

Alignment to State (Illinois and Indiana) and National Science Standards



Ecology/Environmental Science Lesson P²D²

Alignment to Illinois State Goals

STATE GOAL 11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.

Illinois Learning Standards:

LEARNING STANDARD A. Know and apply the concepts, principles and processes of scientific inquiry.

LEARNING STANDARD B. Know and apply the concepts, principles and processes of technological design.

Illinois Assessment Framework Objectives:

BENCHMARK:

- 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.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.B.4a Identify a technological design problem inherent in a commonly used product.
- 11.B.4b Propose and compare different solution designs to the design problem based upon given constraints including available tools, materials and time.
- 11.B.4d Determine the criteria upon which the designs will be judged, identify, advantages and disadvantages of the designs and select the most promising design.
- 11.B.4e Develop and test a prototype or simulation of the solution design using available materials, instruments and technology.
- 11.B.4f Evaluate the test results based on established criteria, note sources of error and recommend improvements.
- 11.B.4g Using available technology, report to an audience the relative success of the design based on the test results and criteria.
- 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.
- 11.B.5a Identify a design problem that has practical applications and propose possible solutions, considering such constraints as available tools, materials, time and costs.
- 11.B.5b Select criteria for a successful design solution to the identified problem.
- 11.B.5c Build and test different models or simulations of the design solution using suitable materials, tools and technology.
- 11.B.5d Choose a model and refine its design based on the test results.
- 11.B.5e Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements.
- 11.B.5f Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts.

BENCHMARK:

- 13.A.5a Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities.
- 13.A.5b Explain criteria that scientists use to evaluate the validity of scientific claims and theories.
- 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.
- 13.B.5a Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, technology obsolescence).
- 13.B.5b Analyze and describe the processes and effects of scientific and technological breakthroughs.
- 13.B.5c Design and conduct an environmental impact study, analyze findings and justify recommendations.
- 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).
- 13.B.5e Assess how scientific and technological progress has affected other fields of study, careers and job markets and aspects of everyday life.

STATE GOAL 12: Understand the fundamental concepts, principles, and interconnections of the life, physical, and earth/space sciences.

Illinois Learning Standards:

LEARNING STANDARD: A. Know and apply concepts that explain how living things function, adapt and change.

LEARNING STANDARD B. Know and apply concepts that describe how living things interact with each other and with their environment.

Illinois Assessment Framework Objectives:

BENCHMARK:

- 12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms.
- 12.B.4b Simulate and analyze factors that influence the size and stability of populations within ecosystems (e.g., birth rate, death rate, predation, migration patterns).
- 12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy).

STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts.

Illinois Learning Standards:

LEARNING STANDARD A. Know and apply the accepted practices of science.

LEARNING STANDARD B. Know and apply concepts that describe the interaction between science, technology and society.

Illinois Assessment Framework Objectives:

BENCHMARK:

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.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.4d Explain how peer review helps to assure the accurate use of data and improves the scientific process.

13.B.4a Compare and contrast scientific inquiry and technological design as pure and applied sciences.

13.B.4b Analyze a particular occupation to identify decisions that may be influenced by a knowledge of science.

13.B.4c Analyze ways that resource management and technology can be used to accommodate population trends.

13.B.4d Analyze local examples of resource use, technology use or conservation programs; document findings; and make recommendations for improvements.

13.B.4e Evaluate claims derived from purported scientific studies used in advertising and marketing strategies.

Ecology/Environmental Science Lesson P²D²

Alignment to Indiana State Science Standards

Principles of Environmental Science-- Standard 1

Environmental Systems

- Env.1.4 Understand and explain that human beings are part of Earth's ecosystems and give examples of how human activities can, deliberately or inadvertently, alter ecosystems.
- Env.1.8 Recognize/ describe the difference between systems in equilibrium and systems in disequilibrium.
- Env.1.10 Identify and measure biological, chemical, and physical factors within an ecosystem.

Natural Resources

- Env.1.28 Understand and describe the concept and the importance of natural and human recycling in conserving our natural resources

Environmental Hazards

- Env.1.31 Understand and explain that waste management includes considerations of quantity, safety, degradability, and cost.
- Env.1.34 Differentiate between natural pollution and pollution caused by humans; give examples of each.

Principles of Biology-- Standard 1

Ecology

- B.1.41 Recognize that and describe how human beings are part of Earth's ecosystems. Note that human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems.
- B.1.43 Understand that and describe how organisms are influenced by a particular combination of living and nonliving components of the environment.
- B.1.44 Describe the flow of matter, nutrients, and energy within ecosystems.
- B.1.45 Recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of the way organisms develop within ecosystems.

Advanced Life Science: Animals Standards—Standard 4

Animal Genetics and the Environment

Ecology

- AS.4.20 Explain the role of resources in every ecosystem. Define trophic level. Explain the concept of energy flow: primary producers, primary consumers, secondary and tertiary consumers, and decomposers.
- AS.4.21 Describe the impact humans have on the capacity of any system to support life. List the factors that limit the capacity of an ecosystem. Discuss the interactions that occur between birth rate, population growth, and carrying capacity of the ecosystem.
- AS.4.22 Explain difference between exponential and logistic growth curves. Define carrying capacity. Describe the impact of carrying capacity on an ecosystem (community ecology). Predict the impacts of overcrowding, disease, and waste on animal health

Alignment with National Science Education Standards

Science as Inquiry

Content Standard A--As a result of their activities in grades 9-12, all students should develop understanding of:

- Abilities necessary to do scientific inquiry
 - Identify questions and concepts that guide scientific investigations.
 - Design and conduct scientific investigations.
 - Formulate and revise scientific explanations and models using logic and evidence.
 - Communicate and defend a scientific argument.

- Understandings about scientific inquiry
 - Scientists usually inquire about how physical, living, or designed systems function. Conceptual principles and knowledge guide scientific inquiries. Historical and current scientific knowledge influence the design and interpretation of investigations and the evaluation of proposed explanations made by other scientists.
 - Scientists conduct investigations for a wide variety of reasons. For example, they may wish to discover new aspects of the natural world, explain recently observed phenomena, or test the conclusions of prior investigations or the predictions of current theories.
 - Scientists rely on technology to enhance the gathering and manipulation of data. New techniques and tools provide new evidence to guide inquiry and new methods to gather data, thereby contributing to the advance of science. The accuracy and precision of the data, and therefore the quality of the exploration, depends on the technology used.
 - Mathematics is essential in scientific inquiry. Mathematical tools and models guide and improve the posing of questions, gathering data, constructing explanations and communicating results.
 - Scientific explanations must adhere to criteria such as: a proposed explanation must be logically consistent; it must abide by the rules of evidence; it must be open to questions and possible modification; and it must be based on historical and current scientific knowledge.
 - Results of scientific inquiry—new knowledge and methods—emerge from different types of investigations and public communication among scientists. In communicating and defending the results of scientific inquiry, arguments must be logical and demonstrate connections between natural phenomena, investigations, and the historical body of scientific knowledge. In addition, the methods and procedures that scientists used to obtain evidence must be clearly reported to enhance opportunities for further investigation.

Life Science

Content Standard C--As a result of their activities in grades 9-12, all students should develop understanding of:

- Interdependence of organisms
 - Human beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected.

Science in Personal and Social Perspectives

Content Standard F--As a result of their activities in grades 9-12, all students should develop understanding of:

- Natural resources
 - The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources, and it depletes those resources that cannot be renewed.
 - Humans use many natural systems as resources. Natural systems have the capacity to reuse waste, but that capacity is limited. Natural systems can change to an extent that exceeds the limits of organisms to adapt naturally or humans to adapt technologically.
- Environmental quality
 - Natural ecosystems provide an array of basic processes that affect humans. Those processes include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients. Humans are changing many of these basic processes, and the changes may be detrimental to humans.
 - Materials from human societies affect both physical and chemical cycles of the earth.
 - Many factors influence environmental quality. Factors that students might investigate include population growth, resource use, population distribution, overconsumption, the capacity of technology to solve problems, poverty, the role of economic, political, and religious views, and different ways humans view the earth.
- Natural and human-induced hazards
 - Human activities can enhance potential for hazards. Acquisition of resources, urban growth, and waste disposal can accelerate rates of natural change.
 - Natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by humans bring benefits to society, as well as cause risks. Students should understand the costs and trade-offs of various hazards—ranging from those with minor risk to a few people to major catastrophes with major risk to many people. The scale of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations.
- Science and technology in local, national, and global challenges
 - Understanding basic concepts and principles of science and technology should precede active debate about the economics, policies, politics, and ethics of various science- and technology-related challenges. However, understanding science alone will not resolve local, national, or global challenges.
 - Individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs, and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them. Students should understand the appropriateness and value of basic questions—"What can happen?"—"What are the odds?"—and "How do scientists and engineers know what will happen?"
 - Humans have a major effect on other species. For example, the influence of humans on other organisms occurs through land use—which decreases space available to other species—and pollution—which changes the chemical composition of air, soil, and water.

History and Nature of Science

Content Standard G--As a result of their activities in grades 9-12, all students should develop understanding of:

- Science as a Human Endeavor
 - Individuals and teams have contributed and will continue to contribute to the scientific enterprise. Doing science or engineering can be as simple as an individual conducting field studies or as complex as hundreds of people working on a major scientific question or technological problem. Pursuing science as a career or as a hobby can be both fascinating and intellectually rewarding.
 - Scientific explanations must meet certain criteria. First and foremost, they must be consistent with experimental and observational evidence about nature, and must make accurate predictions, when appropriate, about systems being studied. They should also be logical, respect the rules of evidence, be open to criticism, report methods and procedures, and make knowledge public. Explanations on how the natural world changes based on myths, personal beliefs, religious values, mystical inspiration, superstition, or authority may be personally useful and socially relevant, but they are not scientific.
 - Because all scientific ideas depend on experimental and observational confirmation, all scientific knowledge is, in principle, subject to change as new evidence becomes available. The core ideas of science such as the conservation of energy or the laws of motion have been subjected to a wide variety of confirmations and are therefore unlikely to change in the areas in which they have been tested. In areas where data or understanding are incomplete, such as the details of human evolution or questions surrounding global warming, new data may well lead to changes in current ideas or resolve current conflicts. In situations where information is still fragmentary, it is normal for scientific ideas to be incomplete, but this is also where the opportunity for making advances may be greatest.

Government Illinois State Learning Standards

GRADE LEVEL: High School

State Goal 14: Understand political systems, with an emphasis on the United States.

- 14.A.4 Analyze how local, state, and national governments serve the purposes for which they were created.
- 14.C.4 Describe the meaning of participatory citizenship (e.g., volunteerism, voting) at all levels of government and society in the United States.
- 14.C.5 Analyze the consequences of participation and non-participation in the electoral process (e.g., women's suffrage, voter registration, effects of media).
- 14.D.4 Analyze roles and influences of individuals, groups and media in shaping current debates on state and national policies.
- 14.D.5 Interpret a variety of public policies and issues from the perspectives of different individuals and groups.

- 14.F.5 Interpret how changing geographical, economic, technological and social forces affect United States political ideas and traditions (e.g., freedom, equality and justice, individual rights).

State Goal 15: Understand economic systems, with an emphasis on the United States.

- 15.C.4b Explain the importance of research, development, invention, technology and entrepreneurship to the United States economy.

- 15.E.4b Describe social and environmental benefits and consequences of production and consumption.

State Goal 17: Understand world geography and the effects of geography on society, with an emphasis on the United States.

- 17.A.4b Use maps and other geographic instruments and technologies to analyze spatial patterns and distributions on earth.

- 17.B.4a Explain the dynamic interactions within and among the Earth's physical systems including variation, productivity and constructive and destructive processes.

- 17.C.5b Describe the impact of human migrations and increased urbanization on ecosystems.

- 17.C.5c Describe geographic factors that affect cooperation and conflict among societies.

State Goal 18: Understand social systems, with an emphasis on the United States.

- 18.B.5 Use methods of social science inquiry (pose questions, collect and analyze data, make an support conclusions with evidence, report findings) to study the development and functions of social systems and report conclusions to a larger audience.

English Illinois State Learning Standards

SUBJECT AREA: English

GRADE LEVEL: Early High School

BENCHMARK:

- 3.A. 4 Use standard English to edit documents for clarity, subject/verb agreement, adverb and adjective agreement and verb tense; proofread for spelling, capitalization and punctuation; and ensure that documents are formatted in final form for submission and/or publication.
- 3.B.4a Produce documents that exhibit a range of writing techniques appropriate to purpose and audience, with clarity of focus, logic of organization, appropriate elaboration and support and overall coherence.
- 3.B.4b Produce, edit, revise and format work for submission and/or publication (e.g., manuscript form, appropriate citation of sources) using contemporary technology.
- 3.B.4c Evaluate written work for its effectiveness and make recommendations for its improvement.
- 3.C.4a Write for real or potentially real situations in academic, professional and civic contexts (e.g., college applications, job applications, business letters, petitions).
- 3.C.4b Using available technology, produce compositions and multimedia works for specified audiences.

BENCHMARK:

- 4.A.4a Apply listening skills as individuals and members of a group in a variety of settings (e.g., lectures, discussions, conversations, team projects, presentations, interviews).
- 4.A.4b Apply listening skills in practical settings (e.g., classroom note taking, interpersonal conflict situations, giving and receiving directions, evaluating persuasive messages).
- 4.A.4c Follow complex oral instructions.
- 4.A.4d Demonstrate understanding of the relationship of verbal and nonverbal messages within a context (e.g., contradictory, supportive, repetitive, substitutive).
- 4.B.4a Deliver planned informative and persuasive oral presentations using visual aids and contemporary technology as individuals and members of a group; demonstrate organization, clarity, vocabulary, credible and accurate supporting evidence.
- 4.B.4b Use group discussion skills to assume leadership and participant roles within an assigned project or to reach a group goal.
- 4.B.4c Use strategies to manage or overcome communication anxiety and apprehension (e.g., developed outlines, notecards, practice).
- 4.B.4d Use verbal and nonverbal strategies to maintain communication and to resolve individual and group conflict.

BENCHMARK:

- 5.A.4a Demonstrate a knowledge of strategies needed to prepare a credible research report (e.g., notes, planning sheets).
- 5.A.4b Design and present a project (e.g., research report, scientific study, career/higher education opportunities) using various formats from multiple sources.
- 5.B.4a Choose and evaluate primary and secondary sources (print and nonprint) for a variety of purposes.

- 5.B.4b Use multiple sources and multiple formats; cite according to standard style manuals.
- 5.C.4a Plan, compose, edit and revise information (e.g., brochures, formal reports, proposals, research summaries, analyses, editorials, articles, overheads, multimedia displays) for presentation to an audience.
- 5.C.4b Produce oral presentations and written documents using supportive research and incorporating contemporary technology.
- 5.C.4c Prepare for and participate in formal debates.

BENCHMARK:

- 1.B.5a Relate reading to prior knowledge and experience and make connections to related information.
- 1.C.5c Critically evaluate information from multiple sources.
- 1.C.5d Summarize and make generalizations from content and relate them to the purpose of the material.
- 1.C.5e Evaluate how authors and illustrators use text and art across materials to express their ideas (e.g., complex dialogue, persuasive techniques).
- 1.C.5f Use tables, graphs and maps to challenge arguments, defend conclusions and persuade others.

BENCHMARK:

- 3.B.5 Using contemporary technology, produce documents of publication quality for specific purposes and audiences; exhibit clarity of focus, logic of organization, appropriate elaboration and support and overall coherence.
- 3.C.5a Communicate information and ideas in narrative, informative and persuasive writing with clarity and effectiveness in a variety of written forms using appropriate traditional and/or electronic formats; adapt content, vocabulary, voice and tone to the audience, purpose and situation.
- 3.C.5b Write for real or potentially real situations in academic, professional and civic contexts (e.g., applications, job applications, business letters, resume, petitions).

BENCHMARK:

- 4.A.5a Use criteria to evaluate a variety of speakers' verbal and nonverbal messages.
- 4.A.5b Use techniques for analysis, synthesis, and evaluation of oral messages.
- 4.B.5a Deliver planned and impromptu oral presentations, as individuals and members of a group, conveying results of research, projects or literature studies to a variety of audiences (e.g., peers, community, business/industry, local organizations) using appropriate visual aids and available technology.
- 4.B.5b Use speaking skills to participate in and lead group discussions; analyze the effectiveness of the spoken interactions based upon the ability of the group to achieve its goals.
- 4.B.5c Implement learned strategies to self-monitor communication anxiety and apprehension (e.g., relaxation and transference techniques, scripting, extemporaneous outlining, repetitive practice).
- 4.B.5d Use verbal and nonverbal strategies to maintain communication and to resolve individual, group and workplace conflict (e.g., mediation skills, formal and informal bargaining skills).

BENCHMARK:

- 5.A.5a Develop a research plan using multiple forms of data.
- 5.A.5b Research, design and present a project to an academic, business or school community audience on a topic selected from among contemporary issues.
- 5.B.5a Evaluate the usefulness of information, synthesize information to support a thesis, and present information in a logical manner in oral and written forms.
- 5.B.5b Credit primary and secondary sources in a form appropriate for presentation or publication for a particular audience.
- 5.C.5a Using contemporary technology, create a research presentation or prepare a documentary related to academic, technical or occupational topics and present the findings in oral or multimedia formats.
- 5.C.5b Support and defend a thesis statement using various references including media and electronic resources.

