UNIT 11
HUMAN ANATOMY

SOME OF THE SYSTEMS OF THE HUMAN BODY

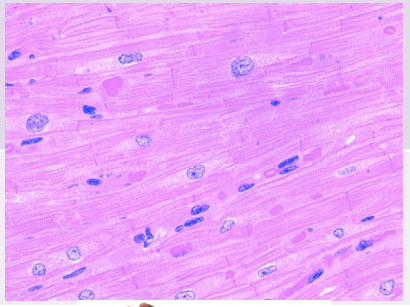
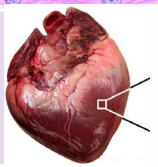
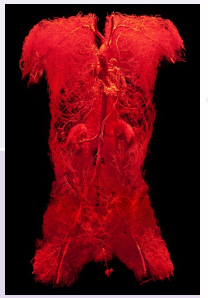
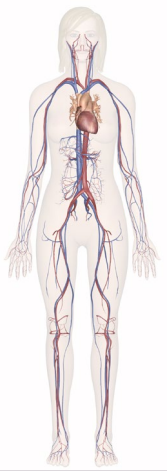
INTRODUCTION

HOW WE ARE ORGANIZED AND FUNCTION

HOW ARE ORGANISMS ORGANIZED?

This relates to taxonomy…

- Organisms are grouped taxonomically by their level of organization (remember *phyla*?) so different organisms are at different levels. Ex: coral are a tissue level vs humans who are at organ system.
- Each level of organization works together to maintain homeostasis

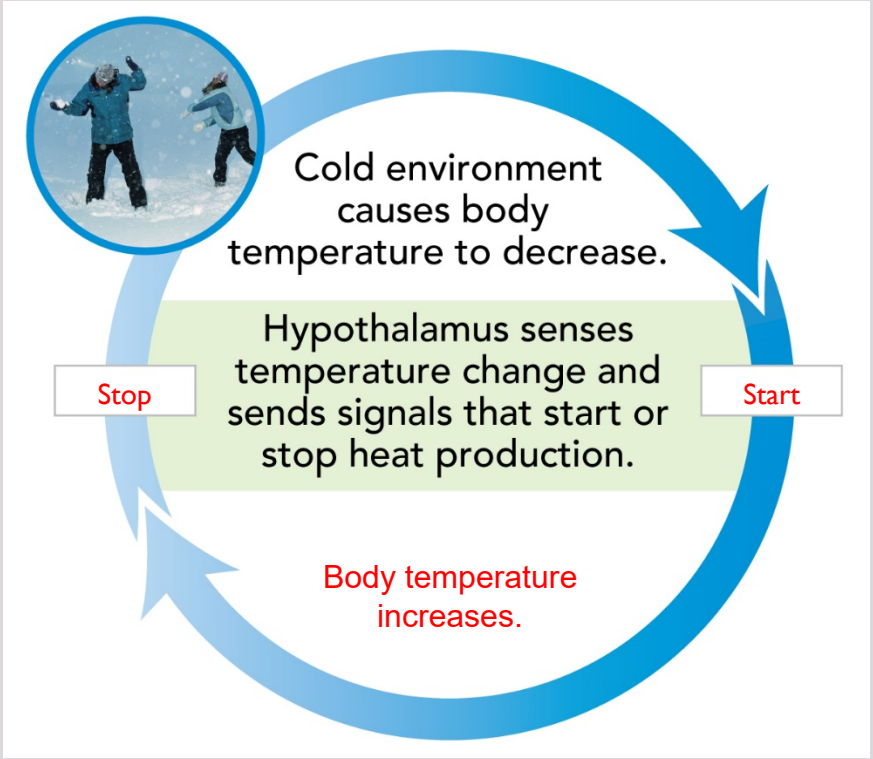
Level	Description	Example	
Cell	the basic unit of life / specialized cells perform a specific task	Heart Cell	
Tissue	A group of cells working together to do a single task	Heart muscle tissue	
Organ	A group of various tissues working together to preform a function	Heart	
Organ System	A group of closely related organs that work together as a unit	Cardiovascular system	
Organism	An individual life form made of several organ systems	Human	

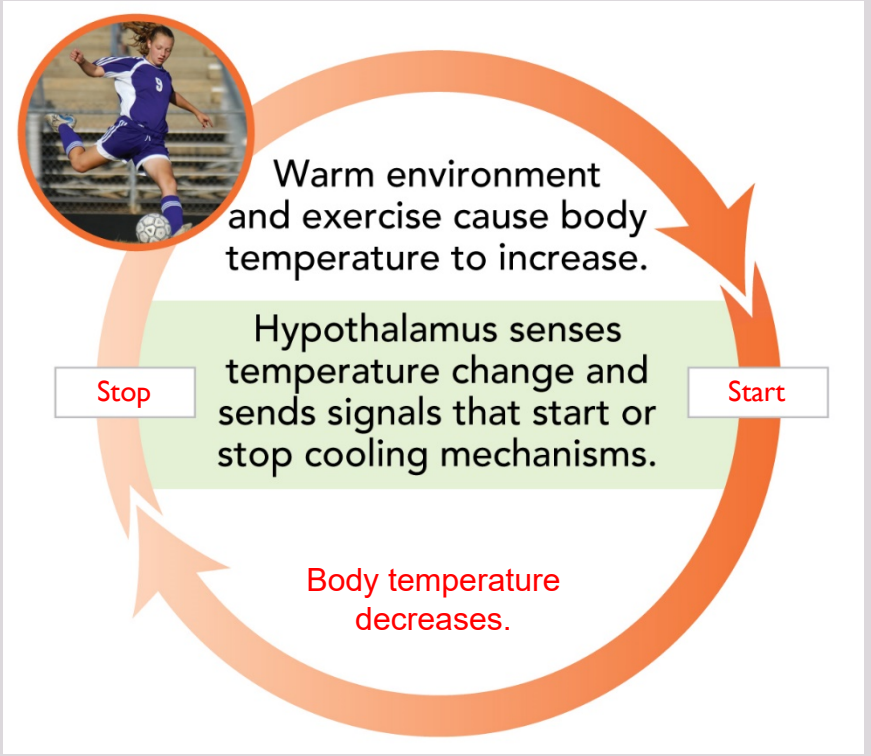
WHAT IS HOMEOSTASIS?

- Means "keeping things the same"
- Homeostasis describes the relatively constant internal conditions that organisms maintain despite changes in internal and external environments.

Quick Question

1. Why is it important to maintain a stable internal body temperature?
2. What does homeostasis mean?
3. What are the levels of organization and which do we belong?



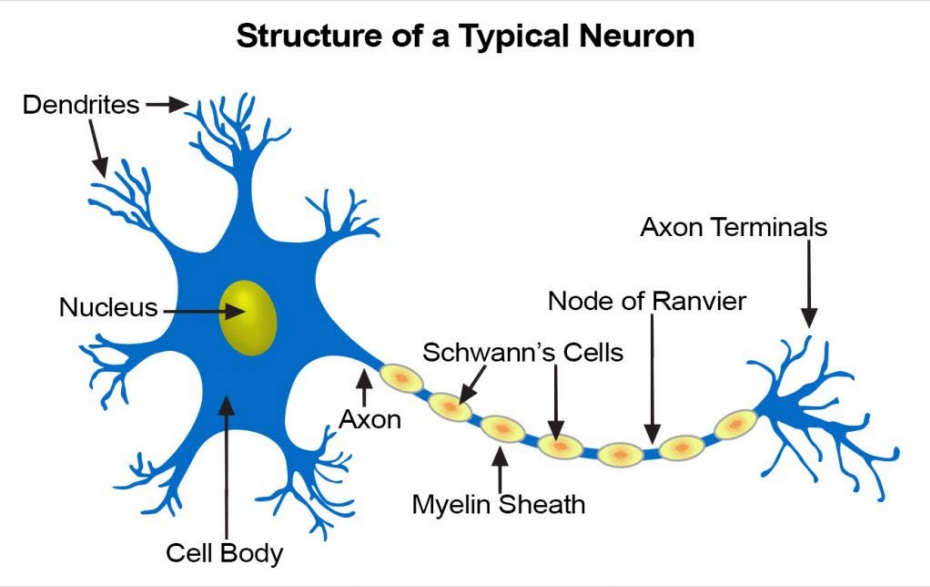


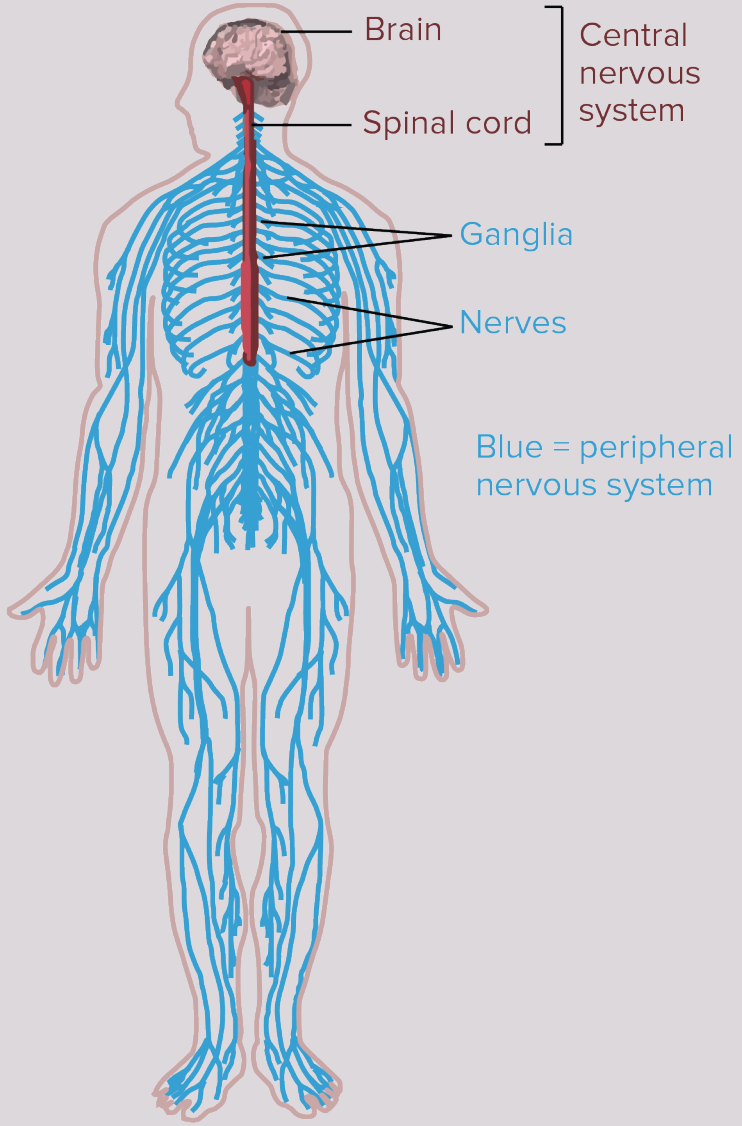
BRAIN

THE NERVOUS SYSTEM

NERVOUS SYSTEM | AN OVERVIEW

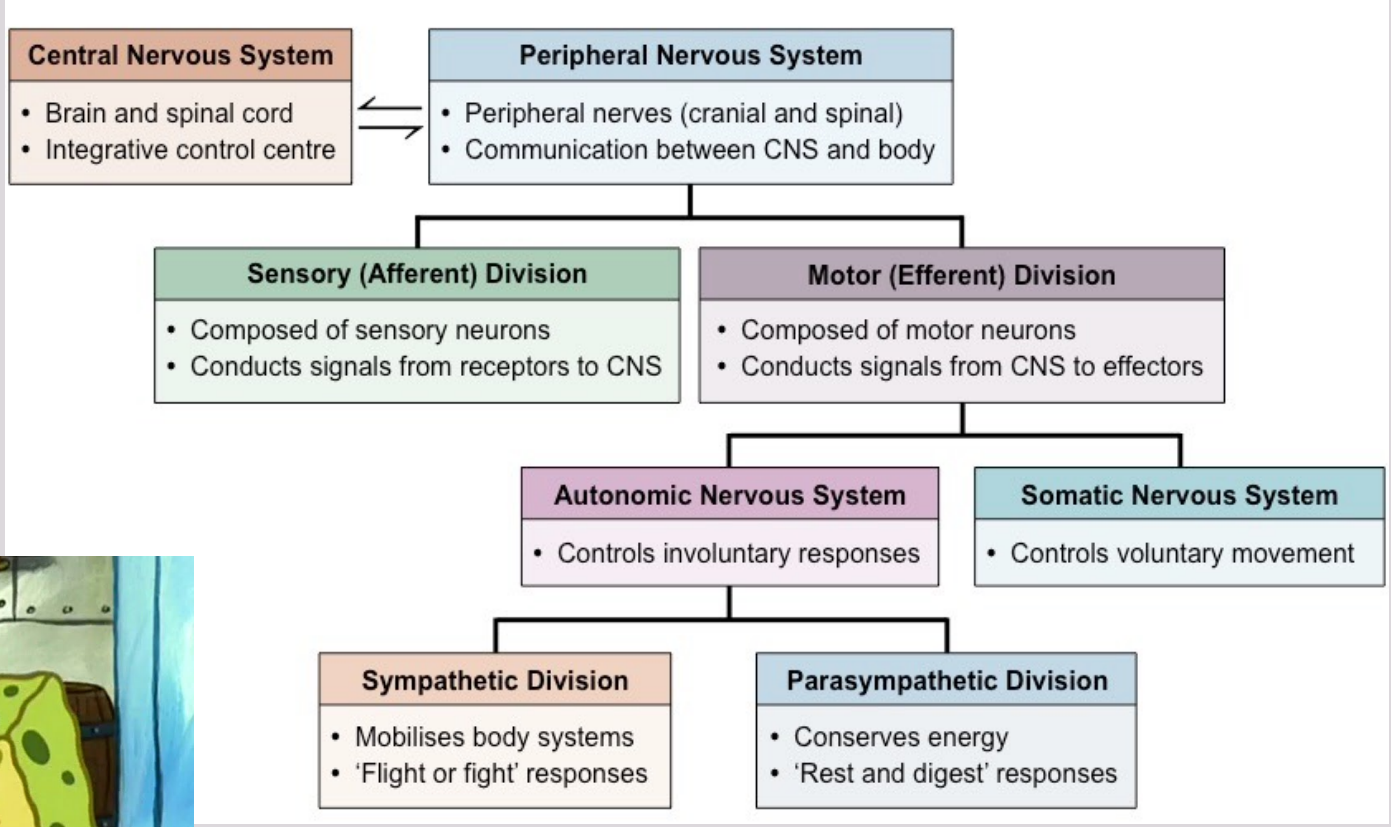
- The nervous system controls body functions through electrochemical signals
- Neurons-nerve cells transmit impulses to and from the brain
- Divided into two parts: central nervous system (CNS) and peripheral nervous system (PNS)





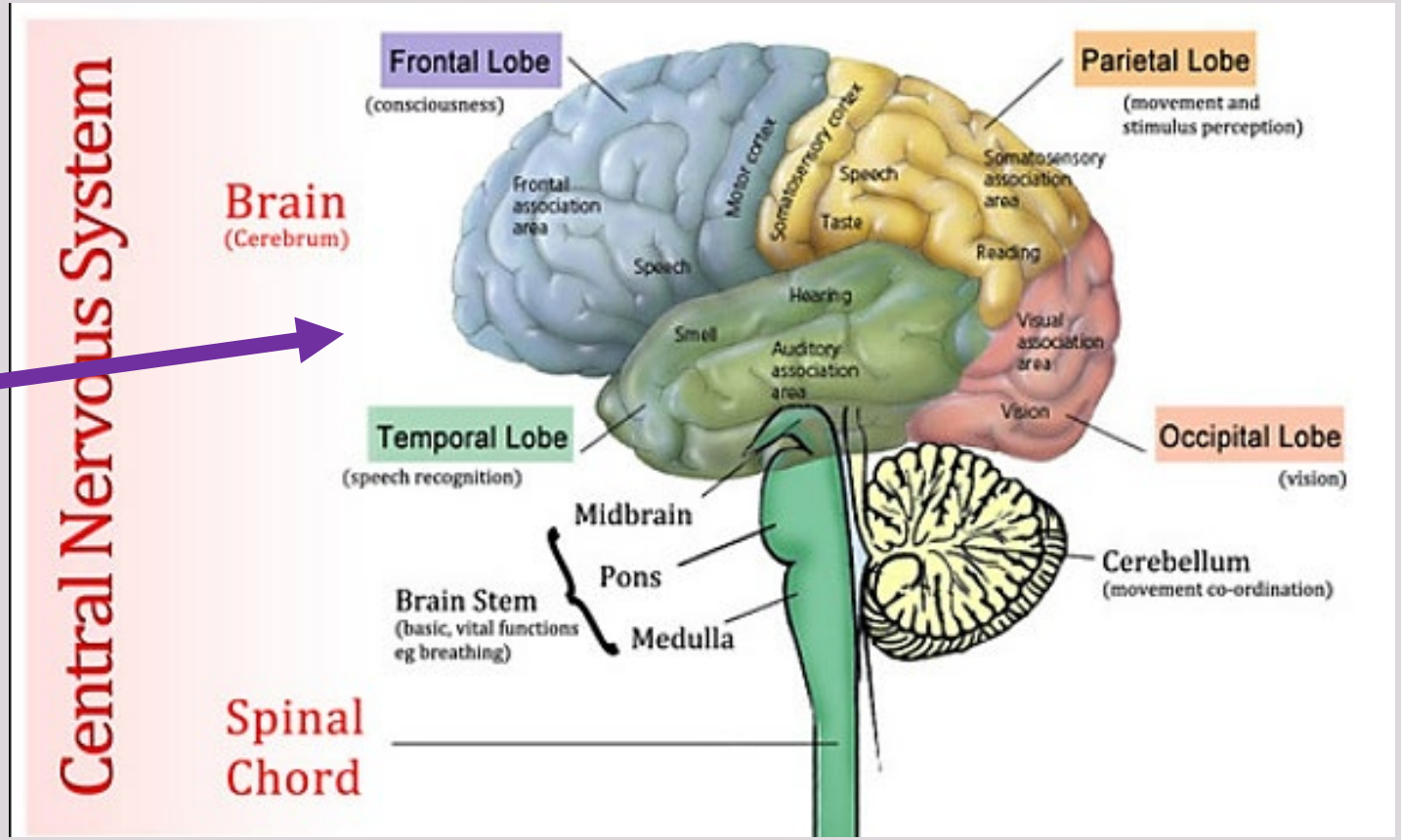
PERIPHERAL NERVOUS SYSTEM

- Peripheral nervous system senses and transmits impulses to the brain muscles and glands
- Sensory receptors pick up and relay messages of movement, pain, temperature, chemical signals and light

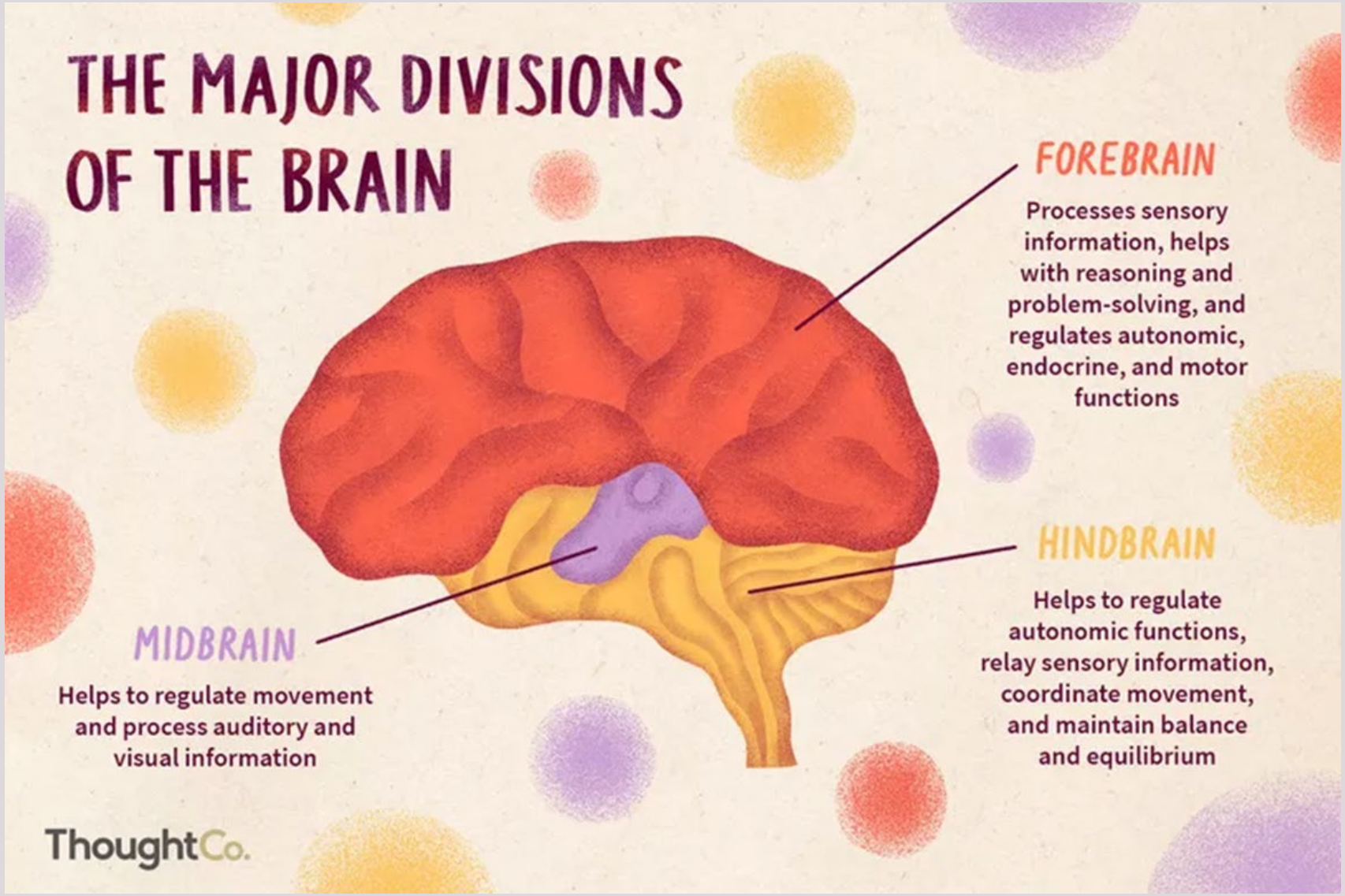


CENTRAL NERVOUS SYSTEM

- Made up of the brain and spinal chord
- Processes and analyzes information
- You need to know the **parts of the brain**



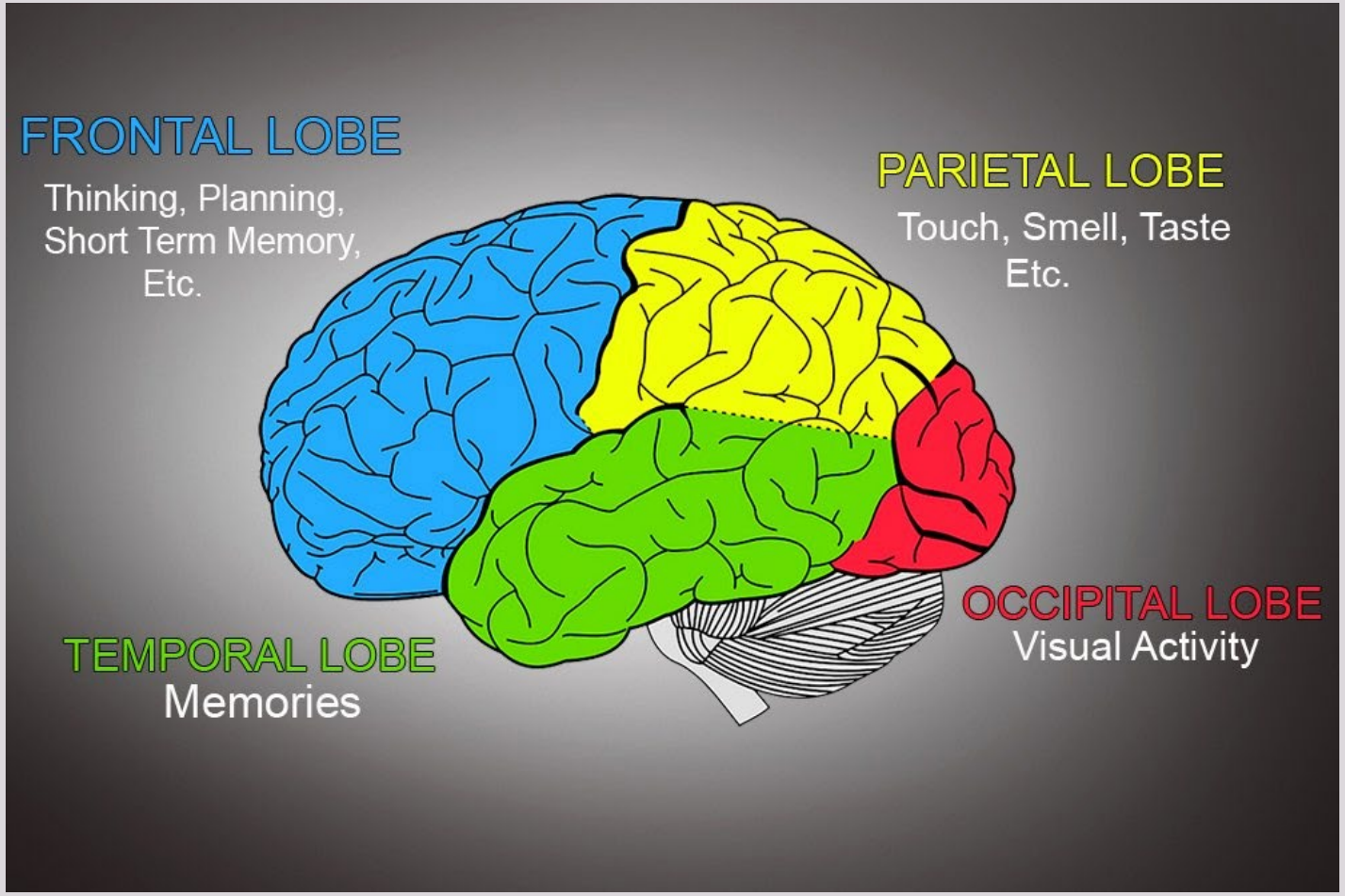
PARTS OF THE BRAIN



PARTS OF THE BRAIN | FOREBRAIN

Cerebrum

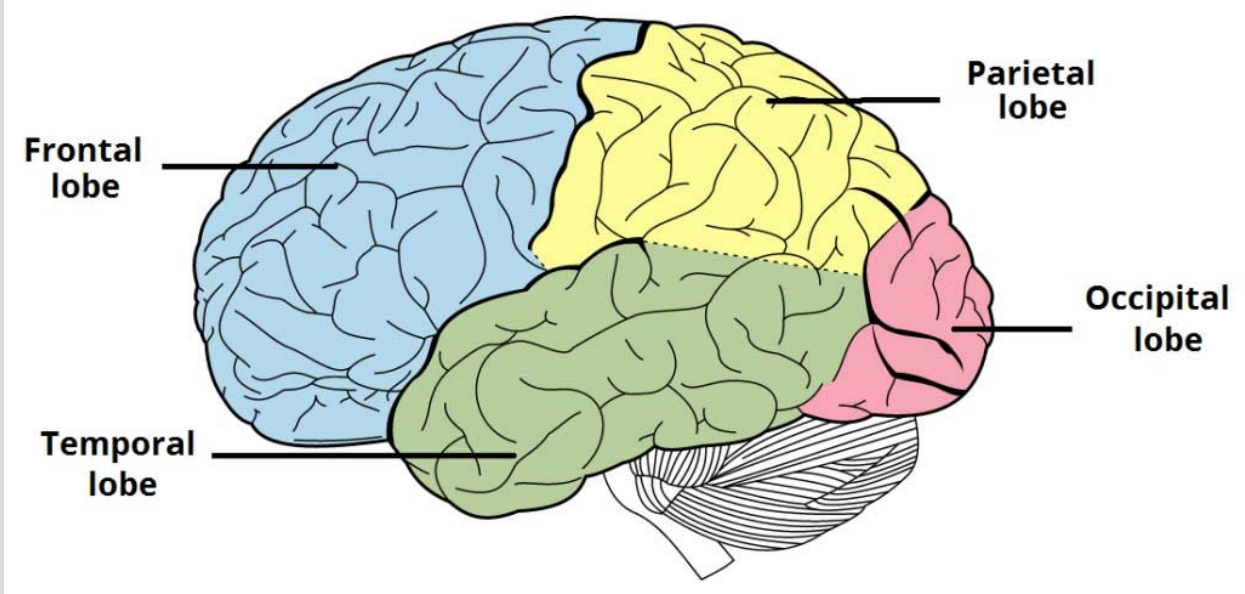
- Think the "top part" of the brain.
- With the assistance of the cerebellum, the cerebrum controls all voluntary actions in the body
- Made up of white and grey matter (the cerebral cortex)



PARTS OF THE BRAIN | FOREBRAIN

Cerebral Cortex

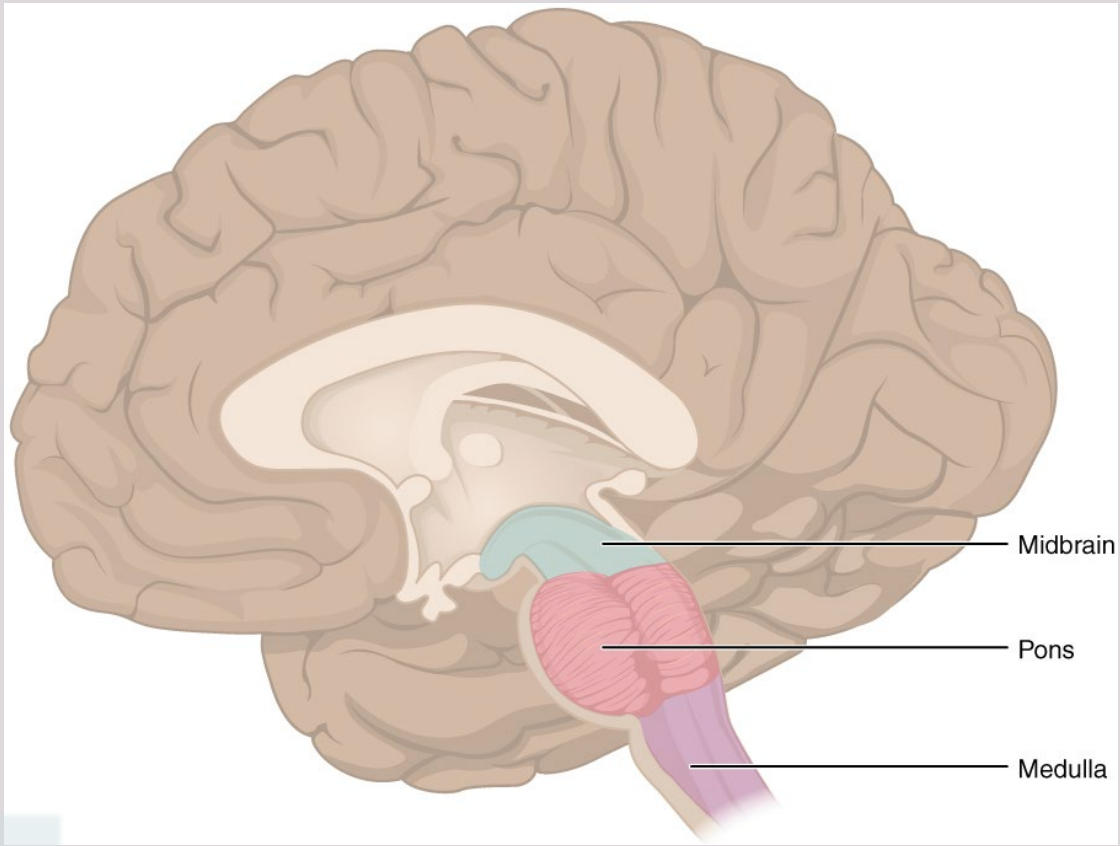
- **Frontal Lobe**
  - involved in movement, decision-making, problem-solving, and planning
- **Parietal Lobe**
  - the function and processing of sensory information, understanding spatial orientation and body awareness
- **Temporal Lobe**
  - play an important role in organizing sensory input, auditory perception, language and speech production, as well as memory association and formation
- **Occipital Lobe**
  - the main centers for visual processing



PARTS OF THE BRAIN | IN-BETWEEN

Brain Stem

- Bottom part of the brain
- Inline with the spinal cord
- includes the midbrain, the pons and medulla oblongata of the hindbrain.



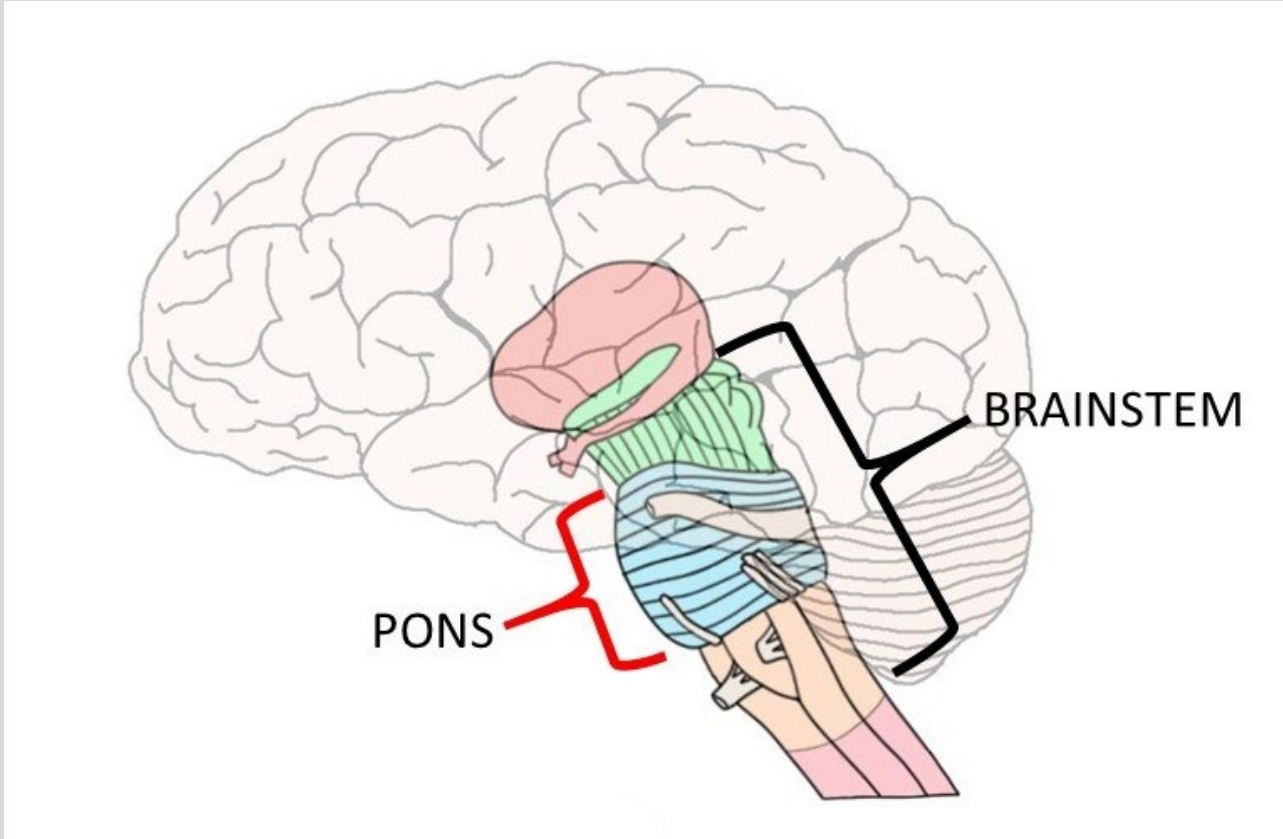
Quick Question

4. What are the four parts of the cerebral cortex?
5. What do they contribute to in 5 words or less?

PARTS OF THE BRAIN | HINDBRAIN

Pons

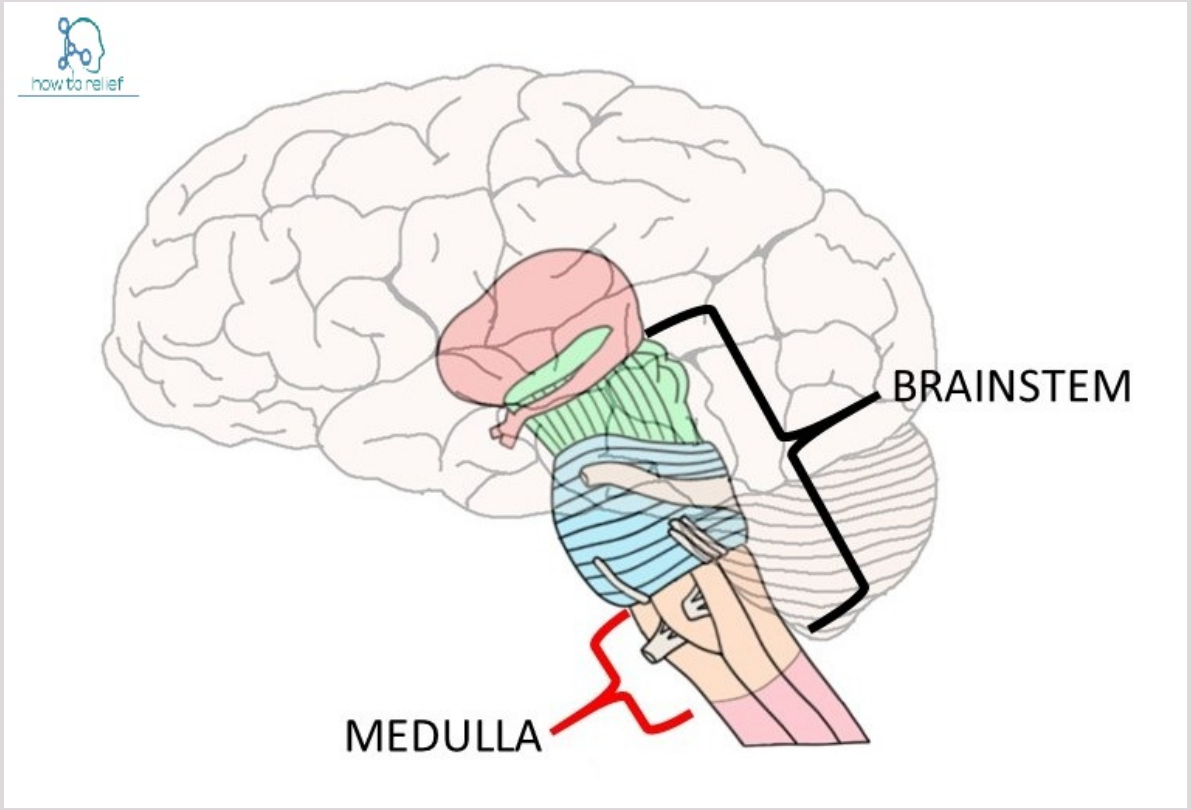
- Connects forebrain to hind brain
- Regulates breathing
- Involved in control of sleep cycles



PARTS OF THE BRAIN | HINDBRAIN

Medulla Oblongata

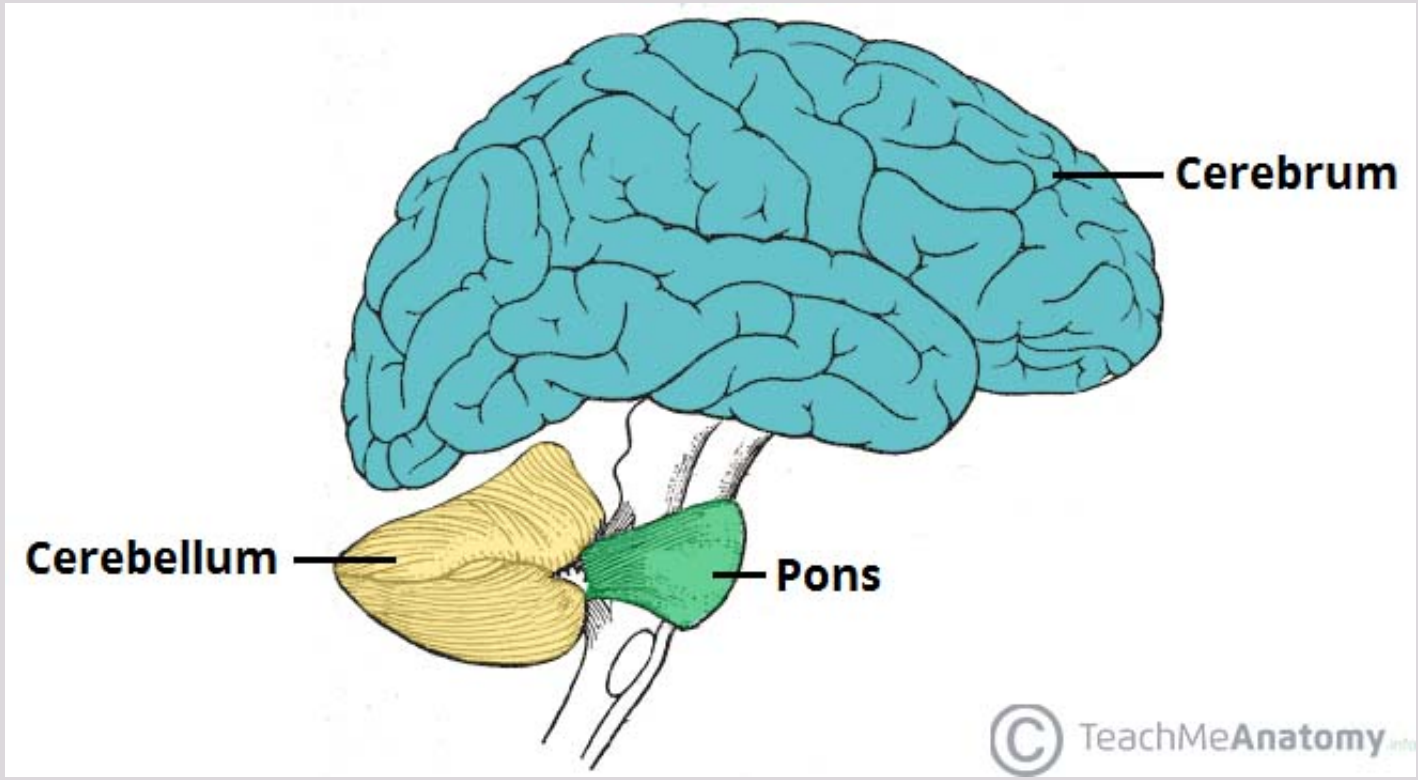
- portion of the hindbrain
- controls autonomic functions: breathing, digestion, heart and blood vessel function, swallowing, and sneezing.
- helps transfer messages between parts of the brain and spinal cord.



PARTS OF THE BRAIN | HINDBRAIN

Cerebellum

- coordinates movement
- controls balance



CARDIOVASCULAR SYSTEM

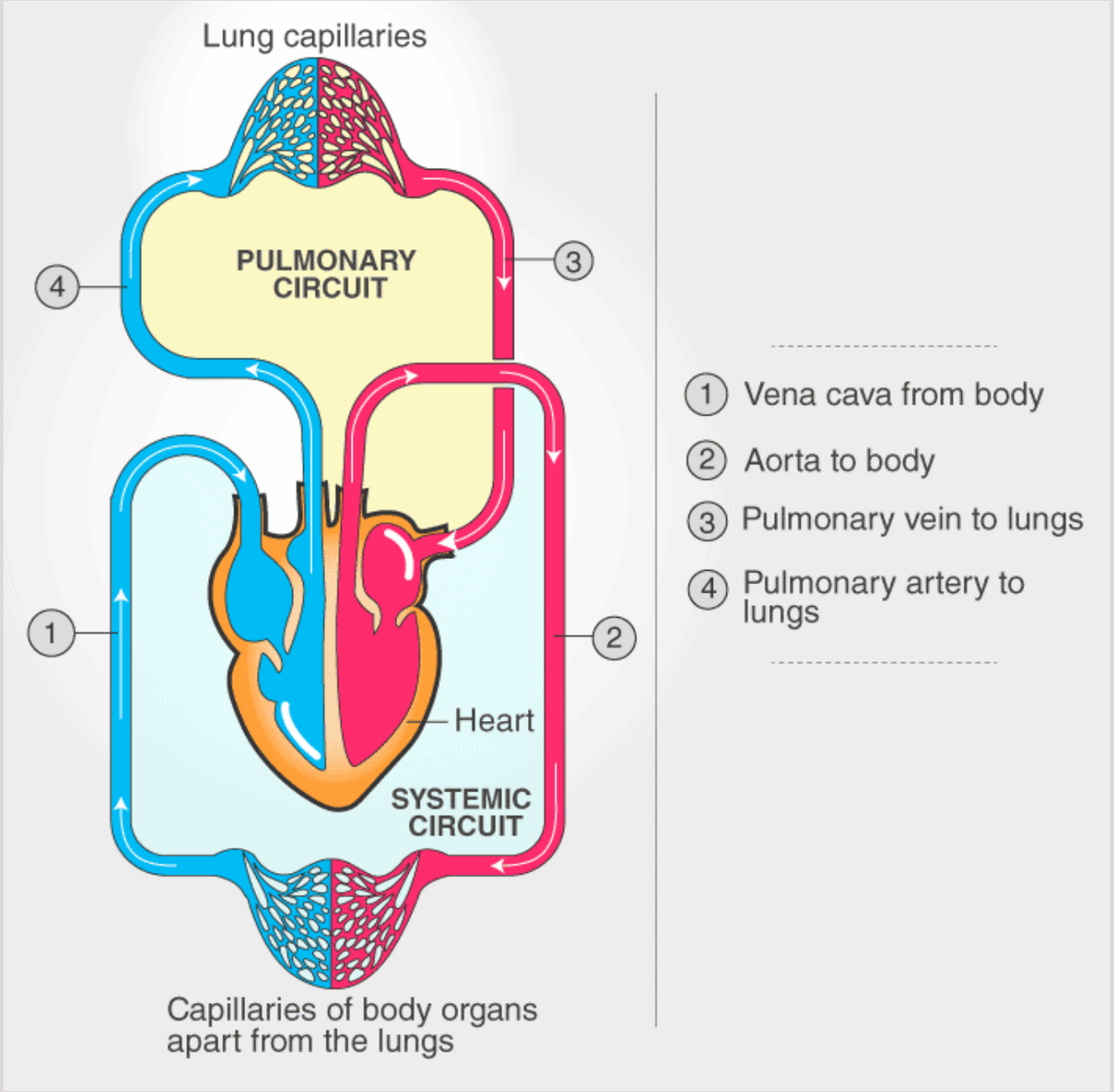
BLOOD FLOW: TRANSPORT OF MATERIALS THROUGHOUT YOUR BODY

OVERVIEW

- Consists of the heart, blood vessels and blood
- Pulmonary circulation
  - the right side of the heart to the lungs
  - Takes away CO_2 (carbon dioxide)
  - to oxygenate the blood
- Systemic circulation
  - the left side of the heart to the rest of the body
  - delivering O_2 (oxygen)

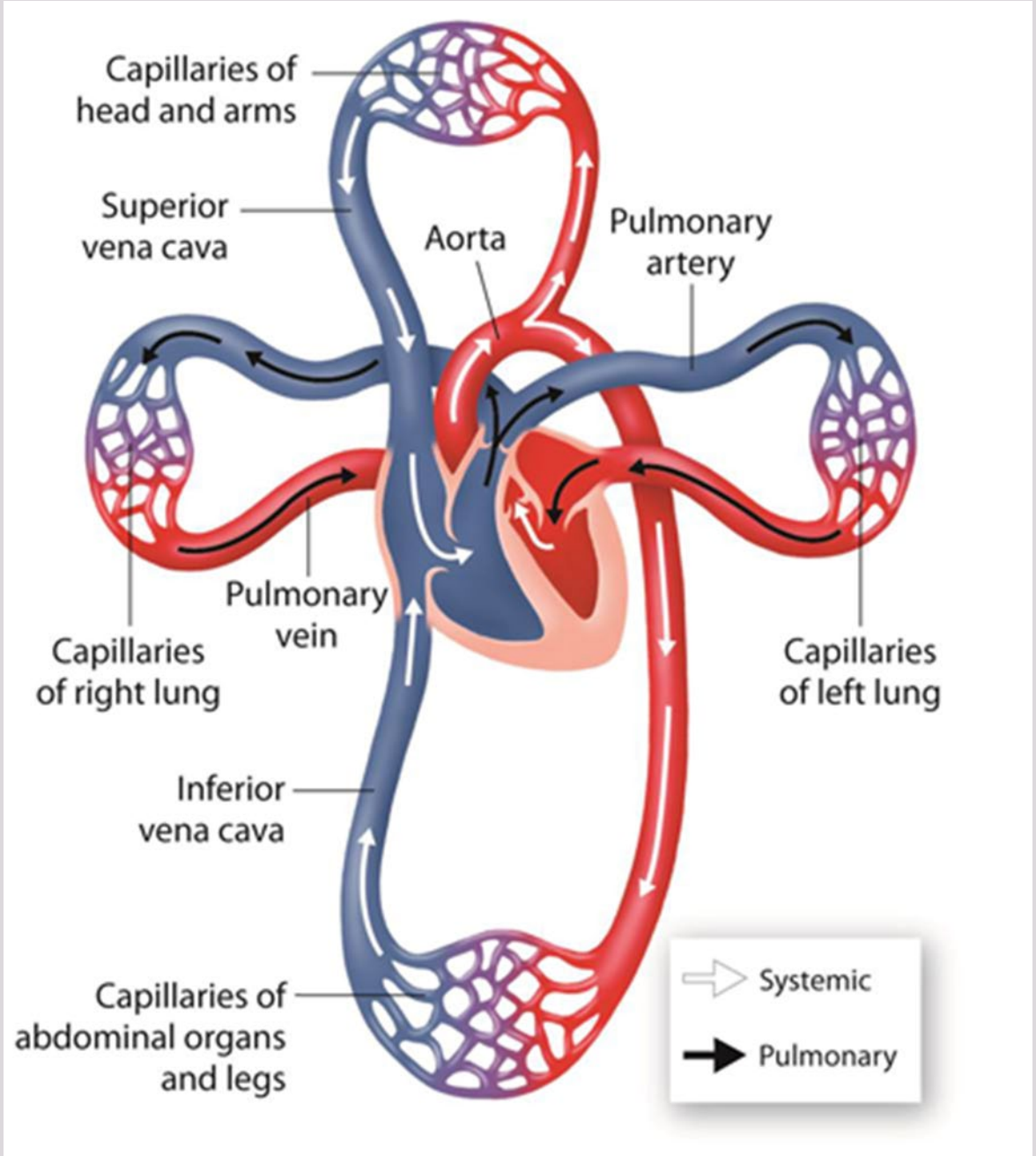
Quick Question

6. What does the red side carry? The blue side?



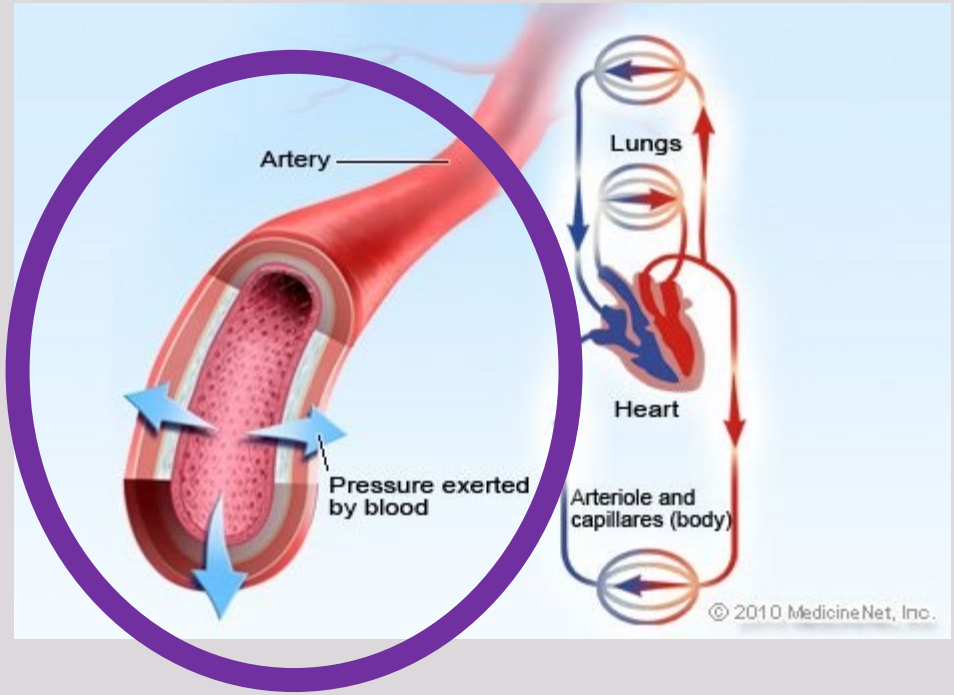
BLOOD FLOW

- Blood flows AWAY from the heart in ARTERIES taking oxygen to our entire body
  - Arteries get smaller as they branch further from the heart
- Eventually the blood flows into *capillaries*
  - tiny blood vessels where gas exchange with other tissue happens
- Once deoxygenated, the blood flows back to the heart in VEINS



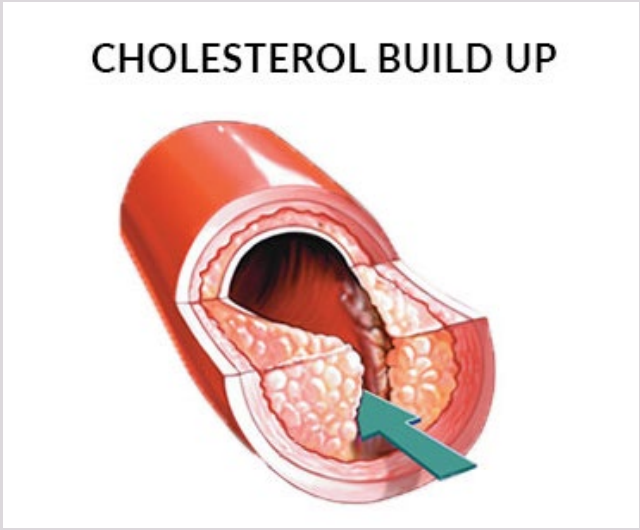
WHAT EFFECTS BLOOD FLOW?

- The contracting (squeezing) of the heart **increases blood pressure** to push blood through the vessels (causes blood pressure)
- Our nervous system **regulates blood pressure** by relaxing or contracting smooth muscle in the vessels
- Kidneys remove excess water from blood, decreasing blood volume which **lowers blood pressure**
- Blood vessels dilate (get bigger) which **decreases blood pressure**
- Blood vessels constrict (get smaller) which **increase blood pressure**



WHAT EFFECTS BLOOD FLOW?

- Increase in the number of red blood cells can thicken blood, causing blood to travel at **a slower rate** than thin blood.
- **High blood pressure** (caused by plaque buildup = high cholesterol) can cause heart attack and stroke (blood clot in the brain), can be related to heart diseases which risk increases with age and unhealthy lifestyle
- Sickle cell anemia, or crescent shaped blood cells, can create blockages like plaque and **increase blood pressure**
- Exercise increases the amount of carbon dioxide in the blood during training and contributes to heart health



Quick Question

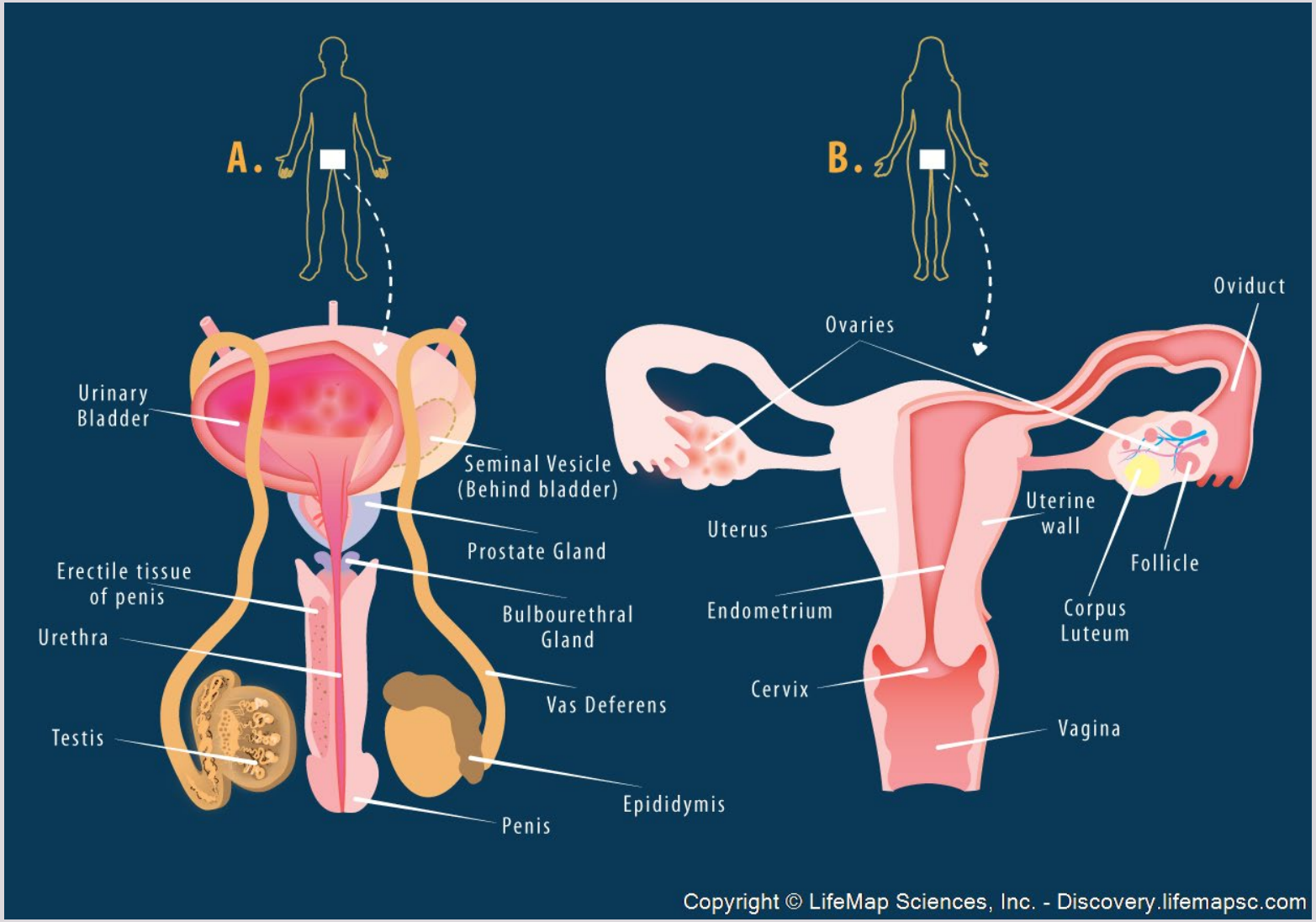
7. What 4 things would affect blood flow?
   Check your vocab list for help.

REPRODUCTIVE SYSTEM

AND HUMAN DEVELOPMENT

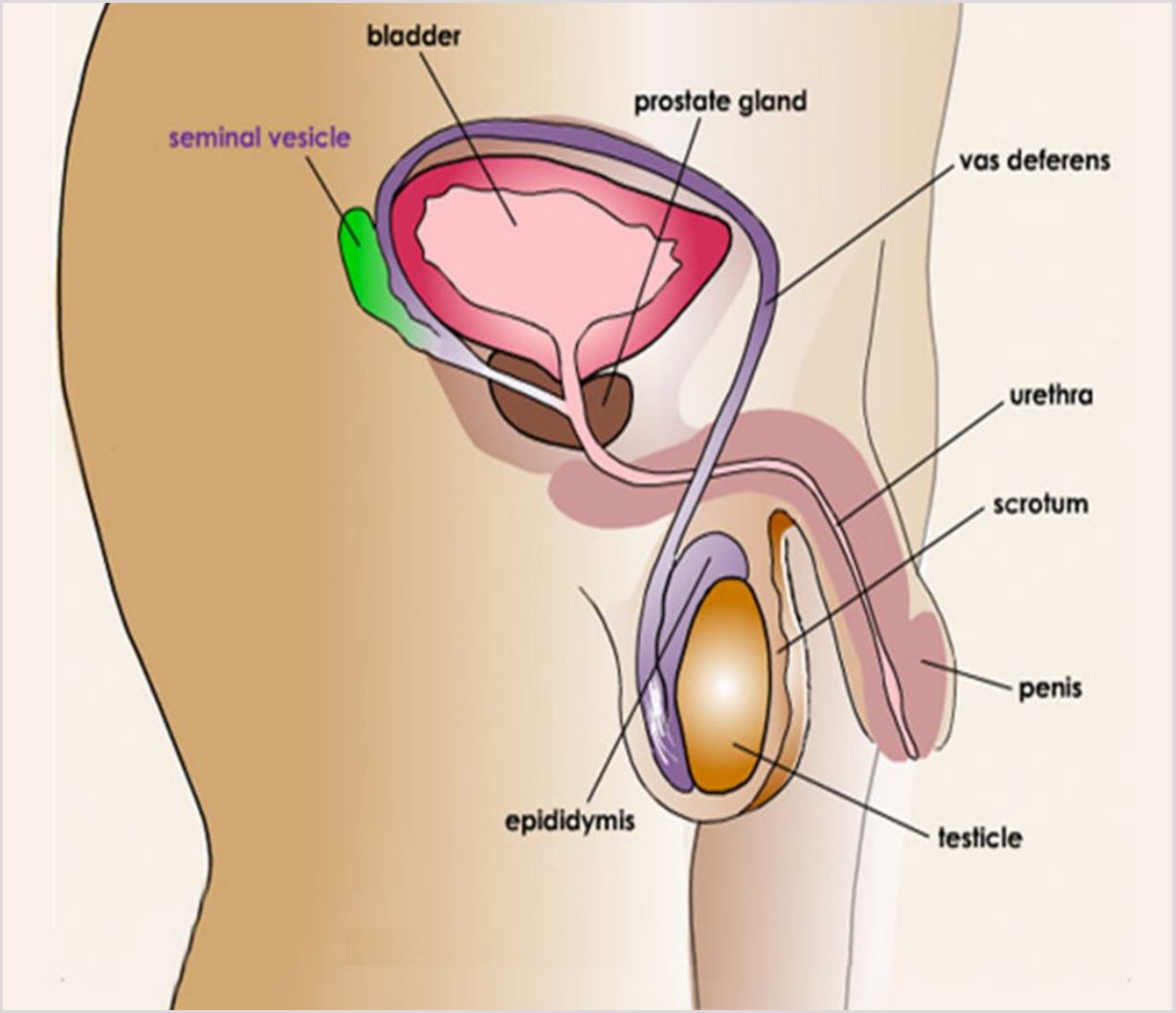
OVERVIEW

- The male and female reproductive systems are controlled by hormones produced by the pituitary gland in the brain and in the reproductive organs themselves
- These organs make, mature and store gametes in the human body



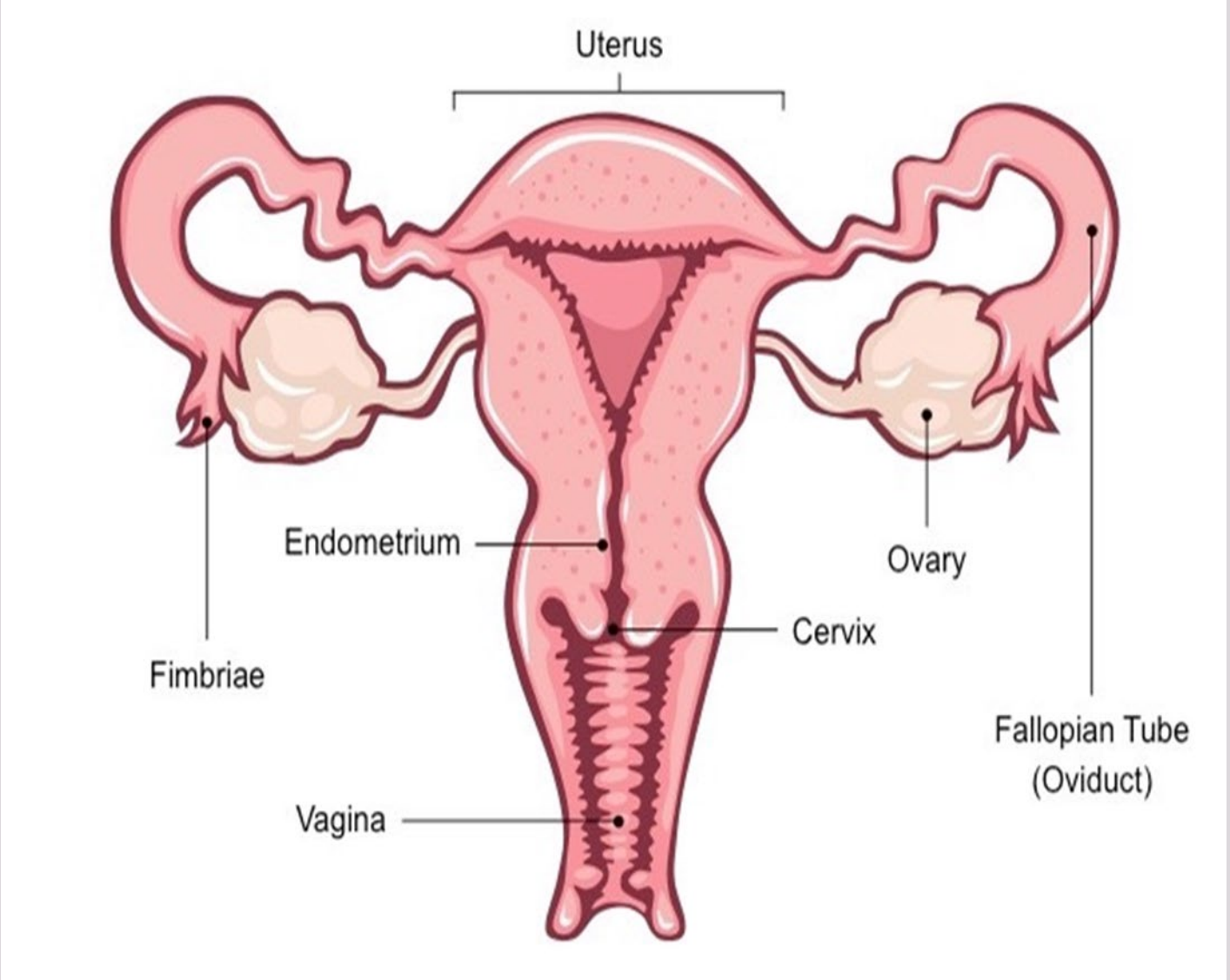
THE MALE REPRODUCTIVE SYSTEM

- Sperm is produced by meiosis in the testes, where it is transported out of the testes and matures in the epididymis, then travels through the vas deferens to the urethra through the penis during ejaculation



FEMALE REPRODUCTIVE SYSTEM

- The female reproductive system's purpose is to produce ova, eggs, and prepare the female body for a developing embryo

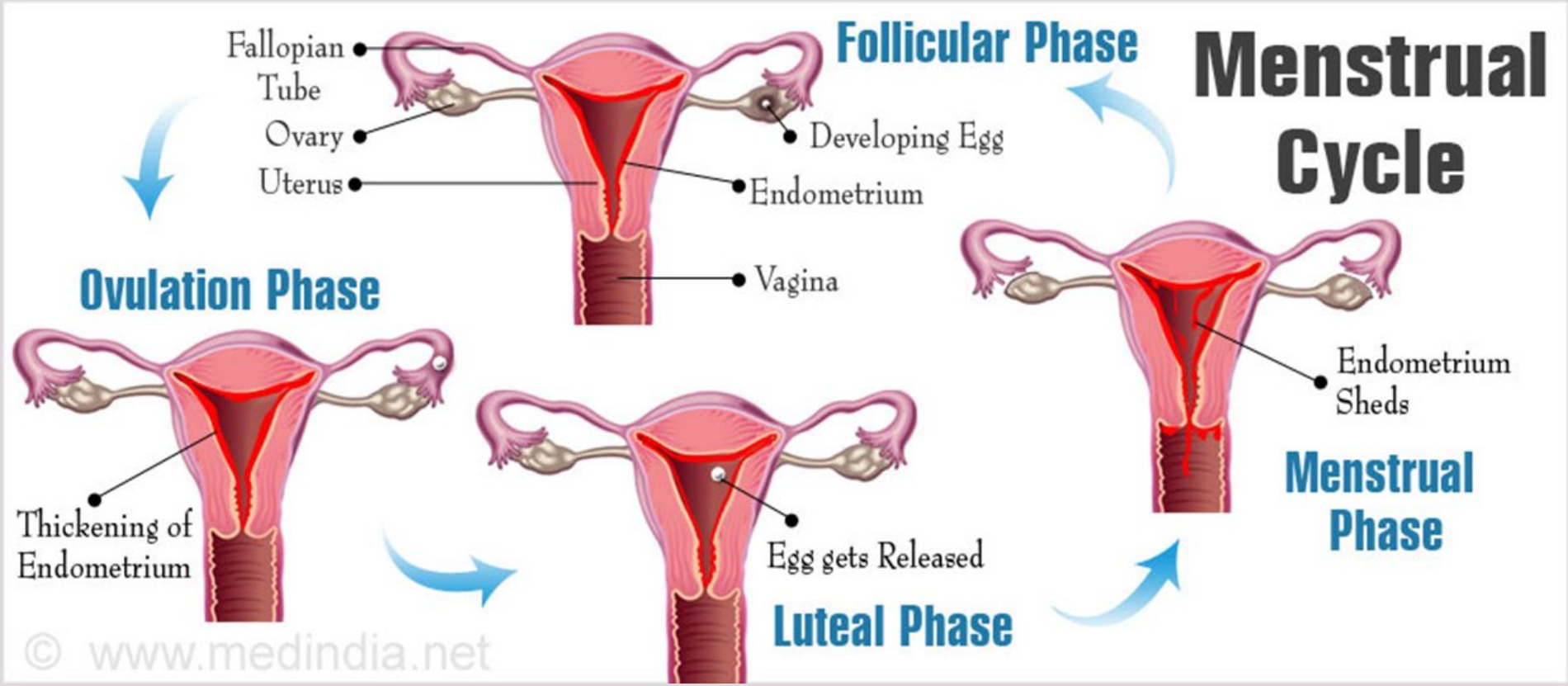


Quick Question

8. Where are the majority of male reproductive organs? Inside or outside of the body? What about female sex organs?

FEMALE MENSTRUAL CYCLE

- When an ovum, egg, is mature it is released from the ovary then travels through the oviduct where it has a chance to be fertilized and implanted into the uterus
- If not fertilized the ovum is discharged with the new lining of the uterus



Quick Question

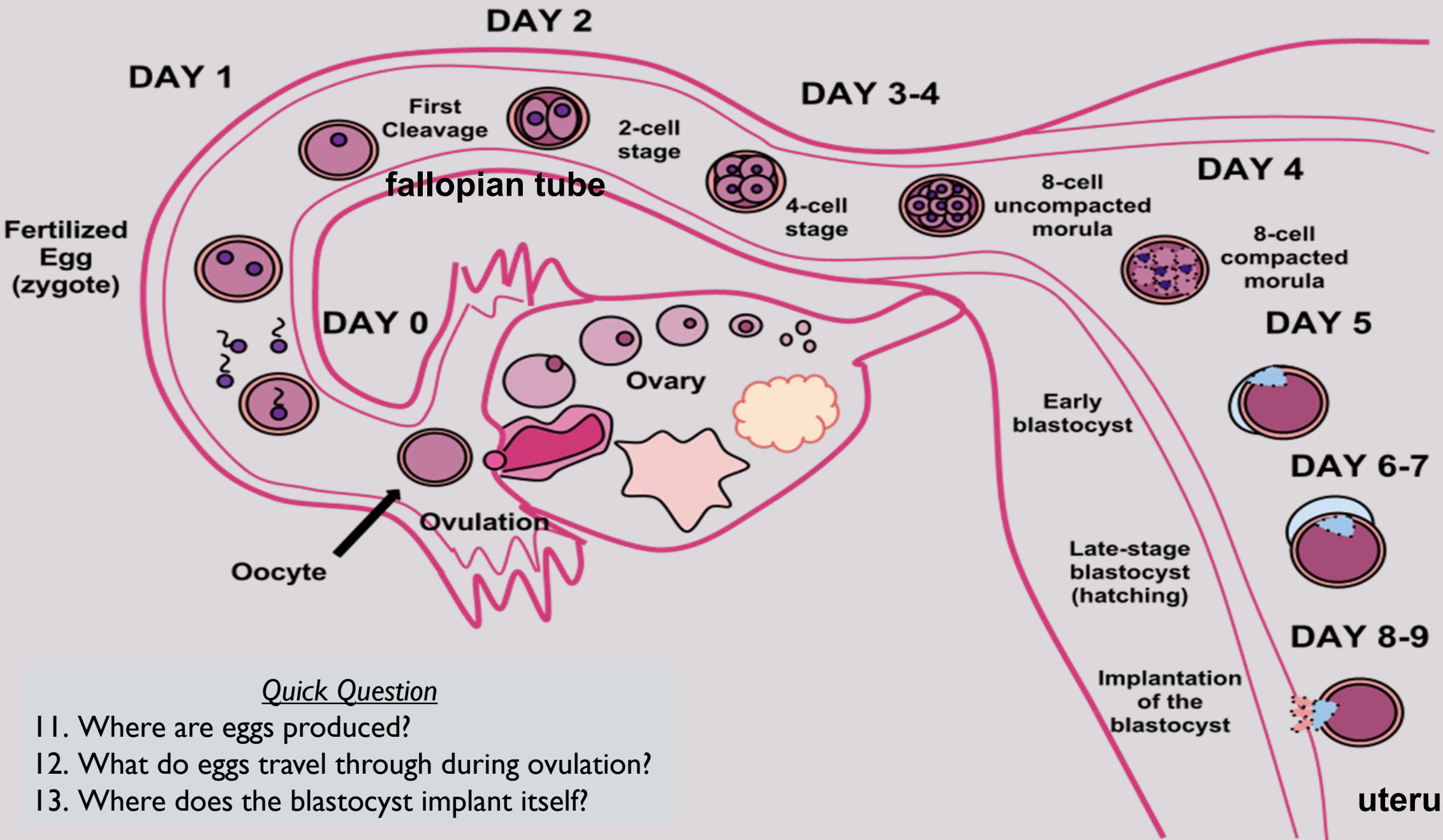
9. When does menstruation NOT occur?
10. What is shed during menstruation?

HUMAN DEVELOPMENT

Fertilization

- **Fertilization** = sperm joining egg to form a diploid cell
- Forms a **zygote** which undergoes mitosis producing an **embryo** (day 2-week 8)
- The embryo is a **morula** (64 cells) about 4 days after fertilization
- The morula turns into a **blastocyst** (6-7 days) which is hollow and will attach into the uterus through implantation

Fertilization



Quick Question

11. Where are eggs produced?
12. What do eggs travel through during ovulation?
13. Where does the blastocyst implant itself?

HUMAN DEVELOPMENT

Embryonic Development

- After implantation: blastocyst creates another layer of tissue and develops nervous tissue
- The embryo develops inside an amniotic sac for protection
- The umbilical cord connects the embryo to the placenta where nutrient, waste and gas exchange occur between mother and embryo

HUMAN DEVELOPMENT

Fetal Development

- At 8 weeks the embryo is referred to as a **fetus**
- After three months most organs and tissues are formed
- Months 4-6: tissue is specialized, heart is strong enough to hear and bone replaces cartilage
- Months 7-9: lungs and other organs prepare for life outside the uterus

(a) 5 weeks. Limb buds, eyes, the heart, the liver, and rudiments of all other organs have started to develop in the embryo, which is only about 1 cm long.

(b) 14 weeks. Growth and development of the offspring, now called a fetus, continue during the second trimester. This fetus is about 6 cm long.

(c) 20 weeks. By the end of the second trimester (at 24 weeks), the fetus grows to about 30 cm in length.

Quick Question

14. List the stages of human development and about how long they stay in that stage.

IMMUNITY

HUMAN IMMUNE SYSTEM

OVERVIEW

- **Diseases** are changes that disrupt the bodies normal function
  - Can be caused by: viruses, bacteria, fungi, protists, environment/pollution, genetics
  - Immune system fights infection with cells that inactivate foreign substances
- Infectious disease spread:
  - Coughing/sneezing
  - physical contact: exchange of bodily fluids (i.e. kiss), contaminated surface, drinking contaminated water,
  - environmental exposure (i.e. radiation, heavy metal poisons like mercury, lead or chromium)

a corona virus

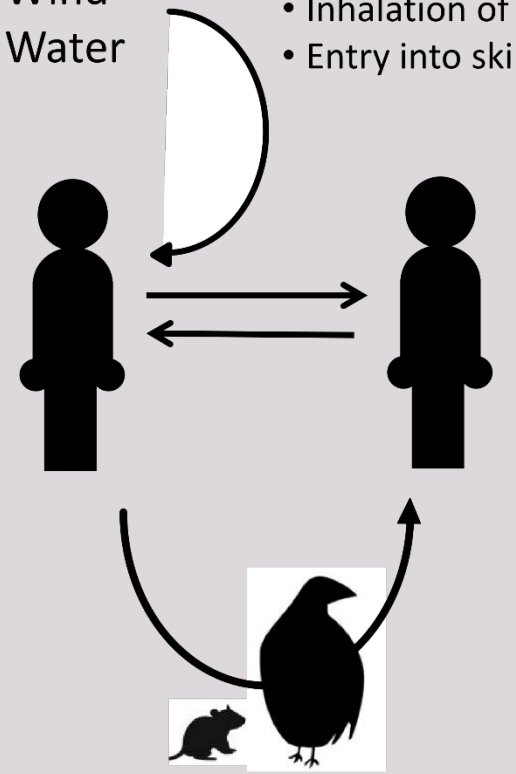
Modes of Infectious Disease Transmission

A. General Transmission

Abiotic environmental factors

- Wind
- Water

- Inhalation of spores
- Entry into skin

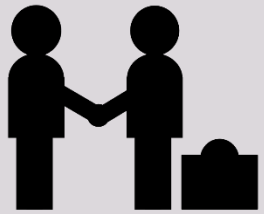


Animal vectors

- Mosquitoes (malaria, dengue)
- Fleas (bubonic plague)

B. Human to Human Transmission

Direct Contact



- Pathogen survives best inside the body
- Eg: HIV, Herpesviruses, Ebola

Indirect Contact

- Pathogen survives harsh environment
- Pick up pathogen from surface or air
- Eg Influenza, norovirus

Droplets

- Pathogens are in droplets, but do not survive long this way
- Eg: Ebola, *Bordetella pertussis*

Airborne

- Pathogens aerosolized and stay infective
- Eg: Influenza, Tuberculosis

Fecal - Oral

- Through contaminated water or food
- Eg: Cholera, Norovirus, Shigella

NONSPECIFIC IMMUNE RESPONSE

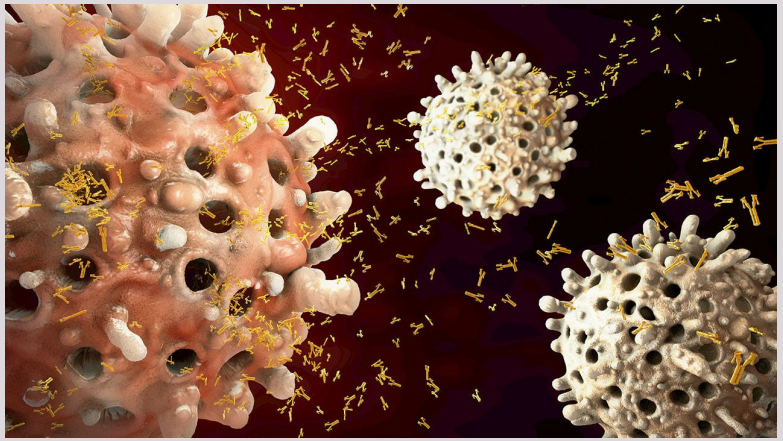
- Don't differentiate among threats
- Chemical or physical barrier to threat

  1- Skin = (barrier) first line of defense

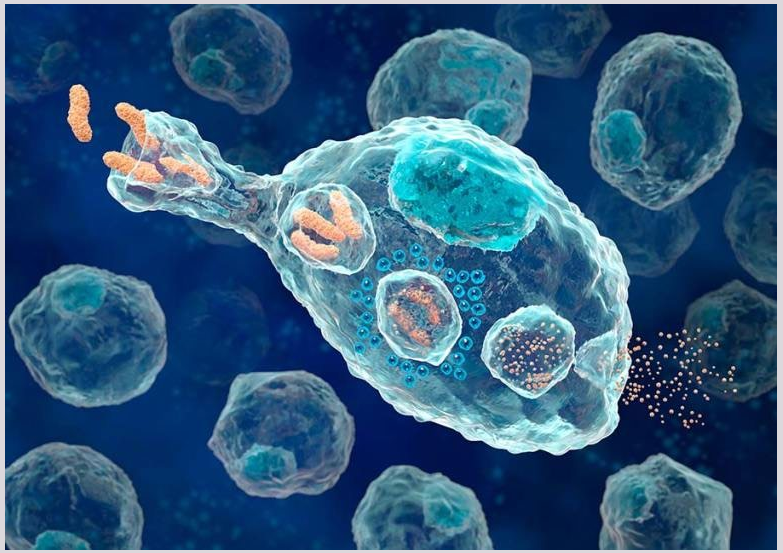
  2- Inflammation – second line of defense, blood vessels in a damaged area expand and deliver excess **white blood cells** (WBC) to attack the *pathogen* (disease-causing agent)

  3 - Fever = increase body temperature and increase heart rate to stop pathogens and increase chemical reactions in immune response

- **Phagocytes** are whole cells that capture invading cells or pieces of cells by surrounding and engulfing them. Once the invading cell is inside the phagocyte it is killed by enzymes

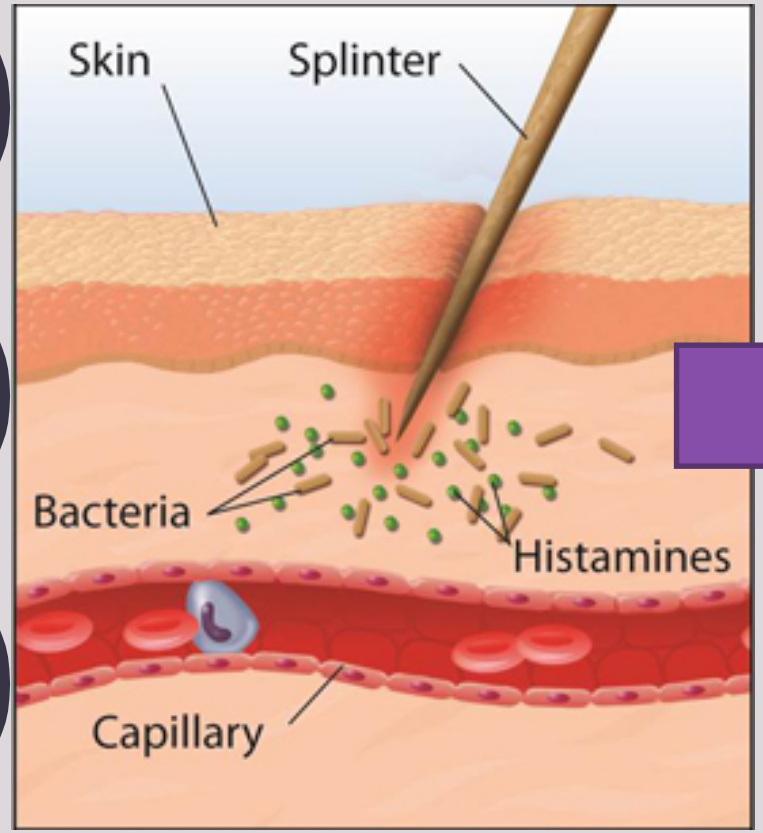


white blood cells (WBC)

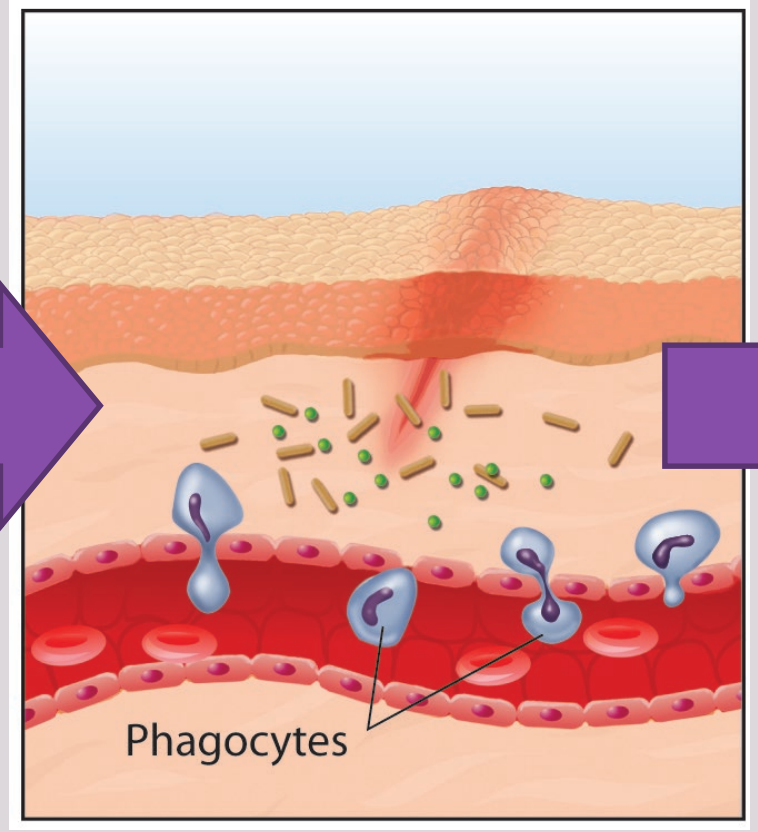


phagocyte (macrophage)

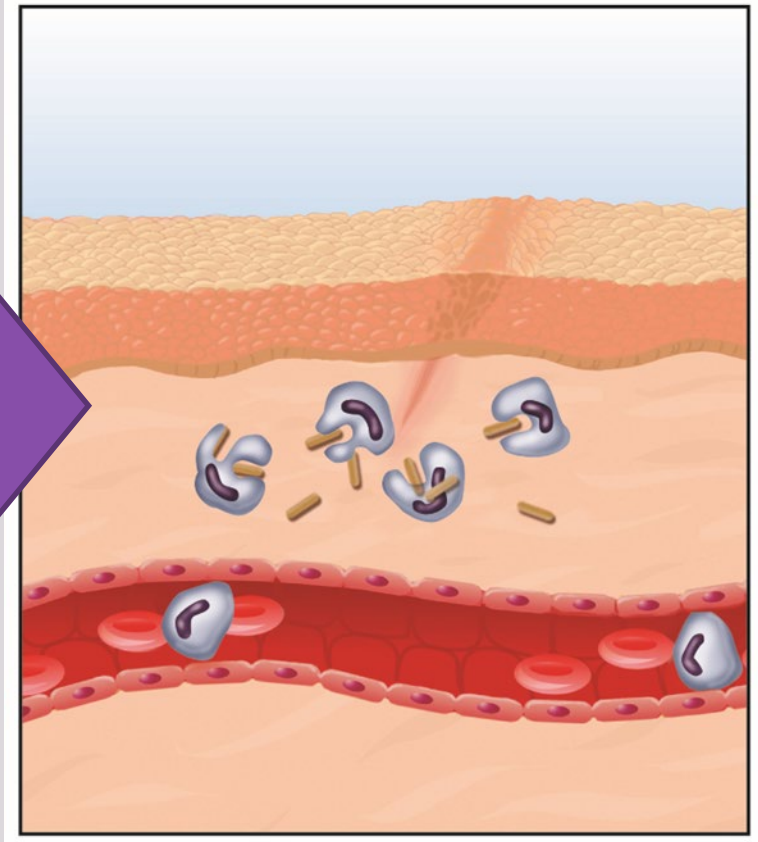
NONSPECIFIC IMMUNE RESPONSE



In response to the wound and invading pathogens, mast cells release histamines, which stimulate increased blood flow to the area.



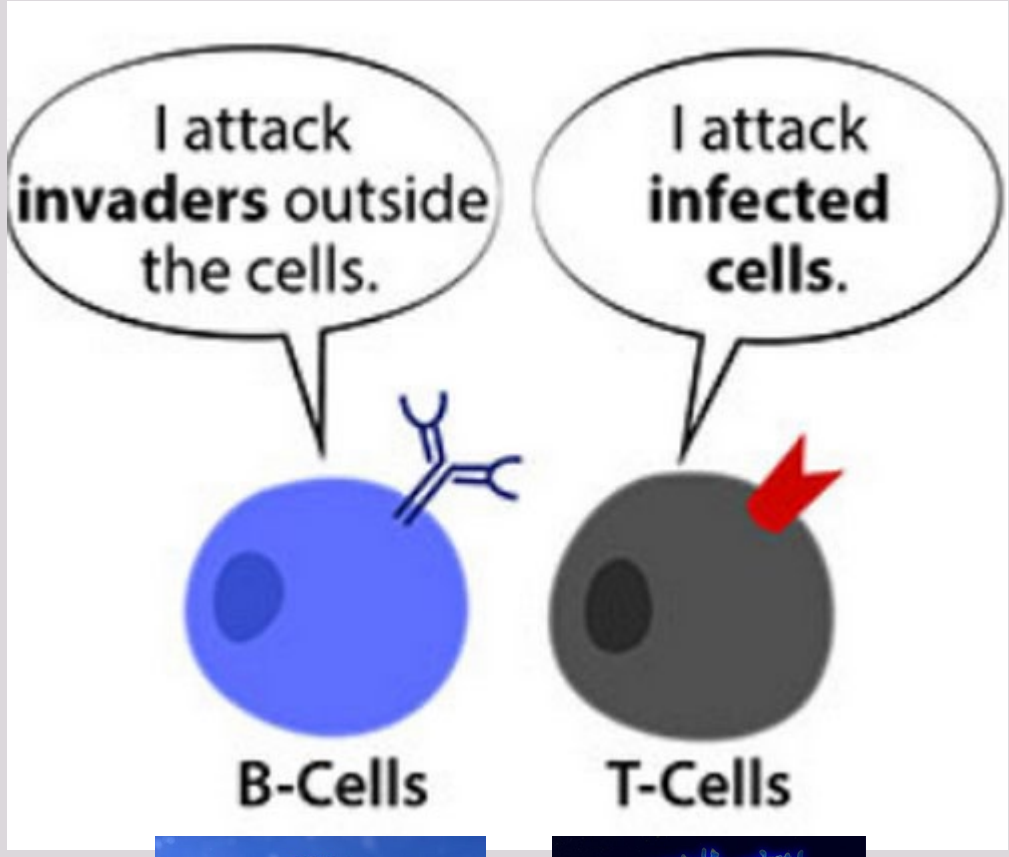
Local blood vessels dilate. Fluid leaves the capillaries and causes swelling. Phagocytes move into the tissue.

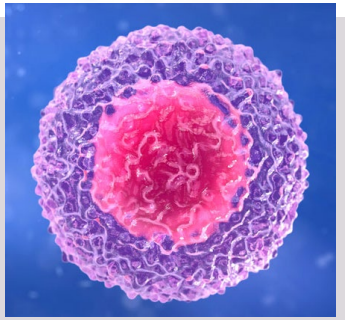


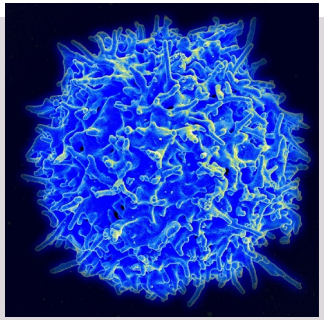
Phagocytes engulf and destroy the bacteria and damaged cells.

SPECIFIC IMMUNE RESPONSE

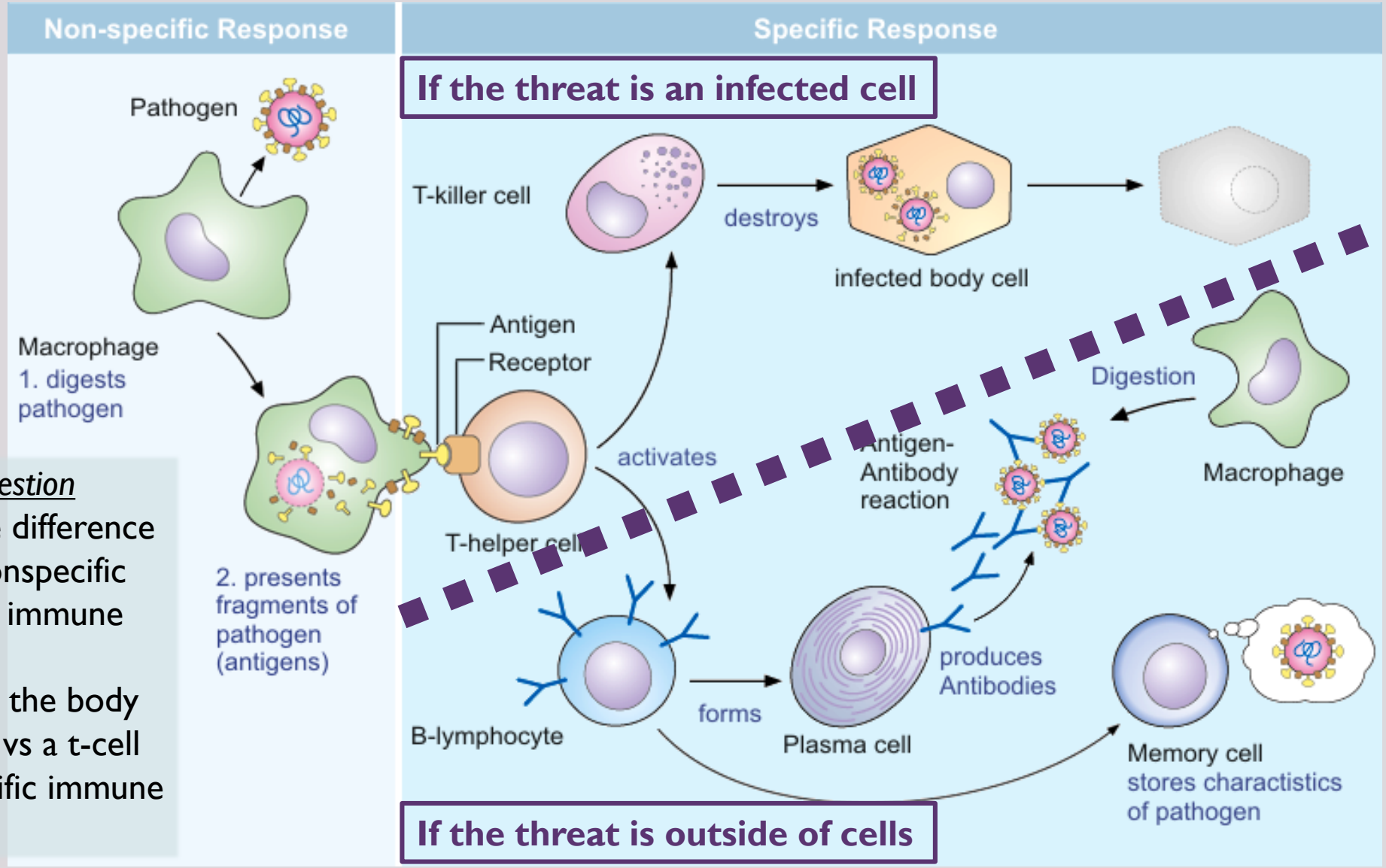
- The immune system's specific defenses distinguish between "self" and "other", inactivating or killing foreign substances or cells.
- **Antigen:** a virus, bacteria, or other pathogen that triggers an immune response (to specific threat)
- **B-cells** recognize a specific antigen and produce *antibodies* (like a flag/marker) so other cells can destroy the pathogen and *memory cells* to recognize future infection
- **T-cells:** killer, suppressor, helper and memory T-cells kill infected cells in the body







SPECIFIC IMMUNE RESPONSE



Quick Question

15. What is the difference between nonspecific and specific immune responses?
16. Why would the body use a b-cell vs a t-cell during specific immune response?

VACCINATIONS & ANTIBIOTICS

VACCINATIONS	ANTIBIOTICS
Usually for viruses	Usually for bacteria
giving a weakened pathogen (virus) so the body develops memory cells to fight future infections	*fight bacterial infections and should be used only when necessary*
Use the bodies natural immune response to PREVENT illness/symptoms (not exposure)	Derived from natural sources (i.e. fungi, insects, bacteria themselves) but used AFTER already ill
new viruses, not resistance	Evolve resistance, not new bacteria
Usually a shot	Taken orally or IV or shot

Interesting article on Antibiotic Synthesis
https://science.howstuffworks.com/life/cellular-microscopic/10-weirdest-sources-antibiotics.htm

OTHER HEALTH THREATS

- **Allergens -** cause the immune system to overreact producing histamines (allergic reaction) which make extra mucus, tears, sneezing, swelling, etc.
- **Autoimmune disease -** the body's Tcells attack healthy cells
- Environmental factors like air quality, water quality and radiation affect health
- **Cancer -** uncontrollable multiplying of cells destroying tissue / mass of growing tissue = *tumor*
  - Caused by genetics or environmental factors called carcinogens, chemicals that cause cancer

ANSWER KEY

TO SELECT QUICK QUESTIONS

1. maintaining stable temperature conditions is important for the chemical reactions that occur in the body. Most of biological processes that are essential for life occur in a very limited temperature range. Temperatures above or below this range can inhibit or denature enzymes, which means that chemical reactions cannot occur.
2. "keeping things the same" or *homo* = "same" *stasis* = "standing"
3. Cell-tissue-organ-organ system-organism / humans are organ-system level organisms
6. Blue = carbon dioxide (to the lungs for the "exhale") red = oxygen (from the lungs "inhale" and to the rest of the body)
7. The factors that most directly affect blood flow are blood pressure, blood volume, resistance and activity level (exercise).
14. (1) egg and sperm, depends (2) zygote after fertilization, ~1-2 days (3) morula, 4 days (4) blastocysts, 6-7 days (5) embryo, 2 days – 8 weeks (6) fetus, >8 weeks
15. Specific immune response protects the body against specific pathogens whereas nonspecific immune response is the same for all pathogen
16. B-cells are for destroying pathogens that are outside of cells like bacteria or protists, T-cells attack infected cells like for a virus.