GRADE **7**

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	Big Ideas
Systems and Interactions Sustainability and Stewardship	Ecosystems are made up of biotic (living) and abiotic (non-living) elements, which depend on each other to survive. *(Overall expectations 2 and 3)* Ecosystems are in a constant state of change. The changes may be caused by nature or by human intervention. *(Overall expectations 1 and 2)* Human activities have the potential to alter the environment. Humans must be aware of these impacts and try to control them. *(Overall expectation 1)*

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 7 | UNDERSTANDING STRUCTURES AND MECHANISMS
FORM AND FUNCTION

OVERVIEW

Humans build structures to meet specific needs. In doing so, they must consider many factors, including not only the functions the structures must perform but also the resources available to build them, the intended lifetime of the structures, and the impact of the structures on the environment. In Grade 7, students will continue to learn about the effects of forces that act on and within different structural forms. They will investigate how different structural forms support or withstand loads by designing, building, and testing structures, using increasingly sophisticated techniques. Other factors that affect a structure's functioning, such as type of structure and centre of gravity, will also be explored. It is necessary to provide opportunities for students with special education needs to participate in these or comparable activities.

As students design, build, and test their structures to determine what loads they can support, it is important that they do it in a manner that ensures their personal safety and the safety of others. This includes understanding why it is important to properly dispose of the remains of broken structures and to protect faces and feet from falling objects.

Fundamental Concepts	Big Ideas
Structure and Function Energy	Structures have a purpose. *(Overall expectation 1)* The form of a structure is dependent on its function. *(Overall expectations 1, 2, and 3)* The interaction between structures and forces is predictable. *(Overall expectations 2 and 3)*

OVERALL EXPECTATIONS

By the end of Grade 7, students will:

1. analyse personal, social, economic, and environmental factors that need to be considered in designing and building structures and devices;
2. design and construct a variety of structures, and investigate the relationship between the design and function of these structures and the forces that act on them;
3. demonstrate an understanding of the relationship between structural forms and the forces that act on and within them.

SPECIFIC EXPECTATIONS

1. Relating Science and Technology to Society and the Environment

By the end of Grade 7, students will:

1.1 evaluate the importance for individuals, society, the economy, and the environment of factors that should be considered in designing and building structures and devices to meet specific needs *(e.g., function; efficiency; ease of use; user preferences; aesthetics; cost; intended lifespan; effect on the environment; safety, health, legal requirements)*

Sample guiding questions: Why is it important for companies to find out what consumers want now and what they might want and/or need in the future? How might this information influence the design and appearance of a structure, the materials it is made from, and so on? What things might a company need to take into account when considering the construction of a new structure that consumers might not consider (e.g., the environmental impact of using certain resources to make the structure, the eventual disposal of the structure)?

1.2 evaluate the impact of ergonomic design on the safety and efficiency of workplaces, tools, and everyday objects *(e.g., furniture, computer equipment, home tools and equipment)*, and describe changes that could be made in personal spaces and activities on the basis of this information *(e.g., use computer keyboards and mice that are ergonomically designed; use kitchen tools such as knives with ergonomic handles; use equipment for household jobs that is designed to ease strain on the body, such as ergonomically designed snow shovels and garden tools)*

Sample guiding questions: What is ergonomics? Why is it important that tools, equipment, and furniture be ergonomically designed? What are some ways in which traditional designs of tools, equipment, and furniture can be changed to be more ergonomic? How might different populations benefit from ergonomic designs (e.g., the elderly, people with physical challenges, students, etc.)?

2. Developing Investigation and Communication Skills

By the end of Grade 7, students will:

2.1 follow established safety procedures for using tools and handling materials *(e.g., wear safety glasses when cutting or drilling)*

2.2 design, construct, and use physical models to investigate the effects of various forces on structures *(e.g., the struts of a roof experience compression forces from shingles; the support cables of a suspension bridge are in tension; a twisted ruler has torsion forces; the pin that holds the two parts of a pair of scissors together has shear forces acting on it)*

2.3 investigate the factors that determine the ability of a structure to support a load *(e.g., the weight of the structure itself; the magnitude of the external loads it will need to support; the strength of the materials used to build it)*

2.4 use technological problem-solving skills (see page 16) to determine the most efficient way for a structure *(e.g., a chair, a shelf, a bridge)* to support a given load

Sample problem: Using the least amount of material (by mass), construct a bridge to support a specific load (e.g., minimum of 4 kilograms).

2.5 investigate methods used by engineers to ensure structural safety *(e.g., incorporating sensors in structures to detect unusual stresses and give early warning of failure; designing structures to carry much heavier loads than they will actually have to bear)*

2.6 use appropriate science and technology vocabulary, including *truss, beam, ergonomics, shear,* and *torsion),* 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., use a graphic organizer to show the steps taken in designing and making a product)*

3. Understanding Basic Concepts

By the end of Grade 7, students will:

3.1 classify structures as solid structures *(e.g., dams)*, frame structures *(e.g., goal posts)*, or shell structures *(e.g., airplane wings)*

3.2 describe ways in which the centre of gravity of a structure *(e.g., a child's high chair, a tower)* affects the structure's stability

3.3 identify the magnitude, direction, point of application, and plane of application of the forces applied to a structure

3.4 distinguish between external forces *(e.g., wind, gravity, earthquakes)* and internal forces (tension, compression, shear, and torsion) acting on a structure

3.5 describe the role of symmetry in structures *(e.g., aesthetic appeal, structural stability)*

3.6 identify and describe factors that can cause a structure to fail *(e.g., bad design, faulty construction, foundation failure, extraordinary loads)*

3.7 identify the factors *(e.g., properties of the material as they relate to the product, availability, costs of shipping, aesthetic appeal, disposal)* that determine the suitability of materials for use in manufacturing a product *(e.g., a running shoe)*

GRADE 7 | UNDERSTANDING MATTER AND ENERGY
PURE SUBSTANCES AND MIXTURES

OVERVIEW

By exploring the distinction between pure substances and mechanical mixtures and solutions, students will come to recognize that most matter is either a solution or a mechanical mixture – including most foods and drinks and many medicines, cosmetics, building materials, and cleaning agents. Students will use this information to weigh the social and environmental consequences of the use of various consumer products. The introduction of a scientific model (the particle theory) to describe the particulate nature of matter will provide students with a conceptual basis for learning in this area.

When experimenting with pure substances and mixtures, 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 why it is important to handle glassware safely (when using plastic containers is not suitable), to choose and safely use an appropriate heat source, and to use safety goggles or face shields to protect their eyes.

Fundamental Concepts	Big Ideas
Matter Systems and Interactions	Matter can be classified according to its physical characteristics. *(Overall expectations 2 and 3)* The particle theory of matter helps to explain the physical characteristics of matter. *(Overall expectations 2 and 3)* Pure substances and mixtures have an impact on society and the environment. *(Overall expectation 1)* Understanding the characteristics of matter allows us to make informed choices about how we use it. *(Overall expectations 1 and 3)*

OVERALL EXPECTATIONS

By the end of Grade 7, students will:

1. evaluate the social and environmental impacts of the use and disposal of pure substances and mixtures;
2. investigate the properties and applications of pure substances and mixtures;
3. demonstrate an understanding of the properties of pure substances and mixtures, and describe these characteristics using the particle theory.

SPECIFIC EXPECTATIONS

1. Relating Science and Technology to Society and the Environment

By the end of Grade 7, students will:

1.1 assess positive and negative environmental impacts related to the disposal of pure substances *(e.g., uranium)* and mixtures *(e.g., paint, sewage)*

Sample issues: (a) Pure substances that are harmful to people or the environment must be disposed of very carefully. That usually means burying them in special landfills or underground chambers that will keep them from getting back into the environment or, if possible, recycling them or converting them into a substance that is not harmful. If these solutions are not possible, then we have to reduce our use of the substance or not use it all. (b) Mixtures that have harmful components must be treated in the same way. Lead-based paint is a mixture that has to be disposed of in special landfills because the lead in it is harmful. Latex paint, which has no harmful components, does not require special treatment. Sometimes, harmful components can be separated from the rest of the mixture, leaving less material for special disposal. Sewage is an example. Solid materials can be removed and decomposed by bacteria, leaving water that can be returned to lakes and rivers. The leftover sludge can be buried or, if it does not contain toxic materials, converted into fertilizer. (c) Nuclear power stations produce no air pollutants, but the used uranium fuel rods remain dangerously radioactive for thousands of years. What options have been proposed for disposing of this waste? How safe are they? How would these concerns affect your decision about whether to heat your home by using electricity that is provided by nuclear energy?

1.2 assess the impact on society and the environment of different industrial methods of separating mixtures and solutions

Sample guiding questions: Why might oil refineries be located away from populated areas? How do air purification systems make air healthier for people to breathe? What are the impacts on the environment of the evaporation process used in making maple syrup?

2. Developing Investigation and Communication Skills

By the end of Grade 7, students will:

2.1 follow established safety procedures for handling chemicals and apparatus *(e.g., wash hands after handling chemicals, take note of universal warning symbols)*

2.2 use scientific inquiry/experimentation skills (see page 12) to investigate factors *(e.g., temperature, type of solute or solvent, particle size, stirring)* that affect the solubility of a substance and the rate at which substances dissolve

2.3 investigate processes *(e.g., filtration, distillation, settling, magnetism)* used for separating different mixtures

Sample problem: Use filtration and magnetism to separate a mixture of water, sand, and paperclips. Use filtration to separate marbles of different sizes. Use evaporation to separate dissolved salt from water.

2.4 use scientific inquiry/experimentation skills (see page 12) to investigate the properties of mixtures and solutions *(e.g., the amount of solute required to form a saturated solution; differences between pure substances and mixtures)*

Sample guiding questions: How does changing the amount of solute or solvent affect the solution? What factors affect the amount of solute that can dissolve in a solvent? What factors affect the speed at which a solute dissolves?

2.5 use appropriate science and technology vocabulary, including *mechanical mixture, solution, solute, insoluble, saturated, unsaturated,* and *dilute,* 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 appropriate mathematical conventions, make a scatter plot to show the relationship between solute, solvent, and temperature)*

3. Understanding Basic Concepts

By the end of Grade 7, students will:

3.1 distinguish between pure substances *(e.g., distilled water, salt, copper pipe)* and mixtures *(e.g., salad dressing, chocolate chip cookies)*

3.2 state the postulates of the particle theory of matter (all matter is made up of particles; all particles are in constant motion; all particles of one substance are identical; temperature affects the speed at which particles move; in a gas, there are spaces between the particles; in liquids and solids, the particles are close together and have strong forces of attraction between them)

3.3 use the particle theory to describe the difference between pure substances (which have identical particles) and mixtures (which have different particles)

3.4 distinguish between solutions and mechanical mixtures

3.5 describe the processes *(e.g., evaporation, sifting, filtration, distillation, magnetism)* used to separate mixtures or solutions into their components, and identify some industrial applications of these processes *(e.g., use of cheesecloth to separate seeds and skins from juice and pulp to make fruit jellies; use of evaporation in maple syrup production; use of different sizes of sieves to separate wheat grains in white bread production; use of strainers in industries to separate slurry into solids and liquids)*

3.6 identify the components of a solution *(e.g., solvent, solute)*

3.7 identify solutes and solvents in various kinds of solutions *(e.g., copper and tin in bronze; iodine and alcohol in iodine solution)*

3.8 describe the concentration of a solution in qualitative terms *(e.g., dilute, concentrated)* and in quantitative terms *(e.g., 5 grams of salt in 1000 ml of water)*

3.9 describe the difference between saturated and unsaturated solutions

3.10 explain why water is referred to as the universal solvent

GRADE 7 | UNDERSTANDING EARTH AND SPACE SYSTEMS
HEAT IN THE ENVIRONMENT

OVERVIEW

Heat energy plays a critical role in natural processes and in human life. Global warming has also focused considerable attention on the processes that control temperatures at the earth's surface. By acquiring a working understanding of the nature of heat, students in Grade 7 will gain new insights into the ways that heat affects our world. Students will learn about the causes and effects of heat, investigate its properties, relate it to geological and meteorological processes, and use their new-found knowledge to design a device to minimize heat transfer. They will also use the particle theory to help them explain their observations.

Experiments with heat require that students identify and explain the importance of practices that ensure their personal safety and the safety of others. This includes knowing why very hot water should always be carried in a closed container (e.g., an insulated flask) and why they should stand when heating things and hold objects that are being heated well away from themselves.

Fundamental Concepts	Big Ideas
Energy Sustainability and Stewardship Systems and Interactions	Heat is a form of energy that can be transformed and transferred. These processes can be explained using the particle theory of matter. *(Overall expectations 2 and 3)* There are many sources of heat. *(Overall expectation 3)* Heat has both positive and negative effects on the environment. *(Overall expectation 1)*

OVERALL EXPECTATIONS

By the end of Grade 7, students will:

1. assess the costs and benefits of technologies that reduce heat loss or heat-related impacts on the environment;
2. investigate ways in which heat changes substances, and describe how heat is transferred;
3. demonstrate an understanding of heat as a form of energy that is associated with the movement of particles and is essential to many processes within the earth's systems.

SPECIFIC EXPECTATIONS

1. Relating Science and Technology to Society and the Environment

By the end of Grade 7, students will:

1.1 assess the social and environmental benefits of technologies that reduce heat loss or transfer *(e.g., insulated clothing, building insulation, green roofs, energy-efficient buildings)*

Sample guiding questions: (a) Insulated clothing protects our bodies and increases our ability to enjoy outdoor activities in winter. What science and technology concepts are at work in coats designed for use in cold weather? Who might be interested in such designs? (b) A well-insulated home is more comfortable and costs less to heat. Reducing heat loss saves energy, and saving energy reduces the environmental impact of energy production. What are some areas of your home where heat might be lost? How can this heat loss be counteracted? What are the benefits of doing so? (c) Green roofs save on heating and cooling costs and reduce the amount of insulation that is needed. But they have not gained wide acceptance in Ontario. What might be some deterrents to having a green roof? How might these deterrents be overcome? (d) Energy-efficient buildings are extremely airtight compared to conventionally constructed buildings. This minimizes the amount of warm (or cool) air that can pass through the structure. What are some of the disadvantages to having airtight buildings (e.g., lack of fresh air, moisture buildup)? How can these problems be solved (e.g., through mechanical ventilation systems with heat recovery and humidity control), and how effective are the solutions?

1.2 assess the environmental and economic impacts of using conventional *(e.g., fossil fuel, nuclear)* and alternative forms of energy *(e.g., geothermal, solar, wind, wave, biofuel)*

Sample issues: (a) Your family is building a new home. Present a case for installing a geothermal heat pump. In your discussion, be sure to include the benefits and costs from both an environmental perspective and an economic perspective. (b) Make a case for (or against) using rural land or marginal land-use areas for wind turbine farms.

2. Developing Investigation and Communication Skills

By the end of Grade 7, students will:

2.1 follow established safety procedures for using heating appliances and handling hot materials *(e.g., use protective gloves when removing items from hot plates)*

2.2 investigate the effects of heating and cooling on the volume of a solid, a liquid, and a gas

2.3 use technological problem-solving skills (see page 16) to identify ways to minimize heat loss

Sample problem: Use the materials provided to create a product (e.g., a model of a piece of winter clothing, a model of a wet suit, a model travel mug for a hot beverage or food item) that will minimize heat loss

2.4 use scientific inquiry/experimentation skills (see page 12) to investigate heat transfer through conduction, convection, and radiation

Sample problem (conduction): After letting spoons made of different materials sit partially submerged in a container of hot water, measure the temperature of the parts sticking out of the water. What conclusions can you draw from your findings?

2.5 use appropriate science and technology vocabulary, including *heat*, *temperature*, *conduction*, *convection*, and *radiation*, 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 the conventions of science, create a labelled diagram to illustrate convection in a liquid or a gas)*

3. Understanding Basic Concepts

By the end of Grade 7, students will:

3.1 use the particle theory to compare how heat affects the motion of particles in a solid, a liquid, and a gas

3.2 identify ways in which heat is produced *(e.g., burning fossil and renewable fuels, electrical resistance, physical activity)*

3.3 use the particle theory to explain the effects of heat on volume in solids *(e.g., rails, sidewalks, and bridge segments expand in hot weather),* liquids *(e.g., sea levels are rising partly because global warming is making the oceans warmer and the water in them is expanding),* and gases *(e.g., the air in car tires expands on hot pavement)*

3.4 explain how heat is transmitted through conduction *(e.g., the transmission of heat from a stove burner to a pot and from the pot to the pot handle),* and describe natural processes that are affected by conduction *(e.g., the formation of igneous and metamorphic rocks and diamonds)*

3.5 explain how heat is transmitted through convection, and describe natural processes that depend on convection *(e.g., thunderstorms, land and sea breezes)*

3.6 explain how heat is transmitted through radiation, and describe the effects of radiation from the sun on different kinds of surfaces *(e.g., an ice-covered lake, a forest, an ocean, an asphalt road)*

3.7 describe the role of radiation in heating and cooling the earth, and explain how greenhouse gases affect the transmission of radiated heat through the atmosphere *(e.g., The earth is warmed by absorbing radiation from the sun. It cools by radiating thermal energy back to space. Greenhouse gases absorb some of the radiation that the earth emits to space and reradiate it back to the earth's surface. If the quantity of greenhouse gases in the atmosphere increases, they absorb more outgoing radiation, and the earth becomes warmer.)*

3.8 identify common sources of greenhouse gases *(e.g., carbon dioxide comes from plant and animal respiration and the burning of fossil fuels; methane comes from wetlands, grazing livestock, termites, fossil fuel extraction, and landfills; nitrous oxide comes from soils and nitrogen fertilizers),* and describe ways of reducing emissions of these gases