

Bemidji Area Schools

Grades 10-12 Applied Biology Science Outcomes

Strand	Substrand	Standard "Understand that ..."	Code	Benchmark "The student will . . ."	Activity
1. The Nature of Science and Engineering	1. The Practice of Science	1. Science is a way of knowing about the natural world and is characterized by empirical criteria, logical argument and skeptical review.	9.1.1.1.1	Explain the implications of the assumption that the rules of the universe are the same everywhere and these rules can be discovered by careful and systematic investigation.	Is it Alive Activity
			9.1.1.1.2	Understand that scientists conduct investigations for a variety of reasons, including: to discover new aspects of the natural world, to explain observed phenomena, to test the conclusions of prior investigations, or to test the predictions of current theories.	Bacteria in BHS Lab Mouthwash Lab
			9.1.1.1.3	Explain how the traditions and norms of science define the bounds of professional scientific practice and reveal instances of scientific error or misconduct. <i>For example:</i> The use of peer review, publications and presentations.	Review of science news article Discovery of new species discussion
			9.1.1.1.4	Explain how societal and scientific ethics impact research practices. <i>For example:</i> Research involving human subjects may be conducted only with the informed consent of the subjects.	Human Genome Project and Cloning DNA Testing Activity
			9.1.1.1.5	Identify sources of bias and explain how bias might influence the direction of research and the interpretation of data. <i>For example:</i> How funding of research can influence questions studied, procedures used, analysis of data, and communication of results.	<i>The Conquerors</i> Video <i>The Ultimate Animal</i> Video Lost World of Medusa
			9.1.1.1.6	Describe how changes in scientific knowledge generally occur in incremental steps that include and build on earlier knowledge.	Genetics Unit (Mendel's theories and pea experiments)

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1. The Nature of Science and Engineering	1. The Practice of Science	2. Scientific inquiry uses multiple interrelated processes to pose and investigate questions about the natural world.	9.1.1.2.1	Formulate a testable hypothesis, design and conduct an experiment to test the hypothesis, analyze the data, consider alternative explanations, and draw conclusions supported by evidence from the investigation.	Mouthwash Lab Bacteria in BHS Lab Respiration Lab and Fish Mean to the Bean Lab Sea Monkey Investigations
			9.1.1.2.2	Evaluate the explanations proposed by others by examining and comparing evidence, identifying faulty reasoning, pointing out statements that go beyond the scientifically acceptable evidence, and suggesting alternative scientific explanations.	Mean to the Bean Lab Bacteria in BHS Lab Respiration Lab and Fish Mouthwash Lab Sea Monkey Investigations
			9.1.1.2.3	Identify the critical assumptions and logic used in a line of reasoning to judge the validity of a claim.	Conclusion Questions Bacteria in BHS Lab Mouthwash Lab
			9.1.1.2.4	Use primary sources or scientific writings to identify and explain how different types of questions and their associated methodologies are used by scientists for investigations in different disciplines..	"Science World" Articles and Questions (Bacteria, new species articles, albino animals, etc....)
			1. Engineering is a way of addressing human needs by applying science concepts and mathematical techniques to develop new products, tools, processes and systems.	9.1.2.1.2	Recognize that risk analysis is used to determine the potential positive and negative consequences of using a new technology or design, including the evaluation of causes and effects of failures. <i>For example:</i> Risks and benefits associated with using lithium batteries.

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1. The Nature of Science and Engineering	3. Interactions Among Science, Technology, Engineering, Mathematics, and Society	1. Natural and designed systems are made up of components that act within a system and interact with other systems.	9.1.3.1.1	Describe a system, including specifications of boundaries and subsystems, relationships to other systems, and identification of inputs and expected outputs. <i>For example:</i> A power plant or ecosystem.	Plant Unit <i>Photosynthesis and Pollination</i> Video Birds and Bees Flower Lab Flower Model
			9.1.3.1.2	Identify properties of a system that are different from those of its parts but appear because of the interaction of those parts.	Plant Unit <i>Photosynthesis and Pollination</i> Video Birds and Bees Flower Lab Flower Model
			9.1.3.1.3	Describe how positive and/or negative feedback occur in systems. <i>For example:</i> The greenhouse effect	Natural Selection Marshan Genetics Lab Natural Selection Lab - with Birds and Flight
			9.1.3.2.1	Provide examples of how diverse cultures, including natives from all of the Americas, have contributed scientific and mathematical ideas and technological inventions. <i>For example:</i> Native American understanding of ecology; Lisa Meitner's contribution to understanding radioactivity; Tesla's ideas and inventions relating to electricity; Watson, Crick and Franklin's discovery of the structure of DNA; or how George Washington Carver's ideas changed land use.	Curriculum from the American Indian Responses to Environmental Challenges workshop
			9.1.3.2.2	Analyze possible careers in science and engineering in terms of education requirements, working practices and rewards.	Guest speakers within the semester

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1. The Nature of Science and Engineering	3. Interactions Among Science, Technology, Engineering, Mathematics, and Society	3. Science and engineering operate in the context of society and both influence and are influenced by this context.	9.1.3.3.1	Describe how values and constraints affect science and engineering. <i>For example:</i> Economic, environmental, social, political, ethical, health, safety, and sustainability issues.	Genetics Unit Response to article on genetic engineering Gattaca responses
			9.1.3.3.2	Communicate, justify, and defend the procedures and results of a scientific inquiry or engineering design project using verbal, graphic, quantitative, virtual, or written means.	Mean to the Bean Lab Mouthwash Lab Bacteria in BHS Lab Analysis and conclusion activities to these
			9.1.3.3.3	Describe how scientific investigations and engineering processes require multi-disciplinary contributions and efforts. <i>For example:</i> Nanotechnology, climate change, agriculture, or biotechnology.	Microbe Zoo Internet Activity Fish Respiration Activity Hybrid Seeds Activity

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1. The Nature of Science and Engineering	3. Interactions Among Science, Technology, Engineering, Mathematics, and Society	4. Science, technology, engineering, and mathematics rely on each other to enhance knowledge and understanding.	9.1.3.4.1	Describe how technological problems and advances often create a demand for new scientific knowledge, improved mathematics, and new technologies.	Vaccination Activities and Discussions Genetics Unit DNA, Genetic Counseling and Karyotyping
			9.1.3.4.2	Determine and use appropriate safety procedures, tools, computers and measurement instruments in science and engineering contexts. <i>For example:</i> Consideration of chemical and biological hazards in the lab.	Consideration of Chemical and Biological Hazards in the Lab
			9.1.3.4.3	Select and use appropriate numeric, symbolic, pictorial, or graphical representation to communicate scientific ideas, procedures and experimental results.	Graphing activities within conclusion questions throughout the semester
			9.1.3.4.4	Relate the reliability of data to consistency of results, identify sources of error, and suggest ways to improve the data collection and analysis. <i>For example:</i> Use statistical analysis or error analysis to make judgments about the validity of results	Discussions and identifying of experimental error throughout the semester
			9.1.3.4.5	Demonstrate how unit consistency and dimensional analysis can guide the calculation of quantitative solutions and verification of results.	Mass and volume measurements within labs throughout the semester Exponential Growth of Bacteria Activity

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3. Earth and Space Science	1. Earth Structure and Processes	3. By observing rock sequences and using fossils to correlate the sequences at various locations, geologic events can be inferred and geologic time can be estimated.	9.3.1.3.1	Use relative dating techniques to explain how the structures of the Earth and life on Earth have changed over short and long periods of time.	<i>Conquerors</i> Video Theories of Evolution Discussion (from book) on Radioactive Dating
			9.3.1.3.2	Cite evidence from the rock record for changes in the composition of the global atmosphere as life evolved on Earth. <i>For example:</i> Banded iron formations as found in Minnesota's Iron Range.	Fossil Activity with Invertebrates
4. Life Science	1. Structure and Function of Living Systems	1. Organisms use the interaction of cellular processes to as well as tissues and organ systems to maintain homeostasis.	9.4.1.1.1	Explain how cell processes are influenced by internal and external factors, such as pH and temperature, and how cells and organisms respond to changes in their environment to maintain homeostasis.	Is It Alive? Activity Yogurt Lab How Much Bacteria in BHS? Lab
			9.4.1.1.2	Describe how the functions of individual organ systems are integrated to maintain homeostasis in an organism.	Pig Dissection Unit Days 1-6: Muscles, Skeletal, Digestive, Respiratory Systems, Cardiac, Reproductive, Endocrine Systems
		9.4.1.2.1	Recognize that cells are composed primarily of a few elements (carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur), and describe the basic molecular structures and the primary functions of carbohydrates, lipids, proteins and nucleic acids.	DNA Strand Activity Leaf Model Activity <i>Photosynthesis</i> Video Clip	
		9.4.1.2.2	Recognize that the work of the cell is carried out primarily by proteins, most of which are enzymes, and that protein function depends on the amino acid sequence and the shape it takes as a consequence of the interactions between those amino acids.	Protein Synthesis Activity DNA Strand Activity Gattaca Codon Bingo	
		2. Cells and cell structures have specific functions that allow an organism to grow, survive and reproduce.			

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4. Life Science	1. Structure and Function of Living Systems	2. Cells and cell structures have specific functions that allow an organism to grow, survive and reproduce.	9.4.1.2.3	Describe how viruses, prokaryotic cells, and eukaryotic cells differ in relative size, complexity and general structure.	Virus 'Wanted' Activity Virus/Bacteria PowerPoint <i>Bacteria and Virus</i> Video from the Discovery Channel Leaf Model Activity
			9.4.1.2.4	Explain the function and importance of cell organelles for prokaryotic and/or eukaryotic cells as related to the basic cell processes of respiration, photosynthesis, protein synthesis and cell	Invertebrate Study Guides Cell Analogy Activity <i>Cell Analogy</i> Video
			9.4.1.2.5	Compare and contrast passive transport (including osmosis and facilitated transport) with active transport such as endocytosis and exocytosis.	Celery Demo Carnation Colors Demo Sodium/Potassium Pump Diagram
			9.4.1.2.6	Explain the process of mitosis in the formation of identical new cells and maintaining chromosome number during asexual reproduction.	In the Family Readings (Horse or Daffodil?) Mitosis Lab
	2. Interdependence Among Living Systems	1. The interrelationship and interdependence of organisms generate dynamic biological communities in ecosystems.	9.4.2.1.1	Describe factors that affect the carrying capacity of an ecosystem and relate these to population growth.	Bacteria and Exponential Growth Interactive Website
			9.4.2.1.2	Explain how ecosystems can change as a result of the introduction of one of more new species. <i>For example:</i> The effect of migration, localized evolution or disease organism.	Invasive Species Discussion (PowerPoint, Internet Activity)

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4. Life Science	2. Interdependence Among Living Systems	2. Matter cycles and energy flows through different levels of organization of living systems and the physical environment, as chemical elements are combined in different ways.	9.4.2.2.1	Use words and equations to differentiate between the processes of photosynthesis and respiration in terms of energy flow, beginning reactants and end products.	<i>Respiration</i> Video Leaf Model
			9.4.2.2.2	Explain how matter and energy is transformed and transferred among organisms in an ecosystem, and how energy is dissipated as heat into the environment.	Energy Pyramid Activity
	3. Evolution in Living Systems	1. Genetic information found in the cell provides information for assembling proteins which dictate expression of traits in an individual.	9.4.3.1.1	Explain the relationships among DNA, genes and chromosomes.	In the Family Readings and Worksheets DNA Model Mitosis/Meosis Lab Genetics Unit
			9.4.3.1.2	In the context of a monohybrid cross, apply the terms phenotype, genotype, allele, homozygous and heterozygous.	Punnett Square Activity Albino Article in the Science World Magazine Albino Animals (MNDNR) Pennies and Punnett Squares Marshan Genetics

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4. Life Science	3. Evolution in Living Systems	2. Variation within a species is the natural result of new inheritable characteristics occurring from new combinations of existing genes or from mutations of genes in reproductive cells.	9.4.3.2.1	Use concepts from Mendel's laws of segregation and independent assortment to explain how sorting and recombination (crossing over) of genes during sexual reproduction (meiosis) increases the occurrence of variation in a species.	<i>DNA/RNA</i> Video DNA Model Activity Marshan Genetics <i>Sponge</i> Video Clip and Discussion Sponge Lab Simple Invertebrate Activities
			9.4.3.2.2	Use the processes of mitosis and meiosis to explain the advantages and disadvantages of asexual and sexual reproduction.	Mitosis/Meiosis Lab <i>Sponge</i> Video Clip and Discussion Sponge Lab Simple Invertebrate Activities
			9.4.3.2.3	Explain how mutations like deletions, insertions, rearrangements or substitutions of DNA segments in gametes may have no effect, may harm, or rarely may be beneficial, and can result in genetic variation within a species.	In the Family Article Karyotypes and Human Chromosomal Differences DNA Counseling

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4. Life Science	3. Evolution in Living Systems	3. Evolution by natural selection is a scientific explanation for the history and diversity of life on Earth.	9.4.3.3.1	Describe how evidence led Darwin to develop the theory of natural selection and common descent to explain evolution.	Birds and Beaks Lab <i>Charles Darwin Biography</i> Video
			9.4.3.3.2	Use scientific evidence, including the fossil record, homologous structures, and genetic and/or biochemical similarities, to show evolutionary relationships among species.	<i>The Conquerors</i> Video Fossil Hunting with Mollusks Activity
			9.4.3.3.3	Recognize that artificial selection has led to offspring through successive generations that can be very different in appearance and behavior from their distant ancestors.	Food and Artificial Selection Lab In the Family Article with Dog Pedigrees
			9.4.3.3.4	Explain why genetic variation within a population is essential for evolution to occur.	Simple Invertebrates Comparison <i>The Conquerors</i> Video
			9.4.3.3.5	Explain how competition for finite resources and the changing environment promotes natural selection on offspring survival, depending on whether the offspring have characteristics that are advantageous or disadvantageous in the new environment.	Albino Articles (X2) <i>Bubonic Plague</i> Video and Article
			9.4.3.3.6	Explain how genetic variation between two populations of a given species is due, in part, to different selective pressures acting independently on each population and how, over time, these differences can lead to the development of new species.	Chapter discussion on evolution

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4. Life Science	4. Human Interactions with Living Systems	1. Human activity has consequences on living organisms and ecosystems.	9.4.4.1.1	Describe the social, economic, and ecological risks and benefits of biotechnology in agriculture and medicine. <i>For example:</i> Selective breeding, genetic engineering, and antibiotic development and use.	Food and Artificial Selection Lab Vaccinations PowerPoint and Activity Antibiotics Discussion
			9.4.4.1.2	Describe the social, economic and ecological risks and benefits of changing a natural ecosystem as a result of human activity. <i>For example:</i> Changing the temperature or composition of water, air or soil; altering the populations and communities, developing artificial ecosystems; or changing the use of land or water.	Coral Artificial Coral Reefs Article and Video Clip
			9.4.4.1.3	Describe contributions from diverse cultures, including Minnesota American Indian tribes and communities, to the understanding of interactions among humans and living systems. <i>For example:</i> American Indian understanding of sustainable land use practices.	Fleming, Pastuer and Darwin Scientists (discussions) Mayan and Incan Land Use and Corn Discussion
		2. Personal and community health can be affected by the environment, body functions and human behavior.	9.4.4.2.2	Explain how the body produces antibodies to fight disease and how vaccines assist this process.	Vaccination PowerPoint Virus 'Wanted' Activity
			9.4.4.2.3	Describe how the immune system sometimes attacks some of the body's own cells and how some allergic reactions are caused by the body's immune responses to usually harmless environmental substances.	Autoimmune Diseases Activity
			9.4.4.2.4	Explain how environmental factors and personal decisions, such as water quality, air quality and smoking affect personal and community health.	Discussion of Public water System and Antibiotics Modern Marvels: <i>City Water</i> Video
			9.4.4.2.5	Recognize that a gene mutation in a cell can result in uncontrolled cell division called cancer, and how exposure of cells to certain chemicals and radiation increases mutations and thus increases the chance of cancer.	Protein Synthesis Lab Cancer Discussion