

Biology

Standard B1: INQUIRY, REFLECTION, AND SOCIAL IMPLICATIONS

Students will understand the nature of science and demonstrate an ability to practice scientific reasoning by applying it to the design, execution, and evaluation of scientific investigations. Students will demonstrate their understanding that scientific knowledge is gathered through various forms of direct and indirect observations and the testing of this information by methods including, but not limited to, experimentation. They will be able to distinguish between types of scientific knowledge (e.g., hypotheses, laws, theories) and become aware of areas of active research in contrast to conclusions that are part of established scientific consensus. They will use their scientific knowledge to assess the costs, risks, and benefits of technological systems as they make personal choices and participate in public policy decisions. These insights will help them analyze the role science plays in society, technology, and potential career opportunities.

BI.I Scientific Inquiry

Science is a way of understanding nature. Scientific research may begin by generating new scientific questions that can be answered through replicable scientific investigations that are logically developed and conducted systematically. Scientific conclusions and explanations result from careful analysis of empirical evidence and the use of logical reasoning. Some questions in science are addressed through indirect rather than direct observation, evaluating the consistency of new evidence with results predicted by models of natural processes. Results from investigations are communicated in reports that are scrutinized through a peer review process.

B1.1A Generate new questions that can be investigated in the laboratory or field.

Project Learning Tree Activities

Biodiversity:

1. Global Invaders
2. Protected Areas: Issues and Analysis
3. Potatoes, Pesticides, and Biodiversity

Municipal Solid Waste:

1. The Waste Stream
2. Source Reduction
4. Composting
6. Landfills
7. Where Does Your Garbage Go?
8. Success Stories and Personal Choices

Places We Live:

3. Mapping Your Community Through Time
4. Neighborhood Design
5. Green Space
6. A Vision for the Future

<p>B1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the Challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.</p>	<p>Project Learning Tree Activities Biodiversity: 1. Global Invaders 3. Potatoes, Pesticides, and Biodiversity Municipal Solid Waste: 6. Landfills</p>
<p>B1.1C Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).</p>	<p>Project Learning Tree Activities Municipal Solid Waste: 1. The Waste Stream 4. Composting 6. Landfills 8. Success Stories and Personal Choices</p>
<p>B1.1D Identify patterns in data and relate them to theoretical models.</p>	<p>Project Learning Tree Activities Municipal Solid Waste: 1. The Waste Stream 3. Recycling and Economics 4. Composting Focus on Risk: 3. Chances Are... Understanding Probability and Risk</p>
<p>B1.1E Describe a reason for a given conclusion using evidence from an investigation.</p>	<p>Project Learning Tree Activities Biodiversity: 1. Global Invaders Municipal Solid Waste: 1. The Waste Stream 2. Source Reduction 6. Landfills 8. Success Stories and Personal Choices Focus on Risk: 1. What is Risk? Electromagnetic Fields Chlorine: Looking at Tradeoffs Places We Live: 6. A Vision for the Future 7. Far-Reaching Decisions</p>

<p>B1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.</p>	<p>Project Learning Tree Activities Biodiversity: 1. Global Invaders Municipal Solid Waste: 1. The Waste Stream 6. Landfills 8. Success Stories and Personal Choices Places We Live: 6. A Vision for the Future</p>
<p>B1.1h Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.</p>	<p>Project Learning Tree Activities Municipal Solid Waste: 1. The Waste Stream 3. Recycling and Economics 4. Composting 6. Landfills</p>

BI.2 Scientific Reflection and Social Implications

The integrity of the scientific process depends on scientists and citizens understanding and respecting the “nature of science.” Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logical reasoning during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal problems from a personal and local scale to a global scale. Science both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities.

<p>B1.2B Identify and critique arguments about personal or societal issues based on scientific evidence.</p>	<p>Project Learning Tree Activities Municipal Solid Waste: 2. Source Reduction 3. Recycling and Economics Focus on Risk: 1. What is Risk? 2. Things Aren't Always What They Seem 4. Risk Assessment: Tools of the Trade 5. Communicating Risk 6. Weighing the Options: A Look at Tradeoffs 7. Decision Making: Ecological Risk, Wildfires, and Natural Hazards Electromagnetic Fields Chlorine: Looking at Tradeoffs Places We Live: 3. Mapping Your Community Through Time 8. Regional Community Issues: The Ogallala Aquifer</p>
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<p>B1.2C Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.</p>	<p>Project Learning Tree Activities Focus on Risk: 1. What is Risk? 7. Decision Making: Ecological Risk, Wildfires, and Natural Hazards</p>
<p>B1.2D Evaluate scientific explanations in a peer review process or discussion format.</p>	<p>Project Learning Tree Activities Biodiversity: 1. Global Invaders Municipal Solid Waste: 1. The Waste Stream 2. Source Reduction Focus on Risk: 1. What is Risk? 2. Things Aren't Always What They Seem 4. Risk Assessment: Tools of the Trade 5. Communicating Risk 6. Weighing the Options: A Look at Tradeoffs 7. Decision Making: Ecological Risk, Wildfires, and Natural Hazards Electromagnetic Fields Places We Live: 7. Far-Reaching Decisions 8. Regional Community Issues: The Ogallala Aquifer</p>
<p>B1.2E Evaluate the future career and occupational prospects of science fields.</p>	<p>Project Learning Tree Activities Places We Live: 4. Neighborhood Design 8. Regional Community Issues: The Ogallala Aquifer</p>

<p>B1.2f Critique solutions to problems, given criteria and scientific constraints.</p>	<p>Project Learning Tree Activities Biodiversity: 1. Global Invaders 2. Protected Areas: Issues and Analysis 3. Potatoes, Pesticides, and Biodiversity Municipal Solid Waste: 1. The Waste Stream 2. Source Reduction 6. Landfills 8. Success Stories and Personal Choices Focus on Risk: 1. What is Risk? 6. Weighing the Options: A Look at Tradeoffs Electromagnetic Fields Places We Live: 5. Green Space 7. Far-Reaching Decisions 8. Regional Community Issues: The Ogallala Aquifer</p>
<p>B1.2g Identify scientific tradeoffs in design decisions and choose among alternative solutions.</p>	<p>Project Learning Tree Activities Municipal Solid Waste: 2. Source Reduction Focus on Risk: 1. What is Risk? 2. Things Aren't Always What They Seem Chlorine: Looking at Tradeoffs Places We Live: 2. Community Character 3. Mapping Your Community Through Time 4. Neighborhood Design 7. Far-Reaching Decisions 8. Regional Community Issues: The Ogallala Aquifer</p>
<p>B1.2i Explain the progression of ideas and explanations that leads to science theories that are part of the current scientific consensus or core knowledge.</p>	<p>Project Learning Tree Activities Biodiversity: 1. Global Invaders</p>
<p>B1.2j Apply science principles or scientific data to anticipate effects of technological design decisions.</p>	<p>Project Learning Tree Activities Focus on Risk: 1. What is Risk? 4. Risk Assessment: Tools of the Trade Electromagnetic Fields Places We Live: 5. Green Space</p>

B1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.

Project Learning Tree Activities

Biodiversity:

1. Global Invaders

Municipal Solid Waste:

1. The Waste Stream
2. Source Reduction
3. Recycling and Economics

Focus on Risk:

1. What is Risk?
 2. Things Aren't Always What They Seem
 6. Weighing the Options: A Look at Tradeoffs
- Chlorine: Looking at Tradeoffs

Places We Live:

2. Community Character
3. Mapping Your Community Through Time

Standard B2: ORGANIZATION AND DEVELOPMENT OF LIVING SYSTEMS

Students describe the general structure and function of cells. They can explain that all living systems are composed of cells and that organisms may be unicellular or multicellular. They understand that cells are composed of biological macromolecules and that the complex processes of the cell allow it to maintain a stable internal environment necessary to maintain life. They make predictions based on these understandings.

L2.p5 Common Elements (prerequisite)

Living systems are made of complex molecules that consist mostly of a few elements, especially carbon, hydrogen, oxygen, nitrogen, and phosphorous. (prerequisite)

L2.p5A Recognize the six most common elements in organic molecules (C, H, N, O, P, S). (prerequisite)

Project Learning Tree Activities

Municipal Solid Waste:

4. Composting

B2.2 Organic Molecules

There are four major categories of organic molecules that make up living systems: carbohydrates, fats, proteins, and nucleic acids.

B2.2B Recognize the six most common elements in organic molecules (C, H, N, O, P, S).

Project Learning Tree Activities

Municipal Solid Waste:

4. Composting

B2.2x Proteins

Protein molecules are long, usually folded chains composed mostly of amino acids and are made of C, H, O, and N.

B2.2g Propose how moving an organism to a new environment may influence its ability to survive and predict the possible impact of this type of transfer.

Project Learning Tree Activities

Biodiversity:

1. Global Invaders

B2.3 Maintaining Environmental Stability

The internal environment of living things must remain relatively constant. Many systems work together to maintain stability. Stability is challenged by changing physical, chemical, and environmental conditions as well as the presence of disease agents.

B2.3C Explain how stability is challenged by changing physical, chemical, and environmental conditions as well as the presence of disease agents.

Project Learning Tree Activities

Biodiversity:

1. Global Invaders

Standard B3: Interdependence of Living Systems and the Environment

Students describe the processes of photosynthesis and cellular respiration and how energy is transferred through food webs. They recognize and analyze the consequences of the dependence of organisms on environmental resources and the interdependence of organisms in ecosystems.

L3.p1 Populations, Communities, and Ecosystems (prerequisite)

Organisms of one species form a population. Populations of different organisms interact and form communities. Living communities and the nonliving factors that interact with them form ecosystems. (prerequisite)

L3.p1A Provide examples of a population, community, and ecosystem. (prerequisite)

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L3.p2 Relationships Among Organisms (prerequisite)

Two types of organisms may interact with one another in several ways; they may be in a producer/consumer, predator/prey, or parasite/host relationship. Or one organism may scavenge or decompose another. Relationships may be competitive or mutually beneficial. Some species have become so adapted to each other that neither could survive without the other. (prerequisite)

L3.p2A Describe common relationships among organisms and provide examples of producer/consumer, predator/prey, or parasite/host relationship. (prerequisite)

Project Learning Tree Activities

Biodiversity:

1. Global Invaders

<p>L3.p2B Describe common ecological relationships between and among species and their environments (competition, territory, carrying capacity, natural balance, population, dependence, survival, and other biotic and abiotic factors). (prerequisite)</p>	<p>Project Learning Tree Activities Biodiversity: 1. Global Invaders 2. Protected Areas: Issues and Analysis 3. Potatoes, Pesticides, and Biodiversity</p>
<p>L3.p2C Describe the role of decomposers in the transfer of energy in an ecosystem. (prerequisite)</p>	<p>Project Learning Tree Activities Municipal Solid Waste: 4. Composting</p>

L3.p3 Factors Influencing Ecosystems (prerequisite)

The number of organisms and populations an ecosystem can support depends on the biotic resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. (prerequisite)

<p>L3.p3A Identify the factors in an ecosystem that influence fluctuations in population size. (prerequisite)</p>	<p>Project Learning Tree Activities Biodiversity: 1. Global Invaders Focus on Risk: 3. Chances Are... Understanding Probability and Risk 6. Weighing the Options: A Look at Tradoffs Places We Live: 3. Mapping Your Community Through Time 5. Green Space</p>
<p>L3.p3D Predict how changes in one population might affect other populations based upon their relationships in a food web. (prerequisite)</p>	<p>Project Learning Tree Activities Biodiversity: 1. Global Invaders 2. Protected Areas: Issues and Analysis 3. Potatoes, Pesticides, and Biodiversity Places We Live: 3. Mapping Your Community Through Time</p>

L3.p4 Human Impact on Ecosystems (prerequisite)

All organisms cause changes in their environments. Some of these changes are detrimental, whereas others are beneficial. (prerequisite)

L3.p4A 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. (prerequisite)

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Focus on Risk:

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6. Weighing the Options: A Look at Tradeoffs
7. Decision Making: Ecological Risk, Wildfires, and Natural Hazards

Chlorine: Looking at Tradeoffs

Places We Live:

1. Personal Places
2. Community Character
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8. Regional Community Issues: The Ogallala Aquifer

B3.2 Ecosystems

The chemical elements that make up the molecules of living things pass through food webs and are combined and recombined in different ways. At each link in an ecosystem, some energy is stored in newly made structures, but much is dissipated into the environment as heat. Continual input of energy from sunlight keeps the process going.

B3.2C Draw the flow of energy through an ecosystem. Predict changes in the food web when one or more organisms are removed.

Project Learning Tree Activities

Biodiversity:

1. Global Invaders

B3.4 Changes in Ecosystems

Although the interrelationships and interdependence of organisms may generate biological communities in ecosystems that are stable for hundreds or thousands of years, ecosystems always change when climate changes or when one or more new species appear as a result of migration or local evolution. The impact of the human species has major consequences for other species.

<p>B3.4A Describe ecosystem stability. Understand that if a disaster such as flood or fire occurs, the damaged ecosystem is likely to recover in stages of succession that eventually result in a system similar to the original one.</p>	<p>Project Learning Tree Activities Focus on Risk: 7. Decision Making: Ecological Risk, Wildfires, and Natural Hazards Places We Live: 2. Community Character 4. Neighborhood Design 5. Green Space 6. A Vision for the Future 7. Far-Reaching Decisions 8. Regional Community Issues: The Ogallala Aquifer</p>
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<p>B3.4C Examine the negative impact of human activities.</p>	<p>Project Learning Tree Activities Biodiversity: 1. Global Invaders 2. Protected Areas: Issues and Analysis 3. Potatoes, Pesticides, and Biodiversity Municipal Solid Waste: 1. The Waste Stream 2. Source Reduction 3. Recycling and Economics 4. Composting 5. Waste-to-Energy 6. Landfills 7. Where Does Your Garbage Go? 8. Success Stories and Personal Choices Focus on Risk: 1. What is Risk? 2. Things Aren't Always What They Seem 4. Risk Assessment: Tools of the Trade 5. Communicating Risk 6. Weighing the Options: A Look at Tradeoffs 7. Decision Making: Ecological Risk, Wildfires, and Natural Hazards Electromagnetic Fields Chlorine: Looking at Tradeoffs Places We Live: 1. Personal Places 2. Community Character 3. Mapping Your Community Through Time 4. Neighborhood Design 5. Green Space 6. A Vision for the Future 7. Far-Reaching Decisions 8. Regional Community Issues: The Ogallala Aquifer</p>
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B3.5 Populations

Populations of living things increase and decrease in size as they interact with other populations and with the environment. The rate of change is dependent upon relative birth and death rates.

<p>B3.5A Graph changes in population growth, given a data table.</p>	<p>Project Learning Tree Activities Focus on Risk: 3. Chances Are... Understanding Probability and Risk</p>
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B3.5B Explain the influences that affect population growth.	Project Learning Tree Activities Biodiversity: 1. Global Invaders Focus on Risk: 3. Chances Are... Understanding Probability and Risk
B3.5C Predict the consequences of an invading organism on the survival of other organisms.	Project Learning Tree Activities Biodiversity: 1. Global Invaders

B3.5x Environmental Factors

The shape of population growth curves vary with the type of organism and environmental conditions, such as availability of nutrients and space. As the population increases and resources become more scarce, the population usually stabilizes at the carrying capacity of that environment.

B3.5d Describe different reproductive strategies employed by various organisms and explain their advantages and disadvantages.	Project Learning Tree Activities Biodiversity: 1. Global Invaders
B3.5e Recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamics within ecosystems.	Project Learning Tree Activities Biodiversity: 3. Potatoes, Pesticides, and Biodiversity

Standard B5: Evolution and Biodiversity

Students recognize that evolution is the result of genetic changes that occur in constantly changing environments. They can explain that modern evolution includes both the concepts of common descent and natural selection. They illustrate how the consequences of natural selection and differential reproduction have led to the great biodiversity on Earth.

L5.p1 Survival and Extinction (prerequisite)

Individual organisms with certain traits in particular environments are more likely than others to survive and have offspring. When an environment changes, the advantage or disadvantage of characteristics can change. Extinction of a species occurs when the environment changes and the characteristics of a species are insufficient to allow survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on the Earth no longer exist. (prerequisite)

L5.p1A Define a species and give examples. (prerequisite)	Project Learning Tree Activities Biodiversity: 1. Global Invaders
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L5.p1B Define a population and identify local populations. (prerequisite)

Project Learning Tree Activities

Biodiversity:

1. Global Invaders