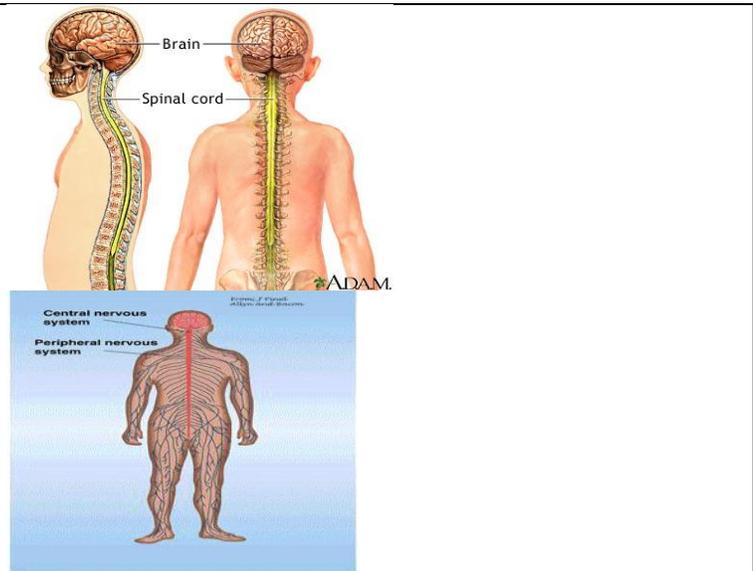


**Central Nervous System (CNS):** the body's main control center and consists of the brain and the spinal cord. The CNS processes information and sends instructions to other parts of the body. The spinal cord relays nerve impulses to and from the brain.

**Peripheral Nervous System (PNS):** made up of a network of nerves that extend throughout the body. The PNS gathers information and delivers it to and from the CNS. **Sensory** and **Motor** nerves are part of the PNS.

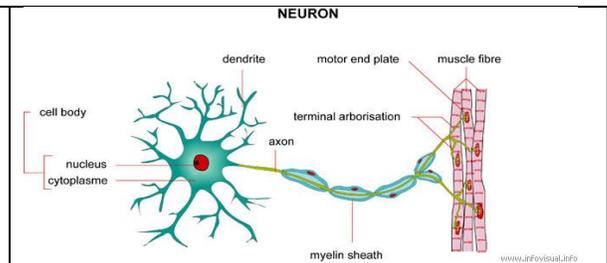


The nervous system consists of two types of cells:

1. **Neurons:** the functional cells of the nervous system. Neurons transmit signals through the body. It is composed of the **cell body** which contains the nucleus, cytoplasm, and organelles. It is also composed of fiberlike extensions called **axons** and **dendrites**. In the PNS, these fibers are bundled into ropelike structures called nerves.

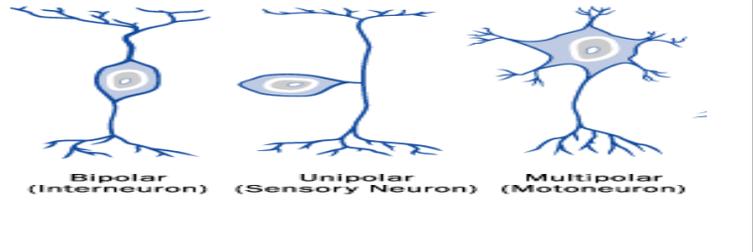
**Axon:** carries an impulse away from cell body

**Dendrite:** receives and carries the impulse to the cell body



**Types of Neurons**

1. **Sensory Neurons:** conduct impulses toward the CNS
2. **Motor Neurons:** conduct impulses away from the CNS
3. **Interneurons:** conduct impulses within the CNS. They connect with sensory, motor, and other interneurons.

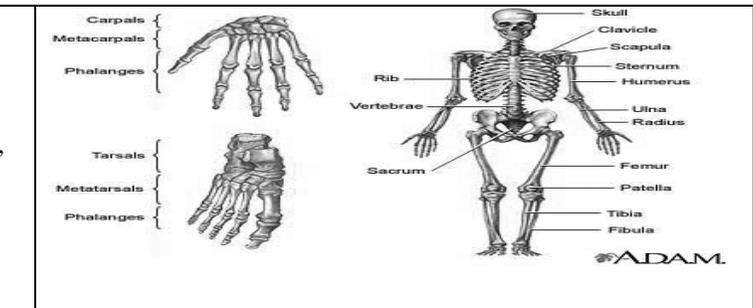


4.4 Explain how the muscular/skeletal system (skeletal, smooth and cardiac muscle, bones, cartilage, ligaments, tendons) works with other systems to support and allow for movement. Recognize that bones produce both red and white blood cells.

The human skeleton has 206 bones. The skeleton is divided into two parts: the **axial** and the **appendicular** skeletons.

**Axial** skeleton: composed of the skull, vertebral column, and rib cage. It protects vital organs such as the brain, heart, and lungs.

**Appendicular** skeleton: composed of the arm and leg bones, with the bones of the pelvis and shoulder areas.



**Periosteum**-tough exterior membrane that surrounds bones. Blood vessels branch through the periosteum.

**Marrow**—soft tissue that fills some spaces in bone.

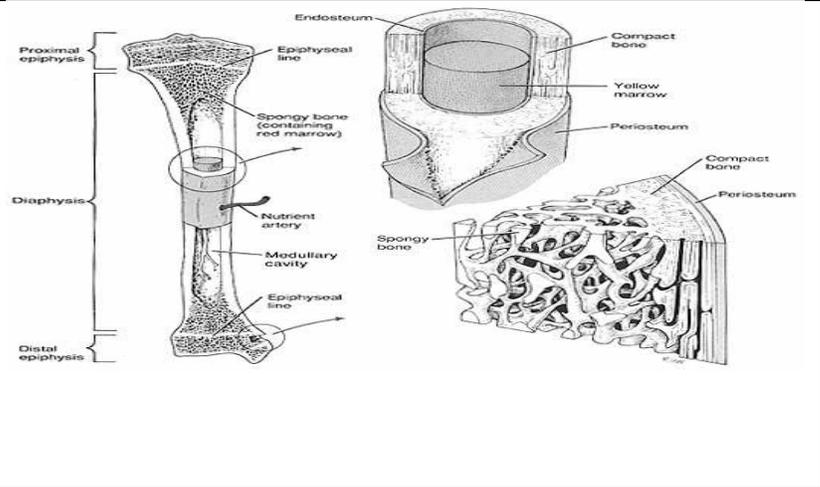
**Red Marrow**-produces red blood cells, white blood cells, and platelets.

**Yellow Marrow**-found within the cavities of long bone shafts-composed primarily of fat, which stores energy

**Haversian Canals**-lengthwise circular channels through which blood vessels and nerves pass.

**Canaliculi**-small channels in compact bone.

**Osteoblasts/Osteocytes**-make new bone and maintain mineral concentrations of the bone.



Cushions of **cartilage** in joints keep the ends of the bones from rubbing against each other. Some freely movable joints are also protected by fluid-filled sacs called **bursae**. These sacs absorb the impact of sudden pressure.

Bones and muscles of freely movable joints are bound together by bands of tough connective tissues.

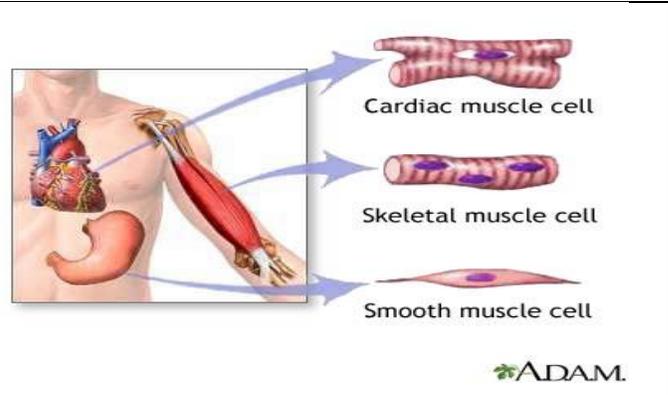
**Ligaments** are connective tissues that join one bone to another.

**Tendons** are connective tissues that attach muscles to bones.

**Skeletal/Striated**-skeletal muscles are voluntary muscles that give us the ability to move. Skeletal muscle tissue is striated (has bands). Striated muscle cells do not divide into two cells during mitosis-only the nuclei divide creating cells with multiple nuclei called muscle fibers.

**Smooth-Muscle**-involuntary muscles that make up many of the organs in your body. Smooth muscles are controlled by the nervous system and hormones from the endocrine system. Examples: dilation of pupils, peristalsis, blood vessels. Each muscle cell contains only one nucleus.

**Cardiac-Muscle**-found only in the heart. Both striated and involuntary. Works slowly and constantly to beat for life.



4.5 Recognize that the sexual reproductive system allows organisms to produce offspring that receive half of their genetic information from their mother and half from their father and that sexually produced offspring resemble, but are not identical to, either of their parents.

Sexual reproduction requires a special form of cell division (meiosis). The number of chromosomes is reduced by half to form gametes.

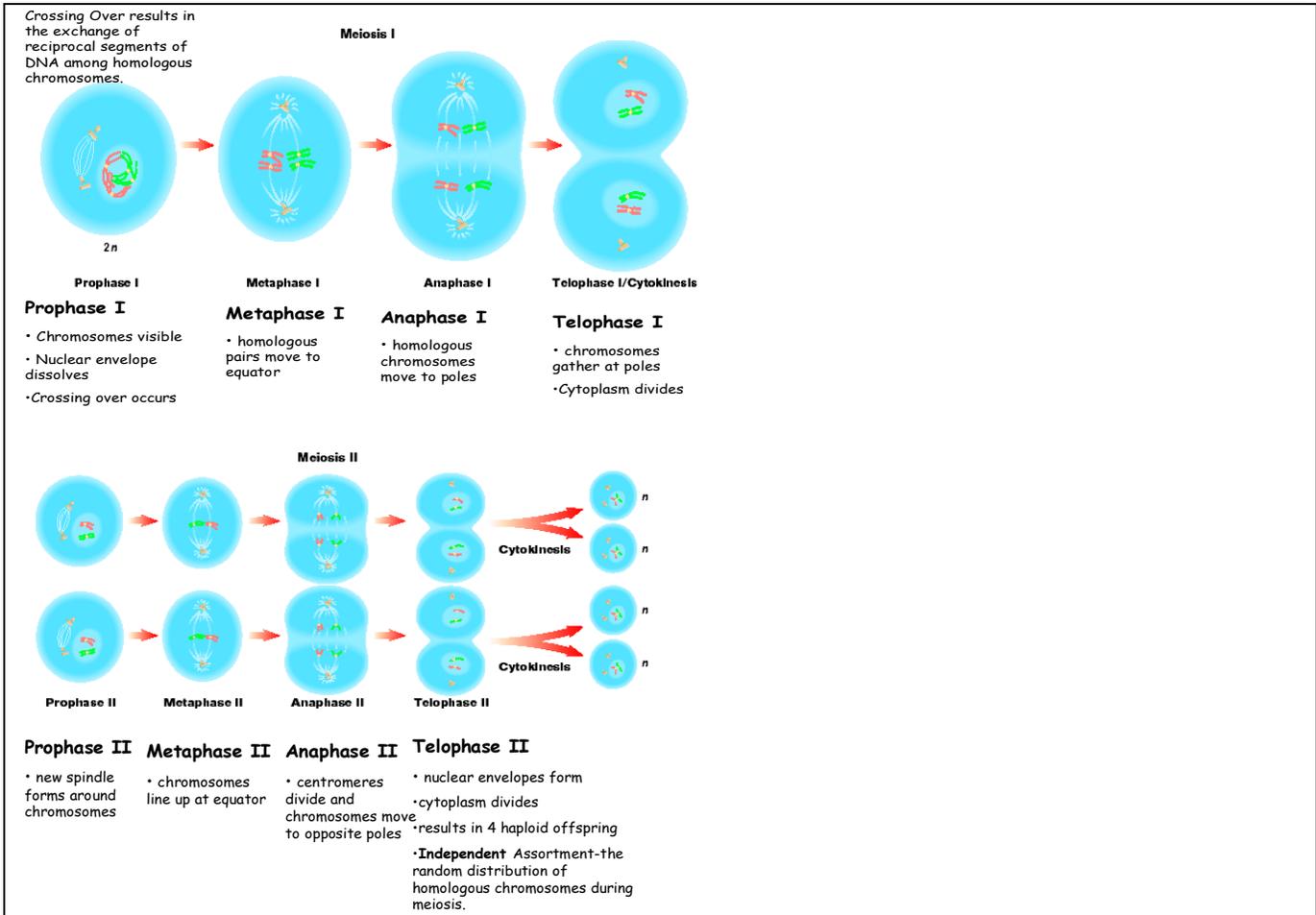
**Gamete**-reproductive cells such as sperm or egg they are haploid cells that participate in fertilization by fusing with another haploid cell.

**Fertilization**-The fusion of two haploid gametes to form a diploid zygote (a fertilized egg), the first cell of a new individual.

**Meiosis**-a type of cellular reproduction in which the number of chromosomes is reduced by half so that daughter cells are haploid (n).

a. chromosome number remains stable over multiple generations

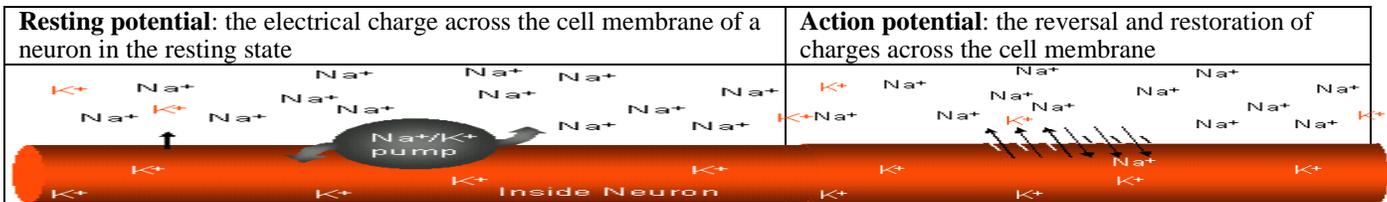
b. in humans meiosis yields 4 haploid cells with 23 chromosomes



4.7 Recognize that communication between cells is required for coordination of body functions. The nerves communicate with electrochemical signals, hormones circulate through the blood, and some cells produce signals to communicate only with nearby cells.

**Nerve Impulse Transmission**

A nerve impulse is a wave of chemical and electrical change that moves along the membrane of a neuron. A neuron has a **membrane potential** which is an electrical charge difference across the cell membrane. The membrane potential can either be:



Steps in nerve impulse transmission:

1. At rest, the inside of the cell has a negative charge while the outside has a positive charge
2. Upon stimulation, channels in the membrane of the first region open, and sodium ions (Na+) flow into the cell. This causes the inside to be positive while the outside is negative.
3. After Na+ enters the first region of the cell, potassium ions (K+) flow out of the cell, restoring the first region to its resting potential. The reversal of charge opens the channels in the next region of the neuron.
4. A charge reversal in the second region starts a charge reversal in the third region, and so on, as the nerve impulse is transmitted along the neuron.

**Synapse**

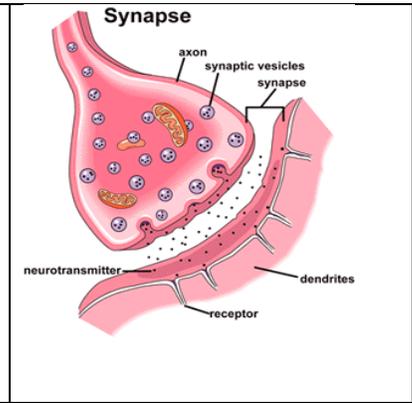
Most neurons do not actually touch one another. Instead, nerve impulses move from neuron to neuron across synapses.

**Synapse:** junctions with tiny gaps between adjacent neurons and between neurons and organs to which they send messages.

**Neurotransmitters:** information crosses synapses in the form of chemical messengers.

*Nerve impulses traveling between two neurons:*

1. At the end of axon, neurotransmitter stored in sacs. Nerve impulse reaches the end of an axon, the impulse causes some of the sacs to fuse with the axon's membrane.
2. Each fused sac releases its neurotransmitter into the synapse gap
3. The neurotransmitter diffuses across the gap and binds to receptors on the next neuron
4. Binding of the neurotransmitter causes a change in membrane potential of the receiving cell



4.8 Recognize that the body's systems interact to maintain homeostasis. Describe the basic function of a physiological feedback loop.

**Homeostasis-** the maintenance of stable internal conditions in spite of changes in the external environment. The nervous system and the endocrine system regulate and monitor organ systems within the body to ensure stability is maintained throughout the body. ie: the brainstem controls homeostasis in the human body by regulating temperature, respiration rates, etc. Hormones assist in maintaining homeostasis as it relates to nutrition, metabolism, excretion and water and mineral balances. (ie: human sweating to control temperature, dogs panting instead of sweating to maintain temperature)

**5. Evolution and Biodiversity**

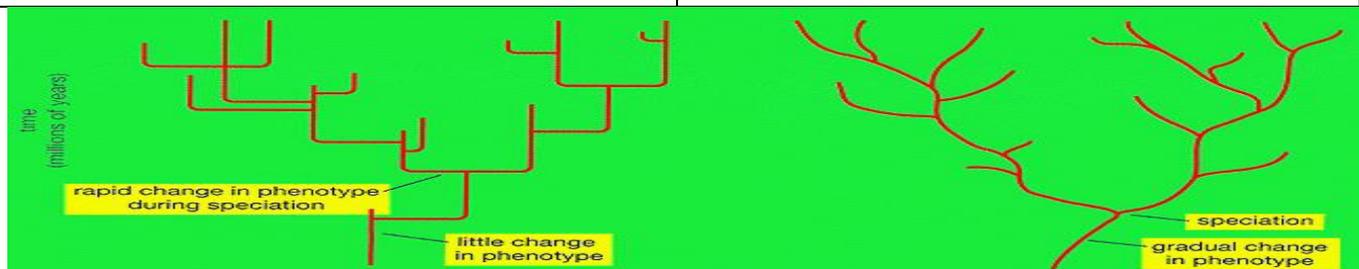
*Broad Concept: Evolution is the result of genetic changes that occur in constantly changing environments. Over many generations, changes in the genetic make-up of populations may affect biodiversity through speciation and extinction.*

5.1 Explain how evolution is demonstrated by evidence from the fossil record, comparative anatomy, genetics, molecular biology, and examples of natural selection.

**Evolution-**changes in populations over long periods of time. Evolution represents the change in a gene pool over time.

**Punctuated Equilibrium-**long periods of genetic stability are interrupted by periods of rapid genetic change

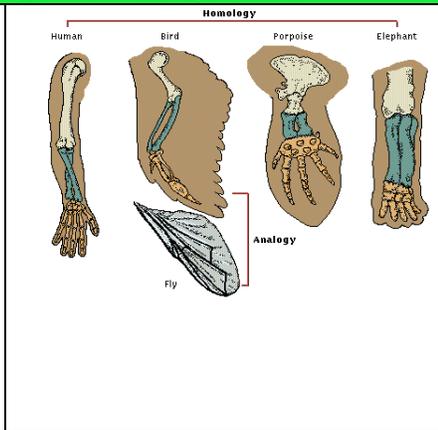
**Gradualism-**new species evolve as the genomes of two populations differentiate over enormous spans of time



**Homologous Structures-**similar traits in different species because of a common ancestor. Homologous Structures show evidence of a common ancestor.

**Analogous Structures-**a structure that is similar in function, but not inherited from a common ancestor. Analogous Structures are evidence of independent evolution.

Other Records of Evolution



**Proteins-**scientists look for similar amino acid sequences to determine shared ancestry. ie: the more common the shared ancestry the more amino acid sequences will be the same

**Nucleic Acids-**scientists can directly estimate the number of changes that have taken place in a gene since divergence from a common ancestor.

**Fossil Record-**evidence from the fossil record can be used to show evolutionary relationships by comparing homologous and analogous structures and locations of fossil finds.

**Comparative Embryology-**comparison of the embryonic forms of various living organisms

**Vestigial Structures-**a structure that is unused but is homologous with structures in other species-thereby suggesting a common ancestry

