Power Notes Answer Key

Section 1.1

Biosphere—Everywhere on Earth where life exists

Biodiversity—Variety of species in a particular area or across the biosphere

Species—A type of living things that can reproduce by interbreeding

Organism—Any individual living thing

1. Cells; All organisms are made up of cells, from single-celled organisms (unicellular) to multicellular organisms.

2. Need for energy—All organisms need chemical energy to carry out their functions including metabolism, which is all of the chemical processes that build up or break down materials.

3. Respond to environment—All organisms must respond to stimuli to survive.

4. Reproduction—Organisms must have the ability to reproduce in order for a species to survive. When organisms reproduce, they pass on their genetic information (DNA) to their offspring.

Section 1.2

Systems—Related parts interact to form a whole. Examples include molecules that function together; cells that work together to perform a function; different organs that work together; different organisms that interact in an ecosystem.

Structure and Function —Function is related to, and dependent upon, structure. Examples include molecular structure and function; cell structure and function; anatomical structure and function.

Homeostasis—Stable internal conditions are maintained through automatic responses and through behavior. Examples include temperature regulation; behavioral responses to external stimuli.

Evolution—Gradual change in genetic makeup of a population of a species. Examples include adaptations in different environments resulting in different species.

Section 1.3

Observing—Using the senses or tools to gather information

Forming hypotheses—Ask a question and try to explain observations

Testing hypotheses—Collecting data to support or reject a hypothesis

Analyzing data—Statistical analysis of data to draw conclusions

Evaluating results—Data and conclusions are studied to determine whether they are valid

Experiment

Using independent and dependent variables to find cause-and-effect relationships

Independent variable—The condition that is manipulated in an experiment; the "cause"

Dependent variable—The factor that is measured in an experiment; the "effect"

Constant—Any condition that is kept the same during an experiment; necessary for determining whether the independent variable produces any change in the dependent variable

Theory

A proposed explanation for a wide range of observations and experimental results that is also supported by a wide range of evidence

Section 1.4

1. Light and lenses used to magnify specimens; limited magnification, but can be used to study living specimens

2. Deflection of electrons used to magnify specimens; provides high magnification and a three-dimensional black-and-white image that can be colored by computer; cannot be used to study living specimen

3. Electrons passing through a specimen used to magnify specimen; provides high magnification and a two-dimensional black-and-white image that can be colored by computer; cannot be used to study living specimens

4. X-rays passing through tissues used to show dense materials (bones, teeth)

5. Magnetic field used to show all tissues, including soft tissues such as tendons and ligaments

6. Magnetic field that can be used to shown activity in particular brain regions while a subject is performing a task

7. Use of computers to simulate complex systems when actual experiments are not possible

8. Study and manipulation of DNA at the molecular level

Section 1.5

Personal health and lifestyle choices—Issues include diet, obesity, exercise, smoking, alcohol and other drugs, cancer prevention

Environment and society—Issues include interaction between environment and humans, political, legal, economic considerations

Biotechnology

Benefits—food production, medical advances, improved crop yields, detection of genetic disorders, forensic science

Risks—unknown long-term effects of genetically modified crops, safety of GM plants, possibility of decreasing biodiversity

Ethical concerns—privacy of genetic testing, possible discrimination based on genetic screening, ethics of choosing characteristics of children, use of genetic information

Section 2.1

Atom

smallest basic unit of matter

Energy levels—regions around a nucleus in which electrons are located

Outermost energy level—electrons in the outermost energy level determine how atoms form ions or form covalent bonds

Element 1—hydrogen

Element 2—oxygen

1. electron

2. nucleus

3. protons

4. neutrons

Compound

made of atoms of two or more elements bonded together

Ions—atoms that gain or lose one or more electrons

Ionic bonds—form between oppositely charged ions due to electrical attraction

Positive ions—formed when atoms lose electrons, tend to be formed by atoms with few outer energy level electrons

Negative ions—formed when atoms gain electrons, tend to be formed by atoms with nearly full outer energy level

Covalent bonds—formed when atoms share one or more pairs of electrons

Molecules—atoms bonded together by covalent bonds; not necessarily a compound

Section 2.2

Polar molecules—molecules that have regions with slight electrical charges due to uneven pull on electrons

Nonpolar molecules—molecules without charged regions due to equal pull on electrons

1. hydrogen bonds

2. formed by attraction between slightly positive hydrogen atom and slightly negative (oxygen) atom

Atom 1—oxygen; slightly negative

Atom 2—hydrogen; slightly positive

1. High specific heat—large amount of energy needed to produce an increase in temperature

2. Cohesion—water molecules "stick" to each other

3. Adhesion—water molecules "stick" to other substances

Solutions—a mixture that is the same throughout (homogeneous)

Solvents—substance present in greatest concentration; dissolves other substances

Solutes—substance present in lower concentration; dissolves in solvent

Acids—release H^+ ions in solution; high H^+ concentration; low pH (<7)

Neutral—neither acidic nor basic; pH of 7

Bases—remove H^+ ions from solution; low H^+ concentration; high pH (>7)

Section 2.3

Monomer—small molecule that is a single unit in a much larger molecule

Polymer—large molecule (macromolecule) formed from many monomers bonded together

1. Functions—broken down to provide a source of energy; make up plant cell walls
Monomer—glucose

2. *Lipid*

Functions—broken down to provide a source of energy; make up cell membranes; used to make steroid hormones

Molecule—phospholipid; phosphate group head; nonpolar fatty acid tails

Protein

Functions—many, including enzymes, oxygen transport, and muscle movement
Polymer—polypeptide (or protein) Monomer—amino acid

Nucleic acid

Types—DNA and RNA

Functions—store genetic information; build proteins

Section 2.4

1. reactants; substances changed by a chemical reaction

2. direction of the reaction

3. products; substances formed during a chemical reaction

4. reactants

5. activation energy

6. total energy released

7. products

8. products

9. activation energy

10. total energy released

11. products

Bond energy

the amount of energy needed to break a bond, or the amount of energy released when a bond forms

Chemical equilibrium

reversible reactions can occur in both directions (reactants to products, or products to reactants, depending on reactant and product concentrations); when reactants and products are formed at the same rate, a reaction is at equilibrium

Exothermic

more energy released than absorbed; energy usually released as heat and/or light; reactants have higher bond energy than products

Endothermic

more energy absorbed than released; products have higher bond energy than reactants

Section 2.5

1. decreases activation energy and increases reaction rate

2. is not used up during a reaction and does not alter the equilibrium of the reaction

Enzymes—catalysts for chemical reactions in living things; almost all are proteins

Homeostasis and enzymes—large changes in temperature or pH can cause enzymes to break down (hydrogen bonds break); stable conditions necessary for an organism's enzymes to function properly

Enzyme structure and function — altered enzyme structure prevents the enzyme from functioning properly

Substrates—reactants acted upon by an enzyme; bind to an enzyme's active sites

Lock-and-key model—only particular substrates will bind to particular enzymes; when bound, enzymes weaken bonds within substrates and allow reactions to occur

Section 3.1

Scientists Who Contributed to the Cell Theory: Hooke, Leeuwenhoek, Schleiden, Schwann, Virchow

Important Technological Advances: Improvements in the microscope, such as better lenses

The Principles of Cell Theory: All organisms are made of cells. All existing cells are produced by other living cells. The cell is the most basic unit of life.

The Cell Theory: one of the first unifying concepts developed in biology.

This is a eukaryotic cell.

Labels: (top) nucleus, organelles; (bottom): DNA, cytoplasm, cell membrane

This is a prokaryotic cell.

All cells have a membrane, cytoplasm, and similar building blocks.

Section 3.2

cytoskeleton: give shape, act as tracks for the movement of organelles, aid division, give strength, aid movement *nucleus:* stores and protects the DNA

endoplasmic reticulum: production of proteins and lipids, breakdown of drugs and alcohol

ribosomes: link amino acids together to form proteins

Golgi apparatus: processes, sorts, and delivers proteins

vesicles: sacs that separate some materials from the rest of the cytoplasm, generally short-lived

mitochondria: supply energy to the cell by converting molecules from food into usable energy

vacuole: sac used for storage of materials, typically quite large in plant cells

lysosomes: sacs containing enzymes that defend a cell from invaders and break down worn-out cell parts

centrioles: consist of microtubules arranged in a circle; organize microtubules to form cilia and flagella; role in cell division not entirely clear

cell wall: rigid layer surrounding the cell membrane in plant, algae, fungi, and most bacteria cells; provides protection, support, and shape

chloroplasts: carry out photosynthesis to convert solar energy into energy-rich molecules

Section 3.3

Cell membrane

Functions: contains cell contents, controls what enters and exits a cell

Fluid mosaic model: describes the arrangement of molecules making up a cell membrane; the membrane is flexible like a fluid and has a variety of molecules like the variety of tiles in a mosaic

Phospholipids: form a double layer surrounding a cell; composed of a charged phosphate group, glycerol, and two fatty acid chains; head is polar and forms hydrogen bonds with water; tail is nonpolar.

Other molecules:

cholesterol strengthens membranes, proteins aid cell identification and movement of molecules across membranes and cell signaling, carbohydrates aid cell identification The sketch should look similar to Figure 3.18.

Selective permeability:

allows some materials to cross; can also use terms such as semipermeable and selectively permeable; enables a cell to maintain homeostasis; molecules can cross in a variety of ways

Receptors:

detect a signal molecule and perform an action in response

Intracellular: located inside a cell; bind to molecules that can cross the membrane

Membrane: located in the membrane; binds to molecules than cannot cross the membrane; change in shape transmits the message to the cell interior

Section 3.4

The figure should look similar to Figure 3.21.

Passive transport: the movement of molecules across a membrane without energy input from the cell

Diffusion: movement of molecules from higher to lower concentration

Osmosis: the diffusion of water

How do different solutions affect cells?

The figure should look similar to Figure 3.23; isotonic, hypertonic, hypotonic.

Facilitated diffusion: the diffusion of molecules across a membrane through transport proteins; requires no energy input from the cell

The figure should look similar to Figure 3.24.

Section 3.5

The figure should look similar to Figure 3.25.

Active transport: drives molecules across a membrane from lower to higher concentration (against a concentration gradient)

Endocytosis: process of taking in liquids or larger molecules into a cell by engulfing in a vesicle; requires energy

The diagram (1., 2. 3.) should look similar to the diagram on page 90 of the text.

Exocytosis: process of releasing substances out of a cell by fusion of a vesicle with the membrane

The diagram (1., 2. 3.) should look similar to the diagram on page 91 of the text.

Section 4.1

1. ATP

2. energy released for cell processes

3. ADP

4. energy from breakdown of molecules

5. 4 cal/mg; 36 ATP from glucose; most common molecule broken down to make ATP

6. 9cal/mg; 146ATP from a triglyceride; stores most of the energy in people

7. 4 cal/mg; infrequently broken down by cells to make ATP

Chemosynthesis—process through which some organisms use chemicals from the environment (rather than light energy) as a source of energy to build carbon-based molecules

Section 4.2

Photosynthesis—process through which light energy is captured and used to build sugars that store chemical energy

1. chloroplast

2. sunlight

3. water

4. thylakoid; chlorophyll and other light-absorbing molecules

5. oxygen

6. energy-carrying molecules transferred to light-independent reactions

7. carbon dioxide from the atmosphere

8. light-independent reactions (Calvin cycle)

9. one six-carbon sugar (glucose)

Photosynthesis equation

$6CO_2 + 6H_2O \Rightarrow\Rightarrow\Rightarrow\Rightarrow\Rightarrow\Rightarrow C_6H_{12}O_6 + 6O_2$

Section 4.3

1. energy absorbed from sunlight and transferred to electrons that enter an electron transport chain

2. water molecules are broken down; electrons enter chlorophyll

3. energy from electrons in transport chain is used to pump H^+ ions across the thylakoid membrane

4. energy absorbed from sunlight is transferred to electrons

5. high-energy electrons used to produce an energy-carrying molecule called NADPH

6. H^+ ions flow (by diffusion) through a channel in the thylakoid membrane

7. The channel is part of ATP synthase, which produces ATP

1. carbon dioxide molecules enter the Calvin cycle

2. energy added to molecules in the cycle; molecules rearranged into higher-energy molecules

3. high-energy three-carbon molecule leaves the cycle; two are bonded together to make a six-carbon sugar

4. energy added to molecules remaining in the cycle to change them into five-carbon molecules

Section 4.4

Cellular respiration—process through which sugars and other carbon-based molecules are broken down to produce ATP when oxygen is available

Glycolysis—anaerobic process in cytoplasm that splits glucose into 2 three-carbon molecules

1. mitochondrion

2. three-carbon molecules

3. Krebs cycle; mitochondrial matrix; produces 2 ATP

4. carbon dioxide

5. energy transferred to 2nd aerobic stage

6. energy from glycolysis and oxygen enter the process

7. water produced; large number of ATP molecules produced

Cellular respiration equation:

$C_6H_{12}O_6 + 6O_2 \Rightarrow\Rightarrow\Rightarrow\Rightarrow\Rightarrow\Rightarrow 6CO_2 + 6H_2O$

Section 4.5

Glycolysis (as a sketch or in words)—2 ATP molecules used to split glucose; 4 ATP(2ATP net) and2 NADH formed as the three-carbon molecules are rearranged into 2 molecules of pyruvate.

1. pyruvate broken down; CO_2 released

2. coenzyme A binds; intermediate enters Krebs cycle

3. citric acid (6-carbon molecule) formed

4. citric acid broken down; NADH made; CO_2 released

5. five-carbon molecule broken down; NADH and ATP made; CO_2 released

6. four-carbon molecule rearranged, NADH and $FADH_2$ made

7. Krebs cycle (or citric acid cycle)

1. energized electrons removed from NADH and $FADH_2$

2. energy from electrons in the electron transport chain is used to pump H^+ ions across the inner mitochondrial membrane

3. H^+ ions flow through ATP synthase, and ATP molecules are produced

4. oxygen picks up electrons that went through the electron transport chain and H^+ ions

Section 4.6

Fermentation—process that allows glycolysis to continue to produce ATP when oxygen is not available, but does not produce ATP

Lactic acid fermentation (as sketch or in words)—pyruvate and NADH enter fermentation; NADH used to convert pyruvate into lactic acid; NAD^+ recycled to glycolysis

Alcoholic fermentation (as sketch or in words)—pyruvate and NADH enter fermentation; NADH used to convert pyruvate into an alcohol and carbon dioxide; NAD^+ recycled to glycolysis

1. cheese

2. yogurt

3. bread

Section 5.1

1. gap 1

2. cell growth, normal functions, replications of organelles

3. synthesis

4. copies DNA

5. gap 2

6. additional growth and carrying out of normal functions

7. mitosis

8. cell division

9. prophase

10. metaphase

11. anaphase

12. telophase

13. cytokinesis

14. mitosis

15. interphase

Cells divide at different rates

Rates of cell division vary widely and are linked to the body's need. The length of gap 1 varies most widely among cell types. Some cells, such as neurons, enter a stage called G0, where cells are unlikely to divide again.

Cell size is limited

If cells were too small, they could not contain all the organelles and molecules necessary for life. If cells were too large, they could not move enough materials across the membrane surface. To maintain a suitable size, cell growth and division must be coordinated.

The smallest cube should be circled.

Section 5.2

Chromosome structure

A chromosome is one long continuous thread of DNA. DNA wraps around proteins called histones. DNA and histones form chromatin, which looks like spaghetti, during interphase. Chromosomes condense tightly for mitosis. Because they are duplicated, they look like an X.

1. interphase: copies DNA, grows, duplicates organelles

2. prophase: chromosomes condense, nuclear envelope breaks down, spindle fibers form

3. metaphase: spindle fibers align chromosomes along the cell equator

4. anaphase: chromatids separate to opposite sides of cell

5. telophase: nuclear membranes start to form around chromosomes, chromosomes begin to uncoil, spindle fibers fall apart

6. cytokinesis: divides the cytoplasm between two daughter cells

Section 5.3

Internal factors: often triggered by external factors; include kinases and cyclins; kinases change the activity of other molecules by adding a phosphate group; cyclins are rapidly made and destroyed at different points in the cell cycle.

External factors: include cell-cell contact and other physical signals; also include chemical signals such as growth factors; growth factors may stimulate growth in a wide variety of cells or may stimulate only specific cells to divide

Carcinogens: substances that produce or promote the development of cancer; examples include tobacco smoke, air pollutants, radiation, and even some mutated genes carried by viruses

Cancer cells: characterized by uncontrolled cell division; continue to grow despite cell-cell contact or lack of growth factors

Tumors: disorganized clumps of cancer cells that do not carry out specialized functions needed by the body

Malignant: cells break away and form new tumors

Benign: cells remain clustered together

Apoptosis: programmed cell death; plays a role in normal development and ridding the body of unhealthy cells Example of apoptosis: cells between fingers

Section 5.4

Binary fission: asexual reproduction of a single-celled organism by division into two roughly equal parts; may sketch a figure similar to the Visual Vocab on page148

Mitosis

Budding: small projection grows on surface of parent and forms a new organism
Fragmentation: parent organism splits into pieces that can each grow into a new organism

Vegetative reproduction: modification of a stem or underground structure from the parent organism; new organism often remains connected

Asexual reproduction: creation of genetically identical offspring from one parent organism; does not involve fusion of gametes

Advantages to species: Can be more efficient if organisms well suited to environment. All organisms can potentially reproduce. Organisms do not need to spend resources finding or attracting a mate.

Disadvantages to species: All organisms respond same way to environment. Organisms may lack adaptability to survive in changing conditions.

Section 5.5

Organ systems: organs that carry out similar functions

Organs: groups of tissues that work together to perform similar or related functions

Tissues: groups of cells that work together to perform a similar function

Cells: smallest, most basic structural unit of life; typically become specialized

homeostasis: maintained by the interaction of different organ systems that coordinate the body's functions

Defining characteristics: ability to divide and renew themselves for long periods of time, remain undifferentiated in form, and can develop into a variety of specialized cell types.

Possible uses: treat patients with leukemia and lymphoma, may help cure diabetes, repair or replace damaged organs, and improve current drug testing techniques

Potential: Totipotent: can grow into any other cell type; includes only a fertilized egg and cells resulting from the first few divisions

Pluripotent: can grow into any cell type other than a totipotent stem cell

Multipotent: can only grow into cells of a closely related family of cells

Origin:

1. Adult stem cells; partially undifferentiated cells located among the specialized cells of many organs and tissues.

2. Embryonic stem cells: taken from clusters of undifferentiated cells in a 3–to-5–day-old embryo; pluripotent; can be grown indefinitely in culture

Section 6.1

Somatic cells: also called body cells, make up most of the body tissues and organs, not passed onto children

Gametes: sex cells, passed on to children

1. autosomes: chromosomes that contain genes not directly related to the sex of an organism

2. homologous chromosomes: pair of chromosomes, inherit one from each parent, carry the same genes although the genes may code for different traits

3. sex chromosomes: contain genes that directly control the development of sexual characteristics

Diploid cell: has two copies of each chromosomes, one from mother and one from father; body cells typically diploid, result from mitosis

Haploid cell: has one copy of each chromosome; gametes typically haploid, result from meiosis

Mitosis: makes genetically identical cells, makes diploid cells, takes place throughout organism's lifetime, involved in asexual reproduction

Meiosis: makes genetically unique cells, makes haploid cells, takes place at certain times in life cycle, involved in sexual reproduction

Section 6.2

Homologous chromosomes: pair of chromosomes, inherit one from each parent, carry the same genes although the genes may code for different traits, separate in meiosis I

Sister chromatids: duplicates of each other, each half of a duplicated chromosome, attached together at the centromere, separate in meiosis II

1. prophase I: chromosomes condense, homologous chromosomes begin to pair up, nuclear envelope breaks down, spindle fibers form

2. metaphase I: spindle fibers align homologous chromosomes along the cell equator

3. anaphase I: homologous chromosomes separate to opposite sides of cell, sister chromatids remain attached together

4. telophase I: spindle fibers fall apart, nuclear membrane may form again, cell undergoes cytokinesis

5. prophase II: nuclear envelope breaks down if necessary, spindle fibers form

6. metaphase II: spindle fibers align chromosomes along the cell equator

7. anaphase II: chromatids separate to opposite sides of cell

8. telophase II: nuclear membranes form around chromosomes, chromosomes begin to uncoil, spindle fibers fall apart, cell undergoes cytokinesis

Section 6.3

Three key choices: control over breeding, use of purebred plants, observation of "either-or" traits that appeared in two forms

Pea plant characteristics: pea shape, pea color, flower color, pod shape, pod color, flower position, plant height

Cross: the mating of two organisms; Mendel mated purebred pea plants with purple flowers with purebred flowers

P: the parental generation; Mendel used purebred plants for the P generation; for example, he crossed purebred plants with purple flowers with purebred plants with white flowers

F_1: the first generation of offspring resulting from the parental cross; for example, Mendel's F_1 plants all had purple flowers; Mendel allowed this generation to self-pollinate

F_2: the second generation; the result of the self-pollination of F_1 plants; for example, in Mendel's F_2 generation, 3/4 had purple flowers and 1/4 had white flowers

Results: For all seven traits, Mendel found that approximately 3/4 of F_2 offspring had one trait and 1/4 of the offspring had the other trait

Conclusions: traits are inherited as discrete units (genes),

law of segregation—inherit two copies of each gene, donate only one copy of each gene in gametes

Section 6.4

Gene: piece of DNA that tells a cell to make a certain polypeptide;

Allele: an alternate form of a gene; there may be many different forms of the same gene in a population; each individual organism has only two forms of that gene, one from the mother and one from the father

Genome: all of an organism's genetic material, unique;

Genotype: the genetic makeup of a specific set of genes; may be homozygous dominant, homozygous recessive, or heterozygous

Homozygous: describes two alleles at the same locus that are the same

Heterozygous: describes two alleles at the same locus that are different

Symbols: represented with individual letters; uppercase letter = dominant; lowercase letter = recessive

Dominant: expressed even when two alleles are different;

Recessive: expressed only when two copies are present

Phenotype: an organism's physical characteristics or traits; influenced by genotype and environmental factors

Section 6.5

Punnett square: grid system for predicting possible genotypes resulting from a cross; *Axes:* represent possible gamete genotypes of each parent; *Grid boxes:* show all possible genotypes of offspring

Monohybrid cross: examines the inheritance of one specific trait; students may choose to sketch a Punnett square for a specific cross

Ratios: predicted genotypic and phenotypic ratios can be determined from a Punnett square; specific ratios will vary based on example Punnett square used

Testcross: cross between an organism with the recessive phenotype (homozygous recessive genotype) and an organism with the dominant phenotype but an unknown genotype; looking at the offspring allows you to figure out the phenotype of the dominant organism

Dihybrid cross: examines the inheritance of two traits; students may choose to sketch a Punnett square for a specific cross

Ratios: predicted genotypic and phenotypic ratios can be determined from a Punnett square; specific ratios will vary based on example Punnett square used

Law of independent assortment: developed by Mendel as a result of examining dihybrid crosses; determined that the inheritance of one trait does not influence the inheritance of a second trait

Probability: the likelihood that a particular event will happen; predicts the average number of occurrences; the distribution of genes in gametes and the fertilization of a particular egg by a particular sperm are random events whose outcome can be predicted with probability

Section 6.6

Fertilization: random; increases unique combinations of genes; in humans, the chance of getting any one combination of chromosomes from any one set of parents is one out of $2^{23}x2^{23}$, which is one out of over 64 trillion combinations

Meiosis: Independent assortment of chromosomes: increases unique combinations of genes; homologous chromosomes pair randomly along the cell equator; in human cells, about 2^{23}, or 8 million, different combinations of chromosomes could result

Crossing over: exchange of chromosomes segments between homologous chromosomes during prophase I of meiosis I; creates new combinations of genes; recombined chromosomes are a combination of genes from both the mother and the father

Figure should look similar to Figure 6.20.

Genetic linkage: genes located close together on same chromosome tend to be inherited together; crossing over less likely to occur between genes located close together; not found by Mendel because he studied traits on separate chromosomes or traits located far apart on the same chromosome; means that not all genes follow the law of independent assortment

Section 7.1

Autosomes—all chromosomes other than sex chromosomes; do not directly determine an organism's sex

Autosomal gene expression—two alleles that interact to produce a phenotypic trait;

Inheritance of autosomes—Punnett square should demonstrate that inheritance occurs according to Mendel's rules, one allele from each parent

Sex chromosomes—chromosomes that determine an organism's sex;

Inheritance of sex chromosomes—Punnett square should indicate that females (XX) can only pass on an X chromosome and males (XY) can pass on either chromosome;

Expression in males—all sex-linked genes are expressed because there is no second allele that could mask the first allele;

Expression in females—similar to autosomal, but one X chromosome in each cell is randomly "turned off " through X chromosome inactivation

Section 7.2

Incomplete dominance—heterozygous phenotype is intermediate between parental phenotypes; parental phenotypes not seen in F_1 generation; neither allele completely dominant nor completely recessive

Codominance—two alleles fully and separately expressed; both parental phenotypes seen in all F_1 offspring; alleles neither dominant nor recessive

Multiple alleles—genes with more than two alleles

Polygenic traits—traits that result from the interaction of two or more genes

Epistasis—a gene that overshadows all other genes for a particular trait

Environment and genotype—phenotype is often the result of interactions between environment and genotype; temperature and sex of sea turtles; identical twins raised separately

Section 7.3

Mendel—crossed pea plants; determined 9: 3: 3: 1 ratios in dihybrid crosses

Conclusions—two alleles for each trait; alleles assort independently;

Punnett and Bateson—crossed pea plants; dihybrid cross ratios differed from 9: 3: 3: 1;

Conclusions—suggested that some traits were linked

Morgan—used fruit flies to determine that linked traits are on the same chromosome

Conclusions—genes cross over during meiosis; chromosomes, not genes, assort independently;

Sturtevant's hypothesis—frequency of cross-overs during meiosis related to distance between genes; the greater the distance, the greater the frequency of cross-overs;

Sturtevant's experiments—studied linked traits in fruit flies; recorded the percentage of times crossing over occurred; used cross-over frequencies to make linkage maps,

Making a linkage map—cross-over frequency converted into map units; 1 percent cross-over equivalent to 1 map unit; by knowing all cross-over frequencies of genes of interest, the relative locations of the genes can be determined; not a map of physical distance between genes

Section 7.4

Sex-linked disorders in males—much more frequent than in females; no 2nd X chromosome to mask the one X chromosome present

Sex-linked disorders in females—only evident when both alleles are recessive; can be a carrier Pedigree—chart for tracing phenotypes and genotypes within a family

Tracing autosomal genes

- equal numbers of males and females
- people with recessive phenotype must be homozygous recessive
- people with dominant phenotype can be either homozygous dominant or heterozygous
- two heterozygotes can have offspring of either phenotype (dominant or recessive) or
- any genotype (homozygous dominant, heterozygous, or homozygous recessive)

Tracing sex-linked genes

- more males than females will exhibit a recessive phenotype; females can be carriers
- females with recessive phenotype have two recessive alleles; males with recessive phenotype have one
- heterozygous females do not show the recessive phenotype, but are carriers
- female carriers can pass on recessive allele to either male or female offspring
- males with recessive phenotype can pass the recessive allele only to female offspring

Karyotype—picture of all chromosomes in a cell

Karyotype shows—large-scale changes in chromosomes

Section 8.1

Griffith's experiments: Injected bacteria into mice and noted that the S type killed mice, but the R type did not. Killed the S bacteria with heat and injected them into mice. Did not kill the mice. Mixed heat-killed S bacteria with live R bacteria and injected them into mice. Killed the mice. Found live S bacteria.

Conclusion: A "transforming principle" was transferred from the heat-killed S bacteria to the R bacteria.

Avery's experiments: purified the transforming principle described in Griffith's experiments and conduced three tests; Qualitative tests that showed DNA was present; not protein Chemical analyses that showed that the proportion of elements matched the proportion of elements in DNA, not protein; Enzyme tests that showed that enzymes that destroyed proteins and RNA did not affect transforming principle. Enzymes that destroyed DNA destroyed the ability of transforming principle to function.

Conclusion: DNA is the transforming principle

Hershey and Chase's experiments: used bacteriophages grown in either radioactive sulfur (component of proteins) or radioactive phosphorus (component of DNA); bacteriophages are viruses that infect bacteria and take over the cell's genetic machinery to make more viruses

Experiment 1:

infected bacteria with bacteriophages grown in radioactive sulfur; separated bacteria from bacteriophages; found no significant radioactivity in the bacteria

Experiment 2:

infected bacteria with bacteriophages grown in radioactive phosphorus; separated bacteria from bacteriophages; found significant radioactivity inside the bacteria, which showed that DNA from the bacteriophages had entered the bacteria

Conclusion: DNA, not protein, is the genetic material.

Section 8.2

Overall shape: double helix

1. deoxyribose sugar

2. phosphate group

Nitrogen-containing bases:

Pyrimidines: thymine, cytosine

Purines: adenine, guanine

Base pairing rules: A pairs with T, C with G

1. H-bonds connect the nitrogen-containing bases in the middle

2. Covalent bonds connect the molecules in the backbone

Chargaff's rules: the amount of A = T and the amount of C = G

Section 8.3

General description: replication is the process by which DNA is copied during the cell cycle

1. enzymes unzip the double helix in two directions at the same time

2. nucleotides pair with the exposed bases on the template strands;

3. DNA polymerase bonds the new nucleotides together ;

4. Two molecules of DNA identical to the original molecule result; each molecule contains one original strand and one new strand

1. sugar-phosphate backbone

2. nitrogen-containing bases

3. nitrogen-containing bases

4. newly synthesized strand of DNA

Section 8.4

1. DNA

2. transcription

3. RNA

4. translation

5. proteins

DNA: deoxyribose sugar; A, C, T, G; double-stranded

RNA: ribose sugar; A, C, U, G; single-stranded

1. A transcription complex consisting of RNA polymerase and other proteins recognizes the start site of a gene and begins to unwind the DNA

2. RNA polymerase reads one side of the DNA template and strings together a complementary strand of RNA nucleotides

3. The growing RNA strand hangs freely as it is transcribed and detaches completely once the entire gene is transcribed

4. DNA molecule

5. nucleotides

6. newly synthesized RNA strand

7. RNA polymerase

1. messenger RNA (mRNA): intermediate message that is translated to form a protein

2. ribosomal RNA (rRNA): forms part of ribosomes

3. transfer RNA (tRNA): brings amino acids from the cytoplasm to a ribosome to help make the growing protein

Section 8.5

Reading frame: series of three nonoverlapping nucleotides read, in order, by a cell; three different reading frames are possible for each mRNA molecule; codons must be read in the correct reading frame for the correct protein to be made

Start codon: signals the start of translation and the amino acid methionine

Ribosome: the site of protein synthesis; made of rRNA and proteins; catalyzes the formation of peptide bonds between amino acids

Large subunit: binds to tRNA

Small subunit: binds to mRNA

Codon: three-nucleotide sequence that codes for an amino acid

Anticodon: three nucleotides on a tRNA molecule that bind to a complementary mRNA codon

Common language: the genetic code is shared by almost all organisms

Stop codon: three codons that signal the end of a chain of amino acids

Transfer RNA (tRNA): type of RNA that carries amino acids from the cytoplasm to the ribosome; one end has a specific anticodon, the other end attaches to a specific amino acid

1. amino acid

2. peptide bond;

3. large ribosomal subunit;

4. tRNA;

5. codons;

6. small ribosomal subunit;

7. mRNA;

8. anticodon

1. ribosome assembles at the start codon; complementary tRNA molecule pairs with the exposed codon

2. ribosome helps bond the new amino acid to the start codon and breaks the bond between the amino acid and the first tRNA

3. ribosome pulls them RNA strand the length of one codon; first tRNA returns to the cytoplasm; another codon is exposed for tRNA binding

Section 8.6

Promoter: aDNA segment that allows a gene to be transcribed; helps RNA polymerase find where a gene starts

Operon: a region of DNA that has promoter, an operator, and one or more genes that code for all the proteins needed to do a specific task; typically found in prokaryotes

***lac* operon:** one of the earliest operons discovered; includes three genes involved in the breakdown of the sugar lactose that are all under the control of a single promoter and operator

Without lactose: a repressor protein is bound to the operator and blocks RNA polymerase from transcribing the genes (off)

With lactose: the repressor protein is bound to lactose, which keeps it off the operator, so RNA polymerase transcribes the genes that, in turn, break down lactose (on)

Controlling transcription in eukaryotic cells: transcription is regulated at many points in eukaryotic cells; control of the start of transcription is still an important point of regulation; have unique combinations of regulatory DNA sequences that are recognized by transcription factors; some genes control the expression of other genes and play an important role in development

mRNA processing: occurs after transcription but before mRNA leaves the nucleus. Introns are removed and the exons are spliced together. Introns are intervening sequences of DNA. Exons are sequences of DNA that are expressed in the protein.

A cap is added that helps mRNA bind to a ribosome and prevents the strand from being broken down too quickly.

A tail is added that helps mRNA exit the nucleus.

Section 8.7

Gene mutations: mutations that affect a single gene

Point mutation: one nucleotide is substituted for another; may be fixed by DNA polymerase

Frameshift mutation: involves the insertion or deletion of a nucleotide in the DNA sequence; shifts the entire sequence by one or more nucleotides; throws off the reading frame

Chromosomal mutations: mutations that affect an entire chromosome; affects many genes

Gene duplication: caused by the exchange of unequal segments during crossing over; results in one chromosome having two copies of some genes and the other chromosome having no copies of those genes

Translocation: movement of a piece of one chromosome to a nonhomologous chromosome; are often reciprocal

Potential impact: Chromosomal mutations typically have a large effect on an organism; may result in a disrupted gene or abnormal regulation of genes

Point mutations may result in premature stop codons or amino acids with very different properties from the correct amino acid; may disrupt a splice site; may disrupt a regulatory DNA sequence

Frameshift mutations may result in a completely altered protein or a premature stop codon.

Silent: Some mutations have no apparent effect.

A point mutation may not change the amino acid that is coded for.

Even if a change occurs, the change may be in an intron that is removed and thus has no effect.

A change may not significantly affect the function of a protein if the new amino acid is similar to the correct one or occurs away from the active site or does not influence protein structure.

Mutagens: agents in the environment that can change DNA; some occur naturally (e.g., UV light); some are created by industrial processes

Section 9.1

Collected from—bacteria

Used for—cutting DNA

Cut DNA at—specific nucleotide sequences (restriction sites)

Can leave—blunt ends (straight cuts) or sticky ends (staggered cuts with free nucleotides)

1. Restriction sites

Gel electrophoresis—separates DNA fragments based on size; smaller fragments travel farther in a certain amount of time than larger fragments

Restriction maps—fragment sizes between restriction sites; do not show anything about genes or DNA sequence

Section 9.2

PCR—technique that quickly copies a desired segment of DNA

1. temperature increased to separate DNA

2. temperature lowered and primers bind to each strand, bracketing the desired segment of DNA

3. temperature increased; polymerases make new strands of DNA

PCR amplifies—every cycle doubles the number of strands of DNA

Section 9.3

DNA fingerprinting

Based on—noncoding regions of DNA; number of nucleotide repeats in particular parts of the genome; a person's molecular identity; a type of restriction map using gel electrophoresis

Person B—fragments at 2, 3, 4, 5

DNA fingerprints and probability—by investigating several parts of the genome, it is very unlikely that two people would randomly share identical numbers of repeats (multiplying each separate probability to find the total probability of a match)

Uses—criminal cases; immigration; paternity; studying biodiversity; identifying species; tracking GM crops

Section 9.4

Cloning in nature—binary fission, some plants; some simple animals

Mammals—nuclear transfer; low success rate; Dolly the sheep first clone of adult mammal

Potential and controversy —could be used in medical treatments; save endangered species; bring back extinct species; low success rate; decrease biodiversity

Genetic engineering—changing an organism's DNA to give the organism new traits

Recombinant DNA—DNA with genes from more than one organism; genes often inserted into bacterial plasmids

Transgenic bacteria—have plasmid with recombinant DNA; used to make human insulin

Transgenic plants—bacteria with recombinant DNA infect plants; used to make crops resistant to disease, insects, frost

Transgenic animals—gene must be inserted in fertilized egg; used for medical research and to study gene expression

Concerns—long-term effects of GM crops on human health, biodiversity; possible unintended consequences

Section 9.5

Gene sequencing—determining the sequence of a gene or an entire genome
Genomics—study of entire genomes; can include sequencing of entire genome; compare genomes within and across species to find similarities and differences among different organisms

Human Genome Project — sequenced entire human genome; still working on identifying all genes, finding their locations, and determining their functions

Bioinformatics—using computer databases to organize and analyze the vast amounts of data that result from studies of genetics (and other biological information)

DNA microarrays—allow scientists to study the expression of many genes at one time; used to compare gene expression in different types of cells

Proteomics—study and comparison of proteins within and across species; used to study evolutionary relationships and human diseases

Section 9.6

Genetic screening—the process of testing DNA to determine a person's risk of having or passing on a genetic disorder; can involve pedigree analysis

Detecting disorders—tests can detect genes that produce disorders such as cystic fibrosis

Detecting disease risk—tests for genes related to an increased risk of cancer, heart disease, etc.

Gene therapy—replacement of defective or missing gene, or adding a new gene, to treat a disease

Methods used

Viruses—genes can be inserted into viruses that are used to infect a person's cells; the desired gene is inserted into the cells by the virus

Immune system—genes inserted to stimulate a person's immune system to recognize and attack cancer cells

Suicide gene—gene inserted into cancer cells that will activate a chemical to kill the cells; normal cells without the gene are not affected

Technical challenges—inserting the gene into the correct cells; controlling gene expression; determining whether the new gene affects the expression of other genes

Section 10.1

Linnaeus: Developed a classification system for all types of organisms known at the time based upon their physical similarities.

Buffon: Proposed that species shared ancestors and suggested that Earth is much older than6000 years.

E. Darwin: Proposed that all organisms descended from a common ancestor, and that more-complex forms of life arose from less-complex forms.

Lamarck: Proposed that all organisms evolved toward perfection and complexity and that structures became larger or smaller with use or disuse.

catastrophism: Natural disasters such as floods and volcanic eruptions have shaped landforms and caused species to become extinct.

gradualism: Changes in landforms resulted from slow changes over a long period of time.

uniformitarianism: The geologic processes that shape Earth are uniform through time.

Section 10.2

Variation: The difference in the physical traits of an individual from those of other individuals in the group to which it belongs.

Tortoise

example: Saddle-backed tortoises, which have long necks and legs, live in areas with a lot of tall plants. Domed tortoises, with shorter necks and legs, live in wet areas with short plants.

Finch

example: Finches with strong, thick beaks live in areas with a lot of large, hard-shelled nuts, while finches with more delicate beaks are found where insects or fruits are widely available.

Finch adaptation: A feature that allows an organism to better survive in its environment.

Fossil evidence: Glyptodon, a giant extinct armadillo that resembled living armadillos. Also fossil shells of marine organisms high up in the mountains, showing great changes that occurred in the past.

Geologic evidence: Land that had been underwater was moved above sea level due to an earthquake, demonstrating that daily geologic processes can add up to a great change over a long period of time.

Section 10.3

Artificial selection: The process by which humans change a species by breeding it for certain traits.

Heritability : The ability of a trait to be passed down from one generation to the next.

Struggle for survival: Populations would grow geometrically if resources were unlimited. Instead, disease and a limited food supply keep the population smaller.

Natural selection: A mechanism by which individuals that have inherited beneficial adaptations produce more offspring on average than do other individuals.

Variation: The heritable differences that exist in every population are the basis for natural selection.

Overproduction: Having many offspring increases the chance of survival but also results in competition for resources.

Adaptation: A certain variation that allows an individual to survive better than other individuals it competes against.

Descent with modification: Heritability of adaptations. More individuals will have the trait in every following generation, as long as the environmental conditions remain beneficial for the trait.

Section 10.4

Fossils: More primitive fossils are found in lower rock layers.

Geography: Island species most closely resemble species on the nearest mainland, and populations can show variations from one island to the next.

Embryology: Crab and barnacle larvae look identical, but have very different adult body forms. Likewise, embryos of vertebrates such as fish, birds, reptiles, and mammals look very similar

Homologous structures: Features that are similar in structure but appear in different organisms and have different functions.

Vestigial structures: Remnants of organs or structures that had a function in an early ancestor

Analogous structures: Structures that perform a similar function, but are not similar in origin.

Section 10.5

DNA sequence analysis: The more related two organisms are, the more similar their DNA will be.

Pseudogenes: No longer function but are still carried along with functional DNA. Like vestigial structures, they provide evidence of a common ancestor.

Homeobox genes: control the development of specific structures. Indicate a very distant common ancestor.

Protein comparisons: Comparing proteins in cells, called molecular fingerprinting, can indicate a common ancestor.

Section 11.1

Genetic Variation

Why it's beneficial: Results in phenotypic variation which increases the likelihood that some individuals can survive a change in the environment.

How it's stored in a population: as alleles in a gene pool

How it's measured: with allele frequencies; how common each allele is in the population

Two main sources

Mutation: a change in a DNA sequence which can form a new allele

Recombination: new allele combinations can form during meiosis, when each parent's alleles are arranged in new ways in the production of gametes

Section 11.2

Normal distribution: distribution in which frequency is highest near the mean value and decreases steadily toward each extreme end of the range

A population follows a normal distribution when: that population is not under natural selection for the trait

Graph: Should resemble a bell-shaped curve; may label "mean" in center.

Microevolution: observable change in allele frequencies of a population over time

Directional selection: favors phenotypes at one extreme of a trait's range; graph should show normal distribution curve shifted over to the right or left;

Example: drug-resistance in bacterial populations

Stabilizing selection: favors intermediate phenotypes; graph should show narrower distribution with peak in the middle (at the mean phenotype);

Example: size of gall fly galls

Disruptive selection: favors phenotypes at both extremes of a trait's range; graph should show two peaks, one near each extreme phenotype, with low frequency in the middle (at the mean phenotype);

Example: body color in male lazuli buntings

Section 11.3

Gene Flow:

Definition: movement of alleles from one population to another

How it works: when animals move from one population to another and breed in the new population; when spores or seeds of plants or fungi are spread to new areas

Lots of gene flow results in: similar populations (genetically)

Limited gene flow results in: different populations (genetically) that could evolve into different species

Genetic Drift:

Definition: changes in allele frequencies due to chance alone

How it works: small populations are more likely to be affected by chance; due to chance some alleles may increase in frequency while others may decrease and even become eliminated from the population.

Bottleneck effect: genetic drift that occurs after an event drastically reduces the size of a population

Founder Effect:

genetic drift that occurs after a small number of individuals colonize a new area

Negative effects: population loses genetic variation, so population is less likely to have some individuals that will be able to adapt to a changing environment; harmful alleles may become more common due to chance alone

Sexual Selection:

Definition: process in which certain traits increase mating success and therefore become more common in the population

How it works: females preferentially mate with males that display certain traits, so those traits get passed on to offspring and can become more exaggerated each generation

Intrasexual: competition/fighting among males for females

Intersexual: males display certain traits to attract females

Section 11.4

Hardy-Weinberg Equilibrium: equilibrium state in which genotype frequencies in a population stay the same from generation to generation

Why it is important: comparing real data with that predicted by the equilibrium model; framework for testing factors that can lead to evolution

1. very large population

2. no emigration or immigration

3. no mutations

4. random mating

5. no natural selection

Hardy-Weinberg Equation: $p^2+2pq+q^2=1$

What it means: frequency of dominant homozygotes + frequency of heterozygotes

+ frequency of recessive homozygotes = 1 (or any reminder of meanings of variables or meaning of equation) How it's used: to predict genotype frequencies of populations in Hardy-Weinberg equilibrium for simple, dominant-recessive traits

1. genetic drift

2. gene flow

3. mutation

4. sexual selection

5. natural selection

Section 11.5

Reproductive isolation: occurs when members of different populations are no longer physically able to mate successfully with one another

Speciation: the rise of two or more species from one existing species

1. behavioral barriers/isolation: differences in courtship of mating behaviors prevents reproduction between populations

2. geographic barriers/isolation: physical barriers that divide a population into two or more groups

3. temporal barriers/isolation: timing of reproductive periods or courtship prevents reproduction between populations

Section 11.6

Convergent Evolution: evolution toward similar characteristics in unrelated species

Divergent Evolution: evolution toward different characteristics in closely related species

Coevolution: process in which species evolve in response to changes in each other

Beneficial Relationships: both species receive benefits from the other as a result of adaptations that each species has evolved over many generations

Evolutionary Arms Races: both species respond to competitive pressure from the other through adaptations over many generations

Extinction: elimination of a species from Earth

Background Extinction: occur randomly but at a very low rate; usually affect only a few species in a small area; can be caused by local changes in the environment

Mass Extinction: rare but very intense; can operate at global level and destroy many species; caused by catastrophic events such as ice age

Patterns in Speciation

Punctuated Equilibrium: episodes of speciation occur suddenly in geologic time and are followed by long periods of little evolutionary change.

Adaptive Radiation: diversification of one ancestral species into many descendent species, usually adapted to a wide range of environments

Section 12.1

Permineralization: when minerals in water are deposited around or replace the hard structure.

Natural casts: when flowing water removes all of the original bone or tissue, leaving just an impression that minerals then fill in.

Trace fossils: record the activity of an organism, including nests, burrows, and footprints.

Amber-preserved fossils: Organisms that become trapped in tree resin that hardens after the tree gets buried underground.

Preserved remains: when an entire organism becomes incased in material such as ice, ash, or immersed in a bog

Relative dating: estimates the time during which an organism lived by comparing the placement of fossil of that organism with the placement of fossils in other layers of rock.

Radiometric dating: technique that uses the natural decay rate of unstable isotopes found in materials in order to calculate the age of the material.

Isotopes: atoms of an element that have the same number of protons but a different number of neutrons. (Students should shade in 6 protons, 6 neutrons for carbon-12 and 6 protons, 8 neutrons for carbon-14).

Half-life: the amount of time it takes for half of an isotope in a sample to decay into a different element, its product isotope. (Students should draw in a descending line of graph from 100% isotope remaining to less than 6.25 remaining at end of graph. Points should intersect at each mark of the x and y-axes.)

Section 12.2

Index fossil

definition: Fossils of organisms that existed only during specific spans of time over large geographic areas.

characteristics: common, easy to identify, found widely around the world, only existed for a relatively brief time.

example: fusulinids, trilobites

nonexample: anything that is rare to find or that are only found in a certain region.

Geologic time scale

Representation of the history of Earth that is organized by major changes or events.

Eras: Last tens to hundreds of millions of years and consist of two or more periods.

Periods: Most commonly used units of time, lasting tens of millions of years.

Epochs: The smallest units of time, lasting several million years.

1. Cenozoic era: Evolution of primates, diversification of mammals, flowering plants.

Continues today.

2. Mesozoic era: Evolution and extinction of dinosaurs, evolution of ferns and cycads, and mammals.

3. Paleozoic era: All existing animal phyla developed, earliest land plants arose.

Section 12.3

Miller-Urey experiment: Demonstrated that organic compounds could be made by passing an electrical current, to simulate lightning, through a closed system that held a mixture of gases.

Meteorite hypothesis: Amino acids may have arrived on Earth through meteorite or asteroid impacts.

Iron-sulfide bubbles hypothesis: Biological molecules combined in compartments of chimney like structures on the ocean floor. The compartments acted as the first cell membranes.

Lipid membrane hypothesis: Lipid spheres, or liposomes, could form around a variety of organic molecules, acting as early cell membranes.

Ribozymes: RNA molecules that can catalyze specific chemical reactions. May have been the first genetic material of cells.

Section 12.4

Cyanobacteria: bacteria that can carry out photosynthesis; changed Earth by

1. depositing minerals in the form of stromatolites

2. producing oxygen as a by-product of photosynthesis

Endosymbiosis: A relationship in which one organism lives within the body of another, and both benefit from the relationship.

1. Early mitochondria and chloroplasts were once simple prokaryotic cells that were taken up by larger prokaryotes.

2. Instead of being digested, some of the larger prokaryotes may have survived inside the larger ones.

3. The smaller prokaryote could have given the larger cell energy or sugars, while the larger cell could have provided a stable environment and nutrients to the smaller cells. (Sketches should reflect a bacterium separate from a larger cell, the bacterium being taken in by a larger cell, and the bacterium completely within the larger cell.)

Section 12.5

Paleozoic

years: 544 million years ago—248 million years ago

major events: Multicellular organisms first appeared. Members of every major animal group evolved. A huge mass extinction occurred at the end of the era.

Cambrian explosion: the Cambrian period. A huge diversity of animal species evolved.

Mesozoic

years: 248 million years ago—65 million years ago.

known as: Age of Reptiles major events: mammals first appeared crocodiles and dinosaurs arose. A mass extinction occurred, and dinosaurs became extinct.

Cenozoic

years: 65 million years ago—present

major events: placental mammals and monotremes evolved and diversified, primates evolved.

Section 12.6

Primates: mammals with flexible hands and feet, forward-looking eyes, and enlarged brains relative to body size.

Prosimians: oldest living primate group. Mostly small and nocturnal.

Anthropoids: humanlike primates

Hominids: primates that walk upright, have long lower limbs, thumbs that oppose the other four fingers, and relatively large brains.

bipedal: can walk on two legs

1. New World monkeys

2. lesser apes

3. humans

Section 13.1

Levels of Organization,

L-R: organism, population, community, ecosystem, biome

Research methods, top to bottom, L-R: observation, experiment, modeling; direct, indirect, lab, field, mathematical, computer

Section 13.2

Ecosystem

top to bottom, L-R: biotic factor, abiotic factor; plant, animal, wind, sunlight, soil

Biodiversity is the assortment, or variety, of living things in an ecosystem

A keystone species is a species that has an unusually large effect on its ecosystem

Section 13.3

Producer and Consumer

by row:

producer/autotroph, get energy from nonliving resources;

consumer/heterotroph, get energy by eating other organisms

Processes by Which Producers Obtain Energy

Photosynthesis: sunlight as source of energy; green plants, cyanobacteria, some protists

Chemosynthesis: chemicals as source of energy; deep-sea organisms, hydrothermal pools, marsh flats

Both: producers make their own energy

Section 13.4

Types of Consumers

herbivore—eats only plants carnivore—eats only other animals;

omnivore—eats both plants and animals;

detritivore—eats dead organic matter

A food web shows the complex network of feeding relationships and flow of energy

Trophic Level:

Producer: phytoplankton, algae

Primary Consumer: zooplankton, shrimp, sea turtle, parrotfish

Secondary Consumer: sponge, jellyfish, triggerfish

Tertiary Consumer: Reef shark

Arrows point from phytoplankton to sea sponge, zooplankton, shrimp; zooplankton to sea sponge, jellyfish; algae: parrotfish, sea turtle; shrimp: jellyfish, triggerfish; triggerfish: reef shark; parrotfish: reef shark

Section 13.5

Boxes can be filled with words or sketches describing each cycle.

Oxygen cycle: oxygen needed for cellular respiration; respiration and photosynthesis are major components of the cycle

Carbon cycle: building block of life; respiration, decomposition, combustion, photosynthesis are major components of the cycle

Hydrologic cycle: pathway of water on Earth; condensation, precipitation, storage, evaporation, and transpiration

Nitrogen cycle: nitrogen fixation converts nitrogen into ammonia, which can be used by other organisms

Phosphorus cycle: phosphate released by the weathering of rocks, plants and fungi take phosphate in roots, phosphorus moves through food chain, returned to soil or water by decomposition

Section 13.6

Trophic level (top to bottom): tertiary consumer, secondary consumer, primary consumer, producer

Energy pyramid: diagram that compares energy used by producers, primary consumers, and other trophic levels

Two other pyramid models: Biomass pyramid measures dry mass at each trophic level; Pyramid of numbers measures the number of individuals at each trophic level

Section 14.1

Habitat: all the biotic and abiotic factors in the area where an organism lives

Ecological niche: all of the physical, chemical, and biological factors that a species needs to survive

Competitive exclusion is a principle that states when two species are competing for the same resources, one species will be better adapted to the niche, and the other will be pushed into another niche or go extinct

Two other results of competitive exclusion: niche partitioning, evolutionary response—divergent evolution

An ecological equivalent is species that occupy similar niches but live in different geographical regions

Section 14.2

Competition: two organisms fight for the same limited resources;

Symbiosis: close relationship between two or more different species that live in close contact;

Predation: one organism captures and eats another organism

Mutualism: both organisms benefit +/+;

Commensalism: one organism benefits, the other is unaffected +/0;

Parasitism: one organism benefits and the other is harmed +/-

Section 14.3

Population density is a measurement of the number of individuals living in a defined space

Formula: # of individuals/area (units^2) = population density

Population dispersion is the way in which individuals of a population are spread in an area or volume

Three dispersion types: clumped, uniform, random (with proper sketch above each label)

A survivorship curve is a generalized diagram of surviving members over time from a measured set of births

Graph should look like the one in Figure 14.8.

Three types of survivorship curves:

Type I: low infant mortality, population survives to old age; large mammals, including humans

Type II: survivorship rate equal at all ages over life span; birds, small mammals, reptiles

Type III: high birth rate, high infant mortality rate; invertebrates, fish, amphibians, plants

Section 14.4

Four factors that affect the size of a population: immigration, births, emigration, death

Exponential and Logistic growth graphs should be similar to those in Figure 14.9 and Figure 14.11

Density-dependent limiting factors: competition, predation, parasitism/disease

Density-independent limiting factors unusual weather, natural disasters, human activities

Section 14.5

Primary succession is the establishment and development of an ecosystem in an area that was previously uninhabited

Sketches should be similar to Figure 14.16; labels: 0-15 years, 15-80 years, 80-115 years, 115-200 years

Secondary succession is the reestablishment of a damaged ecosystem where the soil was left intact

Sketches should be similar to Figure 14.17; labels: 0-2 years, 2-18 years, 18-70 years, 70-100 years

Section 15.1

Earth systems

Biosphere: part of Earth where life exists; all of Earth's ecosystems

Hydrosphere: all of Earth's water, ice, and water vapor

Atmosphere: the air blanketing Earth's surface

Geosphere: continents, rocks, sea floor on Earth's surface, and everything below Earth's surface

Scientists who contributed to the Gaia Hypothesis: James Lovelock, Lynn Margulis

Gaia Hypothesis: Earth is a kind of living organism, in which the atmosphere, hydrosphere, and geosphere act together to yield a biosphere that can support life

Section 15.2

Climate is the long-term pattern of weather conditions in a region

Microclimate is the climate of a small specific place within a larger area

Climate Zones (top to bottom): polar, temperate, tropical, temperate, polar

Factors that influence climate: sunlight, air and water movement, landmasses

Section 15.3

Tropical rain forest: warm and rainy; biodiversity high

Tropical grassland: dry and rainy seasons; tall grasses, scattered trees and shrubs

Temperate grassland: dry and warm summer, snow in winter; short or tall grasses

Desert: very dry, arid climate; cacti have deep root systems or other adaptations

Temperate deciduous forest: hot in summer and cold in winter; broadleaf forest

Temperate rain forest: one long wet season, relatively dry summer; evergreen conifers

Taiga: long, cold winters, and short, warm, humid summers; coniferous trees

Tundra: subzero temperatures during long winter, little precipitation; permafrost, only mosses and other low-lying plants

Section 15.4

1. intertidal zone (organisms must tolerate a range of conditions)

2. neritic zone (few cm to 200 m, most ocean life lives in this zone)

3. bathyal zone (200–2000 m, turbid, murky water)

4. abyssal zone (depths greater than 2000 m, complete darkness)

Two unique coastal habitats: coral reef, kelp forest

Section 15.5

Estuary

Definition: partially enclosed body of water formed where river flows into an ocean

Description: mixture of salt and fresh water; highly productive ecosystem

Other facts: plankton-based food web, important for migratory birds, "nursery of the sea"

Threats: removal due to development means loss of coastal barrier; less protection from storms and floods

Lake Zones

Littoral—shoreline, located between low and high tide marks, waters are well-lit, warm, and shallow

Limnetic—open water zone, abundance of plankton supports communities of fish

Benthic—lake bottom, less sunlight reaches this zone, decomposers live here

Section 16.1

Graph should be similar to that shown in Figure 16.1.

Two technological advancements that have contributed to population growth: gas-powered farm equipment, antibiotics and antiseptics (medical advancements)

Types of resources

nonrenewable: used faster than it forms; oil, coal renewable: cannot be used up or can replenish itself; sunlight, wind, water

Ecological Footprint

Definition: amount of land necessary to produce and maintain enough food and water, shelter, energy, and waste

Size depends on: amount and efficiency of resource use and the amount and toxicity of waste produced

Section 16.2

Greenhouse effect occurs when carbon dioxide, water, and methane molecules absorb energy reradiated by Earth's surface and slow the release of energy from Earth's atmosphere

1. light emitted from the Sun penetrates Earth's atmosphere

2. energy is absorbed by Earth and reradiated as heat (infrared radiation)

3. greenhouse gases in atmosphere absorb longer wavelengths of infrared radiation

4. molecules re-release infrared radiation, which is reabsorbed or lost to outer space

Section 16.3

An indicator species is a species that provides a sign of the quality of the ecosystem's environmental conditions

Biomagnification is a process in which a pollutant moves up the food chain as predators eat prey, accumulating in higher concentrations

Trophic level (top to bottom): quaternary consumer, tertiary consumer, secondary consumer, primary consumer, producer

Section 16.4

Why biodiversity is important: decrease in an ecosystem's biodiversity affects all species; medical and technological advancements come from nature; loss of biodiversity can reduce an ecosystem's stability and make it more difficult for the ecosystem to handle future change

Threats to biodiversity

Habitat fragmentation: occurs when a barrier forms that prevents an organism from accessing its entire home range

Introduced species: any organism that was brought to an ecosystem as the result of human actions

Introduced species

Burmese python, Florida Everglades, feeds on native species, including endangered birds Kudzu, southeastern United States, blankets trees and shrubs, killing native plants Mice, Australia, feed on crops, causing millions of dollars of damage

Section 16.5

Sustainable development is a practice in which resources are used and managed in a way that meets current needs without hurting future generations

Sustainable practices in the fishing industry: rotation, fishing gear review, harvest reduction, fishing bans

An umbrella species is a species whose protection means a wide range of other species will also be protected

Three important environmental laws: Clean Air Act, Clean Water Act, Endangered Species Act

Ways in which humans can protect environment: control population growth; develop technology to produce more food and produce less waste; change practices and maintain ecosystems

Section 17.1

Taxonomy: science of naming and classifying organisms

Scientific Names

Binomial Nomenclature: standard that gives each species a two-part scientific name using Latin Words

Genus: first part of a scientific name; taxa that includes one or more physically similar species that are assumed to be closely related; upper-case and italicized

Species descriptor: second part of a scientific name; often refers to characteristic of species, scientist who first described it, or native location; lower-case and italicized

Advantages Over Common Names: unique name for each species (many species have more than one common name), scientists around the world recognize them (no matter what language they speak)

Linnaean Classification

How it's organized: seven levels, called taxa, that are arranged in a nested hierarchy (each level gets more and more specific and is included in the level above it)

1. Kingdom

2. Phylum

3. Class

4. Order

5. Family

6. Genus

7. Species

Limitations: doesn't account for physical similarities that arose through convergent evolution (physically similar species may not be closely related), does not account for molecular evidence (since this technology wasn't available at the time)

Section 17.2

1. evolutionary history for a group of species

2. cladograms

3. derived characters

4. living species, fossil record, molecular and genetic data

Clade: any group of species that has descended from a common ancestor

Derived character: traits that are shared to different degrees among species; useful for determining evolutionary relationships among a group of species

Node: each place where a branch of a cladogram splits off; represent most recent common ancestor shared by a clade

Section 17.3

Molecular Clocks:

theoretical clocks using mutation rates to measure evolutionary time

How they work: assume that mutations tend to accumulate at a constant rate for a group of related species; the longer two species are separated after diverging from a common ancestor, the more mutations will have accumulated

Linking molecular data with real time: can come from known timing of major geological event known to isolate certain species; can come from fossil evidence

mtDNA: DNA found only in mitochondria; mutation rate is about 10 times that of nuclear DNA, so useful for studying closely related species; passed down unshuffled only from the mother, so useful for tracing mutations through generations in a single species

rRNA: RNA that makes up ribosomes; conservative regions that accumulate mutations slowly, useful for studying distantly related species

Section 17.4

2 Kingdoms: Animalia, Plantae

3 Kingdoms: Animalia, Plantae, Protista

4 Kingdoms: Animalia, Plantae, Protista, Monera

5 Kingdoms: Animalia, Plantae, Protista, Monera, Fungi

6 Kingdoms: Animalia, Plantae, Protista, Fungi, Bacteria, Archaea

1. domains

2. Bacteria/Archaea

3. Bacteria/Archaea

4. Archaea/Bacteria

5. Archaea/Bacteria

6. Eukarya

7. Animalia, Plantae, Fungi, Protista (in no particular order)

Section 18.1

Virus: an infectious particle made only of a strand of DNA or RNA surrounded by a protein coat. *size range:* 50–200 nm

Viroid: an infectious particle that causes disease in plants. Made of a single-stranded RNA without a protein coat. *size range:* 5–150 nm

Prion: an infectious particle made only of proteins that can cause other proteins to fold incorrectly. *size range:* 2–10 nm

Section 18.2

Enveloped virus:

example: influenza *sketch:* Sketch should show envelope and should be labeled.

Helical virus

example: rabies *sketch:* Sketch should be helical in shape and should be labeled.

Polyhedral virus

example: foot-and-mouth *sketch:* Sketch should be many-sided and should be labeled.

1. DNA

2. capsid

3. tail sheath

4. tail fiber

Lytic cycle

Event 2: the viral DNA forms a circle

Event 3: the viral DNA directs the host cell to produce new viral parts that assemble into new bacteriophages.

Event 4: the host bacterium breaks apart and bacteriophages are able to infect new host cells.

Final outcome: The virus destroys the host cells.

Lysogenic cycle

Event 2: the viral DNA forms a prophage by combining with the host cell's DNA

Event 3: the prophage replicates along with the host cell's DNA

Event 4: many cell divisions produce a colony of cells infected with the virus

Final outcome: The prophage may leave the host's DNA and enter the lytic cycle or may continue to incubate in the host's cells.

Section 18.3

1. Common cold: More than 200 viruses cause this illness. Can mutate from one person to another.

2. Influenza: Spreads quickly and causes local epidemics. New vaccines are developed each year.

3. SARS: Viral respiratory disease that appeared in late 2002.

4. HIV: Retrovirus that destroys white blood cells of the host's immune system and eventually causes AIDS.

Vaccine

Definition: substance that stimulates the body's own immune response against invasion by microbes.

Characteristics: made from the same pathogen that it is supposed to protect against. Made of weakened versions of the virus, or parts of the virus, that will cause the body to produce a response.

Examples of diseases that have vaccines: chickenpox, hepatitis A, mumps, rabies, and influenza

Examples of diseases that do not have vaccines: common cold, SARS, HIV, West Nile

Section 18.4

obligate anaerobe: cannot live in the presence of oxygen

facultative aerobe: can survive whether oxygen is present or not

obligate aerobe: needs oxygen to survive

Structural Characteristics

Bacteria: 3 common forms: rod, spiral, and spherical; flagella structurally different from archaea;

Archaea: many shapes; flagella structurally different from bacteria

Molecular Characteristics

Bacteria: cell walls have a polymer called peptidoglycan;

Archaea: cell membranes contain lipids found in no other organism

1. plasmid

2. cell wall

3. cell membrane

4. chromosome

5. pili

6. flagellum

Section 18.5

Provide nutrients: Within animal bodies, prokaryotes break down food and make vitamins and other compounds. They also ferment foods that humans eat, such as yogurt and cheeses.

Benefit ecosystems: Produce oxygen through photosynthesis, and help recycle carbon, nitrogen, hydrogen, and sulfur through the ecosystem.

Fix nitrogen: Convert atmospheric nitrogen into ammonia and other nitrogen compounds that plants can then use. Supply usable nitrogen to ecosystems.

Bioremediation: Break down pollutants, such as oil, into nontoxic or less-toxic compounds.

Section 18.6

1. Tuberculosis: *Mycobacterium tuberculosis* bacteria multiply in the lungs, killing white blood cells. The host responds to the infection by releasing enzymes that cause swelling, which damages the host's lungs.

2. Staph poisoning: *Staphylococcus aureus* can be transferred to food when food handlers don't wash their hands after they blow their nose. Foods can be contaminated with staph after they have been cooked, and will multiply if the food is not refrigerated.

3. Botulism: This illness is caused by the eating of improperly canned foods that were contaminated with endospores of *Clostridium botulinum* before being sealed.

4. Flesh eating infection: caused by *Streptococci* bacteria colonizing tissues they do not usually encounter through a cut, scrape, or surgical incision.

Cause

Overuse: Using antibiotics when bacteria are not causing an illness may create an environment that may make some bacteria resistant to antibiotics through exposure.

Underuse: Failure to take the entire course of antibiotics may just kill the weak bacteria and allow the stronger bacteria the exposure that will make them resistant to future antibiotics.

Misuse: Using antibiotics for reasons other than bacterial illness can create resistant bacteria.

1. A bacterium carries genes for antibiotic resistance on a plasmid.

2. A copy of the plasmid is transferred through conjugation.

3. Resistance is quickly spread through many bacteria.

Section 19.1

Animal-like protists: single-celled protists that consume other organisms.

Plantlike protists: can be single-celled, colonial, or multicellular protists. They make food by photosynthesis but do not have roots, stems, or leaves.

Fungus like protists: Decomposers that can move during part of their life cycle.

Protists are difficult to classify.

Details: Kingdom Protista includes many phyla that are very different from one another, and most are only distantly related.

Conclusion: Kingdom Protista will likely be broken up into multiple kingdoms in the future.

Section 19.2

Protists with flagella: Zooflagellates are animal-like protists that have one or more flagella at some point in their life cycle. More than 2000 species of zooflagellates exist.

Protists with pseudopods: Amoebas and Foraminifera use pseudopods to move and feed. A pseudopod means "fake foot, " and is a temporary extension of cytoplasm and plasma membrane.

Protists with cilia: Paramecia are protists with cilia. Cilia are short, hair like structures that cover some or the entire cell surface and help the organism swim and capture food. They are shorter and more numerous than flagella.

1. food vacuole

2. macronucleus

3. micronucleus

4. oral groove

5. cilia

6. contractile vacuole

1. *Malaria:* caused from infection by the sporozoan *Plasmodium*, which is passed to humans and other animals through the bite of a mosquito. Symptoms include high fever and vomiting, and can lead to death.

2. *Sleeping sickness:* caused from infection by the zooflagellate *Trypanosoma*, which is transmitted by the bite of the tsetse fly, and can cause coma and death.

3. *Intestinal disease:* can be caused by infection by the zooflagellate *Giardia*. People can become infected by drinking water contaminated with feces of infected animals.

Section 19.3

Euglenoids: single-celled organisms with one or two flagella. Both animal-like and plantlike. Can move easily with a pellicle covering their cell surface. Many are photosynthetic, although some also eat other organisms.

Dinoflagellates: single-celled marine plankton that have two flagella. One flagellum wraps around the organism, the other extends from the rear of the cell. Some species cause red tide when they occur in large numbers.

Diatoms: single-celled organisms covered with delicately patterned glasslike shells. Photosynthetic, and may be freshwater or marine.

Green algae: Most are aquatic, are photosynthetic, and have chlorophyll a and b and cell walls made of cellulose, like plants. However they do not have roots, stems, or leaves.

Brown algae: Include the giant kelps. Multicellular, marine organisms. Photosynthetic, but use chlorophyll c, as do the single-celled diatoms.

Red algae: Most are marine, use chlorophyll a for photosynthesis, but pigment phycoerythrin gives them a red color. Can grow at deeper depths because red pigments allow the algae to absorb the blue light that reaches deepest into the ocean.

1. pellicle

2. nucleus

3. chloroplast

4. contractile vacuole

5. eyespot

6. flagellum

Students may sketch or describe the life cycle of Chlamydomonas.

Sexual Reproduction

Sexual reproduction is triggered by stress such as lack of moisture or food. Cells divide by mitosis to produce gametes. When the gametes come together, they join and form a diploid zygote. The zygote may develop into a zygospore by making a thick wall that can protect it during unfavorable conditions. When favorable conditions return, meiosis occurs, producing four haploid cells.

Asexual Reproduction

Parent alga absorbs its flagella and then divides by mitosis, producing up to eight cells. The daughter cells, called zoospores, develop flagella and cell walls. They leave the parent and grow into mature cells.

Section 19.4

Slime molds: eukaryotic organisms that have both fungus like and animal-like traits. Decomposers that can move.

Plasmodial slime molds: for most of their life, they live as a single mass of cytoplasm that is actually a large single cell with many nuclei, called a plasmodium. When food or moisture is in short supply, they produce spores.

Cellular slime molds: Can be in the form of an amoeba-like cell, or may form a slug like body, called a pseudoplasmodium, made of many cells that moves as though it were one organism.

Water molds: fungus like protists that are made up of branching strands of cells and are common in freshwater habitats. Decomposers, and can be parasites of plants or fish.

Downy mildew

***Phytophthora infestans*:** causes a disease called potato blight. An outbreak of this disease in Ireland caused the Great Potato Famine in the 1800s.

Section 19.5

Plants: contain chlorophyll and photosynthesize, have true roots, leaves, and stems, have cell walls made of cellulose.

Both: Are non-moving, grow underground as well as aboveground, may produce spores.

Fungi: Fungi absorb food from their environment, have cell walls made of chitin.

1. Details: Includes yeasts, *Penicillium*, morels, and truffles. Form a sac that contains spores for reproduction.

2. Reproductive feature: Asci

3. Details: Range from molds on spoiled foods to fungi used to ferment certain foods. The fungi involved in mycorrhizae are bread molds.

4. Reproductive feature: zygospore.

5. Details: Fruiting bodies are club-shaped. Includes mushrooms, puffballs, and bracket, or shelf fungi.

6. Reproductive feature: basidia

Section 19.6

Fungi are decomposers:

They decompose dead and decaying organic matter such as leaves, twigs, and logs, and return nutrients such as carbon, nitrogen, and minerals back into the soil. Because of the large surface area of their mycelia, fungi are well adapted for absorbing their food and can recycle nutrients quickly.

Fungi as pathogens:

A few fungi always cause disease. Others are normally harmless but cause disease when a change in the host's homeostasis provides them an opportunity to grow unchecked and cause infection.

of humans:

Overuse and incorrect use of antibiotics can kill off beneficial bacteria and allow fungi to grow unchecked. Some fungal diseases include ringworm, athlete's foot, and some lung diseases.

of plants:

Dutch elm disease, peach scab, and gray mold are diseases that fungi inflict upon plants. Some crops have been genetically engineered to resist fungi.

Fungi as mutualists:

Some fungi join other organisms in forming a symbiotic relationship in which both organisms benefit.

as lichens:

A lichen is a mutualistic relationship between a fungus and algae or photosynthetic bacteria. The algae carry out photosynthesis, making sugars that feed the lichen. The fungi form the lichen body and protect the algae.

as mycorrhizae:

Mycorrhizae are mutualistic associations between plant roots and soil fungi. The mycelium of the fungus can absorb soil nutrients and water faster than the plant's roots could alone. The fungus benefits because it gets sugars and other nutrients from the plant.

1. Many species are edible and they can be used to make citric acid for soft drinks and candy.

2. They are used in the health care industry to make medicines such as antibiotics.

3. As eukaryotes, they have proteins and genes similar to plants and animals, and thus make good model systems for research.

Section 20.1

Characteristics that Plants and Green Algae Share: photosynthetic, eukaryotic, same types of chlorophyll, starch as storage product, cell walls with cellulose

Common Ancestor of All Plants: extinct species of charophycean (a green algae)

Challenges/Adaptations

not drying out/cuticle and stomata transporting resources/vascular system growing upright/lignin reproducing on dry land/pollen and seeds

Plants Evolve With Other Organisms

Mutualisms: Both organisms benefit. Examples: certain fungi and bacteria that coexist with plant roots, flowering plants and their animal pollinators

Plant-Herbivore Interactions: Many plants have adaptations to prevent animals from eating them. Examples: thorns, defensive chemicals

Section 20.2

Seedless Nonvascular Plants: must grow close to the ground to absorb water and nutrients directly, rely on free-standing water to reproduce; Hepatophyta (liverworts), Anthocerophyta (hornworts), Bryophyta (mosses)

Seedless Vascular Plants: depend on water for reproduction but a vascular system allows them to grow up off the ground; Lycophyta (club mosses), Pterophyta (ferns and their relatives—whisk ferns and horsetails)

Cone-bearing Seed Plants: gymnosperms—seed plant whose seeds are not enclosed in fruit; Cycadophyta (cycads), Ginkgophyta (ginkgoes), Coniferophyta (conifers)

Flowering Seed Plants: angiosperms—seed plant whose seeds are enclosed in fruit; Anthophyta (flowering plants)

Section 20.3

Adaptations

Flowers: can allow for efficient pollination by attracting animal pollinators

Fruit: can allow for more efficient seed dispersal

Classification by Botanists

Based on the number of: cotyledons (seed leaves)

Monocots: plant species with one cotyledon in their seeds; parallel leaf veins, flower parts in 3s, scattered vascular bundles

Dicots: plant species with two cotyledons in their seeds; netlike leaf veins, flower partsin4sor5s, ringed vascular bundles

Other Ways to Categorize Flowering Plants

Stem Type: woody (containing wood – a material made up of dead cells high in lignin and cellulose) or herbaceous (not containing wood)

Lifespan: annual – matures from seed, flowers, and dies in same year; biennial – takes 2 years to complete life cycle; perennial – lives for more than 2 years

Section 20.4

Ethnobotany: explores how people in different cultures use plants

Agriculture: requires people to stay in one place so it gave rise to more socially complex centers of human populations; farmers have "tamed" wild species such as corn and rice through artificial selection

Economic Resources: have been traded for thousands of years, still important today in global trade; paper, textiles, and lumber all contribute to our economy

Modern Medicine and Pharmacology: study of drugs and their effects on the body is pharmacology; many medicines used today are derived from plants or are synthetic but based on the chemical structures of plant compounds

Section 21.1

Parenchyma cell: Most common type of plant cell, stores starch, oils, and water for the plant. Found throughout the plant. Have the ability to divide throughout their lives. (Sketch should show thin cell walls.)

Collenchyma cell: Has cell walls that range from thin to thick, providing support while still allowing the plant to grow. Often form into strands. Flexible, and can change size. (Sketch should show cell walls that range from thin to thick.)

Sclerenchyma cell: Strongest of the basic plant cell types. Have a second cell wall hardened by lignin, making cells very tough and rigid. Die when they reach maturity, leaving behind skeletal support for the plant. (Sketch should show thick cell walls.)

Dermal tissue: Covers the outside of a plant. Made of live parenchyma cells in nonwoody plants, and may be covered by a waxy cuticle. Made of dead parenchyma cells as outer bark of woody plants.

Ground tissue: Makes up much of the inside of a plant. Provides support and stores materials in roots and stems. Packed with chloroplasts in leaves.

Vascular tissue: Transport water, mineral nutrients, and organic compounds to all parts of the plant. Makes up xylem and phloem.

Section 21.2

Cohesion: The tendency of hydrogen bonds to form between water molecules. (Sketch should show hydrogen bonds between water molecules.)

Adhesion: The force made by hydrogen bonds forming between water molecules and other substances. (Sketch should show hydrogen bonds forming between water molecules and wall of xylem or other container.)

Cohesion-Tension Theory

Students may sketch or describe the processes of the cohesion-tension theory.

Roots: Water and dissolved minerals are absorbed into the roots.

Xylem: Cohesion and adhesion create tension within the water molecules in the xylem.

Transpiration: Water evaporates through leaf stomata. Major force moving water through plants.

Pressure-flow model

Students may sketch or describe the processes of the pressure-flow model.

Source: Sugars move from their source, such as photosynthesizing leaves, into the phloem.

Phloem: Water moves from the xylem into the phloem by osmosis, due to the higher concentration of sugars in the phloem. The water flow helps move sugars through the phloem.

Sink: the sugars move into the sink, such as a root or fruit, where they are stored.

Section 21.3

Functions of roots: Roots anchor plants and absorb mineral nutrients and water from soil.

1. vascular cylinder

2. apical meristem

3. root cap

Students may sketch or describe types of roots.

Fibrous root: Root system of growth of fine branches where most of the roots are the same size.

Taproot: Root system that has one long, vertical root with smaller branches, allowing plants to get water from deep in the ground.

Function of Stems: Stems support plants, transport materials, and provide storage.

Cactus: photosynthesizes and stores water

Potato or ginger: grow underground

Strawberry: form new plants by runners or stolons

Students may sketch or describe primary growth and secondary growth.

Primary growth: Takes place in apical meristems found at the ends of stems and shoots. Makes stems grow taller or roots grow longer.

Secondary growth: Adds to the width in the stems and roots of woody plants.

Tree rings: Caused by secondary growth. Tree rings form due to the uneven growth over the seasons. One light band (spring wood) and one dark band (summer wood) make up one annual ring. Can be used to determine the age of the tree or past climatic conditions.

Section 21.4

Students may sketch or describe parts of a leaf:

Blade: usually broad and flat, and collects the sunlight for the plant.

Petiole: a thin stalk that connects the blade to the stem of a plant.

Students may sketch or describe the function of guard cells:

Open stoma: allows carbon dioxide necessary for photosynthesis to enter. Open due to potassium ions from neighboring cells accumulating in the guard cells, causing water to also enter the guard cells. Water evaporates from the leaves.

Closed stoma: When the plant is losing water from leaves faster than it is gaining water at its roots, the guard cells deflate and close their stomata. With the stomata closed, the plant may run low on carbon dioxide and slow or stop photosynthesis. The stomata also close at night.

Students may sketch or describe leaf characteristics:

Leaf type: simple leaf, compound leaves, double compound leaves

Leaf veins: parallel veins, pinnate veins

Leaf margin: toothed margin, entire margin, and lobed margin

1. cuticle

2. upper epidermis

3. palisade mesophyll

4. spongy mesophyll

5. lower epidermis

6. stomata

7. xylem

8. phloem

Section 22.1

The basic plant life cycle is called: alternation of generations

1. zygote

2. mature sporophyte

3. meiosis

4. spores

5. mature gametophyte

6. gametes (egg cells and sperm)

7. fertilization

Moss: Sporophyte: stalk with tiny cup at tip in which spores are produced; Gametophyte: familiar, carpet like plant which produces gametes in special reproductive structures

Fern: Sporophyte: familiar, leafy plant with clusters of spore-holding sacs on underside of leaves; Gametophyte: plant body the size of a little fingernail which produces gametes in special reproductive structures

Conifer: Sporophyte: familiar pine tree which produces male and female spores in male and female pine cones; Gametophyte: male gametophytes are pollen grains from which sperm are formed, female gametophytes are microscopic and produce eggs

Section 22.2

1. sepal (modified leaf that protects developing flower bud)

2. petal (modified leaf that can protect reproductive organs, can attract pollinators)

3. stamen (male reproductive structure)

4. filament

5. anther

6. carpel (female reproductive structure)

7. stigma

8. style

9. ovary

Production of gametophytes

Male: male spore divides by mitosis to produce a pollen grain of 2 haploid cells with a thick wall surrounding them;

Female: female spore divides by mitosis 3 times, resulting in 8 nuclei; membranes grow between them forming the 7-celled female gametophyte

Pollination: pollen grain lands on stigma

Double Fertilization: Two sperm from pollen grain travel down pollen tube into ovule; one sperm fertilizes the egg and the other unites with the polar nuclei to form endosperm

Seeds and Fruit: ovule develops into seed (containing embryo and endosperm) and surrounding ovary develops into fruit

Section 22.3

1. animals

2. wind

3. water

4. dormancy

5. allows seedlings to begin to grow under favorable environmental conditions

6. germination

7. an embryo breaks out of its seed coat and begins to grow into a seedling

Germination

Embryo takes up water: seed swells and cracks seed coat open

Embryonic root: first to break through seed coat; called a radicle

Water activates enzymes: which breaks down endosperm into sugars

Embryonic shoot: eventually breaks through soil surface; called a plumule

Leaves: when first leaves emerge and photosynthesis begins, plant is a seedling

Section 22.4

Asexual Reproduction: production of offspring through mitosis; offspring are genetically identical to the single parent

Benefits: allows well-adapted individuals to make many copies of themselves

Regeneration: asexual reproduction in which a new individual grows from a fragment of a stem, leaf, or root

Vegetative Reproduction: asexual reproduction in which stems, leaves, or roots attached to the parent plant produce new individuals

Stolons: stems that grow horizontally along the ground that produce roots and leaves at certain points (strawberries)

Rhizomes: stems that grow horizontally underground that produce new plants/buds at certain points (irises)

Tubers: underground stem modified for storage that can produce new plants from buds (potatoes)

Bulbs: underground stem surrounded by modified leaves adapted for storage that can divide to produce new plants (tulips)

Vegetative Propagation: process in which humans make use of plants' ability to reproduce asexually to grow plants with desirable qualities

Cuttings: a fragment cut from a leaf or stem may be put in soil or water to grow a new individual (African violets)

Grafting: joining vegetative structures from two or more plants together to produce plant with several desirable traits (frost tolerance, disease resistance, etc.)

Section 22.5

Plant Hormones

chemical messenger produced in one part of a plant that stimulates or suppresses the activity of cells in another part

Gibberellins: produce dramatic increases in size—starting germination, rapid growth of young seedlings and some flower stalks

Ethylene: causes ripening of fruit

Cytokinins: stimulate cytokinesis (final stage of cell division); involved in lateral growth (growth of side branches)

Auxins: involved in lengthening of cells produced in apical meristem (growing tip); controls some forms of tropism

Phototropism: plant response to light; plant cells on shaded side of stem lengthen and plant "bends" toward light

Thigmotropism: plant response to touch; tendrils of vines grow in coils around anything they touch

Gravitropism: plant response to gravity; in a germinating seed, roots grow downward into soil and shoot grows upward toward soil surface

Rapid Response: quick responses that do not involve growth; leaves of some species can fold quickly to deter predators or capture insects for a meal

Photoperiodism: plant response to changing lengths of day and night; shorter days in fall trigger leaves of many trees to change color and fall off in preparation for winter dormancy

Section 23.1

Multicellular heterotrophs: all animals are heterotrophs, meaning they eat other organisms to gain the nutrients they need to survive

Collagen: animal cells are supported by collagen; skin, bone, ligaments, fingernails, and hair are all composed of collagen

Diploid/sexual reproduction: diploid means that offspring have one set of chromosomes from each parent

Hox genes: most animals have *Hox* genes, which define the head-to-tail developmental pattern in animal embryos

Section 23.2

1. No tissue

2. Tissue: groups of cells that work together

3. Radial: body parts arranged in a circle around a central axis

4. Bilateral: body divided equally by one plane

5. Protostome: first opening of the digestive cavity forms into the mouth

6. Deuterostome: first opening of the digestive cavity forms into the anus

Section 23.3

Specialized cells of a sponge: pinacocytes, choanocytes, amoebocytes

Three types of cells that compose a cnidarian's body: contracting cells, nerve cells, cnidocytes

Cnidarian classes

Anthozoa: sea anemones and corals; polyp form dominant

Hydrozoa: fire corals, Portuguese man-of-war, hydra; alternate between polyp and medusa

Scyphozoa: jellyfish; medusa form dominant

Cubozoa: tropical box jellyfish, sea wasps; medusa form dominant

Section 23.4

Flatworm: planarians, flukes, tapeworms; solid body, incomplete gut

Mollusk: gastropods, pelecypods, cephalopods; radula, mantle, ctenidia

Annelid: earthworms, marine worms, leeches; segmentation, coelom

Section 23.5

Roundworm characteristics

type of development: protostome

symmetry: bilateral

exoskeleton: made of cuticle

type of coelom: pseudocoelom

reproduction: sexual

Roundworm parasites

hookworms: found within digestive tract of host; feeds on blood

pinworms: found in gut of host

Guinea worms: found in guts and connective tissues of host

Section 23.6

Echinoderm characteristics

Symmetry: bilateral as larvae, radial as adults

Internal skeleton: made up of many tiny interlocking calcium-based plates called ossicles

Water vascular system: a series of water-filled radial canals that extend along each arm from the ring canal surrounding the central disk; involved in movement and circulation

Digestive system: complete

Reproduction: most reproduce sexually

Five classes: feather stars and sea lilies; sea stars; brittle stars and basket stars; sea urchins, sea biscuits, sand dollars; sea cucumbers

Section 24.1

Trilobites: now extinct, 4000 species, bottom feeders

Crustaceans: live in ocean, freshwater streams, or on land

Chelicerates: specialized dagger-like mouthparts

Insects: most terrestrial, have six legs

Myriapods: centipedes and millipedes, long bodies, many pairs of legs

Arthropod characteristics:

exoskeleton, appendages, segmentation

1. new layer of cuticle secreted beneath exoskeleton

2. enzymes digest old cuticle, animal exits it

3. exoskeleton filled with fluid, takes time to harden

Section 24.2

1. abdomen

2. cephalothorax

3. carapace

4. antenna

5. swimmerets

6. walking legs

7. cheliped

Types of Crustaceans

Decapods: five pairs of jointed appendages, fused body segments that contain cephalothorax and abdomen; lobster

Barnacles: sessile filter feeders; barnacle

Isopods: flattened bodies and seven pairs of legs; pill bugs

Tongue worms: parasites that have no eyes, mandibles, or antennae; tongue worm

Section 24.3

Chelicerate groups: horseshoe crab, sea spider, arachnid

Adaptations shared by arachnids: waterproof cuticle, book lung, Malpighian tubules, spiracles

Types of arachnids: spider, mite, tick, chigger, scorpion

1. cephalothorax

2. abdomen

3. eyes

4. brain

5. poison gland

6. heart

7. spinnerets

8. book lung

Section 24.4

Three Body Parts of an Insect: head, thorax, abdomen

Incomplete Metamorphosis: larva, nymph, adult

Complete Metamorphosis: larva—pupa—adult—eggs

Section 24.5

Disease Transmission by a Vector: *(L–R)* tick feeds on host's blood, obtains pathogens; pathogens live inside tick, tick unaffected; tick feeds on another host, transmits pathogens

Human Diseases Spread by Arthropods

Bubonic plague; flea; Black Death of 1300s and 1600s

Yellow fever; mosquito; fever and bleeding *Malaria*; mosquito; eliminated by DDT, still common in tropical regions

West Nile virus; mosquito; fever, headache, skin rashes

Section 25.1

1. Vertebrae: segmented backbone

2. Jaws: helped vertebrates become predators

3. Four limbs: allowed vertebrates to move from the water to life on land

4. Amnion: encloses embryo during development

5. Feathers: insulates bird from cold, allows for flight

6. Hair: helps maintain constant body temperature

Section 25.2

Gills are large sheets of thin, frilly tissue filled with capillaries that take in dissolved oxygen from the water and release carbon dioxide

Countercurrent Flow

Top arrow: water flow Middle arrow: oxygen exchange Bottom arrow: blood flow

Cartilaginous fish

Holocephali: deep-sea fish, feed on crustaceans and invertebrates; ratfish

Elasmobranch: greater than 300 species of sharks, 400 species of rays and skates, sharks, rays and skates

Lateral line system is a series of shallow canals on the sides of the fish made up of cells that are sensitive to small changes in water movement

Section 25.3

1. spiny dorsal fin

2. swim bladder

3. soft dorsal fin

4. heart

5. liver

6. pelvic fin

7. stomach

8. intestine

9. anal fin

10. caudal fin

Ray-fin: fan-shaped array of bones; goldfish or tuna

Lobe fin: paired pectoral and pelvic fins that are round in shape; coelacanth, lungfish

Section 25.4

1. lung

2. kidney

3. intestine

4. esophagus

5. bladder

6. heart

7. liver

8. pancreas

9. stomach

Salamander: over 300 species, long body, four walking limbs, tail

Frogs: over 3000 species, include both frogs and toads

Caecilian: 160 species, legless burrowers

Section 25.5

An amniote is: a vertebrate that has a thin, tough, membranous sac that encloses the embryo or fetus

Set of Characteristics:

keratin: waterproofs skin cells, creates water repellent layer larger kidney and intestine: tissues reabsorb water, so they lose less to excretion

An amniotic egg is: an almost completely waterproof container that keeps the embryo from drying out as it develops

A placenta is: a membranous organ that develops in female mammals during pregnancy; it lines the uterine wall and partially envelops the fetus during development

Section 26.1

1. embryo

2. amnion

3. chorion

4. yolk sac

5. allantois

Two circuits of blood vessels: pulmonary circuit, systemic circuit

An ectotherm is an organism whose body temperature is determined by its surrounding environment

An endotherm is an organism that uses its own metabolic heat to keep its tissues warm

Section 26.2

Reptiles are ectotherms that are covered with dry scales or plates and reproduce by laying amniotic eggs covered with a tough outer shell

Reptile Egg Development

oviparous: deposit eggs into external nest

viviparous: hold the eggs inside the body through the duration of development and give birth to live offspring

Four Groups of Modern Reptiles:

turtles: 200 species, bony shell encases body

sphenodonts: two species live in New Zealand

snakes and lizards: shed skin at regular intervals

crocodilians: 23 species, semiaquatic predators

Section 26.3

Two Hypotheses for the Origin of Flight

Trees-down: birds evolved from animals that used feathers to glide down from trees to the forest floor

Ground-up: birds evolved from running animals that used feathered arms for balance

Bird Adaptations for Flight

Wings: bird wings are curved, similar in shape to airplane wing (airfoil)

Muscles: chest muscles provide power for flight; chest muscles attached at the breastbone (sternum)

Bone structure: hollow, struts and support structure reduces weight without compromising strength

Metabolism: active metabolisms, air sacs store air as bird breathes

Reproductive adaptations: active only during mating season, shrink outside of the mating season, reducing the bird's mass

Section 26.4

Mammals are active, large-brained, endothermic animals with complex social, feeding, and reproductive behaviors

Mammal Adaptations

Hair: layer of hair helps mammals retain heat

Mammary glands: specialized glands that produce milk

Middle ear: three small bones in ear, enables mammals to detect small vibrations, letting them hear higher pitched sounds

Chewing jaw: chewing jaw enables mammal to break up food as soon as it enters the mouth

Three Main Groups of Mammals

monotreme: lay eggs; platypus

marsupial: give birth to immature, underdeveloped live young that mature in mother's pouch; kangaroo, koala

eutherian: give birth to live young that completed fetal development; human, badger

Section 27.1

A stimulus is a type of information that has the potential to make an organism change its behavior

Two Movement-Related Behaviors

kinesis—sketch should show random movement between points

taxis—sketch should show direct movement from A to B

A circadian rhythm is the daily cycle of activity that occurs over a 24-hour period of time

The biological clock is an internal mechanism that controls an organism's activity patterns

Two Examples of Cyclical Behaviors:

Hibernation: behavior in which an animal avoids cold winter temperatures by entering into a dormant state

Migration: behavior in which animals move from one portion of their home range to another to avoid extreme changes in climate

Section 27.2

Innate: behavior is performed correctly the first time an animal tries it; sometimes triggered by a signal called a releaser

Learned: behavior is not innate and must be learned by being taught by others or watching the behavior of other individuals

Imprinting: a rapid and irreversible learning process that only occurs during a short time in an animal's life

Imitation: animals learn by observing the behavior of other animals

Associative learning: an animal learns to associate an action with its consequences

Classical conditioning: a process in which an animal learns to associate a previously neutral stimulus with a behavior that was once triggered by a different stimulus

Operant conditioning: a process in which the likelihood of a specific behavior is increased or decreased by positive or negative reinforcement

Section 27.3

Benefits: increased survivorship, increased reproduction rates

Costs: energy costs, opportunity costs, risk costs

Territoriality is the control of a specific area by one or more individuals of an animal species

Benefits: ability to control resources

Costs: energy and time

Optimal foraging is a theory that states that natural selection should favor behaviors that get the most calories for the cost

Section 27.4

Benefits: improved foraging, reproductive assistance, reduced chance of predation

Costs: increased visibility, increased competition, increased chance of contracting disease

Four Types of Communication: visual, sound, touch, chemical

Altruism is a kind of behavior in which an animal reduces its own fitness to help members of its social group

Eusocial species live in large groups made up of many individuals, most of whom are members of non-reproductive castes

Section 27.5

Animal cognition is the mental process of knowing through perception and reasoning.

Has a role in problem-solving behavior *requiring* insight

Provides an adaptive advantage *for living in* social groups

Helps spread cultural behavior

in which the behavior is taught to one generation by another

Section 28.1

1. stem cells

2. determination—the process whereby stem cells become committed to developing into only one type of cells

3. muscle

4. differentiation—the process by which committed cells acquire their specialized structures and functions

5. cardiac, skeletal, smooth muscle cells

6. cell—the smallest form of life

7. tissue—groups of similar cells that work together to perform a specialized function

8. organ—different types of tissues that function together

9. organ system—two or more organs working in a coordinated way

10. organism—collection of organ systems working together

Section 28.2

Sensors

function: gather information about internal and external conditions and relay information to a control center

Control center

function: receive information from sensors, compare it to set values, send messages through communication networks

Communication system

function: carry messages through nerves or blood to target organs, telling them how to respond to changes

Targets

function: receive messages, change level of activity to help restore homeostasis or increase a change

Section 28.3

Control center

response: Hypothalamus receives information, compares it to set range of body temperatures, and sends messages to counteract change

Communication system

function: Nerves and circulatory system carry messages to target organs to tell them how to respond to change

Targets

response: messages activate sweat glands, dilate blood vessels in skin, and increase heart and breathing rates

1. short-term disruption

2. lasts only a few days or weeks; usually no lasting harm

3. long-term disruption

4. can cause damage to more and more organs

Section 29.1

A stimulus is something that causes a change or a response

Endocrine system

Is made up of: organs that are not connected

Rate of communication: slow

Types of signals: chemical

Examples of processes controlled: growth, reproductive cycles

Nervous system

Is made up of: highly connected network of tissues and cells

Rate of communication: fast

Types of signals: electrical and chemical

Examples of processes controlled: movement, thoughts

Divisions: central nervous system, peripheral nervous system

Section 29.2

1. cell body: contains nucleus and organelles

2. dendrite: receives messages

3. axon: transmits messages

4. Schwann cell: makes up the myelin sheath, which insulates axons

5. synapse: gap between neuron and next cell

6. terminal: part through which impulse leaves

Signal Transmission

Resting Potential:

Definition—difference in charge across the membrane; Details—more Na^+ outside and more K^+ inside

Action Potential:

Definition—electrical impulse caused by Na^+ moving in; Details—requires ion channels in the membrane that have gates that open and close

Neurotransmitters:

Definition—the chemical signal that stimulates the next cell; Details—bind to receptor proteins on adjacent neuron

Section 29.3

How do senses help maintain homeostasis?

Gather information from environment

Sends signals to the brain for interpretation

Examples

Pupils shrink on a sunny day

Goose bumps when it's cold outside

Sense

Vision; eye; photoreceptor; cone cell—color vision, rod cell—black-and-white vision

Hearing; ear; mechanoreceptor; hair cell—bends when hit by sound waves

Smell; nose; chemoreceptor; detects chemicals dissolved in fluid

Taste; tongue; chemoreceptor; detects chemicals dissolved in fluid

Touch; skin; mechanoreceptor, pain receptor, thermoreceptor; detects pressure, pain, and temperature

Section 29.4

1. sensory receptor generates signal

2. passes signal to CNS

3. CNS interprets signal

4. CNS passes signal to PNS

5. PNS stimulates a response

CNS

Brain; processes and interprets signals and generates responses; cerebellum, cerebrum, cerebral cortex

Brainstem; controls life-sustaining processes;

i.e. breathing, heart rate

Spinal cord; delivers signals the length of the body; works in reflex arcs

PNS

Somatic nervous system; voluntary responses; connects CNS to target organs

Autonomic nervous system; involuntary responses; digesting food

Sympathetic nervous system; excites body; fight or flight, raises heart rate

Parasympathetic nervous system; calms body; lowers blood pressure and heart rate

Section 29.5

CT scan; detects structure of the brain

MRI; detects structure of the brain

PET; detects where glucose is being used in the brain

What alters brain chemistry?

Illness

Drugs

Addiction is: physiological need for a substance

Tolerance is: need for more of a drug to produce the same effect

Stimulants: cause more action potentials

Depressants: cause fewer action potentials

Sketches for Normal, Desensitized, and Sensitized should resemble Figure 29.16.

Section 29.6

Gland: organ of endocrine system

Hormone: chemical signal of the endocrine system; produced by glands; travels through the blood stream; affects cells with specific receptors

Hypothalamus: gland in the brain; a structure of the nervous and endocrine system; produces releasing hormones; which are sent to the pituitary gland

Pituitary gland: gland below the hypothalamus in the brain; controls growth

Releasing hormones: hormones that stimulate other glands to produce and release hormones

Hormone imbalances: cause illness

Section 30.1

1. *Main function:* bring oxygen into the body and expel carbon dioxide and water vapor

2. nose, sinus, mouth

3. trachea

4. lungs

5. bronchi

6. bronchioles

7. alveoli

8. Main function: transport oxygen and nutrients to cells and carry wastes and oxygen-poor blood back to the heart and lungs.

9. heart

10. arteries

11. veins

12. capillaries

Section 30.2

1. Oxygen and carbon dioxide are carried by the blood

2. Gases move by diffusion from higher concentration to lower

3. lining of alveoli must be moist to help diffusion

4. alveolus

5. capillary

CO2 diffuses: from the capillary into the alveolus

O2 diffuses: from the alveolus into the capillary

Red blood cell carries: CO2 into the lungs

Hemoglobin is: an iron-rich protein that allows more O2 to enter RBC

Red blood cell carries: O2 away from lungs

Section 30.3

1. From: upper body

2. To: the lungs

3. From: the lungs

4. To: upper body

5. To: the lungs

6. From: the lungs

7. To: lower body

8. From: lower body

Right atrium: blood from upper/lower body enters, pumped to right ventricle

Right ventricle: blood pumped to lungs

Left atrium: blood from lungs enters, pumped to left ventricle

Left ventricle: blood pumped to rest of body

Section 30.4

1. Arteries: carry blood away from heart; have three layers, muscular and elastic to keep blood moving; carry oxygen-rich blood to cells

2. Capillaries: only one layer, one cell thick, carry blood between cells and arteries/veins, form dense capillary beds; materials diffuse into and out of them

3. Veins: carry blood to the heart; larger diameter, valves; need activity of muscles to keep blood moving, carry oxygen-poor blood from cells

4. What they have in common: share epithelial layer; transport blood, gases, and other materials; found in all parts of the body; all part of circulatory system

Section 30.5

1. Name: Plasma; Details: Makes up 55% of blood; clear, pale yellow fluid 95% water; determines concentration gradients; contains many types of molecules; contains proteins that help maintain homeostasis

2. Name: Red blood cells; Details: make up 40 to 45% of blood, concave, carry oxygen, contain hemoglobin, circulate 120 days before degrading; contain protein markers that determine blood type and Rh factor

3. Name: White blood cells; Details: defend body against pathogens; remove foreign material and dead cells; contain no hemoglobin; can circulate through lymphatic system

4. Platelets: Details: cell fragments, form clots to control bleeding, change shape when needed to form a complex web that traps while blood cells and other platelets

Section 30.6

1. Main Function: collect interstitial fluid, clean and filter it, and return it to circulatory system; defend body against pathogens and remove foreign materials and dead cells from lymph.

2. Lymph vessels

3. collect lymph, circulate it to nodes, and eventually return it to circulatory system

4. lymph nodes

5. clean and filter lymph to trap and destroy pathogens and other materials

6. tonsils

7. spleen

8. thymus

9. tonsils and spleen clean and filter lymph; thymus and spleen develop and contain many lymphocytes and other white blood cells to destroy harmful bacteria and foreign organisms

Section 31.1

Germ theory

proposes that: small particles, not spirits cause disease

supported by: Koch's postulates

these particles are: pathogens

examples: viruses, bacteria, fungi, protozoa, parasites

are spread by: direct contact; examples: kissing, shaking hands, sexual intercourse

are spread by: indirect contact; examples: vectors, touching a door handle, inhaling a pathogen

Section 31.2

The immune system is:

body system that fights infection and prevents illness

skin: physically blocks pathogens from entering the body

Mucous membrane: in nose and throat; traps particles before they enter

Circulatory system: transports cells of the immune system

Phagocyte: cell that engulfs and destroys pathogens

T cell: destroys infected body cells

B cell: produces antibodies

Antibody: protein that causes pathogens to clump or become ineffective Interferon: protein that stops viruses from reproducing

Passive immunity: passed through genetics or by mother's milk

Active immunity: gained after the body undergoes a specific immune response

Both: prevent future illness if the body becomes infected

Section 31.3

Nonspecific immune responses are: those that are the same every time examples: fever; inflammation

Specific immune responses detect: antigens

produce: immunity include: cellular immunity; uses: T cells; form: memory cells; to destroy: infected body cells

include: humoral immunity; uses: B cells; form: memory cells; to produce: antibodies give: immunity

Tissue rejection occurs when: white blood cells recognize donor tissue as foreign and attack and destroy the tissue

Section 31.4

Antibiotic; destroys pathogens that have entered the body

Antiseptic; includes soap, destroys pathogens outside of the body

Vaccine; given to a person to prevent illness

Antibiotic resistance is: when a population of bacteria or fungi are no longer affected by an antibiotic because they have a genetic mutation or difference from the rest of the population.

Effect/result: stimulates a specific immune response; causes memory cells to be produced; allows immune system to respond to an infection without getting sick; allows for quick response to infection

Section 31.5

Allergy

Is: an immune response to a normally harmless particle

Caused by: allergens

Are: proteins on the surface of particles that do not cause disease

Types of: food, chemical, airborne

Causes

White blood cells cannot recognize healthy body cells

White blood cells attack healthy body cells

Tissues and systems fail because of white blood cell attack

Section 31.6

1. cancer of the bone marrow; Characterized by: immature white blood cells; Causes: weakened immune system

2. opportunistic infection; Occur because: white blood cells cannot fight infections; But if the immune system was healthy: it would be able to fight off these infections

HIV is transmitted to a person by: bodily fluid

Pathogen reproduces in and destroys T cells

Body cannot replace the dying T cells fast enough

T cells cannot help in immune responses

AIDS, which is: The condition of having several opportunistic infections and a very low amount of T cells

Section 32.1

Water

Function: involved in chemical reactions, helps digest food, eliminate wastes, maintains blood volume, regulates body temperature, keeps skin smooth;

Found in: water itself

Carbohydrates

Types: complex and simple;

Function: main source of energy;

Found in: fruits, vegetables, honey, sugar, grains, potatoes

Proteins

Functions: raw materials for growth, repair, make up all enzymes and many hormones;

Found in: meats, dairy products, eggs, some plant foods

Fats

Types: saturated, unsaturated;

Function: provide energy and are key components in cell membranes, neuron, and certain hormones;

Found in: red meats, dairy products, plant oils, some fish and fish oils

Minerals

Function: used to carry out cell processes and to build or repair tissues;

Found in: dairy products, leafy greens, legumes, nuts, meats, seafoods, whole grains

Vitamins

Types: water-soluble, fat-soluble;

Function: work with enzymes to regulate cell functions, growth, development;

Found in: dairy products, leafy greens, legumes, nuts, meats, seafoods, whole grains

Section 32.2

1. Mouth; Function: chew and shred food; amylase begins digestion of carbohydrates

2. Esophagus; Function: peristaltic movement moves food into stomach

3. Stomach; Function: begins digestion of protein, mixes and churns food into chyme

4. Liver/gallbladder/pancreas; Function: produces bile to help digest fats; produces enzymes to digest fats, finish protein digestion

5. Small intestine; Function: completes digestion of proteins and sugars, digests fats

6. Large intestine and rectum/anus; Function: absorb water and form solid wastes; eliminates solid wastes from body

Section 32.3

1. microvilli

2. villus

3. blood vessels

4. capillaries

5. lymph vessels

Name: duodenum; Absorbs: simple sugars, amino acids, minerals

Name: jejunum; Absorbs: glucose, some amino acids, vitamin C, most B vitamins, some water

Name: ileum; Absorbs: fat-soluble vitamins, B12, fatty acids, cholesterol, and some water

Name: large intestine: Eliminates: solid waste

Section 32.4

1. cortex

2. medulla

3. ureter

4. glomerulus

Function: filter and clean the blood

5. Bowman's capsule

Function: hold the filtrate; molecules are reabsorbed into the capillaries to balance the blood chemically

6. Loop of Henle

Function: water is reabsorbed (or not) here one last time

7. Collecting ducts

Function: collect urine from nephrons and send it to the ureter

Section 33.1

Skeletal system: body system that protects, supports, and moves the body

Appendicular skeleton: includes arms and legs and allows for movement

Axial skeleton: skull, rib cage, and spinal column; supports and protects the body

Vertebrae: bone of the spinal column that protects the spinal cord

Cartilage: connective tissue that prevents bones from wearing out

Ligament: connective tissue that connects bones across a joint

Joint: place where two bones meet; ball-and-socket, gliding, hinge, pivot, saddle

Compact bone: dense bone

Spongy bone: cradles bone marrow that produces blood cells

Calcification: process that hardens bone

Section 33.2

Three Types of Muscle

a. Skeletal muscle: muscle the attaches to and moves bones voluntarily and, sometimes, involuntarily; ligament: connects bones and muscle

b. Smooth muscle: moves substances involuntarily through the organs

(digestive system) and blood vessels

c. Cardiac muscle: muscle in the heart that pumps blood, involuntarily

Structures of Muscle

a. Muscle fiber: cell of the muscle system

b. Myofibril: strand of protein within a muscle fiber

c. Sarcomere: unit within a myofibril that contains all of the proteins necessary for muscle contraction

d. Actin: filament that is pulled during contraction

e. Myosin: filament that does the pulling during contraction

Muscle contraction: Muscle is stimulated; myosin grabs and pulls actin toward the center of the sarcomere; muscle is contracted. Students could include drawings of contraction with labels.

Section 33.3

Integumentary system: body system that surrounds all others, includes skin and the structures within it

Epidermis: upper layer of skin, consisting of dead cells and oils

Dermis: second layer of skin that contains most of the tissues within the skin

Hair follicle: elongated pit that produces keratin that forms hair glands: sweat gland; oil gland

1. blood vessel

2. fat cells

3. pressure receptor

Section 34.1

1. fallopian tube

2. ovary

3. uterus

4. pubic bone

5. bladder

6. urethra

7. cervix

8. rectum

9. vagina

1. vas defrens

2. pubic bone

3. prostate gland

4. penis

5. urethra

6. bladder

7. seminal vesicle

8. rectum

9. bulbourethral gland

10. epididymus

11. scrotum

12. testis

Section 34.2

1. 46; potential egg

2. 23; meiosis 1

3. 23; meiosis 11

4. 23; first polar body

5. 23; second polar body

1. 46; potential sperm

2. 23, 23; meiosis 1

3. 23, 23, 23, 23; meiosis 11

4. all sperm cells have 23 chromosomes

1. *Flow phase*

Details: Uterus lining detaches and flows out of the body along with some blood and other fluids. All hormones are low.

2. *Follicular Phase*

Details: Increase in FSH and LH stimulates maturing and release of egg (ovulation); increase in estrogen causes lining to thicken.

3. *Luteal Phase*

Details: Corpus luteum formed; release of progesterone and estrogen stops production of FSH and LH; increases number of blood vessels in lining.

Section 34.3

1. Zygote

2. Blastocyst

3. *Amniotic sac*

Details: membrane filled with fluid that cushions embryo and protects it from sudden temperature changes

4. *Placenta*

Details: connects mother and embryo to allow for exchange of oxygen, nutrients, and wastes OR chorion; Details: chorionic villi help to nourish the embryo as it develops

5. *Umbilical cord*

Details: two arteries and a vein that connects the embryo to the mother and transports oxygen, nutrients, and wastes

Section 34.4

Dilation of the Cervix

Details: true contractions of the uterus push the walls of the cervix apart so the baby can enter the vaginal canal

Emergence of the Baby

Details: most babies are born headfirst; they enter the vaginal canal and are pushed through it to emerge outside the mother's body

Expulsion of Placenta

Details: placenta detaches from the uterine wall, and uterine contractions expel it from the mother's body

1. Infancy: birth to about age 2; period of rapid growth and development

2. childhood: age 2 to about age 12; growth slows, but children gain fine-motor skills and increased language abilities

3. adolescence: begins at sexual maturity, usually 14 to 16; period of greater strength, coordination, endurance; major rearrangement of the brain

4. adulthood: when people reach their peak in terms of skills and abilities; when physical aging begins