSULIN**.
4. **INSULIN** removes glucose from the blood; blood glucose concentration **DECREASES**.
5. A little too much glucose is removed from the blood by the **INSULIN** so the **PANCREAS** now has to secrete the hormone **GLUCAGON** ---> **GLYCOGEN** is converted into **GLUCOSE** in the **LIVER**.
6. The conversion of **GLYCOGEN** into **GLUCOSE** increases the concentration of glucose in the blood.
7. The concentration of glucose in the blood returns to normal..... that's **HOMEOSTASIS**!