


**Biology and Society:
An Avoidable Tragedy**

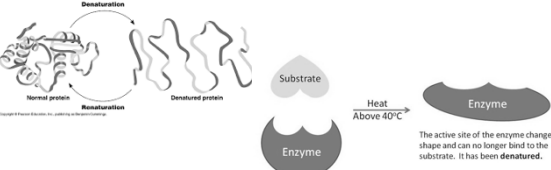
- Our bodies are kept in a narrow temperature range.
- When we exercise, our bodies are cooled by
 - evaporation of sweat on the skin and
 - expansion of blood vessels near the skin surface.



© 2013 Pearson Education, Inc.

**Biology and Society:
An Avoidable Tragedy**

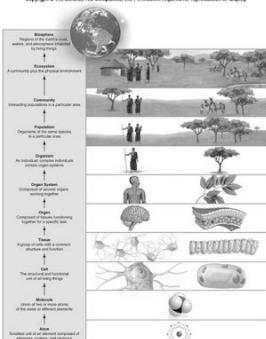
- Extreme conditions can lead to
 - loss of consciousness in heat exhaustion,
 - even higher body temperatures, which can disrupt the brain's control center, and
 - heat stroke, a life-threatening emergency.



© 2013 Pearson Education, Inc.

THE STRUCTURAL ORGANIZATION OF ANIMALS

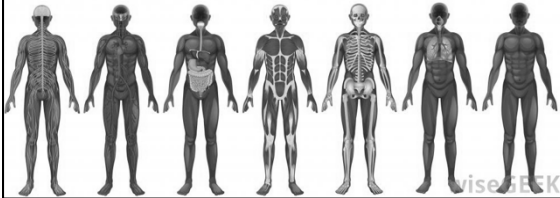
- Life is characterized by a hierarchy of organization.
- In animals,
 - individual cells are grouped into tissues,
 - tissues combine to form organs,
 - organs are organized into organ systems, and
 - organ systems make up the entire organism.



© 2013 Pearson Education, Inc.

Form Fits Function

- Biologists distinguish anatomy from physiology.
 - **Anatomy** is the study of the structure of an organism's parts.
 - **Physiology** is the study of the function of those parts.



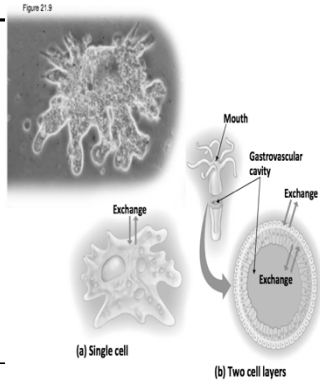
EXCHANGES WITH THE EXTERNAL ENVIRONMENT

- Every organism is an **open system**, continuously exchanging chemicals and energy with its surroundings to survive.
- An animal's size and shape affect its exchanges with its surrounding environment.
- All living cells must be bathed in a watery solution so that exchange of materials can occur.

© 2013 Pearson Education, Inc.

EXCHANGES WITH THE EXTERNAL ENVIRONMENT

- The entire surface area of a single-celled amoeba is in contact with its watery environment.
- A hydra has a body wall only two cell layers thick.
- Both layers of cells are bathed in pond water, enabling exchange with the environment.






© 2013 Pearson Education, Inc.

**Evolution Connection:
Adaptations for Thermoregulation**

– Animals regulate their body temperatures using adaptations that are

- anatomical,
- physiological, and/or
- behavioral.


METHODS OF THERMOREGULATION		
<p>Anatomical Adaptations (such as hair, fat, and feathers)</p>  <p>Fat</p> <p>Hair</p>	<p>Physiological Adaptations (such as panting, shivering, and sweating)</p>  <p>Panting</p>	<p>Behavioral Adaptations (such as bathing, basking, hibernating, and migrating)</p>  <p>Bathing</p>

© 2013 Pearson Education, Inc.

**Evolution Connection:
Adaptations for Thermoregulation**

– A major anatomical adaptation in mammals and birds is insulation, consisting of

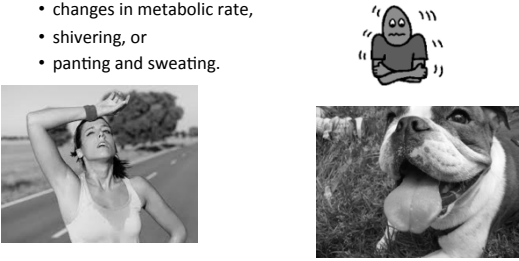

- hair (fur),
- feathers, or
- fat layers.



**Evolution Connection:
Adaptations for Thermoregulation**

– Some adaptations are physiological, such as

- changes in metabolic rate,
- shivering, or
- panting and sweating.





© 2013 Pearson Education, Inc.

The Process of Science:
How Does a Python Warm Her Eggs?

– **Observation:** A female Burmese python incubating eggs

- wraps her body around them,
- raises her body temperature, and
- frequently contracts the muscles in her coils.



© 2013 Pearson Education, Inc.

EXCHANGES WITH THE EXTERNAL ENVIRONMENT


– Animals use three organ systems to exchange materials with the external environment:

1. digestive,
2. respiratory, and
3. urinary.

© 2013 Pearson Education, Inc.


REGULATING THE INTERNAL ENVIRONMENT

– Animals adjust to a changing environment.



Homeostasis

“Happy Zone”

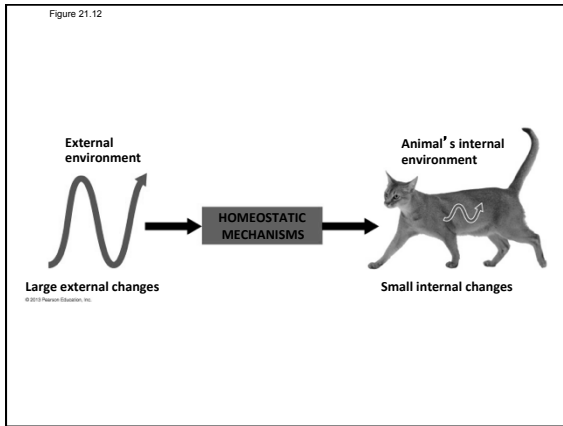


– **Homeostasis** is the body’s ability to stay relatively unchanged even when the world around it changes.

– The internal environment of vertebrates includes the **interstitial fluid** that

- fills the spaces between cells and
- exchanges nutrients and wastes with microscopic blood vessels.

© 2013 Pearson Education, Inc.



Negative and Positive Feedback

— Most mechanisms of homeostasis depend on a principle called **negative feedback**,

- in which the results of a process inhibit that same process,
- such as a thermostat that turns off a heater when room temperature rises to the set point.

PLAY Animation: Negative Feedback

PLAY Animation: Positive Feedback

© 2013 Pearson Education, Inc.

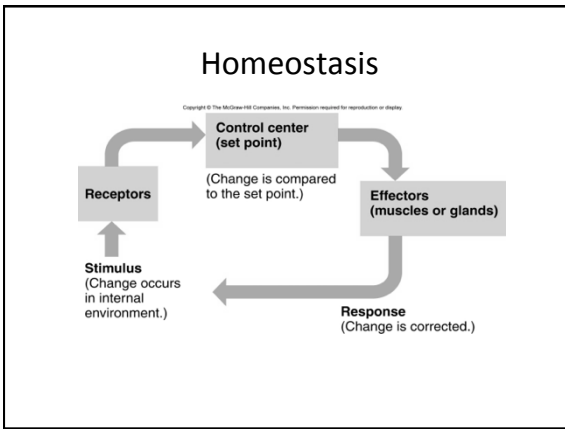
*What does the word "feedback" mean?
With what do you associate this term?*

•Brainstorm:

Feedback Loop Parts

A. COMPONENTS OF CREATING BALANCE

- 1. STIMULUS**- change that occurs in the internal environment
(ex. Not enough oxygen getting to cells, heart rate too high)
- 2. RECEPTOR** -Sensor that monitors the internal environment
(ex. Nerve fibers of the heart detect the heart rate)
- 3. CONTROL CENTER(set point)**-is what a particular value should be and is controlled by the brain.
(ex. Brain-controls the heart rate)
- 4. EFFECTOR**-causes responses that alter conditions in internal environment, muscles or glands
(ex. Adrenalin is released by adrenal gland to speed up the heart when more oxygen is needed for cells)
- 5. RESPONSE**-how the change is corrected (ex. Heart rate increases)



“What things/processes in the human body need to be kept within a particular range?”

- Body Temperature
- Blood pressure
- Blood pH
- O₂ and CO₂ concentration
- Osmoregulation-Water balance
- Blood glucose

OVERVIEW:
Parts of Body involved

- **kidneys :**
 - regulate water & mineral salts concentration
- **skin :**
 - regulate body temperature
- **liver & pancreas :**
 - regulate blood glucose level

Negative and Positive Feedback

- Less common is **positive feedback**,
 - in which the results of a process intensify that same process,
 - such as uterine contractions during childbirth.

© 2013 Pearson Education, Inc.

Thermoregulation

- Thermoregulation is the maintenance of internal body temperature.
 - **Endotherms**
 - such as mammals and birds
 - derive the majority of their body heat from their metabolism.
 - **Ectotherms**
 - such as most invertebrates, fishes, amphibians, and nonbird reptiles
 - obtain body heat primarily by absorbing it from their surroundings.

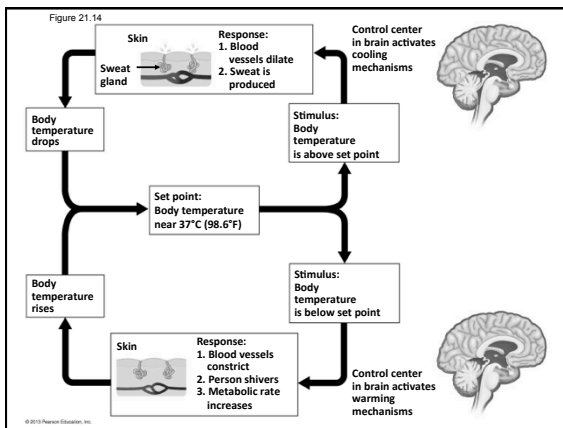
© 2013 Pearson Education, Inc.

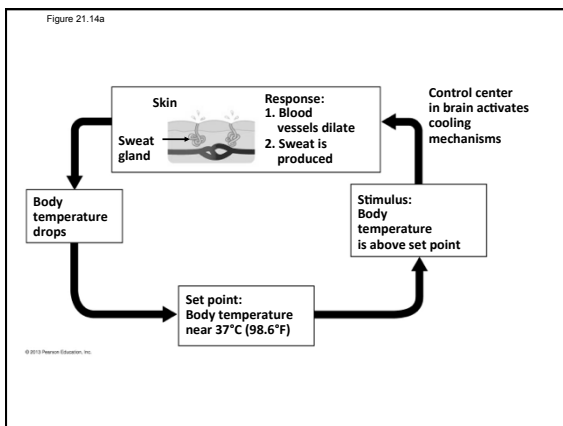
Thermoregulation

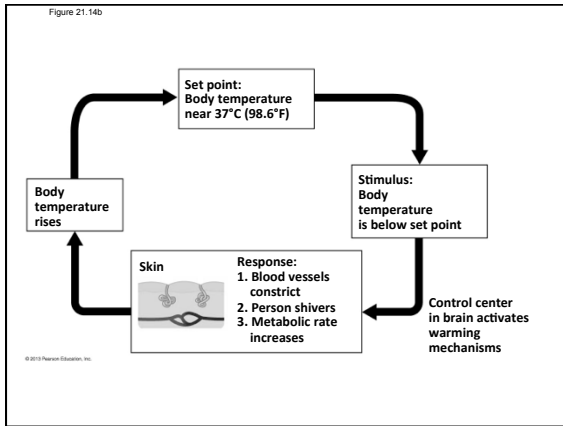
- Humans have homeostatic mechanisms that aid in **thermoregulation**, which
 - cool or
 - heat the body.
- **Fever**
 - is an abnormally high internal body temperature and
 - usually indicates an ongoing fight against infection.

PLAY Blast Animation: Negative Feedback: Body Temperature

© 2013 Pearson Education, Inc.







OVERVIEW OF ANIMAL NUTRITION

– Food provides the raw materials that animals, including people, need to

- build tissue and
- fuel cellular work.

Animal Diets

– **Herbivores** mainly feed on plants or algae.

– **Carnivores** mainly eat other animals.

– **Omnivores** eat

- animals and
- plants or algae.

Herbivore
(mainly eats plants or algae)

Carnivore
(mainly eats animals)

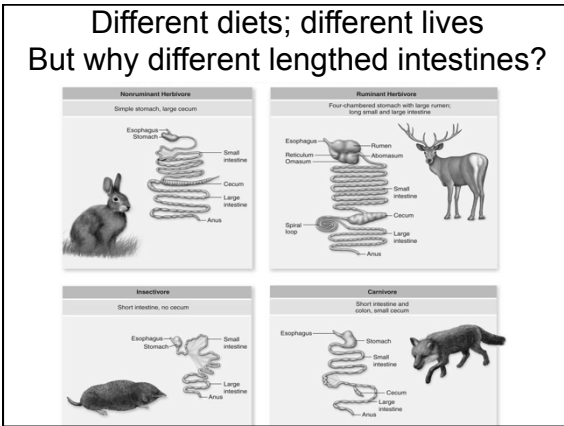
Omnivore
(regularly eats animals as well as plants or algae)

© 2013 Pearson Education, Inc.

Different diets; different lives

• All animals eat other organisms

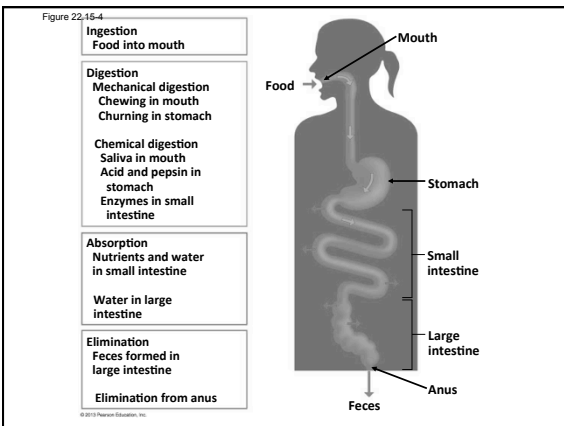
Herbivores	Carnivores	Omnivores
eat mainly plants	eat other animals	eat animals & plants
Example: •Gorillas, cows, rabbits, snails	•Sharks, hawks, spiders, snakes	•Cockroaches, bears, raccoons, humans •Humans evolved as hunters, scavengers & gatherers
Digestive System Length: Longest	Shortest	Medium
WHY? •Cellulose is rough •Requires bacteria to break it down •Long digestive system to hold/grow bacteria	•Meat is easy to digest •Short time to break down so short system	•Mix of both •Split the difference



The Four Stages of Food Processing


- **Ingestion** is another word for eating.
- **Digestion** is the breakdown of food into molecules small enough for the body to absorb.
- **Absorption** is the uptake of the small nutrient molecules by cells lining the digestive tract.
- **Elimination** is the disposal of undigested materials left over from food.

© 2013 Pearson Education, Inc.

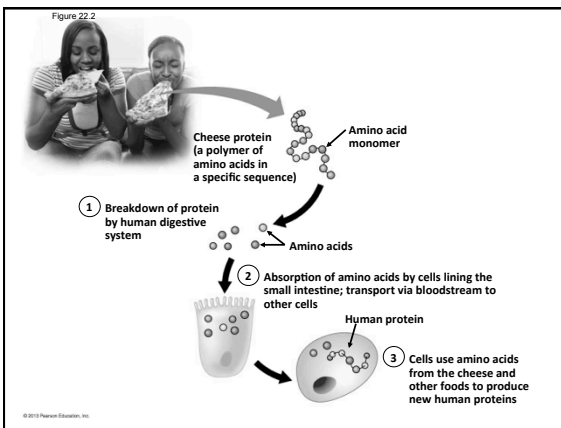


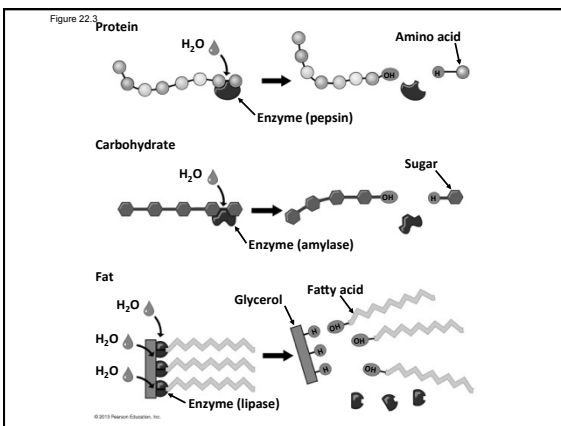
Digestion: A Closer Look

- The dismantling of food molecules is necessary because food molecules are
 - too large to cross the membranes of animal cells and
 - different from molecules that make up an animal's body.
- **Mechanical digestion**
 - begins the process and
 - involves physical processes like chewing.
- **Chemical digestion** is the chemical breakdown of food by digestive enzymes.
 - Chemical digestion proceeds via hydrolysis, chemical reactions that break down polymers into monomers using water in the process.
 - Like most biological reactions, digestion also requires enzymes.



© 2013 Pearson Education, Inc.





Digestive Compartments

- How do animals digest their food without digesting themselves?
- In animals, chemical digestion is contained safely within some kind of compartment.
- As a cell engulfs food by phagocytosis,
 - a **food vacuole** forms,
 - which then fuses with a lysosome filled with digestive enzymes, and
 - as food is digested, small food molecules pass through the vacuole membrane into the cytoplasm, which nourishes the cell.

© 2013 Pearson Education, Inc.

Digestive Compartments

- Food vacuoles are the simplest of all digestive compartments.
- Sponges are the only animals that digest food solely within their cells.

Gastrovascular cavities	Alimentary Canal
<p>Gastrovascular cavities are digestive compartments surrounded by cells and have only a single opening.</p>	<p>A digestive tube, or alimentary canal, has two separate openings:</p> <ul style="list-style-type: none"> • a mouth and • an anus.

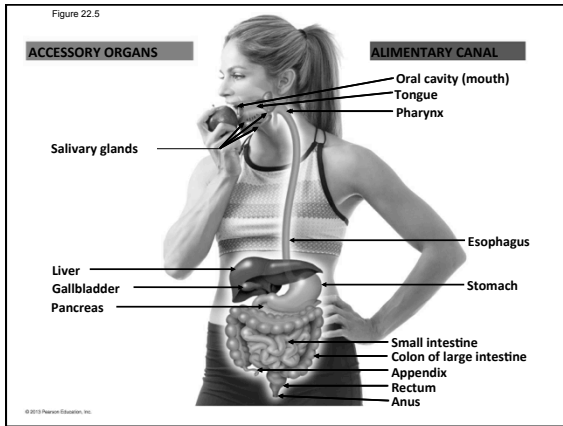
MAIN TYPES OF DIGESTIVE COMPARTMENTS

© 2013 Pearson Education, Inc.

A TOUR OF THE HUMAN DIGESTIVE SYSTEM System Map

- The human digestive system consists of
 - a digestive tube, the alimentary canal (or gut), and
 - accessory organs that secrete digestive chemicals.

© 2013 Pearson Education, Inc.



The Mouth

— The **mouth**, or **oral cavity**, functions in

- ingestion and
- the preliminary steps of digestion.

1. Chemical digestion begins in the mouth with the secretion of saliva from **salivary glands**.
2. The muscular **tongue**
 - tastes,
 - shapes food into a ball, and
 - pushes the food to the back of the **mouth** for **swallowing**.

© 2013 Pearson Education, Inc.

The Pharynx

— The **pharynx**

- connects the mouth to the esophagus and
- opens to the trachea, which leads to the lungs.

— During swallowing, a reflex

- moves the opening of the trachea upward and
- tips the epiglottis to close the trachea entrance.

BREATHING

Pharynx

Air flowing into open trachea (windpipe)

Epiglottis up

Esophagus closed

SWALLOWING

Adam's apple

Trachea closed

Epiglottis down

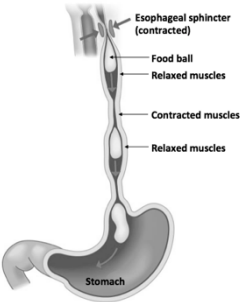
Food flowing into open esophagus


© 2013 Pearson Education, Inc.

The Esophagus

– The **esophagus**

- is a muscular tube,
- connects the pharynx to the stomach, and
- moves food down by **peristalsis** alternating waves of muscle contraction and relaxation.





© 2013 Pearson Education, Inc.

The Stomach

– The **stomach**

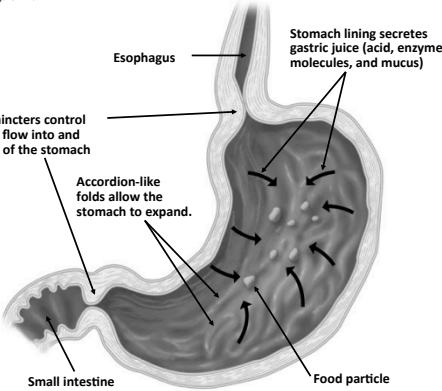
- can store food for several hours and
- churns food into a thick soup called **chyme**.

– Fluid in the stomach contains **gastric juice**, made of

- strong acid,
- digestive enzymes,
- mucus, and
- the enzyme **pepsin**, which digests proteins.

© 2013 Pearson Education, Inc.


Figure 22.9



© 2013 Pearson Education, Inc.

Stomach Ailments

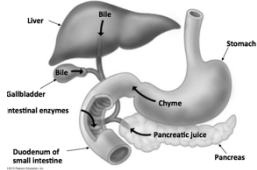
- Heartburn is caused by backflow of chyme into the esophagus.
- Gastric ulcers are
 - erosions of the stomach lining and
 - often caused by the bacterium *Helicobacter pylori*.



© 2013 Pearson Education, Inc.

The Small Intestine

- The **small intestine** is
 - the longest part of the alimentary canal and
 - the major organ for chemical digestion and absorption of nutrients into the bloodstream.
- Most chemical digestion occurs in the **duodenum**, the first part of the small intestine.
- In the duodenum, chyme from the stomach mixes with
 - pancreatic juice,
 - bile, and
 - a digestive juice secreted by the intestinal lining.



© 2013 Pearson Education, Inc.

Chemical Digestion in the Small Intestine

- The **pancreas** secretes juice that
 - neutralizes stomach acids in the duodenum and
 - aids in digestion.
- The **liver** secretes **bile**, which
 - is stored in the **gallbladder** and
 - helps digest fats.

© 2013 Pearson Education, Inc.

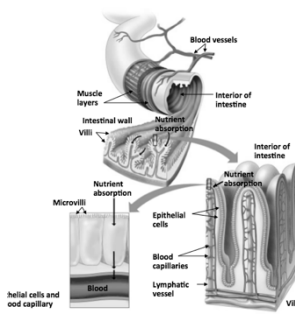
Absorption of Nutrients

- In the duodenum, nutrients are
 - completely digested and
 - ready to be absorbed.
- Nutrients only enter the body if they are absorbed into the walls of the digestive tract.

© 2013 Pearson Education, Inc.

Absorption of Nutrients

- Villi and microvilli on the surface of the small intestine increase
 - the surface area and
 - capacity for absorption.



© 2013 Pearson Education, Inc.

The Large Intestine

- The **large intestine** is
 - shorter, but wider, than the small intestine and
 - about 1.5 meters in length.
- At the junction of the small and large intestine is a small, finger-like extension called the **appendix**.
 - The appendix contains white blood cells that make minor contributions to the immune system.
 - Appendicitis is a bacterial infection of the appendix.

© 2013 Pearson Education, Inc.

The Large Intestine

- The **colon**
 - forms the main portion of the large intestine,
 - **absorbs water** from the alimentary canal, and
 - produces **feces**, the waste product of food.
- The **rectum**
 - forms the last 15 cm (6 inches) of the large intestine and
 - stores feces until elimination.
- The **anus**
 - consists of two sphincters and
 - regulates the opening of the rectum.

© 2013 Pearson Education, Inc.

