GRADE **6**

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	Big Ideas
Systems and Interactions Sustainability and Stewardship	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

1. Relating Science and Technology to Society and the Environment

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: A local 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.

2. 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)*

3. 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)*

3.2 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 6 | UNDERSTANDING STRUCTURES AND MECHANISMS
FLIGHT

OVERVIEW

The use of flight technologies has substantial effects on both society and the environment. In order to understand the principles of flight, students must first learn about the properties of air that make flight possible. Through investigations, observations, and experiments, students will discover that flight occurs when the characteristics of structures take advantage of certain properties of air (for example, air takes up space, has mass, expands, and can exert a force when compressed). They will then apply their newly acquired knowledge to design and test a flying device.

It is important that students be able to identify practices that ensure their personal safety and the safety of others and demonstrate an understanding of these practices. As students explore flying things, it is important that they understand why projectiles of any kind should always be aimed away from spectators, and why buildings, trees, and overhead wires present hazards to anyone flying kites or airplanes.

Fundamental Concepts	Big Ideas
Structure and Function	Flight occurs when the characteristics of structures take advantage of certain properties of air. *(Overall expectations 1, 2, and 3)*
Matter	Air has many properties that can be used for flight and for other purposes. *(Overall expectations 1, 2, and 3)*

OVERALL EXPECTATIONS

By the end of Grade 6, students will:

1. assess the societal and environmental impacts of flying devices that make use of properties of air;
2. investigate ways in which flying devices make use of properties of air;
3. explain ways in which properties of air can be applied to the principles of flight and flying devices.

SPECIFIC EXPECTATIONS

1. Relating Science and Technology to Society and the Environment

By the end of Grade 6, students will:

1.1 assess the benefits and costs of aviation technology for society and the environment, taking different social and economic perspectives into account *(e.g., the perspectives of farmers, airline workers, doctors, home owners, tour operators)*

Sample issues: (a) Crop dusting from planes allows the chemicals to spread quickly over large crop areas, which is critical to pest control and crop protection. However, the planes cannot direct the chemicals onto the target crop with precision, so the chemicals spread where they are not wanted. (b) The speed and ease of air travel allow quick transportation of organs for lifesaving transplants, quick transportation of injured patients to hospitals, and trips for business and pleasure. However, air travel also increases the risk of spreading infectious diseases and creates noise and air pollution.

2. Developing Investigation and Communication Skills

By the end of Grade 6, students will:

2.1 follow established safety procedures for using tools and materials and operating flying devices *(e.g., aim flying devices away from each other when launching them; fly kites and airplanes a safe distance from overhead hydro wires)*

2.2 use scientific inquiry/experimentation skills (see page 12) to investigate the properties of air *(e.g., air takes up space, has mass, can be compressed)*

Sample guiding questions: How do we know that air is there? When have you felt the force or pressure of air? Where might you see some of these principles applied in daily life?

2.3 investigate characteristics and adaptations that enable living things to fly *(e.g., a bat's wings are made up of long, thin bones covered with a very light membrane that forms an airfoil surface; insects can twist and turn their wings, which helps them to hover in the air or even fly backwards; some seeds, such as the keys of a maple tree or dandelion seeds, have parachutes or wings like a glider that allow them to be carried by the wind)*

2.4 use technological problem-solving skills (see page 16) to design, build, and test a flying device *(e.g., a kite, a paper airplane, a hot air balloon)*

Sample guiding questions: How does your device use the principles of flight? What were some challenges in getting your device off the ground? How might you change your device to make it fly better?

2.5 use appropriate science and technology vocabulary, including *aerodynamics, compress, flight, glide, propel, drag, thrust,* and *lift,* in oral and written communication

2.6 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 technological conventions, make a drawing of the flying device they constructed)*

3. Understanding Basic Concepts

By the end of Grade 6, students will:

3.1 identify the properties of air that make flight possible *(e.g., air takes up space, has mass, expands, can exert a force when compressed)*

3.2 identify common applications of the properties of air, such as its compressibility and insulating qualities *(e.g., home insulation, tires, sleeping bags, layered clothing)*

3.3 identify and describe the four forces of flight – lift, weight, drag, and thrust

3.4 describe, in qualitative terms, the relationships between the forces of lift, weight, thrust, and drag that are required for flight *(e.g., lift must be greater than weight for a plane to take off; thrust must be greater than drag for a plane to take off; lift must be less than weight for a plane to land; thrust must be less than drag for a plane to land)*

3.5 describe ways in which flying devices or living things use unbalanced forces to control their flight *(e.g., a plane can be steered up or down by tilting the elevators on the tail; when a bird flaps its wings, the wings develop lift as well as forward and upward force, thus causing it to take off)*

3.6 describe ways in which the four forces of flight can be altered *(e.g., increasing the angle of attack increases the lift; lightweight materials help to keep the overall mass of the plane down, so that it can fly with smaller lift force; jet engines can vary the amount of thrust, which enables the plane to move forward; using the flaps on airplane wings changes the amount of drag, which reduces the speed of the plane)*

GRADE 6 | UNDERSTANDING MATTER AND ENERGY
ELECTRICITY AND ELECTRICAL DEVICES

OVERVIEW

Electricity is a form of energy that students encounter every day. Students will already be familiar with many of the uses of this convenient source of energy. Building on their prior learning, students will explore devices that convert electricity to other forms of energy. The building of circuits should further strengthen students' understanding of how electrical systems work.

We live in an age when everyone is concerned about how we use electrical energy and how we will continue to meet the demand for it. Students need opportunities to think about how electrical energy can be conserved both at home and at school and about alternative ways of producing energy. They must learn to think critically about the information and ideas they encounter. Throughout their investigations, they should also be encouraged to examine the opinions of others and to question those opinions as they form their own opinions and plans of action.

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 when working with and around electricity. This includes knowing why hands should be dry when handling alternating current (AC) equipment and why equipment with frayed plugs should be reported to the teacher.

Fundamental Concepts	Big Ideas
Energy Systems and Interactions Sustainability and Stewardship	Electrical energy can be transformed into other forms of energy. *(Overall expectations 2 and 3)* Other forms of energy can be transformed into electrical energy. *(Overall expectations 2 and 3)* Electrical energy plays a significant role in society, and its production has an impact on the environment. *(Overall expectation 1)* Society must find ways to minimize the impact of energy production on the environment. *(Overall expectation 1)*

OVERALL EXPECTATIONS

By the end of Grade 6, students will:

1. evaluate the impact of the use of electricity on both the way we live and the environment;
2. investigate the characteristics of static and current electricity, and construct simple circuits;
3. demonstrate an understanding of the principles of electrical energy and its transformation into and from other forms of energy.

SPECIFIC EXPECTATIONS

1. Relating Science and Technology to Society and the Environment

By the end of Grade 6, students will:

1.1 assess the short- and long-term environmental effects of the different ways in which electricity is generated in Canada *(e.g., hydro, thermal, nuclear, wind, solar)*, including the effect of each method on natural resources and living things in the environment

Sample problems: (a) Electricity in Ontario is generated by nuclear plants, hydroelectric plants, coal-fired plants, and natural gas plants, and a small percentage is obtained through alternative energy sources. Choose an electricity-generating plant that supplies electricity in your community, and compare the environmental effects of the generating method it uses with a method used in another part of the province. (b) The James Bay Hydroelectric Project was one of the biggest hydroelectric developments of the past century, but it has also had a serious impact on the environment and the James Bay Cree people. Investigate both sides of this issue, and suggest how things might be approached differently today.

1.2 assess opportunities for reducing electricity consumption at home or at school that could affect the use of non-renewable resources in a positive way or reduce the impact of electricity generation on the environment

Sample issue: Peak demand times for electricity are morning and early evening. Because electricity cannot be stored in a cost-effective way, it must be supplied as it is being used. This means that almost all of a utility's available power plants must run to meet the demand and prevent system outages. Some utility companies are considering a plan to pay consumers to reduce their electricity consumption, especially during peak hours. This plan would not only reduce demand but would also reduce the cost of electricity for all customers and the impact of electricity production on the environment.

2. Developing Investigation and Communication Skills

By the end of Grade 6, students will:

2.1 follow established safety procedures for working with electricity *(e.g., ensure hands are completely dry when working with electricity; be aware of electrical hazards at home, at school, and in the community)*

2.2 design and build series and parallel circuits, draw labelled diagrams identifying the components used in each, and describe the role of each component in the circuit

2.3 use scientific inquiry/experimentation skills (see page 12) to investigate the characteristics of static electricity

Sample guiding questions: Is static electricity really static? Explain. What causes static electricity? Is it easier to generate static electricity in a dry room or a humid room? Why? Which materials accept a charge better than others? Where would you find static electricity in action?

2.4 design, build, and test a device that produces electricity *(e.g., a battery built from a lemon or potato; a wind turbine)*

Sample guiding questions: How can you find the positive and negative ends of your battery? How much voltage does your battery produce? How can you increase the voltage? What would happen if you exchanged the lemon for an apple? For a potato or a carrot? For other fruits or vegetables? How does a wind turbine produce electricity? Is this a good method of producing electricity? Why? Why not?

2.5 use technological problem-solving skills (see page 16) to design, build, and test a device that transforms electrical energy into another form of energy in order to perform a function *(e.g., a device that makes a sound, that moves, that lights up)*

Sample guiding questions: What function will your device perform? What does your device transform the electrical energy into? How does your device work?

2.6 use appropriate science and technology vocabulary, including *current, battery, circuit, transform, static, electrostatic,* and *energy,* 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 scientific and technological conventions, create a labelled diagram showing the component parts of the device they created to transform electrical energy into another form of energy and perform a function)*

3. Understanding Basic Concepts

By the end of Grade 6, students will:

3.1 distinguish between current and static electricity

3.2 use the principles of static electricity to explain common electrostatic phenomena *(e.g., the attraction of hairs to a comb that has been rubbed on a piece of wool; the attraction of small pieces of paper to a plastic ruler that has been rubbed with a rag; the attraction of pieces of clothing to each other when they come out of a clothes dryer)*

3.3 identify materials that are good conductors of electricity *(e.g., copper, gold, silver, aluminum, water [when it has a high mineral content])* and good insulators *(e.g., glass, plastic, rubber, ceramics)*

3.4 describe how various forms of energy can be transformed into electrical energy *(e.g., batteries use chemical energy; hydroelectric plants use water power; nuclear generating stations use nuclear energy; wind turbines use wind power; solar panels use energy from the sun; wave power stations use energy from ocean waves)*

3.5 identify ways in which electrical energy is transformed into other forms of energy *(e.g., electrical energy is transformed into heat energy in a toaster, light and sound energy in a television, mechanical energy in a blender)*

3.6 explain the functions of the components of a simple electrical circuit *(e.g., a battery is the power source; a length of wire is the conductor that carries the electrical current to the load; a light bulb or motor is the load)*

3.7 describe series circuits (components connected in a daisy chain) and parallel circuits (components connected side by side like the rungs of a ladder), and identify where each is used *(e.g., some strings of patio lights are in series circuits – when one light burns out, the whole string goes out; parallel circuits are used for wiring lighting and electrical outlets in your house – when one light burns out, the others keep burning)*

3.8 describe ways in which the use of electricity by society, including the amount of electrical energy used, has changed over time *(e.g., drying clothes in a dryer instead of using a clothesline; playing video games instead of playing board games; using electric lights instead of candles)*

GRADE 6 | UNDERSTANDING EARTH AND SPACE SYSTEMS
SPACE

OVERVIEW

Our ability to observe and study objects in space has been greatly enhanced by the use of technological devices. The application of these technologies affects our lives in many ways. Space science involves learning about objects in the sky, particularly their form, movements, and interactions. In learning about space, students will focus on past and present-day contributions of space science to the quality of human life while developing an understanding of the phenomena that result from the movement of different bodies in space. Investigations will involve working with models of the different bodies to allow students to explore their size, position, and motion and help them gain an understanding of Earth as a component of larger systems.

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. As students design, build, and test models, for example, it is important that they understand why Styrofoam needs to be cut in a well-ventilated space and how to use equipment safely and correctly.

Fundamental Concepts	Big Ideas
Systems and Interactions	Earth is a part of a large interrelated system. *(Overall expectations 2 and 3)* Technological and scientific advances that enable humans to study space affect our lives. *(Overall expectations 1 and 2)*

OVERALL EXPECTATIONS

By the end of Grade 6, students will:

1. assess the impact of space exploration on society and the environment;
2. investigate characteristics of the systems of which the earth is a part and the relationship between the earth, the sun, and the moon;
3. demonstrate an understanding of components of the systems of which the earth is a part, and explain the phenomena that result from the movement of different bodies in space.

SPECIFIC EXPECTATIONS

1. Relating Science and Technology to Society and the Environment

By the end of Grade 6, students will:

1.1 assess the contributions of Canadians *(e.g., astronauts Marc Garneau and Roberta Bondar; astronomers Richard Bond, David Levy, and Helen Hogg; Spar Aerospace Limited's development of the Canadarm; the University of British Columbia's development of the "Humble" space telescope)* to the exploration and scientific understanding of space

1.2 evaluate the social and environmental costs and benefits of space exploration, taking different points of view into account *(e.g., the point of view of health care workers and workers in other agencies that compete with space programs for public money; astronauts and their families; the general public; scientists)*

Sample issue: Space exploration has brought many benefits to society. High-quality radio and television signals are now relayed around the globe by satellite. Biological experiments in space, such as the growing of insulin crystals, are contributing to our ability to fight disease. The technology used for space shuttle fuel pumps is now being used to make better artificial hearts. Geographical data obtained by satellites have improved the quality of maps and made navigation safer. But space exploration is also very expensive, involves risks to the lives of astronauts and others, produces pollution, and creates space junk that may eventually fall back to Earth. Are the benefits worth the costs and risks?

2. Developing Investigation and Communication Skills

By the end of Grade 6, students will:

2.1 follow established safety procedures for handling tools and materials and observing the sun *(e.g., use appropriate eye protection when testing a sundial)*

2.2 use technological problem-solving skills (see page 16) to design, build, and test devices *(e.g., a sundial, a model of the earth's rotation around the sun)* for investigating the motions of different bodies in the solar system

Sample guiding questions: In what direction does your sundial fin need to point? Why? In what direction might you expect the shadow to move? How would daylight saving time affect the accuracy of your sundial? How might your model of the earth and sun best be used to explain the reason for day and night? What impact does the tilt of the earth's axis have on cycles on earth? What does the earth do to cause the day and night cycle?

2.3 use scientific inquiry/research skills (see page 15) to investigate scientific and technological advances that allow humans to adapt to life in space

Sample guiding questions: Why is life in space a challenge for humans? How might some of those challenges be overcome? What technologies exist now to allow us to overcome the challenges? In what ways does the International Space Station mimic conditions on Earth? What technologies create conditions similar to Earth's on the space station, and what differences remain? How might robotics play a role in human adaptation to space life? Under what circumstances might robots replace humans in space exploration?

2.4 use appropriate science and technology vocabulary, including *axis, tilt, rotation, revolution, planets, moons, comets,* and *asteroids,* 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 identify and order main ideas and supporting details for a report about how science and technology can help humans adapt to life in space)*

3. Understanding Basic Concepts

By the end of Grade 6, students will:

3.1 identify components of the solar system, including the sun, the earth, and other planets, natural satellites, comets, asteroids, and meteoroids, and describe their physical characteristics in qualitative terms *(e.g., The earth's surface is very young; much of it is covered with water. The moon is the earth's only natural satellite. Comets are the largest objects in our solar system; their centres contain rock particles trapped in frozen liquid; their tails are made up of gas and dust.)*

3.2 identify the bodies in space that emit light *(e.g., stars)* and those that reflect light *(e.g., moons and planets)*

3.3 explain how humans meet their basic biological needs in space *(e.g., obtaining air, water, and food and managing bodily functions)*

3.4 identify the technological tools and devices needed for space exploration *(e.g., telescopes, spectroscopes, spacecraft, life-support systems)*

3.5 describe the effects of the relative positions and motions of the earth, moon, and sun *(e.g., use models or simulations to show solar and lunar eclipses, phases of the moon, tides)*