

Biology Course of Study

Science Inquiry and Application

During the years of grades 9 through 12, all students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

- Identify questions and concepts that guide scientific investigations.
- Design and conduct scientific investigations.
- Use technology and mathematics to improve investigations and communications.
- Formulate and revise explanations and models using logic and evidence (critical thinking).
- Recognize and analyze explanations and models.
- Communicate and support a scientific argument.

Reading Standards

Key Ideas and Details:

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Craft and Structure:

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Writing Standards

Text Types and Purposes:

1. Write arguments focused on discipline-specific content.
 - a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
 - b. Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
 - c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
 - d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
 - e. Provide a concluding statement or section that follows from or supports the argument presented.
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical

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Integration of Knowledge and Ideas:

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Range of Reading and Level of Text Complexity:

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

processes.

- a. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
 - b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
 - c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
 - d. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
 - e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
 - f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
3. Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In history/social studies, students must be able to incorporate narrative accounts into their analyses of individuals or events of historical import. In science and technical subjects, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results.

Production and Distribution of Writing:

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

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6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge:

7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
9. Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing:

10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

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Topic: *Heredity*

This topic focuses on the explanation of genetic patterns of inheritance.

Content Elaborations

In high school biology, Mendel’s laws of inheritance (introduced in grade 8) are interwoven with current knowledge of DNA and chromosome structure and function to build toward basic knowledge of modern genetics. Sorting and recombination of genes in sexual reproduction and meiosis specifically result in a variance in traits of the offspring of any two parents and explicitly connect the knowledge to evolution.

The gene interactions described in middle school were limited primarily to dominance and co-dominance traits. In high school genetic mechanisms, both classical and modern including incomplete dominance, sex-linked traits, goodness of fit test (Chi-square), and dihybrid crosses are investigated through real-world examples. Genes that affect more than one trait (pleiotropy), traits affected by more than one gene (epistasis), and polygenetic traits can be introduced using simple real-world examples. Additionally, genes that modify or regulate the expression of another gene should be included in explorations at the high school level. Dihybrid crosses can be used to explore linkage groups. Modern genetics techniques, such as cloning must be explored in this unit.

It is imperative that the technological developments that led to the current knowledge of heredity be included in the study of heredity. For example, the development of the model for DNA structure was the result of the use of technology and the studies and ideas of many scientists. Watson and Crick developed the final model but did not do the original studies.

Learning Targets	Honors Learning Targets	STEM Learning Targets
Cellular Genetics		
<ul style="list-style-type: none"> • Differentiate between the types of cell division that result in somatic cells and in gametes. • Summarize the phases of meiosis (I and II) and identify these phases in a diagram. • Identify the diploid (2N) and haploid (N) number of chromosomes for an organism’s body and sex cells. • Defend how meiosis and sexual reproduction produces variation in a species and why this is important to the survival of a species. • Explain how crossing over occurs and how it results in increased diversity for a species. 	<ul style="list-style-type: none"> • Relate polyploidy to diploid and haploid organisms. • Describe the regulation of the cell cycle, including discussion of checkpoints, telomeres, and cancer. • Relate prokaryotic cell division to eukaryotic cell division. 	<ul style="list-style-type: none"> • Describe the regulation of the cell cycle, including discussion of checkpoints, telomeres, and cancer. • Compare time for mitosis with various cells.

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<ul style="list-style-type: none"> Distinguish the reasons cells divide: for growth, repair, maintenance, and reproduction of the organism. 		
Learning Targets	Honors Learning Targets	STEM Learning Targets
Structure and Function of DNA in Cells		
<ul style="list-style-type: none"> Outline the contributions that Franklin, Watson, and Crick made to the discovery of the shape of deoxyribonucleic acid (DNA). Relate Chargaff's base-pairing rules (A-T and C-G) to DNA structure and replication. Identify the components of the nucleotide (sugar, phosphate, and nitrogenous bases). Identify the four nitrogenous bases in DNA (adenine, cytosine, guanine, thymine). Model the process of DNA replication. Identify the four nitrogenous bases in RNA and how they pair up. Differentiate between DNA and RNA. Compare and contrast the three types of RNA. Explain the process of protein synthesis, including transcription and translation. Relate how DNA codons store information in the sequences (order) of the four bases to the arrangement of amino acids in a protein. 	<ul style="list-style-type: none"> Summarize gene expression in prokaryotes and eukaryotes (i.e., introns, exons, operon model, promoter region). Analyze Chargaff's data to explain base pairing rules. 	<ul style="list-style-type: none"> Design a 3D Model of DNA either using engineering software (i.e., Inventor) or designed to scale. Analyze Chargaff's data to explain base pairing rules.
Learning Targets	Honors Learning Targets	STEM Learning Targets
Genetic Mechanisms and Inheritance		
<ul style="list-style-type: none"> Describe Gregor Mendel's experiments with pea plants and his principle of dominance. Interpret how genes for different traits can be 	<ul style="list-style-type: none"> Investigate gene linkage. 	<ul style="list-style-type: none"> Complete and interpret karyotypes. Investigate gene linkage.

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<p>distributed independently of each other according to Mendel’s Law of Independent Assortment.</p> <ul style="list-style-type: none"> • Show how alleles are equally distributed into gametes according to Mendel’s Law of Segregation. • Utilize a Punnett square to predict probable outcomes (phenotype and genotype) for a monohybrid and dihybrid cross. • Relate inheritance to the effects of several genetic disorders in humans. • Analyze a pedigree chart to predict the probable mode of inheritance of a trait. • Predict the probable outcomes of a genetic cross involving sex-linked traits. • Predict the probable outcomes of crosses involving the inheritance of the ABO blood group and the Rh factor. • Utilize dihybrid crosses to explore gene linkage groups. • Solve genetics problems involving complex inheritance such as incomplete dominance, co-dominance, multiple alleles, pleiotropy, epistasis, and polygenic traits. • Apply mathematical models (i.e., Chi square test, etc.) to analyze predicted and actual outcomes. 		
Learning Targets	Honors Learning Targets	STEM Learning Targets
Mutations		
<ul style="list-style-type: none"> • Describe errors in meiosis (nondisjunction) resulting in monosomy and trisomy. 	<ul style="list-style-type: none"> • Explore the effects of genetic disorders. 	<ul style="list-style-type: none"> • Explore the effects of genetic disorders.

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<ul style="list-style-type: none"> • Predict the effect of DNA mutations on the amino acid sequence of a protein. 		
Learning Targets	Honors Learning Targets	STEM Learning Targets
Modern Genetics		
<ul style="list-style-type: none"> • Model the process of gel electrophoresis procedures. • Appraise the value of the application of stem cells to modern medicine • Analyze ethical and philosophical ramifications that may arise as a result of cloning. 	<ul style="list-style-type: none"> • Summarize genetic engineering techniques. 	<ul style="list-style-type: none"> • Interpret the results of gel electrophoresis. • Investigate gene chips. • Summarize genetic engineering techniques.
Additional Resources		
Pacing:		
<p>Content Vocabulary</p> <ul style="list-style-type: none"> • adenine • allele • anaphase • anticodon • autosome • cell cycle • cell division • cell plate • centriole • centromere • chi square • chromatid • chromosome • cleavage furrow • cloning • codominance • codon • crossing over • cytokinesis • cytosine 	<ul style="list-style-type: none"> • law of segregation • meiosis • metaphase • monohybrid cross • monosomy • mRNA • multiple alleles • mutation • nitrogenous base • nondisjunction • nucleotide • pedigree phenotype • phosphate • pleiotropy • polygenic traits • polypeptide chain • prophase • protein • protein synthesis • Punnett square 	<p>Academic Vocabulary</p>

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<ul style="list-style-type: none"> • deoxyribose • diploid • DNA • DNA polymerase • dominance • dominant • double helix • dyhybrid cross • epistasis • fertilization • gamete • gel electrophoresis • gene • genotype • guanine • haploid • heterozygous • homologous chromosomes • homozygous • hybrid • hydrogen bonds • incomplete dominance • interphase • karyotype • law of independent assortment • purine • pyrimidine • recessive • replication • ribose • ribosome • RNA • rRNA • sex linkage • sister chromatid • somatic • spindle fibers • stem cells • telophase • tetrad • thymine • trait • transcription • translation • trisomy • tRNA • true or pure breeding • uracil • zygote 	
<p>Formative Assessments</p>	<p>Summative Assessments</p>
<p>Resources</p>	<p>Enrichment Strategies</p>
<p>Integrations</p> <ul style="list-style-type: none"> • ELA: • Math: • Social Studies: 	<p>Intervention Strategies</p>

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Topic: *Evolution*

This topic explains the natural origins for the diversity of life.

Content Elaborations

Biological evolution explains the natural origins for the diversity of life. Emphasis shifts from thinking in terms of selection of individuals with a particular trait to changing proportions of a trait in populations. The study of evolution must include Modern Synthesis, the unification of genetics and evolution, and historical perspectives of evolutionary theory. The study of evolution must include gene flow, mutation, speciation, natural selection, genetic drift, sexual selection, and Hardy Weinberg's law.

The basic concept of biological evolution is that the Earth's present-day species descended from earlier, common ancestral species. At the high school level, the term natural selection is used to describe the process by which traits become more or less common in a population due to consistent environmental effects upon the survival or reproduction of the individual with the trait. Mathematical reasoning must be applied to solve problems (e.g., use Hardy Weinberg's law to explain gene frequency patterns in a population).

Modern ideas about evolution provide a natural explanation for the diversity of life on Earth as represented in the fossil record, in the similarities of existing species, and in modern molecular evidence. From a long-term perspective, evolution is the descent with modification of different lineages from common ancestors.

Different phenotypes result from new combinations of existing genes or from mutations of genes in reproductive cells. At the high school level, the expectation is to combine grade 8 knowledge with explanation of the internal structure and function of chromosomes. Natural selection works on the phenotype.

Populations evolve over time. Evolution is the consequence of the interactions of:

1. The potential for a population to increase its numbers
2. The genetic variability of offspring due to mutation and recombination of genes
3. A finite supply of the resources required for life
4. The differential survival and reproduction of individuals with the specific phenotype

Mutations are described in the content elaboration for Heredity. Apply the knowledge of mutation and genetic drift to real-world examples. Recent molecular-sequence data generally, but not always, support earlier hypotheses regarding lineages of organisms based upon morphological comparisons.

Heritable characteristics influence how likely an organism is to survive and reproduce in a particular environment. When an environment changes, the survival value of inherited characteristics may change. This may or may not cause a change in species that inhabit the environment. Formulate and revise explanations for gene flow and sexual selection based on real-world problems.

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Learning Targets	Honors Learning Targets	STEM Learning Targets
Mechanisms		
<ul style="list-style-type: none"> • Summarize how life forms have changed throughout 4.6 billion years of the earth’s history. • Examine the historical development of the theory of evolution, including the works of Lamarck and Darwin. • Describe how the observations made by Darwin on his voyage of the Beagle led to the development of his theory of natural selection. • Defend natural selection as the mechanism for how evolution works. • Justify how species descend (with modifications) from other species over time. • Identify factors that lead to the development of new species: behavioral, reproductive, geographic, and temporal isolation. • Describe evolution as a change in gene frequency within the gene pool. • Correlate how the founder effect causes genetic drift. 	<ul style="list-style-type: none"> • Examine the historical development of the theory of evolution, including the works of Lamarck, Darwin, Wallace, Hutton, Lyell, Cuvier, and ancient philosophers. 	
Learning Targets	Honors Learning Targets	STEM Learning Targets
Diversity of Life		
<ul style="list-style-type: none"> • Define the term species. • Apply the five conditions of the Hardy Weinberg Principle to describe why species change over time. • Explain sources of variation including mutation, 	<ul style="list-style-type: none"> • Calculate gene frequency using the Hardy-Weinberg Principle. • Calculate absolute time using various methods. 	<ul style="list-style-type: none"> • Calculate gene frequency using the Hardy-Weinberg Principle. • Explore and critique the various techniques and tools of calculating absolute time. • Calculate biochemical changes over time.

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<p>crossing over, and independent assortment that are necessary for evolution.</p> <ul style="list-style-type: none"> • Describe evidence for evolution from the fossil record and geographic distribution, homologous structures, vestigial structures, embryology, and DNA sequences. • Analyze the results of natural selection: directional, stabilizing, or disruptive selection. 		
Additional Resources		
Pacing:		
<p>Content Vocabulary</p> <ul style="list-style-type: none"> • acquired characteristic • adapt • common ancestor • directional selection • disruptive selection • embryology • environment evolution • fitness • fossil • Founder effect • frequency • gene flow • gene pool 	<ul style="list-style-type: none"> • genetic drift • genetic variation • geographic distribution • gradualism • Hardy Weinberg • inherited trait • interbreed • natural selection • punctuated equilibrium • speciation • stabilizing selection • variation • vestigial organs 	<p>Academic Vocabulary</p>
Formative Assessments	Summative Assessments	
Resources	Enrichment Strategies	
<p>Integrations</p> <ul style="list-style-type: none"> • ELA: • Math: • Social Studies: 	Intervention Strategies	

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Topic: *Diversity and Interdependence of Life*

This topic focuses on the study of diversity and similarity at the molecular level or organisms.

Content Elaborations

The great diversity of organisms and ecological niches they occupy result from more than 3.5 billion years of evolution. Some ecosystems can be reasonably persistent over hundreds or thousands of years. Like many complex systems, ecosystems tend to have cyclic fluctuations around a state of rough equilibrium. In the long run, however, ecosystems always change as geological or biological conditions vary. Misconceptions about population growth capacity, interspecies and intra-species competition for resources, and what occurs when a species immigrates to or emigrates from ecosystems are included in this topic. Technology must be used to access real-time/authentic data to study population changes and growth in specific locations.

Classification systems are frameworks developed by scientists for describing the diversity of organisms, indicating the degree of relatedness between organisms. Recent molecular-sequence data generally support earlier hypotheses regarding lineages of organisms based upon morphological comparisons. Both morphological comparisons and molecular evidence must be used to describe biodiversity (cladograms can be used to address this).

Organisms transform energy (flow of energy) and matter (cycles of matter) as they survive and reproduce. The cycling of matter and flow of energy occurs at all levels of biological organization, from molecules to ecosystems. At the high school level, the concept of energy flow as unidirectional in ecosystems is explored.

Mathematical graphing and algebraic knowledge (at the high school level) must be used to explain concepts of carrying capacity and homeostasis within biomes. Use real-time data to investigate population changes that occur locally or regionally. Mathematical models can include exponential growth model and the logistic growth model. The simplest version of the logistic growth model is $dN/dt = rN (K - N/K)$; the only new variable added to the exponential model is K for carrying capacity.

Note 1: Exponential growth equation in simplest form, change in population size N per unit time t is a product of r (the per capita reproductive rate) and N (population size).

Note 2: Carrying capacity is defined as the population equilibrium sized when births and deaths are equal; hence $dN/dt = zero$.

Note 3: Constructing food webs/food chains to show interactions between organisms within ecosystems was covered in upper elementary school and middle school; constructing them as a way to demonstrate content knowledge is not appropriate for this grade. Students may use these diagrams to help explain real-world relationships or events within an ecosystem but not to identify simple trophic levels, producers, predator-prey, and symbiotic relations.

Learning Targets	Honors Learning Targets	STEM Learning Targets
Classification Systems		
<ul style="list-style-type: none"> Utilize binomial nomenclature to write a scientific name and to describe the genus and 	<ul style="list-style-type: none"> Examine the various methods of classifying organisms in contemporary biology. 	

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<p>species of an organism.</p> <ul style="list-style-type: none"> • Identify Linnaeus’s seven taxa. • Illustrate how organisms are grouped based on physical characteristics, genetic similarities, and evolutionary relationships using cladograms. 		
Learning Targets	Honors Learning Targets	STEM Learning Targets
Population Ecology		
<ul style="list-style-type: none"> • Define the term population and describe ways by which populations are studied (capture-recapture). • Identify characteristics of a population: geographical distribution, density, and growth rate. • Describe growth rate as a combination of factors including birth rate, death rate, and emigration and immigration. • Compare logistic and exponential growth of populations and describe conditions under which a population might experience these types of growth. • Compare the effects of density dependent and density independent limiting factors on the growth of a population. • Graph and describe a predator-prey cycle. • Define the term “carrying capacity” and describe the factors that might alter carrying capacity. • Describe what happens to a population when it exceeds carrying capacity. • Read and analyze tables and graphs pertaining to human population growth (demographics). 		<ul style="list-style-type: none"> • Graph growth rates to predict changes in population dynamics for a variety of environmental conditions.

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Learning Targets	Honors Learning Targets	STEM Learning Targets
Ecosystems		
<ul style="list-style-type: none"> • Differentiate among the terms population, community, ecosystem, biome and biosphere, and species. • Be able to identify these in a description or diagram. • List and describe the three parts of the biosphere (lithosphere, atmosphere, and hydrosphere). • Be able to identify these in a description or diagram. • Describe the unidirectional flow and loss of energy through ecosystems in the form of food webs, food chains, and ecological pyramids. • Describe the roles of organisms within an ecosystem (autotrophs, heterotrophs, producers, consumers, scavengers, decomposers, saprophytes, carnivores, omnivores, and detritivores). • Describe how producers/autotrophs make their own food by photosynthesis or chemosynthesis. • Use Chi Square to determine the probability of a hypothesis's accuracy. • Write a null hypothesis and an alternative hypothesis. • Determine the expected values. • Apply the Chi Square formula (formula will be given). • Determine the degrees of freedom. 		

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- Use a table to determine the level of probability to evaluate the hypothesis.
- Classify consumers/heterotrophs based on how they get energy (omnivore, herbivore, carnivore, detritivore, primary consumer, secondary consumer, etc.).
- Classify organisms in a food chain, food web, or by description.
- Describe the nitrogen cycle, including nitrification and denitrification.

Additional Resources

Pacing:

Content Vocabulary

- | | |
|--|-----------------------|
| • autotrophs | • food webs |
| • biogeochemical cycles | • genus |
| • biome | • herbivores |
| • binomial nomenclature | • heterotrophs |
| • biosphere | • kingdom |
| • carnivores | • linear growth |
| • carrying capacity | • omnivores |
| • cladogram | • phylogeny |
| • consumers | • population |
| • decomposers | • population dynamics |
| • density-dependent limiting factors | • predator |
| • density-independent limiting factors | • prey |
| • detritivores | • producers |
| • dichotomous key | • scavengers |
| • domain | • species |
| • ecological pyramids | • species community |
| • ecosystem | • taxonomy |
| • exponential growth food chains | |

Academic Vocabulary

Formative Assessments

Summative Assessments

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Resources	Enrichment Strategies
Integrations <ul style="list-style-type: none">• ELA:• Math:• Social Studies:	Intervention Strategies

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Topic: *Cells*

The cell is a system that conducts a variety of functions associated with life.

Content Elaborations

This topic focuses on the cell as a system itself (single-celled organism) and as part of larger systems (multicellular organism), sometimes as part of a multicellular organism, always as part of an ecosystem. The cell is a system that conducts a variety of functions associated with life. Details of cellular processes such as photosynthesis, chemosynthesis, cellular respiration, cell division, and differentiation are studied at this grade level. Additionally, cellular organelles studied are cytoskeleton, Golgi complex, and endoplasmic reticulum.

From about 4 billion years ago to about 2 billion years ago, only simple, single-celled microorganisms are found in the fossil record. Once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms evolved.

Every cell is covered by a membrane that controls what can enter and leave the cell. In all but quite primitive cells, a complex network of proteins provides organization and shape. Within the cell are specialized parts for the transport of materials, energy transformation, protein building, waste disposal, information feedback, and movement. In addition to these basic cellular functions, most cells in multicellular organisms perform some specific functions that others do not.

A living cell is composed of a small number of elements, mainly carbon, hydrogen, nitrogen, oxygen, phosphorous, and sulfur. Carbon, because of its small size and four available bonding electrons, can join to other carbon atoms in chains and rings to form large and complex molecules. The essential functions of cells involve chemical reactions that involve water and carbohydrates, proteins, lipids, and nucleic acids. A special group of proteins – enzymes – enables chemical reactions to occur within living systems.

Cell functions are regulated. Complex interactions among the different kinds of molecules in the cell cause distinct cycles of activities, such as growth and division. Most cells function within a narrow range of temperature and pH. At very low temperatures, reaction rates are slow. High temperatures and/or extremes of pH can irreversibly change the structure of most protein molecules. Even small changes in pH can alter how molecules interact.

The sequence of DNA bases on a chromosome determines the sequence of amino acids in a protein. Proteins catalyze most chemical reactions in cells. Protein molecules are long, usually folded chains made from combinations of the 20 typical amino-acid sub-units found in the cell. The function of each protein molecule depends on its specific sequence of amino acids and the shape the chain takes as a result of that sequence.

Note 1: The idea that protein molecules assembled by cells conduct the work that goes on inside and outside the cells in an organism can be learned without going into the biochemical details. It is sufficient for students to know that the molecules involved are different configurations of a few amino acids and that the different shapes of the molecules influence what they do.

Note 2: The concept of the cell and its parts as a functioning system is more important than memorizing parts of the cell.

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Learning Targets	Honors Learning Targets	STEM Learning Targets
Macromolecules		
<ul style="list-style-type: none"> • Identify the most abundant elements in living organisms. • Explain the properties of carbon and how it relates to macromolecules. • Distinguish between the structure and function of the four major macromolecules (carbohydrates, lipids, proteins, and nucleic acids). • Illustrate the characteristics of enzymes and their functions. • Describe the optimal conditions for pH and temperature as it relates to cell function. • Illustrate how macromolecule bonds are formed and broken. 	<ul style="list-style-type: none"> • Investigate the structural hierarchy of proteins. 	<ul style="list-style-type: none"> • Utilize engineering software to construct models of macromolecules. • Utilize technology to evaluate effects of pH and temperature on enzyme activity.
Learning Targets	Honors Learning Targets	STEM Learning Targets
Cells		
<ul style="list-style-type: none"> • Organize the terms cell, tissue, organ, organ system, and organism. • Differentiate between prokaryotic, and eukaryotic (i.e., plant v. animal) organisms. • Identify and compare unicellular and multicellular organisms. • Identify the contributions of Hooke, von Leeuwenhoek, Schleiden, Schwann, and Virchow in the development of cell theory. • Summarize the three statements of cell theory. • Relate cell structure and function of cellular 	<ul style="list-style-type: none"> • Investigate details of the light and dark reactions of photosynthesis. • Investigate details of aerobic and anaerobic respiration. 	<ul style="list-style-type: none"> • Compare microscopes (light, SEM, TEM, and digital) images and how these images are produced. • Analyze data to determine direction of osmosis.

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<p>organelles to one another.</p> <ul style="list-style-type: none"> • Defend the endosymbiotic theory as it applies to the theory of eukaryotic cells. • Describe how organelles interact to perform the following cellular tasks: <ul style="list-style-type: none"> ○ Transport (passive—diffusion, facilitated diffusion, osmosis; active—endocytosis and exocytosis) ○ Photosynthesis (light and dark reactions) ○ Respiration (ATP, aerobic, anaerobic) ○ Reproduction (mitosis) 		
Additional Resources		
Pacing:		
<p>Content Vocabulary</p> <ul style="list-style-type: none"> • absorption spectrum • acid • active site • active transport • ADP • aerobic respiration • amino acid • anaerobic respiration • anaphase • ATP • base • bilayer • carbohydrate • carbon • catalyst • cell cycle • cell membrane • cell theory • cell wall • chlorophyll • chloroplast • functional group • glucose • glycerol • Golgi body/complex/apparatus • granum • homeostasis • hydrolysis • hypertonic • hypotonic • interphase • isotonic • Krebs cycle (citric acid cycle) • light reactions • lipids • lysosome • macromolecule • metaphase • mitochondrion • mitosis • monomers • monosaccharide 	<p>Academic Vocabulary</p>	

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<ul style="list-style-type: none"> • cilia • cytokinesis • cytoplasm • cytoskeleton • dark reactions (Calvin cycle) • daughter cells • dehydration synthesis • denature • differentiation • diffusion • disaccharide • electron transport chain • endocytosis • endoplasmic reticulum (smooth and rough) • endosymbiosis • enzyme • equilibrium • eukaryote • unicellular • exocytosis • facilitated diffusion • fatty acid • fermentation (alcoholic and lactic acid) • flagellum • fluid mosaic model • glycolysis • multicellular • nucleic acid • nucleolus • nucleotide • nucleus • osmosis • passive transport • peptide bond • pH • pH scale • phospholipid • photon • pigment • plasmolysis • polymer • polysaccharide • prokaryote • prophase • proteins • pseudopod • pyruvate • ribosome • stroma • substrate • telophase • thylakoid • turgor pressure • vacuole 	
<p>Formative Assessments</p>	<p>Summative Assessments</p>
<p>Resources</p>	<p>Enrichment Strategies</p>
<p>Integrations</p> <ul style="list-style-type: none"> • ELA: • Math: • Social Studies: 	<p>Intervention Strategies</p>