GRADE **8**

GRADE 8 | UNDERSTANDING LIFE SYSTEMS
CELLS

OVERVIEW

Cells are the smallest unit of life, and each cell is a system nested within a system. In Grade 8, students will continue to develop their knowledge of organisms by focusing on the structure and function of cells in plants and animals. Our knowledge of cells has increased enormously since the middle of the twentieth century, and students will examine the implications of this knowledge for individuals, society, and the environment.

Students will also be introduced to the use of microscopes. These are invaluable tools for scientists and provide students with opportunities to explore objects in amazing detail. Microscopes are precision instruments and must be handled with great care. It is important that students be able to identify and explain the importance of practices for handling and using microscopes that not only respect the fragility of the tool but also ensure their personal safety and the safety of others.

Fundamental Concepts	Big Ideas
Systems and Interactions Structure and Function	Cells are the basis of life. *(Overall expectations 2 and 3)* Cells organize into tissues, tissues into organs, organs into organ systems, and organ systems into organisms. *(Overall expectations 2 and 3)* Healthy cells contribute to healthy organisms. *(Overall expectations 1 and 2)* Systems are interdependent. *(Overall expectations 1 and 3)*

OVERALL EXPECTATIONS

By the end of Grade 8, students will:

1. assess the impact of cell biology on individuals, society, and the environment;
2. investigate functions and processes of plant and animal cells;
3. demonstrate an understanding of the basic structure and function of plant and animal cells and cell processes.

SPECIFIC EXPECTATIONS

1. Relating Science and Technology to Society and the Environment

By the end of Grade 8, students will:

1.1 assess the role of selected technologies *(e.g., the development of the electron microscope, the ability to infuse dyes into cells, in vitro fertilization)* in enhancing our understanding of cells and cellular processes

Sample guiding questions: How have electron microscopes helped our understanding of cells and cell processes? What are some disadvantages of using this technology that might affect its availability or effectiveness? How might infusing dye into cells be a useful tool for diagnosing and/or treating diseases, or for understanding how cells work? How might the understanding of cells and cell processes help in treating disease?

1.2 assess the potential that our understanding of cells and cell processes has for both beneficial and harmful effects on human health and the environment, taking different perspectives into account *(e.g., the perspectives of farmers, pesticide manufacturers, people with life-threatening illnesses)*

Sample issues: (a) Medical scientists can identify changes in a cell or in chromosomes that signal the development of medical problems. But because of the cost of the procedure, this service may not be available to everyone. (b) Scientists can develop pest-resistant crops that reduce the need for chemical pesticides. But there are some concerns that these crops may cross-breed with native plants and disrupt natural populations and balances.

2. Developing Investigation and Communication Skills

By the end of Grade 8, students will:

2.1 follow established safety procedures for handling apparatus and materials *(e.g., wash hands after preparing materials for slides)* and use microscopes correctly and safely *(e.g., carry the microscope with both hands, place it near the centre of the desk, ensure that the sun cannot be directly focused through the instrument when sunlight is used for illumination, keep both eyes open when viewing to avoid eye strain)*

2.2 use a microscope correctly and safely to find and observe components of plant and animal cells *(e.g., using an onion slice or a prepared slide of a protist)* and make accurate drawings of their observations

2.3 prepare dry- and wet-mount slides of a variety of objects for use with a microscope *(e.g., a piece of newspaper, a hair)*

2.4 use scientific inquiry/experimentation skills (see page 12) to investigate the processes of osmosis and diffusion

Sample guiding questions: What question will your experiments try to answer? What do you predict might happen in your experiment? What variables might you need to consider? What conclusions might you draw from the results of your experiment? How closely do your predictions compare with what you actually observed in your experiments? How might what you have learned about osmosis and diffusion be useful in daily life (e.g., how might this help you to keep your houseplants from wilting?)

2.5 use appropriate science and technology vocabulary, including *organelle, diffusion, osmosis, cell theory, selective permeability, membrane, stage,* and *eyepiece,* 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, make a labelled drawing of a cell; create a slide show to explain the results of investigations into the processes of osmosis and diffusion)*

3. Understanding Basic Concepts

By the end of Grade 8, students will:

3.1 demonstrate an understanding of the postulates of the cell theory *(e.g., the cell is the basic unit of life; all cells come from pre-existing cells; all living things are made up of one or more cells)*

3.2 identify structures and organelles in cells, including the nucleus, cell membrane, cell wall, chloroplasts, vacuole, mitochondria, and cytoplasm, and explain the basic functions of each *(e.g., the nucleus holds all the information needed to make every cell in the body)*

3.3 compare the structure and function of plant and animal cells

3.4 explain the processes of diffusion and osmosis and their roles within a cell

3.5 identify unicellular organisms *(e.g., amoebae)* and multicellular organisms *(e.g., invertebrates [worms], vertebrates [frogs])*, and compare ways in which they meet their basic needs *(e.g., nutrition, movement, gas exchange)*

3.6 describe the organization of cells into tissues, organs, and systems *(e.g., groups of cells with similar functions combine to make up tissues; groups of tissues with similar functions combine to make organs; groups of organs work together as organ systems)*

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	Big Ideas
Systems and Interactions Continuity and Change	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 low-quality 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)*

3. 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 ($W = F \times d$) 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)*

GRADE 8 | UNDERSTANDING MATTER AND ENERGY
FLUIDS

OVERVIEW

Fluids are essential to many industrial processes and form the basis of hydraulic and pneumatic devices. Any substance that flows is considered to be a fluid. This includes such things as water, shampoo, sunscreen, and honey. Even gases, such as air, can be classified as fluids. Students will learn about the diverse applications of the principles involved in fluid mechanics, the impacts of technological innovations based on the properties of fluids, and the industries and jobs related to fluids. To learn about the properties of fluids, students will experiment with and investigate the viscosity and density of different liquids and ways in which these properties affect objects placed in those liquids. Students will explore the implications of Archimedes' principle by investigating and measuring the buoyant forces on different objects.

When designing, building, and testing devices, 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 being able to recognize and remedy possible safety hazards in testing situations and knowing how to use joining equipment and materials properly and safely.

Fundamental Concepts	Big Ideas
Matter Systems and Interactions	Fluids are an important component of many systems. *(Overall expectations 1, 2, and 3)* Fluids have different properties that determine how they can be used. *(Overall expectations 1, 2, and 3)* Fluids are essential to life. *(Overall expectation 3)*

OVERALL EXPECTATIONS

By the end of Grade 8, students will:

1. analyse how the properties of fluids are used in various technologies, and assess the impact of these technologies on society and the environment;
2. investigate the properties of fluids;
3. demonstrate an understanding of the properties and uses of fluids.

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 selected technologies that are based on the properties of fluids

Sample issues: (a) The use of heavy hydraulic equipment on construction sites increases productivity. It also reduces the need for manual labourers. (b) Dialysis and blood-separation techniques have decreased mortality rates. But the costs of the equipment can mean that the service is not available to everyone who needs it.

1.2 assess the impact of fluid spills on society and the environment, including the cost of the cleanup and the effort involved

Sample issues: An oil tanker spills its load in B.C.'s inside coastal waters. A fuel truck jackknifes and is leaking gasoline onto a major highway and into local groundwater. A farm truck moving down a country road is leaking liquid fertilizer. The family car is in need of repair – there is brake fluid running down the driveway.

2. Developing Investigation and Communication Skills

By the end of Grade 8, students will:

2.1 follow established safety practices for using apparatus, tools, and materials *(e.g., use syringes and tubing for the purposes for which they were designed)*

2.2 determine the mass-to-volume ratio of different amounts of the same substance *(e.g., water, corn syrup, copper pennies)*

2.3 investigate and compare the density of a variety of liquids *(e.g., water, salt water, corn syrup, liquid soap)*

Sample problem: Construct and calibrate a hydrometer and use it to find the density of a variety of liquids.

2.4 investigate applications of the principles of fluid mechanics *(e.g., in aeronautical research, shipping, food services, plumbing, hydrodynamic engineering)*

2.5 use scientific inquiry/experimentation skills (see page 12) to identify factors that affect the flow rates of various fluids

Sample problem: Devise an experiment to find out how the flow rate of a fluid is affected by changing its temperature; by changing the angle or tilt at which it is poured; by changing the diameter of the tube through which it is poured.

2.6 use technological problem-solving skills (see page 16) to design, build, and test devices that use pneumatic or hydraulic systems

Sample problem: Use your knowledge of Pascal's law to design, construct, and test a working model of a device (e.g., a dentist's chair, an automobile hoist, a hydraulic brake, a backhoe) that operates using hydraulics and/or pneumatics.

2.7 use appropriate science and technology vocabulary, including *viscosity*, *density*, *particle theory of matter*, *hydraulic*, and *pneumatic*, in oral and written communication

2.8 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 scientific and/or technological conventions, create a technical drawing of a pneumatic/hydraulic device; create a brochure or a multimedia presentation outlining safe and unsafe uses of the device that was modelled)*

3. Understanding Basic Concepts

By the end of Grade 8, students will:

3.1 demonstrate an understanding of viscosity and compare the viscosity of various liquids *(e.g., water, syrup, oil, shampoo, ketchup)*

3.2 describe the relationship between mass, volume, and density as a property of matter

3.3 explain the difference between solids, liquids, and gases in terms of density, using the particle theory of matter *(e.g., in general, solids are more dense than liquids, which are more dense than gases)*

3.4 explain the difference between liquids and gases in terms of their compressibility *(e.g., gases are more compressible than liquids)* and how their compressibility affects their usage *(e.g., pneumatic devices are used to operate bus doors because they work over a larger temperature range and are safer for this purpose than hydraulic devices)*

3.5 determine the buoyancy of an object, given its density, in a variety of fluids *(e.g., less dense objects float, more dense objects sink)*

3.6 explain in qualitative terms the relationship between pressure, volume, and temperature when a liquid *(e.g., water)* or a gas *(e.g., air)* is compressed or heated

3.7 explain how forces are transferred in all directions in fluids (Pascal's law)

3.8 compare the ways in which fluids are used and controlled in living things to the ways in which they are used and controlled in manufactured devices *(e.g., compare the role of valves in the circulatory system to the role of valves in an internal combustion engine; compare the role of a fish's swim bladder to the role of the ballast tanks in a submarine)*

GRADE 8 | UNDERSTANDING EARTH AND SPACE SYSTEMS
WATER SYSTEMS

OVERVIEW

More than 70 per cent of the earth's surface is covered with water, and most of this water is found in the oceans. In learning about the earth's water systems, students will develop an understanding of the important role that water systems play in global ecosystems. They will evaluate the role media play in portraying controversial water issues and research recent technological innovations related to Earth's water systems. Students will gain a basic understanding of Earth's water systems and come to a better understanding of their own role in caring for this precious resource.

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 making the teacher aware of any potential allergic reactions (e.g., to bee stings), wearing the clothing and footwear appropriate for the conditions they are working in, and staying within the area of study.

Fundamental Concepts	Big Ideas
Sustainability and Stewardship Systems and Interactions Change and Continuity	Water is crucial to life on Earth. *(Overall expectations 1 and 2)* Water systems influence climate and weather patterns. *(Overall expectation 3)* Water is an important resource that needs to be managed sustainably. *(Overall expectations 1 and 2)*

OVERALL EXPECTATIONS

By the end of Grade 8, students will:

1. assess the impact of human activities and technologies on the sustainability of water resources;
2. investigate factors that affect local water quality;
3. demonstrate an understanding of the characteristics of the earth's water systems and the influence of water systems on a specific region.

SPECIFIC EXPECTATIONS

1. Relating Science and Technology to Society and the Environment

By the end of Grade 8, students will:

1.1 evaluate personal water consumption, compare it with personal water consumption in other countries, and propose a plan of action to reduce personal water consumption to help address water sustainability issues

1.2 assess how various media sources *(e.g., Canadian Geographic; the science section in newspapers; Internet websites; local, national, and international news on television and radio)* address issues related to the impact of human activities on the long-term sustainability of local, national, or international water systems

Sample issues: (a) You are doing research on the implications of exporting water from Canada to other countries. Your sources are a national newspaper, a scientific magazine, and some selected Internet sites. Each has a slightly different opinion on the issue. (b) A farmer wants to ensure that her nutrient management strategies are not adversely affecting the local water system. She consults the agriculture section of a local newspaper, a Canadian magazine with an environmental focus, and local farm reports. She finds conflicting information. (c) The Protocol for Safe Drinking Water in First Nations Communities addresses drinking water concerns in First Nations communities. Various government agencies, news agencies, and interest groups have different perspectives on its development and release.

Sample guiding questions: How does each of these texts address the purpose and the intended audience for the piece? Are there implied messages in the text, and if so, what are they? How does the information in each of the texts compare? Why might they take different positions? What different groups are represented in the texts? How does each text capture and maintain the interest of the reader? Why might different people or groups of people react differently to these texts?

1.3 assess the impact on local and global water systems of a scientific discovery or technological innovation *(e.g., enhancing the efficiency of naturally occurring bacteria that consume hydrocarbons from oil spills and convert them to carbon dioxide and water; development of desalination techniques to provide fresh water from sea water)*

Sample issues: (a) Bioremediation (e.g., the use of microorganisms to clean up contaminated soil or water) can eliminate contamination in many environments with a speed and thoroughness much greater than traditional methods and at significantly lower costs. However, it is effective on a limited number of contaminants; in some cases, the time involved is relatively long; and considerable knowledge and experience are needed to design and implement a successful bioremediation program. (b) Desalination is a method that allows sea water to be made into fresh water. The cost to do this is declining, while extracting water from rivers and lakes is becoming more expensive as well as ecologically harmful, and groundwater in many locations is depleted. However, not every area that needs a supply of fresh water is on a coastline.

Sample guiding questions: What scientific discoveries or technologies are currently affecting Earth's water systems? What kind of an impact are these advances having on water systems? What discoveries or technologies are available (or in development) that can help clean our water systems?

2. Developing Investigation and Communication Skills

By the end of Grade 8, students will:

2.1 follow established safety procedures for the use of apparatus and chemicals *(e.g., when using water-testing equipment and water-testing chemicals)*

2.2 investigate how municipalities process water *(e.g., obtain it, test it, and treat it)* and manage water *(e.g., distribute it, measure consumption, and dispose of waste water)*

2.3 test water samples for a variety of chemical characteristics *(e.g., pH, salinity, chlorine)*

Sample problem: Test the pH, salinity, and chlorine content of tap water, rain water, bottled water, filtered water, and water from a variety of other sources such as streams, rivers, ponds, or lakes. Record and compare the findings and draw conclusions from them.

2.4 use scientific inquiry/research skills (see page 15) to investigate local water issues

Sample guiding questions: Where does your local water supply come from? How is water used in the area where you live? How does the use of water in your community affect the local water supply? How might you find out? What are some local issues regarding the water supply for your area? Why have these become issues? How are they currently being addressed by your city, town, or region? How might you and your family have become aware of the issue? What are some things that you think others should know about their local water supply and how it is managed?

2.5 use technological problem-solving skills (see page 16) to design, build, and test a water system device that performs a practical function or meets a need

Sample problem: Design, build, and test a filtration device that makes unclean water clean; build a working model of an irrigation system.

2.6 use appropriate science and technology vocabulary, including *water table*, *aquifer*, *polar ice-cap*, and *salinity*, 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 scientific conventions, draw a labelled diagram of a water treatment facility; create a brochure about the safe use of wells and septic tanks)*

3. Understanding Basic Concepts

By the end of Grade 8, students will:

3.1 identify the various states of water on the earth's surface, their distribution, relative amounts, and circulation, and the conditions under which they exist *(e.g., water is a solid in glaciers, snow, and polar ice-caps; a liquid in oceans, lakes, rivers, and aquifers; and a gas in the atmosphere)*

3.2 demonstrate an understanding of the watershed as a fundamental geographic unit, and explain how it relates to water management and planning

3.3 explain how human and natural factors cause changes in the water table *(e.g., lawn watering, inefficient showers and toilets, drought, floods, overuse of wells, extraction by bottled water industry)*

3.4 identify factors *(e.g., annual precipitation, temperature, climate change)* that affect the size of glaciers and polar ice-caps, and describe the effects of these changes on local and global water systems

3.5 explain changes in atmospheric conditions caused by the presence of bodies of water *(e.g., differences in temperature near large bodies of water; microclimates; storms off coastal areas)*