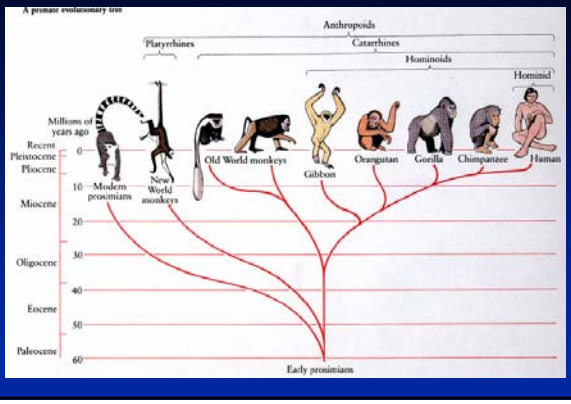
Earliest Primates

1. Primates evolved more than 60 million years ago during the Paleocene
2. First primates resemble tree shrews
   - Long snouts
   - Poor daytime vision

Tree shrews

Scratch????



Hominoids

1. Apes, humans, and extinct species of their lineages
2. In biochemistry and body form, humans are closer to apes than to monkeys
3. Hominids
   - Subgroup that includes humans and extinct humanlike species

Trends in Lineage Leading to Humans

1. Less reliance on smell, more on vision
2. Skeletal changes to allow bipedalism
3. Modifications of hand to allow refined hand movements
4. Bow-shaped jaw and smaller teeth
5. Longer lifespan and longer period of dependency

Adaptations to an Arboreal Lifestyle

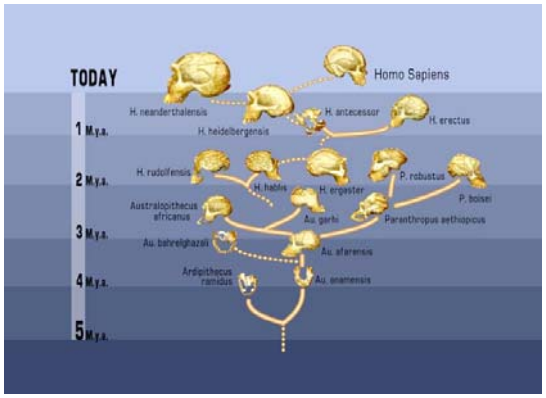
1. During the Eocene, certain primates became adapted to life in trees
   - Better daytime vision
   - Shorter snout
   - Larger brain
   - Forward-directed eyes
   - Capacity for grasping motions

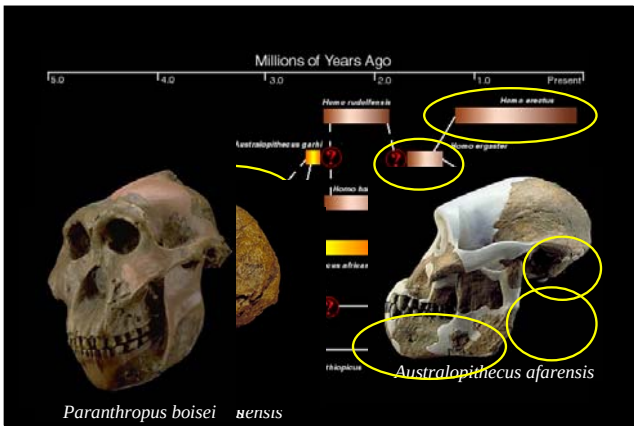
First Hominids

1. Earliest known is *Ardipithecus ramidus*
   - Lived 4.4 million years ago in Africa
   - More apelike than humanlike
2. Numerous australopiths evolved during the next 2 million years
   - Large face, protruding jaw, small skull
   - Walked upright

Australopiths

1. Earliest known is *A. anamensis*
2. *A. afarensis* and *A. africanus* arose next
3. All three were slightly built (gracile)
4. Species that arose later, *A. boisei* and *A. robustus*, had heavier builds
5. Exact family tree is not known





Humans Arise

1. First member of the genus *Homo* is *H. habilis*
2. Lived in woodlands during late Miocene

Homo erectus

1. Evolved in Africa
2. Migrated into Europe and Asia about 1.5 million - 2 million years ago
3. Had a larger brain than *H. habilis*
4. Was a creative toolmaker
5. Built fires and used furs for clothing

Homo sapiens

1. Modern man evolved by 100,000 years ago
2. Had smaller teeth and jaws than *H. erectus*
3. Facial bones were smaller, skull was larger

Homo Neanderthalensis

1. Early humans that lived in Europe and Near East
2. Massively built, with large brains
3. Disappeared when *H. sapiens* appeared
4. DNA evidence suggests that they did not contribute to modern European populations

Earliest Fossils Are African

1. Africa appears to be the cradle of human evolution
2. No human fossils older than 1.8 million years exist anywhere but Africa
3. *Homo erectus* left Africa in waves from 2 million to 500,000 years ago

Where Did *H. sapiens* Arise?

1. Two hypotheses:
   - Multiregional model (dying hypothesis)
   - African emergence model
2. Both attempt to address both biochemical and fossil evidence

Multiregional Model

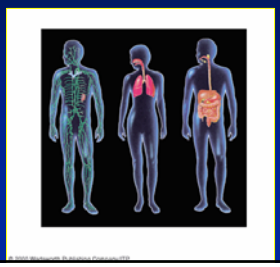
1. Argues that *H. erectus* migrated to many locations by about 1 million years ago
2. Geographically separated populations gave rise to phenotypically different races of *H. sapiens* in different locations
3. Gene flow prevented races from becoming species

African Emergence Model

1. Argues that *H. sapiens* arose in sub-Saharan Africa
2. *H. sapiens* migrated out of Africa and into regions where *H. erectus* had preceded them
3. Only after leaving Africa did phenotypic differences between races arise

Tissues, Organs and Organ Systems

- Three developmental origins for cells
- Cells aggregate to build organs, each from one of four kinds of tissue
- organs work together as organ systems



Tissue

1. A group of cells and intercellular substances that interact in one or more tasks
2. Four types

Epithelial tissue	Muscle tissue
Connective tissue	Nervous tissue

Organs

1. An organ is a group of tissues organized to perform a task or tasks
2. Heart is an organ that pumps blood through body
3. Heart consists of muscle tissue, nervous tissue, connective tissue, and epithelial tissue

Organ Systems

1. Organs interact physically, chemically, or both to perform a common task

1. Circulatory system includes the heart, the arteries, and other vessels that transport blood through the body

What Do Organ Systems Do?

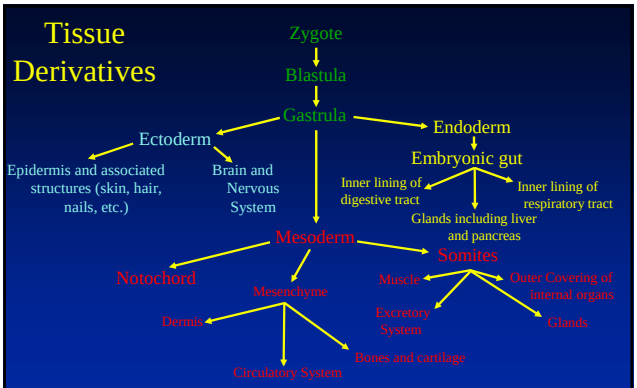
1. Maintain stable internal conditions
2. Acquire nutrients and raw materials; dispose of wastes
3. Protect the body against injury and attack
4. Allow reproduction and nourishment of young

Developmental Origins of Tissue

Three primary tissues: ectoderm, mesoderm, and endoderm.

1. **Ectoderm**
   - gives rise to the skin's outer layer and to tissues of the nervous system.
2. **Mesoderm**
   - gives rise to tissues of muscle, bone, and most of the circulatory, reproductive, and urinary systems.
3. **Endoderm**
   - gives rise to the lining of the gut, digestive organs, thyroid, respiratory system.

Tissue Derivatives

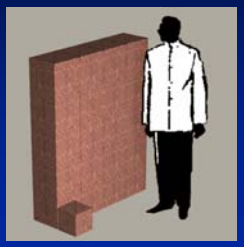


Number of Cells in a Human Body

>1,000,000,000,000

1 penny

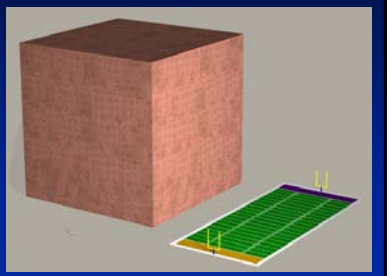
1,000,000 pennies
million



1,000,000,000 pennies
billion

1,000,000,000,000 pennies
trillion

value	$10,000,000,166.40 (Ten billion, one hundred and sixty-six dollars and forty cents)
width	273 feet
height	273 feet
thickness	273 feet
total weight	3,125,000 tons
height stacked	986,426 Miles
area (laid flat)	89,675.2 acres



One trillion

A million seconds is 13 days.
A billion seconds is 31 years.
A trillion seconds is 31,688 years.
The country has not existed for a trillion seconds.
Western civilization has not been around a trillion seconds.
One trillion seconds ago – 31,688 years –
Neanderthals stalked the plains of Europe.

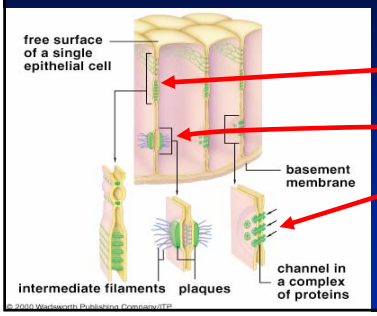
Cells Are Organized Into 4 Kinds of Tissues

Four types of tissues are seen in most animals:

1. Epithelial (largely endoderm)
2. Connective (largely mesoderm)
3. Muscle (largely mesoderm)
4. Nervous tissues (largely ectoderm)

A **tissue** is a group of cells and intercellular substances, all interacting in one or more tasks.

Cell-to-Cell Contacts



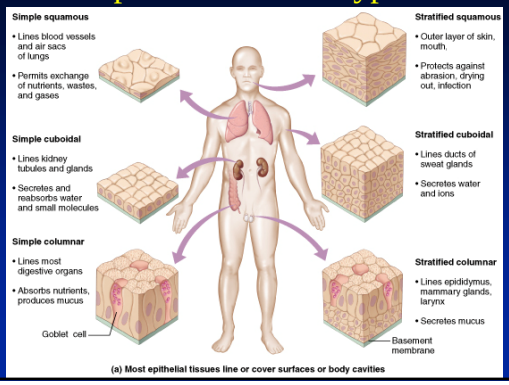
In all tissues

1. **Tight junctions**
   - **Stop leaks**
2. **Adhering junctions**
   - **Spot welds**
3. **Gap junctions**
   - **Communication channels**

Epithelial Tissue

1. Sheetlike tissue that lines blood vessels, organs, gut, or outside of organism
2. Function is absorption or secretion
3. Two types of secretory glands:
   a. Exocrine glands secrete mucus, saliva, earwax, oil, milk, digestive products through ducts or tubes
   b. Endocrine glands have no ducts or tubes and secrete hormones directly into fluid around gland (e.g., adrenal glands secrete adrenaline into blood)

Epithelial Tissue Types



Connective Tissue

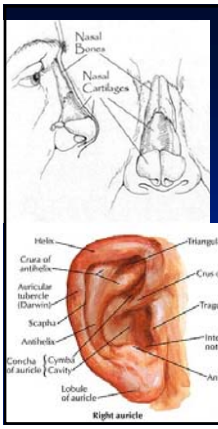
1. **Cartilage**
2. **Bone**
3. **Adipose tissue**
4. **Blood**

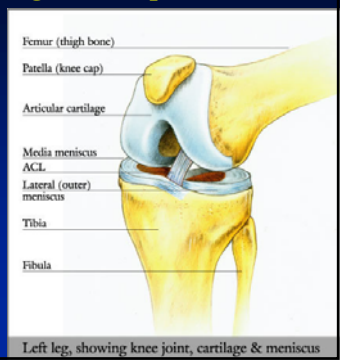
1. **Composed of**
   - **Fibroblasts**
     - **Collagen**
     - **Elastin**
2. **Classification**
   - **Loose**
   - **Dense, irregular**
   - **Dense, regular**

Connective Tissue

1. Most abundant and widely varied
2. Connective tissue cells secrete fibers of structural proteins (collagen or elastin). Found in skin.
3. Includes soft connective tissues (fibers, fibroblasts, ligaments, tendons) and specialized connective tissues (cartilage, bone, adipose tissue, blood)
4. Functions in binding, supporting, strengthening, protecting, and insulating other tissues in the body.

Cartilage Examples





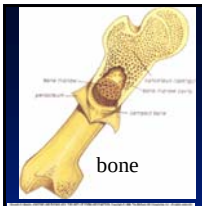
Cartilage

Real or Fake?

Cartilage

Real!!

A mold containing human cartilage cells was implanted on the back of a hairless mouse without an immune system.



bone

adipose tissue

Other Connective Tissues

1. Like cartilage, <u>bone</u> is another structural connective tissue. It is mineral hardened with calcium.
2. <u>Adipose tissue</u> is full of fat droplets and is an energy resource.
3. <u>Blood</u> is a fluid connective tissue with transport functions.

red blood cells

Muscle Tissue

1. Muscle tissue contains cells that contract (shorten) when stimulated and lengthen when relaxed.
2. Three muscle tissue types:
   a. Skeletal – striated muscle attached to bones. Voluntary muscle.
   b. Smooth – not striated, line vessels and organs. Involuntary muscle.
   c. Cardiac – striated muscle in walls of heart.

Muscle Types

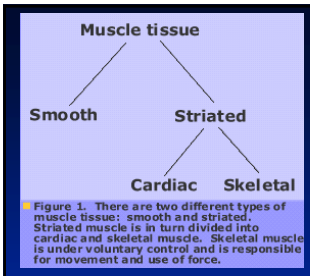
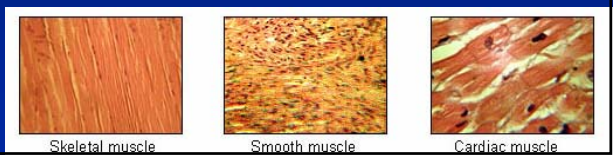


Figure 1. There are two different types of muscle tissue: smooth and striated. Striated muscle is in turn divided into cardiac and skeletal muscle. Skeletal muscle is under voluntary control and is responsible for movement and use of force.

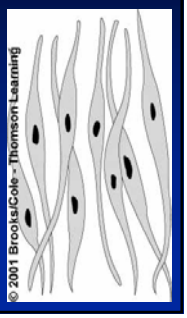


Skeletal Muscle

1. Located in muscles that attach to bones
2. Long cylindrical cells are striated
3. Cells are bundled closely together in parallel arrays

Smooth Muscle

1. In walls of many internal organs and some blood vessels
2. Cells are not striped and taper at the ends



Cardiac Muscle

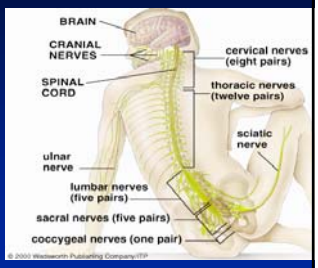
1. Present only in the heart
2. Cells are striated and branching
3. Ends of cells are joined by communication junctions that allow the cells to contract as a unit

Nervous Tissue

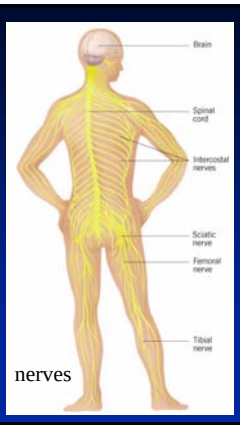
1. Detects stimuli, integrates information, and relays commands for response
2. Consists of excitable neurons and supporting neuroglial cells

Nervous Tissue

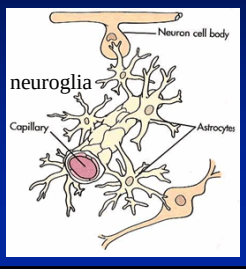
1. Neurons – excitable cells, used to communicate with nervous tissue.
2. Neuroglia – support cells (more than half of all nervous tissue).
3. >100 billion neurons communicate throughout your body.



Nervous System



nerves



neuron

Neurons

1. Excitable cells
2. When stimulated, an electrical impulse travels along the plasma membrane
3. Arrival of the impulse at the neuron endings triggers events that stimulate or inhibit adjacent neurons or other cells

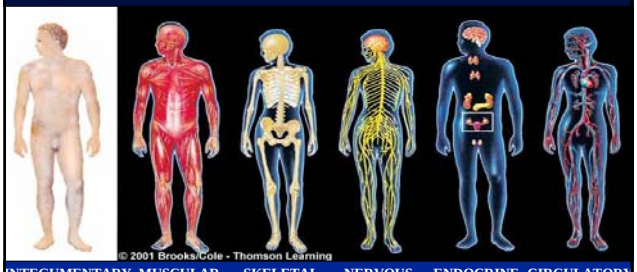
Neuroglia

1. Constitute more than half of the nervous tissue
2. Protect and support the neurons, both structurally and metabolically

Major Organ Systems

1. Integumentary
2. Muscular
3. Skeletal
4. Nervous
5. Endocrine
6. Circulatory
7. Lymphatic
8. Respiratory
9. Urinary
10. Reproductive

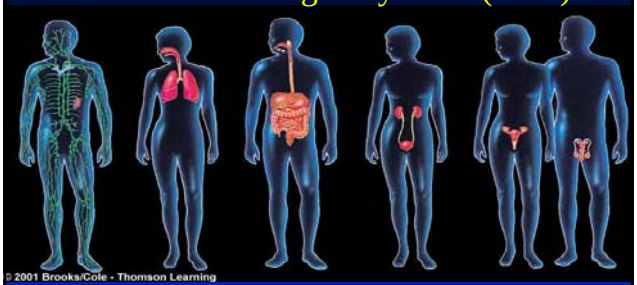
11 Vertebrate Organ Systems



INTEGUMENTARY SYSTEM | MUSCULAR SYSTEM | SKELETAL SYSTEM | NERVOUS SYSTEM | ENDOCRINE SYSTEM | CIRCULATORY SYSTEM

Figure 29.11(a) from page 480 of your text

11 Vertebrate Organ Systems (cont.)



LYMPHATIC SYSTEM | RESPIRATORY SYSTEM | DIGESTIVE SYSTEM | URINARY SYSTEM | REPRODUCTIVE SYSTEM

Figure 28.11(d) from page 477 of your text

Homeostasis

The component parts of every animal work together to maintain the stable fluid environment that all of its living cells require.

Homeostasis is all about keeping the internal environment in equilibrium.

Homeostasis

Three components interact to maintain homeostasis:

1. Sensory receptors detect stimuli.
2. An integrator is your brain and it processes the information and selects a response.
3. Effectors carry out responses.

Positive and negative feedback mechanisms adjust conditions. The body is dynamic and conditions are constantly changing.

Body Fluids

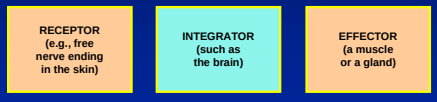
1. The human body contains about 15 liters of fluid
2. Fluid outside of cells is extracellular fluid
   - Interstitial fluid lies between cells
   - Plasma is the fluid portion of the blood

Fluid Balance

1. Changes in extracellular fluid cause changes in cells
2. The component parts of every animal work to maintain a stable fluid environment for living cells

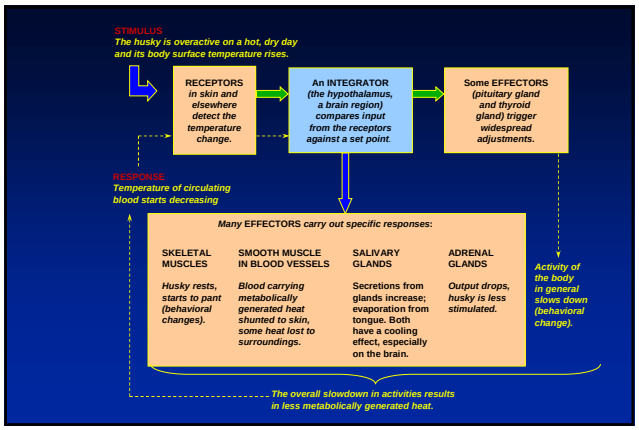
Homeostasis

1. Stable operating conditions in the internal environment
2. Three components interact



Negative Feedback

1. Some activity alters a condition in the internal environment
2. Alteration triggers a response
3. Response reverses the altered condition



Positive Feedback

1. Some activity alters the internal environment
2. The alteration triggers a response
3. The response intensifies the change in the internal condition

Homeostasis animation