Ontario Provincial Science Standards

GRADE 6| UNDERSTANDING LIFE SYSTEMS BIODIVERSITY

OVERVIEW

Because all living things (including humans) are connected, maintaining biodiversity is critical to the health of the planet. Students will learn that biodiversity includes diversity among individuals, species, and ecosystems. Through observations of a specific habitat and the classification of organisms, students will have a first-hand opportunity to appreciate the diversity of living things while recognizing the roles and interactions of individual species within the whole. Care must be taken to ensure that all students, including students with special education needs, have comparable opportunities to explore the natural world.

When assessing human impacts on species and ecosystems, especially at a local level, students must be given opportunities to look at a variety of points of view. They should consider how and why the perspectives of developers, people concerned about the environment, and residents of the local community might be similar or different. Through thoughtful consideration of various viewpoints and biases, students not only can look for ways in which people might come to agreement on how to minimize the negative impact of their actions, but also will be able to make more informed decisions about their own positions and about action they can take.

In preparation for working outside the school, it is important that students be able to identify and demonstrate an understanding of practices that ensure their personal safety and the safety of others. This includes making the teacher aware of any potential personal dangers of being outside (e.g., allergic reactions to bee stings), knowing why it is important to wear clothing and footwear appropriate for the conditions, and staying within the area of study.

Fundamental Concepts

Systems and Interactions

Sustainability and Stewardship

Big Ideas

- Biodiversity includes diversity of individuals, species, and ecosystems. (Overall expectations 2 and 3)
- Classification of the components within a diverse system is a beginning point for understanding the interrelationships among the components. (Overall expectations 2 and 3)
- Because all living things are connected, maintaining diversity is critical to the health of the planet. (Overall expectations 1 and 3)
- Humans make choices that can have an impact on biodiversity. (Overall expectation 1)

OVERALL EXPECTATIONS

By the end of Grade 6, students will:

1. assess human impacts on biodiversity, and identify ways of preserving biodiversity;

2. investigate the characteristics of living things, and classify diverse organisms according to specific characteristics;

3. demonstrate an understanding of biodiversity, its contributions to the stability of natural systems, and its benefits to humans.

Specific Expectations

By the end of Grade 6, students will:

1.1 analyse a local issue related to biodiversity (e.g., the effects of human activities on urban biodiversity, flooding of traditional Aboriginal hunting and gathering areas as a result of dam construction), taking different points of view into consideration (e.g., the points of view of members of the local community, business owners, people concerned about the environment, mine owners, local First Nations, Métis, Inuit), propose action that can be taken to preserve biodiversity, and act on the proposal Sample issue: Alocal forest is slated to be cut down to make room for a new shopping plaza. Sample guiding questions: What are the positive and negative aspects of the issue (e.g., a community will have access to goods and services in the new shopping plaza that were not there before; getting the land for the shopping plaza means losing a local forest)? Who might have differing opinions on this issue? Why? What are some things that you might do as an individual, or that we might do as a class, to make others aware of the issues and concerns (e.g., write a letter to the local newspaper, the mayor, or the Member of Parliament; design and hang awareness posters in the community)?

1.2 assess the benefits that human societies derive from biodiversity (e.g., thousands of products such as food, clothing, medicine, and building materials come from plants and animals) and the problems that occur when biodiversity is diminished (e.g., monocultures are more vulnerable to pests and diseases) Sample issue: Monoculture systems on farms allow crops to be grown in the soil that is best for them. But monoculture systems reduce diversity, and so more soil and pest problems result. In turn, farmers apply more chemical fertilizers and pesticides, which pollute the land, the water, and the food they are producing.

Developing Investigation and Communication Skills

By the end of Grade 6, students will:

2.1 follow established safety procedures for outdoor activities and field work (e.g., stay with a partner when exploring habitats; wash hands after exploring a habitat)

2.2 investigate the organisms found in a specific habitat and classify them according to a classification system

2.3 use scientific inquiry/research skills (see page 15) to compare the characteristics of organisms within the plant or animal kingdoms (e.g., compare the characteristics of a fish and a mammal, of coniferous and deciduous trees, of ferns and flowering plants) Sample guiding questions: What are the criteria you

will use to compare organisms? Why are these good criteria to use to compare the organisms? How might the criteria change if you picked two different organisms? Why is it important to be able to compare organisms in some organized way?

2.4 use appropriate science and technology vocabulary, including classification, biodiversity, natural community, interrelationships, vertebrate, invertebrate, stability, characteristics, and organism, in oral and written communication

2.5 use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes (e.g., use a graphic organizer to show comparisons between organisms in various communities)

Understanding Basic Concepts

By the end of Grade 6, students will:

3.1 identify and describe the distinguishing characteristics of different groups of plants and animals (e.g., invertebrates have no spinal column; insects have three basic body parts; flowering plants produce flowers and fruits), and use these characteristics to further classify various kinds of plants and animals (e.g., invertebrates – arthropods – insects; vertebrates – mammals – primates; seed plants – flowering plants – grasses) 3. Understanding Basic Concepts

3.2 demonstrate an understanding of biodiversity as the variety of life on earth, including variety within each species of plant and animal, among species of plants and animals in communities, and among communities and the physical landscapes that support them

3.3 describe ways in which biodiversity within species is important for maintaining the resilience of those species (e.g., because of genetic differences, not all squirrels are affected equally by infectious diseases such as mange; some species of bacteria have become resistant to antibiotics because resistant individuals have survived and reproduced)

3.4 describe ways in which biodiversity within and among communities is important for maintaining the resilience of these communities (e.g., having a variety of species of wheat allows for some part of the crop to survive adverse conditions)

3.5 describe interrelationships within species (e.g., wolves travel in packs to defend their territory, raise their cubs, and hunt large prey), between species (e.g., the brightly-coloured anemone fish protects its eggs by laying them among the poisonous tentacles of the sea anemone, and in return the fish's bright colours attract prey for the anemone to eat; birds and bees take sustenance from plants and carry pollen between plants), and between species and their environment (e.g., algae and water lilies compete for sunlight in a pond), and explain how these interrelationships sustain biodiversity

3.6 identify everyday products that come from a diversity of organisms (e.g., traditional pain relievers are derived from the bark of the white willow tree; tofu is made from soybeans; silk is made from silkworm cocoons; nutritional supplements, shampoos, toothpastes, and deodorants contain pollen collected by bees)

3.7 explain how invasive species (e.g., zebra mussel, Asian longhorned beetle, purple loosestrife) reduce biodiversity in local environments

GRADE 7| UNDERSTANDING LIFE SYSTEMS INTERACTIONS IN THE ENVIRONMENT

OVERVIEW

By Grade 7, students realize that humans have many impacts on the environment. In the study of this topic, they will analyse some of these impacts and their consequences, while reflecting upon their personal responsibility to protect the environment. During investigations, the students will observe existing ecosystems and investigate factors that may affect balances within the system. Students will learn that ecosystems consist of communities of plants and animals that are dependent on each other as well as on the non-living parts of the environment. Care must be taken to ensure that all students, including students with special education needs, have comparable opportunities to explore the natural world.

In preparation for working outside the school, it is important that students be able to identify and explain the importance of practices that ensure their personal safety and the safety of others. This includes understanding why it is important to make the teacher aware of any potential allergic reactions (e.g., to bee stings), to wear the clothing and footwear appropriate for the conditions, and to stay within the area of study.

Fundamental Concepts

- Systems and Interactions
- Sustainability and Stewardship

Big Ideas

- Ecosystems are made up of biotic (living) and abiotic (non-living) elements, which depend on each other to survive.
- Ecosystems are in a constant state of change. The changes may be caused by nature or by human intervention.
- Human activities have the potential to alter the environment. Humans must be aware of these impacts and try to control them

OVERALL EXPECTATIONS

By the end of Grade 7, students will:

1. assess the impacts of human activities and technologies on the environment, and evaluate ways of controlling these impacts;

2. investigate interactions within the environment, and identify factors that affect the balance between different components of an ecosystem;

3. demonstrate an understanding of interactions between and among biotic and abiotic elements in the environment.

Specific Expectations

1. Relating Science and Technology to Society and the Environment

By the end of Grade 7, students will:

1.1 assess the impact of selected technologies on the environment Sample issue: The use of technologies such as cars and computers has many impacts on the environment. What are some of these impacts and how do they affect the ability of the environment to support life?

1.2 analyse the costs and benefits of selected strategies for protecting the environment Sample issues: (a) Many people recycle because it makes them feel that they are doing something good for the environment. But the focus on recycling takes the emphasis away from strategies like reducing or reusing. (b) Integrated Pest Management (IPM) is a pest management strategy that uses a variety of methods to prevent or control pest problems. But some of the methods can be as much of a problem as the pests themselves. (c) Some groups consider widening highways to reduce traffic congestion to be preferable to improving public transit systems. In some cases, however, highway expansion increases the problems that already existed, and other unexpected problems also arise. (d) Controlling the water flow in natural systems has a domino effect on the environmental integrity of the water system.

2. Developing Investigation and Communication Skills

By the end of Grade 7, students will:

2.1 follow established safety procedures for investigating ecosystems (e.g., stay with a partner, wash hands after investigating an ecosystem)

2.2 design and construct a model ecosystem (e.g., a composter, a classroom terrarium, a greenhouse), and use it to investigate interactions between the biotic and abiotic components in an ecosystem Sample guiding questions: What are some biotic components of this ecosystem? What are some abiotic components? How do these components affect each other (abiotic and abiotic; biotic and biotic; abiotic and biotic)? What are some of the interactions that are occurring in the model ecosystem?

2.3 use scientific inquiry/research skills (see page 15) to investigate occurrences (e.g., a forest fire, a drought, an infestation of invasive species such as zebra mussels in a local lake or purple loosestrife in a wetland habitat) that affect the balance within a local ecosystem Sample guiding questions: Should naturally caused fires in national parks be allowed to burn to their natural end? How do human activities and natural occurrences contribute to droughts? What happens in a drought? What is the impact of invasive species such as zebra mussels, spiny water fleas, round gobies, and sea lampreys on Ontario lakes, and what can be done to lessen the impact?

2.4 use appropriate science and technology vocabulary, including sustainability, biotic, ecosystem, community, population, and producer, in oral and written communication

2.5 use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes (e.g., design a multimedia presentation explaining the interrelationships between biotic and abiotic components in a specific ecosystem)

3. Understanding Basic Concepts

By the end of Grade 7, students will:

3.1 demonstrate an understanding of an ecosystem (e.g., a log, a pond, a forest) as a system of interactions between living organisms and their environment

3.2 identify biotic and abiotic elements in an ecosystem, and describe the interactions between them (e.g., between hours of sunlight and the growth of plants in a pond; between a termite colony and a decaying log; between the soil, plants, and animals in a forest)

3.3 describe the roles and interactions of producers, consumers, and decomposers within an ecosystem (e.g., Plants are producers in ponds. They take energy from the sun and produce food, oxygen, and shelter for the other pond life. Black bears are consumers in forests.They eat fruits, berries, and other consumers. By eating other consumers, they help to keep a balance in the forest community. Bacteria and fungi are decomposers.They help to maintain healthy soil by breaking down organic materials such as manure, bone, spider silk, and bark. Earthworms then ingest the decaying matter, take needed nutrients from it, and return those nutrients to the soil through their castings.)

3.4 describe the transfer of energy in a food chain and explain the effects of the elimination of any part of the chain

3.5 describe how matter is cycled within the environment and explain how it promotes sustainability (e.g., bears carry salmon into the forest, where the remains decompose and add nutrients to the soil, thus supporting plant growth; through crop rotation, nutrients for future crops are created from the decomposition of the waste matter of previous crops)

3.6 distinguish between primary succession (e.g., the growth of native grasses on a sand dune) and secondary succession (e.g., the growth of grasses and shrubs in a ploughed field) within an ecosystem

3.7 explain why an ecosystem is limited in the number of living things (e.g., plants and animals, including humans) that it can support

3.8 describe ways in which human activities and technologies alter balances and interactions in the environment (e.g., clear-cutting a forest, overusing motorized water vehicles, managing wolf-killings in Yukon)

3.9 describe Aboriginal perspectives on sustainability and describe ways in which they can be used in habitat and wildlife management (e.g., the partnership between the Anishinabek Nation and the Ministry of Natural Resources for managing natural resources in Ontario)

GRADE 8| UNDERSTANDING STRUCTURES AND MECHANISMS SYSTEMS IN ACTION

OVERVIEW

The smooth functioning of society depends on a great number and variety of systems. The needs of society can influence the evolution of established systems or demand the introduction of new ones. Whether large or small, human, mechanical, or natural, all systems consist of many components that can be studied and improved. Students will learn to calculate the mechanical advantage of mechanical systems, and will learn about the overall safety, efficiency, and effectiveness of a variety of systems. It is necessary to provide opportunities for students with disabilities to participate in these or comparable activities.

When making and/or experimenting with and testing devices or structures, it is important that students be able to identify and explain the importance of practices that ensure their personal safety and the safety of others. This includes knowing the correct way to use tools and equipment, knowing when and how to use protective eyewear, and knowing how to operate electricity and electrical systems safely.

Fundamental Concepts

- Systems and Interactions
- Continuity and Change

Big Ideas

- Systems are designed to accomplish tasks. (Overall expectations 1, 2, and 3)
- All systems include an input and an output. (Overall expectations 2 and 3)
- Systems are designed to optimize human and natural resources. (Overall expectations 1 and 3)

Overall Expectations

By the end of Grade 8, students will:

1. assess the personal, social, and/or environmental impacts of a system, and evaluate improvements to a system and/or alternative ways of meeting the same needs;

2. investigate a working system and the ways in which components of the system contribute to its desired function;

3. demonstrate an understanding of different types of systems and the factors that contribute to their safe and efficient operation.

Specific Expectations

1. **Relating Science and Technology to Society and the Environment**

By the end of Grade 8, students will:

1.1 assess the social, economic, and environmental impacts of automating systems Sample issues: (a) Automation was feared by some people who believed that replacing humans with automated systems would lead to high unemployment. However, others argued that automation would actually lead to higher employment, because it freed some of the labour force to enter higher-skilled, higher-paying jobs. (b) Although automation is often viewed as a way to minimize human error in systems, as the degree and sophistication of automation increase so do the chances of more serious errors and their consequences. (c) The effects of automation can be environmentally disastrous. Serious pollution coincided with the development of factories and the widespread use of coal to run their machinery. Although factories and automation continue to exist, we are more aware of what these systems can do to the environment. (d) Mass-produced furniture is made of lowquality materials, lacks durability, and involves minimal original craftsmanship, and it therefore can be purchased at a reasonable price. However, many consumers tend to discard it readily, and it often is sent to landfills, thus creating environmental problems.

1.2 assess the impact on individuals, society, and the environment of alternative ways of meeting needs that are currently met by existing systems, taking different points of view into consideration Sample issues: (a) A large city decides that it will put in more bicycle lanes and bikeways instead of expanding its existing public transit system. (b) A school system decides to have students and teachers in school year-round, instead of having everyone on vacation in July and August.

2. Developing Investigation and Communication Skills

By the end of Grade 8, students will:

2.1 follow established safety procedures for working with apparatus, tools, materials, and electrical systems (e.g., tie hair back before working with drills, saws, and sanders)

2.2 investigate the work done in a variety of everyday activities and record the findings quantitatively (e.g., calculate the work done when lifting dumbbells by measuring the force required to move the dumbbell and multiplying by the distance the dumbbell moves)

2.3 use scientific inquiry/experimentation skills (see page 12) to investigate mechanical advantage in a variety of mechanisms and simple machines Sample problems: Conduct experiments to determine what happens when the length of the effort arm and/or the load arm in a lever are changed, and note qualitative or quantitative changes in mechanical advantage. Conduct experiments to determine what happens when the diameter of the piston in a hydraulic system is changed, and note qualitative or quantitative changes in mechanical advantage. Conduct experiments to determine what happens when the number of pulleys that support a load is changed, and note qualitative or quantitative changes in mechanical advantage.

2.4 use technological problem-solving skills (see page 16) to investigate a system (e.g., an optical system, a mechanical system, an electrical system) that performs a function or meets a need Sample problem: Create a device that will carry a snack from one place to another. Describe the function of each component part, and examine the effects of making a change to one or more of the components. Sample guiding questions: What purpose or need does your device fulfil? When you tested your device, which component or components worked as intended? Which did not? Why do

you think the problem occurred? Predict what will happen if you remove or change the size or direction of one or more of the components.

2.5 investigate the information (e.g., owner's manual for a car, weather advisories for a region, pest forecasts/warnings for a crop/region) and support (e.g., a technical support line for computers) provided to consumers/clients to ensure that a system functions safely and effectively Sample guiding questions: What are the criteria for a good owner's manual (for a car, an MP3 player, etc.) or for an effective help or support service? Why is it important to have this kind of information? What other information might have been included to make the manual more helpful? How might the help or support service be improved? What might be some consequences of not having this kind of help and support?

2.6 use appropriate science and technology vocabulary, including mechanical advantage, input, output, friction, gravity, forces, and efficiency, in oral and written communication

2.7 use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes (e.g., using appropriate mathematical conventions, create a graph to represent changes in mechanical advantage when certain factors in a mechanism are manipulated)

Understanding Basic Concepts

By the end of Grade 8, students will:

3.1 identify various types of systems (e.g., mechanical systems, body systems, optical systems, mass transit systems, Aboriginal clan systems, health care systems)

3.2 identify the purpose, inputs, and outputs of various systems (e.g., a garden – purpose: to grow things; input: seeds, water, fertilizer; output: flowers, food)

3.3 identify the various processes and components of a system (e.g., robot, front-end loader/backhoe, heating system, transportation system, health care system) that allow it to perform its function efficiently and safely

3.4 compare, using examples, the scientific definition with the everyday use of the terms work, force, energy, and efficiency

3.5 understand and use the formula work = force · distance ($W = F \cdot d$) to establish the relationship between work, force, and distance moved parallel to the force in simple systems

3.6 calculate the mechanical advantage (MA= force needed without a simple machine divided by force needed with a simple machine) of various mechanical systems (e.g., a wheelbarrow allows a smaller force to lift a larger weight, a hockey stick allows a short movement of hands to move the blade a larger distance, a simple fixed pulley system redirects the effort force)

3.7 explain ways in which mechanical systems produce heat, and describe ways to make these systems more efficient (e.g., friction produces heat, which can be reduced by lubrication)

3.8 describe systems that have improved the productivity of various industries (e.g., robotic systems have increased the rate of production in factories that assemble the fine parts of wrist watches)

3.9 identify social factors that influence the evolution of a system (e.g., growing concern over the amount of waste creates a need for recycling centres, and the recycling centres must grow as population and waste increase; the desire to make tasks easier creates a need for pulley systems, gear systems, and hydraulic and pneumatic systems; changes in traditional work hours created by technological advances can influence changes in a child care system)