Please note: this Science Grade 8 document has been provided to assist school districts, schools, and teachers in preparing to deliver Science Grade 8 in 2006/2007, the first of year of prescribed implementation.

Feedback on an earlier draft of Science 8 to 10 was collected from June to December 2005. This feedback was provided by focussed review sessions as well as interested teachers, students, parents, school district staff, education partners, and stakeholders. This document reflects revisions made as a result of this feedback.

This information in this document supersedes the information re Grade 8 Science contained in the *Science 8 to 10 Integrated Resource Package 1996*. The entire updated Grade 8-10 curriculum will be implemented according to the following implementation schedule: September 2006 for grade 8; September 2007 for grade 9; September 2008 for grade 10.

SCIENCE GRADE 8

Integrated Resource Package 2006

BRITISH COLUMBIA
The Best Place on Earth

GBG016

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ACKNOWLEDGMENTS

Many people contributed their expertise to this document. The Project Manager was Mr. Waël Afifi of the Ministry of Education, working with other ministry personnel and our partners in education. We would like to thank all who participated in this process.

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This Integrated Resource Package (IRP) provides information teachers will require in order to implement Science 8 to 10. This document supersedes the *Science 8 to 10 Integrated Resource Package 1996*, according to the following implementation schedule: September 2006 for grade 8; September 2007 for grade 9; September 2008 for grade 10.

The information contained in this document is also available on the Internet at www.bced.gov.bc.ca/irp/irp.htm

The following paragraphs provide brief descriptions of the components of the IRP.

INTRODUCTION

The Introduction provides general information about Science 8 to 10, including special features and requirements.

Included in this section are

- a rationale for teaching Science 8 to 10 in BC schools
- information about graduation program requirements and provincial examinations
- goals for Science 8 to 10
- information about the revision process that led to the publication of this document
- descriptions of the curriculum organizers—groupings for prescribed learning outcomes that share a common focus
- Aboriginal content in the science curriculum
- suggested time allotments for each course
- a graphic overview of the curriculum content from K to 10

CONSIDERATIONS FOR PROGRAM DELIVERY

This section of the IRP contains additional information to help educators develop their school practices and plan their program delivery to meet the needs of all learners.

PRESCRIBED LEARNING OUTCOMES

This section contains the *prescribed learning outcomes.* Prescribed learning outcomes are the legally required content standards for the provincial education system. They define the required attitudes, skills, and knowledge for each subject. The learning outcomes are statements of what students are expected to know and be able to do by the end of the course.

STUDENT ACHIEVEMENT

This section of the IRP contains information about classroom assessment and measuring student achievement, including sets of specific achievement indicators for each prescribed learning outcome. Achievement indicators are statements that describe what students should be able to do in order to demonstrate that they fully meet the expectations set out by the prescribed learning outcomes. Achievement indicators are not mandatory; they are provided to assist teachers in assessing how well their students achieve the prescribed learning outcomes.

Also included in this section are key elements—descriptions of content that help determine the intended depth and breadth of prescribed learning outcomes.

CLASSROOM ASSESSMENT MODEL

This section contains a series of classroom units that address the learning outcomes. The units have been developed and piloted by BC teachers, and are provided to support classroom assessment. These units are suggestions only—teachers may use or modify the units to assist them as they plan for the implementation of this curriculum.

Each unit includes the prescribed learning outcomes and suggested achievement indicators, a suggested timeframe, a sequence of suggested assessment activities, and sample assessment instruments.

LEARNING RESOURCES

This section contains general information on learning resources, providing a link to titles, descriptions, and ordering information for the recommended learning resources in the Earth Science 8 to 10 Grade Collections.

GLOSSARY

The glossary defines selected terms used in this Integrated Resource Package.

INTRODUCTION

This Integrated Resource Package (IRP) sets out the provincially prescribed curriculum for Science 8 to 10. The development of this IRP has been guided by the principles of learning:

- Learning requires the active participation of the student.
- People learn in a variety of ways and at different rates.
- Learning is both an individual and a group process.

In addition to these three principles, this document recognizes that British Columbia's schools include students of varied backgrounds, interests, abilities, and needs. Wherever appropriate for this curriculum, ways to meet these needs and to ensure equity and access for all learners have been integrated as much as possible into the learning outcomes, achievement indicators, and assessment activities.

Science 8 to 10, in draft form, was available for public review and response from June to December, 2005. Feedback from educators, students, parents, and other educational partners informed the development of this updated IRP.

RATIONALE

Science education in British Columbia is designed to provide opportunities for students to develop scientific knowledge, skills, and attitudes that will be relevant in their everyday lives and their future careers. In addition to introducing them to current concepts, findings, and processes in various scientific disciplines – biology, physics, chemistry, astronomy, and geology – it encourages them to

- develop a positive attitude toward science
- examine basic concepts, principles, laws, and theories through scientific inquiry
- demonstrate respect for precision
- develop awareness of assumptions in all forms of science-related communication
- separate fundamental concepts from the less important or irrelevant
- identify supporting or refuting information and bias
- recognize that scientific knowledge is continually developing
- use given criteria for evaluating evidence and sources of information
- actively gain knowledge, skills, and attitudes that provide the basis for sound and ethical problem solving and decision making
- assess the impact of science and technology on individuals, society, and the environment
- cultivate appreciation of the scientific endeavour and their potential to contribute to science

To prepare students for further education and for their adult lives, the Science 8 to 10 curriculum engages students in the investigation of scientific questions and the development of plausible solutions. Science education develops and builds on students' sense of wonder about the world around them and encourages a feeling of responsibility to sustain it. Science education fosters students' desire to meet a challenge, take risks, and learn from mistakes. It prompts a curiosity about the changing world and helps students understand that the skills and knowledge they are gaining will be refined and expanded to reflect advances in scientific knowledge and technology.

REQUIREMENTS AND GRADUATION CREDITS

Science 10 is designated as a provincially examinable, four-credit course, and must be reported as such to the Ministry of Education for transcript purposes. Letter grades and percentages must be reported for this course.

GRADUATION PROGRAM EXAMINATION

Although the instructional approach for Science 8 to 10 is intended to be experiential in nature, the Grade 10 course has a set Graduation Program examination, worth 20% of the final course mark. All students taking Science 10 are required to write the examination in order to receive credit for this course.

For more information, refer to the Ministry of Education examinations web site:
www.bced.gov.bc.ca/exams/

GOALS FOR SCIENCE 8 TO 10

The over-riding goals for Science 8 to 10 are represented in the prescribed learning outcomes for Science 8 to 10 in each curriculum organizer. These goals are in alignment with the foundational statements from the Pan-Canadian Science Framework (Council of Ministers of Education, Canada,1997) that delineate the four critical aspects of students' scientific literacy.

- **GOAL 1: Science,technology, society,and the environment (STSE) –** Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology.
- **GOAL 2: Skills –** Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.
- **GOAL 3: Knowledge –** Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.
- **GOAL 4: Attitudes –** Students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment.

THE 2006 SCIENCE 8 TO 10 REVISION

This 2006 revision incorporates components from the 1996 provincial Science 8 to 10 curriculum and contributions of groups of British Columbia educators. At the same time, the allocation of topics at each grade reflects a commitment by the Ministry of Education to align, where possible and appropriate, the scope and sequence of science education in British Columbia with the scope and sequence outlined in the *K to 12 Common Framework of Learning Outcomes* (developed and published by the Council of Ministers of Education, Canada, under the aegis of the *Pan-Canadian Protocol for Collaboration on School Curriculum*). Among other benefits, it is anticipated that this alignment will facilitate inter-provincial transfers for students leaving or arriving in British Columbia and give British Columbia educators access to a wider range of choice when acquiring textbooks and other learning resources to teach Science 8 to 10.

A variety of resources were used in the development of this IRP:

- British Columbia *Science 8 to 10 IRP* (1996)
- *Pan-Canadian Common Framework of Science Learning Outcomes* (1997), Council of Ministers of Education, Canada (http://cmec.ca/science/framework/)
- Science Curriculum Review Report (2001) http://www.bced.gov.bc.ca/branches/pser/whatsnew.htm#scrr
- Provincial science curricula
  - APEF (Atlantic Provinces Education Foundation)
  - Ontario
  - Manitoba
  - Alberta
- *Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education*, 3rd Edition (2000), Kendall, J. S. & Marzano, R.J. (http://www.mcrel.org/standards-benchmarks)
- *Atlas of Science Literacy* (2001), American Association for the Advancement of Science, Project 2061, National Science Teachers Association, Washington DC
- *Designs for Science Literacy* (2000), American Association for the Advancement of Science, Project 2061, National Science Teachers Association, Washington DC

- *Shared Learnings* (1998), Aboriginal Education Initiative, British Columbia Ministry of Education

CURRICULUM ORGANIZERS

A curriculum organizer consists of a set of prescribed learning outcomes that share a common focus. The prescribed learning outcomes for Science 8 to 10 are grouped under the following curriculum organizers:

- Processes of Science
- Life Sciences
- Physical Sciences
- Earth and Space Science

Note that these four organizers are for the purposes of identifying prescribed learning outcomes; they are not intended to suggest a linear delivery of course material.

Processes of Science

Students in Science 8 to 10 are building on skills and processes that they have been developing from Kindergarten through to Grade 7. These include skills such as observing, classifying, predicting, inferring, and hypothesizing. Scientific reasoning, critical thinking, and decision making are also part of that foundation.

Beginning in Grade 8, the curriculum places greater emphasis on skills related to lab safety, scientific communication (e.g., representing information in graphic form), scientific literacy (e.g., being able to comprehend and evaluate science-related material), and understanding and using scientific technology (e.g., microscopes, equipment involved in the study of electricity). These emphases are maintained and reinforced at all three grade level, 8 to 10.

Although some discrete instruction related to Processes of Science will likely occur, it is anticipated that skills and processes of science will mostly be developed as part of work related to the other curriculum organizers (e.g., understanding how microscopes work and learning how to use them will occur in relation to the study of optics and the study of life science topics such as cells and micro-organisms). The curriculum accordingly assumes that instruction and assessment related to these skills an processes will be integrated and will occur frequently as appropriate throughout each year.

Life Science

At the 8 to 10 level, the Life Science organizer embraces a range of biology topics, moving from the microscopic level (the study of cellular processes and how these relate to tissues, organ systems in organisms, and reproduction) to the macroscopic level (the study of ecological complexity and the diversity, continuity, interactions, and balance among organisms and their environments).

Physical Science

At the 8 to 10 level, the Physical Science organizer incorporates a series of topics that give students a foundation for understanding Physics (via a focus on optics, fluids, electricity, and motion) and Chemistry (via a focus on atoms, elements, and chemical reactions). Two main Physical Science topics are dealt with in each year of the 8-10 program.

Earth and Space Science

As a complement to the study of topics in other areas of science (especially Physical Science), the Earth and Space Science organizer gives students an opportunity to examine some of the macroscopic applications of scientific principles and technologies in the study of terrestrial and extra-terrestrial systems.

ABORIGINAL CONTENT IN THE SCIENCE CURRICULUM

The science curriculum guide integrates prescribed learning outcomes within a classroom model that includes instructional strategies, assessment tools and models that can help teachers provide all students with an understanding and appreciation of Aboriginal science. Integration of authentic Aboriginal content into the K to 10 science curriculum with the support of Aboriginal people will help

promote understanding of BC's Aboriginal peoples among *all* students.

The incorporating of Aboriginal science with western science can provide a meaningful context for Aboriginal students and enhance the learning experience for all students. The inclusion of Aboriginal examples of science and technologies can make the subject more authentic, exciting, relevant and interesting for *all* students.

Traditional Ecological Knowledge and Wisdom (TEKW) is defined as the study of systems of knowledge developed by a given culture. It brings the concept of wisdom to our discussion of science and technology. TEKW tends to be holistic, viewing the world as an interconnected whole where humans are not regarded as more important than nature. It is a subset of traditional science, and is considered a branch of biological and ecological science. This knowledge with its characteristic respect for sustaining community and environment offers proven conceptual approaches which are becoming increasingly important to all BC residents.

Examples of TEKW science may be accessed through living elders and specialists of various kinds or found in the literature of TEKW, anthropology, ethnology, ecology, biology, botany, ethnobiology, medicine, horticulture, agriculture, astronomy, geology, climatology, architecture, navigation, nautical science, engineering, and mathematics.

Recognition of the importance of incorporating TEKW into environmental planning is evident in science-based reports and agreements in Canada and internationally. The Brundtland Commission report, *Our Common Future* (World Commission on Environment and Development, 1987), drew our attention to the contributions of traditional knowledge. In British Columbia, the report of the scientific panel for sustainable forest practices in Clayoquot Sound emphasizes TEKW and the importance of including indigenous knowledge in planning and managing traditional territories. The recognition of TEKW globally is explicitly addressed in international agreements including the Convention on Biological Diversity, Agenda 21, and UNCED '92, or the Earth Summit at Rio de Janeiro.

SUGGESTED TIME FRAME

Provincial curricula are developed in accordance with the amount of instructional time allocated for each subject area, while still allowing for flexibility to address local needs. For Science 8 to 10, around 12.5% of instructional hours per school year is recommended.

The following chart shows the suggested estimated instructional time to deliver the prescribed learning outcomes for each Science curriculum organizer. These estimates have been provided as suggestions only; when delivering the prescribed curriculum, teachers will adjust the instructional time as necessary.

Grade 8

Curriculum Organizer	Suggested Time Allocation
PROCESSES OF SCIENCE	integrated with other organizers
LIFE SCIENCE	20-25 hours
PHYSICAL SCIENCE	40-48 hours
EARTH AND SPACE SCIENCE	20-22 hours

Grade 9

Curriculum Organizer	Suggested Time Allocation
PROCESSES OF SCIENCE	integrated with other organizers
LIFE SCIENCE	20-25 hours
PHYSICAL SCIENCE	40-45 hours
EARTH AND SPACE SCIENCE	20-25 hours

Grade 10

Curriculum Organizer	Suggested Time Allocation
PROCESSES OF SCIENCE	integrated with other organizers
LIFE SCIENCE	20-25 hours
PHYSICAL SCIENCE	40-45 hours
EARTH AND SPACE SCIENCE	20-25 hours

SCIENCE K-10: AT A GLANCE

	PROCESSES AND SKILLS OF SCIENCE	LIFE SCIENCE	PHYSICAL SCIENCE	EARTH AND SPACE SCIENCE
Kindergarten	• observing • communicating (sharing)	Characteristics of Living Things	Properties of Objects and Materials	Surroundings
Grade 1	• communicating (recording) • classifying	Needs of Living Things	Force and Motion	Daily and Seasonal Changes
Grade 2	• interpreting observations • making inferences	Animal Growth and Changes	Properties of Matter	Air, Water, and Soil
Grade 3	• questioning • measuring and reporting	Plant Growth and Changes	Materials and Structures	Stars and Planets
Grade 4	• interpreting data • predicting	Habitats and Communities	Light and Sound	Weather
Grade 5	• designing experiments • fair testing	Human Body	Forces and Simple Machines	Renewable and Non-Renewable Resources
Grade 6	• controlling variables • scientific problem solving	Diversity of Life	Electricity	Exploration of Extreme Environments
Grade 7	• hypothesizing • developing models	Ecosystems	Chemistry	Earth's Crust
Grade 8	• safety • scientific method • representing and interpreting scientific information • scientific literacy • ethical behaviour and cooperative skills • application of scientific principles • science-related technology	Cells and Systems	Optics Fluids and Dynamics	Water Systems on Earth
Grade 9		Reproduction	Atoms, Elements, and Compounds Characteristics of Electricity	Space Exploration
Grade 10		Sustainability of Ecosystems	Chemical Reactions and Radioactivity Motion	Energy Transfer in Natural Systems

CONSIDERATIONS FOR PROGRAM DELIVERY

This section of the IRP contains additional information to help educators develop their school practices and plan their program delivery to meet the needs of all learners. Included in this section is information about:

- Alternative Delivery policy
- addressing local contexts
- involving parents and guardians
- course requirements respecting beliefs
- safety considerations
- confidentiality
- inclusion, equity, and accessibility
- working with the school and community
- working with the Aboriginal community
- information and communications technology
- copyright

ALTERNATIVE DELIVERY POLICY

The Alternative Delivery policy does not apply to the Science 8 to 10 curriculum.

The Alternative Delivery policy outlines how students, and their parents or guardians, in consultation with their local school authority, may choose means other than instruction by a teacher within the regular classroom setting for addressing prescribed learning outcomes contained in the Health curriculum organizer of the following curriculum documents:

- Health and Career Education K to 7, and Personal Planning K to 7 Personal Development curriculum organizer (until September 2008)
- Health and Career Education 8 and 9
- Planning 10

The policy recognizes the family as the primary educator in the development of children's attitudes, standards, and values, but the policy still requires that all prescribed learning outcomes be addressed and assessed in the agreed-upon alternative manner of delivery.

It is important to note the significance of the term "alternative delivery" as it relates to the Alternative Delivery policy. The policy does not permit schools to omit addressing or assessing any of the prescribed learning outcomes within the health and career education curriculum. Neither does it allow students to be excused from meeting any learning outcomes related to health. It is expected that students who arrange for alternative delivery will address the health-related learning outcomes and will be able to demonstrate their understanding of these learning outcomes.

For more information about policy relating to alternative delivery, refer to www.bced.gov.bc.ca/policy/

ADDRESSING LOCAL CONTEXTS

There is some flexibility in the Science 8 to 10 curriculum, providing opportunities for individual teacher and student choice in the selection of topics to meet learning outcomes. This flexibility enables educators to plan their programs by using topics and examples that are relevant to their local context and to the particular interests of their students. When selecting topics it may be appropriate to incorporate student input.

INVOLVING PARENTS AND GUARDIANS

The family is the primary educator in the development of students' attitudes and values. The school plays a supportive role by focussing on the prescribed learning outcomes in the Science 8 to 10 curriculum. Parents and guardians can support, enrich, and extend the curriculum at home.

It is highly recommended that schools inform parents and guardians about the Science 8 to 10 curriculum, and teachers (along with school and district administrators) may choose to do so by

- informing parents/guardians and students of the prescribed learning outcomes for the subject by sending home class letters, providing an overview during parent-teacher interviews, etc.
- responding to parent and guardian requests to discuss course unit plans, learning resources, etc.

COURSE REQUIREMENTS RESPECTING BELIEFS

For many students and teachers, the study of some science concepts may lead to issues and questions that go beyond the immediate scope of curriculum (e.g., science is used to meet many industrial requirements, but industrial decision makers must consider factors other than scientific feasibility before adopting a particular process). The technological application of science in areas such as genetic engineering, human reproduction, and medical technology raises questions of ethics and values. Because these social questions arise, in part, from capabilities that science makes possible, they should be addressed. It must be made clear to students, however, that science only provides the background for what is hoped will be informed personal and social decisions. Teachers must handle these questions objectively and with sensitivity.

Reconciling scientific discoveries (for example, in age dating) and religious faith poses a particular challenge for some students. While respecting the personal beliefs of students, teachers should be careful to distinguish between knowledge based on the application of scientific methods, and religious teachings and associated beliefs such as creationism, theory of divine creation, or intelligent design theory.

SAFETY CONSIDERATIONS

Science education is an activity-based process that provides an exciting method of teaching and learning. However, experiments and demonstrations may involve inherent risks for both the teacher and the student.

Safety guidelines must be discussed with students. These safety guidelines must support and encourage the investigative approach generally and laboratory instruction specifically, while at the same time promoting safety in the classroom and laboratory. Encouraging a positive safety attitude is a responsibility shared among the board, school administrators, teachers, and students in every school district. The co-operation of all these groups helps develop a strong safety consciousness both inside and outside our schools.

Field work and field trips require special vigilance with respect to traffic and road safety, safe practices in study areas and when obtaining samples, and an awareness of changes in weather.

Another important aspect of in-school safety is the Workplace Hazardous Materials Information Systems (WHMIS). Through labelling, material safety data sheets, and education and training, WHMIS is designed to ensure that those using hazardous materials have sufficient information to handle them safely. Each school district should have an individual trained in WHMIS who can work with teachers to establish safe, well-ventilated classroom and laboratory working conditions.

To assist teachers in providing a safe science-learning environment, the Ministry of Education publishes the *Science Safety Resource Manual*, which has been distributed to every school.

> The *Science Safety Resource Manual* is available online at www.bced.gov.bc.ca/irp/resdocs/scisafety.htm

CONFIDENTIALITY

The *Freedom of Information and Protection of Privacy Act* (FOIPPA) applies to students, to school district employees, and to all curricula. Teachers, administrators, and district staff should consider the following:

- Be aware of district and school guidelines regarding the provisions of FOIPPA and how it applies to all subjects, including Science 8 to 10.
- Do not use students' Personal Education Numbers (PEN) on any assignments that students wish to keep confidential.
- Ensure students are aware that if they disclose personal information that indicates they are at risk for harm, then that information cannot be kept confidential.

- Inform students of their rights under FOIPPA, especially the right to have access to their own personal information in their school records. Inform parents of their rights to access their children's school records.
- Minimize the type and amount of personal information collected, and ensure that it is used only for purposes that relate directly to the reason for which it is collected.
- Inform students that they will be the only ones recording personal information about themselves unless they, or their parents, have consented to teachers collecting that information from other people (including parents).
- Provide students and their parents with the reason(s) they are being asked to provide personal information in the context of the Science 8 to 10 curriculum.
- Inform students and their parents that they can ask the school to correct or annotate any of the personal information held by the school, in accordance with Section 29 of FOIPPA.
- Ensure students are aware that their parents may have access to the schoolwork they create only insofar as it pertains to students' progress.
- Ensure that any information used in assessing students' progress is up-to-date, accurate, and complete.

For more information about confidentiality, refer to www.mser.gov.bc.ca/FOI_POP/index.htm

INCLUSION, EQUITY, AND ACCESSIBILITY FOR ALL LEARNERS

British Columbia's schools include students of varied backgrounds, interests, and abilities. The Kindergarten to grade 12 school system focusses on meeting the needs of all students. When selecting specific topics, activities, and resources to support the implementation of Science 8 to 10, teachers are encouraged to ensure that these choices support inclusion, equity, and accessibility for all students. In particular, teachers should ensure that classroom instruction, assessment, and resources reflect sensitivity to diversity and incorporate positive role portrayals, relevant issues, and themes such as inclusion, respect, and acceptance.

Government policy supports the principles of integration and inclusion of students who have English as a second language and of students with special needs. Most of the prescribed learning outcomes and suggested achievement indicators in this IRP can be met by all students, including those with special needs and/or ESL needs. Some strategies may require adaptations to ensure that those with special and/or ESL needs can successfully achieve the learning outcomes. Where necessary, modifications can be made to the prescribed learning outcomes for students with Individual Education Plans.

For more information about resources and support for students with special needs, refer to www.bced.gov.bc.ca/specialed/

For more information about resources and support for ESL students, refer to www.bced.gov.bc.ca/esl/

WORKING WITH THE SCHOOL AND COMMUNITY

This curriculum addresses a wide range of skills and understandings that students are developing in other areas of their lives. It is important to recognize that learning related to this curriculum extends beyond the science classroom.

School and district-wide programs support and extend learning in Science 8 to 10. Community organizations may also support the curriculum with locally developed learning resources, guest speakers, workshops, and field studies. Teachers may wish to draw on the expertise of these community organizations and members.

WORKING WITH THE ABORIGINAL COMMUNITY

The Ministry of Education is dedicated to ensuring that the cultures and contributions of Aboriginal peoples in BC are reflected in all provincial curricula. To address these topics in the classroom in a way that is accurate and that respectfully reflects Aboriginal concepts of teaching and learning, teachers are strongly encouraged to seek the advice and support of local Aboriginal communities. As Aboriginal communities are diverse in terms of language, culture, and available resources, each community will have its own unique protocol to gain support for integration of local knowledge and expertise. To begin discussion of possible instructional and assessment activities, teachers should first contact Aboriginal education co-ordinators, teachers, support workers, and counsellors in their district who will be able to facilitate the identification of local resources and contacts such as elders, chiefs, tribal or band councils, Aboriginal cultural centres, Aboriginal Friendship Centres, and Métis or Inuit organizations.

In addition, teachers may wish to consult the various Ministry of Education publications available, including the "Planning Your Program" section of the resource, *Shared Learnings.* This resource was developed to help all teachers provide students with knowledge of, and opportunities to share experiences with, Aboriginal peoples in BC.

For more information about these documents, consult the Aboriginal Education web site: www.bced.gov.bc.ca/abed/welcome.htm

INFORMATION AND COMMUNICATIONS TECHNOLOGY

The study of information and communications technology is increasingly important in our society. Students need to be able to acquire and analyse information, to reason and communicate, to make informed decisions, and to understand and use information and communications technology for a variety of purposes. Development of these skills is important for students in their education, their future careers, and their everyday lives.

Literacy in the area of information and communications technology can be defined as the ability to obtain and share knowledge through investigation, study, instruction, or transmission of information by means of media technology. Becoming literate in this area involves finding, gathering, assessing, and communicating information using electronic means, as well as developing the knowledge and skills to use and solve problems effectively with the technology. Literacy also involves a critical examination and understanding of the ethical and social issues related to the use of information and communications technology. When planning for instruction and assessment in Science 8 to 10, teachers should provide opportunities for students to develop literacy in relation to information and communications technology sources, and to reflect critically on the role of these technologies in society.

COPYRIGHT AND RESPONSIBILITY

Copyright is the legal protection of literary, dramatic, artistic, and musical works; sound recordings; performances; and communications signals. Copyright provides creators with the legal right to be paid for their work and the right to say how their work is to be used. There are some exceptions in the law (i.e., specific things permitted) for schools but these are very limited, such as copying for private study or research. The copyright law determines how resources can be used in the classroom and by students at home.

In order to respect copyright it is necessary to understand the law. It is unlawful to do the following, unless permission has been given by a copyright owner:

- photocopy copyrighted material to avoid purchasing the original resource for any reason
- photocopy or perform copyrighted material beyond a very small part—in some cases the

copyright law considers it "fair" to copy whole works, such as an article in a journal or a photograph, for purposes of research and private study, criticism, and review

- show videotaped television or radio programs to students in the classroom unless these are cleared for copyright for educational use (there are exceptions such as for news and news commentary taped within one year of broadcast that by law have record-keeping requirements—see the web site at the end of this section for more details)
- photocopy print music, workbooks, instructional materials, instruction manuals, teacher guides, and commercially available tests and examinations
- show videotapes at schools that are not cleared for public performance
- perform music or do performances of copyrighted material for entertainment (i.e., for purposes other than a specific educational objective)
- copy work from the Internet without an express message that the work can be copied

Permission from or on behalf of the copyright owner must be given in writing. Permission may also be given to copy or use all or some portion of copyrighted work through a licence or agreement.

Many creators, publishers, and producers have formed groups or "collectives" to negotiate royalty payments and copying conditions for educational institutions. It is important to know what licences are in place and how these affect the activities schools are involved in. Some licences may also have royalty payments that are determined by the quantity of photocopying or the length of performances. In these cases, it is important to assess the educational value and merits of copying or performing certain works to protect the school's financial exposure (i.e., only copy or use that portion that is absolutely necessary to meet an educational objective).

It is important for education professionals, parents, and students to respect the value of original thinking and the importance of not plagiarizing the work of others. The works of others should not be used without their permission.

For more information about copyright, refer to

www.cmec.ca/copyright/indexe.stm

PRESCRIBED LEARNING OUTCOMES

Prescribed learning outcomes are content standards for the provincial education system; they are the prescribed curriculum. Clearly stated and expressed in measurable and observable terms, learning outcomes set out the required attitudes, skills, and knowledge—what students are expected to know and be able to do—by the end of the subject and grade.

Schools have the responsibility to ensure that all prescribed learning outcomes in this curriculum are met; however, schools have flexibility in determining how delivery of the curriculum can best take place.

It is expected that student achievement will vary in relation to the learning outcomes. Evaluation, reporting, and student placement with respect to these outcomes are dependent on the professional judgment and experience of teachers, guided by provincial policy.

Prescribed learning outcomes for Science 8 to 10 are presented by grade and by curriculum organizer and suborganizer, and are coded alphanumerically for ease of reference; however, this arrangement is not intended to imply a required instructional sequence.

Wording of Prescribed Learning Outcomes

All learning outcomes complete the stem, "It is expected that students will …."

When used in a prescribed learning outcome, the word "including" indicates that any ensuing item **must be addressed**. Lists of items introduced by the word "including" represent a set of minimum requirements associated with the general requirement set out by the outcome. The lists are not necessarily exhaustive, however, and teachers may choose to address additional items that also fall under the general requirement set out by the outcome.

Conversely, the abbreviation "e.g.," (for example) in a prescribed learning outcome indicates that the ensuing items are provided for illustrative purposes or clarification, and are **not requirements that must be addressed**. Presented in parentheses, the list of items introduced by "e.g.," is neither exhaustive nor prescriptive, nor is it put forward in any special order of importance or priority. Teachers are free to substitute items of their own choosing that they feel best address the intent of the learning outcome.

Domains of Learning

Prescribed learning outcomes in BC curricula identify required learning in relation to one or more of the three domains of learning: cognitive, psychomotor, and affective. The following definitions of the three domains are based on Bloom's taxonomy.

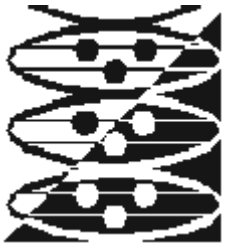
The **cognitive domain** deals with the recall or recognition of knowledge and the development of intellectual abilities. The cognitive domain can be further specified as including three cognitive levels: knowledge, understanding and application, and higher mental processes. These levels are determined by the verb used in the learning outcome, and illustrate how student learning develops over time.

- *Knowledge* includes those behaviours that emphasize the recognition or recall of ideas, material, or phenomena.
- *Understanding and application* represents a comprehension of the literal message contained in a communication, and the ability to apply an appropriate theory, principle, idea, or method to a new situation.
- *Higher mental processes* include analysis, synthesis, and evaluation. The higher mental processes level subsumes both the knowledge and the understanding and application levels.

The **affective domain** concerns attitudes, beliefs, and the spectrum of values and value systems.

The **psychomotor domain** includes those aspects of learning associated with movement and skill demonstration, and integrates the cognitive and affective consequences with physical performances.

Domains of learning and cognitive levels also form the basis of the Assessment Overview Tables provided for each grade in the Classroom Assessment Model. In addition, domains of learning and, particularly, cognitive levels, inform the design and development of the Graduation Program examination for Science 10.



PRESCRIBED LEARNING OUTCOMES

Grade 8

GRADE 8

Processes of Science

It is expected that students will:

A1 demonstrate safe procedures
A2 perform experiments using the scientific method
A3 represent and interpret information in graphic form
A4 use models to explain how systems operate
A5 demonstrate scientific literacy
A6 demonstrate ethical, responsible, cooperative behaviour
A7 describe the relationship between scientific principles and technology
A8 demonstrate competence in the use of technologies specific to investigative procedures and research

Life Science: Cells and Systems

It is expected that students will:

B1 demonstrate knowledge of the characteristics of living things
B2 relate the main features and properties of cells to their functions
B3 explain the relationship between cells, tissues, organs, and organ systems
B4 explain the functioning of the immune system, and the roles of the primary, secondary, and tertiary defence systems

Physical Science: Optics

It is expected that students will:

C1 demonstrate knowledge of the behaviour of waves
C2 explain the properties of visible light
C3 compare visible light to other types of electromagnetic radiation
C4 explain how human vision works

Physical Science: Fluids and Dynamics

It is expected that students will:

C5 explain the concept of force
C6 describe the relationship between solids, liquids, and gases, using the kinetic molecular theory
C7 determine the density of various substances
C8 explain the relationship between pressure, temperature, area, and force in fluids
C9 recognize similarities between natural and constructed fluid systems (e.g., hydraulic, pneumatic)

Earth and Space Science: Water Systems on Earth

It is expected that students will:

D1 explain the significance of salinity and temperature in the world's oceans
D2 describe how water and ice shape the landscape
D3 describe factors that affect productivity and species distribution in aquatic environments

STUDENT ACHIEVEMENT

This section of the IRP contains information about classroom assessment and student achievement, including specific achievement indicators to assist teachers in assessing student achievement in relation to each prescribed learning outcome. Also included in this section are key elements – descriptions of content that help determine the intended depth and breadth of prescribed learning outcomes.

CLASSROOM ASSESSMENT AND EVALUATION

Assessment is the systematic gathering of information about what students know, are able to do, and are working toward. Assessment evidence can be collected using a wide variety of methods, such as

- observation
- student self-assessments and peer assessments
- quizzes and tests (written, oral, practical)
- samples of student work
- projects
- oral and written reports
- journals and learning logs
- performance reviews
- portfolio assessments

Student performance is based on the information collected through assessment activities. Teachers use their insight, knowledge about learning, and experience with students, along with the specific criteria they establish, to make judgments about student performance in relation to prescribed learning outcomes.

There are three major types of assessment that can be used in conjunction with each other to support student achievement.

- Assessment **for** learning is assessment for purposes of greater learning achievement.
- Assessment **as** learning is assessment as a process of developing and supporting students' active participation in their own learning.
- Assessment **of** learning is assessment for purposes of providing evidence of achievement for reporting.

Assessment for Learning

Classroom assessment for learning provides ways to engage and encourage students to become involved in their own day-to-day assessment—to acquire the skills of thoughtful self-assessment and to promote their own achievement.

This type of assessment serves to answer the following questions

- What do students need to learn to be successful?
- What does the evidence of this learning look like?

Assessment for learning is criterion-referenced, in which a student's achievement is compared to established criteria rather than to the performance of other students. Criteria are based on prescribed learning outcomes, as well as on suggested achievement indicators or other learning expectations.

Students benefit most when assessment feedback is provided on a regular, ongoing basis. When assessment is seen as an opportunity to promote learning rather than as a final judgment, it shows students their strengths and suggests how they can develop further. Students can use this information to redirect their efforts, make plans, communicate with others (e.g., peers, teachers, parents) about their growth, and set future learning goals.

Assessment for learning also provides an opportunity for teachers to review what their students are learning and what areas need further attention. This information can be used to inform teaching and create a direct link between assessment and instruction. Using assessment as a way of obtaining feedback on instruction supports student achievement by informing teacher planning and classroom practice.

Assessment as Learning

Assessment as learning actively involves students in their own learning processes. With support and guidance from their teacher, students take responsibility for their own learning, constructing

meaning for themselves. Through a process of continuous self-assessment, students develop the ability to take stock of what they have already learned, determine what they have not yet learned, and decide how they can best improve their own achievement.

Although assessment as learning is student-driven, teachers can play a key role in facilitating how this assessment takes place. By providing regular opportunities for reflection and self-assessment, teachers can help students develop, practise, and become comfortable with critical analysis of their own learning.

Assessment of Learning

Assessment of learning can be addressed through summative assessment, including large-scale assessments and teacher assessments. These summative assessments can occur at the end of the year or at periodic stages in the instructional process.

Large-scale assessments, such as Foundation Skills Assessment (FSA) and Graduation Program exams, gather information on student performance throughout the province and provide information for the development and revision of curriculum. These assessments are used to make judgments about students' achievement in relation to provincial and national standards. The large-scale provincial assessment for Science 8 to 10 is the graduation program examination for Science 10, worth 20% of the final course mark. This exam is a requirement for all students taking Science 10.

Assessment of learning is also used to inform formal reporting of student achievement.

For Ministry of Education reporting policy, refer to www.bced.gov.bc.ca/policy/policies/student_reporting.htm

Assessment *for* Learning	Assessment *as* Learning	Assessment *of* Learning
Formative assessment *ongoing in the classroom* • teacher assessment, student self-assessment, and/or student peer assessment • criterion-referenced—criteria based on prescribed learning outcomes identified in the provincial curriculum, reflecting performance in relation to a specific learning task • involves both teacher and student in a process of continual reflection and review about progress • teachers adjust their plans and engage in corrective teaching in response to formative assessment	Formative assessment *ongoing in the classroom* • self-assessment • provides students with information on their own achievement and prompts them to consider how they can continue to improve their learning • student-determined criteria based on previous learning and personal learning goals • students use assessment information to make adaptations to their learning process and to develop new understandings	Summative assessment *occurs at end of year or at key stages* • teacher assessment • may be either criterion-referenced (based on prescribed learning outcomes) or norm-referenced (comparing student achievement to that of others) • information on student performance can be shared with parents/guardians, school and district staff, and other education professionals (e.g., for the purposes of curriculum development) • used to make judgments about students' performance in relation to provincial standards

For more information about assessment for, as, and of learning, refer to the following resource developed by the Western and Northern Canadian Protocol (WNCP): *Rethinking Assessment with Purpose in Mind*.

This resource is available online at www.wncp.ca

Criterion-Referenced Assessment and Evaluation

In criterion-referenced evaluation, a student's performance is compared to established criteria rather than to the performance of other students. Evaluation in relation to prescribed curriculum requires that criteria be established based on the learning outcomes.

Criteria are the basis for evaluating student progress. They identify, in specific terms, the critical aspects of a performance or a product that indicate how well the student is meeting the prescribed learning outcomes. For example, weighted criteria, rating scales, or scoring guides (reference sets) are ways that student performance can be evaluated using criteria.

Wherever possible, students should be involved in setting the assessment criteria. This helps students develop an understanding of what high-quality work or performance looks like.

Criterion-referenced assessment and evaluation may involve these steps:

Step 1	Identify the prescribed learning outcomes and suggested achievement indicators (as articulated in this IRP) that will be used as the basis for assessment.
Step 2	Establish criteria. When appropriate, involve students in establishing criteria.
Step 3	Plan learning activities that will help students gain the attitudes, skills, or knowledge outlined in the criteria.
Step 4	Prior to the learning activity, inform students of the criteria against which their work will be evaluated.
Step 5	Provide examples of the desired levels of performance.
Step 6	Conduct the learning activities.
Step 7	Use appropriate assessment instruments (e.g., rating scale, checklist, scoring guide) and methods (e.g., observation, collection, self-assessment) based on the particular assignment and student.
Step 8	Review the assessment data and evaluate each student's level of performance or quality of work in relation to criteria.
Step 9	Where appropriate, provide feedback and/or a letter grade to indicate how well the criteria are met.
Step 10	Communicate the results of the assessment and evaluation to students and parents/guardians.

KEY ELEMENTS

Key elements provide an overview of content in each curriculum organizer and suborganizer. They can be used to determine the expected depth and breadth of the prescribed learning outcomes.

Note that some topics appear at multiple grade levels in order to emphasize their importance and to allow for developmental learning.

ACHIEVEMENT INDICATORS

To support teachers in assessing provincially prescribed curricula, this IRP includes sets of achievement indicators in relation to each learning outcome.

Achievement indicators, taken together as a set, define the specific level of attitudes demonstrated, skills applied, or knowledge acquired by the student in relation to a corresponding prescribed learning outcome. They describe what evidence a teacher might look for to determine whether or not the student has fully met the intent of the learning outcome. Since each achievement indicator defines only one aspect of what is covered by the corresponding learning outcome, teachers should consider students' abilities to accomplish all of the aspects set out by the entire set of achievement indicators in determining whether or not students have fully met the learning outcome.

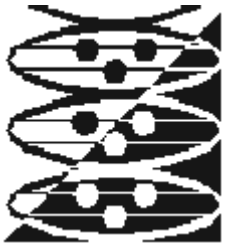
In some cases, achievement indicators may also include suggestions as to the type of task that would provide evidence of having met the learning outcome (e.g., a constructed response such as a list, comparison, analysis, or chart; a product created and presented such as a report, drama presentation, poster, letter, or model; a particular skill demonstrated such as interpreting graphs).

Achievement indicators support assessment *for* learning, assessment *as* learning, and assessment *of* learning. They provide teachers and parents with tools that can be used to reflect on what students are learning. They also provide students with a means of self-assessment and ways of defining how they can improve their own achievement.

Achievement indicators are not mandatory; they are suggestions only, provided to assist teachers in assessing how well their students achieve the prescribed learning outcomes. Achievement indicators may be useful to provincial examination development teams and inform the development of exam items. However, examination questions, item formats, exemplars, rubrics, or scoring guides will not necessarily be limited to the achievement indicators as outlined in the Integrated Resource Packages.

> Specifications for provincial examinations are available online at www.bced.gov.bc.ca/exams/specs/

The following pages contain the suggested achievement indicators corresponding to each prescribed learning outcome for the Science 8 to 10 curriculum. The achievement indicators are arranged by curriculum organizer and suborganizer for each grade; however, this order is not intended to imply a required sequence of instruction and assessment.



STUDENT ACHIEVEMENT

Grade 8

GRADE 8

KEY ELEMENTS: PROCESSES OF SCIENCE

Estimated Time: integrate with other curriculum organizers

The prescribed learning outcomes related to Processes of Science support the development of attitudes, skills, and knowledge essential for an understanding of science. These learning outcomes should not be taught in isolation, but should be integrated with activities related to the other three curriculum organizers.

Vocabulary

accuracy, compound light microscope, conclusion, control, dependent variables, experiment, hypothesis, independent variables, observation, precision, prediction, principle, procedure, scientific literacy, validity, variable

Knowledge

- metric system (SI units)
- angle measured in degrees
- elements of a valid experiment
- dependent and independent variables
- appropriate scale
- application of scientific principles in the development of technologies

Skills and Attitudes

- recognize dangers
- demonstrate emergency response procedures
- use personal protective equipment
- use proper techniques for handling and disposing of lab materials
- use safe dissection techniques
- use microscopes, triple-beam and electronic balances, thermometers, ray boxes, lenses, mirrors
- make accurate measurements using a variety of instruments (e.g., rulers, balances, graduated cylinders)
- use the Internet as a research tool
- communicate results
- use the appropriate type of graph to represent a given type of data
- use bar graphs, line graphs, pie charts, tables, and diagrams to extract and convey information
- deduce relationships between variables given a graph
- use models to demonstrate how systems operate
- apply given criteria for evaluating evidence and sources of information
- identify main points, supporting or refuting information, and bias in a science-related article or illustration
- demonstrate ethical, responsible, cooperative behaviour
- acquire and apply scientific and technological knowledge to the benefit of self, society, and the environment

GRADE 8 PROCESSES OF SCIENCE

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding prescribed learning outcome.* *Students who have fully met the prescribed learning outcome are able to:*
A1 demonstrate safe procedures	❑ identify a variety of dangers in procedures (e.g., cuts from sharp objects; burns from heating devices; shocks from misuse of electrical equipment) ❑ identify appropriate equipment for an lab activity (e.g., Bunsen burner vs. hotplate) ❑ identify and use appropriate personal protective equipment (e.g., hand and eye protection) and procedures (e.g., hair tied back, clear work area, no loose clothing, no horseplay) ❑ use proper techniques for handling and disposing of lab materials (e.g., using tongs, waste receptacles to handle and dispose of chemical or biological materials) ❑ with teacher support, describe appropriate emergency response procedures (e.g., how to use a fire extinguisher/blanket, eye wash station, first aid for cuts, knowing who to contact and how) ❑ describe safe dissection techniques involved in an actual (or virtual) dissection
A2 perform experiments using the scientific method	❑ describe the elements of a valid experiment: - formulate an hypothesis - make a prediction - identify controlled versus experimental variables - observe, measure, and record using appropriate units - interpret data - draw conclusions ❑ use information and conclusions as a basis for further comparisons, investigations, or analyses ❑ communicate results using a variety of methods

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
A3 represent and interpret information in graphic form	❑ identify the most appropriate type of graph to represent a given type of data (e.g., pie, bar, table, line graph) ❑ convey information, using appropriate units as applicable, in - bar graphs (e.g., variables in aquatic environments) - line graphs (e.g., mass versus volume) - pie charts (e.g., percentages of water distribution) - tables - diagrams (e.g., of a cell, of systems) ❑ distinguish between dependent and independent variables in a graph ❑ draw a best fit line or curve given a set of data points on a graph ❑ extrapolate and interpolate points on a graph ❑ use appropriate scale and axis to create a graph ❑ extract relevant information from pie charts, bar graphs, line graphs, and tables
A4 use models to explain how systems operate	❑ give examples of how various processes could be modelled (e.g., diagrams or demonstrations of energy transfer, refraction, wave action, phase change) ❑ construct a variety of models (e.g., a cell, the eye, wave components) ❑ describe the relationships between components of the model and what it represents
A5 demonstrate scientific literacy	❑ identify the main points in a science-related article or illustration ❑ describe the qualities of the scientifically literate person, such as - awareness of assumptions (their own and authors') - respect for precision - ability to separate fundamental concepts from the irrelevant or unimportant - recognizing that scientific knowledge is continually developing and often builds upon previous theories ❑ use given criteria for evaluating evidence and sources of information (e.g., identify supporting or refuting information and bias) ❑ explain how science and technology affect individuals, society, and the environment

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
A6 demonstrate ethical, responsible, cooperative behaviour	❑ describe and demonstrate - ethical behaviour (e.g., honesty, fairness, reliability) - open-mindedness (e.g., ongoing examination and reassessment of own beliefs) - willingness to question and promote discussion - skills of collaboration and co-operation - respect for the contributions of others
A7 describe the relationship between scientific principles and technology	❑ give examples of scientific principles that have resulted in the development of technologies (e.g., pressure—diving equipment, pumps, vacuum cleaners; optics—lasers, eyeglasses, headlights, mirrors) ❑ identify a variety of technologies and explain how they have advanced our understanding of science (e.g. microscopes for observing cell structure)
A8 demonstrate competence in the use of technologies specific to investigative procedures and research	❑ select and carefully use appropriate technologies, including - microscope - balances and other measurement tools (e.g., thermometers) - ray boxes, lenses, mirrors ❑ proficiently use the Internet as a research tool

GRADE 8

KEY ELEMENTS: LIFE SCIENCE

Estimated Time: 20-25 hours

By the end of the grade, students will have a basic understanding of the characteristics, needs, and interdependence of cells, tissues, organs, and organ systems.

Vocabulary

antibody, antigen, bacteria, cell wall, cell membrane, cells, circulatory system, chloroplast, cytoplasm, diffusion, digestive system, excretion, gas exchange, gastric juice, immune, metabolism, mitochondrion, mucus, nucleus, nutrients, organ, organ system, organelles, organisms, osmosis, pathogen, phagocytic white blood cells, reproduction, respiratory system, ribosome, tertiary defence system, tissue, toxins, vacuole, viruses, white blood cells

Knowledge

- characteristics of living things
- cell theory
- structure and function of cell organelles
- osmosis and diffusion
- relationship between cells, tissues, organs, and organ systems
- basics of various systems of the human body (i.e., respiratory, circulatory, digestive, and excretory)
- how organ systems work together to obtain and transport nutrients, remove wastes, and exchange gases
- pathogens and toxins
- immune system: primary, secondary, and tertiary defence systems

Skills and Attitudes

- use scalpels safely
- use a microscope
- demonstrate safe dissection techniques by doing an actual (or virtual) dissection
- create diagrams or models of cells and organ systems
- show respect for living things

GRADE 8 LIFE SCIENCE: CELLS AND SYSTEMS

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding prescribed learning outcome.* *Students who have fully met the prescribed learning outcome are able to:*
B1 demonstrate knowledge of the characteristics of living things	❑ identify various characteristics of living things (e.g., require energy, respond to the environment, perform gas exchange, excrete waste, reproduce) ❑ relate characteristics of living things to viruses, bacteria, plants, and animals
B2 relate the main features and properties of cells to their functions	❑ summarize cell theory (e.g., recognize that all living things are composed of cells, and all cells come from pre-existing cells) ❑ accurately list similarities and differences between cell types (plant, animal, and bacteria) ❑ describe the structure and function of cell organelles (e.g., cell membrane, nucleus, cytoplasm, mitochondrion, cell wall, chloroplast, vacuole, ribosome) ❑ recognize and name parts of a cell using a microscope ❑ relate the concepts of osmosis and diffusion to transport of materials across cell membranes
B3 explain the relationship between cells, tissues, organs, and organ systems	❑ define the terms *tissue*, *organ*, and *organ system* ❑ distinguish between cells, tissues, organs, and organ systems, based on structure and function ❑ identify the main components of the human organ systems (e.g., respiratory, circulatory, digestive, and excretory systems) ❑ describe how organ systems work together to obtain and transport nutrients, remove wastes, and exchange gases
B4 explain the functioning of the immune system, and the roles of the primary, secondary, and tertiary defence systems	❑ identify components of the primary defence systems, including skin, tears, ear wax, saliva, gastric juice, cilia, mucus ❑ identify phagocytic white blood cells as the major component of the secondary defence system ❑ identify white blood cells that produce antibodies as the major component of the tertiary defence system ❑ describe how each of the defence system components works (e.g., skin prevents bacteria from entering the body, phagocytic white blood cells engulf and destroy viruses and bacteria, and white blood cells produce antibodies that combine with antigens) ❑ describe factors that can have a negative effect on body systems, including pathogens (e.g., *E. coli*, influenza viruses, HIV) and toxins (e.g., botulism)

GRADE 8

KEY ELEMENTS: PHYSICAL SCIENCE

Estimated Time: 40-48 hours

By the end of the grade, students will have a basic understanding of forces and the properties of waves, light, and fluids.

Optics (estimated time: 20-24 hours)

Vocabulary

amplitude, angle of incidence, angle of reflection, angle of refraction, blind spot, concave, converging, convex, cornea, crest, diverging, electromagnetic radiation, energy, focal point, frequency, gamma rays, infrared, iris, lens, microwaves, normal, opaque, optic nerve, pupil, radio waves, refraction, retina, sclera, spectrum, translucent, transparent, trough, visible light, ultraviolet, wave, wavelength, X-rays

Knowledge

- waves: reflection, refraction, and energy transfer
- light: properties, transmission, reflection, absorption, refraction
- electromagnetic spectrum
- types and applications of electromagnetic radiation
- parts of the eye
- cornea-lens-retina system
- human vision and optical systems

Skills and Attitudes

- use dissection equipment safely
- use a ray box
- use a microscope
- use mirrors and lenses
- show respect for living things

KEY ELEMENTS: PHYSICAL SCIENCE

Fluids and Dynamics (estimated time: 20-24 hours)

Vocabulary

area, compression, condensation, convection, density, evaporation, expansion, force, friction, gravitation, hydraulic, magnetic, mass, melting, pneumatic, pressure, solidification, sublimation, volume, weight

Knowledge

- types of forces
- pairs of objects that apply forces on each other
- relationship between mass and weight
- balanced and unbalanced forces on a single object
- kinetic molecular theory
- solids, liquids, and gases
- changes of state
- mass, volume, and density
- relationship between pressure, temperature, heat (energy transferred due to a temperature difference), force, and area in fluids
- nature of fluids
- natural and constructed fluid systems (hydraulic and pneumatic)

Skills and Attitudes

- use balances, graduated cylinders, thermometers, spring scales
- demonstrate appropriate behaviour with syringes
- calculate density

GRADE 8 PHYSICAL SCIENCE: OPTICS

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding prescribed learning outcome.* *Students who have fully met the prescribed learning outcome are able to:*
C1 demonstrate knowledge of the behaviour of waves	❑ define *waves* and describe their characteristics, using examples and sketches ❑ demonstrate wavelength, frequency, and amplitude, with corresponding explanations ❑ describe how waves are reflected off a barrier and refracted when passing from one medium to another
C2 explain the properties of visible light	❑ connect the behaviour of waves to visible light (e.g., both waves and light reflect and refract) ❑ identify and describe properties of visible light (e.g., prism to demonstrate spectrum of colour, pinhole camera to demonstrate how light travels in a straight line) ❑ show how light is transmitted and absorbed by different materials (e.g., opaque, translucent, transparent; creation of shadows) ❑ demonstrate how visible light is reflected (e.g., relate angle of incidence and angle of reflection for curved and plane mirrors) ❑ demonstrate how visible light is refracted (e.g., bending of rays, changes of speed, diverging and converging lenses)
C3 compare visible light to other types of electromagnetic radiation	❑ differentiate radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays in terms of wavelength, frequency, and energy transferred ❑ relate different types of electromagnetic radiation to their daily lives
C4 explain how human vision works	❑ illustrate the parts of the eye, including sclera, cornea, retina, lens, optic nerve and blind spot, iris, and pupil ❑ describe the cornea-lens-retina system ❑ describe common defects in human vision (e.g., near-sighted, far-sighted) ❑ describe several ways of correcting or extending human vision (e.g., contact lenses, laser surgery, binoculars) ❑ identify similarities and differences between the eye and another optical system (e.g., microscopes, telescopes)

GRADE 8 PHYSICAL SCIENCE: FLUIDS AND DYNAMICS

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding prescribed learning outcome.* *Students who have fully met the prescribed learning outcome are able to:*
C5 explain the concept of force	❑ define *force* (push or pull of one object on another) ❑ list different types of forces (e.g., magnetic, friction, gravitational, elastic, electrical) ❑ differentiate between mass and weight ❑ describe the movement of objects in terms of balanced and unbalanced forces
C6 describe the relationship between solids, liquids, and gases, using the kinetic molecular theory	❑ outline the kinetic molecular theory ❑ distinguish between solids, liquids, and gases based on particle arrangement and motion ❑ define terms related to changes of state (e.g., temperature, heat, evaporation, condensation, solidification, melting, sublimation)
C7 determine the density of various substances	❑ for a fixed mass and temperature, describe the differences between volume and density for each of the states of matter ❑ describe the effects of changes in temperature on the density of solids, liquids, and gases (e.g., compression and expansion) ❑ conduct experiments to calculate the density of regularly shaped objects [D= m/V] and irregularly shaped objects [D = $m/(V_2-V_1)$]
C8 explain the relationship between pressure, temperature, area, and force in fluids	❑ explain pressure with reference to force and area (i.e., compression and expansion) ❑ describe the relationship between temperature, area, and pressure, with reference to the kinetic molecular theory
C9 recognize similarities between natural and constructed fluid systems (e.g., hydraulic, pneumatic)	❑ give examples of natural fluid systems (e.g., circulatory and respiratory system) and constructed fluid systems (e.g., hydraulic and air brakes) ❑ recognize the scientific principles involved in fluid systems (e.g., fluids can be compressed and flow; pressure differences can cause movement) ❑ identify possible problems in natural or constructed fluid systems (e.g., high/low blood pressure)

GRADE 8

KEY ELEMENTS: EARTH AND SPACE SCIENCE

Estimated Time: 20-22 hours

By the end of this grade, students will have understood the properties of water and its effect on the biosphere and surface of the Earth.

Vocabulary

arêtes, climate, convection, crevasse, density, deposition, erosion, erratics, eskers, fiord, freezing point, glaciers, gravity, ground water, hanging valley, horns, hydrologist, iceberg, landslide, melting, moraines, ocean current, outwash, salinity, striations, tectonic processes, tsunami, turbidity currents, weathering (chemical, biological, physical)

Knowledge

- sources of fresh water
- properties of salt water and fresh water
- effect of ocean currents and winds on regional climates
- effect of water and ice on surface features
- weathering and erosion
- evidence and effects of glaciation
- impact of waves, tides, and water flow on surface features
- productivity and species distribution in aquatic environments
- diversity of aquatic life forms

Skills and Attitudes

- use the Internet for research
- use given criteria for evaluating evidence and sources of information (e.g., identify supporting or refuting information and bias)
- relate cause to effect
- assess human impact
- show respect and sensitivity for the environment

GRADE 8 EARTH AND SPACE SCIENCE: WATER SYSTEMS ON EARTH

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding prescribed learning outcome.* *Students who have fully met the prescribed learning outcome are able to:*
D1 explain the significance of salinity and temperature in the world's oceans	❑ describe the world distribution of water (97.2% ocean, 2.8% fresh, 2.15% ice, 0.61% groundwater, 0.01 lakes and rivers, 0.001% atmosphere) ❑ identify similarities and differences between salt water and fresh water (e.g., freezing point, density) ❑ define *ocean currents* ❑ describe how winds and ocean currents influence regional climates (e.g., moderating effects)
D2 describe how water and ice shape the landscape	❑ define weathering and erosion ❑ describe how gravity directs the movement of water and ice and transports weathered materials through slow processes (rivers and glaciers) and fast processes (landslides) ❑ identify and illustrate various alpine and continental glacial features (e.g., cirques, arêtes, horns, hanging valleys, crevasses, moraines, eskers, outwash, fiords, icebergs, striations, erratics) ❑ describe how waves and tides are generated (e.g., waves: wind action; tsunamis: tectonic processes; tides: gravitational pull) ❑ describe the impact of water movement (e.g., waves, tides, river flow) on surface features (e.g., weathering, erosion, deposition)
D3 describe factors that affect productivity and species distribution in aquatic environments	❑ identify various factors that affect productivity and species distribution in aquatic environments (e.g., temperature, nutrients in the water, turbidity, currents, sunlight, salinity, pollutants, water depth, resource extraction, dams) ❑ describe how changes in aquatic environments are monitored (e.g., through the use of satellite imagery) ❑ relate human activities to the distribution of aquatic species, with specific reference to First Nations peoples in BC (e.g., harvesting technologies, preservation techniques, use of resource)

CLASSROOM ASSESSMENT MODEL

The Classroom Assessment Model outlines a series of assessment units for Science 8 to 10. These units have been structured by grade level and according to the curriculum organizers:

- Life Science
- Physical Science
- Earth and Space Science

Processes of Science are integrated throughout the other three organizers. These units collectively address all of the prescribed learning outcomes for Science 8 to 10.

This organization is not intended to prescribe a linear means of course delivery. Teachers are encouraged to address the learning outcomes in any order, and to combine and organize the units to meet the needs of their students and to respond to local requirements. Some students with special needs may have learning outcomes set for them that are modified and documented in their Individualized Education Plan (IEP). For more information, see the section on Inclusion, Equity, and Accessibility for All Learners in the Introduction to this IRP.

CONSIDERATIONS FOR INSTRUCTION AND ASSESSMENT IN SCIENCE 8 TO 10

It is highly recommended that parents and guardians be kept informed about all aspects of Science 8 to 10. For suggested strategies for involving parents and guardians, refer to the Introduction to this IRP.

Teachers are responsible for setting a positive classroom climate in which students feel comfortable learning about and discussing topics in Science 8 to 10. Guidelines that may help educators establish a positive climate that is open to free inquiry and respectful of various points of view can be found in the section on Establishing a Positive Classroom Climate in the Introduction to this IRP.

Teachers may also wish to consider the following:

- Involve students in establishing guidelines for group discussion and presentations. Guidelines might include using appropriate listening and speaking skills, respecting students who are reluctant to share personal information in group settings, and agreeing to maintain confidentiality if sharing of personal information occurs.
- Promote critical thinking and open-mindedness, and refrain from taking sides on issues where there may be more than one point of view.
- Develop and discuss procedures associated with recording and using personal information that may be collected as part of students' work for the purposes of instruction and/or assessment (e.g., why the information is being collected, what the information will be used for, where the information will be kept; who can access it—students, administrators, parents; how safely it will be kept).
- Ensure students are aware that if they disclose personal information that indicates they are at risk for harm, then that information cannot be kept confidential. For more information, see the section on Confidentiality in the Introduction to this IRP.

Classroom Assessment and Evaluation

Teachers should consider using a variety of assessment techniques to assess students' abilities to meet the prescribed learning outcomes. Tools and techniques for assessment in Science 8 to 10 can include

- teacher assessment tools such as observation checklists, rating scales, and scoring guides
- self-assessment tools such as checklists, rating scales, and scoring guides
- peer assessment tools such as checklists, rating scales, and scoring guides
- journals or learning logs
- video (to record and critique student demonstration)
- written tests, oral tests (true/false, multiple choice, short answer)
- worksheets
- portfolios
- student-teacher conferences

Assessment in Science 8 to 10 can also occur while students are engaged in, and based on the product of, activities such as

- case studies and simulations
- group and class discussions
- brainstorms, clusters, webs
- research projects
- role plays
- charts and graphs
- posters, collages, models, web sites
- oral and multimedia presentations
- peer teaching
- personal pledges or contracts

For more information about student assessment, refer to the section on Student Achievement.

Information and Communications Technology

The Science 8 to 10 curriculum requires students to be able to use and analyse the most current information to make informed decisions on a range of topics. This information is often found on the Internet as well as in other information and communications technology resources. When organizing for instruction and assessment, Science 8 to 10 teachers should consider how students will best be able to access the relevant technology, and ensure that students are aware of school district policies on Internet and computer use.

CONTENTS OF THE MODEL

Assessment Overview Table

The Assessment Overview Table provides teachers with suggestions and guidelines for assessment of each grade of the curriculum. This table identifies the domains of learning and cognitive levels of the learning outcomes, along with a listing of suggested assessment activities and a suggested weight for grading for each curriculum organizer.

Key Elements

This section includes a brief description of the unit, identifying relevant vocabulary, knowledge, skills, and attitudes.

Suggested Timeframe

The suggested time indicates the average number of hours needed to address the prescribed learning outcomes identified in that unit; it does not necessarily indicate the time required to implement the suggested instructional and assessment activities listed.

Prescribed Learning Outcomes and Suggested Achievement Indicators

Each set of prescribed learning outcomes identifies the content standards for that unit. The corresponding achievement indicators provide additional information about the expected level or degree of student performance and can be used as the basis for assessment.

Suggested Planning and Assessment Activities

Planning and assessment activities have been included for each prescribed learning outcome and set of corresponding achievement indicators. Each suggested assessment activity directly corresponds to a particular planning activity as indicated by the order and arrangement of these activities.

A wide variety of planning (instructional) activities has been included to address a variety of learning and teaching styles. The assessment activities describe a variety of tools and methods for gathering evidence of student performance.

These strategies are suggestions only, designed to provide guidance for teachers in planning and carrying out assessment to meet the prescribed learning outcomes. Criteria identified are likewise suggested only and may not always be directly referenced in a prescribed learning outcome.

Recommended Learning Resources

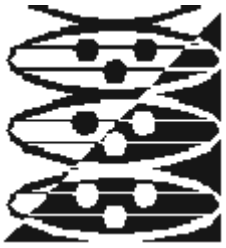
This section lists the Science 8 to 10 recommended learning resources that relate to the specific learning outcomes in each topic. The resources listed do not necessarily relate to the suggested instruction and assessment. Teachers may choose to use these resources, or they may use other locally approved resources. See the section on

Recommended Learning Resources in this IRP for more information.

As new resources are recommended, information will be posted on the ministry web site: http://www.bced.gov.bc.ca/irp_resources/lr/resource/consub.htm

Assessment Instruments

Sample assessment instruments have been included at the end of each unit, and are provided to help teachers determine the extent to which students are meeting the prescribed learning outcomes. These instruments contain criteria specifically keyed to one or more of the suggested assessment activities contained in the unit. These criteria are suggested only and may not always be directly referenced in a prescribed learning outcome.



CLASSROOM ASSESSMENT MODEL

Grade 8

GRADE 8: ASSESSMENT OVERVIEW TABLE

The purpose of this table is to provide teachers with suggestions and guidelines for formative and summative classroom-based assessment and grading of Grade 8 Science.

Curriculum Organizers/ Suborganizers	Suggested Assessment Activities	Suggested Weight for Grading	Number of Outcomes	Number of Outcomes by Domain*			
				K	U&A	HMP	AFF
PROCESSES OF SCIENCE	• integrated throughout – assessed in relation to performance tasks associated with each of the other organizers	25%	8	1	5	1	1
LIFE SCIENCE	• demonstrating • summarizing • comparing • diagramming & illustrating • observing/reporting • role playing • problem solving • written test (e.g., lab report)	20%	4	2	2	0	0
PHYSICAL SCIENCE	• demonstrating • experimenting • diagramming & illustrating • observing/reporting • researching • problem solving • modelling (e.g., lab report)	35%	9	2	6	1	0
EARTH AND SPACE SCIENCE	• explaining • diagramming & illustrating • observing/reporting • researching • modelling (e.g., field study)	20%	3	1	2	0	0
TOTALS		100%	24	6	15	2	1

* The following abbreviations are used to represent the three cognitive levels within the cognitive domain: K = Knowledge; U&A = Understanding and Application; HMP = Higher Mental Processes; AFF = Affective domain.

GRADE 8 PROCESSES OF SCIENCE

KEY ELEMENTS: PROCESSES OF SCIENCE

Estimated Time: integrate with other curriculum organizers

The prescribed learning outcomes related to Processes of Science support the development of attitudes, skills, and knowledge essential for an understanding of science. These learning outcomes should not be taught in isolation, but should be integrated with activities related to the other three curriculum organizers.

Vocabulary

accuracy, compound light microscope, conclusion, control, dependent variables, experiment, hypothesis, independent variables, observation, precision, prediction, principle, procedure, scientific literacy, validity, variable

Knowledge

- metric system (SI units)
- angle measured in degrees
- elements of a valid experiment
- dependent and independent variables
- appropriate scale
- application of scientific principles in the development of technologies

Skills and Attitudes

- recognize dangers
- demonstrate emergency response procedures
- use personal protective equipment
- use proper techniques for handling and disposing of lab materials
- use safe dissection techniques
- use microscopes, triple-beam and electronic balances, thermometers, ray boxes, lenses, mirrors
- make accurate measurements using a variety of instruments (e.g., rulers, balances, graduated cylinders)
- use the Internet as a research tool
- communicate results
- use the appropriate type of graph to represent a given type of data
- use bar graphs, line graphs, pie charts, tables, and diagrams to extract and convey information
- deduce relationships between variables given a graph
- use models to demonstrate how systems operate
- apply given criteria for evaluating evidence and sources of information
- identify main points, supporting or refuting information, and bias in a science-related article or illustration
- demonstrate ethical, responsible, cooperative behaviour
- acquire and apply scientific and technological knowledge to the benefit of self, society, and the environment

GRADE 8 PROCESSES OF SCIENCE

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding prescribed learning outcome.* *Students who have fully met the prescribed learning outcome are able to:*
A1 demonstrate safe procedures	❑ identify a variety of dangers in procedures (e.g., cuts from sharp objects; burns from heating devices; shocks from misuse of electrical equipment) ❑ identify appropriate equipment for an lab activity (e.g., Bunsen burner vs. hotplate) ❑ identify and use appropriate personal protective equipment (e.g., hand and eye protection) and procedures (e.g., hair tied back, clear work area, no loose clothing, no horseplay) ❑ use proper techniques for handling and disposing of lab materials (e.g., using tongs, waste receptacles to handle and dispose of chemical or biological materials) ❑ with teacher support, describe appropriate emergency response procedures (e.g., how to use a fire extinguisher/blanket, eye wash station, first aid for cuts, knowing who to contact and how) ❑ describe safe dissection techniques involved in an actual (or virtual) dissection
A2 perform experiments using the scientific method	❑ describe the elements of a valid experiment: - formulate an hypothesis - make a prediction - identify controlled versus experimental variables - observe, measure, and record - interpret data - draw conclusions ❑ use information and conclusions as a basis for further comparisons, investigations, or analyses ❑ communicate results using a variety of methods

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
A3 represent and interpret information in graphic form	❑ identify the most appropriate type of graph to represent a given type of data (e.g., pie, bar, table, line graph) ❑ convey information, using appropriate units as applicable, in - bar graphs (e.g., variables in aquatic environments) - line graphs (e.g., mass versus volume) - pie charts (e.g., percentages of water distribution) - tables - diagrams (e.g., of a cell, of systems) ❑ distinguish between dependent and independent variables in a graph ❑ draw a best fit line or curve given a set of data points on a graph ❑ extrapolate and interpolate points on a graph ❑ use appropriate scale and axis to create a graph ❑ extract relevant information from pie charts, bar graphs, line graphs, and tables
A4 use models to explain how systems operate	❑ give examples of how various processes could be modelled (e.g., diagrams or demonstrations of heat transfer, refraction, wave action, phase change) ❑ construct a variety of models (e.g., a cell, the eye, wave components) ❑ describe the relationships between components of the model and what it represents
A5 demonstrate scientific literacy	❑ identify the main points in a science-related article or illustration ❑ describe the qualities of the scientifically literate person, such as - awareness of assumptions (their own and authors') - respect for precision - ability to separate fundamental concepts from the irrelevant or unimportant - recognizing that scientific knowledge is continually developing and often builds upon previous theories ❑ use given criteria for evaluating evidence and sources of information (e.g., identify supporting or refuting information and bias) ❑ explain how science and technology affect individuals, society, and the environment

PRESCRIBED LEARNING OUTCOMES	SUGGESTED ACHIEVEMENT INDICATORS
A6 demonstrate ethical, responsible, cooperative behaviour	❑ describe and demonstrate - ethical behaviour (e.g., honesty, fairness, reliability) - open-mindedness (e.g., ongoing examination and reassessment of own beliefs) - willingness to question and promote discussion - skills of collaboration and co-operation - respect for the contributions of others
A7 describe the relationship between scientific principles and technology	❑ give examples of scientific principles that have resulted in the development of technologies (e.g., pressure—diving equipment, pumps, vacuum cleaners; optics—lasers, eyeglasses, headlights, mirrors) ❑ identify a variety of technologies and explain how they have advanced our understanding of science (e.g. microscopes for observing cell structure)
A8 demonstrate competence in the use of technologies specific to investigative procedures and research	❑ select and carefully use appropriate technologies, including - microscope - balances and other measurement tools (e.g., thermometers) - ray boxes, lenses, mirrors ❑ proficiently use the Internet as a research tool

GRADE 8 LIFE SCIENCE

KEY ELEMENTS: LIFE SCIENCE

Estimated Time: 20-25 hours

By the end of the grade, students will have a basic understanding of the characteristics, needs, and interdependence of cells, tissues, organs, and organ systems.

Vocabulary

antibody, antigen, bacteria, cell wall, cell membrane, cells, circulatory system, chloroplast, cytoplasm, diffusion, digestive system, excretion, gas exchange, gastric juice, immune, metabolism, mitochondrion, mucus, nucleus, nutrients, organ, organ system, organelles, organisms, osmosis, pathogen, phagocytic white blood cells, reproduction, respiratory system, ribosome, tertiary defence system, tissue, toxins, vacuole, viruses, white blood cells

Knowledge

- characteristics of living things
- cell theory
- structure and function of cell organelles
- osmosis and diffusion
- relationship between cells, tissues, organs, and organ systems
- basics of various systems of the human body (i.e., respiratory, circulatory, digestive, and excretory)
- how organ systems work together to obtain and transport nutrients, remove wastes, and exchange gases
- pathogens and toxins
- immune system: primary, secondary, and tertiary defence systems

Skills and Attitudes

- use scalpels safely
- use a microscope
- demonstrate safe dissection techniques by doing an actual (or virtual) dissection
- create diagrams or models of cells and organ systems
- show respect for living things

GRADE 8 LIFE SCIENCE: CELLS AND SYSTEMS

Prescribed Learning Outcomes

It is expected that students will:

B1 demonstrate knowledge of the characteristics of living things

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ identify various characteristics of living things (e.g., require energy, respond to the environment, perform gas exchange, excrete waste, reproduce)
- ❑ relate characteristics of living things to viruses, bacteria, plants, and animals

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Using a Think-Pair-Share strategy, have students first discuss and answer the question "What characteristics are shared by living things?" Then classify responses into categories (e.g., composed of cells, reproduce, perform gas exchange, require energy, respond to the environment, produce wastes).	• Have students write down answers to the question. Student answers should show appropriate classification of characteristics.
• Provide students with information on characteristics of plants, paramecia, viruses, and humans. Have students classify the information into categories in a chart form (see **Sample Characteristics of Living Organisms Chart** at the end of this unit). • Ask students to answer the following questions: - Is fire a living thing, according to a scientist's perspective? Explain. - Is a virus a living thing, according to a scientist's perspective? Explain.	• Assess student charts, checking for correct classification using the **Sample Characteristics of Living Organisms Chart** at the end of this unit. • Use the accompanying rubric to evaluate student responses.

Rubric

Score	Criteria
4	The response is correct, complete and detailed. It contains examples and/or elaboration to support the answer. It includes evidence of higher-order thinking.
3	The response is correct and complete. It contains examples and/or elaboration to support the answer.
2	The response is generally correct and complete. It may contain minor errors. It contains examples and/or elaboration to support the answer.
1	The response is partially correct but is incomplete and /or contains errors. It contains no examples or elaboration to support the answer.

• Using compound microscopes, have students work in pairs to identify organisms and signs of life that are observed in a pond water sample. - Purpose: to identify signs of life in a sample of pond water - Materials: microscope, glass slide, cover-slips, medicine dropper, lens paper, pond water - Procedure: • Ensure that lens, glass slide and cover-slip are clean prior to usage. • Place a drop of pond water on the clean glass slide. • Carefully place cover-slip on top, **at a 45 degree angle**, ensuring that no air bubbles form. • Observe the slide under low power, illustrating all the different organisms observed under the microscope. • Referring back to the list of characteristics of living things, identify, list and describe the signs of life that are observed. They should then write up the results of their observations.	• Assessment will be based on a lab write up, which will include diagrams of the organisms viewed, identification and description of the viewed "characteristics of life," and response to the following discussion questions: - What characteristics distinguished the living from the non-living things on the slide? - Which life processes were not evident on the slide? Explain why. - If you were to observe your slide on the following day, what changes might have occurred? Explain why.

GRADE 8 LIFE SCIENCE: CELLS AND SYSTEMS

Prescribed Learning Outcomes

It is expected that students will:

B2 relate the main features and properties of cells to their functions

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ summarize cell theory (e.g., recognize that all living things are composed of cells, and all cells come from pre-existing cells)
- ❑ accurately list similarities and differences between cell types (plant, animal, and bacteria)
- ❑ describe the structure and function of cell organelles (e.g., cell membrane, nucleus, cytoplasm, mitochondrion, cell wall, chloroplast, vacuole, ribosome)
- ❑ recognize and name parts of a cell using a microscope
- ❑ relate the concepts of osmosis and diffusion to transport of materials across cell membranes

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Inform students that the cell is a centre for production. It has special divisions for each part of the production of the product, just like a factory. Then ask students to use a piece of poster paper to make an imaginary model of how a cell works, if it were a factory. Replace all the organelles with production line sections. The organelles that need replacing are - cell membrane - cytoplasm - ribosomes - nucleus - chromosomes - vacuole - mitochondria On a separate piece of lined paper, students should make a legend explaining - the organelle and the factory section/job used to replace it - the reason why this factory job or section works like the organelle	• Use the following to assess student models: - Poster: all organelles included and clearly labelled - Legend: organelle's replacements and reason for choosing replacement

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- Have students view and diagram prepared slides of a generalized plant cell and a generalized animal cell, as well as a live specimen of a plant cell. Ask students to indicate organelles visible and magnification used for each diagram.

- Have students develop a list of similarities and differences between plant cells, animal cells, and bacteria.

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- When assessing students' diagrams, look for the following:
  - titles
  - clear labels that connect to the object with a straight line
  - indication of the power of magnification used when viewing a slide
- Have students create job advertisements that incorporate a job description for plant cells, animal cells, and bacteria. Use a rubric such as the following to assess their work:

<table>
<tr><td colspan="2">Rubric</td></tr>
<tr><td>Score</td><td>Criteria</td></tr>
<tr><td>3</td><td>The advertisement includes all key features of plant cells, animal cells, and bacteria. It includes realistic job description</td></tr>
<tr><td>2</td><td>The advertisement includes the majority of the key features of plant cells, animal cells, and bacteria. It includes a realistic job description</td></tr>
<tr><td>1</td><td>The advertisement includes some of the key features of plant cells, animal cells, and bacteria. The job description is not realistic.</td></tr>
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- To demonstrate the concepts of high and low concentrations, have a group of students stand close together in one corner of the classroom. The remaining students can be spread throughout the room. Ask students to identify which part of the room has the highest concentration of students.

  Then have students conduct experiments on diffusion, osmosis, and diffusion across a cell membrane.

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- For each experiment, students should be able to
  - use the words *high concentration* and *low concentration*, and explain the movement of water and/or substances used in this experiment
  - identify which substance *diffused* in this experiment and explain why
  - explain the concept of equilibrium and support their answers with evidence from observations
  - apply the concepts of diffusion and osmosis to explain the movement of materials into and out of a cell

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</table>

GRADE 8 LIFE SCIENCE: CELLS AND SYSTEMS

Prescribed Learning Outcomes

It is expected that students will:

B3 explain the relationship between cells, tissues, organs, and organ systems

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ define the terms *tissue*, *organ*, and *organ system*
- ❑ distinguish between cells, tissues, organs, and organ systems, based on structure and function
- ❑ identify the main components of the human organ systems (e.g., respiratory, circulatory, digestive, and excretory systems)
- ❑ describe how organ systems work together to obtain and transport nutrients, remove wastes, and exchange gases

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Show students slide or pictures of cells, tissues, organs, and systems. Emphasize the progression in levels of organization from cell to system. Example: - Cells have a particular structure and function (e.g., heart cells). - Groups of similar cells form tissues that perform a specific function (e.g., heart tissue). - Groups of tissues form organs that work together to perform a particular function (e.g., heart). - Groups of different organs work together in organ systems to perform a specific function (e.g., circulatory system). - Groups of different systems work together in an organism to perform all life processes.	• Have students develop and describe an analogy for the levels of organization from cells to organ systems. Possible analogies could involve team sports, school groups, etc. Look for indications that student analogies address - roles of differing components - levels of organization - an overall goal or function - means of communication among individuals and groups
• Determine students' prior knowledge of the human body and review as necessary. • Give student an unlined piece of paper. Have students use a ruler and pencil to divide the page into four sections. In the four sections of their page, have students write one name of the four body systems: digestive, respiratory, circulatory, and excretory systems.	• Have students write and possibly draw as much as they can remember about each system, without referring to a textbook. Assess drawings for accuracy and completeness (e.g., circulatory: heart, veins, arteries, capillaries; respiratory: lungs, diaphragm; digestive: stomach, small intestine; excretory: kidney, bladder, colon).

• To help students review and reflect on how organ systems work together to obtain and transport nutrients, remove wastes, and exchange gases, assign each student the task of preparing a personal concept map for one of the body systems studied. Using a jigsaw strategy, have students consolidate their concept maps into a group concept map, taking note of similar concepts and terms that appear in the different systems.	• Provide each group with a sheet of white poster paper. Then working around the central topic *"All about my Body,"* have students map out the concepts of the major body systems studied, being sure to indicate where cross-links or connections between different systems occur. Assess student work using the **Concept Map Rubric**. Look particularly for their ability to highlight the functions of nutrient transport, waste removal, and gas exchange.

GRADE 8 LIFE SCIENCE: CELLS AND SYSTEMS

Prescribed Learning Outcomes

It is expected that students will:

B4 explain the functioning of the immune system, and the roles of the primary, secondary, and tertiary defence systems

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ identify components of the primary defence systems, including skin, tears, ear wax, saliva, gastric juice, cilia, mucus
- ❑ identify phagocytic white blood cells as the major component of the secondary defence system
- ❑ identify white blood cells that produce antibodies as the major component of the tertiary defence system
- ❑ describe how each of the defence system components works (e.g., skin prevents bacteria from entering the body; phagocytic white blood cells engulf and destroy viruses and bacteria, and white blood cells produce antibodies that combine with antigens)
- ❑ describe factors that can have a negative effect on body systems, including pathogens (e.g., *E. coli*, influenza viruses, HIV) and toxins (e.g., botulism)

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Brainstorm - what is meant by primary defence system - what body structures might be considered part of this defence (skin, tears, ear wax, saliva, gastric juice, cilia, mucus) - how these components might work • Have students in a Think-Pair-Share activity identify - what is meant by secondary and tertiary defence systems - components of these defences and their functions	• Have students create a concept map or web showing primary, secondary, and tertiary defence systems. Look for evidence that students have - identified the important components - provided descriptions of functions - identified interrelationships correctly and completely
• Ask students to research print and electronic texts for information on how factors such as pathogens (e.g., *E. coli*, HIV, Avian flu) and toxins (e.g., botulism, harmful substances such as drugs, alcohol, nicotine) can have a negative effect on each of the body systems. • Have students create a booklet in which each page will have the following format: - description of pathogens and toxins - symptoms caused - systems affected	• When assessing student booklets, look for - complete information for each factor - all sections neat, legible with headings underlined • Have students take a test to determine their knowledge of the pathogens, toxins, and immune components studies.

• Have students create a board game that incorporates information about the body's various systems and how they interact with each other to maintain a healthy body. Have them create a plan before they make and play their game, including - brainstorming ideas (what are all the different ways) - identifying materials needed and steps to follow - making a sketch of the game Following the game, have students identify ways to improve the game or justify the original design.	• Assess student work on the board game using the **Board Game Assessment Tool** (at the end of this Grade 8 Classroom Model). Use the same evaluation tool to have students evaluate their own work. • If students suggest modifications to their design or justify their original design, have them describe strengths and weaknesses.

GRADE 8 PHYSICAL SCIENCE

KEY ELEMENTS: PHYSICAL SCIENCE

Estimated Time: 40-48 hours

By the end of the grade, students will have a basic understanding of forces and the properties of waves, light, and fluids.

Optics (estimated time: 20-24 hours)

Vocabulary

amplitude, angle of incidence, angle of reflection, angle of refraction, blind spot, concave, converging, convex, cornea, crest, diverging, electromagnetic radiation, energy, focal point, frequency, gamma rays, infrared, iris, lens, microwaves, normal, opaque, optic nerve, pupil, radio waves, refraction, retina, sclera, spectrum, translucent, transparent, trough, visible light, ultraviolet, wave, wavelength, X-rays

Knowledge

- waves: reflection, refraction, and energy transfer
- light: properties, transmission, reflection, absorption, refraction
- electromagnetic spectrum
- types and applications of electromagnetic radiation
- parts of the eye
- cornea-lens-retina system
- human vision and optical systems

Skills and Attitudes

- use dissection equipment safely
- use a ray box
- use a microscope
- use mirrors and lenses
- show respect for living things

KEY ELEMENTS: PHYSICAL SCIENCE

Fluids and Dynamics (estimated time: 20-24 hours)

Vocabulary

area, compression, condensation, convection, density, evaporation, expansion, force, friction, gravitation, hydraulic, magnetic, mass, melting, pneumatic, pressure, solidification, sublimation, volume, weight

Knowledge

- types of forces
- pairs of objects that apply forces on each other
- relationship between mass and weight
- balanced and unbalanced forces on a single object
- kinetic molecular theory
- solids, liquids, and gases
- changes of state
- mass, volume, and density
- relationship between pressure, temperature, heat (energy transferred due to a temperature difference), force, and area in fluids
- nature of fluids
- natural and constructed fluid systems (hydraulic and pneumatic)

Skills and Attitudes

- use balances, graduated cylinders, thermometers, spring scales
- demonstrate appropriate behaviour with syringes
- calculate density

GRADE 8 PHYSICAL SCIENCE: OPTICS

Prescribed Learning Outcomes

It is expected that students will:

C1 demonstrate knowledge of the behaviour of waves

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ define *waves* and describe their characteristics, using examples and sketches
- ❑ demonstrate wavelength, frequency, and amplitude, with corresponding explanations
- ❑ describe how waves are reflected off a barrier and refracted when passing from one medium to another

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Use a ripple tank and oscillating motor to generate waves in water. Have students snap a long rope, spring, or slinky to observe wave shape and motion. Have students sketch and label the component parts of a wave: crest, trough, amplitude, and wavelength. • Use a pendulum to demonstrate the concepts of frequency and amplitude. Ask students to suggest how frequency can be observed and measured in a pendulum and other devices (e.g., merry-go-round, flashing traffic lights, dial clock). Have students measure the frequency of different lengths of a pendulum by counting repetitions, measuring time, and using the formula *frequency = # reps/time interval*. They can then use this formula to determine the frequency of other items (e.g., old turntables, heart rate).	• Given diagrams of different wave shapes and sizes, assess students on their ability to measure - the size of various wave amplitudes based on height of a crest or depth of a trough - the magnitude of different wavelengths, based on the distance between successive corresponding points of motion • Using everyday phenomena as examples, students should use the appropriate equation to perform specific calculations of frequency, given - number of repetitions, oscillations or repeated motions of a device - the time taken for these repetitions to occur
• Have two students stretch out a slinky; use back-and-forth arm motion (parallel to the slinky) to generate compression waves and side-to-side motion (perpendicular to the slinky) to generate transverse waves. They should vary the rate of side-to-side motion, and observe the effects on as well as the inverse relationship between wavelength and frequency. Then, have them tie a slinky to a string and attach the string to a fixed object, observing the effects of a wave passing from slinky to string (i.e., refraction and reflection) and reflecting back from the fixed end.	• Have students prepare lab reports describing qualitatively the various effects on wave motion in a rope/slinky. These effects should include - reflection from a fixed end - refraction and reflection through different media - rate of motion on frequency and wavelength

• Use a ripple tank and a straight-wave generator to push parallel waves toward flat and curved (parabolic) barriers as well as regions of deep and shallow water in the tank. Have students sketch the change in pattern of waves as they reflect or refract in each situation.	• Assess students on their ability to sketch simple patterns of waves - reflecting off a flat barrier at the same but opposite angle as the approaching waves - reflecting to a *focal* point off a concave barrier - becoming shorter and changing direction correctly when refracting into shallow water - becoming longer and changing direction correctly when refracting into deep water
• As an extension, have students formulate ideas on how the frequency of wheel rotation can be used to determine a cyclist's speed.	• Consider the student's ability to determine the circumference of a bicycle tire and use this information to determine the distance travelled per second (speed) based on the number of tire rotations per second (frequency). This could be done as a lab report or a problem-solving assignment in which frequency of rotation as well as wheel circumference are provided.

GRADE 8 PHYSICAL SCIENCE: OPTICS

Prescribed Learning Outcomes

It is expected that students will:

C2 explain the properties of visible light

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ connect the behaviour of waves to visible light (e.g., both waves and light reflect and refract)
- ❑ identify and describe properties of visible light (e.g., prism to demonstrate spectrum of colour, pinhole camera to demonstrate how light travels in a straight line)
- ❑ show how light is transmitted and absorbed by different materials (e.g., opaque, translucent, transparent; creation of shadows)
- ❑ demonstrate how visible light is reflected (e.g., relate angle of incidence and angle of reflection for curved and plane mirrors)
- ❑ demonstrate how visible light is refracted (e.g., bending of rays, changes of speed, diverging and converging lenses)

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Use a spectroscope or prism to demonstrate how visible light from the Sun can be broken into component colours (red, orange, yellow, green, blue, indigo, violet). Explain that these colours represent different light wavelengths and frequencies (i.e., red – long wavelength, low frequency; violet – short wavelength, high frequency).	• Assess the ability of students to sketch the component colours of visible light - in the correct order - indicating relative size of wavelengths for each colour - describing the inverse relationship between wavelength and frequency for the light spectrum
• Place various materials on an overhead projector to demonstrate their abilities to transmit light, including - a block of wood - thin and thick blocks of paraffin wax - rectangular prisms of tinted, frosted, and clear glass or Plexiglas - petri dishes of water, milk Have students create a table listing those materials that are opaque, translucent, and transparent. After completing the table, have students define: *transparent*, *translucent*, and *opaque* in their own words/diagrams.	• Determine if the materials were correctly arranged according to their opacity. Assess the ability of students to differentiate the terms by performing a lab quiz where they - aim a light source (such as a ray box) at different materials - clearly indicate the relative opacity of each material

• Have groups construct pinhole cameras: take two pieces of cardboard, and cut a 3 cm-wide hole in the centre of one. Tape a piece of aluminium foil over the hole and carefully poke a hole in the middle with a needle. Use clamps to attach both cardboard pieces to a metre stick, about 50 cm apart, and aim the apparatus (foil piece in front) directly toward the Sun until its image appears on the second cardboard piece. Have students construct simple diagrams showing how the Sun's image appears on the second cardboard piece. As an extension, have students compare the ratio of object/image distance to object/image height for a pinhole camera. Explain the equivalence of these ratios, that is, d(object)/d(image) = h(object)/h(image)	• Have students draw accurate ray diagrams of images produced by pinhole cameras. Such diagrams should include - straight lines to indicate paths of light from object through pinhole to screen - the correct orientation of the image relative to the object They should be able to infer from their diagrams - that light travels in straight lines - that the image produced is upside-down - the relative height of the image compared to the object • Given appropriate values, have students calculate image height, given object size, distance from the camera and length of camera (image distance).
• Ask students to explain how contact lenses and glasses help people with limited vision to see objects more clearly. Discuss with the class how light changes speed (like a wave) when travelling from one material into another, thereby changing direction and refracting. Have students use ray boxes to send a light ray into a semicircular prism at various angles to observe refraction from air to glass and glass into air. • Have students examine a magnifying glass and ask them to describe the lens shape. Explain to students that this shape is convex. Instruct students to hold the glass up to their eye, then slowly increase the distance between the instrument and their face and describe what happens. Demonstrate how a convex lens can project an inverted image of a lit candle (or lightbulb) onto a screen. Have students perform a simple lab exercise, using a ray box to send several parallel light rays into a converging (convex) lens and observe the pattern of refraction. Ask them to repeat this procedure for a diverging (concave) lens.	• Students should be able to prepare presentations on refraction that include - accurate drawings showing boundary between the two materials, incident and refracted rays, normal line, as well as incident and refracted angles - concluding statements comparing angles of incidence and refraction for light travelling from air into a denser medium and vice versa • Assess students on their ability to - make accurate drawings to illustrate convergence and divergence of refracted rays for the respective lenses - explain the inverted nature of images produced by a convex lens when an object is placed beyond the focal point of the lens - explain that no image is produced when the object is placed at the focal point of the lens - explain that when an object is placed within the focal length of a convex lens, an erect image occurs, and that this image cannot be projected onto a screen - explain that although concave lenses produce smaller images, those images cannot be projected onto a screen

• Ask students to predict how a beam of light will act when it hits a plane mirror at various angles. Have students design a simple experiment using a ray box and a plane mirror to test their predictions.	• Students should be able to prepare reports on their experiment. Accurate drawings should be constructed and include the following: - reflecting surface - incident ray - reflected ray - normal line - incident angle - reflected angle (equal to incident angle)
• Ask students to explain the purpose of anti-theft store mirrors and side-view mirrors in large vehicles. (These are convex mirrors that produce small erect images and allow the observer to gain a larger view of an area.) Provide students with a concave mirror. Instruct them to hold the mirror up to their face then slowly increase the distance between the instrument and their face and describe what happens. Demonstrate how a concave mirror can project an inverted image of a lit candle (or lightbulb) onto a screen. Have students perform a simple lab exercise, using a ray box, to send several parallel light rays into a converging (concave) mirror and observe the pattern of refraction. Ask them to repeat this procedure for a diverging (convex) mirror.	• Assess students on their ability to - make accurate drawings to illustrate convergence and divergence of reflected rays for the respective mirrors - explain the inverted nature of images produced by a concave mirror when an object is placed beyond the focal point of the mirror - explain that no image is produced when the object is placed at the focal point of the mirror - explain that when an object is placed within the focal length of a concave mirror, an erect image occurs, and that this image cannot be projected onto a screen - explain that although convex mirrors produce smaller images, those images cannot be projected onto a screen Students are also expected to make concluding statements correlating patterns of reflection and refraction for both converging and diverging lenses and mirrors.

GRADE 8 PHYSICAL SCIENCE: OPTICS

Prescribed Learning Outcomes

It is expected that students will:

C3 compare visible light to other types of electromagnetic radiation

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ differentiate radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays in terms of wavelength, frequency, and energy transferred
- ❑ relate different types of electromagnetic radiation to their daily lives

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Ask students to consider what forms of energy are given off by the Sun. After mentioning visible light, heat, and possibly ultra-violet, explain that visible light and heat transmit energy our bodies can detect, and are part of a broader range of energy types called the electromagnetic spectrum. Discuss with students that this spectrum of energy ranges from radio waves up to gamma radiation, and corresponds with increasing frequency and decreasing wavelength.	• Students should be able to list all forms of the spectrum in order from lowest to highest energy transferred, and describe how wavelength and frequency changes with increasing energy. Students should explain that we can only detect small portions of the spectrum without special instruments (e.g., we can detect visible light with our eyes and feel infrared on our skin).
• Demonstrate instruments/materials that can emit or detect different electromagnetic spectra: - Crooke's Radiometer (infra-red) - black light source on laundry soap and other phosphorescent materials (ultra-violet) - x-ray photographs - portable radio with antenna Discuss other sources/uses of electromagnetic energy, including - telecommunications (radio waves) - infra-red scanners - radar detection - ovens, greenhouses (infrared) - telescopes (all types)	
• Have students construct concept maps linking different forms of electromagnetic energy with the devices/materials used to detect or emit them.	• Assessment of the maps should include the following criteria: - the central theme of electromagnetic radiation and its component parts - devices/sources linked to the type of radiation they emit - devices/materials linked to the type of radiation they detect

GRADE 8 PHYSICAL SCIENCE: OPTICS

Prescribed Learning Outcomes

It is expected that students will:

C4 explain how human vision works

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ illustrate the parts of the eye, including sclera, cornea, retina, lens, optic nerve and blind spot, iris, and pupil
- ❑ describe the cornea-lens-retina system
- ❑ describe common defects in human vision (e.g., near-sighted, far-sighted)
- ❑ describe several ways of correcting or extending human vision (e.g., contact lenses, laser surgery, binoculars)
- ❑ identify similarities and differences between the eye and another optical system (e.g., microscopes, telescopes)

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Have students perform an eyeball dissection either as a classroom lab or a virtual online exercise. Have them identify the main parts, including: sclera, cornea, retina, lens, optic nerve and blind spot, iris and pupil. Ask students to research the function of each part.	• Have students prepare a lab report. Provide a task definition by adapting the sample provided at the end of the Classroom Model for this grade to include the following criteria: - a labelled diagram of the eye - information on how the individual parts work Assess using the Lab Report Scoring Rubric, also provided at the end of the Classroom Model for this grade
• Ask students to refer to their notes on convex lenses; have them describe how a candle-magnifying glass-screen system is similar to that in the eye. In particular, ask students to explain how the lens focuses light, and where this light must be focused.	• Assess student notes to determine if the notes explain the process and its importance in allowing light to focus on the retina.

• Have student groups conduct research on a particular vision defect, with choices including (but not limited to) near-sightedness and far-sightedness.	• Assessment should be based on the presentation of ideas, which may include posters, formal reports, demonstrations, and/or forums. Look for evidence that presentations - define the defect - describe the mechanics that produce the defect - explain the methods used to correct or limit the defect - demonstrate the skills of cooperation - use models to explain how the systems operate - demonstrate attributes of scientific literacy - describe relationships between scientific principles and technology - demonstrate thorough and relevant research, citing sources
• Divide the class into two groups, one to take apart an old microscope and/or telescope, the other to examine the parts of a model of the eye. Groups should display and label the parts of the microscope and eyes on poster board, and describe the function of the major parts, (e.g., microscope: all lenses and mirrors, body tube, focus adjustment knob(s); eye: sclera, cornea, retina, optic nerve, iris, and pupil). Then create a T-chart, asking students to identify the similarities and differences.	• Assess group work according to the following criteria: - describe the functions of the major parts - list obvious similarities and differences - displays and labels are relevant and accurate - groups work cooperatively

GRADE 8 PHYSICAL SCIENCE: FLUIDS AND DYNAMICS

Prescribed Learning Outcomes

It is expected that students will:

C5 explain the concept of force

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ define *force* (push or pull of one object on another)
- ❑ list different types of forces (e.g., magnetic, friction, gravitational, elastic, electrical)
- ❑ differentiate between mass and weight
- ❑ describe the movement of objects in terms of balanced and unbalanced forces

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Brainstorm with students a definition of force (push or pull). Then demonstrate different types of force (magnetic, friction, gravitational, and electrical). Demonstrations could include - pushing a book - dropping a ball - bouncing a ball - pulling a cart with a spring scale, measure the force - using a magnet and nail - rubbing a vinyl strip with polyester to show it attracts small bits of paper - squeezing a ball or balloon - rolling a ball (push it from the side, push it from the part closest to you, and push it from the part farthest from you)	• Ask students to write the definition of force in their science journals and record all observations of the various demonstrations. • Have students write reports containing diagrams of observations of magnetic attraction and repulsion, electrical attraction and repulsion, friction and gravity (both for vertical and horizontal movements.) They should use the definition of force to state why and when they observed forces. Diagrams should show what objects are pushing or pulling on other objects. Diagrams should be carefully drawn and labelled, and arrows should indicate the force and motion—longer arrow means greater force or speed. Student reports should answer the question "What do these forces do? (they all cause motion to change—push away or pull toward). Report conclusions should address the question, "What are the effects of a force?" (answer: change motion—start motion, speed up motion, slow down motion, stop motion, change direction, and change shape).

• Define friction as a force that opposes motion (include air resistance). Then ask students to conduct an experiment to show - gravity—let a ball fall vertically, then toss a ball from same height; describe their paths and measure the time it takes to fall to the floor - friction—slide a book across a table; slide a ball across a table; slide a 10g block of wood then ice across the table (ensure that the initial speed for each slid object is the same)	• Ask students to prepare reports (can be marked out of 22) containing observations, diagrams, and answers to questions, including - time to fall (4 points); question: Which goes further and why? - sliding book and ball (4 points); question: Which takes longer and goes further and why? - sliding block and ice (5 points); questions: Which takes longer and goes further and why? Which is easier to walk on—a sidewalk or a sheet of ice? Why? (3 points) - Drop a sheet of paper then crumple it and drop from the same height. Which takes longer? Why? (2 points) Conclusions should contain the definition of friction and list the types of friction (4 points).
• Have students conduct an experiment where known masses are weighed with a spring scale to determine the relationship between mass and weight.	• As students conduct experiments, ensure that they - follow procedures - collect and organize appropriate data - use equipment safely • Ask students to write reports containing data of mass, weight, and weight-to-mass ratio (three columns). Using the ratio, they should indicate the relationship between weight and mass. They should also include units.
• Ask students to conduct activities (demonstration or experiment) showing balanced and unbalanced forces on a single object. For example, students could slide an object (wheels and no wheels) at a steady motion and a changing motion and measure the forces with a scale. They could also conduct activities that involve holding an object with a scale, etc.	• Have students draw diagrams that use arrows of various lengths to illustrate balanced and unbalanced forces on a single object (a longer arrow means a greater force). Ask them to explain what happens to the motion of an object when forces are balanced (motion remains the same) versus unbalanced (motion changes).

GRADE 8 PHYSICAL SCIENCE: FLUIDS AND DYNAMICS

Prescribed Learning Outcomes

It is expected that students will:

C6 describe the relationship between solids, liquids, and gases, using the kinetic molecular theory

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ outline the kinetic molecular theory
- ❑ distinguish between solids, liquids, and gases based on particle arrangement and motion
- ❑ define terms related to changes of state (e.g., temperature, heat, evaporation, condensation, solidification, melting, sublimation)

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Define for students the terms *solid* (fixed volume and shape), *liquid* (fixed volume and shape of container) and *gas* (volume of container and shape of container). Ask students to look around to identify types of matter in the classroom. Brainstorm and list on the board these objects and state whether they are solid, liquid, or gas.	• introductory activity (no assessment required)
• Place the maximum number of marbles on a small Petri dish so that the marbles cannot move (solid). Then, place the same number of marbles in a larger Petri dish, so that they move around (liquid). Finally, place the same number of marbles in a large tank (gas). • Have students create drawings of solids, liquids, and gases using kinetic molecular theory and identifying each state (phase).	• Ask students to describe what is happening to the marbles in each of the situations. Students should be able to indicate which model represents solid, liquid, and gas. • Ask students to write definitions of solid, liquid, and gas in their science journals, and restate in their own words the relationship between the three states (solid, liquid, and gas). Student should then draw diagrams showing how the particles move, using arrows to indicate motion and spacing of particles for a specific substance. Assess for accuracy.

• Define for students the terms related to changes of state (e.g., temperature, heat, evaporation, condensation, solidification, melting, sublimation) and give examples for each. • To help students more fully appreciate the significance of changes of state in relation to kinetic molecular theory, introduce the concepts of *endothermic* and *exothermic*, and explain their meaning.	• Ask students to write in their science journals definitions of temperature, heat (energy transferred due to a temperature difference), evaporation, condensation, solidification, melting, and sublimation. • Have students construct concept maps to show how the terms and processes are connected. Concept maps should identify - states of matter - processes that link states - whether energy is added or removed for the process to take place

GRADE 8 PHYSICAL SCIENCE: FLUIDS AND DYNAMICS

Prescribed Learning Outcomes

It is expected that students will:

C7 determine the density of various substances

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ for a fixed mass and temperature, describe the differences between volume and density for each of the states of matter
- ❑ describe the effects of changes in temperature on the density of solids, liquids, and gases (e.g., compression and expansion)
- ❑ conduct experiments to calculate the density of regularly shaped objects [D= m/V] and irregularly shaped objects [$D = m/(V_2-V_1)$]

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Define *volume* and *density*. Provide students with the formula for calculating volume (length x width x height), and the formula for density (mass/volume). Then have students calculate the mass and volume for various regular and irregular materials and/or substances (e.g., rocks, blocks, cubes). Volume of other shapes can be found by measuring water displacement.	• Give students a lab quiz, where they are expected to measure or calculate mass and volume of a variety of objects, and calculate the density of each. Look for evidence that - answers are well organized and correct - calculations show proper methodology - measurements or calculations are clearly demonstrated - proper units are used - work is done collaboratively
• Demonstrate for students how volume changes as temperature and/or phase changes (e.g., puts chunks of dry ice in a balloon and watch it over time; place a balloon outside in cold weather and watch it shrink; place water in a pop bottle to a certain level, and then freeze it; watch a bag of popcorn in a microwave).	• Ask students to describe in their journals what they see during the experiments in terms of change in volume. Look for evidence that student journals show that as temperature increases so does volume (except for water changing from solid to liquid). • Using sample data, have students calculate density before and after a temperature change. Calculations should clearly indicate as volume increases density decreases, and vice versa.

GRADE 8 PHYSICAL SCIENCE: FLUIDS AND DYNAMICS

Prescribed Learning Outcomes

It is expected that students will:

C8 explain the relationship between pressure, temperature, area, and force in fluids

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ explain pressure with reference to force and area (i.e., compression and expansion)
- ❑ describe the relationship between temperature, area, and pressure, with reference to the kinetic molecular theory

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Define pressure (force/area) and give several examples: balloon, squirt gun, squeeze bag, football (deflated and blown up). Ask students to explain what is happening, describing it in terms of kinetic molecular theory. • Have students half fill a balloon, and predict what will happen if they squeeze the balloon (pressure will increase). Then have them conduct the experiment, describing what happened and relating it to their predictions.	• Ask students to explain (using detailed diagrams) what happens when a force is exerted against solids, liquids and gases. Students should clearly indicate that compression or expansion cause an increase or decrease in pressure.
• Ask students a series of questions to explore their understanding of the relationship between temperature and pressure at a constant volume: - Why does pressure increase when an object is heated? - Why should tires be under-inflated in the summer and over-inflated in the winter?	• Answers to questions should clearly indicate that - the particles go faster and make more collisions with their container, and these collisions cause the pressure to increase - when the temperature is high in the summer, the particles go faster and the pressure increases, thus it is necessary to remove air from a tire to maintain proper tire pressure; conversely, in the winter particles move slower and pressure decreases, thus it is necessary to add more air to the tire to maintain proper tire pressure

GRADE 8 PHYSICAL SCIENCE: FLUIDS AND DYNAMICS

Prescribed Learning Outcomes

It is expected that students will:

C9 recognize similarities between natural and constructed fluid systems (e.g., hydraulic, pneumatic)

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ give examples of natural fluid systems (e.g., circulatory and respiratory system) and constructed fluid systems (e.g., hydraulic and air brakes)
- ❑ recognize the scientific principles involved in fluid systems (e.g., fluids can be compressed and flow; pressure differences can cause movement)
- ❑ identify possible problems in natural or constructed fluid systems (e.g., high/low blood pressure)

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Ask students to research examples of natural and human-made fluid systems and where they occur. Students should use a variety of print and Internet sources to complete their research.	• Have student groups prepare presentations (e.g., models, posters, PowerPoint) that show natural fluids system and constructed fluid systems. Look for evidence that presentations - explain expansion, compression, fluid flow, and possible problems associated with these systems - demonstrate the skills of cooperation - use models to explain how the systems operate - demonstrate attributes of scientific literacy - describe relationships between scientific principles and technology - demonstrate thorough and relevant research, citing sources

GRADE 8 EARTH AND SPACE SCIENCE

KEY ELEMENTS: EARTH AND SPACE SCIENCE

Estimated Time: 20-22 hours

By the end of this grade, students will have understood the properties of water and its effect on the biosphere and surface of the Earth.

Vocabulary

arêtes, climate, convection, crevasse, density, deposition, erosion, erratics, eskers, fiord, freezing point, glaciers, gravity, ground water, hanging valley, horns, hydrologist, iceberg, landslide, melting, moraines, ocean current, outwash, salinity, striations, tectonic processes, tsunami, turbidity currents, weathering (chemical, biological, physical)

Knowledge

- sources of fresh water
- properties of salt water and fresh water
- effect of ocean currents and winds on regional climates
- effect of water and ice on surface features
- weathering and erosion
- evidence and effects of glaciation
- impact of waves, tides, and water flow on surface features
- productivity and species distribution in aquatic environments
- diversity of aquatic life forms

Skills and Attitudes

- use the Internet for research
- use given criteria for evaluating evidence and sources of information (e.g., identify supporting or refuting information and bias)
- relate cause to effect
- assess human impact
- show respect and sensitivity for the environment

GRADE 8 EARTH AND SPACE SCIENCE: WATER SYSTEMS ON EARTH

Prescribed Learning Outcomes

It is expected that students will:

D1 explain the significance of salinity and temperature in the world's oceans

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ describe the world distribution of water and illustrate the water cycle (97.2% ocean; 2.8% fresh; 2.15% ice, 0.61% groundwater, .01 lakes and rivers, .001% atmosphere)
- ❑ identify similarities and differences between salt water and fresh water (e.g., freezing point, density)
- ❑ define ocean currents
- ❑ describe how winds and ocean currents influence regional climates (e.g., moderating effects)

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• To assess the state of students' background knowledge of the distribution of water, use strategies such as - think, pair, share - anticipation guide (e.g., some true/false questions and discussion)	• Have each student label and annotate (with icons and words) a world map to indicate water distribution. Ensure they include: oceans, fresh water, ice, ground water, lakes and rivers, atmosphere.
• Demonstrate the differences between fresh and salt water by - comparing the buoyancy of the same floating object in containers of each type of water - comparing temperatures of two identical samples of slush (e.g., made by crushing ice in a blender), one of which has an added quantity of salt (calcium chloride, or simple table salt) - demonstrating differences in boiling point Follow with a class discussion about the implications of these findings for the water cycle and aquatic environments.	• Have students produce a T-chart or Venn diagram to compare properties of two given samples of water – one fresh and one salt. Assess their work for - understanding differences between freezing point and boiling point - understanding differences in buoyancy and density - number of examples of implications
• Discuss with students the term *convection*. Consider using a commercial convection glassware tube or similar apparatus to demonstrate how dye moves when water is heated.	• Ask students to record predictions of what will happen when the demonstration is conducted. Then have them record observations and generate an explanation of what they saw. Assess their work using the following rubric: **Score** | **Criteria** 4 | includes detailed observations with clear, relevant graphics; explanation uses the kinetic molecular theory to explain density differences and account for convection

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<tr><td>3</td><td>includes full details of observations; explanation to account for convection movement refers to both falling of cool water and rising of heated water and refers to kinetic molecular theory</td></tr>
<tr><td>2</td><td>includes some details of observations, though labelling or presentation of graphics may be unclear; explanation refers to both falling of cool water and rising of heated water</td></tr>
<tr><td>1</td><td>includes basic description of events; may be incomplete or unclear, with poorly drawn graphics; explanation is minimal or lacking (e.g., explanation may identify heat as cause of movement)</td></tr>
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<td>• Provide notes on ocean currents and their relationships to winds and climate. Discuss these briefly, and have students read materials dealing with currents and gyres (including how and why ocean currents form).</td>
<td>• Have students use a journal to record in their own words the material they have read. Assess their journal entries, looking at the extent to which these
- highlight key points (main ideas)
- identify supporting details, where relevant
- describe cause and effect relationships (determining factors)</td>
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<td>• Assign students in groups to find out information about a particular gyre (e.g., the North Atlantic, South Atlantic, North Pacific, South Pacific, South Indian gyres) and identify
- the gyre's location
- the currents that make up the gyre
- two cities at different points on the gyre
- mean temperature and precipitation data for each of their cities
Once the information is assembled, conduct a jigsaw activity by reconstituting groups. Each new group needs to
- share knowledge of all the gyres, their currents, and their (10) cities
- develop explanations for the data that they have about each city's climate (temperature and rainfall)</td>
<td>• Have each of the final groups from the jigsaw activity produce a world map on which they locate and label
- the gyres
- the cities
- the currents
Students should also find a way to represent the city data on their maps, and generate an explanation for the differences and or similarities. To assess student understanding, consider how well each group
- created a map that is correct and complete
- explained the differences in their city data with reference to currents and gyres
- noticed any discrepancies in the data that cannot be easily explained with reference to ocean currents and gyres (e.g., a periodic effect such as El Niño, or an effect caused by atmospheric conditions such as a prevailing wind)</td>
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GRADE 8 EARTH AND SPACE SCIENCE: WATER SYSTEMS ON EARTH

Prescribed Learning Outcomes

It is expected that students will:

D2 describe how water and ice shape the landscape

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ define *weathering* and *erosion*
- ❑ describe how gravity directs the movement of water and ice and transports weathered materials through slow processes (rivers and glaciers) and fast processes (landslides)
- ❑ identify and illustrate various alpine and continental glacial features (e.g., cirques, arêtes, horns, hanging valleys, crevasses, moraines, eskers, outwash, fiords, icebergs, striations, erratics)
- ❑ describe how waves and tides are generated (e.g., waves: wind action; tsunamis: tectonic processes; tides: gravitational pull)
- ❑ describe the impact of water movement (e.g., waves, tides, river flow) on surface features (e.g., weathering, erosion, deposition)

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Introduce the terms *weathering* and *erosion*. Then, take students for a walk outside the school to examine the effects of different types of weathering on various objects (e.g., cracks, exposure of aggregate, staining of concrete by metal, plants growing through cracks in pavement). • Demonstrate erosion by using a sand table or trough filled with sand and running water. Have students brainstorm ideas on how water and ice cause weathering and erosion.	• Ask students to describe and explain (e.g., using diagrams, point form notes) what they have seen. Student explanations should include how - water and ice can break apart rock in place (weathering) - weathered material is transported by water and/or ice (erosion)
• Give students a list of terms related to glaciation (e.g., till, arêtes, horns, moraines, eskers, striations, erratics). Ask students to conduct research to identify the meanings of terms, find examples, and determine causes of formation.	• Give students a picture or diagram of a glacier or glaciated region, along with a separate list of features. Student research should be sufficiently thorough that they are able to identify, correctly label, and annotate each feature, and explain how it was formed (i.e., erosion vs. deposition).

• Brainstorm how waves are generated (see Physical Science—Optics). Using a glass tank of shallow water elevated on legs, have students - drop a marble in the water - push a block of wood back and forth in the water - tap carefully on the bottom of the tank with their fingers - blow on the surface of the water In each demonstration, ask students, "What is happening" and as a followl-up, "What are you simulating?"	• Ask students to describe what they have seen during the wave demonstration. Students should - point out the tectonic processes involved, including horizontal and vertical processes - indicate that wind, earthquakes, and debris falling into a body of water (e.g., landslides, meteorites) generate waves
• Brainstorm how tides are generated (effect of moon and Sun). Students should suggest why tides go up and down. (Point out that the Earth rotates and the moon revolves around the Earth.)	• Ask students to indicate on a diagram the position of the moon and Sun in relation to high and low tides, and the differences between those tides (with reference to their positions).
• Give students the following case study: *You are a geologist assigned to study a BC town where waves, tides, and/or river flow are affecting surface features. The town council wants to know what they must do to limit the adverse impact of weathering and erosion.*	• Ask students to develop a presentation to the town council. Presentations should - identify problem areas (e.g., erosion on cliffs, outside river banks, danger of tsunamis) and predict potential consequences - provide suggestions on how to minimize the effects (e.g., reinforcing unstable banks on a cliff, building breakwaters, create early warning systems) - explain how science and technology can be used and scientific principles applied in this situation - separate fundamental concepts from the irrelevant or unimportant (e.g., a tsunami warning might not be important to an interior town)

GRADE 8 EARTH AND SPACE SCIENCE: WATER SYSTEMS ON EARTH

Prescribed Learning Outcomes

It is expected that students will:

D3 describe factors that affect productivity and species distribution in aquatic environments

Suggested Achievement Indicators

The following set of indicators may be used to assess student achievement for the prescribed learning outcome above. Students who have fully met the prescribed learning outcome are able to:

- ❑ identify various factors that affect productivity and species distribution in aquatic environments (e.g., temperature, nutrients in the water, turbidity, currents, sunlight, salinity, pollutants, water depth, resource extraction, dams)
- ❑ describe how changes in aquatic environments are monitored (e.g., through the use of satellite imagery)
- ❑ relate human activities to the distribution of aquatic species, with specific reference to First Nations peoples in BC (e.g., harvesting technologies, preservation techniques, use of resource)

PLANNING FOR ASSESSMENT	ASSESSMENT STRATEGIES
• Have students research a given aquatic species (e.g., mussels, salmon, kelp, duck). Ask students to answer questions such as: - Where does each species live? - How abundant are they? - What are their predators? - How do they obtain nutrients? - How would each species respond to changes in their aquatic environment? - How would this environment be affected if their species disappeared? • Have students share research on related organisms, and present their combined information on a poster, which includes a diagram of the aquatic environment (e.g., intertidal).	• Assess the extent to which students are able to - connect information about species to previously learned information on aquatic environments (e.g., temperature, turbidity) - show interrelationships among species - identify factors that would affect productivity - explain the interdependence of the various species and their environments
• Have students read articles dealing with one or more methods by which aquatic environments are monitored.	• Have students evaluate the article they read, identifying - the main points of the article - author's assumptions - the scientific principles used in the technology
• Provide students with historical and current information on the use of aquatic resources by First Nations peoples in BC. Resources could include information on whales, salmon, eulachon, shellfish (clams, oysters, and abalone), seals, otter, sea urchins, whitefish, white sturgeon. Information should cover the following topics: - season and location obtained	• Have students do a group self-evaluation of their storyboards and presentations using the **Storyboard and Oral Presentation: Group Self-Evaluation Scale**. Give students the rubric in advance so they are familiar with the criteria for the self-evaluation.

- method of capture - preservation techniques - uses - concerns with this resource today • Have students work in groups of 3 - 4 to put together a 'storyboard' of several frames that outlines the sequence of events that occur during the capture and use of the resource. Students should include in their presentations the significance of the resource for one or more Aboriginal communities. • Students could supplement the information with their own research, perhaps by contacting the nearest First Nations community.	

SAMPLE CHARACTERISTICS OF LIVING ORGANISMS CHART

Characteristics	Paramecium	Plant	Human
cellular composition	only one cell	multi-cellular	multi-cellular
retrieval/ use of energy	food funnels down oral groove into gullet	photosynthesis	ingests food in the mouth and processes it in the digestive system
production of waste	wastes and extra water excreted through contractile vacuoles; gives off carbon dioxide	gives off extra water through transpiration	gives off carbon dioxide, urea, and non-nutritious residues of foods
response to environment	swims to catch food	grows toward light	nervous system is used to receive external stimuli and send messages to parts of the body

BOARD GAME ASSESSMENT TOOL

Teacher Evaluation

Pre-game assessment

Use the following to evaluate student board game plans. Did students

- identify practical problem and criteria?
- clearly identify and arrange all steps in a logical sequence?
- provide required materials and reasons for selection?
- include a sketch of the planned board game?

Post-game assessment

Use the following to evaluate student board game analyses after peer assessment has taken place. Did students

- identify strengths and weaknesses of the game?
- justify the original plan or include suggestions for further revisions to the game?

Peer Assessment

Board Game Developers:
Peer Assessors:

Criteria	Scoring				
• all major components of board game are present and clearly labelled	1	2	3	4	5
• game instructions are clear and easy to follow	1	2	3	4	5
• game shows creativity	1	2	3	4	5
• game is aesthetically pleasing	1	2	3	4	5
• game content includes reference to - all primary defence systems - the secondary defence system - the tertiary defence system - vaccines and antibodies - each of the body systems studied	1	2	3	4	5

Constructive Comments:

CONCEPT MAP RUBRIC

Criteria	*Performance Indicators*			
	Does not meet expectations **1 mark**	**Minimally meets expectations** **2 marks**	**Fully meets expectations** **3 marks**	**Exceeds expectations** **4 marks**
Title and title image	unclear, hard to distinguish from other info	clear, but not eye-catching	clear, uses an image that relates to the key idea	stands out attracting attention, uses symbolism or humour
Ideas branch down from the title image with increasing detail	little logical order, lack of detail	ideas branch but are sometimes confusing, some supporting detail is provided	ideas are logically connected and show more detail as they branch	ideas are logically connected and accurately give more detail as they branch
Connecting words or phrases are appropriate and indicate understanding	few linking connecting words or phrases	connecting works are present, but there are few or they don't truly link the ideas	connecting words show understanding, but some could improve	connecting words are obvious and clearly relate to the concepts
Ideas are coded with colour	little or no use of colour or other code to connect sections of the concept map	colour or coding is used to link sections of the concept map, but is confusing.	colour or coding for sections of the concept map is clear and will help with memory	the use of colour or coding is effective in making the connections memorable
Main ideas have appropriate illustrations	no illustrations	some key ideas are illustrated, some images are irrelevant	concept map illustrates all the key ideas and some of the supporting details	images are clear and lead to an understanding of content

The concept map is out of 20 marks and is due _____.

STORYBOARD AND ORAL PRESENTATION: GROUP SELF-EVALUATION SCALE

Use this checklist to determine areas of strength and weakness in your group project.

Names:_____	**Never**	**Sometimes**	**Usually**	**Always**
TOPIC				
interesting to us				
interesting to the audience				
PREPARATION ***We were able to***				
find sufficient information				
use appropriate information to produce a complete storyboard				
produce a logical storyboard sequence				
use an effective introduction				
use an effective conclusion				
use captions to explain the storyboard				
PRESENTATION ***We were able to***				
speak clearly and confidently				
speak with expression				
use appropriate vocabulary				
speak fluently with few pauses or hesitations				
make eye contact with the audience				
explain the storyboard sequentially and logically				
answer student questions following the presentation				

Next time we would:

LAB REPORT: PERFORMANCE TASK DEFINITION

Name Block
Lab Number Date

[ACTIVITY NAME]

Purpose: something that one sets out for oneself as an objective, the aim of the experiment; may be stated as a question

Materials: list of things you used in the experiment

Procedure:
1) Some experiments will just require you to list the textbook – name, page number and procedure numbers.
2) Other experiments will require you to enter the complete procedure, listing the steps to follow in conducting the experiment.

Observations: These would come in the same order as the procedures. Try to answer the following question: What was done for each procedure? What was seen/ heard/ felt/ smelled/ when you did the procedure? For example:
a) Measurements of (length/mass/volume) were taken and recorded.
The (mass/length/volume) of _____ was _____.
b) Tables are drawn with a ruler and include all data. Correct symbols for units are used. The table is completed in pencil. A title for the table is included.
c) Observed objects were drawn.
d) Equipment used and its set up were diagrammed.
e) It was observed that : (complete the sentence)
the object was seen to _____
the object sounded like _____
the object felt like _____
the object smelled like _____ (use caution when smelling)
(Note: Most of the above would not be used for any one procedure)

Questions: At the end of each experiment you will find a question set that may be assigned. You must answer these in this section.

Conclusions: Try to answer some of the following questions for each experiment:
1. Name and describe any new terms and procedures you may have learned. (Did you do what you said you wanted to in the purpose?)
2. What other instruments (apparatus) might one have used in this experiment?
3. How accurate do you think your results are? Explain.
4. Have you learned a new skill, for example: Could what you learned help you predict something?
5. Try to generalize: Would this procedure work for other materials? If so, what?
6. How could you use what you learned in your daily life? Has this experiment changed your attitude about something?
7. Does what you learned have any value to you? (other than, "because I have to remember it for the test")
8. How do you interpret your observations?
9. What are the connections and relationships that you have learned (more) about?

Remember: not all of the above can be answered for every experiment; but # 8 is always answered.

SCORING RUBRIC FOR LAB REPORT

	Beginning 1	*Developing* 2	*Accomplished* 3	*Exemplary* 4	*Score*
Purpose	Purpose is not written.	Purpose is written but the desired relationship is not stated.	Purpose is stated identifying the relationship to be determined.	Purpose is stated, clearly identifying the relationship to be determined and written in 3rd person passive.	
Procedure	Procedure is not written.	Procedure is written but the processes to be followed are not clear.	Procedure is written and the processes to be followed are easy to follow.	Procedure is written. The processes to be used are easy to follow and include other options to pursue.	
Observations, Data and Diagrams	Observations, data and diagrams are not included.	Observations, data and diagrams are included but are incomplete and/or messy.	Observations, data, and diagrams are included and are complete and neat.	Observations, data, and diagrams are included and are complete and neat. A pencil and ruler have been used when required.	
Questions and Answers	Questions and answers are not included.	Questions and answers are included but are incomplete.	Questions and answers are included and are mostly complete.	Questions and answers are included and are complete.	
Conclusion	Conclusion is not included.	Conclusion is included but is incomplete or has personal opinions such as "It smelled yucky" or "I liked this lab."	Conclusion is included and is complete in 3rd person passive.	Conclusion is included. It is complete, written in 3rd person passive, and includes suggestions for future experiments.	
Total Score =					

LEARNING RESOURCES

This section contains general information on learning resources, and provides a link to the titles, descriptions, and ordering information for the recommended learning resources in the Science 8 to 10 Grade Collections.

What Are Recommended Learning Resources?

Recommended learning resources are resources that have undergone a provincial evaluation process using teacher evaluators and have Minister's Order granting them provincial recommended status. These resources may include print, video, software and CD-ROMs, games and manipulatives, and other multimedia formats. They are generally materials suitable for student use, but may also include information aimed primarily at teachers.

Information about the recommended resources is organized in the format of a Grade Collection. A Grade Collection can be regarded as a "starter set" of basic resources to deliver the curriculum. In many cases, the Grade Collection provides a choice of more than one resource to support curriculum organizers, enabling teachers to select resources that best suit different teaching and learning styles. Teachers may also wish to supplement Grade Collection resources with locally approved materials.

What Kinds of Resources Are Found in a Grade Collection?

The Grade Collection charts list the recommended learning resources by media format, showing links to the curriculum organizers and suborganizers. Each chart is followed by an annotated bibliography. Teachers should check with suppliers for complete and up-to-date ordering information. Most suppliers maintain web sites that are easy to access.

The ministry updates the Grade Collections for each subject on a regular basis on the ministry web site:

www.bced.gov.bc.ca/irp_resources/lr/resource/gradcoll.htm

Please check this site for the most current list of recommended learning resources in the Grade Collections for each IRP.

Science 8 to 10 Grade Collections

The Grade Collections for Science 8 to 10 list the recommended learning resources for these courses. Resources previously recommended for the 1996 version of the curriculum, where still valid, continue to support this reformatted IRP. The ministry updates the Grade Collections on a regular basis as new resources are developed and evaluated.

Information about the recommended Grade Collection resources for Science 8 to 10 is maintained on the following ministry web site:

www.bced.gov.bc.ca/irp/esg/esgtoc.htm

How Can Teachers Choose Learning Resources to Meet Their Classroom Needs?

Teachers must use either

- provincially recommended resources
  OR
- resources that have been evaluated through a local, board-approved process.

Prior to selecting and purchasing new learning resources, an inventory of those resources that are already available should be established through consultation with the school and district resource centres. The ministry also works with school districts to negotiate cost-effective access to various learning resources.

What Are the Criteria Used to Evaluate Learning Resources?

The Ministry of Education evaluates learning resources that support BC curriculum, and that will be used by teachers and/or students for instructional and assessment purposes. Evaluation criteria focus on content, instructional design,

technical considerations, and social considerations.

Additional information concerning the review and selection of learning resources is available from the ministry publication, *Evaluating, Selecting and Managing Learning Resources: A* Guide (Revised 2002)

www.bced.gov.bc.ca/irp/resdocs/esm_guide.pdf

What Funding is Available for Purchasing Learning Resources?

As part of the selection process, teachers should be aware of school and district funding policies and procedures to determine how much money is available for their needs. Funding for various purposes, including the purchase of learning resources, is provided to school districts. Learning resource selection should be viewed as an ongoing process that requires a determination of needs, as well as long-term planning to co-ordinate individual goals and local priorities.

GLOSSARY

This glossary includes terms used in this Integrated Resource Package, defined specifically in relation to how they pertain to Science 8 to 10 topics. It is provided for clarity only, and is not intended to be an exhaustive list of terminology related to Science 8 to 10 topics.

A

abiotic
The non-living parts of the environment such as water, air, rocks.

acid
A compound containing hydrogen, which when it reacts with a compound containing a hydroxide ion, produces a salt and water.

adaptive radiation
The process by which members of a species adapt to a variety of habitats.

Alpha radiation
A type of radiation resulting from the emission of helium nuclei from the nuclei of atoms.

alkali metal
A chemical family of very reactive metals sharing similar chemical properties, containing the elements: lithium, sodium, rubidium, cesium, and francium.

alkaline earth metal
A chemical family of reactive metals sharing similar chemical properties, containing the elements: beryllium, magnesium, calcium, strontium, barium, and radium.

amplitude
The height of a wave crest or depth of a wave trough, measured from its middle, or equilibrium point.

angle of incidence
The angle of a ray of light approaching the boundary between two materials (such as from air into glass), measured between the incident ray and the normal.

angle of refraction
The angle of a ray of light emerging from the boundary between two materials (such as from air into glass), measured between the refracted ray and the normal.

antibody
A protein produced by B lymphocytes that complexes with invading antigens.

antigen
A foreign material that enters an organism.

arête
A sharp crested ridge that separates opposing alpine glaciers.

asexual reproduction
A form of reproduction in which only one parent is involved, and in which all the offspring are identical to each other and to the parent.

atom
The smallest particle of an element that can exist by itself.

atomic mass
The total mass of the protons, neutrons and electrons that make up an atom.

atomic number
The number of protons found in the nucleus of an atom.

B

bacteria
Small (1 – 100 μm) prokaryotic cells.

base
A compound containing hydroxide, which when it reacts with an ionic compound containing a positive hydrogen ion, produces a salt and water.

Beta particle
A high speed electron that is emitted by a radioactive nucleus in beta decay.

binary fission
A method of asexual reproduction in which the cell or organism splits into two equal parts.

bioaccumulation
The accumulation of a substance, such as a toxic chemical, in various tissues of a living organism.

biodegradation
The process by which a product can be broken down naturally, by biological agents, especially bacteria.

biome
A large area of the Earth that has characteristic climate, plants, animals and soil (e.g., Desert).

biotic
All of the organisms in the environment.

Bohr diagram
A diagram that shows the arrangement of an element's subatomic particles.

Bohr Model
The current model of the atom, which describes the arrangement of the element's subatomic particles: neutrons and electrons in the nucleus, and electrons in electron shells.

boiling point
The temperature at which a liquid undergoes a phase change to become a gas.

bromothymol blue
A type of acid-base indicator that turns yellow when added to an acid.

budding
A method of asexual reproduction in which the offspring develops as a bud on the parent, until it drops off and becomes an independent organism.

C

cancer
A disease in which uncontrolled cell division results in the growth of malignant tumours in the body.

catalyst
A substance that speeds up a chemical reaction without being changed itself.

cell wall
A structure in plant cells (and some other types of cells) made of cellulose and other materials, which provides support for the plant cell.

centriole
An organelle found in pairs in animal cells, which organizes the spindle for chromosome division.

chloroplast
An organelle in plant cells that converts carbon dioxide and water into oxygen and glucose.

circulatory system
The system that distributes nutrients and oxygen to the cells as well as removing wastes and carbon dioxide from the cells.

climate
Weather conditions in an area, including rainfall and temperature.

climax community
The final stage of succession, where a stable group of two or more species is able to survive and reproduce indefinitely in the same habitat.

combustion
A type of chemical reaction in which oxygen is one of the reactants, and where heat is produced.

commensalism
A type of symbiotic relationship in which one organism benefits and the other is unaffected.

compound
A pure substance that is made up of two or more elements that have been chemically combined.

compression
The decrease in size (volume) of an object, caused by an increased external pressure acting on the object.

concentration
The amount of solute present in a specific volume of solution.

condensation
The change of state of a substance from gas form to liquid form, such as from steam to water.

conductivity
The ability or power of a substance to conduct or transmit heat or electricity.

Conservation of mass
A scientific law that states that in a chemical reaction, the total mass of the reactants always equals the total mass of the products.

continental drift theory
Theory put forth by A. Wegener in the early 20th century that proposed that continents moved around on the Earth's surface and were at one time joined together.

continental shelf
A shallow, undersea plain stretching off the coast of a continent.

convection
A type of heat transfer in fluids (liquid or gas) where hot, less dense fluid rises and cold, denser fluid sinks. This causes heat to be distributed evenly throughout the fluid.

converging
A description of light rays coming to a focal point after reflecting off a converging mirror or refracting through a converging lens.

covalent bonding
The formation of a chemical bond through the sharing of one or more pairs of electrons.

covalent compound
A compound that is formed when non-metallic atoms share electrons to form a covalent bond.

crest
The highest point in a wave amplitude as measured from its middle or equilibrium point.
cytoplasm
The aqueous material and suspended organelles between the nucleus and cell membrane.

D

decomposer
An organism that feeds on waste and dead organisms.
decomposition
A type of chemical reaction in which a compound is broken down into two or more elements or simpler compounds.
density
The amount of mass contained in a given volume, usually measured in kg/cm^3.
deposition
Phase change of a gas to a solid.
digestive system
The system that allows organisms to take in, break down and absorb nutrients.
diverging
A description of light rays spreading apart after reflecting off a diverging mirror or refracting through a diverging lens.
DNA
The genetic material of the cell, that is composed of four different types of nucleotides arranged in a chain.
double replacement
A type of chemical reaction during which elements in different compounds exchange places (e.g., AB + CD→ AD + CB).
drumlin
An elongated (oval) hill formed by glacial movement.

E

ecological succession
The process of gradual change that occurs when organisms colonize a habitat, modify it, and are forced out by a new species better adapted to the now altered environment.
ecosystem
A network of interactions linking the biotic and abiotic things. **electromagnetic radiation**
The total range or spectrum of energy in the form of waves that extend from the longest radio waves to the shortest gamma and cosmic rays.
embryonic development
The stages through which the developing offspring progresses from fertilization until about 8 to 10 weeks.
energy
The capacity for applying a force to effect motion. It is often thought of as the amount of movement or potential movement, usually measured in joules (J).
erosion
The movement of weathered materials.
erratic
Large rocks carried to a new location by a glacier and left behind after the glacier melts. The erratic differs from the rock types surrounding it.
eukaryotic cell
A cell with a nucleus and membrane bound organelles.

excretory system
The system that allows organisms to remove wastes.

expansion
The increase in size of an object, caused by a decreased external pressure acting on the object.

evaporation
The change of state of a substance from liquid form to gas form.

F

fertilization
The process in which a male and female gamete fuse to form a zygote.

fission
The process by which a large nucleus splits into two pieces of roughly equal mass, accompanied by the release of large amounts of energy.

food chain
A series of organisms, each of which relies for its food on the organism before it in the chain.(e.g., Sun→grass→ rabbit→fox).

food pyramid
A diagram used to illustrate relationships between an organism's population size and its place in a food chain.

food web
Food chains linked together within a particular ecosystem.

fragmentation
A type of asexual reproduction in which a large or small fragment of an organism can break off and develop into a new organism.

freezing point
The characteristic temperature at which a liquid solidifies.

focal point
The point at which converging light rays meet or from which light rays diverge.

force
A push or pull acting on an object, usually measured in newtons (N). For example, a magnet applies a pulling force on a piece of iron.

frequency
The number of repetitive motions, or oscillations, that occur in a given time, usually measured in cycles/second or hertz (Hz).

friction
A type of force that acts to oppose the motion of one object in contact with and relative to another object.

fusion
The joining of two small atomic nuclei to make a larger one. It is usually involves the release of a large amount of energy.

G

gamete
A reproductive cell of a sexually reproducing organism. Produced through the process of meiosis, the cell contains only half the number of chromosomes.

Gamma rays
The highest energy or frequency and shortest wavelength portion of the electromagnetic spectrum.

Gamma radiation
Electromagnetic radiation emitted from the nuclei of atoms.

gastric juice
A fluid with a pH of 2-3 produced by the walls of the stomach.

gas exchange
Carbon dioxide enters the blood and oxygen leaves the blood at the body cells. The process is reversed in the lungs.

gene
A segment of chromosome, which codes for a specific protein.

genetic engineering
The alteration of the genetic material of an organism through the addition or substitution of certain genes.

glaciation
The condition or result of being covered with a thick sheet of ice.

gravitation
A type of pulling force that acts between two or more objects, such as the earth and a baseball.

H

half-life
The amount of time required for half the nuclei in a sample of a radioactive isotope to decay.

halogen
A family of reactive non-metals sharing similar chemical properties, that contains the elements fluorine, chlorine, bromine, iodine, and astatine.

heavy metals
Metals such as mercury, lead and cadmium which have no known vital or beneficial effect on organisms, and their accumulation over time in the bodies of mammals can cause serious illness.

horn
A sharp peak formed by the movement of two or more opposing glaciers.

hot spot
Location of excess radioactivity, causing magma to rise from the mantle through the lithosphere to the surface.

hydraulic
A term that describes a device that is operated by the action of water or other liquid.

I

infrared
A type of electromagnetic radiation that, relative to light, has a longer wavelength and lower energy/frequency. It is also referred to as heat radiation.

immune system
The system that allows organisms to defend against disease.

inorganic
The chemistry of compounds that do not contain carbon.

ionic bonding
The bond that forms as a result of the attraction between positively and negatively charged ions.

ionic compound
A compound that forms as a result of positive and negative ions being held together by an ionic bond.

ion
An atom or group of atoms that is positively r negatively charged as a result of either gaining or losing one or more electrons.

isotopes
Atomic nuclei having the same number of protons but different numbers of neutrons.

K

keystone species
A particular type of organism that exerts great influence on an ecosystem relative to its abundance.

L

laws of electrical charge
Opposite charges attract each other,
similar charges repel each other,
charged objects attract neutral objects.

lens
A curved piece of transparent material that refracts light in such a way as to converge or diverge parallel light rays.

Lewis diagram
A representation of the element's atom showing only the outer valence electrons.

light
The form of energy that can be detected by the eye.

litmus paper
A type of acid-base indicator that turns one colour when added to a base, and a different colour in an acid.

M

magnetic
A type of force that acts on the elements iron, nickel or cobalt.

mantle convection
Thermal energy transfer in the mantle where hot, light magma rises and cold, dense lithospheric plate material sinks.

mass
The amount of matter that makes up an object, usually measured in kilograms (kg).

mass number
The total number of protons and neutrons found in the nucleus of an atom.

melting
The change of state of a substance from solid form to liquid form.

melting point
The temperature at which a substance changes from a sold to liquid state.

metabolism
The chemical reactions that take place in a living organism to provide energy, utilize materials and carry out vital processes.

mid-ocean ridge
Undersea mountain range that marks a divergent plate boundary; also called a spreading ridge.

mitochondrion
An organelle in eukaryotic cells that converts oxygen and glucose into cellular energy (ATP) carbon dioxide and water.

mirror
A device or surface that reflects light.

microwave
A type of electromagnetic radiation that has a longer wavelength and lower energy/frequency than infrared radiation.

molecule
A particle that consists of two or more atoms that are joined together.

multiple ion charge
Some metallic elements can form two different ionic charges depending on what type of chemical reaction they undergo (e.g., Fe+2 or Fe+3).

mutation
A change in the genetic material of the cell, which may have either a beneficial, harmful or neutral affect on the organism.

mutualism
A type of symbiotic relationship in which organisms interact for mutual benefit.

moraine
Material carried in, on, or under a glacier, which is deposited at the edges or end at the glacial flow.

N

natural selection
The process, proposed by Darwin, where the environment acts to select fit individuals.

nervous system
The system that allows the various parts of an organism communicate and work in concert.

neutralization
A chemical reaction in which an acid and a base combine to produce a salt and water.

noble gases
A family of non reactive element sharing similar chemical properties, that contains the elements: helium, neon, argon, krypton, xenon, radon.

normal
An imaginary line that is perpendicular to the boundary between two materials (such as air and glass) and intersects the point at which the incident ray reaches the boundary.

nucleus
A membrane-bound structure in eukaryotic cells that contains the genetic material and regulates the cell's activities (i.e., growth and metabolism). The nucleus is also the control centre that contains the cell's genetic material, which directs the production of proteins.

nutrient
A material that organisms need to live and grow.

O

ocean current
A large stream of moving water produced by gravity, wind friction, and water density.

opaque
A description of a material's ability to prevent any light from passing through it.

organ
A group of tissues that perform a function.

organ system
A group of organs and tissues that perform a function to keep an organism alive.

organelles
A part of a eukaryotic cell that performs an essential life function.

organic
The chemistry of compounds that contain carbon.

organism
A living being that could be single-celled or multi-celled.

osmosis
The movement of water from a region of low solute concentration to a region of high solute concentration through a semi-permeable membrane.

P

paleoglaciation
A term describing past periods of extensive glaciation that covered most of the continents.

parasitism
A type of symbiotic relationship in which one organism benefits and the other is harmed.

pathogen
A bacteria, toxin, or other harmful material that can cause damage to an organism.

PCBs
Any of several compounds that are produced by replacing hydrogen atoms in biphenyl with chlorine, and are poisonous environmental pollutants which tend to accumulate in animal tissues.

pesticide
A substance used to control populations of plant or animal pests.

pH
A symbol denoting the concentration of hydrogen ions in a solution.

phagocytic white blood cells
Specialized white blood cells that act to remove foreign substances within the body (e.g., bacteria, dead tissue cells, and small mineral particles) and thus fight infection. They are called phagocytic because they engulf and absorb the foreign substance.

phenolphthalein
A type of acid-base indicator that turns pink when added to a base.

plate boundary
Location where two plates meet and move relative to each other.

plate tectonic theory
Theory explaining that the Earth's surface is made up of several lithospheric plates that move around relative to one another, sliding over the semi-fluid asthenosphere.

pneumatic
A term that describes a device that is operated by air or other gas.

polyatomic ion
A group of atoms that collectively carry a charge.

potassium
An element that is considered an nutrient, and needed to live and grow.

predation
A situation wherein one organism [the predator] kills and consumes another organism [the prey].

pressure
The amount of force acting over a given area on an object, usually measured in Newtons/cm^2.

proliferation
To grow or multiply by rapidly producing new tissues, cells, or offspring.

prokaryotic cell
A cell with no nucleus and membrane bound organelles, but with a nucleoid region and molecules that perform the functions of the organelles of eukaryotic cells.

R

radioactive decay
The process in which the nuclei of radioactive parent isotopes emit alpha, beta, or gamma radiation to form decay products.

radio waves
A type of electromagnetic radiation that has the longest wavelength and lowest energy/frequency compared to all other types.

reproductive system
The systems that allow organisms to produce offspring.

refraction
The bending or changing direction of a wave or light ray as it passes from one material into another.

ribosome
An organelle in eukaryotic cells that converts oxygen and glucose into cellular energy (ATP) carbon dioxide and water.

respiratory system
The system responsible for acquiring oxygen and removing carbon dioxide from the body.

ridge push and slab pull
A process that facilitates plate movement whereby dense, subducting plate material pulls the rest of the attached plate toward the subduction zone and down into the mantle, while the weight of the ridge being formed along a spreading mid-ocean ridge pushes the rest of (the same) tectonic plate away from the ridge, often towards a subduction zone

S

salinity
The amount of salt in ocean water expressed in parts per thousand

salt
A compound formed by the reaction of an acid and a base.

selectively permeable membrane
The type of membrane that surrounds cells. It controls what enters and leaves the cell.

sexual reproduction
The type of reproduction that requires the involvement of two parents, each of whom contributes a gamete. The fusion of the two gametes produces the zygote, the first cell of an offspring.

single replacement
A type of chemical reaction in which one element replaces another in a compound.

solidification
The change of state of a substance from liquid form to solid form, such as from water to ice.

spectrum
A range of frequencies for a given type of radiation. For example, the visible spectrum contains a range of several colours or frequencies of white light.

spreading ridge
Undersea mountain range that marks a divergent plate boundary; also called a mid-ocean ridge.

state
A phase of matter; may be solid, liquid or gas.

stem cells
The self –regenerating cells found in the marrow of the long bones that give rise by differentiation and cell division to different types of cells.

striations
Parallel grooves in rocks or bedrock formed by glaciers scraping rocks over other rocks.

subatomic particle
A particle that is smaller than an atom. It is a term that usually refers to the proton, neutron, and electron that make up the atom.

subduction zone
Zone representing a convergent plate boundary, where one plate subducts beneath and is destroyed by the other overriding plate

sublimation
The change of state of a substance from solid form to gas form or vice versa.

surface area
The extent of a two dimensional surface enclosed within a boundary.

symbiosis
A relationship in which two different organisms live in a close association.

synthesis
A type of chemical reaction in which two or more elements or compounds combine to form a single compound.

T

tectonic processes
The convergence, divergence and transform movement of the earth's lithospheric plates.

tertiary defence system
A component of the immune system that involves the creation of antibodies – proteins created by specialized white blood cells in response to foreign substances (antigens). By combining with the foreign substance (antigen), the antibodies may themselves neutralize it or alternatively flag it to bring it to the attention of other white blood cells that will attack and destroy it.

tissue
A group of structurally similar cells that perform a common function.

transform fault
A type of plate boundary where two plates slide past each other horizontally in opposite directions relative to each other.

translucent
A description of a material's ability to partially allow light to pass through it in such a way that it becomes diffused. Such materials do not allow objects to be seen distinctly.

transparent
A description of a material's ability to allow light to pass through it freely. Objects can be clearly seen through such materials.

trench
A long narrow depression in the ocean floor that marks a convergent plate boundary and is part of a subduction zone.

trophic level
The number of energy transfers an organism is from the original solar energy entering the food chain.

trough
The lowest point in a wave amplitude as measured from its middle or equilibrium point.

turbidity
Cloudiness in water caused by suspended materials.

U

ultraviolet
A type of electromagnetic radiation that, relative to light, has a shorter wavelength and higher energy/frequency.

V

vacuole
A membrane bound sac that holds fluids or other materials

vegetative reproduction
A method of asexual reproduction in plants, in which an offspring develops from a part of the plant other than the flower.

virus
A small (10 – 100nm) non-cellular particle that reproduces inside of other cells

viscosity
A description of a fluid's resistance to flow. For example, corn syrup has a higher viscosity than water.

visible light
A type of electromagnetic radiation that, relative to other forms, has an average wavelength and energy/frequency. It is composed of the following component colours: red, orange, yellow, green, blue and violet.

volume
the amount of space taken up by an object, usually measured in liters or cubic centimeters (cm^3).

W

wave
A transfer of energy as a disturbance from one point in a material to another without causing any permanent displacement of the material.

wavelength
The distance between successive crests or troughs in a series of waves.

weathering
The breaking down of rock by physical, chemical or biological means.

weight
The amount of pulling force that gravity from earth or another celestial body exerts on an object.

white blood cell
Cells produced by red bone marrow and found in the blood or lymph. These cells fight pathogens in several different ways.

wind action
The processes or results of wind.

X

X-rays
A type of electromagnetic radiation that has a shorter wavelength and higher energy/frequency than ultraviolet.

Z

zygote
The cell formed by the fusion of a male and female gamete, until it divides.