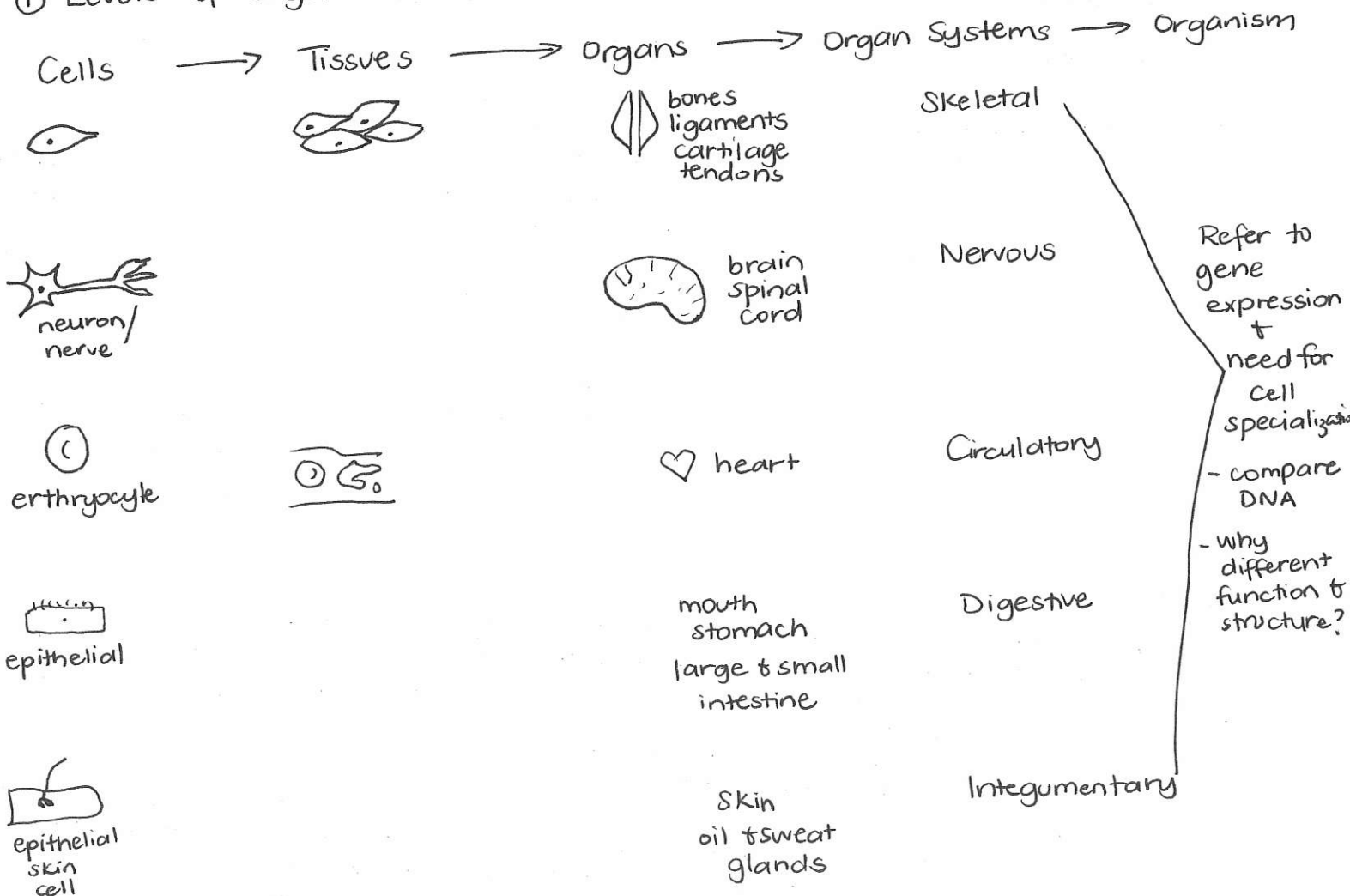


# Unit 12 Lecture Discussion

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- Nervous
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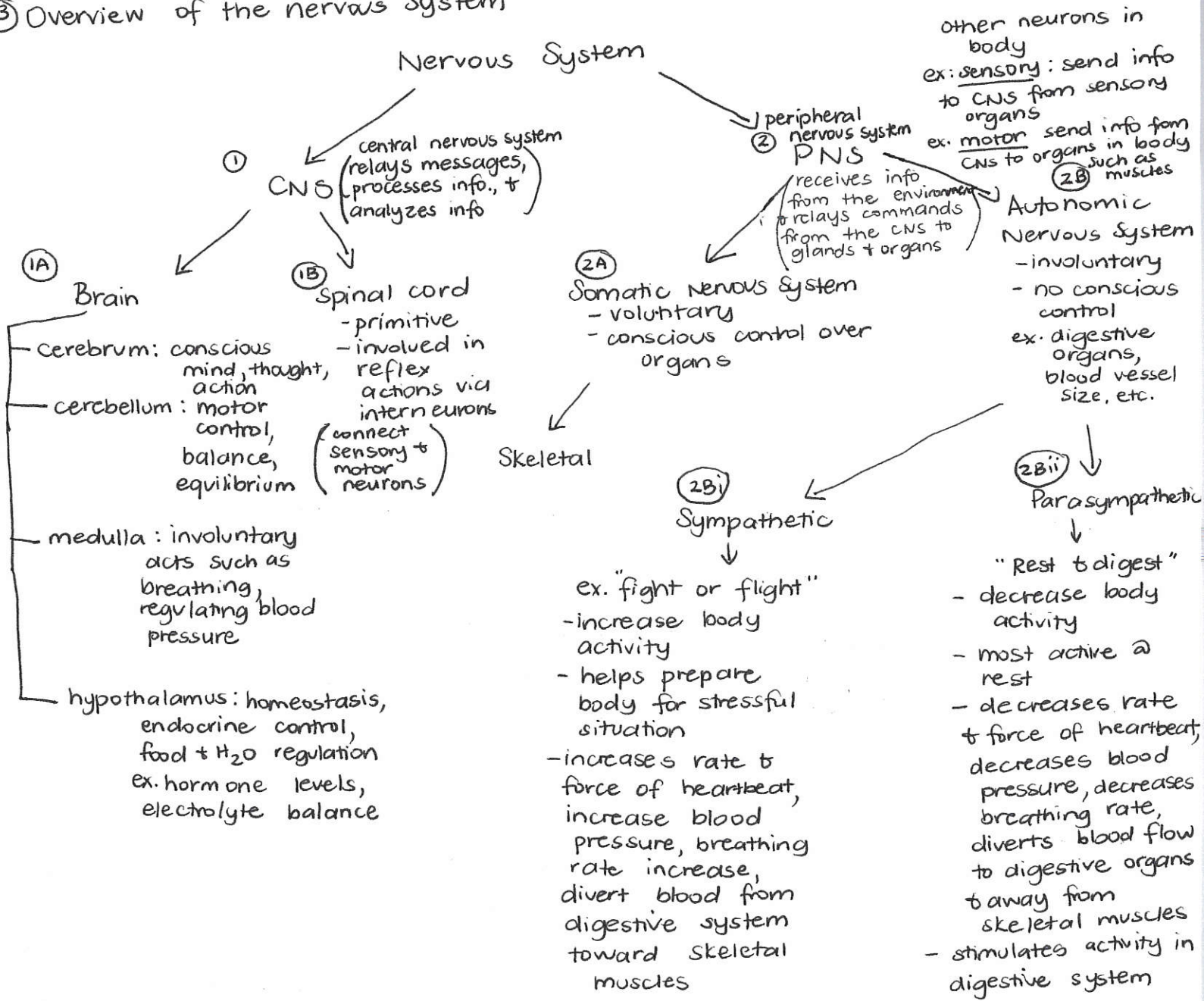
Main question: How do organ systems interact within the body?

## ① Levels of Organization



② What are the functions of the animal systems  
- see PPT

③ Overview of the nervous system



Reflex action:

- simple in which a stimulus leads to an immediate action
- ex. pupillary light reflex where light flashed in one eye causes the pupil to constrict
- The pathway of a reflex is the reflex arc that consists of the following neurons:
  - a) afferent (sensory) nerve
  - b) interneurons within the CNS (spinal cord)
  - c) efferent (motor) nerve
- ex. if you step on a tack with your foot, the sensory receptors relay a message to your sensory neuron, which sends a message to your interneurons in the spinal cord that activates the motor neurons to cause your muscles to contract, thereby pulling your foot away from the tack
- In total: you need (in addition to the aforementioned neurons) the sensory receptors
- not all reflex arcs include interneurons

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### ④ Overview of the Integumentary system

- main function: protection - barrier against injury & infection & radiation  
regulate body temperature  
remove waste products - <sup>elaborate!</sup> acts as an organ of excretion
- contains sensory receptors for pressure, heat, cold, & pain
- how regulate body temperature?
  - a) when hot, sweat glands produce sweat which, when evaporated, removes heat from body
  - b) when hot, blood vessels dilate (vasodilation) increasing s.a. so that heat from core is released
  - c) when cold, blood vessels constrict (vasoconstriction) reducing surface area to conserve heat

### ⑤ Overview of respiratory system

- main function: serve as the conduit for the exchange of oxygen &  $\text{CO}_2$  between blood, air, & the tissues
- relate gas exchange in alveoli to diffusion
- relate hemoglobin & role
- relate to cellular respiration

### ⑥ Overview of digestive system

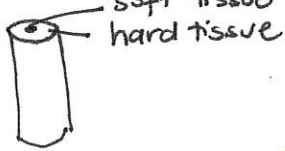
- main function: help convert foods into simpler molecules that can be absorbed & used by the cells of the body
- include physical vs chemical digestion
  - relate to enzymes & pH
    - ex. amylase & starch in saliva ( $\approx 6.2-7.4$ )
    - ex. pepsin & protein in stomach
    - ex. lipase & lipids in small intestine ( $\approx 6$ )
    - ex. amylase - starch in small intestine
    - ex. maltase, sucrase, & lactase in small
- most absorption here due to villi
- large intestine - primary role to remove  $\text{H}_2\text{O}$  from undigested material

# ① Overview of excretory system

- remove waste products from blood, maintain blood pH, regulate H<sub>2</sub>O content in blood & blood volume
- kidneys help maintain homeostasis
- relate dialysis to osmosis
  - blood removed from body through tube in arm & pumped through a special tubing that allows salts & small molecules such as nitrogen wastes, to pass through. These wastes diffuse out of the blood, allowing purified blood to be returned to body
- relate to skin/integumentary

# ② Overview of skeletal system

- supports body, protects internal organs, provides movement, stores mineral reserves, & provides site for blood cell formation
- bones



## PPT QUES

# ③ Overview of Muscular system

- works with skeletal system to produce voluntary movement, helps to circulate blood & move food through the digestive system
- draw types of muscle tissue
  - skeletal - attached to bones, voluntary movements, controlled by CNS, many nuclei <sup>\* why?</sup>
  - smooth - no voluntary control, ex. stomach <sup>→ have lots of mitochondria & ER</sup>
  - cardiac - heart only, <sup>\* why?</sup>

# ④ Overview of circulatory system

- distributes O<sub>2</sub>, nutrients, hormones to cells; fights infection, remove cell waste, helps regulate body temperature
- role of hemoglobin in RBC's
- role of white blood cells, & platelets
- review vasoconstriction & vasodilation

# ⑤ Overview of reproductive system

- to produce & deliver gametes, as well as prepare body to nourish a zygote in females
- review gametes: meiosis, haploid vs diploid, chromosome #, location of meiosis
- largely influenced by nervous & endocrine system
  - ← sperm release
  - ← stimulate milk production
  - pituitary gland & hormones 4 puberty
  - ex. estrogen
  - ovaries < progesterone ] sex hormones produced by gonads
  - testes < testosterone
- baby: circulatory system - carry food & O<sub>2</sub> to embryo, wastes away
- endocrine - hormones

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### ⑫ Overview of endocrine system

- made up of glands that release their products (hormones) into the bloodstream. These hormones deliver messages throughout the body
- review hormones / macromolecule
- ex. blood glucose (15 mins.)
- ex. puberty (5 years)
- ex. ejection of breast milk (1-2 mins.)
- ex. female reproductive cycle (average 28 days)
- although hormones enter blood it is transported everywhere, it only affects some organs in body. \*why? organs have receptors for hormone with specific shape] ex. insulin
- the effect is slower & longer lasting than nervous system
- Hypothalamus produces releasing hormones that tell the pituitary gland (master gland) to release hormones such as growth hormone, antidiuretic hormone (ADH) → causes kidneys to retain H<sub>2</sub>O
- Adrenal glands on top of kidneys- secretes adrenaline & noradrenaline  
stress → release adrenaline from adrenal glands
- Pancreas - produces insulin & glucagon
  - ↳ allows cells to remove extra glucose from blood to use & CR
  - ↳ stimulates liver to store glucose as glycogen
  - ↳ drop glucose
  - ↳ When low<sup>in</sup> blood → released → target liver to break down glycogen to release free glucose in blood
  - ↳ increase glucose in blood

PPT QUES

13 Overview of the lymphatic / immune system

- function: fight infection through the production of cells that inactiva. foreign substances or cells
- 2 categories: Nonspecific and specific

Immune system

Non-specific

- do not discriminate between one threat and another
- include physical to chemical barriers
- most important defense is the skin
- ex. mucus, saliva, + tears (contain lysozyme (an enzyme that breaks down the cell wall of some bacteria), stomach acid, cilia lining your nose + throat all are the first line of defense
- Second line of defense include the inflammatory response - a nonspecific defense reaction to tissue damage caused by injury or infection. This includes the production of white blood cells, the expansion of blood vessels (swelling).
- The 2nd line also includes the use of fever as few pathogens can survive beyond certain temperatures. It also slows or stops the growth of pathogens. The higher temperature also increases the heart rate so more white blood cells reach the site of infection faster.
- Interferons (substances that interfere with the growth of a virus) are produced when viruses enter the body.

Specific

- If pathogens pass the non-specific line of defense, specific defenses are employed to attack a specific pathogen. These defenses are called the immune response.
- triggers of the immune response are antigens
- The cells that recognize specific antigens are B lymphocytes (B cells) and T lymphocytes (T cells)
- produce antibodies (proteins that recognize + bind to antigens)
- Once body has been exposed to the pathogen, memory B cells are capable of producing antibodies specific to that pathogen
- different types such as cytotoxic T cells or killer T cells, helper T cells, memory T cells
- killer T cells destroy bacterial, fungi, protozoan or foreign tissue

Acquired Immunity

- immunity that is produced/acquired by infection or vaccination or by the transfer of antibody or lymphocytes from an immune donor
- the type of immunity produced by the body's reaction to a vaccine is known as active immunity
  - this occurs after exposure to an antigen, as a result of the immune response or natural exposure to an antigen (fighting an infection) that produces antibodies
- If antibodies from another organism are injected into the bloodstream, this produces passive immunity against the pathogen. This type of immunity is temporary due to the destruction of foreign antibodies, and can develop naturally (breast-fed babies) or deliberately (vaccine with antibodies)

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- Autoimmune diseases - when the immune system makes a mistake and attacks the body's own cells
- ex. Type 1 diabetes, rheumatoid arthritis, multiple sclerosis (MS)
  - Type 1 diabetes - antibodies attacks the insulin-producing cells of the pancreas
  - In rheumatoid arthritis - antibodies attack the connective tissue around the joints
  - In MS, antibodies destroy the functions of the neurons in the brain + spinal cord
  - Medications can be used to treat symptoms (ex. insulin injections for Type 1 diabetes) or suppress the immune system

- Allergies: overreactions of the immune system to antigens
- ex. allergens include dust, mold, bee stings, pollen
- ↓  
antigens that cause allergic reactions
- when allergy-causing antigens (allergens) enter the body, they attach themselves to mast cells (specialized immune cells that initiate the inflammatory response). The activated mast cells release histamine which increase blood flow & fluids to surrounding area. The result is also increased mucus production in the respiratory system. This stimulates sneezing, watery eyes, runny nose, & irritation
  - medications include antihistamines that counter the effects of the histamines

### PPT QUES

#### ⑭ Overview of homeostasis

- Roles of internal feedback mechanism is to maintain homeostasis

- Internal feedback mechanism triggers within a system in which the result of the process controls the process itself
- ex. thermostat uses this internal feedback mechanism → if temp. low beyond a certain temp., turn on heater. If set temp. reached, the thermostat receives feedback & heater turned off
- 2 types of feedback

### Negative

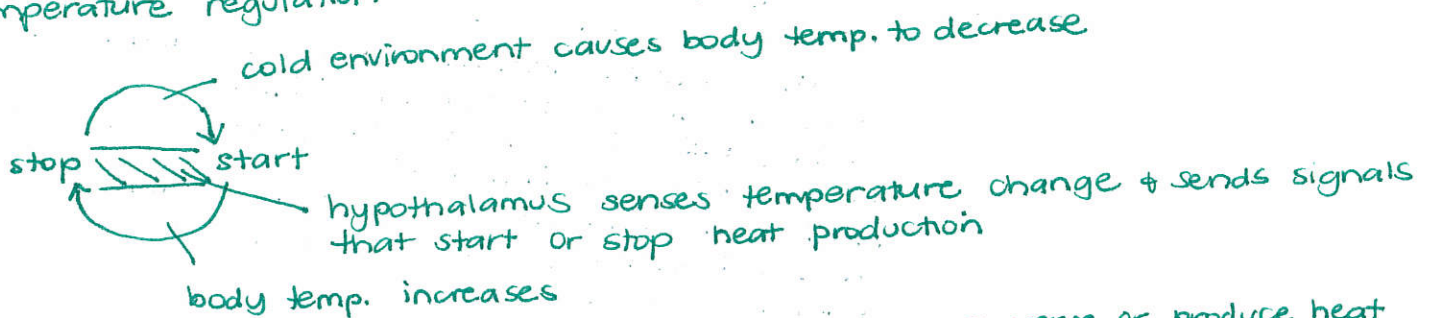
- more common
- an increase in the product/result causes a decrease in the response
- ex. temp. regulation

### Positive

- increase in product or response causes increase in response
- process of amplification - small change results in larger changes
- ex. childbirth - uterine contractions begin, hypothalamus releases more hormone, oxytocin, causing more contractions

- Nervous system is master control center & regulation (collect info & send commands)
- different systems interact to maintain homeostasis → why? organisms function properly only within a narrow range of internal chemical & physical conditions, ex. temperature, pH, O<sub>2</sub> levels, energy, H<sub>2</sub>O (which are all influenced by external environments, ex. seasons, activity level of organism, sleeping, running from a predator)

## ① Temperature regulation



Temperature → sensory neurons in skin → brain (hypothalamus)

- "thermostat"
- base of brain
- responsible for control center for recognition of & response to hunger, thirst, fatigue, anger, & body temp.

- if cold → conserve or produce heat via endocrine & circulatory systems → release hormones to constrict blood vessels
  - shiver to generate heat
  - result: increase body temp. (vasoconstriction)
- if hot → lower body temp. by releasing hormones to dilate blood vessels (vasodilate)
  - sweating
  - drink H<sub>2</sub>O

## ② Sugar regulation

- low blood glucose in blood → glucagon released from pancreas. Glucagon stimulates cells in liver & skeletal muscles to break down glycogen & increase glucose levels in blood.
- high blood glucose in blood → pancreas releases insulin (which stimulates cells in body to take glucose out of bloodstream. Extra glucose is stored as glycogen in liver & muscle cells)



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### ③ Water balance

- exercising strenuously, results in loss of  $H_2O$  via sweating
- hypothalamus controls the concentration of  $H_2O$  in the blood → as  $H_2O$  is lost in blood, the concentration of dissolved materials increases. The hypothalamus will then
  - a) signal the pituitary gland to release the hormone antidiuretic hormone (ADH). ADH is carried in the blood to the kidneys where less  $H_2O$  is removed from blood (causing a more concentrated yellow urine). You will then feel thirsty
- when the concentration of  $H_2O$  is high, the pituitary releases less ADH thereby resulting in the kidneys removing more  $H_2O$  from the blood, restoring the blood concentration back to normal.  
(dilute, "water-like" urine)
- review dialysis & osmosis

PPT QUES

### ①5 System interactions

#### a) Reproduction

- largely influenced by nervous & endocrine system (stimulates milk production)
- baby: circulatory - transports food &  $O_2$  to embryo & wastes from baby

#### b) Immune & digestive

- stomach acid kills pathogens
- integumentary: skin is main barrier
  - mucus membranes like the nose, mouth, & other body cavities & mucus secreted traps pathogens & small foreign objects
- Nervous - brain helps recognize danger & react accordingly
- Endocrine: adrenaline - help fight or flee attacker

- circulatory, respiratory, & muscular - work harder & faster to deliver  $O_2$  & energy to fight or flee

### c) Nutrients

- to locate food → nervous (sensory clues such as sights & smells that food is nearby)
  - muscular (pulls on bones / skeletal structures to move animal toward food)
  - skeletal
- digestive system - digest & absorb nutrients
- circulatory system - distribute nutrients throughout body
- nervous system - controls muscles that move food through digestive organs (peristalsis)
- hormones (endocrine system) - stimulate the pancreas to release enzymes crucial in breaking down food

PPT QUES