Gateway Biology Review- Answer Key

Characteristics of Living Things

- Reproduce
- Grow
- Develop
- Need food/require energy
- Made of cells
- Respond to their environment
- Adapt to their environment

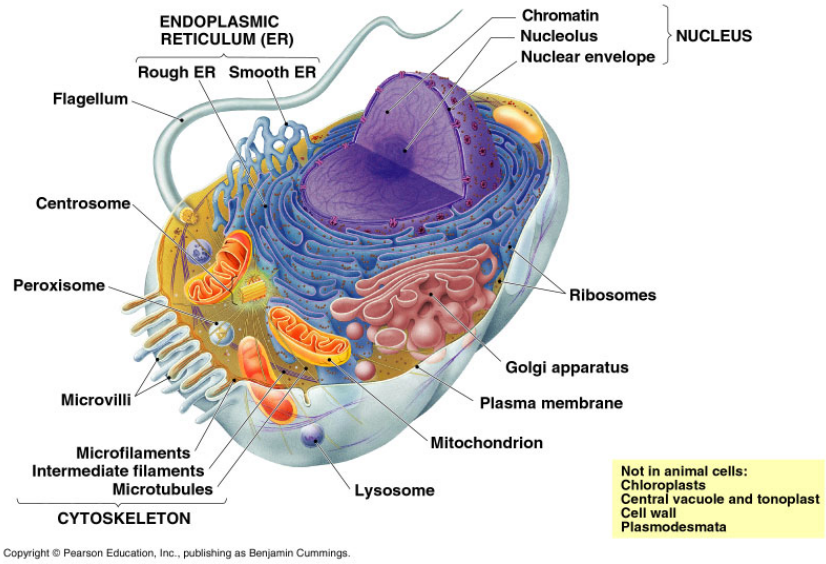
Cells and Heredity

Cell Theory

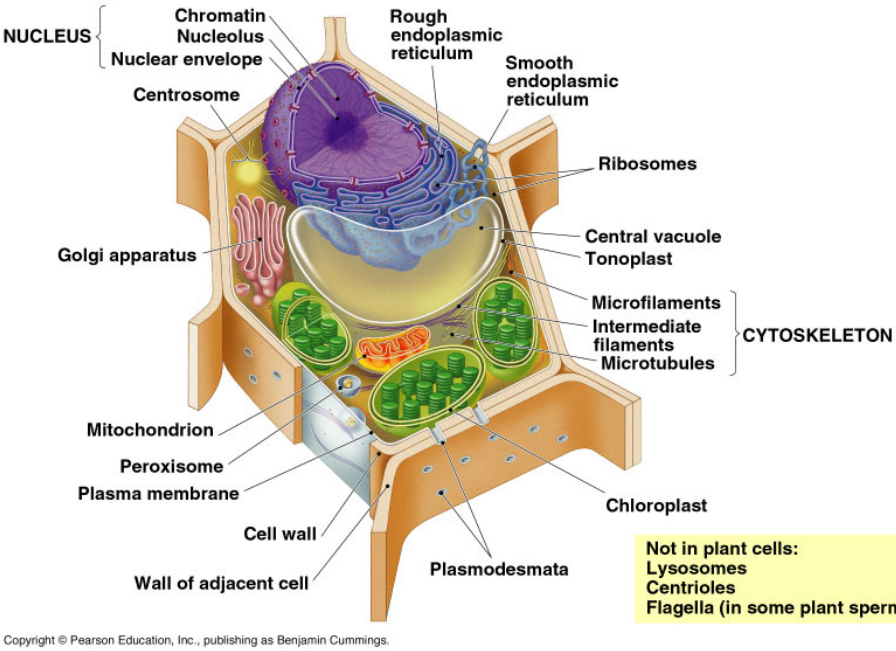
1. All living things are made of cells.
2. The cell is the basic unit of structure and function
3. All cells come from preexisting cells

Organelles and Cell Parts

1. Cell Membrane (Plasma membrane)
   - **Surrounds** cell
   - Selective barrier
   - Controls what substances enter and exit the cell
2. Cytoplasm
   - Jelly-like material that **fills** the cell
3. Ribosomes:
   - Site of **protein synthesis** (where **proteins** are made)
4. Golgi Apparatus
   - Prepare proteins that will leave the cell or be placed in the plasma membrane
   - "Post Office" of the cell
5. Mitochondria
   - **Powerhouse** of the cell
   - Site of cellular **respiration** which produces ATP from sugars (glucose)
6. Lysosome
   - **Digest** macromolecules
   - Single celled organisms—eating, digest food
   - Digest/recycle old organelles; "stomach of the cell"
   - Immune system
7. Centrosome
   - Produce microtubules during **cell division**
8. Rough Endoplasmic Reticulum
   - **Ribosomes** attached
   - Production of proteins



Animal Cell



Plant Cell

9. Smooth Endoplasmic Reticulum
    - **No ribosomes** attached
    - Produce lipids
    - Detoxification of drugs and poisons
10. Nucleus
    - Stores/protects **DNA**
11. Nuclear Envelope
    - Membrane that surrounds the **nucleus**
12. Nucleolus
    - Found in the **nucleus**
    - Produces ribosomal RNA (rRNA) which forms ribosomes
13. DNA
    - Deoxyribonucleic Acid
    - Contains genes/hereditary information
    - Determines structure of proteins
14. Chloroplast
    - Site of **photosynthesis**, which stores the sun's energy in sugars (glucose)
    - Found in **plants**
15. Vacuole
    - **Storage**
    - Waste, nutrients, water, ions
16. Cell Wall
    - **Supports** and **protects** plant cells, bacteria, fungi, some protists
    - Allows cell to exist in hypotonic environment
17. Cilia and Flagella
    - **Movement** (locomotion)
18. Microfilaments and Microtubules
    - **Structural** components, "skeleton" of the cell.

Cellular Classification

Unicellular Organisms

- **Single** celled
- Bacteria, archaea, some protists (euglena, paramecium, amoeba)

Multicellular Organisms

- More than **one** cell
- Plants, animals, fungi, some protists

Eukaryote

- **Nucleus** present
- **Linear** DNA
- Single or multi-celled
- Membrane bound **organelles**
- Plants, Animals, Fungi, Protists

Prokaryote

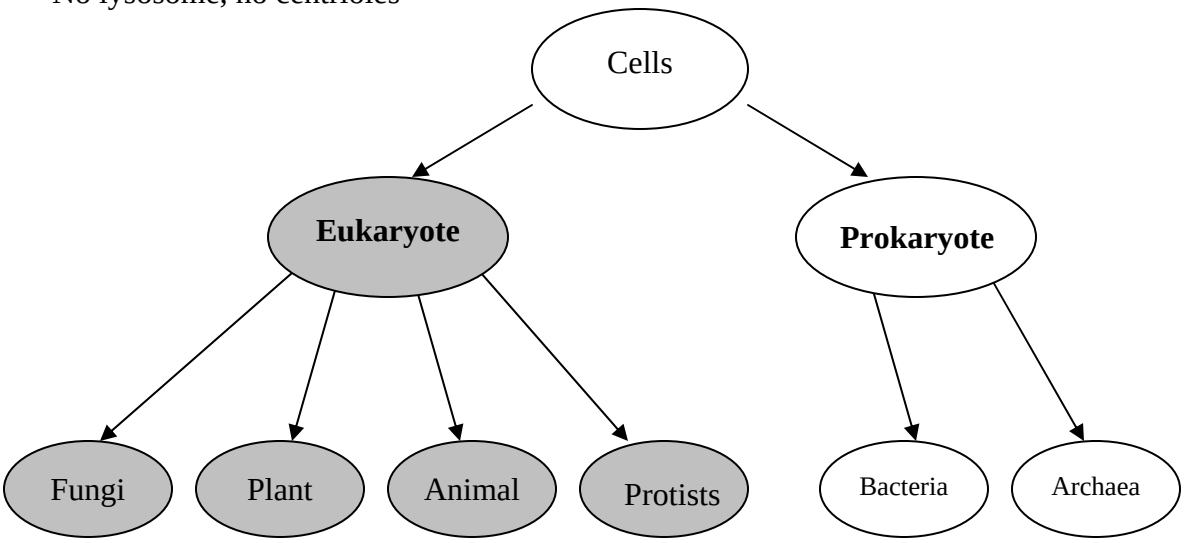
- **No** nucleus
- **No** membrane bound organelles
- **Single** celled
- **Circular** DNA
- "Primitive"
- Bacteria, Archaea

Plant

- **Eukaryotic**
- Cell wall (cellulose)
- Vacuole, chloroplast, plasmodesmata
- No lysosome, no centrioles

Animal

- **Eukaryotic**
- Lysosomes, centrioles
- No cell wall, no vacuole, no chloroplast



Above are the six kingdoms into which living organisms are subdivided.
Which of the kingdoms contain only multicellular organisms? **Plant, Animal**
Which of the kingdoms contain only single-celled organisms? **Bacteria, Archaea**
Which of the kingdoms contain both single-celled and multicellular organisms? **Fungi, Protist**

Practice: Decide whether each of the following is *unicellular or multicellular*, *prokaryotic or eukaryotic*; and state the *kingdom* to which belongs.

1. Human **M/E/Animal**
2. Cat **M/E/Animal**
3. Bacteria **U/P/Bacteria**
4. Oak Tree **M/E/Plant**
5. Gold Fish **M/E/Animal**
6. Euglena **U/E/Protist**
7. Mushroom **M/E/Fungi**
8. Fly **M/E/Animal**
9. Snake **M/E/Animal**
10. Paramecium **U/E/Protist**
11. Daffodil **M/E/Plant**
12. Cyanobacteria **U/E/Protist**
13. Virus **None**
14. Kelp **M/E/Protist**

Homeostasis

- Maintaining a **constant** and **stable** environment inside of an organism
- Examples
  - Breathe in oxygen
  - Breathe out carbon dioxide
  - Eat Food
    - Energy
    - Building Blocks
  - Eliminate Waste
  - Maintain Temperature
  - Blood pH
  - Blood sugar

- How does each of the following organs, systems, or responses function in maintaining homeostasis?
  - Kidneys
  - Cardiovascular System
  - Shivering
  - Sweating
  - Sunning
  - Buffers in our blood
  - Roots on a plant
  - Leaves on a plant
  - Digestive System
  - Mitochondria
  - Lysosome
  - Stomach

Cellular Transport

Materials Transported into a cell:

- **Nutrients**
- **Water**
- **Sugar (carbohydrates)**
- **Ions**
- **Amino Acids**
- **Fats**
- **Oxygen**

Materials Transported out of a cell

- **Waste**
- **Carbon Dioxide**
- **Proteins**
- **Sugar**
- **Hormones**

Methods of Transport Across a Cell Membrane

Active Transport

- Requires **Energy** (ATP)
- Uses Transport Protein

Passive Transport

- Does **not** require energy
- Particles move from **high** concentration to **low** concentration.
- Works to reach equilibrium

➢ Diffusion
  - Movement of **particles** through the membrane down a concentration gradient

➢ Osmosis
  - Movement of **water** through a semi-permeable membrane from an area of low solute concentration to an area of high solute concentration.

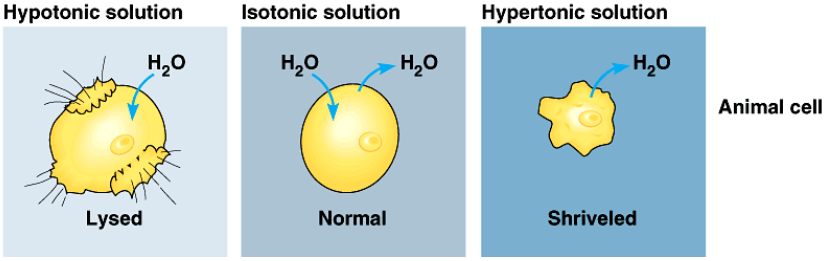
➢ Facilitated Diffusion
  - Movement of particles through a cell membrane by means of a transport protein.
  - Down the concentration gradient
  - Does NOT require energy.

<u>Osmosis</u>

- Movement of **water**
- Water makes up about 70% of the cell and is required for transport of food, nutrients, and waste throughout the body.
- Water moves from a **hypotonic** solution to a **hypertonic** solution.
- Hypotonic Solution: Lower solute concentration
- Hypertonic Solution: Greater solute concentration
- Isotonic Solution: equal solute concentration

} These are relative terms used to compare two solutions

- Animal Cells need to be surrounded by an **isotonic** solution
  - Animal cells in a hypotonic solution gain water and will **swell** and **burst**
  - Animal cells in a hypertonic solution lose water and will **shrivel**
- Plant Cells need to be surrounded by a hypotonic solution.
  - Plant cells in an isotonic solution become **flaccid**
  - Plant cells in a hypertonic solution lose water undergo **plasmolysis**



Endocytosis

- "Cell **eating**"
- A cell takes in macromolecules or other substances when regions of the plasma membrane surround the substance, pinch off, and form a vesicle within the cell.

Exocytosis

- A cell secretes macromolecules –waste, hormones, neurotransmitters, etc.

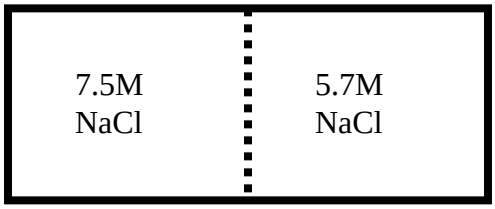
Practice:

1. An animal cell is placed in a hypertonic solution; what will happen to the cell? **Lose water, shrivel**

2. A plant cell contains a solute concentration of 0.5M; in what direction will water move if the cell is placed in a 0.2M solution? **Into the cell**

3. What term best describes the process by which a drop of food coloring over time spreads out uniformly through a beaker of water? **diffusion**

4. In the diagram to the right, what will be the direction of net water movement across the semi-permeable membrane? **To the left**

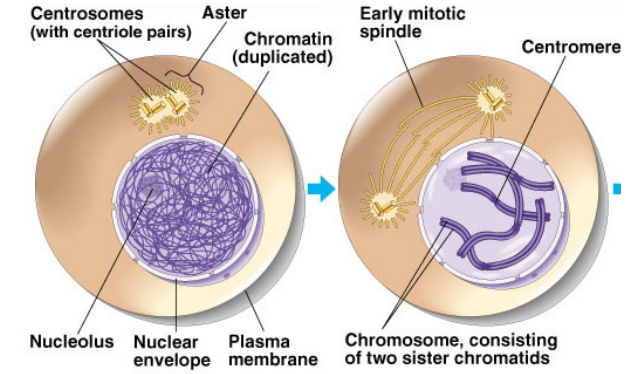


Cell Division

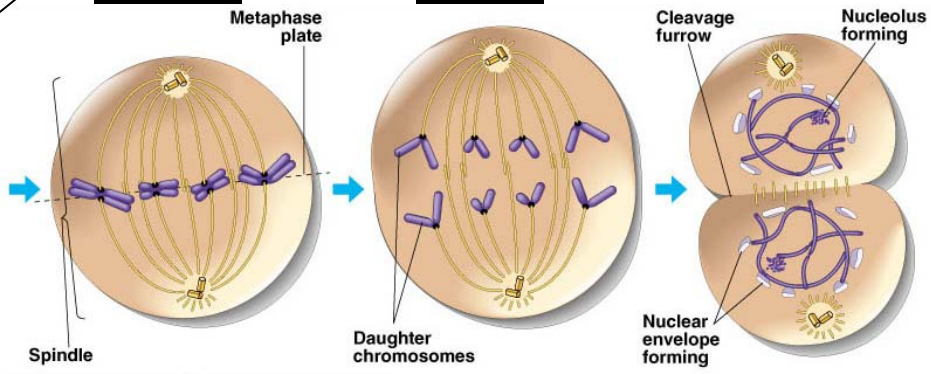
Mitosis

- **Growth** and **Repair**
- **Somatic** (body) cells
- Daughter cells:
  - **Two** produced
  - **Diploid**
  - **Identical** to the parent

Label each step of the cell cycle on the line below each picture



Interphase **Prophase**

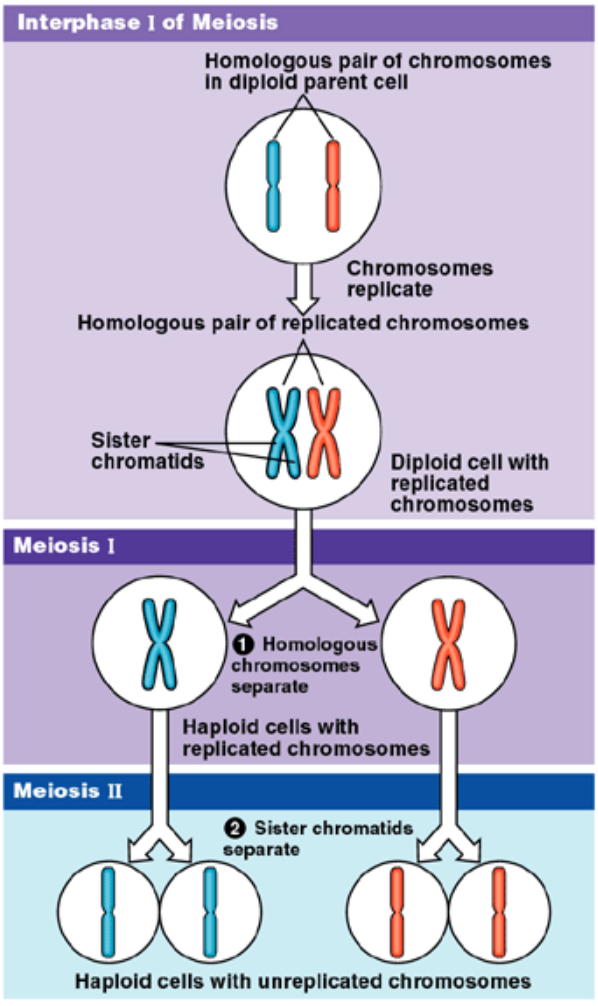


Metaphase **Anaphase** **Telophase**

- Steps of Mitosis:
  - **Prophase**
    - Chromatin coiled to form discrete chromosomes
    - Nucleoli disappear
    - Form mitotic spindle, lengthen microtubules
    - Nuclear membrane breaks down
    - Microtubules attach to chromosomes at kinetochore
  - **Metaphase**
    - Chromosomes lined up at **middle** of cell
  - **Anaphase**
    - Microtubules shorten
    - Chromatids **separate**, pulled toward opposite sides of the cell
  - **Telophase**
    - Daughter nuclei form at either side
    - Chromatin becomes less tightly coiled
    - Cytokinesis (division of cytoplasm) occurs during telophase.

<u>Meiosis</u>

- **Sexual** reproduction (why is meiosis required for sexual reproduction)
- Form **gametes** (sperm and egg)
- Daughter cells
  - **Four** produced (two nuclear divisions)
  - **Haploid** (cuts the number of chromosomes in <u>half</u>)
  - Different from parent and unique from each other
- Steps
  - Prophase I
  - Metaphase I
  - Anaphase I
  - Telophase I
  - Prophase II
  - Metaphase II
  - Anaphase II
  - Telophase II



Comparing Mitosis and Meiosis:	Mitosis	Meiosis
1. Two identical daughter cells	**X**	
2. Four daughter cells		**X**
3. Chromosome number halved		**X**
4. Chromosome number maintained	**X**	
5. Two rounds of cell division		**X**
6. One round of cell division	**X**	
7. Associated with sexual reproduction		**X**
8. Associated with asexual reproduction	**X**	
9. Genetic variation more likely		**X**
10. daughter cells identical to parent	**X**	
11. daughter cells not identical to parent		**X**
12. duplication of chromosomes occurs	**X**	**X**
13. necessary for growth and maintenance	**X**	
14. produces gametes		**X**

Energy/ Matter Transformations

Macromolecules

Carbohydrates, Proteins, Lipids, and Nucleic acids are all organic macromolecules.
Organic Molecules are composed primarily of carbon and are the building blocks of all living organisms.

	Carbohydrates	**Proteins**	**Lipids**	**Nucleic Acids**
AKA	**Sugars**		**fats**	
Components	Monosaccharide	Amino Acids	1 glycerol + 3 Fatty Acids	Nucleotide (Sugar + Phosphate + Nitrogenous Base)
Polymer	**Polysaccharide**	**Polypeptide**	None	**DNA, RNA**
Function	▪ Short Term **Energy** Storage ▪ Structure ▪ Identification of cells	▪ **Enzymes** ▪ Structure	▪ Long Term **Energy** Storage ▪ Padding ▪ Insulation	▪ Store **hereditary** Information ▪ Ribosomes ▪ Protein Synthesis
Examples	Glucose, sucrose, lactose, glycogen, cellulose	▪ Hemoglobin ▪ Hair ▪ Nails ▪ Lactase ▪ Muscles	▪ Body Fat ▪ Oils ▪ Wax ▪ Phospholipids in cell membrane	▪ DNA ▪ RNA ▪ tRNA ▪ ribosomes
Food Source	• Rice • Bread • Potatoes • Fruits	• Meat • Cheese • Soy • Beans	• Butter • Olive Oil • Mayonnaise • Margarine	• Meat • Fruits and Vegetables
Energy Contained	**4** kcal/g	**4** kcal/g	**9** kcal/g	

<u>Carbohydrates</u>

- Glucose
  - Required to produce ATP through cellular **respiration**
- Glycogen
  - Polymer of **glucose**
  - Short term energy storage for **animals**
  - Stored in the liver and muscles
- Starch
  - Polymer of **glucose**
  - Short term energy storage for **plants** (example: potato)
  - Stored in the roots
- Cellulose
  - Polymer of **glucose**
  - Structural
  - Cell walls in **plants**

<u>Lipids</u>

- **Energy** storage
  - Fats—animals
  - Oils—plants
- Padding and Insulation

Nucleic Acids

DNA

- Structure
  - **Double** Helix (Looks like a **twisted ladder**)
  - **Two** strands of nucleotides joined down the middle by hydrogen bonds
  - Four bases –**Adenine**, **Thymine**, **Guanine**, **Cytosine**
  - A pairs with T
  - G pairs with C

- DNA Replication
  - **Semi**-conservative
  - Double Helix unwinds, and each strand separates
  - Each strand used as template to construct new complementary strand
  - Occurs before Mitosis and Meiosis

- DNA Determines structure of proteins
  - Each group of three bases codes for a single **amino acid**
  - Proteins assembled through process of **transcription** and **translation**

RNA

- **Single** stranded
- Ribonucleic Acid (contains ribose rather than deoxyribose).
- Four bases—Adenine, Uracil, Guanine, Cytosine (Uracil replaces Thymine)
- Three types
  - rRNA—forms the ribosomes
  - tRNA—transports amino acids from cytoplasm to ribosomes
  - mRNA—carries information for protein structure from DNA to a ribosome

Proteins

- Composed of amino acids

- Uses
  - Enzymes
  - Muscle
  - Hair
  - Nails
  - Microtubules

- Protein Synthesis
  - Transcription
    - **Copies** information from DNA to mRNA
    - mRNA then transported from DNA to a **ribosome**
      - Eukaryotes—mRNA leaves nucleus to find ribosome
      - Prokaryotes—no nucleus, transcription and translation can occur simultaneously
    - mRNA attaches to ribosome

  - Translation
    - Information in mRNA used to construct specific sequence of amino acids
    - Information is translated from language of nucleotides to the language of amino acids
    - **tRNA** carries amino acids to ribosomes where they are linked together.

Practice:

The substances in your body that are needed in order to grow and maintain life come from the nutrients in food. There are 6 classes of nutrients in food- carbohydrates, proteins, lipids, water, vitamins, and minerals. Of these, carbohydrates, proteins, and fats are the major sources of energy for the body. Analyze and evaluate the sample daily diet of a 16 year old male. Be sure to include the following in your evaluation:

- Total calories ingested
- Percent of calories contributed by each of the nutrients
- Compliance with the RDI standards set by the USDA.

Dietary Reference Intake for Food Areas	**Males 14-18 years old**	**Females 14-18 years old**
Carbohydrates	130	130
Total Fat	30	30
Protein	52	46

Food	**Caloric Value**	**Grams of Fat**	**Grams of Protein**	**Grams of Carbohydrates**
1 bowl of Honey Nut Cheerios	120	1.5	3	24
8 oz. 2% milk	121	4.7	8	12
8 oz. orange juice	112	.5	2	26
Deluxe chicken sandwich (lettuce, tomato, mayo)	390	24.5	24	30
French fries	152	11	8	13
Ketchup	15	0	.2	4
8 oz. Mountain Dew	129	0	0	32
2 chocolate chip cookies	79	4	1	10
Slice of pizza	110	2	3	16
8 oz. Pepsi	136	0	0	37
Grilled cheese	320	19	20	30
2 burritos (fully loaded)	660	9	12	48
2 scoops ice cream	300	16	5	34
TOTALS	**2644**	**86.2**	**86.2**	**316**

Respiration and Photosynthesis

- Respiration
  - Process of using energy from sugar (glucose) to produce **ATP**
  - $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + 38ATP$
  - Occurs in **mitochondria**
  - Occurs in both **animals** and **plants**
  - ATP provides energy to do work in the cell
  - When ATP is used, it is converted to **ADP**; respiration then uses energy in sugars to convert ADP back to ATP by adding a phosphate.

- Photosynthesis
  - Process of using energy from the sun to produce **sugars** (glucose)
  - $6CO_2 + 6H_2O + \text{Light Energy} \rightarrow C_6H_{12}O_6 + 6O_2$
  - Occurs in **chloroplast** of plants and some algae

- How are photosynthesis and respiration related?
  The products of respiration are the reactants of photosynthesis; the products of photosynthesis are the reactants of respiration.

- Where and how are excess sugars stored in plants?
  Excess sugars are stored as starch in the roots. Starch is a polymer of glucose.

- Where and how are excess sugars stored in animals?
  Excess sugars are stored as glycogen in the liver of animals. Glycogen is a polymer of glucose.

- Construct a food chain that traces the flow of energy from the sun, to your lunch, through you, and to the muscles that make your arm move.
  Sun → grass →cow → hamburger →person
  In a person, hamburger is broken down/digested; sugars move to mitochondria in muscle, yield ATP through cellular respiration. ATP makes muscles move.

Genetics/ DNA

Heredity and Mendelian Genetics

Genetics: The study of **heredity** (the passing of traits from parents to offspring)
Gregor Mendel: The father of genetics.

DNA: Consists of many **genes**
Gene: Stretch of DNA that codes for a given **trait**.
Allele: Alternate **version** of a gene

Dominant and Recessive Traits

Dominant Allele

- Gene that is fully expressed.
- **Masks**/ "speaks louder than" a recessive allele.

Recessive Allele

- Masked/not expressed if dominant allele is present.
- Only expressed if dominant allele is **absent**.

Genotype

- The **genetic** makeup of an organism

  - Homozygous: having two of the ***same*** allele
  - Heterozygous: having two ***different*** alleles.

  - Homozygous Dominant: having two **dominant** alleles
  - Homozygous Recessive: having two **recessive** alleles
  - Heterozygous: having one of each allele

Phenotype

- The physical and physiological traits of an organism
- How the genes are **expressed**
- What you would see in a photograph

Example:
In peas, Y is a dominant allele that instructs for yellow seeds; y is a recessive allele that produces green seeds. Given the following genotypes, fill in the term that best describes each, and then indicate what the phenotype of the organism will be.

Genotype	Description of Genotype	Phenotype
YY	**Homozygous Dominant**	**Yellow**
Yy	**Heterozygous**	**Yellow**
yy	**Homozygous Recessive**	**Green**

A Punnett Square can be used to predict the genotypes and phenotypes of the offspring produced by a given genetic cross.

Generations

- Parental (P): The organisms involved in the **initial** cross
- First Filial (F_1): The offspring of the **Parental** Generation
- Second Filial (F_2): The offspring of the First **Filial** Generation

A chicken and a rooster mate. The chicken has white feathers and the rooster has brown feathers. Brown is dominant, and white is recessive. Assuming the rooster is heterozygous, predict the frequency of each genotype and phenotype in their offspring.

	B	**b**
b	**Bb**	**bb**
b	**Bb**	**bb**

Genotype: 50% heterozygous, 50% homozygous recessive

Phenotype: 50% brown, 50% white

What is the cellular process that determines which alleles an offspring will receive from their parents? **Meiosis**

Practice:

1. A plant that is homozygous dominant for height is crossed with a plant that is homozygous recessive. (T = tall; t = short). Use a Punnett Square to predict the genotypic and phenotypic ratios of the F_1 generation.

	T	**T**
t	**Tt**	**Tt**
t	**Tt**	**Tt**

Genotypic Ratio: 100% Tt

Phenotypic Ratio: 100% Tall

2. Using question number 1, what would be the genotypic and phenotypic ratios of a cross of two F_1 individuals?

	T	**t**
T	**TT**	**Tt**
t	**Tt**	**tt**

Genotypic Ratio: 1TT : 2 Tt : 1tt

Phenotypic Ratio: 3 Tall : 1 Short

Determining Sex

Human male: **XY**

Human female: **XX**

- ❖ Which parent determines the sex of a human offspring? **Father**
- ❖ What is the probability of having a boy? A girl? **50%/50%**

Sex linked traits

- Carried on the X chromosome
- Example: hemophilia, color blindness.
- Disorders occur more often in males than females. Why? **Males have one X chromosome, so if one is defective, they do not have a backup copy as do females.**

Mutation

A **change** in the base sequence of DNA.

A change in DNA can lead to a change in the **protein** coded for by that gene.

A change in the protein structure can lead to certain disorders, for example, sickle cell anemia.

The Six Kingdoms

Bacteria and Archaea

- **Single** Celled, prokaryote
- Cell wall
- Live in damp places or in water
- Asexual reproduction—binary fission
- **Decomposers** (breaks down organic material)
- Nitrogen fixation (rhizobium)
- Parasites (tuberculosis, cholera, strep-throat)
- Symbiotic relationships (humans)

Complete the chart comparing bacteria and viruses:

	Bacteria	Viruses
Kingdom(s)	Archaebacteria, Eubacteria	n/a
Example	Strep throat, Gonorrhea	Cold, Flu, Chicken pox
Considered living? (yes/no)	**Yes**	**No** by most scientists
Structure	**Cell walls** with peptidoglycan (Eubacteria)	**DNA or RNA** core surrounded by protein coat
Can diseases be successfully treated with antibiotics?	**Yes**	**No**

Protista

- **Eukaryotes** (has a nucleus)
- Single Celled
  - Euglena
  - Diatoms
  - Dinoflagellates
  - Ciliates
  - Flagellates
  - Sacrodina (amoeba)
  - Sporozoa (malaria)
- Multi-celled
  - Kelp
  - Seaweed

Plants

- Multicellular, eukaryotic
- Examples:

Animals

- Multicelled, eukaryotic
- Examples:

Fungi

- Multicelled or single celled; eukaryotic
- Examples:

Plants

- Photosynthetic Autotrophs
- How are plant cells different from animal cells?
  Plant cells have a cell wall and vacuole; Plant cells do not have centrioles and lysosomes.
- Major parts of a plant
  - Roots
    - absorb water and nutrients from the **soil**.
    - Store excess sugars (in the form of **starch**)
  - Stem
    - connects roots to the rest of the plant
  - Leaves
    - site of **photosynthesis**
- Transport in a plant
  - Xylem: transports water and nutrients from the roots to the rest of the plant
  - Phloem: transports products of photosynthesis to the rest of the plant.

- What environmental factors might affect a plant? **Water supply, light, pH, acid rain, pollutants**

Ecology

Biome

- A major biological community that occurs over a **large area** of land.
- Determined primarily by precipitation
- Affected by elevation, latitude, soil type, geographical features.

Terrestrial Biomes

1. Tropical Rain Forest
    - Rain: 200-450 cm (80-180 in) per year (A **lot** of rain)
    - Rich in number of species (many different types of organisms)
    - Central America, South America, Africa, Asia
    - Examples of Animals and Plants: **tree frog, monkeys, birds, green canopy**
2. Desert
    - Rain: fewer than 25 cm (10 in) per year (Very **little** rain)
    - Sparse vegetation
    - May be **warm** or **cold**
    - Examples of Animals and Plants: **Cactus, snakes, lizards, nocturnal animals**
3. Savanna
    - Rain: 90-150 cm (35-60 in) per year
    - Prevalent in Africa.
    - Dry **grassland**
    - Widely spaced trees; animals active during rainy season
    - Examples of Animals and Plants: **giraffes, zebras, grasses**
4. Temperate Deciduous Forest
    - Rain: 75-250 cm (30-100 in)
    - Mild Climate, plentiful rain
    - Deciduous trees **shed leaves in fall**
    - Warm summer, cold winter
    - Mammals hibernate in winter, birds migrate
    - Eastern US, Southeastern Canada, Europe, Asia
    - Examples of Animals and Plants: **Bears, Deer, Oak Trees**
5. Temperate Grasslands
    - Halfway between equator and poles
    - **Interior** of North America, Eurasia, South America
    - fertile soil, used for agriculture
    - Examples of Animals and Plants: **Grazing animals (Bison), grasses, field mice**
6. Coniferous Forest
    - **Cone bearing** trees: **pine, spruce, fir, hemlock**
    - Pacific Northwest (temperate rain forests)
    - Northern Coniferous Forest (Taiga)
        - Cold and wet
        - Winters long and cold; precipitation in summer
        - Coniferous forests (spruce and fir)
        - Large mammals: **elk, moose, deer, wolves, bears, lynx, wolverines**

7. Tundra
    - Between taiga and poles
    - 20% of Earth's surface
    - Rain: less than 25 cm (10 in)
    - **Permafrost** 1m deep (3ft)
    - Examples of Animals: **Foxes, lemmings, owls, caribou**
    - Alpine Tundra
        - found at high latitudes
        - high winds and cold temperatures

Aquatic Biomes

1. **Freshwater** Communities
    - Standing bodies of water
        - lakes, ponds
    - Moving bodies of water
        - streams, rivers
    - Wetlands
        - Swamp, marsh, bog
    - ~2% of Earth's surface
    - Plants, fishes, arthropods, mollusks, microscopic organisms

2. **Marine** Communities (salt water)
    - 75% Earth's surface covered by ocean
    - Average depth 3km (1.9mi)
    - Mostly dark, cold
    - Photosynthetic organisms mostly towards surface
    - Heterotrophic organisms throughout
    - Fish, plankton (algae, diatoms, bacteria).

Flow of Energy Through an Ecosystem

In order to live, organisms must obtain energy and nutrients

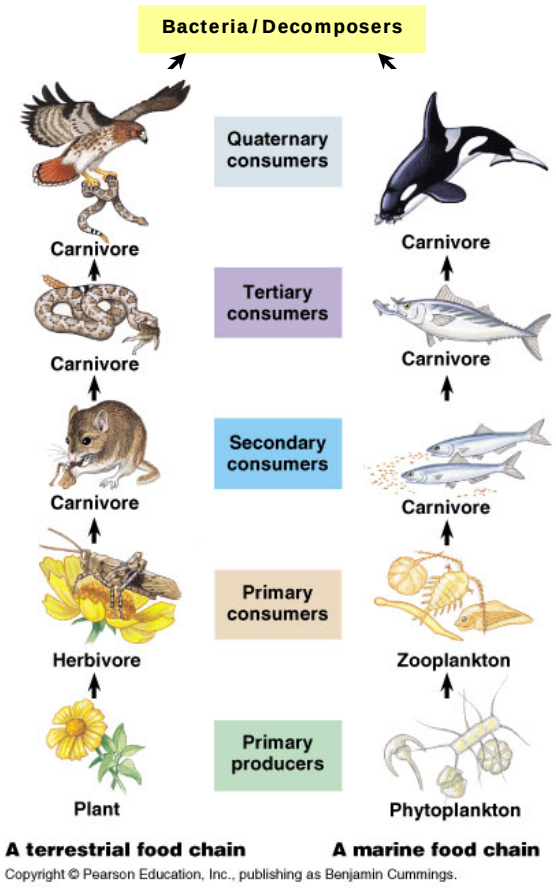
- Heterotrophs
    - Obtain energy and nutrients from the **food** they **eat**
- Autotrophs
    - Obtain energy from the **sun**
    - Obtain nutrients from the soil.

- Producer
    - Uses energy from the sun and carbon from the environment to **make** its **own** food.
    - "bottom of the food chain"
    - Why are producers necessary in any ecosystem? **Make energy from the sun available/usable for heterotrophs.**

- Consumer
    - Obtains energy through **eating other organisms**
        - Herbivore: eats only **plants**
        - Carnivore: eats only **animals**
        - Omnivore: eats both **plants** and **animals**
    - Primary consumer: eats producers

- Secondary consumer: eats the consumers that eat the producers
- Means of obtaining nutrition
  - Predation
    - Ecological interaction in which one organism (predator) feeds on another living organism(prey).
    - Predator may or may not kill the prey.
  - Scavenging
    - An animal ingests dead plants, animals, or both.
    - Vultures, termites, beetles

- Decomposer (**Saprophytes**)
  - Breakdown (absorb nutrients from) non-living organic material—corpses, plants, waste of living organisms—and convert them to inorganic forms.
  - Bacteria, fungi
  - Why are decomposers necessary in any ecosystem? **Recycle nutrients.**



Food Chain

- **Linear** pathway of energy transport through an ecosystem
- algae→krill→cod→seal→killer whale→bacteria
- Producers always come first in the food chain.
- Decomposers always come last in the food chain; they will break down dead organisms and allow nutrients to be recycled.
- Arrows indicate the **direction** in which **energy** flows through the ecosystem.

Food Web

- A **network** of interconnected food chains in an ecosystem
- Producers are at the beginning.
- Decomposers are at the end.
- Arrows indicate the **direction** in which energy flows through the ecosystem.

Practice:

1. Draw a food chain with at least five organisms. Label all organisms as being a producer, a consumer, or a decomposer. Make sure arrows are drawn to show how the energy is transferred.

Producer	**Consumer**	**Consumer**	**Consumer**	**Decomposer**
Grass →	**Grasshopper →**	**Bird →**	**Cat →**	**Mushroom**

2. How does a food chain prove the Law of Conservation of Matter and Energy?
The energy is not disappearing but is being transferred from one organism to another.

Symbiosis

- "**Living Together**"
- Ecological interaction in which two or more species live together in a close, long-term association.

1. Mutualism
    - **Both partners benefit**
    - Ants and aphids
        - Aphids supply sugars to ants; ants protect aphids from insect predators

2. Commensalism
    - One species **benefits**, the other is **neither** harmed nor helped
    - Birds and bison
        - birds feed on insects flushed out of grass by grazing bison
    - Barnacles and whales

3. Parasitism
    - One species (the parasite) **benefits**; the other (the host) is **harmed**.
    - One organism feeds on and usually lives on or in another.
    - Bacterial infection of animals
    - Fungus infects trees
    - Malaria

Practice:
Match the type of relationship with the correct term

1. _A_ Both species benefit from each other.
2. _C_ One species benefits; the other is unaffected.
3. _B_ One species benefits; the other is harmed.

a. mutualism
b. parasitism
c. commensalism

Cycles of Matter

Carbon Cycle

- Carbon is the key ingredient in all living organisms
- Processes involved: **biological** (example: photosynthesis), **geochemical** (example: release of CO_2 by volcanoes), **human activity** (example: burning of fossil fuels)

Nitrogen Cycle

- All organisms require nitrogen to build **proteins**
- Forms of nitrogen: N_2 in **atmosphere**; NH_3, NO_3^-, NO_2^- in **wastes**; nitrate from fertilizers
- Some bacteria convert N_2 into NH_3 during **nitrogen fixation.**
- Some bacteria convert nitrates into N_2 during **denitrification**.

Water Cycle

- All organisms require water to survive.
- Processes: evaporation, transpiration, condensation, precipitation, seepage, runoff

Important Ecological Terms

Abiotic factors

- **Nonliving** chemical or physical factors in the environment.
- **Examples: Air, soil, water, wind**

Biotic factors

- **Living** organisms in the environment.
- **Examples: Plants, animals, fungi, microorganisms**

Ecosystem

- **All** living and nonliving things in a given area

Community

- **All living organisms** that inhabit a given area.
- A group of populations

Population

- A group of individuals belonging to the **same species** that live together in the same area

Competition

- Two or more organisms require the same resource that is in limited supply.
- Food, shelter, light, water, mates
- The strongest organism will win the competition and will be more likely to live and pass its genes on to the next generation (**natural selection**).

Habitat

- Place or environment in which populations live

Niche

- **Role** of a species in an ecosystem
- Relationships, activities, resources used

Succession

- The series of **predictable** changes that occurs in a community over time
- **Primary** succession occurs on a surface where no soil exists. Example: **bare rock**, areas covered by **volcanic** ash
- **Secondary** succession occurs in an area where a disturbances changes an existing community without destroying the soil. Example: **plowed land**, area **burned** by wildfire

Adaptation and Natural Selection

Natural Selection

- Idea first stated by **Charles Darwin**
- "Survival of the **fittest**"
- Organisms that are best **adapted** to their environment are more likely to live long enough to produce offspring and pass their traits on to the next generation.
- In terms of evolution and natural selection, the number one goal of any organism is to pass its **genes** on to the next generation through the production of **offspring**.

Selective Breeding

- Organisms with **desired** traits are chosen to mate so that their offspring also possess desired traits.
- Examples: **Pedigree dogs and cats**

Adaptation

- Characteristic of an organism that helps it to better survive in a given environment.
- Types of adaptation:
  - Structural: characteristics of an organism's anatomy. (wings on a bird)
  - Physiological: characteristics relating to internal body processes. (antibiotic resistance)
  - Behavioral: how an organism acts and responds to its environment (bird migration)
- List three additional examples of adaptations and state the type of adaptation:
  - **Webbed feet of a duck (structural)**
  - **"ink" from an squid (physiological/behavioral)**
  - **Gills on a fish (structural/physiological)**

Evolution

- Change in groups of organisms over a long period of time
- Evidence for evolutionary changes
  - Fossils (The deeper the fossil, the _____ it is)
  - Comparative anatomy and the study of _____ structures (Example: human arm, dolphin fin, bat wing, dog foreleg)
  - Comparative _____ (The fewer the differences in DNA, the closer the organisms are related)
  - Comparative _____ (Example: all vertebrates have gill slits, tail, and notochord in early development)
  - _____ evidence (Example: bacteria can quickly become resistant to antibiotics)

Practice:

Classify the following adaptations as behavioral, structural, or physiological. Discuss the reason(s) for your choices.

1. Bees build a hive – **Behavioral; provide a place to make food**
2. Young ducklings follow their mother- **Behavioral; protection, food, and learning**
3. A woodpecker's beak is pointed and sharp- **Structural; to make a home**
4. Flat shape of a leaf- **Structural- to catch and absorb light and water**
5. Scent given off by a skunk- **Physiological- protect self from enemies**

Human Systems and Basic Life Functions

System	Function	Major Components
Circulatory/ Cardiovascular	Transport blood to all parts of the body. Blood carries: oxygen, CO_2, nutrients, waste	Heart, veins, arteries, capillaries
Respiratory	Exchange of Oxygen and Carbon Dioxide between the body and the environment.	Lungs
Immune	Protect the body from disease and foreign substances	T-cells, B-cells, Antibodies, lymphatic system, spleen
Digestive	Breakdown food; supply nutrients to the body	Stomach, Intestines, Pancreas, Liver
Excretory	Remove metabolic waste from the blood and dispose (production of urine)	Kidneys (in humans)
Reproductive	Production of offspring	Male contributes sperm; female contributes egg
Nervous	Sense/measure conditions within and outside of the body. Respond to these conditions: movement of muscle, release adrenaline, control of heart rate.	Brain, spinal cord, nerves
Endocrine	Production and release of hormones	Endocrine glands: pituitary, adrenal, overies, testes, etc.

Biology Exercises

Answer the following questions in paragraph form. Your answers will not necessarily be essays; they are short practice questions and may require one to three paragraphs. Answer on a separate piece of paper; feel free to give me a copy of your work so I can look over it and give you feedback.

1. Compare and contrast a plant cell and an animal cell.
2. Compare and contrast prokaryotes and eukaryotes.
3. A plant is watered with highly concentrated salt water. Even though the plant is given plenty of water it soon begins to wilt. Explain why the plant is wilting.
4. A plant and an insect are placed in an air-tight container; fresh oxygen is not allowed to enter the container. After about a week the plant died. A day later the insect died. If the insect had a sufficient amount of food and water, explain why the insect died.
5. In terms of the carbon cycle, explain how a carbon atom of one of your cells could have at one time been in George Washington's body. Draw a food chain or food web to illustrate your point.
6. Explain how a molecule of water in your body could, at one time, have been located in a tree in your back yard. Use scientific terminology to explain the path the water molecule followed from the tree to your body.
7. An animal cell is only capable of cellular respiration; a plant cell is capable of both cellular respiration and photosynthesis. Why do both organisms require cellular respiration? Why does only the plant cell require photosynthesis?