

Bemidji Area Schools

Grades 9-12 Environmental Science Outcomes

Strand	Substrand	Standard "Understand that ..."	Code	Benchmark	Activities
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.	Calorie Lab Specific Heats of Building Materials Lab
			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	Lichen Activities Snow Insulation Labs Tap Water Tour How Does Salt Effect Our Environment? Lab
			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	Global Warming Curriculum and Activities "Cool It" Activity and Video
			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.	Insulation Value of Clothing Labs Is it Water? Lab Tap Water Tour
	2. Scientific inquiry uses multiple interrelated processes to pose and investigate questions about the natural world.				
	2. The Practice of Engineering	1. Engineering is a way of addressing human needs by applying science concepts and mathematical techniques to develop new products, tools, processes and systems.	9.1.2.1.1	Understand that engineering designs and products are often continually checked and critiqued for alternatives, risks, costs and benefits, so that subsequent designs are refined and improved. <i>For example:</i> If the price of an essential raw material changes, the product design may need to be changed.	Alternate Energy Sources Activity Modern Marvels: Oil

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1. The Nature of Science and Engineering	2. The Practice of Engineering	2. Engineering design is an analytical and creative process of devising a solution to meet a need or solve a specific problem.	9.1.2.2.1	Identify a problem and the associated constraints on possible design solutions. <i>For example:</i> Constraints can include time, money, scientific knowledge and available technology.	NOVA: Car of the Future Activity and Interactive Websites
		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.
	2. Men and women throughout the history of all cultures, including Minnesota American Indian tribes and communities, have been involved in engineering design and scientific inquiry.		9.1.3.2.2	Analyze possible careers in science and engineering in terms of education requirements, working practices and rewards.	DNR Employment (Various speakers and video from MNDNR on job outlooks) Eco-Tourism possibilities
	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.	Population Unit Have and Have Nots World in Balance Activity Ecological Footprint Activity Measuring Substances in Water Lab
			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.	Hybrid PowerPoint Activity
			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.	Lichen Studies (2) Hibernation Activities (3) Animal Populations Activities (3)

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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.	Hibernating Animals/Human Medicine Articles and Activities Ground Water Purification Lab Fuel Efficient Vehicles Activities
			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.	Flame Test Lab (Water Unit)
			9.1.3.4.3	Select and use appropriate numeric, symbolic, pictorial, or graphical representation to communicate scientific ideas, procedures and experimental results.	Deer vs. Wolf Populations Activity Doubling Rates of Countries Lab Human Life Spans Lab Lake Bemidji Ice Data Activity Population Density of Trees Lab
			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	Mark and Recapture Lab Lichen Labs Random Sampling Lab Student Drivers Lab Population Density of Trees Lab
2. Physical Science	1. Matter	1. The structure of the atom determines chemical properties of elements.	9.2.1.1.3	Explain the arrangement of the elements on the Periodic Table, including the relationships among elements in a given column or row.	Measuring water and Substances Lab Calorie Lab
		2. Chemical reactions involve the rearrangement of atoms as chemical bonds are broken and formed through transferring or sharing of electrons and the absorption or release of energy.	9.2.1.2.3	Describe a chemical reaction using words and symbolic equations. <i>For example:</i> The reaction of hydrogen gas with oxygen gas can be written: $2H_2 + O_2 \rightarrow 2H_2O$.	Calorie Lab Tap Water Tour Lignite Activity

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2. Physical Science	3. Energy	2. Energy can be transformed within a system or transferred to other systems or the environment, but is always conserved.	9.2.3.2.1	Identify the energy forms and explain the transfers of energy involved in the operation of common devices. <i>For example:</i> Light bulbs, electric motors, automobiles or bicycles.	CFL vs. Incandescent Light Bulbs Lab Solar Car and Charger Demos <i>Alternative Energy Sources</i> DVD
			9.2.3.2.4	Explain and calculate current, voltage and resistance, and describe energy transfers in simple electric circuits.	Calculating Wattage of Appliances Activity Energy Star Activity How Much Electricity Does My Household Use? Activity
			9.2.3.2.6	Compare fission and fusion in terms of the reactants, the products and the conversion from matter into energy. <i>For example:</i> The fusion of hydrogen produces energy in the sun. <i>Another example:</i> The use of chain reactions in nuclear reactors.	Modern Marvels: Energy <i>Alternative Energy Sources</i> DVD Chapter Notes
			9.2.3.2.7	Describe the properties and uses of forms of electromagnetic radiation from radio frequencies through gamma radiation. <i>For example:</i> Compare the energy of microwaves and X-rays.	Flame Test Lab (Water Unit)
	4. Human Interactions with Physical Systems	1. There are benefits, costs and risks to different means of generating and using energy.	9.2.4.1.1	Compare local and global environmental and economic advantages and disadvantages of generating electricity using various sources or energy. <i>For example:</i> Fossil fuels, nuclear fission, wind, sun or tidal energy.	Lignite Activities <i>Alternative Energy</i> DVD Chapter Notes
			9.2.4.1.2	Describe the trade-offs involved when technological developments impact the way we use energy, natural resources, or synthetic materials. <i>For example:</i> Fluorescent light bulbs use less energy than incandescent lights, but contain toxic mercury.	CFL vs. Incandescent Light Bulb Activity Lignite Activities Student Drivers Lab

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3. Earth and Space Science	2. Interdependence Within the Earth System	1. The Earth system has internal and external sources of energy, which produce heat and drive the motion of material in the oceans, atmosphere and solid earth.	9.3.2.1.1	Compare and contrast the energy sources of the Earth, including the sun, the decay of radioactive isotopes and gravitational energy.	<i>Alternative Energy Sources</i> DVD Weather Patterns Within the Earth Lab
		2. Global climate is determined by distribution of energy from the sun at the Earth's surface.	9.3.2.2.2	Explain how evidence from the geologic record, including ice core samples, indicates that climate changes have occurred at varying rates over geologic time and continue to occur today.	Lake Bemidji Ice Activities and Video Clip 'Cool It' Activity
	4. Human Interactions with the Earth Systems	1. People consider potential benefits, costs and risks to make decisions on how they interact with natural systems.	9.3.4.1.2	Explain how human activity and natural processes are altering the hydrosphere, biosphere, lithosphere and atmosphere, including pollution, topography and climate. <i>For example:</i> Active volcanoes and the burning of fossil fuels contribute to the greenhouse effect.	Modern Marvels: Logging Techniques MNDNR Forestry Primer Lignite Activity Ecological Footprint Student Drivers Lab
4. Life Science	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.	Populations PowerPoint Population Density Lab of Humans Exponential Growth Activities Understanding Exponential Growth Internet Activity 'Have and Have Nots' Activity
			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.	Populations PowerPoint Deer vs. Wolf Populations Activity Hibernation Activities and Article
		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.	9.4.2.2.2	Explain how matter and energy is transformed and transferred among organisms in an ecosystem, and how energy is dissipated as heat into the environment.	Foot Web/Chain Activity Chapter Notes Predator/Prey/Scavenger/Decomposers Discussion

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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.	Lifespan Lab MNDNR Primer (forestry Unit) Biofuels Article
			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.	Groundwater Lab Modern Marvels: Logging Techniques Populations PowerPoint How Populated is Our Earth? Internet Activity Ecological Footprint Activity
		2. Personal and community health can be affected by the environment, body functions and human behavior.	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.	Measuring Substances in Water Lab Flame Test Lab Lichen Labs Student Drivers Lab
2. Physical Science	1. Matter	1. The periodic table illustrates how patterns in the physical and chemical properties of elements are related to atomic structure.	9C.2.1.1.2	Identify and compare trends on the periodic table, including reactivity and relative sizes of atoms and ions; use the trends to explain the properties of subgroups, including metals, non-metals, alkali metals, alkaline earth metals, halogens and noble gases.	Measuring Substances in Water Lab Calories Lab Modern Marvels: City Water
			3. Chemical reactions describe a chemical change in which one or more reactants are transformed into one or more products.	9C.2.1.3.2	Use solubility and activity of ions to determine whether a double replacement or single replacement reaction will occur.
			9C.2.1.3.6	Describe the factors that affect the rate of a chemical reaction, including temperature, pressure, mixing, concentration, particle size, surface area and catalyst.	Is It Water? Lab

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1. The Nature of Science and Engineering	3. Interactions Among Science, Technology, Engineering, Mathematics, and Society	4. Physical and mathematical models are used to describe physical systems.	9P.1.3.4.1	Use significant figures and an understanding of accuracy and precision in scientific measurements to determine and express the uncertainty of a result.	Measuring Water and Contaminants Lab Insulative Value of Cotton Clothing Lab
			9P.2.3.4.1	Describe and calculate the quantity of heat transferred between solids and/or liquids, using specific heat, mass and change in temperature.	Calorie Lab Aluminum Animals Lab
2. Physical Science	3. Energy	4. Heat energy is transferred between objects or regions that are at different temperatures by the processes of convection, conduction and radiation.	9P.2.3.4.3	Compare the rate at which objects at different temperatures will transfer thermal energy by electromagnetic radiation.	Aluminum Animals Lab Building Materials Lab Insulation Lab Fat vs. Oil Insulative Properties Lab How Good of an Insulator is Air? Lab Snow Layers Lab