

1.0 Cellular Physiology

1.1 Body fluid compartments and solutes.

1.2 Movements of substances between
compartments.

1.3 Physiology of the cell.

Chapter 1

Organization of the Human Body

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Learning Outcomes

- 1 Describe body organization from simple to more complex levels.
- 2 List the body organ systems, their general functions, and the major organs contained in each.
- 3 Define the anatomical position and explain its importance.
- 4 Use anatomical terminology correctly.
- 5 Name the body cavities and the organs contained in each.
- 6 Explain the abdominal regions and quadrants.
- 7 Explain why a basic understanding of chemistry is important in studying the body.
- 8 Describe important molecules and compounds of the human body.

Learning Outcomes (cont.)

- 9 Label the parts of a cell and list their functions.
- 10 List and describe the ways substances move across a cell membrane.
- 11 Describe the stages of cell division.
- 12 Explain how mutations occur and what effects they may produce.
- 13 Describe the uses of the genetic techniques, DNA fingerprinting, and the polymerase chain reaction.
- 14 Describe the different patterns of inheritance.
- 15 Describe the locations and characteristics of the four main tissue types.
- 16 Comprehend the cause of various genetic conditions.

Introduction

- Human body is complex in its structure and function
- The body is organized from the chemical level all the way up to the organ system level

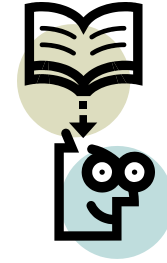
You will also learn important terminology used in the clinical setting to describe body positions and parts.

Study of the Body

- **Anatomy**
 - Study of body structure
 - Normal position of body structures
- **Physiology**
 - Study of function
- Anatomy of the body allows it to function
- Homeostasis
 - Relative consistency of the body's internal environment
 - Body conditions must remain stable/balanced



Apply Your Knowledge



True or False: **ANSWER:**

T Anatomy is the study of structure

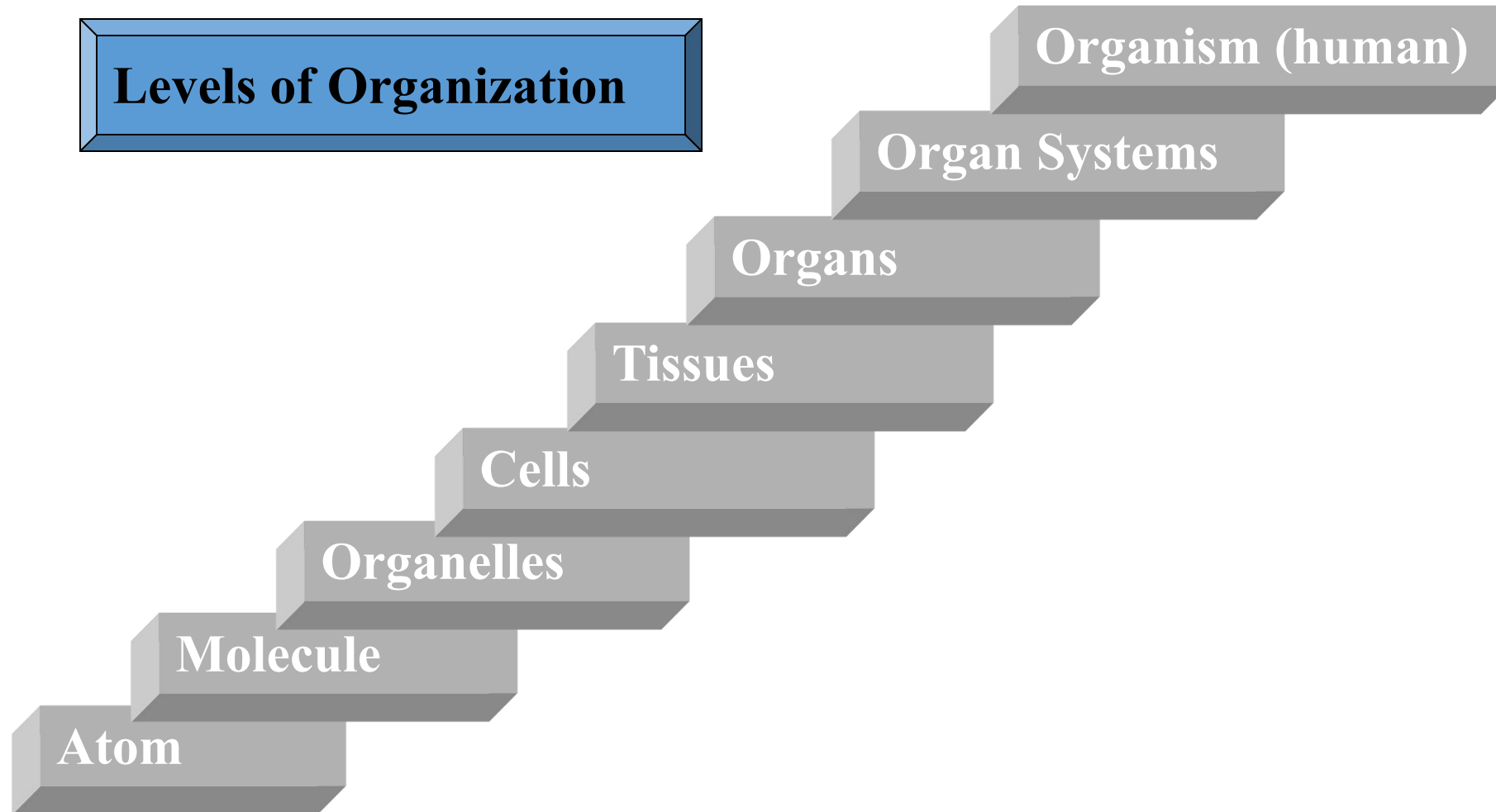
Good!

F Physiology is the study of function and structure.

Physiology is the study of function.

T Homeostasis is the relative consistency of the body's internal environment.

Organization of the Body



Apply Your Knowledge



Match the following:

ANSWER:

C Atoms

B Matter

G Molecules

E Organelles

A Cells

D Tissues

F Organs

A. The smallest living units in the body

B. Anything that takes up space and has weight

C. Simplest unit of matter

D. Same type of cells organized together

E. Molecules joined together

F. Combination of two or more tissue types

G. Atoms that bond together



Body Organs and Systems

- **Organ**

- Structure formed by organization of two or more different tissue types that work together to carry out specific functions

- **Organ system**

- Organs join together to carry out vital functions
- ***The purpose of the 11 organ systems is for the human body to maintain **homeostasis**.

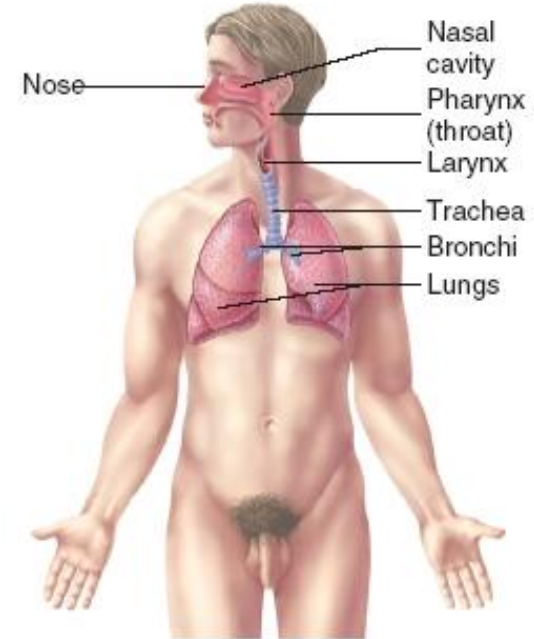
The 11 Human Body Systems

The 11 human body systems are as follows:

- nervous system
- integumentary system
- respiratory system
- digestive system
- excretory system
- skeletal system
- muscular system
- circulatory system
- endocrine system
- reproductive system
- lymphatic (immune) system

Body Organs and Systems (cont.)

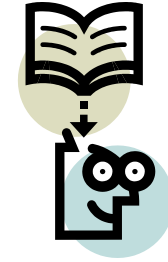
- For example
 - The respiratory system consists of the following organs:
 - Nose
 - Nasal cavity
 - Pharynx
 - Larynx
 - Bronchi
 - Lungs



Respiratory System

Exchanges oxygen and carbon dioxide between the blood and air and regulates blood pH. Consists of the lungs and respiratory passages.

Apply Your Knowledge



What is the difference between organs and organ systems?

ANSWER: Organs are made of tissues working together to carry out a specific function and an organ system is formed when organs work together to carry out vital functions.

List two major components of the cardiovascular system.

The heart and blood vessels

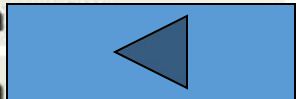
Right
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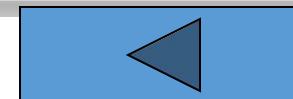
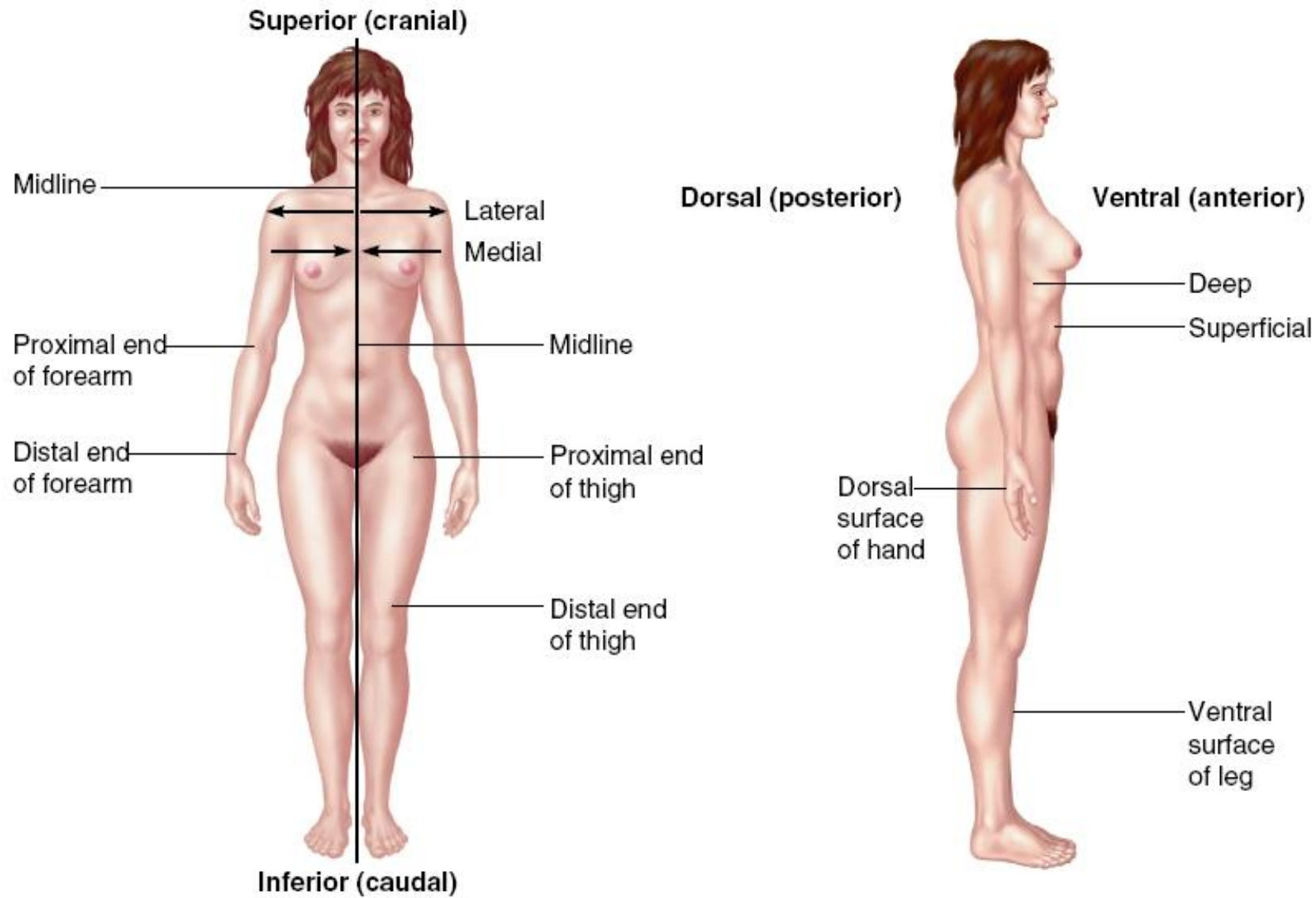
Anatomical Terminology

- Terms used to describe the location of body parts and various body regions
- Anatomical position
 - Body is standing upright, facing forward, with the arms at the sides and palms of hands facing forward
 - Used to identify the position of body structures compared to other body surfaces

TABLE 23-1 Directional Anatomical Terms

Term	Definition	Example
Superior (cranial)	Above or close to the head	The thoracic cavity is superior to the abdominal cavity.
Inferior (caudal)	Below or close to the feet	The neck is inferior to the head.
Anterior (ventral)	Toward the front of the body	The nose is anterior to the ears.
Posterior (dorsal)	Toward the back of the body	The brain is posterior to the eyes.
Medial	Close to the midline of the body	The nose is medial to the ear.
Lateral	Farther away from the midline of the body	The ears are lateral to the nose.
Proximal	Close to a point of attachment or to the trunk of the body	The knee is proximal to the toes.
Distal	Farther away from a point of attachment or from the trunk of the body	The fingers are distal to the elbow.
Superficial	Close to the surface of the body	Skin is superficial to muscles.
Deep	More internal	Bones are deep to skin.





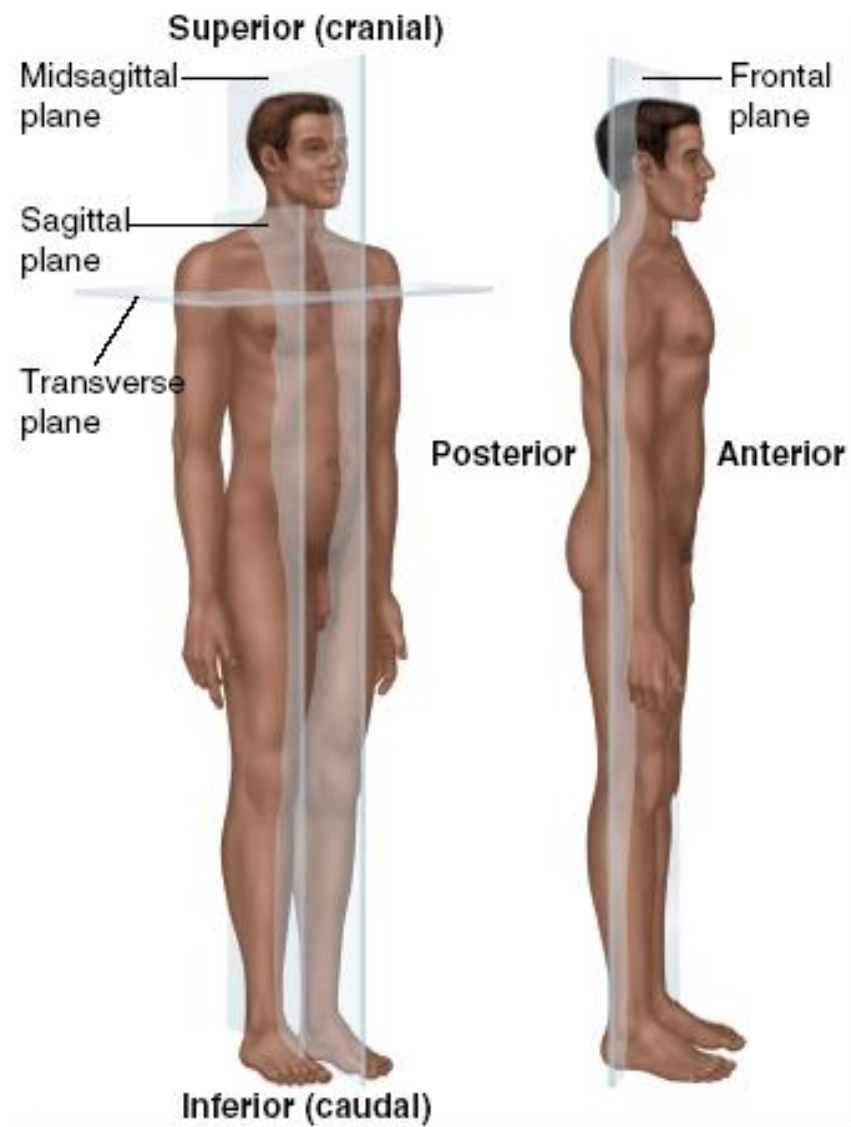


Figure 23-4. Spatial terms are based on imaginary cuts or planes through the body.



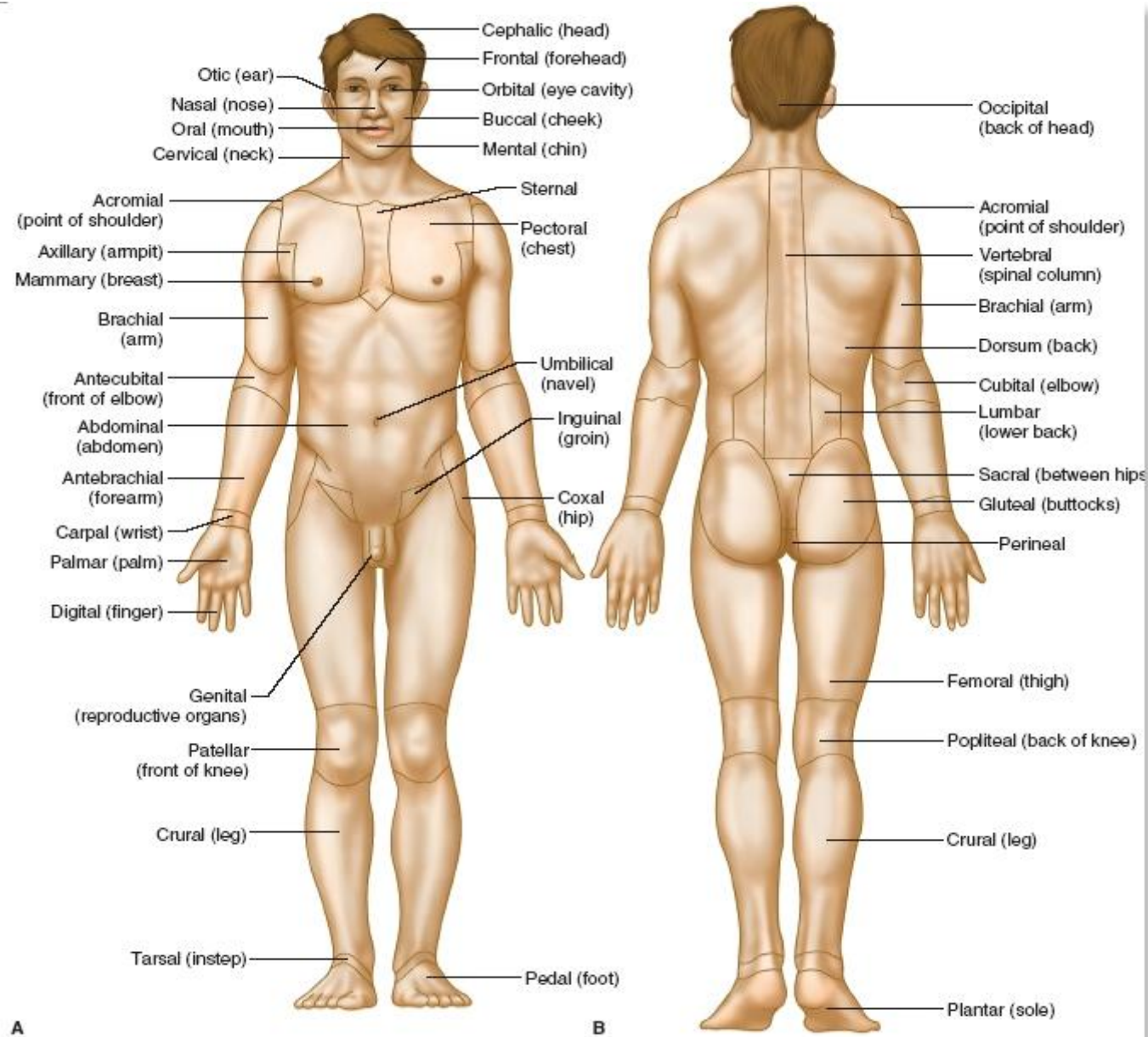
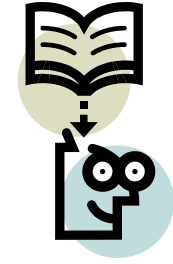


Figure 23-5
Anatomical
Terms
(regional
anatomy
before
surgery)



Apply Your Knowledge



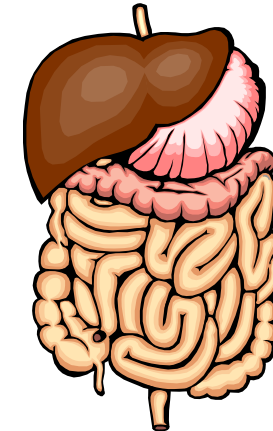
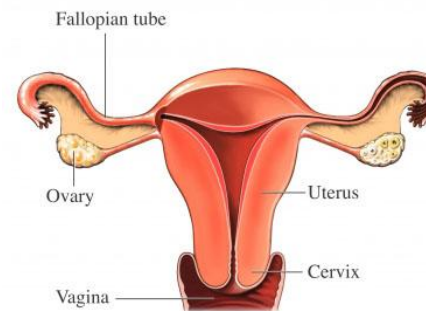
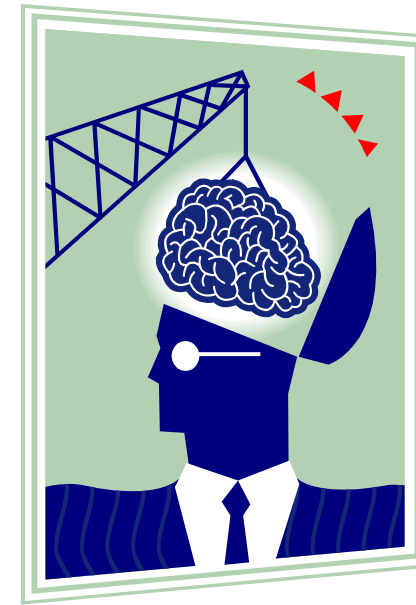
What is the anatomical position?

ANSWER: Anatomical position is the body standing upright, facing forward, with the arms at the sides and palms of hands facing forward.

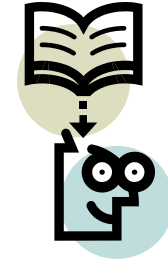
*Good
Answer!*

Body Cavities and Abdominal Regions

- Dorsal cavity
 - Cranial – brain
 - Spinal – spinal cord
- Ventral cavity
 - Thoracic – lungs, heart, esophagus, and trachea
 - **Diaphragm** – muscle separating these two sections
- Abdominopelvic
 - Abdominal cavity – organs of digestion
 - Pelvic cavity – bladder and internal reproductive organs



Apply Your Knowledge



What are the two largest body cavities?

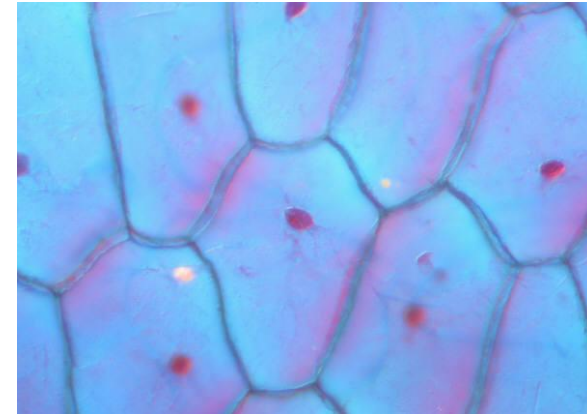
ANSWER: Dorsal and ventral cavities

YES!

Biochemistry : Chemistry of Life

- *Chemistry*

- The study of what matter is composed of and how matter changes
- Body structures and functions result from chemical changes that occur within body cells or fluids



Chemistry of Life (cont.)

- Molecules
 - Two or more atoms of one element chemically combine
 - Basic unit of compounds
- ***Compounds***
 - Two or more atoms of more than one element combine
- Water is an example of a compound
 - 2 hydrogen atoms and 1 oxygen atom
 - Critical to both chemical and physical processes in human physiology
 - About 2/3 of body weight.

Chemistry of Life (cont.)

- **Metabolism** – overall chemical functioning of the body
 - **Anabolism**
 - Small molecules combine to form larger ones
 - **Catabolism**
 - Larger molecules are broken down into smaller ones
- **Electrolytes** – substances that release ions when put into water
 - **Ions** – positively or negatively charged particles
 - Movement of ions into and out of body structures regulate or trigger physiologic states
 - Essential for
 - Fluid balance
 - Muscle contraction
 - Nerve impulse conduction

Chemistry of Life: *Electrolytes (cont.)*

- Acids and bases
 - **Acids** – electrolytes that release hydrogen ions
 - Sour taste, such as lemon juice
 - pH less than 7
 - **Bases** – (alkalis) electrolytes that release hydroxyl ions
 - Slippery and taste bitter, such as detergents
 - pH greater than 7
 - pH of 7 is neutral

Chemistry of Life: *Biochemistry*

- Study of matter and chemical reactions in the body
 - Organic matter
 - Contains carbon and hydrogen
 - Large molecules
 - Classes of organic matter
 - Carbohydrates
 - Lipids
 - Proteins
 - Nucleic acids

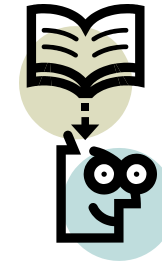


Chemistry of Life: *Biochemistry (cont.)*

- ***Inorganic*** matter
 - Generally does not contain hydrogen or carbon
 - Small molecules
 - Examples
 - Water – most abundant
 - Oxygen
 - Carbon dioxide
 - Salts



Apply Your Knowledge



Designate an A or a B to indicate whether the item is an acid or a base.

ANSWER:

A Lemon juice

A Gastric fluid

B Sodium bicarbonate

B Egg white

B Household ammonia

A Vinegar

Super!

Cell Characteristics

- Basic unit of life
- Body has millions of cells = 37.2 trillion
- Three main parts
 - Cell membrane
 - Cytoplasm
 - Nucleus

Cell Characteristics (cont.)

- Cell membrane

- Outer limit
- Thin and selectively permeable
- Trilaminar model - Robertson



- Cytoplasm

- Inside of cell
- Made up of water, proteins, ions, and nutrients
- Organelles

- Cilia
- Lysosomes

- Flagellum
- Ribosomes

☐ Endoplasmic reticulum

☐ Mitochondria

☐ Golgi apparatus

☐

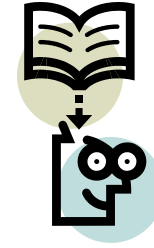
☐ Centrioles

Chemistry of Life: *Biochemistry (cont.)*

- Nucleus
 - Round structure near the center
 - Contains chromosomes
 - Threadlike structures made up of DNA
 - Histone proteins
 - Chromatin
- Nuclear membrane
- Nuclear pore
- Pore complex



Apply Your Knowledge



What are the three main parts of a cell, and in which one is DNA found?

ANSWER: The three main parts of a cell are:

- **Cell membrane**
- **Cytoplasm**
- **Nucleus – this is where DNA is found**

Excellent!

Movement Through Cell Membranes

- Selectively permeable membrane controls movement in and out of cells
 - Passive mechanisms
 - No energy required to move substances
 - Active mechanisms
 - Require the cell to use energy to move substances

Movement Through Cell Membranes (cont.)

- ***Diffusion*** – movement from area of high concentration to area of low concentration
- ***Osmosis*** – diffusion or movement of water across a semipermeable membrane
- ***Filtration*** – substances are forced under pressure across a membrane that acts like a filter
- ***Active Transport*** – substances move across the cell membrane with the help of a carrier molecule

Cell Division

- Reproduction through cell division
 - Mitosis, meiosis, *cytokinesis* (splitting the cytoplasm)
- *Interphase*
 - Cell carries out normal function and is not dividing
 - Prepares for cell division by duplicating its DNA
 - *Mutations* – errors/variations in duplication of DNA that are passed on to daughter cells

Cell Division (cont.)

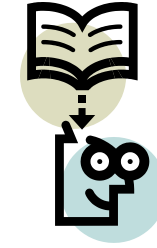
- **Mitosis** – follows interphase
 - Cell enters mitosis – a part of cell division in which the nucleus divides
 - Cell membrane constriction divides the cytoplasm of the cell
 - Stages
 - *Prophase*
 - *Anaphase*
 - *Metaphase*
 - *Telophase*
 - Replicates all 23 chromosome pairs so cells are identical

Cell Division (cont.)

- Meiosis

- Reproductive cell division
- Must have female and male sex cells
- Nucleus copies all 23 chromosome pairs
 - 2 divisions → 4 cells with only 1 of each chromosome pair Eg: gamete before fertilization= has 23 chroms
 - When combined during fertilization, resulting cell contains 46 chromosomes = zygote after ferti

Apply Your Knowledge



What are mitosis, meiosis, and interphase?

ANSWER:

Mitosis is a part of cell division in which the nucleus divides.

Meiosis is reproductive cell division requiring both female and male sex cells.

During interphase, the cell carries out normal function and is not dividing.

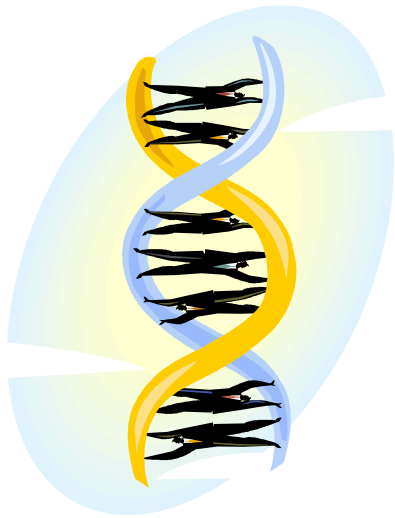


Bravo!

Genetic Techniques

- DNA
 - Primary component of genes
 - Found in nucleus of cells
- **Gene** – a segment of DNA that determines a body trait
= **human species is one, but traits are many**
- Length from several *bps* to several kbps.
- Genetic techniques involve using or manipulating genes
- **Marker (locus):** A specific position in chromosome. It may be **1 bp or** several hundred bps in length.
- **Alleles:** DNA sequences within a marker or locus (gene and allele sometimes have same meaning)

Genetic Techniques (cont.)

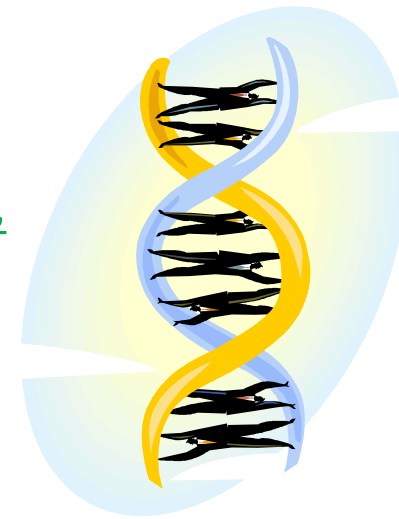


- Polymerase chain reaction (PCR)
 - Quick, easy method of making millions of copies of any fragment of DNA
 - Used in the study of genetics
 - Necessary tool for improving human health
 - Leading to new kinds of genetic testing

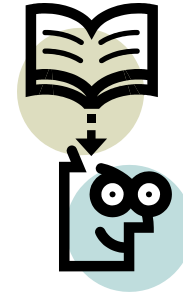
Genetic Techniques (cont.)

- DNA fingerprinting

- Unique sequences of nucleotides in a person's DNA
- Same for every cell, tissue, or organ of that person = that trait= ht, weight, life ambition, goal, life desire
[Same trait = same goals, same desires]
- Reliable method for identifying and distinguishing among humans(traits)
- Used in
 - Criminal cases
 - Paternity cases for custody and child support issues
 - Human resource management to identify disease susceptibility.



Apply Your Knowledge



Designate whether the following is related to PCR (Polymerase Chain Reaction) or DF (DNA fingerprinting).

ANSWER:

DF Unique sequences of nucleotides in a person's DNA

DF Reliable method for identifying and distinguishing among humans traits

PCR Used in the study of genetics

PCR Used in criminal and paternity cases

PCR Necessary tool for improving human health

VERY GOOD!



Heredity

- The transfer of genetic traits from parent to child
- 23 chromosomes from each parents = 46 chromosomes
 - 23 from sperm
 - 23 from ovum
- **Sex Chromosomes** – the 23rd pair determines the gender of the child
- **Sperms = two types** having either x or y chromosome as the 23rd chromosome.
- So if y sperm + x ovum = xy zygote = male child
- If x sperm + x ovum = xx zygote = girl child



- **Human Genome**

- • The totality of DNA characteristic of all the 23 pairs of chromosomes.
- — The human genome has about 3×10^9 *bps in length*.
- 97% of the human genome is non-coding regions called introns
= common features to all humans = language speaking, body organs, blood.
- 3% is responsible for controlling the human genetic behavior = features of a trait = different person has different life purpose, goal, perceptions,
(Implementor, developer, idealist). The coding region is called exon (encodes into amino acids + proteins).
- — There are totally about 40,000 genes, over 5000 have been identified. There are much more left
- — Human Genome Project is to get identified the DNA sequence (every bp) of human genome (only a few individuals)

Heredity (cont.)

- Homologous chromosomes (*autosomes*)
 - First 22 pairs are the same size and shape
 - Carry *same genes* that code a character, but genes may be of *different forms* called *alleles*
 - Dominant alleles
 - ☐ Recessive alleles
- ☐ Traits are determined by multiple alleles
 - ☐ Complex inheritance – inherited traits determined by multiple genes
 - ☐ Sex-linked traits – carried on the sex chromosomes, X and Y

Traits = some people do only some job better than others

- Development of society - who?
- Judgment for society -
- Service to society - who?
- Revolt against a culture -
- Create a new culture (idealists)-

Trait = personality = philosophy = mindset

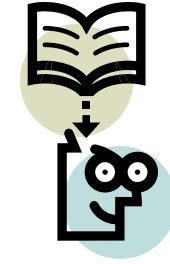
Common Genetic Disorders

- **Albinism** – little or no pigmentation in the skin
- **Cystic fibrosis** – life-threatening disease that affects the lungs and pancreas
- **Down syndrome** (*Trisomy 21 chromosome*) – causes mental retardation and physical abnormalities
- **Fragile X syndrome** – most common inherited cause of learning disability
- **Hemophilia** – blood disorder; lack of clotting factor

Common Genetic Disorders (cont.)

- **Klinefelter's syndrome** – chromosomal abnormality that affects males
- **Muscular dystrophy** – affects muscular and nervous systems
- **Phenylketonuria (PKU)** – cannot synthesize the enzyme that converts phenylalanine to tyrosine
- **Turner's syndrome** – an X chromosome is completely or partially missing

Apply Your Knowledge



What is cystic fibrosis?

ANSWER: Cystic fibrosis is a life-threatening genetic disorder that affects the lungs and pancreas.

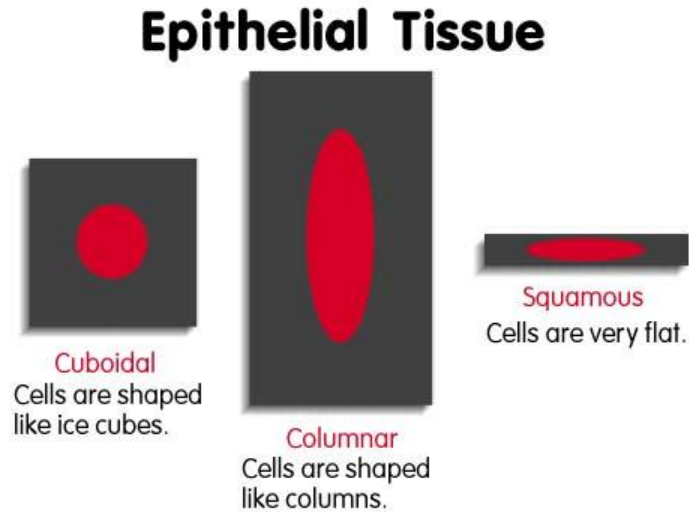
Correct!



Major Tissue Types

- **Epithelial tissue**

- Covering, lining, or gland
- Tissue that covers the body and most organs
 - Glandular epithelium is composed of cells that make and secrete substances
 - **Exocrine gland** – secretes product into duct
 - **Endocrine gland** – secretes product directly into tissue fluid or blood
- **Lacks blood vessels**, has a nerve supply, divides constantly
- Function based on location



Major Tissue Types (cont.)

- **Connective tissue**

- Most abundant
- **Matrix** separates the cells
 - Matter between cells of connective tissue
 - Components vary
 - Generally has a rich blood supply, except for cartilage
- Eg - Blood
 - Plasma is matrix
 - Transports substances throughout the body
- Osseous tissue (bone)
 - Matrix of mineral salts
 - Metabolically active
- Cartilage
 - Matrix rigid
 - Gives shape to structures, protects ends of long bones, and forms discs between the vertebrae

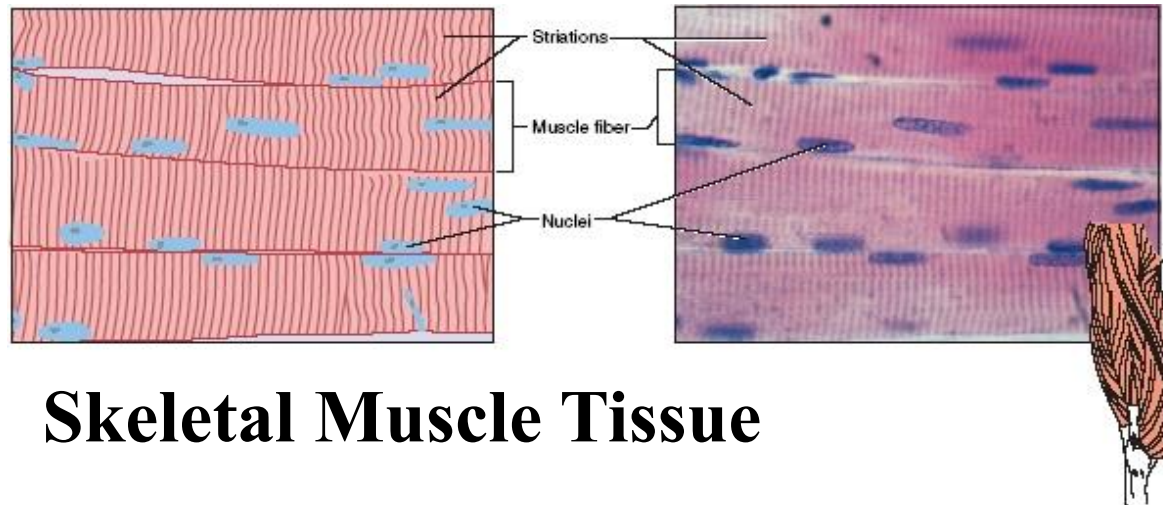
Major Tissue Types (cont.)

- Dense connective tissue
 - Ligaments, tendons, and joint capsules
 - Dermis of skin
- Adipose tissue
 - Adipocytes (fat cells) store fats
 - Stores energy
 - Insulates body

Major Tissue Types (cont.)

- ***Muscle tissue***

- Shortens and elongates
- Contracts and relaxes
- Includes skeletal, smooth, and cardiac muscles

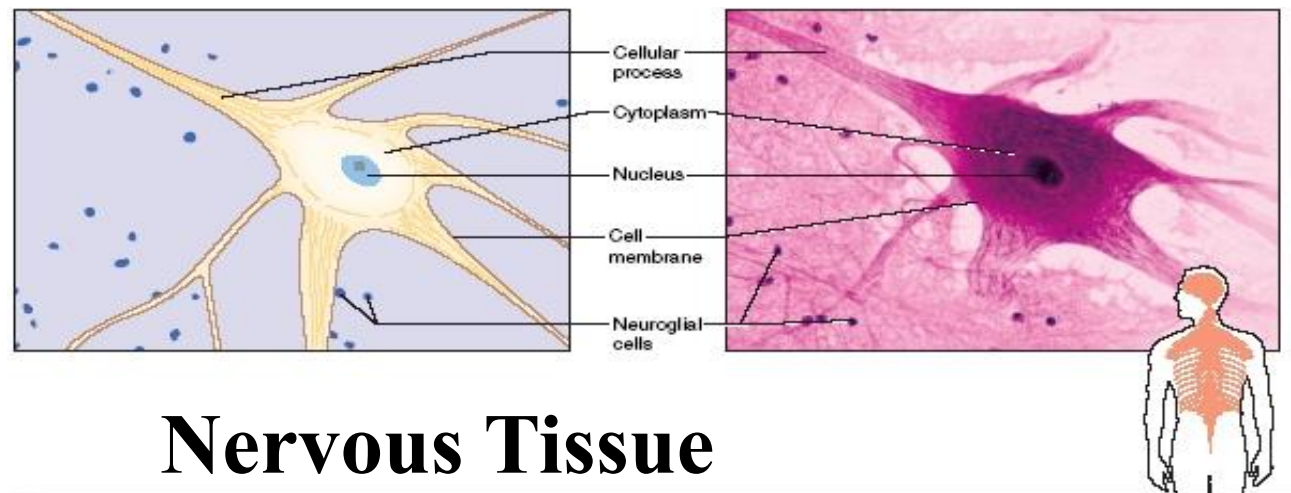


Skeletal Muscle Tissue

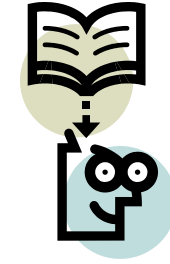
Major Tissue Types (cont.)

- ***Nervous tissue***

- Brain, spinal cord, and peripheral nerves
- Specializes to send impulses to neurons, muscles, and glands
- Neurons – largest cells, transmit impulses = 86 billion
- Neuroglial cells – smaller, more abundant, and act as support for neurons



Apply Your Knowledge



What are the major tissue types?

ANSWER:

↳ **Epithelial tissue**

↳ **Connective tissue**

↳ **Muscle tissue**

↳ **Nerve tissue**

Impressive!



In Summary

- The body is divided into levels of organization from simplest to most complex
- Anatomy and physiology are the study of structure and function of the human body
 - Using directional anatomical terms enables you to describe specific locations
- It is important to understand
 - The relationship between body levels
 - The basics of the organization of the body
 - The relationships found within each organization

Why the British are free-thinking and the Chinese love conformity: It's all in the genes

End of lecture 1

Our history begins before we are born. We represent the hereditary influences of our race, and our ancestors virtually live in us.

~ James Nasmyth

1850



Assignment - 1

What is **DNA finger printing**?

Is DNA finger print sequencing of a person related to his thumb finger print patterns? Validate your opinion.

How is this **applicable** to human resource development?

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