

Geneva CUSD 304
Content-Area Curriculum Frameworks
Grades 6-12
Science

Mission Statement	<p><u>The Mission of Science Education Is:</u></p> <ol style="list-style-type: none"> 1) to nurture an active interest in science that continues throughout life. 2) to teach the learning skills and concepts necessary for the scientific process. 3) to develop student understanding of the interrelationships between science, society, and the environment 4) to encourage students to discover and develop their talent in science.
Course Sequence (Grades 6-12)	<p>6th grade: Earth Science</p> <p>7th grade: Life Science</p> <p>8th grade: Physical Science</p> <p>9th grade: General Science Earth Science Biology Biology Honors</p> <p>10th, 11th, 12th grade: Chemistry Chemistry Honors Physics Astronomy Natural Disasters Anatomy and Physiology I and II Horticulture I and II AP Chemistry AP Biology AP Environmental Science</p>

Course Framework

Course Title Grade Level Semesters (1-2-3-4) Prerequisite	Advanced Placement Biology 11 th /12 th 2 Grade of A in Biology and B in chemistry or department approval
Course Description	<p>This is an advanced, capstone science course that is presented in a more rigorous and analytical manner than general biology. It should not be considered as a simple continuation of general biology. This course allows students to pursue college-level biology while still in high school and to receive advanced placement credit upon entering college. The course covers the topics and laboratories typically offered by colleges in the freshman year. Laboratories are involved and may include longitudinal studies such as fruit flies. The unifying theme of evolution is stressed throughout the course. Areas of study include biochemistry, molecular biology, genetics, evolution, taxonomy, zoology, botany, and ecology.</p> <p>Students enrolled in AP courses are expected to take the AP exam in May.</p>
District-approved Materials and/or Resources	Biology Publisher: Benjamin Cummings ISBN: 0-08053-6777-2 Copy write: 2005

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>1: Exploring Life</p>	<p>Resources that will support instruction</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<p>A. Know and apply the concepts, principles and processes of scientific inquiry.</p> <ul style="list-style-type: none"> • 11.A.4a Formulate hypotheses referencing prior research and knowledge. • 11.A.4b Conduct controlled experiments or simulations to test hypotheses. • 11.A.5a Formulate hypotheses referencing prior research and knowledge. • 11.A.5b Design procedures to test the selected hypotheses • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). • 13.A.5c Explain the strengths, weaknesses and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling and statistical studies. • 13.A.5d Explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Exploring Life on Its Many Levels</p> <ul style="list-style-type: none"> • Briefly describe the unifying themes that characterize the biological sciences. • Diagram the hierarchy of structural levels in biological organization. • Explain how the properties of life emerge from complex organization. • Describe the two major dynamic processes of any ecosystem. • Distinguish between prokaryotic and eukaryotic cells. • Describe the basic structure and function of DNA. • Describe the dilemma of reductionism. • Discuss the goals and activities of systems biology. List three research developments that have advanced systems biology. • Explain the importance of regulatory mechanisms in living things. Distinguish between positive and negative feedback. <p>Evolution, Unity, and Diversity</p> <ul style="list-style-type: none"> • Distinguish among the three domains of life. List and distinguish among the three kingdoms of multicellular, eukaryotic life. • Explain the phrase “life’s dual nature of unity and diversity.” 	

	<ul style="list-style-type: none"> • Describe the observations and inferences that led Charles Darwin to his theory of evolution by natural selection. • Explain why diagrams of evolutionary relationships have a treelike form. <p>The Process of Science</p> <ul style="list-style-type: none"> • Distinguish between discovery science and hypothesis-based science. Explain why both types of exploration contribute to our understanding of nature. • Distinguish between quantitative and qualitative data. • Distinguish between inductive and deductive reasoning. • Explain why hypotheses must be testable and falsifiable but are not provable. • Describe what is meant by a controlled experiment. • Distinguish between the everyday meaning of the term <i>theory</i> and its meaning to scientists. • Explain how science is influenced by social and cultural factors. • Distinguish between science and technology. Explain how science and technology are interdependent. 	
<p>Assessments</p>	<p>Performance Tasks</p> <p>Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam</p>	<p>Other Evidence</p>

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>2: The Chemical Context of life</p>	<p>Resources that will support instruction</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.C.4b Analyze and explain the atomic and nuclear structure of matter. • 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Elements and Compounds</p> <ol style="list-style-type: none"> 1. Distinguish between an element and a compound. 2. Identify the four elements that make up 96% of living matter. 3. Define the term trace element and give an example. <p>Atoms and Molecules</p> <ol style="list-style-type: none"> 4. Draw and label a simplified model of an atom. Explain how this model simplifies our understanding of atomic structure. 5. Distinguish between each of the following pairs of terms: <ol style="list-style-type: none"> a. neutron and proton b. atomic number and mass number c. atomic weight and mass number 6. Explain how the atomic number and mass number of an atom can be used to determine the number of neutrons. 7. Explain how two isotopes of an element are similar. Explain how they are different. 8. Describe two biological applications that use radioactive isotopes. 9. Define the terms energy and potential energy. Explain why electrons in the first electron shell have less potential energy than electrons in higher electron shells. 10. Distinguish among nonpolar covalent, polar covalent and ionic bonds. 11. Explain why strong covalent bonds and weak bonds are both essential in living organisms. 12. Distinguish between hydrogen bonds and van der Waals interactions. 13. Give an example that illustrates how a molecule's shape can determine its biological function. 14. Explain what is meant by a chemical equilibrium. 	

Assessments	Performance Tasks	Other Evidence
	Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	

Unit Frameworks

Unit of Study: major topics	3: Water and the Fitness of the Environment	Resources that will support instruction Water Lab Activities
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. • 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. • 12.D.4b Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions. 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	The Properties of Water <ol style="list-style-type: none"> 1. With the use of a diagram or diagrams, explain why water molecules are: <ol style="list-style-type: none"> a. polar b. capable of hydrogen bonding with four neighboring water molecules 2. List four characteristics of water that are emergent properties resulting from hydrogen bonding. 3. Define cohesion and adhesion. Explain how water's cohesion and adhesion contribute to the movement of water from the root to the leaves of a tree. 4. Distinguish between heat and temperature, using examples to clarify your definitions. 5. Explain the following observations by referring to the properties of water: <ol style="list-style-type: none"> a. Coastal areas have milder climates than adjacent inland areas. b. Ocean temperatures fluctuate much less than air temperatures on land. c. Insects like water striders can walk on the surface of a pond without breaking the surface. d. If you slightly overfill a water glass, the water will form a convex surface above the top of the glass. e. If you place a paper towel so that it touches spilled water, the towel will draw in the water. f. Ice floats on water. g. Humans sweat and dogs pant to cool themselves on hot days. 6. Distinguish among a solute, a solvent, and a solution. 7. Distinguish between hydrophobic and hydrophilic substances. 8. Explain how you would make up a one molar (1M) solution of ethyl alcohol. The Dissociation of Water Molecules <ol style="list-style-type: none"> 9. Name the products of the dissociation of water and give their concentration 	

	<p>in pure water.</p> <p>10. Define acid, base, and pH.</p> <p>11. Explain how acids and bases may directly or indirectly alter the hydrogen ion concentration of a solution</p> <p>12. Using the bicarbonate buffer system as an example, explain how buffers work.</p> <p>13. Briefly explain the causes and effects of acid precipitation.</p>	
<p>Assessments</p>	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>

Unit Frameworks

Unit of Study: major topics	4: Carbon and the Molecular Diversity of Life	Resources that will support instruction Molecular model building
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.C.4b Analyze and explain the atomic and nuclear structure of matter. • 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. • 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. • 12.D.4b Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions. 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p style="text-align: center;">The Importance of Carbon</p> <ol style="list-style-type: none"> 1. Explain how carbon’s electron configuration accounts for its ability to form large, complex, and diverse organic molecules. 2. Describe how carbon skeletons may vary, and explain how this variation contributes to the diversity and complexity of organic molecules. 3. Describe the basic structure of a hydrocarbon and explain why these molecules are hydrophobic. 4. Distinguish among the three types of isomers: structural, geometric, and enantiomer. <p style="text-align: center;">Functional Groups</p> <ol style="list-style-type: none"> 5. Name the major functional groups found in organic molecules. Describe the basic structure of each functional group and outline the chemical properties of the organic molecules in which they occur. 	
Assessments	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence

Unit Frameworks

Unit of Study: major topics	5: Structure and Function of Macromolecules	Resources that will support instruction Molecular model building
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.C.4b Analyze and explain the atomic and nuclear structure of matter. • 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. • 12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. • 12.D.4b Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions. 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	The Principles of Polymers <ol style="list-style-type: none"> 1. List the four major classes of macromolecules. 2. Distinguish between monomers and polymers. 3. Draw diagrams to illustrate condensation and hydrolysis reactions. <p style="text-align: center;">Carbohydrates Serve as Fuel and Building Material</p> <ol style="list-style-type: none"> 4. Distinguish among monosaccharides, disaccharides, and polysaccharides. 5. Describe the formation of a glycosidic linkage. 6. Distinguish between the glycosidic linkages found in starch and cellulose. Explain why the difference is biologically important. 7. Describe the role of symbiosis in cellulose digestion. <p style="text-align: center;">Lipids Are a Diverse Group of Hydrophobic Molecules</p> <ol style="list-style-type: none"> 8. Describe the building-block molecules, structure, and biological importance of fats, phospholipids, and steroids. 9. Identify an ester linkage and describe how it is formed. 10. Distinguish between saturated and unsaturated fats. 11. Name the principal energy storage molecules of plants and animals. <p style="text-align: center;">Proteins Have Many Structures and Many Functions</p> <ol style="list-style-type: none"> 12. Distinguish between a protein and a polypeptide. 13. Explain how a peptide bond forms between two amino acids. 14. List and describe the four major components of an amino acid. Explain how amino acids may be grouped according to the physical and chemical properties of the R group. 15. Explain what determines protein conformation and why it is important. 16. Explain how the primary structure of a protein is determined. 	

	<p>17. Name two types of secondary protein structure. Explain the role of hydrogen bonds in maintaining secondary structure.</p> <p>18. Explain how weak interactions and disulfide bridges contribute to tertiary protein structure.</p> <p>19. List four conditions under which proteins may be denatured.</p> <p style="text-align: center;">Nucleic Acids Store and Transmit Hereditary Information</p> <p>20. List the major components of a nucleotide, and describe how these monomers are linked to form a nucleic acid.</p> <p>21. Distinguish between:</p> <ol style="list-style-type: none"> a. pyrimidine and purine b. nucleotide and nucleoside c. ribose and deoxyribose d. 5' end and 3' end of a nucleotide <p>22. Briefly describe the three-dimensional structure of DNA.</p>		
<p>Assessments</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;"> <p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p> </td> <td style="width: 50%; padding: 5px;"> <p>Other Evidence</p> </td> </tr> </table>	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>
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Unit Frameworks

Unit of Study: major topics	6: A Tour of the Cell	Resources that will support instruction Plant and Animal Cell Microscopy Lab
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>How We Study Cells</p> <ul style="list-style-type: none"> • Distinguish between magnification and resolving power. • Describe the principles, advantages, and limitations of the light microscope, transmission electron microscope, and scanning electron microscope. • Describe the major steps of cell fractionation and explain why it is a useful technique. <p>A Panoramic View of the Cell</p> <ul style="list-style-type: none"> • Distinguish between prokaryotic and eukaryotic cells. • Explain why there are both upper and lower limits to cell size. • Explain the advantages of compartmentalization in eukaryotic cells. <p>The Nucleus and Ribosomes</p> <ul style="list-style-type: none"> • Describe the structure and function of the nuclear envelope, including the role of the pore complex. • Briefly explain how the nucleus controls protein synthesis in the cytoplasm. • Explain how the nucleolus contributes to protein synthesis. • Describe the structure and function of a eukaryotic ribosome. • Distinguish between free and bound ribosomes in terms of location and function. <p>The Endomembrane System</p> <ul style="list-style-type: none"> • List the components of the endomembrane system, and describe the structure and functions of each component. • Compare the structure and functions of smooth and rough ER. • Explain the significance of the <i>cis</i> and <i>trans</i> sides of the Golgi apparatus. 	

	<ul style="list-style-type: none"> • Describe the cisternal maturation model of Golgi function. • Describe three examples of intracellular digestion by lysosomes. • Name three different kinds of vacuoles, giving the function of each kind. <p>Other Membranous Organelles</p> <ul style="list-style-type: none"> • Briefly describe the energy conversions carried out by mitochondria and chloroplasts. • Describe the structure of a mitochondrion and explain the importance of compartmentalization in mitochondrial function. • Distinguish among amyloplasts, chromoplasts, and chloroplasts. • Identify the three functional compartments of a chloroplast. Explain the importance of compartmentalization in chloroplast function. • Describe the evidence that mitochondria and chloroplasts are semiautonomous organelles. • Explain the roles of peroxisomes in eukaryotic cells. <p>The Cytoskeleton</p> <ul style="list-style-type: none"> • Describe the functions of the cytoskeleton. • Compare the structure, monomers, and functions of microtubules, microfilaments, and intermediate filaments. • Explain how the ultrastructure of cilia and flagella relates to their functions. <p>Cell Surfaces and Junctions</p> <ul style="list-style-type: none"> • Describe the basic structure of a plant cell wall. • Describe the structure and list four functions of the extracellular matrix in animal cells. • Explain how the extracellular matrix may act to integrate changes inside and outside the cell. • Name the intercellular junctions found in plant and animal cells and list the function of each type of junction. 	
Assessments	Performance Tasks Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence

Unit Frameworks

Unit of Study: major topics	7: Membrane Structure and Function	Resources that will support instruction Osmosis and Diffusion Lab
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Membrane Structure</p> <ul style="list-style-type: none"> • Explain why phospholipids are amphipathic molecules. • Explain what freeze-fracture techniques reveal about the arrangement of proteins in membranes. • Describe the fluidity of the components of a cell membrane and explain how membrane fluidity is influenced by temperature and membrane composition. • Explain how cholesterol resists changes in membrane fluidity with temperature change. <p>Traffic Across Membranes</p> <ul style="list-style-type: none"> • Distinguish between peripheral and integral membrane proteins. • List six major functions of membrane proteins. • Explain the role of membrane carbohydrates in cell-cell recognition. • Explain how hydrophobic molecules cross cell membranes. • Distinguish between channel proteins and carrier proteins. • Define diffusion. Explain why diffusion is a spontaneous process. • Explain why a concentration gradient of a substance across a membrane represents potential energy. • Distinguish among hypertonic, hypotonic, and isotonic solutions. • Define osmosis and predict the direction of water movement based on differences in solute concentrations. • Describe how living cells with and without cell walls regulate water balance. • Explain how transport proteins facilitate diffusion. • Distinguish among osmosis, facilitated diffusion, and active transport. • Describe the two forces that combine to produce an electrochemical 	

	<p>gradient.</p> <ul style="list-style-type: none"> • Explain how an electrogenic pump creates voltage across a membrane. • Describe the process of cotransport. • Explain how large molecules are transported across a cell membrane. • Distinguish between pinocytosis and receptor-mediated endocytosis. 	
<p>Assessments</p>	<p>Performance Tasks</p> <p>Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam</p>	<p>Other Evidence</p>

Unit Frameworks

Unit of Study: major topics	8: An Introduction to Metabolism	Resources that will support instruction Enzyme Activity Lab
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. • 12.E.4a Explain how external and internal energy sources drive Earth processes • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 11.A.4a Formulate hypotheses referencing prior research and knowledge. • 11.A.4b Conduct controlled experiments or simulations to test hypotheses. • 11.A.4c Collect, organize and analyze data accurately and precisely. • 11.A.4d Apply statistical methods to the data to reach and support conclusions. • 11.A.4e Formulate alternative hypotheses to explain unexpected results. • 11.A.4f Using available technology, report, display and defend to an audience conclusions drawn from investigations. • 11.A.5a Formulate hypotheses referencing prior research and knowledge. • 11.A.5b Design procedures to test the selected hypotheses • 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. • 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results. • 11.A.5e Report, display and defend the results of investigations to audiences that may include professionals and technical experts. 	
Objectives <ul style="list-style-type: none"> • Conceptual • Factual • Procedural 	<p style="text-align: center;">Metabolism, Energy, and Life</p> <ol style="list-style-type: none"> 1. Explain the role of catabolic and anabolic pathways in cellular metabolism. 2. Distinguish between kinetic and potential energy. 3. Explain why an organism is considered an open system. 4. Explain the first and second laws of thermodynamics in your own words. 5. Explain why highly ordered living organisms do not violate the second law of thermodynamics. 6. Write and define each component of the equation for free-energy change. 7. Distinguish between exergonic and endergonic reactions in terms of free energy change. 	

	<p>8. Explain why metabolic disequilibrium is one of the defining features of life.</p> <p>9. List the three main kinds of cellular work. Explain in general terms how cells obtain the energy to do cellular work.</p> <p>10. Describe the structure of ATP and identify the major class of macromolecules to which ATP belongs.</p> <p>11. Explain how ATP performs cellular work.</p> <p style="text-align: center;">Enzymes are Catalytic Proteins</p> <p>12. Describe the function of enzymes in biological systems.</p> <p>13. Explain why an investment of activation energy is necessary to initiate a spontaneous reaction.</p> <p>14. Explain how enzyme structure determines enzyme specificity.</p> <p>15. Explain the induced-fit model of enzyme function.</p> <p>16. Describe the mechanisms by which enzymes lower activation energy.</p> <p>17. Explain how substrate concentration affects the rate of an enzyme-catalyzed reaction.</p> <p>18. Explain how temperature, pH, cofactors, and enzyme inhibitors can affect enzyme activity.</p> <p style="text-align: center;">The Control of Metabolism</p> <p>19. Explain how metabolic pathways are regulated.</p> <p>20. Explain how the location of enzymes in a cell may help order metabolism.</p>		
Assessments	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td data-bbox="394 1375 1219 1879" style="width: 70%; vertical-align: top;"> Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam </td> <td data-bbox="1219 1375 1510 1879" style="width: 30%; vertical-align: top;"> Other Evidence </td> </tr> </table>	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence
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Unit Frameworks

Unit of Study: major topics	9: Cellular Respiration: Harvesting Chemical Energy	Resources that will support instruction Respiration Lab
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. • 12.E.4a Explain how external and internal energy sources drive Earth processes • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction • 11.A.4a Formulate hypotheses referencing prior research and knowledge. • 11.A.4b Conduct controlled experiments or simulations to test hypotheses. • 11.A.4c Collect, organize and analyze data accurately and precisely. • 11.A.4d Apply statistical methods to the data to reach and support conclusions. • 11.A.4e Formulate alternative hypotheses to explain unexpected results. • 11.A.4f Using available technology, report, display and defend to an audience conclusions drawn from investigations. • 11.A.5a Formulate hypotheses referencing prior research and knowledge. • 11.A.5b Design procedures to test the selected hypotheses • 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. • 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results. • 11.A.5e Report, display and defend the results of investigations to audiences that may include professionals and technical experts. 	
Objectives <ul style="list-style-type: none"> • Conceptual • Factual • Procedural 	The Principles of Energy Harvest <ol style="list-style-type: none"> 1. In general terms, distinguish between fermentation and cellular respiration. 2. Write the summary equation for cellular respiration. Write the specific chemical equation for the degradation of glucose. 3. Define oxidation and reduction. 4. Explain in general terms how redox reactions are involved in energy exchanges. 5. Describe the role of NAD⁺ in cellular respiration. 6. In general terms, explain the role of the electron transport chain in cellular respiration. The Process of Cellular Respiration <ol style="list-style-type: none"> 7. Name the three stages of cellular respiration and state the region of the 	

eukaryotic cell where each stage occurs.

8. Describe how the carbon skeleton of glucose changes as it proceeds through glycolysis.
9. Explain why ATP is required for the preparatory steps of glycolysis.
- 10 Identify where substrate-level phosphorylation and the reduction of NAD^+ . occur in glycolysis.
- 11 Describe where pyruvate is oxidized to acetyl CoA, what molecules are . produced, and how this process links glycolysis to the citric acid cycle.
- 12 List the products of the citric acid cycle. Explain why it is called a cycle. .
- 13 Describe the point at which glucose is completely oxidized during cellular . respiration.
- 14 Distinguish between substrate level phosphorylation and oxidative . phosphorylation.
- 15 In general terms, explain how the exergonic “slide” of electrons down the . electron transport chain is coupled to the endergonic production of ATP by chemiosmosis.
- 16 Explain where and how the respiratory electron transport chain creates a . proton gradient.
- 17 Describe the structure and function of the four subunits of ATP synthase. .
- 18 Summarize the net ATP yield from the oxidation of a glucose molecule by . constructing an ATP ledger.
- 19 Explain why it is not possible to state an exact number of ATP molecules . generated by the oxidation of glucose.

Related Metabolic Processes

- 20 State the basic function of fermentation. .
- 21 Compare the fate of pyruvate in alcohol fermentation and lactic acid . fermentation.
- 22 Compare the processes of fermentation and cellular respiration. .
- 23 Describe the evidence that suggests that glycolysis is an ancient metabolic . pathway.
- 24 Describe how food molecules other than glucose can be oxidized to make

	<p>. ATP.</p> <p>25 Explain how glycolysis and the citric acid cycle can contribute to anabolic pathways.</p> <p>26 Explain how ATP production is controlled by the cell and describe the role that the allosteric enzyme phosphofructokinase plays in the process.</p>	
Assessments	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	Other Evidence

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>10: Photosynthesis</p>	<p>Resources that will support instruction</p> <p>Photosynthesis lab</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.C.5a Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. • 12.E.4a Explain how external and internal energy sources drive Earth processes • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction • 11.A.4a Formulate hypotheses referencing prior research and knowledge. • 11.A.4b Conduct controlled experiments or simulations to test hypotheses. • 11.A.4c Collect, organize and analyze data accurately and precisely. • 11.A.4d Apply statistical methods to the data to reach and support conclusions. • 11.A.4e Formulate alternative hypotheses to explain unexpected results. • 11.A.4f Using available technology, report, display and defend to an audience conclusions drawn from investigations. • 11.A.5a Formulate hypotheses referencing prior research and knowledge. • 11.A.5b Design procedures to test the selected hypotheses • 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. • 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results. • 11.A.5e Report, display and defend the results of investigations to audiences that may include professionals and technical experts. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>The Process That Feeds the Biosphere</p> <ol style="list-style-type: none"> 1. Distinguish between autotrophic and heterotrophic nutrition. 2. Distinguish between photoautotrophs and chemoautotrophs. 3. Describe the structure of a chloroplast, listing all membranes and compartments. 	

The Pathways of Photosynthesis

4. Write a summary equation for photosynthesis.
5. Explain van Niel's hypothesis and describe how it contributed to our current understanding of photosynthesis. Explain the evidence that supported his hypothesis.
6. In general terms, explain the role of redox reactions in photosynthesis.
7. Describe the two main stages of photosynthesis in general terms.
8. Describe the relationship between an action spectrum and an absorption spectrum. Explain why the action spectrum for photosynthesis differs from the absorption spectrum for chlorophyll a.
9. Explain how carotenoids protect the cell from damage by light.
10. List the wavelengths of light that are most effective for photosynthesis.
11. Explain what happens when a solution of chlorophyll a absorbs photons. Explain what happens when chlorophyll a in an intact chloroplast absorbs photons.
12. List the components of a photosystem and explain the function of each component.
13. Trace the movement of electrons in noncyclic electron flow. Trace the movement of electrons in cyclic electron flow.
14. Explain the functions of cyclic and noncyclic electron flow.
15. Describe the similarities and differences in chemiosmosis between oxidative phosphorylation in mitochondria and photophosphorylation in chloroplasts.
16. State the function of each of the three phases of the Calvin cycle.
17. Describe the role of ATP and NADPH in the Calvin cycle.
18. Describe what happens to rubisco when O₂ concentration is much higher than CO₂ concentration.
19. Describe the major consequences of photorespiration. Explain why it is thought to be an evolutionary relict.
20. Describe two important photosynthetic adaptations that minimize photorespiration.
21. List the possible fates of photosynthetic products.

Assessments	Performance Tasks	Other Evidence
	Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>11: Cell Communication</p>	<p>Resources that will support instruction</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>An Overview of Cell Signaling</p> <ol style="list-style-type: none"> 1. Describe the basic signal-transduction pathway used for mating in yeast. Explain why we believe these pathways evolved before the first multicellular organisms appeared on Earth. 2. Define ‘paracrine signaling’, and give an example. 3. Define local regulation and explain why hormone are not local regulators. 4. Explain how plant and animal hormones travel to target cells. 5. List and briefly define the three stages of cell signaling. <p style="text-align: center;">Signal Reception and the Initiation of Transduction</p> <ol style="list-style-type: none"> 6. Describe the nature of a ligand-receptor interaction and state how such interactions initiate a signal-transduction system. 7. State where signal receptors may be located in target cells. 8. Compare and contrast G-protein-linked receptors, tyrosine-kinase receptors, and ligand-gated ion channels. <p style="text-align: center;">Signal-Transduction Pathways</p> <ol style="list-style-type: none"> 9. Describe two advantages of using a multistep pathway in the transduction stage of cell signaling. 	

	<p>10. Explain how the original signal molecule can produce a cellular response when it may not even enter the target cell.</p> <p>11. Describe how phosphorylation propagates signal information.</p> <p>12. Explain why a single cell may require hundreds of different protein kinases.</p> <p>13. Explain how protein phosphatases turn off signal-transduction pathways.</p> <p>14. Define the term ‘second messenger’. Briefly describe the role of these molecules in signaling pathways.</p> <p>15. Describe how cyclic AMP is formed and how it propagates signal information in target cells.</p> <p>16. Explain how the cholera bacterium causes the symptoms of cholera by disrupting G-protein signaling pathways.</p> <p>17. Describe how the cytosolic concentration of Ca^{2+} can be altered and how the increased pool of Ca^{2+} is involved with signal transduction.</p> <p style="text-align: center;">Cellular Responses to Signals</p> <p>18. Describe how signal information is transduced into cellular responses in the cytoplasm and in the nucleus.</p> <p>19. Describe how signal amplification is accomplished in target cells.</p> <p>20. Explain why different types of cells may respond differently to the same signal molecule.</p> <p>21. Explain how scaffolding proteins help to coordinate a cell’s response to incoming signals.</p>	
<p>Assessments</p>	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>

Unit Frameworks

Unit of Study: major topics	12: The Cell Cycle	Resources that will support instruction Mitosis Microscopy Lab
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 11.A.4a Formulate hypotheses referencing prior research and knowledge. • 11.A.4b Conduct controlled experiments or simulations to test hypotheses. • 11.A.4c Collect, organize and analyze data accurately and precisely. • 11.A.4d Apply statistical methods to the data to reach and support conclusions. • 11.A.4e Formulate alternative hypotheses to explain unexpected results. • 11.A.4f Using available technology, report, display and defend to an audience conclusions drawn from investigations. • 11.A.5a Formulate hypotheses referencing prior research and knowledge. • 11.A.5b Design procedures to test the selected hypotheses • 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. • 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results. • 11.A.5e Report, display and defend the results of investigations to audiences that may include professionals and technical experts. 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	The Key Roles of Cell Division <ol style="list-style-type: none"> 1. Explain how cell division functions in reproduction, growth, and repair. 2. Describe the structural organization of a prokaryotic and eukaryotic genome. 3. Describe the major events of cell division that enable the genome of one cell to be passed on to two daughter cells. 4. Describe how the chromosome number changes throughout the human life cycle. 5. List the phases of the cell cycle and describe the sequence of events that occurs during each phase. 6. List the phases of mitosis and describe the events characteristic of each 	

phase.

7. Recognize the phases of mitosis from diagrams and micrographs.
8. Draw or describe the spindle apparatus, including centrosomes, kinetochore microtubules, nonkinetochore microtubules, asters, and centrioles (in animal cells).
9. Describe what characteristic changes occur in the spindle apparatus during each phase of mitosis.
10. Explain the current models for poleward chromosomal movement and elongation of the cell's polar axis.
11. Compare cytokinesis in animals and plants.
12. Describe the process of binary fission in bacteria and explain how eukaryotic mitosis may have evolved from binary fission.

Regulation of the Cell Cycle

13. Describe the roles of checkpoints, cyclin, Cdk, and MPF in the cell cycle control system.
14. Describe the internal and external factors that influence the cell cycle control system.
15. Explain how the abnormal cell division of cancerous cells escapes normal cell cycle controls.
16. Distinguish between benign, malignant, and metastatic tumors.
 - **11.A.4a** Formulate hypotheses referencing prior research and knowledge.
 - **11.A.4b** Conduct controlled experiments or simulations to test hypotheses.
 - **11.A.4c** Collect, organize and analyze data accurately and precisely.
 - **11.A.4d** Apply statistical methods to the data to reach and support conclusions.
 - **11.A.4e** Formulate alternative hypotheses to explain unexpected results.
 - **11.A.4f** Using available technology, report, display and defend to an audience conclusions drawn from investigations.
 - **11.A.5a** Formulate hypotheses referencing prior research and knowledge.
 - **11.A.5b** Design procedures to test the selected hypotheses
 - **11.A.5c** Conduct systematic controlled experiments to test the selected hypotheses.
 - **11.A.5d** Apply statistical methods to make predictions and to test the accuracy of results.
 - **11.A.5e** Report, display and defend the results of investigations to audiences that may include professionals and technical experts.

Assessments	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence
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Unit Frameworks

<p>Unit of Study: major topics</p>	<p>Unit 13: Meiosis and Sexual Life Cycles</p>	<p>Resources that will support instruction</p> <p>Meiosis Simulation lab</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects • 11.A.4a Formulate hypotheses referencing prior research and knowledge. • 11.A.4b Conduct controlled experiments or simulations to test hypotheses. • 11.A.4c Collect, organize and analyze data accurately and precisely. • 11.A.4d Apply statistical methods to the data to reach and support conclusions. • 11.A.4e Formulate alternative hypotheses to explain unexpected results. • 11.A.4f Using available technology, report, display and defend to an audience conclusions drawn from investigations. • 11.A.5a Formulate hypotheses referencing prior research and knowledge. • 11.A.5b Design procedures to test the selected hypotheses • 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. • 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results. • 11.A.5e Report, display and defend the results of investigations to audiences that may include professionals and technical experts. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>The Basis of Heredity</p> <ol style="list-style-type: none"> 1. Explain in general terms how traits are transmitted from parents to offspring. 2. Distinguish between asexual and sexual reproduction. <p style="text-align: center;">The Role of Meiosis in Sexual Life Cycles</p> <ol style="list-style-type: none"> 3. Distinguish between the following pairs of terms: 4. Explain how haploid and diploid cells differ from each other. State which cells in the human body are diploid and which are haploid. 5. Explain why fertilization and meiosis must alternate in all sexual life cycles. 6. Distinguish among the three life-cycle patterns characteristic of 	

	<p>eukaryotes, and name one organism that displays each pattern.</p> <ol style="list-style-type: none"> 7. List the phases of meiosis I and meiosis II and describe the events characteristic of each phase. 8. Recognize the phases of meiosis from diagrams or micrographs. 9. Describe the process of synapsis during prophase I and explain how genetic recombination occurs. 10. Describe three events that occur during meiosis I but not during mitosis. <p style="text-align: center;">Origins of Genetic Variation</p> <ol style="list-style-type: none"> 11. Explain how independent assortment, crossing over, and random fertilization contribute to genetic variation in sexually reproducing organisms. 12. Explain why heritable variation is crucial to Darwin's theory of evolution by natural selection. 		
Assessments	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td data-bbox="464 1066 1214 1465"> Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam </td> <td data-bbox="1214 1066 1549 1465" style="text-align: center; vertical-align: top;"> Other Evidence </td> </tr> </table>	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence
Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence		

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>14: Mendel and the Gene Idea</p>	<p>Resources that will support instruction</p> <p>Genetics of Drosophila lab</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 11.A.4a Formulate hypotheses referencing prior research and knowledge. • 11.A.4b Conduct controlled experiments or simulations to test hypotheses. • 11.A.4c Collect, organize and analyze data accurately and precisely. • 11.A.4d Apply statistical methods to the data to reach and support conclusions. • 11.A.4e Formulate alternative hypotheses to explain unexpected results. • 11.A.4f Using available technology, report, display and defend to an audience conclusions drawn from investigations. • 11.A.5a Formulate hypotheses referencing prior research and knowledge. • 11.A.5b Design procedures to test the selected hypotheses • 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. • 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results. • 11.A.5e Report, display and defend the results of investigations to audiences that may include professionals and technical experts. • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 13.A.4a Estimate and suggest ways to reduce the degree of risk involved in science activities. • 13.A.4b Assess the validity of scientific data by analyzing the results, sample set, sample size, similar previous experimentation, possible misrepresentation of data presented and potential sources of error. • 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Gregor Mendel’s Discoveries</p> <ol style="list-style-type: none"> 1. Explain how Mendel’s particulate mechanism differed from the blending theory of inheritance. 2. Define the following terms: <i>true-breeding</i>, <i>hybridization</i>, <i>monohybrid cross</i>, <i>P generation</i>, <i>F₁ generation</i>, and <i>F₂ generation</i>. 3. List and explain the four components of Mendel’s hypothesis that led him to deduce the law of segregation. 4. Use a Punnett square to predict the results of a monohybrid cross, stating the phenotypic and genotypic ratios of the F₂ generation. 	

5. Distinguish between the following pairs of terms: *dominant and recessive*; *heterozygous and homozygous*; *genotype and phenotype*.
6. Explain how a testcross can be used to determine if an individual with the dominant phenotype is homozygous or heterozygous.
7. Use a Punnett square to predict the results of a dihybrid cross and state the phenotypic and genotypic ratios of the F₂ generation.
8. State Mendel's law of independent assortment and describe how this law can be explained by the behavior of chromosomes during meiosis.
9. Use the rule of multiplication to calculate the probability that a particular F₂ individual will be homozygous recessive or dominant.
10. Given a Mendelian cross, use the rule of addition to calculate the probability that a particular F₂ individual will be heterozygous.
11. Use the laws of probability to predict, from a trihybrid cross between two individuals that are heterozygous for all three traits, what expected proportion of the offspring would be:
 - a. homozygous dominant for the three traits
 - b. heterozygous for all three traits
 - c. homozygous recessive for two specific traits and heterozygous for the third
12. Explain why it is important that Mendel used large sample sizes in his studies.

Extending Mendelian Genetics

13. Give an example of incomplete dominance and explain why it does not support the blending theory of inheritance.
14. Explain how phenotypic expression of the heterozygote differs with complete dominance, incomplete dominance, and codominance.
15. Explain why Tay-Sachs disease is considered recessive at the organismal level but codominant at the molecular level.
16. Explain why genetic dominance does not mean that a dominant allele subdues a recessive allele. Illustrate your explanation with the use of round versus wrinkled pea seed shape.
17. Explain why dominant alleles are not necessarily more common in a population. Illustrate your explanation with an example.
18. Describe the inheritance of the ABO blood system and explain why the I^A and I^B alleles are said to be codominant.
19. Define and give examples of *pleiotropy* and *epistasis*.
20. Describe a simple model for polygenic inheritance and explain why most

	<p>polygenic characters are described in quantitative terms.</p> <p>21. Describe how environmental conditions can influence the phenotypic expression of a character. Explain what is meant by “a norm of reaction.”</p> <p>22. Distinguish between the specific and broad interpretations of the terms <i>phenotype</i> and <i>genotype</i>.</p> <p style="text-align: center;">Mendelian Inheritance in Humans</p> <p>23. Explain why studies of human inheritance are not as easily conducted as Mendel’s work with his peas.</p> <p>24. Given a simple family pedigree, deduce the genotypes for some of the family members.</p> <p>25. Explain how a lethal recessive allele can be maintained in a population.</p> <p>26. Describe the inheritance and expression of cystic fibrosis, Tay-Sachs disease, and sickle-cell disease.</p> <p>27. Explain why lethal dominant genes are much rarer than lethal recessive genes.</p> <p>28. Give an example of a late-acting lethal dominant gene in humans and explain how it can escape elimination by natural selection.</p> <p>29. Define and give examples of multifactorial disorders in humans.</p> <p>30. Explain how carrier recognition, fetal testing, and newborn screening can be used in genetic screening and counseling.</p>	
Assessments	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	Other Evidence

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>15: The Chromosomal Basis of Inheritance</p>	<p>Resources that will support instruction</p> <p>Genetics Problem Sets</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Relating Mendelian Inheritance to the Behavior of Chromosomes</p> <ol style="list-style-type: none"> 1. Explain how the observations of cytologists and geneticists provided the basis for the chromosome theory of inheritance. 2. Explain why <i>Drosophila melanogaster</i> is a good experimental organism for genetic studies. 3. Explain why linked genes do not assort independently. 4. Distinguish between parental and recombinant phenotypes. 5. Explain how crossing over can unlink genes. 6. Explain how Sturtevant created linkage maps. 7. Define a map unit. 8. Explain why Mendel did not find linkage between seed color and flower color, despite the fact that these genes are on the same chromosome. 9. Explain how genetic maps are constructed for genes located far apart on a chromosome. 10. Explain the effect of multiple crossovers between loci. 11. Explain what additional information cytogenetic maps provide. 	

	<p style="text-align: center;">Sex Chromosomes</p> <p>12. Describe how sex is genetically determined in humans and explain the significance of the <i>SRY</i> gene.</p> <p>13. Distinguish between linked genes and sex-linked genes.</p> <p>14. Explain why sex-linked diseases are more common in human males.</p> <p>15. Describe the inheritance patterns and symptoms of color blindness, Duchenne muscular dystrophy, and hemophilia.</p> <p>16. Describe the process of X inactivation in female mammals. Explain how this phenomenon produces the tortoiseshell coloration in cats.</p>	
<p>Assessments</p>	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>

Unit Frameworks

Unit of Study: major topics	16: The Molecular Basis of Inheritance	Resources that will support instruction Molecular Model Building
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>DNA as the Genetic Material</p> <ol style="list-style-type: none"> 1. Explain why researchers originally thought protein was the genetic material. 2. Summarize the experiments performed by the following scientists that provided evidence that DNA is the genetic material: <ol style="list-style-type: none"> a. Frederick Griffith b. Oswald Avery, Maclyn McCarty, and Colin MacLeod c. Alfred Hershey and Martha Chase d. Erwin Chargaff 3. Explain how Watson and Crick deduced the structure of DNA and describe the evidence they used. Explain the significance of the research of Rosalind Franklin. 4. Describe the structure of DNA. Explain the base-pairing rule and describe its significance. <p>DNA Replication and Repair</p> <ol style="list-style-type: none"> 5. Describe the semiconservative model of replication and the significance of the experiments of Matthew Meselson and Franklin Stahl. 6. Describe the process of DNA replication, including the role of the origins of replication and replication forks. 	

	<ol style="list-style-type: none"> 7. Explain the role of DNA polymerases in replication. 8. Explain what energy source drives the polymerization of DNA. 9. Define antiparallel and explain why continuous synthesis of both DNA strands is not possible. 10. Distinguish between the leading strand and the lagging strand. 11. Explain how the lagging strand is synthesized even though DNA polymerase can add nucleotides only to the 3' end. Describe the significance of Okazaki fragments. 12. Explain the roles of DNA ligase, primer, primase, helicase, topoisomerase, and single-strand binding proteins. 13. Explain why an analogy can be made comparing DNA replication to a locomotive made of DNA polymerase moving along a railroad track of DNA. 14. Explain the roles of DNA polymerase, mismatch repair enzymes, and nuclease in DNA proofreading and repair. 15. Describe the structure and function of telomeres. 16. Explain the possible significance of telomerase in germ cells and cancerous cells. 	
Assessments	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>17: From Gene to Protein</p>	<p>Resources that will support instruction:</p> <p>Protein Building Simulation</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>The Connection Between Genes and Proteins</p> <ol style="list-style-type: none"> 1. Explain why dwarf peas have shorter stems than tall varieties. 2. Explain the reasoning that led Archibald Garrod to first suggest that genes dictate phenotypes through enzymes. 3. Describe Beadle and Tatum’s experiments with Neurospora and explain the contribution they made to our understanding of how genes control metabolism. 4. Distinguish between the “one gene one enzyme” hypothesis and the “one gene one polypeptide” hypothesis and explain why the original hypothesis was changed. 5. Explain how RNA differs from DNA. 6. Briefly explain how information flows from gene to protein. 7. Distinguish between transcription and translation. 	

8. Compare where transcription and translation occur in prokaryotes and in eukaryotes.
9. Define codon and explain the relationship between the linear sequence of codons on mRNA and the linear sequence of amino acids in a polypeptide.
10. Explain the early techniques used to identify what amino acids are specified by the triplets UUU, AAA, GGG, and CCC.
11. Explain why polypeptides begin with methionine when they are synthesized.
12. Explain what it means to say that the genetic code is redundant and unambiguous.
13. Explain the significance of the reading frame during translation.
14. Explain the evolutionary significance of a nearly universal genetic code.

The Synthesis and Processing of RNA

15. Explain how RNA polymerase recognizes where transcription should begin. Describe the promoter, the terminator, and the transcription unit.
16. Explain the general process of transcription, including the three major steps of initiation, elongation, and termination.
17. Explain how RNA is modified after transcription in eukaryotic cells.
18. Define and explain the role of *ribozyme*.
19. Describe the functional and evolutionary significance of introns.

The Synthesis of Protein

20. Describe the structure and functions of tRNA.
21. Explain the significance of wobble.
22. Explain how tRNA is joined to the appropriate amino acid.
23. Describe the structure and functions of ribosomes.
24. Describe the process of translation (including initiation, elongation, and termination) and explain which enzymes, protein factors, and energy sources are needed for each stage.

	<p>25. Describe the significance of polyribosomes.</p> <p>26. Explain what determines the primary structure of a protein and describe how a polypeptide must be modified before it becomes fully functional.</p> <p>27. Describe what determines whether a ribosome will be free in the cytosol or attached to the rough endoplasmic reticulum.</p> <p>28. Describe two properties of RNA that allow it to perform so many different functions.</p> <p>29. Compare protein synthesis in prokaryotes and in eukaryotes.</p> <p>30. Define <i>point mutations</i>. Distinguish between base-pair substitutions and base-pair insertions. Give examples of each and note the significance of such changes.</p> <p>31. Describe several examples of mutagens and explain how they cause mutations.</p> <p>32. Describe the historical evolution of the concept of a gene.</p>	
<p>Assessments</p>	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>18: The Genetics of Viruses and Bacteria</p>	<p>Resources that will support instruction</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>The Genetics of Viruses</p> <ol style="list-style-type: none"> 1. Recount the history leading up to the discovery of viruses. Include the contributions of Adolf Mayer, Dimitri Ivanowsky, Martinus Beijerinck, and Wendell Stanley. 2. List and describe the structural components of viruses. 3. Explain why viruses are obligate intracellular parasites. 4. Explain how a virus identifies its host cell. 5. Describe bacterial defenses against phages. 6. Distinguish between the lytic and lysogenic reproductive cycles, using phage lambda as an example. 7. Describe the reproductive cycle of an enveloped virus. Explain the reproductive cycle of the herpesvirus. 	

8. Describe the reproductive cycle of retroviruses.
9. List some characteristics that viruses share with living organisms and explain why viruses do not fit our usual definition of life.
10. Describe the evidence that viruses probably evolved from fragments of cellular nucleic acids.
11. Define and describe mobile genetic elements.
12. Explain how viral infections in animals cause disease.
13. Describe the best current medical defenses against viruses. Explain how AZT helps to fight HIV infections.
14. Describe the mechanisms by which new viral diseases emerge.
15. Distinguish between the horizontal and vertical routes of viral transmission in plants.
16. Describe viroids and prions.
17. Explain how a non-replicating protein can act as a transmissible pathogen.

The Genetics of Bacteria

18. Describe the structure of a bacterial chromosome.
19. Compare the sources of genetic variation in bacteria and humans.
20. Compare the processes of transformation, transduction, and conjugation.
21. Distinguish between generalized and specialized transduction.
22. Define an episome. Explain why a plasmid can be an episome.
23. Explain how the F plasmid controls conjugation in bacteria.
24. Describe the significance of R plasmids. Explain how the widespread use of antibiotics contributes to R plasmid-related disease.
25. Explain how transposable elements may cause recombination of bacterial DNA.
26. Distinguish between an insertion sequence and a transposon.
27. Describe the role of transposase in the process of transposition.
28. Briefly describe two main strategies that cells use to control metabolism.

	<p>29. Explain the adaptive advantage of genes grouped into an operon.</p> <p>30. Using the trp operon as an example, explain the concept of an operon and the function of the operator, repressor, and corepressor.</p> <p>31. Distinguish between structural and regulatory genes.</p> <p>32. Describe how the lac operon functions and explain the role of the inducer, allolactose.</p> <p>33. Explain how repressible and inducible enzymes differ and how those differences reflect differences in the pathways they control.</p> <p>34. Distinguish between positive and negative control and give examples of each from the lac operon.</p> <p>35. Explain how cyclic AMP and catabolite activator protein are affected by glucose concentration.</p>	
<p>Assessments</p>	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>

Unit Frameworks

Unit of Study: major topics	19: Eukaryotic Genomes: Organization, Regulation, and Evolution	Resources that will support instruction
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>The Structure of Eukaryotic Chromatin</p> <ol style="list-style-type: none"> 1. Compare the structure and organization of prokaryotic and eukaryotic genomes. 2. Describe the current model for progressive levels of DNA packing in eukaryotes. 3. Explain how histones influence folding in eukaryotic DNA. 4. Distinguish between heterochromatin and euchromatin. <p style="text-align: center;">The Control of Gene Expression</p> <ol style="list-style-type: none"> 5. Explain the relationship between differentiation and differential gene expression. 6. Describe at what level gene expression is generally controlled. 7. Explain how DNA methylation and histone acetylation affect 	

chromatin structure and the regulation of transcription.

8. Define *epigenetic inheritance*.
9. Describe the processing of pre-mRNA in eukaryotes.
10. Define *control elements* and explain how they influence transcription.
11. Distinguish between general and specific transcription factors.
12. Explain the role that promoters, enhancers, activators, and repressors may play in transcriptional control.
13. Explain how eukaryotic genes can be coordinately expressed and give some examples of coordinate gene expression in eukaryotes.
14. Describe the process and significance of alternative RNA splicing.
15. Describe factors that influence the life span of mRNA in the cytoplasm. Compare the longevity of mRNA in prokaryotes and in eukaryotes.
16. Explain how gene expression may be controlled at the translational and post-translational level.

The Molecular Biology of Cancer

17. Distinguish between proto-oncogenes and oncogenes. Describe three genetic changes that can convert proto-oncogenes into oncogenes.
18. Explain how mutations in tumor-suppressor genes can contribute to cancer.
19. Explain how excessive cell division can result from mutations in the *ras* proto-oncogenes.
20. Explain why a mutation knocking out the *p53* gene can lead to excessive cell growth and cancer. Describe three ways that *p53* prevents a cell from passing on mutations caused by DNA damage.
21. Describe the set of genetic factors typically associated with the development of cancer.
22. Explain how viruses can cause cancer. Describe several examples.
23. Explain how inherited cancer alleles can lead to a predisposition to certain cancers.

Genome Organization at the DNA Level

	<ol style="list-style-type: none"> 24. Describe the structure and functions of the portions of eukaryotic DNA that do not encode protein or RNA. 25. Distinguish between transposons and retrotransposons. 26. Describe the structure and location of <i>Alu</i> elements in primate genomes. 27. Describe the structure and possible function of simple sequence DNA. 28. Using the genes for rRNA as an example, explain how multigene families of identical genes can be advantageous for a cell. 29. Using a-globin and b-globin genes as examples, describe how multigene families of nonidentical genes may have evolved. 30. Define <i>pseudogenes</i>. Explain how such genes may have evolved. 31. Describe the hypothesis for the evolution of a-lactalbumin from an ancestral lysozyme gene. 32. Explain how exon shuffling could lead to the formation of new proteins with novel functions. 33. Describe how transposition of an <i>Alu</i> element may allow the formation of new genetic combinations while retaining gene function. 	
Assessments	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>20: DNA Technology and Genomics</p>	<p>Resources that will support instruction</p> <p>Transformation of Bacteria lab Gel electrophoresis lab</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 11.A.4a Formulate hypotheses referencing prior research and knowledge. • 11.A.4b Conduct controlled experiments or simulations to test hypotheses. • 11.A.4c Collect, organize and analyze data accurately and precisely. • 11.A.4d Apply statistical methods to the data to reach and support conclusions. • 11.A.4e Formulate alternative hypotheses to explain unexpected results. • 11.A.4f Using available technology, report, display and defend to an audience conclusions drawn from investigations. • 11.A.5a Formulate hypotheses referencing prior research and knowledge. • 11.A.5b Design procedures to test the selected hypotheses • 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. • 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results. • 11.A.5e Report, display and defend the results of investigations to audiences that may include professionals and technical experts. • 13.A.4a Estimate and suggest ways to reduce the degree of risk involved in science activities. • 13.A.4c Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers). • 13.A.5a Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. • 13.B.5b Analyze and describe the processes and effects of scientific and technological breakthroughs. • 13.B.5d Analyze the costs, benefits and effects of scientific and technological policies at the local, state, national and global levels (e.g., genetic research, Internet access). 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual 	<p>DNA Cloning</p>	

- **Factual**
- **Procedural**

1. Explain how advances in recombinant DNA technology have helped scientists study the eukaryotic genome.
2. Describe the natural function of restriction enzymes and explain how they are used in recombinant DNA technology.
3. Explain how the creation of sticky ends by restriction enzymes is useful in producing a recombinant DNA molecule.
4. Outline the procedures for cloning a eukaryotic gene in a bacterial plasmid.
5. Describe techniques that allow identification of recombinant cells that have taken up a gene of interest.
6. Define and distinguish between genomic libraries using plasmids, phages, and cDNA.
7. Describe the role of an expression vector.
8. Describe two advantages of using yeast cells instead of bacteria as hosts for cloning or expressing eukaryotic genes.
9. Describe two techniques to introduce recombinant DNA into eukaryotic cells.
10. Describe the polymerase chain reaction (PCR) and explain the advantages and limitations of this procedure.
11. Explain how gel electrophoresis is used to analyze nucleic acids and to distinguish between two alleles of a gene.
12. Describe the process of nucleic acid hybridization.
13. Describe the Southern blotting procedure and explain how it can be used to detect and analyze instances of restriction fragment length polymorphism (RFLP).
14. Explain how RFLP analysis facilitated the process of genomic mapping.

DNA Analysis and Genomics

15. Explain the goals of the Human Genome Project.
16. Explain how linkage mapping, physical mapping, and DNA sequencing each contributed to the genome mapping project.
17. Describe the alternate approach to whole-genome sequencing pursued by J. Craig Venter and the Celera Genomics company.
18. Explain how researchers recognize protein-coding genes within DNA sequences.
19. Describe the surprising results of the Human Genome Project.

	<p>20. Explain how the vertebrate genome, including that of humans, generates greater diversity than the genomes of invertebrate organisms.</p> <p>21. Explain how in vitro mutagenesis and RNA interference help researchers to discover the functions of some genes.</p> <p>22. Explain the purposes of gene expression studies. Describe the use of DNA microarray assays and explain how they facilitate such studies.</p> <p>23. Define and compare the fields of proteomics and genomics.</p> <p>24. Explain the significance of single nucleotide polymorphisms in the study of the human evolution.</p> <p style="text-align: center;">Practical Applications of DNA Technology</p> <p>25. Describe how DNA technology can have medical applications in such areas as the diagnosis of genetic disease, the development of gene therapy, vaccine production, and the development of pharmaceutical products.</p> <p>26. Explain how DNA technology is used in the forensic sciences.</p> <p>27. Describe how gene manipulation has practical applications for environmental and agricultural work.</p> <p>28. Describe how plant genes can be manipulated using the Ti plasmid carried by Agrobacterium as a vector.</p> <p>29. Explain how DNA technology can be used to improve the nutritional value of crops and to develop plants that can produce pharmaceutical products.</p> <p>30. Discuss the safety and ethical questions related to recombinant DNA studies and the biotechnology industry.</p>		
Assessments	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%; padding: 5px;"> Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam </td> <td style="width: 30%; padding: 5px; vertical-align: top;"> Other Evidence </td> </tr> </table>	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence
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Unit Frameworks

Unit of Study: major topics	21: The Genetic Basis of Development	Resources that will support instruction
<p>Illinois Learning Standards, Benchmarks,</p> <p>National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>From Single Cell to Multicellular Organism</p> <ol style="list-style-type: none"> 1. List the animals used as models for developmental biology research and provide a rationale for their choice. 2. Distinguish between the patterns of morphogenesis in plants and in animals. <p style="text-align: center;">Differential Gene Expression</p> <ol style="list-style-type: none"> 3. Describe how genomic equivalence was determined for plants and animals. 4. Describe what kinds of changes occur to the genome during differentiation. 5. Describe the general process by which the ewe Dolly and the first mice were cloned. 6. Describe the characteristics of stem cells. Explain their significance to medicine. 7. Distinguish between determination and differentiation. Explain why determination precedes differentiation. 8. Describe the molecular basis of determination. 	

	<p>9. Describe the two sources of information that instruct a cell to express genes at the appropriate time.</p> <p style="text-align: center;">Genetic and Cellular Mechanisms of Pattern Formation</p> <p>10. Describe how <i>Drosophila</i> was used to investigate the basic aspects of pattern formation (axis formation and segmentation).</p> <p>11. Explain how maternal genes affect polarity and development in <i>Drosophila</i> embryos.</p> <p>12. Describe how gradients of morphogens may specify the axes of developing <i>Drosophila</i> embryos.</p> <p>13. Describe how homeotic genes define the anatomical identity of the segments of a developing organism.</p> <p>14. Describe how the study of nematodes contributed to an understanding of the role of induction in development.</p> <p>15. Describe how apoptosis functions in normal and abnormal development.</p> <p>16. Describe how the study of tomatoes has contributed to the understanding of flower development.</p> <p>17. Describe how the study of <i>Arabidopsis</i> has contributed to the understanding of organ identity in plants.</p> <p>18. Provide evidence of the conservation of homeobox patterns.</p>				
<p>Assessments</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: left;">Performance Tasks</th> <th style="width: 50%; text-align: left;">Other Evidence</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;"> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p> </td> <td style="vertical-align: top;"></td> </tr> </tbody> </table>	Performance Tasks	Other Evidence	<p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	
Performance Tasks	Other Evidence				
<p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>					

Unit Frameworks

Unit of Study: major topics	22:Descent with Modification: A Darwinian View of Life	Resources that will support instruction Video: Great Transformations...
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.5a Analyze and explain biodiversity issues and the causes and effects of extinction. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). • 12.E.4b Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth. • 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories. 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	The Historical Context for Evolutionary Theory <ol style="list-style-type: none"> 1. Explain the mechanism for evolutionary change proposed by Charles Darwin in <i>On the Origin of Species</i>. 2. Define <i>evolution</i> and <i>adaptation</i>. 3. Compare and contrast Aristotle’s scala naturae to Carolus Linnaeus’ classification scheme. 4. Describe the theories of catastrophism, gradualism, and uniformitarianism. 5. Explain the mechanism for evolutionary change proposed by Jean-Baptiste de Lamarck. Explain why modern biology has rejected Lamarck’s theories. The Darwinian Revolution	

	<ol style="list-style-type: none"> 6. Describe how Darwin’s observations on the voyage of the HMS <i>Beagle</i> led him to formulate and support his theory of evolution. 7. Explain how the principle of gradualism and Charles Lyell’s theory of uniformitarianism influenced Darwin’s ideas about evolution. 8. Explain what Darwin meant by “descent with modification.” 9. Explain what evidence convinced Darwin that species change over time. 10. Explain how Linnaeus’ classification scheme fit Darwin’s theory of evolution by natural selection. 11. Describe the three inferences Darwin made from his observations that led him to propose natural selection as a mechanism for evolutionary change. 12. Explain how an essay by the Rev. Thomas Malthus influenced Charles Darwin. 13. Distinguish between artificial selection and natural selection. 14. Explain why an individual organism cannot evolve. 15. Describe the experiments that supported Reznick and Endler’s hypothesis that differences in life-history traits between guppy populations are due to selective pressure based on predation. 16. Explain how the existence of homologous and vestigial structures can be explained by Darwin’s theory of natural selection. 17. Explain how evidence from biogeography supports the theory of evolution by natural selection. 18. Explain the problem with the statement that Darwinism is “just a theory.” Distinguish between the scientific and colloquial use of the word <i>theory</i>. 		
Assessments	<table border="1"> <tr> <td data-bbox="514 1509 1143 1873"> Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam </td> <td data-bbox="1143 1509 1485 1873"> Other Evidence </td> </tr> </table>	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence
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Unit Frameworks

<p>Unit of Study: major topics</p>	<p>23: The Evolution of Populations</p>	<p>Resources that will support instruction</p> <p>Hardy-Weinberg Simulation lab</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). • 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories. • 11.A.4a Formulate hypotheses referencing prior research and knowledge. • 11.A.4b Conduct controlled experiments or simulations to test hypotheses. • 11.A.4c Collect, organize and analyze data accurately and precisely. • 11.A.4d Apply statistical methods to the data to reach and support conclusions. • 11.A.4e Formulate alternative hypotheses to explain unexpected results. • 11.A.4f Using available technology, report, display and defend to an audience conclusions drawn from investigations. • 11.A.5a Formulate hypotheses referencing prior research and knowledge. • 11.A.5b Design procedures to test the selected hypotheses • 11.A.5c Conduct systematic controlled experiments to test the selected hypotheses. • 11.A.5d Apply statistical methods to make predictions and to test the accuracy of results. • 11.A.5e Report, display and defend the results of investigations to audiences that may include professionals and technical experts. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Population Genetics</p> <ol style="list-style-type: none"> 1. Explain the statement “It is the population, not the individual, that evolves.” 2. Explain how Mendel’s particulate hypothesis of inheritance provided 	

much-needed support for Darwin's theory of evolution by natural selection.

3. Distinguish between discrete and quantitative traits. Explain how Mendel's laws of inheritance apply to quantitative traits.
4. Explain what is meant by "the modern synthesis."
5. Define the terms *population*, *species*, and *gene pool*.
6. Explain why meiosis and random fertilization alone will not alter the frequency of alleles or genotypes in a population.
7. List the five conditions that must be met for a population to remain in Hardy-Weinberg equilibrium.
8. Write the Hardy-Weinberg equation. Use the equation to calculate allele frequencies when the frequency of homozygous recessive individuals in a population is 25%.

Mutation and Sexual Recombination

9. Explain why the majority of point mutations are harmless.
10. Explain why mutation has little quantitative effect on allele frequencies in a large population.
11. Describe the significance of transposons in the generation of genetic variability.
12. Explain how sexual recombination generates genetic variability.

Natural Selection, Genetic Drift, and Gene Flow

13. Explain the following statement: "Only natural selection leads to the adaptation of organisms to their environment."
14. Explain the role of population size in genetic drift.
15. Distinguish between the bottleneck effect and the founder effect.
16. Describe how gene flow can act to reduce genetic differences between adjacent populations.

Genetic Variation, the Substrate for Natural Selection

17. Explain how quantitative and discrete characters contribute to variation within a population.
18. Distinguish between average heterozygosity and nucleotide variability.

	<p>Explain why average heterozygosity tends to be greater than nucleotide variability.</p> <p>19. Define a <i>cline</i>.</p> <p>20. Define <i>relative fitness</i>.</p> <p>a. Explain why relative fitness is zero for a healthy, long-lived, sterile organism.</p> <p>b. Explain why relative fitness could be high for a short-lived organism.</p> <p>21. Distinguish among directional, disruptive, and stabilizing selection. Give an example of each mode of selection.</p> <p>22. Explain how diploidy can protect a rare recessive allele from elimination by natural selection.</p> <p>23. Describe how heterozygote advantage and frequency-dependent selection promote balanced polymorphism.</p> <p>24. Define <i>neutral variations</i>. Explain why natural selection does not act on these alleles.</p> <p>25. Distinguish between intrasexual selection and intersexual selection.</p> <p>26. Explain how female preferences for showy male traits may benefit the female.</p> <p>27. Describe the disadvantages of sexual reproduction.</p> <p>28. Explain how the genetic variation promoted by sex may be advantageous to individuals on a generational time scale.</p> <p>29. List four reasons why natural selection cannot produce perfect organisms.</p>	
<p>Assessments</p>	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>

Unit Frameworks

Unit of Study: major topics	24: The Origin of Species	Resources that will support instruction
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.5a Analyze and explain biodiversity issues and the causes and effects of extinction. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). • 12.E.4b Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth. 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	What Is a Species? <ol style="list-style-type: none"> 1. Distinguish between anagenesis and cladogenesis. 2. Define Ernst Mayr’s biological species concept. 3. Distinguish between prezygotic and postzygotic isolating mechanisms. 4. Describe five prezygotic isolating mechanisms and give an example of each. 5. Explain a possible cause for reduced hybrid viability. 6. Explain how hybrid breakdown maintains separate species even if fertilization occurs. 7. Describe some limitations of the biological species concept. 8. Define and distinguish among the following: ecological species concept, paleontological species concept, phylogenetic species concept, and morphological species concept. Modes of Speciation <ol style="list-style-type: none"> 9. Distinguish between allopatric and sympatric speciation. 10. Explain the allopatric speciation model and describe the mechanisms that may lead to divergence of isolated gene pools. 	

	<p>11. Describe examples of adaptive radiation in the Galápagos and Hawaiian archipelagoes.</p> <p>12. Explain how reproductive barriers evolve. Describe an example of the evolution of a prezygotic barrier and the evolution of a postzygotic barrier.</p> <p>13. Define <i>sympatric speciation</i> and explain how polyploidy can cause reproductive isolation.</p> <p>14. Distinguish between an autopolyploid and an allopolyploid species and describe examples of each.</p> <p>15. Describe how cichlid fishes may have speciated in sympatry in Lake Victoria.</p> <p style="text-align: center;">Adaptive Radiation</p> <p>16. Define <i>adaptive radiation</i> and describe the circumstances under which adaptive radiation may occur.</p> <p>17. Describe the two gene loci implicated in speciation in <i>Mimulus</i>.</p> <p style="text-align: center;">From Speciation to Macroevolution</p> <p>18. Explain in general terms how a complex structure can evolve by natural selection.</p> <p>19. Define <i>exaptation</i> and illustrate this concept with an example.</p> <p>20. Explain how slight genetic divergences may lead to major morphological differences between species.</p> <p>21. Explain how the evolution of changes in temporal and spatial developmental dynamics can result in evolutionary novelties.</p> <p>22. Define <i>evo-devo</i>, <i>heterochrony</i>, <i>allometric growth</i>, and <i>paedomorphosis</i>.</p> <p>23. Explain why extracting a single evolutionary progression from a fossil record can be misleading.</p> <p>24. Define and illustrate the concept of species selection.</p> <p>25. Explain why evolutionary change is not goal-directed.</p>	
Assessments	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	Other Evidence

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>25:Phylogeny and Systematics</p>	<p>Resources that will support instruction</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.5a Analyze and explain biodiversity issues and the causes and effects of extinction. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). • 12.E.4b Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth. • 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories. 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Phylogenies are Based on Common Ancestries</p> <ol style="list-style-type: none"> 1. Distinguish between phylogeny and systematics. 2. Describe the process of sedimentation and the formation of fossils. Explain which portions of organisms are most likely to fossilize. 3. Explain why it is crucial to distinguish between homology and analogy before selecting characters to use in the reconstruction of phylogeny. 4. Explain why bird and bat wings are homologous as vertebrate forelimbs but analogous as wings. 5. Define <i>molecular systematics</i>. Explain some of the problems that systematists may face in carrying out molecular comparisons of nucleic acids. <p>Phylogenetic Systematics: Connecting Classification with Evolutionary History</p> <ol style="list-style-type: none"> 6. Explain the following characteristics of the Linnaean system of classification: <ol style="list-style-type: none"> a. binomial nomenclature b. hierarchical classification 	

	<ol style="list-style-type: none"> 7. List the major taxonomic categories from most to least inclusive. 8. Define a <i>clade</i>. Distinguish between a monophyletic clade and paraphyletic and polyphyletic groupings of species. 9. Distinguish between shared primitive characters and shared derived characters. 10. Explain how shared derived characters can be used to construct a phylogenetic diagram. 11. Explain how outgroup comparison can be used to distinguish between shared primitive characters and shared derived characters. 12. Define an <i>ingroup</i>. 13. Distinguish between a phylogram and an ultrameric tree. 14. Discuss how systematists use the principles of maximum parsimony and maximum likelihood in reconstructing phylogenies. 15. Explain why any phylogenetic diagram represents a hypothesis about evolutionary relationships among organisms. 16. Distinguish between orthologous and paralogous genes. Explain how gene duplication has led to families of paralogous genes. 17. Explain how molecular clocks are used to determine the approximate time of key evolutionary events. Explain how molecular clocks are calibrated in actual time. 18. Describe some of the limitations of molecular clocks. 19. Explain the neutral theory of evolutionary change. 20. Explain how scientists determined the approximate time when HIV-1 M first infected humans. 21. Describe the evidence that suggests there is a universal tree of life. 		
Assessments	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td data-bbox="443 1514 1206 1841"> Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam </td> <td data-bbox="1206 1514 1500 1841" style="text-align: center; vertical-align: top;"> Other Evidence </td> </tr> </table>	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence
Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence		

Unit Frameworks

Unit of Study: major topics	26: The Tree of Life: An Introduction to Biological Diversity	Resources that will support instruction
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.5a Analyze and explain biodiversity issues and the causes and effects of extinction. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). • 12.E.4b Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth. • 12.E.4a Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate tectonics). 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>The Origin of Life</p> <ol style="list-style-type: none"> 1. Describe the four stages of the hypothesis for the origin of life on Earth by chemical evolution. 2. Describe the contributions that A. I. Oparin, J.B.S. Haldane, and Stanley Miller made toward developing a model for the abiotic synthesis of organic molecules. Describe the conditions and locations where most of these chemical reactions probably occurred on Earth. 3. Describe the evidence that suggests that RNA was the first genetic material. Explain the significance of the discovery of ribozymes. 4. Describe how natural selection may have worked in an early RNA world. 5. Describe how natural selection may have favored the proliferation of stable protobionts with self-replicating, catalytic RNA. <p style="text-align: center;">Introduction to the History of Life</p> <ol style="list-style-type: none"> 6. Explain how the histories of Earth and life are inseparable. 	

	<p>7. Explain how index fossils can be used to determine the relative age of fossil-bearing rock strata. Explain how radiometric dating can be used to determine the absolute age of rock strata. Explain how magnetism can be used to date rock strata.</p> <p>8. Describe the major events in Earth’s history from its origin until 2 billion years ago. In particular, note when Earth first formed, when life first evolved, and what forms of life existed in each eon.</p> <p>9. Describe the mass extinctions of the Permian and Cretaceous periods. Discuss a hypothesis that accounts for each of these mass extinctions.</p> <p style="text-align: center;">The Major Lineages of Life</p> <p>10. Describe how chemiosmotic ATP production may have arisen.</p> <p>11. Describe the timing and significance of the evolution of oxygenic photosynthesis.</p> <p>12. Explain the endosymbiotic theory for the evolution of the eukaryotic cell. Describe the evidence that supports this theory.</p> <p>13. Explain how genetic annealing may have led to modern eukaryotic genomes.</p> <p>14. Describe the timing of key events in the evolution of the first eukaryotes and later multicellular eukaryotes.</p> <p>15. Explain how the snowball-Earth hypothesis explains why multicellular eukaryotes were so limited in size, diversity, and distribution until the late Proterozoic.</p> <p>16. Describe the key evolutionary adaptations that arose as life colonized land.</p> <p>17. Explain how continental drift explains Australia’s unique flora and fauna.</p> <p>18. Explain why R. H. Whittaker’s five-kingdom system has been replaced by a new system with three domains.</p>		
<p>Assessments</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%; padding: 5px;"> <p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p> </td> <td style="width: 30%; padding: 5px;"> <p>Other Evidence</p> </td> </tr> </table>	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>
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Unit Frameworks

Unit of Study: major topics	27:Prokaryotes	Resources that will support instruction Bacteria Microscopy lab
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	Structural, Functional, and Genetic Adaptations Contribute to Prokaryotic Success <ol style="list-style-type: none"> 1. Explain why it might be said that the history of life on Earth is one long “age of prokaryotes.” 2. Explain why prokaryotes are unable to grow in very salty or sugary foods, such as cured meats or jam. 3. State the function(s) of each of the following prokaryotic features: <ol style="list-style-type: none"> a. capsule b. fimbria c. sex pilus d. nucleoid e. plasmid f. endospore 4. Describe how prokaryotes carry out cellular respiration when they lack compartmentalized organelles such as mitochondria. 5. List the three domains of life. 6. Describe the structure, composition, and functions of prokaryotic cell walls. 7. Distinguish the structure and staining properties of gram-positive bacteria from those of gram-negative bacteria. 	

8. Explain why disease-causing gram-negative bacterial species are generally more deadly than disease-causing gram-positive bacteria.
9. Explain how the organization of prokaryotic genomes differs from that of eukaryotic genomes.
10. Describe the evidence of parallel adaptive evolution found in Lenski's experiments on *E. coli*.

Nutritional and Metabolic Diversity

11. Distinguish, with prokaryotic examples, among photoautotrophs, chemoautotrophs, photoheterotrophs, and chemoheterotrophs.
12. Distinguish among obligate aerobes, facultative anaerobes, and obligate anaerobes.
13. Explain the importance of nitrogen fixation to life on Earth.
14. Describe the specializations for nitrogen fixation in the cyanobacterium *Anabaena*.

A Survey of Prokaryotic Diversity

15. Explain why new assays for prokaryotic diversity that do not require researchers to culture microbes have been so fruitful.
16. Explain why some archaea are known as extremophiles. Describe the distinguishing features of methanogens, extreme halophiles, and extreme thermophiles.

The Ecological Impact of Prokaryotes

17. In general terms, describe the role of chemoheterotrophic and autotrophic prokaryotes in the cycling of chemical elements between the biological and chemical components of ecosystems.
18. Describe the mutualistic interaction between humans and *Bacteroides thetaiotaomicron*.
19. Distinguish among mutualism, commensalism, and parasitism. Provide an example of a prokaryote partner in each type of symbiosis.
20. Distinguish between exotoxins and endotoxins and give an example of each.
21. Describe the evidence that suggests that the dangerous *E. coli* strain O157:H7 arose through horizontal gene transfer.
22. Define *bioremediation*. Describe two examples of bioremediation involving

	prokaryotes.	
Assessments	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>28:Protists</p>	<p>Resources that will support instruction</p> <p>Protist Microscopy lab</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Protists Are Extremely Diverse</p> <ol style="list-style-type: none"> 1. Explain why the kingdom Protista is no longer considered a legitimate taxonomic group. 2. Describe the different nutritional strategies of protists. 3. Describe the three ecological categories of protists. Explain why the terms <i>protozoa</i> and <i>algae</i> are not useful as taxonomic categories. 4. Describe the evidence that supports the theory that mitochondria and plastids evolved by serial endosymbiosis. Explain which living organisms are likely relatives of the prokaryotes that gave rise to mitochondria and plastids. 5. Describe the evidence that suggests that mitochondria were acquired before plastids in eukaryotic evolution. 6. Explain the role of secondary endosymbiosis in the evolution of photosynthetic protists. <p>A Sample of Protistan Diversity</p> <ol style="list-style-type: none"> 7. Describe the reduced mitochondria of diplomonads. Explain why this group is successful despite this feature. 	

	<ol style="list-style-type: none"> 8. Explain how trypanosomes avoid detection by the human immune system. 9. Explain why <i>Plasmodium</i> continues to pose a great risk to human health despite modern medical advances. 10. Describe the process and significance of conjugation in ciliate life cycles. 11. List three differences between oomycetes and fungi. 12. Describe the life cycle, ecology, and impact on humans of the following stramenopiles: <ol style="list-style-type: none"> a. downy mildew b. diatoms c. kelp 13. Describe how amoeboid protists move and feed. 14. Explain why foraminiferans and gymnamoebas are not considered to be closely related, although both are amoebas. 15. Compare the life cycles and ecology of plasmodial and cellular slime molds. 16. Explain the problem faced by <i>Dictyostelium</i> aggregates of constraining “cheaters” that never contribute to the stalk of the fruiting body. Discuss how research on this topic may lead to insights into the evolution of multicellularity. 17. Explain the basis for the proposal for a new “plant” kingdom, Viridiplantae. 18. Describe three mechanisms by which large size and complexity have evolved in chlorophytes. 	
Assessments	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>29:Plant Diversity I: How Plants Colonized Land</p>	<p>Resources that will support instruction</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>An Overview of Land Plant Evolution</p> <ol style="list-style-type: none"> 1. Describe four shared derived homologies that link charophyceans and land plants. 2. Distinguish among the kingdoms Plantae, Streptophyta, and Viridiplantae. Note which of these is used in the textbook. 3. Describe five characteristics that distinguish land plants from charophycean algae. Explain how these features are adaptive for life on land. 4. Define and distinguish among the stages of the alternation of generations life cycle 5. Describe evidence that suggests that plants arose roughly 475 million years ago. 	

	<p style="text-align: center;">Bryophytes</p> <ol style="list-style-type: none"> 6. List and distinguish among the three phyla of bryophytes. Briefly describe the characteristics of each group. 7. Distinguish between the phylum Bryophyta and the bryophytes. 8. Explain why bryophyte rhizoids are not considered roots. 9. Explain why most bryophytes grow close to the ground. 10. Diagram the life cycle of a bryophyte. Label the gametophyte and sporophyte stages and the locations of gamete production, fertilization, and spore production. 11. Describe the ecological and economic significance of bryophytes. <p style="text-align: center;">The Origin and Diversity of Vascular Plants</p> <ol style="list-style-type: none"> 12. Describe the five traits that characterize modern vascular plants. Explain how these characteristics have contributed to their success on land. 13. Distinguish between microphylls and megaphylls. 14. Distinguish between the homosporous and heterosporous condition. 15. Explain why seedless vascular plants are most commonly found in damp habitats. 16. Name the two clades of living seedless vascular plants. 17. Explain how vascular plants differ from bryophytes. 18. Distinguish between giant and small lycophytes. 19. Explain why whisk ferns are no longer considered to be “living fossils.” 20. Describe the production and dispersal of fern spores. 		
Assessments	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%; padding: 5px;"> Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam </td> <td style="width: 30%; padding: 5px; vertical-align: top;"> Other Evidence </td> </tr> </table>	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence
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Unit Frameworks

<p>Unit of Study: major topics</p>	<p>30: Plant Diversity II: The Evolution of Seed Plants</p>	<p>Resources that will support instruction</p> <p>Plant Diversity Station lab</p>
<p>Illinois Learning Standards, Benchmarks,</p> <p>National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Key Terrestrial Adaptations Were Crucial to the Success of Seed Plants</p> <ol style="list-style-type: none"> 1. Name five terrestrial adaptations that contributed to the success of seed plants. 2. Compare the size and independence of the gametophytes of bryophytes with those of seed plants. 3. Describe the ovule of a seed plant. 4. Contrast the male gametophytes of bryophytes with those of seed plants. 5. Explain why pollen grains were an important adaptation for successful reproduction on land. 6. Explain how a seed can be said to include contributions from three distinct generations. 7. Compare spores with seeds as dispersal stages in plant life cycles. <p>Gymnosperms</p>	

8. Explain how climatic changes with the formation of the supercontinent Pangaea favored the spread of gymnosperms.
9. List and distinguish among the four phyla of gymnosperms.
10. Describe the life history of a pine. Indicate which structures are part of the gametophyte generation and which are part of the sporophyte generation.

Angiosperms (Flowering Plants)

11. Identify the following floral structures and describe a function for each:
 - a. sepal
 - b. petal
 - c. stamen
 - d. carpel
 - e. filament
 - f. anther
 - g. stigma
 - h. style
 - i. ovary
 - j. ovule
12. Define *fruit*. Explain how fruits may be adapted to disperse seeds.
13. Explain why a cereal grain is a fruit rather than a seed.
14. Diagram the generalized life cycle of an angiosperm. Indicate which structures are part of the gametophyte generation and which are part of the sporophyte generation.
15. Describe the role of the generative cell and the tube cell within the angiosperm pollen grain.
16. Explain the process and function of double fertilization.
17. Explain the significance of *Archaeofructus*.
18. Explain the significance of *Amborella*.
19. Distinguish between monocots and eudicots.
20. Explain how animals may have influenced the evolution of terrestrial plants and vice versa.

Plants and Human Welfare

21. Name the six angiosperms that are most important in the diet of the human species.
22. Describe the current threat to plant diversity caused by human population growth.

Assessments	Performance Tasks	Other Evidence
	Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	

Unit Frameworks

Unit of Study: major topics	31: Fungi	Resources that will support instruction Mushroom dissection lab
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Introduction to the Fungi</p> <ol style="list-style-type: none"> 1. List the characteristics that distinguish fungi from members of other multicellular kingdoms. 2. Explain how fungi acquire their nutrients. 3. Describe the basic body plan of a fungus. 4. Describe the processes of plasmogamy and karyogamy in fungi. 5. Explain the significance of heterokaryotic stages in fungal life cycles. <p style="text-align: center;">Diversity of Fungi</p> <ol style="list-style-type: none"> 6. Describe the evidence that suggests that Fungi and Animalia are sister kingdoms. 7. Explain the possible significance of the flagellated spores of members of the phylum Chytridiomycota. 8. Describe the life cycle of the black bread mold, <i>Rhizopus stolonifer</i>. 9. Describe two alternate hypotheses to explain the reduced mitochondria of the microsporidia. 10. Distinguish between ectomycorrhizae and endomycorrhizae. 	

	<p>11. Distinguish among the Zygomycota, Ascomycota, and Basidiomycota. Include a description of the sexual structure that characterizes each group and list some common examples of each group.</p> <p style="text-align: center;">Ecological Impacts of Fungi</p> <p>12. Describe some of the roles of fungi in ecosystems.</p> <p>13. Describe the structure of a lichen. Explain the roles of the fungal component of the lichen.</p> <p>14. Explain how lichens may act as pioneers on newly burned soil or volcanic rock.</p> <p>15. Describe the role of fungi as agricultural pests.</p> <p>16. Define mycosis, and describe some human mycoses.</p> <p>17. Describe three commercial roles played by fungi.</p>		
<p>Assessments</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;"> <p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p> </td> <td style="width: 50%; padding: 5px;"> <p>Other Evidence</p> </td> </tr> </table>	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>
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Unit Frameworks

Unit of Study: major topics	32: An Introduction to Animal Diversity	Resources that will support instruction
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
Objectives Conceptual <ul style="list-style-type: none"> ○ Factual ○ Procedural 	<p>What Is an Animal?</p> <ol style="list-style-type: none"> 1. List the five characteristics that combine to define animals. 2. Describe the role of <i>Hox</i> genes in animal development. <p style="text-align: center;">The Origins of Animal Diversity</p> <ol style="list-style-type: none"> 3. Describe the evidence that suggests animals may have first evolved about a billion years ago. 4. Explain the significance of the Cambrian explosion. Describe three hypotheses for the cause of the Cambrian explosion. 5. Outline the major grades of the animal kingdom based on symmetry, embryonic germ layers, the presence or absence and type of coelom, and protostome or deuterostome development. 6. Distinguish between radial and bilateral symmetry. Explain how animal symmetry may match the animal’s way of life. 7. Distinguish among the acoelomate, pseudocoelomate, and coelomate grades. Explain the functions of a body cavity. 	

	<p>8. Distinguish between the following pairs of terms:</p> <ol style="list-style-type: none"> diploblastic and triploblastic spiral and radial cleavage determinate and indeterminate cleavage schizocoelous and enterocoelous development <p>9. Compare the developmental differences between protostomes and deuterostomes, including:</p> <ol style="list-style-type: none"> pattern of cleavage fate of the blastopore coelom formation <p>10. Name five major features of animal phylogeny that are supported by systematic analyses of morphological characters and recent molecular studies.</p> <p>11. Distinguish between the ecdysozoans and the lophotrochozoans. Describe the characteristic features of each group.</p>				
<p>Assessments</p>	<table border="1"> <thead> <tr> <th data-bbox="396 892 1230 934">Performance Tasks</th> <th data-bbox="1230 892 1490 934">Other Evidence</th> </tr> </thead> <tbody> <tr> <td data-bbox="396 934 1230 1659"> <p>Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam</p> </td> <td data-bbox="1230 934 1490 1659"></td> </tr> </tbody> </table>	Performance Tasks	Other Evidence	<p>Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam</p>	
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Unit Frameworks

Unit of Study: major topics	33: Invertebrates	Resources that will support instruction
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Sponges</p> <ol style="list-style-type: none"> 1. From a diagram, identify the parts of a sponge (including the spongocoel, porocyte, epidermis, choanocyte, mesohyl, amoebocyte, osculum, and spicules) and describe the function of each. <p style="text-align: center;">Eumetazoa</p> <ol style="list-style-type: none"> 2. List the characteristics of the phylum Cnidaria that distinguish it from the other animal phyla. 3. Describe the specialized cells that are found in Cnidarians. 4. Describe the two basic body plans in Cnidaria and their role in Cnidarian life cycles. 5. List the four classes of Cnidaria and distinguish among them based on life cycle and morphological characteristics. <p style="text-align: center;">Bilateria</p> <ol style="list-style-type: none"> 6. Distinguish between: <ol style="list-style-type: none"> a. diploblastic and triploblastic development b. acoelomates and coelomates c. gastrovascular cavity and alimentary canal 	

d. protostome and deuterostome

7. List the characteristics of the phylum Platyhelminthes that distinguish it from the other animal phyla.
8. Distinguish among the four classes of Platyhelminthes and give examples of each.
9. Describe the generalized life cycle of a trematode and give an example of one fluke that parasitizes humans.
10. Explain how trematodes evade detection by the immune systems of their hosts.
11. Describe the anatomy and generalized life cycle of a tapeworm.
12. Describe unique features of rotifers that distinguish them from other pseudocoelomates.
13. Define *parthenogenesis* and describe asexual forms of rotifer reproduction.
14. Define *lophophore* and list three lophophorate phyla.
15. List the distinguishing characteristics of the phylum Nemertea.
16. Explain the relationship between nemertean and flatworms.
17. List the characteristics that distinguish the phylum Mollusca from the other animal phyla.
18. Describe the basic body plan of a mollusc and explain how it has been modified in the Bivalvia, Cephalopoda, Gastropoda, and Polyplacophora.
19. List the characteristics that distinguish the phylum Annelida from other animal phyla.
20. Distinguish among the three classes of Annelida and give examples of each.
21. Describe the adaptations that enable some leeches to feed on blood.
22. List the characteristics of the phylum Nematoda that distinguish it from other wormlike animals.
23. Give examples of both parasitic and free-living species of nematodes.
24. List the characteristics of arthropods that distinguish them from the other animal phyla. List the three features that account for the success of this phylum.
25. Describe advantages and disadvantages of an exoskeleton.
26. Distinguish between hemocoel and coelom.
27. Define and distinguish between the major arthropod lines of evolution represented

	<p>by:</p> <ol style="list-style-type: none"> a. Cheliceriformes b. Hexapoda c. Crustacea d. Myriapoda <p>28. Describe three specialized features of spiders.</p> <p>29. Describe two features that may account for the great diversity of insects.</p> <p style="text-align: center;">Deuterostomia</p> <p>30. List the characteristics of echinoderms that distinguish them from other animal phyla.</p> <p>31. Distinguish among the six classes of echinoderms and give examples of each.</p> <p>32. Explain why the phylum Chordata is included in a chapter on invertebrates.</p> <p>33. Describe the developmental similarities between echinoderms and chordates.</p>	
<p>Assessments</p>	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>34: Vertebrates</p>	<p>Resources that will support instruction</p> <p>Human Evolution Video</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.A.5b Analyze the transmission of genetic traits, diseases and defects. • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Invertebrate Chordates and the Origin of Vertebrates</p> <ol style="list-style-type: none"> 1. Distinguish between the phyla of deuterostomes. 2. Describe the four derived traits that define the phylum Chordata. 3. Distinguish among the three subphyla of the phylum Chordata and give examples of each. 4. Discuss the evidence for and against Garstang’s hypothesis that vertebrates had a tunicate-like ancestor. 5. Explain what lancelets suggest about the evolution of the chordate brain. <p style="text-align: center;">Craniates Are Chordates with a Head</p> <ol style="list-style-type: none"> 6. Discuss the importance of genetic duplication in chordate evolution. 7. Explain the fate of the neural crest cells in craniate development. 8. Explain what <i>Haikouella</i> and <i>Haikouichthys</i> tell us about craniate evolution. 	

Vertebrates Are Craniates with a Backbone

9. Describe the way of life and unique characters of the lamprey.
10. Describe conodonts, and explain why they are considered vertebrates.
11. Describe the trends in mineralized structures in early vertebrates.

Gnathostomes Are Vertebrates with Jaws

12. Explain one hypothesis for the evolution of the jaws of gnathostomes.
13. List the shared, derived characters that characterize gnathostomes.
14. Describe the evidence that suggests that the loss of bone in Chondrichthyes is a derived feature.
15. Describe the features of sharks that are adaptive for their active, predatory lifestyle.
16. Describe and distinguish between Chondrichthyes and Osteichthyes, noting the main traits of each group.
17. Identify and describe the main subgroups of Osteichthyes.
18. Name the three living lineages of lobe-fins.

Tetrapods Are Gnathostomes with Limbs and Feet

19. Define and distinguish between *gnathostomes*, *tetrapods*, and *amniotes*.
20. Explain what *Acanthostega* suggests about the origin of tetrapods.
21. Describe the common traits of amphibians and distinguish among the three orders of living amphibians.

Amniotes Have Amniotic Eggs

22. Describe an amniotic egg and explain its significance in the evolution of reptiles and mammals.
23. Explain why the reptile clade includes birds.
24. Describe a number of reptile features that are adaptive for life on land.
25. Explain why non-bird reptiles should be called “ectothermic” rather than “cold-blooded.”
26. Define and describe the *parareptiles*.
27. Distinguish between the lepidosaurs and the archosaurs.

	<p>28. Compare the interpretations of dinosaurs as ectotherms or endotherms.</p> <p>29. Describe the specialized adaptations of snakes that make them successful predators.</p> <p>30. List the modifications of birds that are adaptive for flight.</p> <p>31. Summarize the evidence supporting the hypothesis that birds evolved from theropod dinosaur ancestors.</p> <p>32. Explain the significance of <i>Archaeopteryx</i>.</p> <p>33. Describe the characteristic derived characters of mammals.</p> <p>34. Describe the evolutionary origin of mammals.</p> <p>35. Distinguish among monotreme, marsupial, and eutherian mammals.</p> <p>36. Describe the adaptive radiation of mammals during the Cretaceous and early Tertiary periods.</p> <p>37. Compare and contrast the four main evolutionary clades of eutherian mammals.</p> <p style="text-align: center;">Primates and the Evolution of <i>Homo sapiens</i></p> <p>38. Describe the general characteristics of primates. Note in particular the features associated with an arboreal existence.</p> <p>39. Distinguish between the two subgroups of primates and describe their early evolutionary relationship.</p> <p>40. Distinguish between <i>hominoid</i> and <i>hominid</i>.</p> <p>41. Explain what <i>Sahelanthropus</i> tells us about hominid evolution.</p> <p>42. Describe the evolution of <i>Homo sapiens</i> from australopith ancestors. Clarify the order in which distinctive human traits arose</p>		
Assessments	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%; padding: 5px;"> Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam </td> <td style="width: 30%; padding: 5px;"> Other Evidence </td> </tr> </table>	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence
Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence		

Unit Frameworks

Unit of Study: major topics	35: Plant Structure, Growth, and Development	Resources that will support instruction Plant Cell Microscopy Lab
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>The Plant Body</p> <ol style="list-style-type: none"> 1. Describe and compare the three basic organs of vascular plants. Explain how these basic organs are interdependent. 2. List the basic functions of roots. Describe and compare the structures and functions of fibrous roots, taproots, root hairs, and adventitious roots. 3. Describe the basic structure of plant stems. 4. Explain the phenomenon of apical dominance. 5. Describe the structures and functions of four types of modified shoots. 6. Describe and distinguish between the leaves of monocots and those of eudicots. 7. Describe the three tissue systems that make up plant organs. 8. Describe and distinguish between the three basic cell types of plant tissues. For each tissue, describe one characteristic structural feature and explain its functional significance. 9. Explain the functional relationship between a sieve-tube member and its companion cell. <p>The Process of Plant Growth and Development</p>	

10. Distinguish between determinate and indeterminate growth. Give an example of each type of growth.
11. Distinguish among annual, biennial, and perennial plants.
12. Explain this statement: “In contrast to most animals, which have a stage of embryonic growth, plants have regions of embryonic growth.”
13. Distinguish between the primary and secondary plant body.
14. Describe in detail the primary growth of the tissues of roots and shoots.
15. Describe in detail the secondary growth of the tissues of roots and shoots.
16. Name the cells that make up the tissue known as wood. Name the tissues that comprise the bark.

Mechanisms of Plant Growth and Development

17. Explain why *Arabidopsis* is an excellent model for the study of plant development.
18. Explain what each of these *Arabidopsis* mutants has taught us about plant development:
 - a. *fass* mutant
 - b. *gnom* mutant
 - c. *KNOTTED-1* mutant
 - d. *GLABRA-2* mutant
19. Define and distinguish between *morphogenesis*, *differentiation*, and *growth*.
20. Explain why (a) the plane and symmetry of cell division, (b) the orientation of cell expansion, and (c) cortical microtubules are important determinants of plant growth and development.
21. Explain how pattern formation may be determined in plants.
22. Give an example to demonstrate how a cell’s location influences its developmental
23. Explain how a vegetative shoot tip changes into a floral meristem.
24. Describe how three classes of organ identity genes interact to produce the spatial pattern of floral organs in *Arabidopsis*.

Assessments	Performance Tasks	Other Evidence
	Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	

Unit Frameworks

Unit of Study: major topics	36: Transport in Vascular Plants	Resources that will support instruction Transpiration Lab
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p style="text-align: center;">An Overview of Transport Mechanisms in Plants</p> <ol style="list-style-type: none"> 1. Describe how proton pumps function in transport of materials across plant membranes, using the terms <i>proton gradient</i>, <i>membrane potential</i>, <i>cotransport</i>, and <i>chemiosmosis</i>. 2. Define osmosis and <i>water potential</i>. Explain how water potential is measured. 3. Explain how solutes and pressure affect water potential. 4. Explain how the physical properties of plant cells are changed when the plant is placed into solutions that have higher, lower, or the same solute concentration. 5. Define the terms <i>flaccid</i>, <i>plasmolyze</i>, <i>turgor pressure</i>, and <i>turgid</i>. 6. Explain how aquaporins affect the rate of water transport across membranes. 7. Name the three major compartments in vacuolated plant cells. 8. Distinguish between the symplast and the apoplast. 9. Describe three routes available for lateral transport in plants. 	

10. Define *bulk* flow and describe the forces that generate pressure in the vascular tissue of plants.
11. Relate the structure of sieve-tube cells, vessel cells, and tracheids to their functions in bulk flow.

Absorption of Water and Minerals by Roots

12. Explain what routes are available to water and minerals moving into the vascular cylinder of the root.
13. Explain how mycorrhizae enhance uptake of materials by roots.
14. Explain how the endodermis functions as a selective barrier between the root cortex and vascular cylinder.

Transport of Xylem Sap

15. Describe the potential and limits of root pressure to move xylem sap.
16. Define the terms *transpiration* and *guttation*.
17. Explain how transpirational pull moves xylem sap up from the root tips to the leaves.
18. Explain how cavitation prevents the transport of water through xylem vessels.
19. Explain this statement: "The ascent of xylem sap is ultimately solar powered."

The Control of Transpiration

20. Explain the importance and costs of the extensive inner surface area of a leaf.
21. Discuss the factors that may alter the stomatal density of a leaf.
22. Describe the role of guard cells in photosynthesis-transpiration.
23. Explain how and when stomata open and close. Describe the cues that trigger stomatal opening at dawn.
24. Explain how xerophytes reduce transpiration.
25. Describe crassulacean acid metabolism and explain why it is an important adaptation to reduce transpiration in arid environments.

	<p style="text-align: center;">Translocation of Phloem Sap</p> <p>26. Define and describe the process of translocation. Trace the path of phloem sap from a primary sugar source to a sugar sink.</p> <p>27. Describe the process of sugar loading and unloading.</p> <p>28. Define <i>pressure flow</i>. Explain the significance of this process in angiosperms.</p>	
Assessments	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exams</p>	<p>Other Evidence</p>

Unit Frameworks

Unit of Study: major topics	39: Plant Response to Internal and External Signals	Resources that will support instruction
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Signal Transduction and Plant Responses</p> <ol style="list-style-type: none"> 1. Compare the growth of a plant in darkness (etiolation) to the characteristics of greening (de-etiolation). 2. Describe the signal pathways associated with de-etiolation. 3. Describe the role of second messengers in the process of de-etiolation. 4. Describe the two main mechanisms by which a signaling pathway can activate an enzyme. 5. Explain, using several examples, what researchers have learned about the activity of plant hormones by study of mutant plants. <p style="text-align: center;">Plant Responses to Hormones</p> <ol style="list-style-type: none"> 6. For the following scientists, describe their hypothesis, experiments, and conclusions about the mechanism of phototropism: <ol style="list-style-type: none"> a. Charles and Francis Darwin b. Peter Boysen-Jensen c. Frits Went 7. List six classes of plant hormones, describe their major functions, and note where they are produced in the plant. 8. Explain how a hormone may cause its effect on plant growth and development. 	

9. Describe a possible mechanism for the polar transport of auxin.
10. According to the acid growth hypothesis, explain how auxin can initiate cell elongation.
11. Explain why 2,4-D is widely used as a weed killer.
12. Explain how the ratio of cytokinin to auxin affects cell division and cell differentiation.
13. Describe the evidence that suggests that factors other than auxin from the terminal bud may control apical dominance.
14. Describe how stem elongation and fruit growth depend on a synergism between auxin and gibberellins.
15. Explain the probable mechanism by which gibberellins trigger seed germination.
16. Describe the functions of brassinosteroids in plants.
17. Describe how abscisic acid (ABA) helps prepare a plant for winter.
18. Describe the effects of ABA on seed dormancy and drought stress.
19. Describe the role of ethylene in the triple response to mechanical stress, apoptosis, leaf abscission, and fruit ripening.

Plant Responses to Light

20. Define *photomorphogenesis* and note which colors are most important to this process.
21. Compare the roles of blue-light photoreceptors and phytochromes.
22. Describe the phenomenon of chromophore photoreversibility and explain its role in light-induced germination of lettuce seeds.
23. Define *circadian rhythm* and explain what happens when an organism is artificially maintained in a constant environment.
24. List some common factors that entrain biological clocks.
25. Define *photoperiodism*.
26. Distinguish among short-day, long-day, and day-neutral plants. Explain why these names are misleading.
27. Explain what factors other than night length may control flowering and what is necessary for flowering to occur.

Plant Responses to Environmental Stimuli Other than Light

	<p>28. Describe how plants apparently tell up from down. Explain why roots display positive gravitropism and shoots exhibit negative gravitropism.</p> <p>29. Distinguish between thigmotropism and thigmomorphogenesis.</p> <p>30. Describe how motor organs can cause rapid leaf movements.</p> <p>31. Provide a plausible explanation for how a stimulus that causes rapid leaf movement can be transmitted through the plant.</p> <p>32. Describe the challenges posed by, and the responses of plants to, the following environmental stresses: drought, flooding, salt stress, heat stress, and cold stress.</p> <p style="text-align: center;">Plant Defense: Responses to Herbivores and Pathogens</p> <p>33. Explain how plants deter herbivores with physical and chemical defenses.</p> <p>34. Describe the multiple ways that plants defend against pathogens.</p>	
Assessments	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exams</p>	<p>Other Evidence</p>

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>40: Basic Principles of Animal Form and Function</p>	<p>Resources that will support instruction</p> <p>Animal Cell Type Microscopy Lab</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Functional Animal Anatomy: An Overview</p> <ol style="list-style-type: none"> 1. Define <i>bioenergetics</i>. 2. Distinguish between anatomy and physiology. Explain how functional anatomy relates to these terms. <p style="text-align: center;">Body Plans and the External Environment</p> <ol style="list-style-type: none"> 3. Explain how physical laws constrain animal form. 4. Explain how the size and shape of an animal’s body affect its interactions with the environment. 5. Define <i>tissue</i>. 6. Distinguish among collagenous fibers, elastic fibers, and reticular fibers. 7. From micrographs or diagrams, correctly identify the following animal tissues, explain how their structure relates to their functions, and note examples of each type. <ol style="list-style-type: none"> a. Epithelial tissue b. Connective tissue <ol style="list-style-type: none"> i. Loose connective tissue ii. Adipose tissue iii. Fibrous connective tissue 	

- iv. Cartilage
- v. Bone
- vi. Blood
- c. Muscle tissue
 - i. Skeletal (striated) muscle
 - ii. Cardiac muscle
 - iii. Smooth muscle
- d. Nervous tissue
 - i. Neuron

Introduction to the Bioenergetics of Animals

- 8. Describe the basic sources of chemical energy and their fate in animal cells.
- 9. Define *biosynthesis*.
- 10. Define *metabolic rate* and explain how it can be determined for animals.
- 11. Distinguish between endothermic and exothermic animals.
- 12. Describe the relationship between metabolic rate and body size.
- 13. Distinguish between basal metabolic rate and standard metabolic rate. Describe the major factors that influence energy requirements.
- 14. Describe the natural variations found in the energy strategies of endotherms and ectotherms.

Regulating the Internal Environment

- 15. Distinguish between regulators and conformers for a particular environmental variable.
- 16. Define *homeostasis*. Describe the three functional components of a homeostatic control system.
- 17. Distinguish between positive and negative feedback mechanisms.
- 18. Define *thermoregulation*. Explain in general terms how endotherms and ectotherms manage their heat budgets.
- 19. Name four physical processes by which animals exchange heat with their environment.
- 20. Discuss the role of hair, feathers, and adipose tissue in insulation.
- 21. Explain the role of vasoconstriction and vasodilation in modifying the transfer of body heat with the environment.

	<p>22. Describe animal adaptations to facilitate evaporative cooling.</p> <p>23. Describe thermoregulatory mechanisms utilized by endothermic invertebrates.</p> <p>24. Explain how ectotherms and endotherms may acclimatize to changing environmental temperatures.</p> <p>25. Explain the role of heat-shock proteins in helping cells to cope with severe temperature changes.</p> <p>26. Define <i>torpor</i>, <i>hibernation</i>, <i>estivation</i>, and <i>daily torpor</i>.</p>	
Assessments	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>41: Animal Nutrition</p>	<p>Resources that will support instruction</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Nutritional Requirements of Animals</p> <ol style="list-style-type: none"> 1. Compare the bioenergetics of animals when energy balance is positive and when it is negative. 2. Name the three nutrition needs that must be met by a nutritionally adequate diet. 3. Distinguish among undernourishment, overnourishment, and malnourishment. 4. Explain why fat hoarding may have provided a fitness advantage to our hunter-gatherer ancestors. 5. Explain the role of leptin in the regulation of fat storage and use. 6. Define <i>essential nutrients</i> and describe the four classes of essential nutrients. 7. Distinguish between water-soluble and fat-soluble vitamins. <p>Overview of Food Processing</p>	

	<p>8. Define and compare the four main stages of food processing.</p> <p>9. Compare intracellular and extracellular digestion.</p> <p style="text-align: center;">The Mammalian Digestive System</p> <p>10. Describe the common processes and structural components of the mammalian digestive system.</p> <p>11. Name three functions of saliva.</p> <p>12. Compare where and how the major types of macromolecules are digested and absorbed within the mammalian digestive system.</p> <p>13. Explain why pepsin does not digest the stomach lining. Explain how the small intestine is specialized for digestion and absorption.</p> <p>14. Explain how the small intestine is specialized for digestion and absorption.</p> <p>15. Describe the major functions of the large intestine.</p> <p style="text-align: center;">Evolutionary Adaptations of Vertebrate Digestive Systems</p> <p>16. Relate variations in dentition and length of the digestive system to the feeding strategies and diets of herbivores, carnivores, and omnivores.</p> <p>17. Describe the roles of symbiotic microorganisms in vertebrate digestion.</p>	
Assessments	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>42:Circulation and Gas Exchange</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions).
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p>Circulation in Animals</p> <ol style="list-style-type: none"> 1. Describe the need for circulatory and respiratory systems due to increasing animal body size. 2. Explain how a gastrovascular cavity functions in part as a circulatory system. 3. Distinguish between open and closed circulatory systems. List the three basic components common to both systems. 4. List the structural components of a vertebrate circulatory system and relate their structure to their functions. 5. Describe the general relationship between metabolic rates and the structure of the vertebrate circulatory system. 6. Using diagrams, compare and contrast the circulatory systems of fish, amphibians, non-bird reptiles, and mammals or birds. 7. Distinguish between pulmonary and systemic circuits and explain the functions of each. 8. Explain the advantage of double circulation over a single circuit.

9. Define a *cardiac cycle*, distinguish between systole and diastole, and explain what causes the first and second heart sounds.
10. Define *cardiac output* and describe two factors that influence it.
11. List the four heart valves, describe their location, and explain their functions.
12. Define *heart murmur* and explain its cause.
13. Define *sinoatrial (SA) node* and describe its location in the heart.
14. Distinguish between a myogenic heart and a neurogenic heart.
15. Describe the origin and pathway of the action potential (cardiac impulse) in the normal human heart.
16. Explain how the pace of the SA node can be modulated by nerves, hormones, body temperature, and exercise.
17. Relate the structures of capillaries, arteries, and veins to their functions.
18. Explain why blood flow through capillaries is substantially slower than it is through arteries and veins.
19. Define *blood pressure* and describe how it is measured.
20. Explain how peripheral resistance and cardiac output affect blood pressure.
21. Explain how blood returns to the heart even though it must sometimes travel from the lower extremities against gravity.
22. Explain how blood flow through capillary beds is regulated.
23. Explain how osmotic pressure and hydrostatic pressure regulate the exchange of fluid and solutes across capillaries.
24. Describe the composition of lymph and explain how the lymphatic system helps the normal functioning of the circulatory system. Explain the role of lymph nodes in body defense.
25. Describe the composition and functions of plasma.
26. Relate the structure of erythrocytes to their function.
27. List the five main types of white blood cells and characterize their functions.
28. Describe the structure of platelets.
29. Outline the formation of erythrocytes from their origin from stem cells in the red marrow of bones to their destruction by phagocytic cells.
30. Describe the hormonal control of erythrocyte production.
31. Outline the sequence of events that occurs during blood clotting and explain

what prevents spontaneous clotting in the absence of injury.

32. Distinguish between a heart attack and a stroke.
33. Distinguish between low-density lipoproteins (LDLs) and high-density lipoproteins (HDLs).
34. List the factors that have been correlated with an increased risk of cardiovascular disease.

Gas Exchange in Animals

35. Define *gas exchange* and distinguish between a respiratory medium and a respiratory surface.
36. Describe the general requirements for a respiratory surface and list a variety of respiratory organs that meet these requirements.
37. Describe respiratory adaptations of aquatic animals.
38. Describe the advantages and disadvantages of water as a respiratory medium.
39. Describe countercurrent exchange and explain why it is more efficient than the concurrent flow of water and blood.
40. Describe the advantages and disadvantages of air as a respiratory medium and explain how insect tracheal systems are adapted for efficient gas exchange in a terrestrial environment.
41. For the human respiratory system, describe the movement of air through air passageways to the alveolus, listing the structures that air must pass through on its journey.
42. Compare positive and negative pressure breathing. Explain how respiratory movements in humans ventilate the lungs.
43. Distinguish between tidal volume, vital capacity, and residual volume.
44. Explain how the respiratory systems of birds and mammals differ.
45. Explain how breathing is controlled in humans.
46. Define *partial pressure* and explain how it influences diffusion across respiratory surfaces.
47. Describe the adaptive advantage of respiratory pigments in circulatory systems. Distinguish between hemocyanin and hemoglobin as respiratory pigments.
48. Draw the Hb-oxygen dissociation curve, explain the significance of its shape, and explain how the affinity of hemoglobin for oxygen changes with oxygen concentration.

	<p>49. Describe how carbon dioxide is picked up at the tissues and deposited in the lungs.</p> <p>50. Describe the respiratory adaptations of the pronghorn that give it great speed and endurance.</p> <p>51. Describe respiratory adaptations of diving mammals and the role of myoglobin.</p>
<p>Assessments</p>	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>

Unit Frameworks

Unit of Study: major topics	43: The Immune System	Resources that will support instruction
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	Nonspecific Defenses Against Infection <ol style="list-style-type: none"> 1. Explain what is meant by nonspecific defense and list the nonspecific lines of defense in the vertebrate body. 2. Distinguish between: <ol style="list-style-type: none"> a. innate and acquired immunity b. humoral and cell mediated response 3. Explain how the physical barrier of skin is reinforced by chemical defenses. 4. Define <i>phagocytosis</i>. Name four types of phagocytic leukocytes. 5. Explain how interferon limits cell-to-cell spread of viruses. 6. Describe the inflammation response, including how it is triggered. 7. Describe the factors that influence phagocytosis during the inflammation response. 8. Explain how the action of natural killer cells differs from the action of phagocytes. 9. Explain what occurs during the condition known as septic shock. 10. Describe the roles of antimicrobial proteins in innate immunity. 	

How Specific Immunity Arises

11. Distinguish between antigens and antibodies.
12. Distinguish between antigen and epitope.
13. Explain how B lymphocytes and T lymphocytes recognize specific antigens
14. Explain how the particular structure of a lymphocyte's antigen binding site forms during development. Explain the role of recombinase in generating the staggering variability of lymphocytes.
15. Explain why the antigen receptors of lymphocytes are tested for self-reactivity during development. Predict the consequences that would occur if such testing did not take place.
16. Describe the mechanism of clonal selection. Distinguish between effector cells and memory cells.
17. Distinguish between primary and secondary immune responses.
18. Describe the cellular basis for immunological memory.
19. Describe the variation found in the major histocompatibility complex (MHC) and its role in the rejection of tissue transplants. Explain the adaptive advantage of this variation.
20. Compare the structures and functions of cytotoxic T cells and helper T cells.
21. Compare the production and functions of class I MHC and class II MHC molecules.

Immune Responses

22. Distinguish between humoral immunity and cell-mediated immunity.
23. Describe the roles of helper T lymphocytes in both humoral and cell-mediated immunity.
24. Describe the functions of the proteins CD4 and CD8.
25. Explain how cytotoxic T cells and natural killer cells defend against tumors.
26. Distinguish between T-dependent antigens and T-independent antigens.
27. Explain why macrophages are regarded as the main antigen-presenting cells in the primary response but memory B cells are the main antigen-presenting cells in the secondary response.
28. Explain how antibodies interact with antigens.

29. Diagram and label the structure of an antibody and explain how this structure allows antibodies to (a) recognize and bind to antigens, and (b) assist in the destruction and elimination of antigens.
 30. Distinguish between the variable (V) and constant (C) regions of an antibody molecule.
 31. Describe the production and uses of monoclonal antibodies.
 32. Compare the processes of neutralization, opsonization, and agglutination.
- Immunity in Health and Disease**
33. Distinguish between active and passive immunity and describe examples of each.
 34. Explain how the immune response to Rh factor differs from the response to A and B blood antigens.
 35. Describe the potential problem of Rh incompatibility between a mother and her unborn fetus and explain what precautionary measures may be taken.
 36. Explain what is done medically to reduce the risk of tissue transplant rejection due to differences in the MHC. Explain what is unique about the source of potential immune rejection in bone marrow grafts.
 37. Describe an allergic reaction, including the roles of IgE, mast cells, and histamine.
 38. Explain what causes anaphylactic shock and how it can be treated.
 39. List three autoimmune disorders and describe possible mechanisms of autoimmunity.
 40. Distinguish between inborn and acquired immunodeficiency.
 41. Explain how general health and mental well-being might affect the immune system.
 42. Describe the infectious agent that causes AIDS and explain how it enters a susceptible cell.
 43. Explain how HIV is transmitted and describe its incidence throughout the world. Note strategies that can reduce a person's risk of infection.

Assessments	Performance Tasks	Other Evidence
	Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	

Unit Frameworks

Unit of Study: major topics	44: Osmoregulation and Excretion	Resources that will support instruction
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p style="text-align: center;">An Overview of Osmoregulation</p> <ol style="list-style-type: none"> 1. Define <i>osmoregulation</i> and <i>excretion</i>. 2. Define <i>osmolarity</i> and distinguish among <i>isoosmotic</i>, <i>hyperosmotic</i>, and <i>hypoosmotic</i> solutions. 3. Distinguish between osmoregulators and osmoconformers. Explain why osmoregulation has an energy cost. 4. Distinguish between stenohaline and euryhaline animals, and explain why euryhaline animals include both osmoconformers and osmoregulators. 5. Discuss the osmoregulatory strategies of marine animals. 6. Explain how the osmoregulatory problems of freshwater animals differ from those of marine animals. 7. Describe anhydrobiosis as an adaptation that helps tardigrades and nematodes to survive periods of dehydration. 8. Describe some adaptations that reduce water loss in terrestrial animals. 9. Describe the ultimate function of osmoregulation. Explain how hemolymph and interstitial fluids are involved in this process. 10. Explain the role of transport epithelia in osmoregulation and excretion. <p style="text-align: center;">Water Balance and Waste Disposal</p>	

11. Describe the production and elimination of ammonia. Explain why ammonia excretion is most common in aquatic species.
12. Compare the strategies to eliminate waste as ammonia, urea, or uric acid. Note which animal groups are associated with each process and why a particular strategy is most adaptive for a particular group.
13. Compare the amounts of nitrogenous waste produced by endotherms and ectotherms, and by predators and herbivores.

Excretory Systems

14. Describe the key steps in the process of urine production.
15. Describe how a flame-bulb (protonephridial) excretory system functions.
16. Explain how the metanephridial excretory tubule of annelids functions. Compare the structure to the protonephridial system.
17. Describe the Malpighian tubule excretory system of insects.
18. Using a diagram, identify and give the function of each structure in the mammalian excretory system.
19. Using a diagram, identify and describe the function of each region of the nephron.
20. Describe and explain the relationships among the processes of filtration, reabsorption, and secretion in the mammalian kidney.
21. Distinguish between cortical and juxtamedullary nephrons. Explain the significance of the juxtamedullary nephrons of birds and mammals.
22. Explain how the loop of Henle enhances water conservation by the kidney.
23. Explain how the loop of Henle functions as a countercurrent multiplier system.
24. Describe the nervous and hormonal controls involved in the regulation of the kidney.
25. Explain how the feeding habits of the South American vampire bat illustrate the versatility of the mammalian kidney.
26. Describe the structural and physiological adaptations in the kidneys of nonmammalian species that allow them to osmoregulate in different environments.

Assessments	Performance Tasks Homework completion Contribution to classroom discussion	Other Evidence
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	Lab work and reports Quizzes Exam	
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Unit Frameworks

Unit of Study: major topics	45: Hormones and the Endocrine System	Resources that will support instruction
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p style="text-align: center;">An Introduction to Regulatory Systems</p> <ol style="list-style-type: none"> 1. Compare the response times of the two major systems of internal communication: the nervous system and the endocrine system. 2. Explain how neurosecretory cells, epinephrine, and control of day/night cycles illustrate the integration of the endocrine and nervous systems. 3. Describe the organization of a stimulus, receptor, control center, efferent signal, and effector in a simple endocrine pathway. 4. Describe an example of a negative feedback loop in an endocrine pathway involved in maintaining homeostasis. 5. Explain why the neurohormone pathway that regulates the release of milk by a nursing mother is an example of positive feedback. <p style="text-align: center;">Chemical Signals and Their Modes of Action</p>	

6. List the three major classes of molecules that function as hormones in vertebrates.
7. Name the three key events involved in signaling by vertebrate hormones.
8. Explain what changes may be triggered by a signal transduction pathway initiated by the binding of a water-soluble hormone to a receptor in the plasma membrane of a target cell.
9. Discuss how and why different target cells exposed to the same hormone may respond in different ways.
10. Describe the nature and location of intracellular receptors for hormones that pass easily through cell membranes. Explain how their role compares to the signal-transduction pathway noted above, and describe the changes they are likely to trigger within the target cell.
11. Explain the role of local regulators in paracrine signaling. Describe the diverse functions of cytokines, growth factors, nitric oxide, and prostaglandins.

The Vertebrate Endocrine System

12. Explain how the hypothalamus and pituitary glands interact and how they coordinate the endocrine system.
13. Describe the location of the pituitary. List and explain the functions of the hormones released from the anterior and posterior lobes.
14. Explain the role of tropic hormones in coordinating endocrine signaling throughout the body. Distinguish between releasing hormones and inhibiting hormones.
15. List the hormones of the thyroid gland and explain their roles in development and metabolism. Explain the causes and symptoms of hyperthyroidism, hypothyroidism, and goiter.
16. Note the location of the parathyroid glands and describe the hormonal control of calcium homeostasis.
17. Distinguish between alpha and beta cells in the pancreas and explain how their antagonistic hormones (insulin and glucagon) regulate carbohydrate metabolism.
18. Distinguish between type I diabetes mellitus and type II diabetes mellitus.
19. List the hormones of the adrenal medulla, describe their functions, and explain how their secretions are controlled.
20. List the hormones of the adrenal cortex and describe their functions.
21. List the hormones of three categories of steroid hormones produced by the

	<p>gonads. Describe variations in their production between the sexes. Note the functions of each category of steroid and explain how secretions are controlled.</p> <p>22. Describe several examples of invertebrate hormones that function in the control of reproduction and development.</p>	
<p>Assessments</p>	<p>Performance Tasks</p> <p>Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam</p>	<p>Other Evidence</p>

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>46: Animal Reproduction</p>	<p>Resources that will support instruction</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p style="text-align: center;">Overview of Animal Reproduction</p> <ol style="list-style-type: none"> 1. Distinguish between asexual and sexual reproduction. 2. List and describe four mechanisms of asexual reproduction. 3. Describe several adaptive advantages of asexual reproduction. Discuss the conditions that may favor the occurrence of asexual reproduction. 4. Explain the advantages of periodic reproduction. Describe factors that may control the timing of reproductive events. 5. Describe an example of an animal life cycle that alternates between asexual and sexual reproduction. 6. Define <i>parthenogenesis</i> and describe the conditions that favor its occurrence. Note examples of invertebrate and vertebrate species that use this form of reproduction. 7. Explain how hermaphroditism may be advantageous in sessile or burrowing animals that have difficulty encountering a member of the 	

opposite sex.

8. Distinguish between male-first and female-first sequential hermaphroditism. Note the adaptive advantages of these reproductive systems.

Mechanisms of Sexual Reproduction

9. Describe mechanisms that increase the probability that mature sperm will encounter fertile eggs of the same species in organisms that use external fertilization.
10. Explain the function of pheromones in mate attraction.
11. Compare reproductive systems using internal and external fertilization on the basis of the relative number of zygotes and protection of the embryos.
12. List and describe various methods of egg and embryo protection.
13. Compare the reproductive systems of a polychaete worm, a parasitic flatworm, an insect, a common nonmammalian vertebrate, and a mammal.

Mammalian Reproduction

14. Using a diagram, identify and give the function of each component of the reproductive system of the human male.
15. Using a diagram, identify and give the function of each component of the reproductive system of the human female.
16. Describe the two physiological reactions common to sexual arousal in both sexes.
17. Describe the four phases of the sexual response cycle.
18. Compare menstrual cycles and estrous cycles.
19. Describe the stages of the human female reproductive cycle.
20. Explain how the uterine cycle and ovarian cycle are synchronized in female mammals. Note in detail the functions of the hormones involved.
21. Describe human oogenesis.
22. Describe spermatogenesis and the structure and function of mature sperm.
23. Describe three major differences between oogenesis and spermatogenesis.
24. Describe human menopause. Describe a possible evolutionary explanation for human menopause.
25. Describe the influence of androgens on primary and secondary sex

	<p>characteristics and behavior.</p> <p>26. Compare the patterns of hormone secretion and reproductive events in male and female mammals.</p> <p>27. Define <i>conception</i>, <i>gestation</i>, and <i>parturition</i>.</p> <p>28. Compare the length of pregnancies in humans, rodents, dogs, cows, and elephants.</p> <p>29. Describe the changes that occur in the mother and the developing embryo during each trimester of a human pregnancy.</p> <p>30. Explain the role of embryonic hormones during the first few months of pregnancy.</p> <p>31. Describe the stages of parturition.</p> <p>32. Describe the control of lactation.</p> <p>33. Describe mechanisms that may help prevent the mother's immune system from rejecting the developing embryo.</p> <p>34. List the various methods of contraception and explain how each works.</p> <p>35. Describe techniques that allow us to learn about the health and genetics of a fetus.</p> <p>36. Explain how and when in vitro fertilization, zygote intrafallopian transfer, and gamete intrafallopian transfer may be used.</p>	
Assessments	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exams</p>	Other Evidence

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>47: Animal Development</p>	<p>Resources that will support instruction</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p style="text-align: center;">The Stages of Embryonic Development in Animals</p> <ol style="list-style-type: none"> 1. Compare the concepts of preformation and epigenesis. 2. List the two functions of fertilization. 3. Describe the acrosomal reaction and explain how it ensures that gametes are conspecific. 4. Describe the cortical reaction. 5. Explain how the fast and slow blocks to polyspermy function sequentially to prevent multiple sperm from fertilizing the egg. 6. Describe the changes that occur in an activated egg and explain the importance of cytoplasmic materials to egg activation. 7. Compare fertilization in a sea urchin and in a mammal. 8. Describe the general process of cleavage. 9. Explain the importance of embryo polarity during cleavage. Compare the 	

characteristics of the animal hemisphere, vegetal hemisphere, and gray crescent in amphibian embryos.

10. Describe the formation of a blastula in sea urchin, amphibian, and bird embryos. Distinguish among meroblastic cleavage, holoblastic cleavage, and the formation of the blastoderm.
11. Describe the product of cleavage in an insect embryo.
12. Describe the process of gastrulation and explain its importance. Explain how this process rearranges the embryo. List adult structures derived from each of the primary germ layers.
13. Compare gastrulation in a sea urchin, a frog, and a chick.
14. Describe the formation of the notochord, neural tube, and somites in a frog.
15. Describe the significance and fate of neural crest cells. Explain why neural crest cells have been called a “fourth germ layer.”
16. List and explain the functions of the extraembryonic membranes in reptile eggs.
17. Describe the events of cleavage in a mammalian embryo. Explain the significance of the inner cell mass.
18. Explain the role of the trophoblast in implantation of a human embryo.
19. Explain the functions of the extraembryonic membranes in mammalian development.

The Cellular and Molecular Basis of Morphogenesis and Differentiation in Animals

20. Describe the significance of changes in cell shape and cell position during embryonic development. Explain how these cellular processes occur. Describe the process of convergent extension.
21. Describe the role of the extracellular matrix in embryonic development.
22. Describe the locations and functions of cell adhesion molecules.
23. Describe the two general principles that integrate our knowledge of the genetic and cellular mechanisms underlying differentiation.
24. Describe the process of fate mapping and the significance of fate maps.
25. Describe the two important conclusions that have resulted from the experimental manipulation of parts of embryos and the use of fate maps.
26. Explain how the three body axes are established in early amphibian and chick

	<p>development.</p> <p>27. Explain the significance of Spemann's organizer in amphibian development.</p> <p>28. Explain what is known about the molecular basis of induction.</p> <p>29. Explain pattern formation in a developing chick limb, including the roles of the apical ectodermal ridge and the zone of polarizing activity.</p> <p>30. Explain how a limb bud is directed to develop into either a forelimb or a hind limb.</p>	
Assessments	<p>Performance Tasks</p> <p>Homework completion</p> <p>Contribution to classroom discussion</p> <p>Lab work and reports</p> <p>Quizzes</p> <p>Exam</p>	<p>Other Evidence</p>

Unit Frameworks

<p>Unit of Study: major topics</p>	<p>48: The Nervous Systems</p>	<p>Resources that will support instruction</p>
<p>Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit</p>	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
<p>Objectives</p> <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p style="text-align: center;">An Overview of Nervous Systems</p> <ol style="list-style-type: none"> 1. Compare and contrast the nervous systems of the following animals and explain how variations in design and complexity relate to their phylogeny, natural history, and habitat: hydra, sea star, planarian, insect, squid, and vertebrate. 2. Name the three stages in the processing of information by nervous systems. 3. Distinguish among sensory neurons, interneurons, and motor neurons. 4. List and describe the major parts of a neuron and explain the function of each. 5. Describe the function of astrocytes, radial glia, oligodendrocytes, and Schwann cells. <p style="text-align: center;">The Nature of Nerve Signals</p> <ol style="list-style-type: none"> 6. Define a <i>membrane potential</i> and a <i>resting potential</i>. 	

7. Describe the factors that contribute to a membrane potential.
8. Explain why the membrane potential of a resting neuron is typically around -70 to -80 mV.
9. Explain the role of the sodium-potassium pump in maintaining the resting potential.
10. Distinguish between gated and ungated ion channels and among stretch-gated ion channels, ligand-gated ion channels, and voltage-gated ion channels.
11. Define a *graded potential* and explain how it is different from a resting potential or an action potential.
12. Describe the characteristics of an *action potential*. Explain the role of voltage-gated ion channels in this process.
13. Describe the two main factors that underlie the repolarizing phase of the action potential.
14. Define the *refractory period*.
15. Explain how an action potential is propagated along an axon.
16. Describe the factors that affect the speed of action potentials along an axon and describe adaptations that increase the speed of propagation. Describe saltatory conduction.
17. Compare an electrical synapse and a chemical synapse.
18. Describe the structures of a chemical synapse and explain how they transmit an action potential from one cell to another.
19. Explain how excitatory postsynaptic potentials (EPSPs) and inhibitory postsynaptic potentials (IPSPs) affect the postsynaptic membrane potential.
20. Define *summation* and distinguish between temporal and spatial summation. Explain how summation applies to EPSPs and IPSPs.
21. Explain the role of the axon hillock.
22. Describe the role of signal transduction pathways in indirect synaptic transmission.
23. Describe the specific properties of the neurotransmitters acetylcholine and biogenic amines.
24. Identify and describe the functions of the four amino acids and several neuropeptides that work as neurotransmitters.
25. Explain how endorphins function as natural analgesics.
26. Describe the roles of nitric oxide and carbon monoxide as local regulators.

Vertebrate Nervous Systems

- 27. Compare the structures and functions of the central nervous system and the peripheral nervous system.
- 28. Distinguish between the functions of the autonomic nervous system and the somatic nervous system.
- 29. Describe the embryonic development of the vertebrate brain.
- 30. Describe the structures and functions of the following brain regions: medulla oblongata, pons, midbrain, cerebellum, thalamus, epithalamus, hypothalamus, and cerebrum.
- 31. Describe the specific functions of the reticular system.
- 32. Explain how the suprachiasmatic nuclei (SCN) function as a mammalian biological clock.
- 33. Relate the specific regions of the cerebrum to their functions.
- 34. Distinguish between the functions of the left and right hemispheres of the cerebrum.
- 35. Describe the specific functions of the brain regions associated with language, speech, emotions, memory, and learning.
- 36. Explain the possible role of long-term potentiation in memory storage and learning in the vertebrate brain.
- 37. Describe our current understanding of human consciousness.
- 38. Explain how research on stem cells and neural development may lead to new treatments for injuries and disease.
- 39. Describe current treatments for schizophrenia.
- 40. Distinguish between bipolar disorder and major depression.
- 41. Describe the symptoms and brain pathology that characterize Alzheimer’s disease. Discuss possible treatments for this disease.
- 42. Explain the cause of Parkinson’s disease.

Assessments	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence
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Unit Frameworks

Unit of Study: major topics	49: Sensory and Motor Mechanisms	Resources that will support instruction
Illinois Learning Standards, Benchmarks, National Standards Assessment Frameworks, or other standards that will be taught in this unit	<ul style="list-style-type: none"> • 12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. • 12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry. • 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). • 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. • 12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). 	
Objectives <ul style="list-style-type: none"> ○ Conceptual ○ Factual ○ Procedural 	<p style="text-align: center;">Sensing, Acting, and Brains</p> <ol style="list-style-type: none"> 1. Differentiate between sensation and perception. <p style="text-align: center;">Introduction to Sensory Reception</p> <ol style="list-style-type: none"> 2. Explain the difference between exteroceptors and interoceptors. 3. Describe the four general functions of receptor cells as they convert energy stimuli into changes in membrane potentials and then transmit signals to the central nervous system. 4. Distinguish between sensory transduction and receptor potential. 5. Explain the importance of sensory adaptation. 6. List the five types of sensory receptors and explain the energy transduced by each type. 	

Hearing and Equilibrium

7. Explain the role of mechanoreceptors in hearing and balance.
8. Describe the structure and function of invertebrate statocysts.
9. Explain how insects may detect sound.
10. Refer to a diagram of the human ear and give the function of each structure.
11. Explain how the mammalian ear functions as a hearing organ.
12. Explain how the mammalian ear functions to maintain body balance and equilibrium.
13. Describe the hearing and equilibrium systems of nonmammalian vertebrates.

Chemoreception: Taste and Smell

14. Explain how the chemoreceptors involved with taste function in insects and humans.
15. Describe what happens after an odorant binds to an odorant receptor on the plasma membrane of the olfactory cilia.
16. Explain the basis of the sensory discrimination of human smell.

Photoreceptors and Vision

17. Compare the structures of, and processing of light by, the eyecups of *Planaria*, the compound eye of insects, and the single-lens eyes of molluscs.
18. Refer to a diagram of the vertebrate eye to identify and give the function of each structure.
19. Describe the functions of the rod cells and cone cells of the vertebrate eye.
20. Explain and compare how the rods and cones of the retina transduce stimuli into action potentials.
21. Explain how the retina assists the cerebral cortex in the processing of visual information.

Movement and Locomotion

22. Describe three functions of a skeleton.
23. Describe how hydrostatic skeletons function and explain why they are not

	<p>found in large terrestrial organisms.</p> <p>24. Distinguish between an exoskeleton and an endoskeleton.</p> <p>25. Explain how the structure of the arthropod exoskeleton provides both strength and flexibility.</p> <p>26. Explain how a skeleton combines with an antagonistic muscle arrangement to provide a mechanism for movement.</p> <p>27. Explain how body proportions and posture impact physical support on land.</p> <p>28. Using a diagram, identify the components of a skeletal muscle cell.</p> <p>29. Explain the sliding-filament model of muscle contraction.</p> <p>30. Explain how muscle contraction is controlled.</p> <p>31. Explain how the nervous system produces graded contraction of whole muscles.</p> <p>32. Explain the adaptive advantages of slow and fast muscle fibers.</p> <p>33. Distinguish among skeletal muscle, cardiac muscle, and smooth muscle.</p> <p>34. List the advantages and disadvantages associated with moving through: a. an aquatic environment b. a terrestrial environment c. air</p> <p>35. Discuss the factors that affect the energy cost of locomotion.</p>	
Assessments	Performance Tasks Homework completion Contribution to classroom discussion Lab work and reports Quizzes Exam	Other Evidence