

## SCIENCE 12: Specialized Science (4 credits)

### Description

The curriculum for Specialized Science 12 is designed to provide flexibility for teachers and students while ensuring that the rigorous provincial curriculum standards are met. Based on your students' interests, your strengths, and your department's course offerings, you may combine Big Ideas and Content, and add Elaborations to the Curricular Competencies to construct the curriculum for your course.

The following pages provide a description of how to construct a Specialized Science 12 curriculum for your classroom.

1. Review Tables A and B to combine Big Ideas, Curricular Competencies, and Content to tailor the Specialized Science 12 curriculum for you and your students.
2. You may want to use or adapt Example 1 or 2 below for your use as the curriculum for Specialized Science 12. Teachers on the curriculum development team created these examples to illustrate the flexibility of the curriculum.

## Table A: Big Ideas

- Select the Big Ideas that best suit the course you are offering. Note that the Big Ideas below are adapted from Grades 11 and 12 courses and the course name is identified in parentheses after each Big Idea. (**Note:** You may want to refer to other Science curricula for other Big Ideas that reflect your intent.)
- Identify, adapt, or create Big Ideas, if desired, after you have reviewed and selected the Content topics for your course (see Table B).
- The course should integrate a minimum of three Big Ideas from at least two different areas of science – biology, chemistry, physics, and earth, space and environmental sciences – for specialized science learning.

<p>Biodiversity is dependent on the complex interactions and processes between biotic and abiotic factors.</p> <p>(adapted from Environmental Science 11)</p>	<p>Climate change impacts biodiversity and ecosystem health.</p> <p>(adapted from Environmental Science 12)</p>	<p>All members of a species have common characteristics that evolve over time.</p> <p>(adapted from Life Sciences 11)</p>	<p>Our evolving understanding of genetics has implications for health, society, and environment.</p> <p>(adapted from Anatomy and Physiology 12)</p>	<p>Chemical reactions are due to energy changes that result from the breaking and re-formation of bonds.</p> <p>(adapted from Chemistry 11)</p>
<p>Changes in equilibrium drive chemical processes.</p> <p>(adapted from Chemistry 12)</p>	<p>Energy is always conserved.</p> <p>(adapted from Physics 11)</p>	<p>Forces interact within fields and cause linear and circular motions.</p> <p>(adapted from Physics 12)</p>	<p>Geologic materials can change as they cycle through the geosphere and can be used as resources.</p> <p>(adapted from Earth Sciences 11)</p>	<p>Rock layers and the fossil record reflect geologic changes through time.</p> <p>(adapted from Geology 12)</p>

## Table B: Curricular Competencies and Content

- Review the Curricular Competencies. Note that the Curricular Competencies remain the same regardless of the Content selected.
- Add Elaborations to link the Curricular Competencies to the Big Ideas that you selected for your curriculum. You may want to refer to Grade 11 or 12 Science curricula for Elaboration ideas.
- Select at least three topics from the Content column.

### Learning Standards

Curricular Competencies	Content
<p><i>Students are expected to be able to do the following:</i></p> <p><b>Questioning and predicting</b></p> <ul style="list-style-type: none"> <li>• Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal, local, or global interest</li> <li>• Make observations aimed at identifying their own questions, including increasingly abstract ones, about the natural world</li> <li>• Formulate multiple hypotheses and predict multiple outcomes</li> </ul> <p><b>Planning and conducting</b></p> <ul style="list-style-type: none"> <li>• Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative)</li> <li>• Assess risks and address ethical, cultural, and/or environmental issues associated with their proposed methods</li> <li>• Use appropriate SI units and appropriate equipment, including digital technologies, to systematically and accurately collect and record data</li> <li>• Apply the concepts of accuracy and precision to experimental procedures and data:               <ul style="list-style-type: none"> <li>– significant figures</li> <li>– uncertainty</li> <li>– scientific notation</li> </ul> </li> </ul>	<p><i>Students are expected to know:</i></p> <ul style="list-style-type: none"> <li>• <b>at least three</b> of the following:               <ul style="list-style-type: none"> <li>– related Content from Anatomy and Physiology 12</li> <li>– related Content from Chemistry 11</li> <li>– related Content from Chemistry 12</li> <li>– related Content from Earth Sciences 11</li> <li>– related Content from Environmental Science 11</li> <li>– related Content from Environmental Science 12</li> <li>– related Content from Geology 12</li> <li>– related Content from Life Sciences 11</li> <li>– related Content from Physics 11</li> <li>– related Content from Physics 12</li> <li>– related Content from Science for Citizens 11</li> </ul> </li> <li>• any additional content not covered by the above</li> </ul>

Learning Standards (continued)

Curricular Competencies	Content
<p><b>Processing and analyzing data and information</b></p> <ul style="list-style-type: none"> <li>• Experience and interpret the local environment</li> <li>• Apply First Peoples perspectives and knowledge, other ways of knowing, and local knowledge as sources of information</li> <li>• Seek and analyze patterns, trends, and connections in data, including describing relationships between variables, performing calculations, and identifying inconsistencies</li> <li>• Construct, analyze, and interpret graphs, models, and/or diagrams</li> <li>• Use knowledge of scientific concepts to draw conclusions that are consistent with evidence</li> <li>• Analyze cause-and-effect relationships</li> </ul> <p><b>Evaluating</b></p> <ul style="list-style-type: none"> <li>• Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions</li> <li>• Describe specific ways to improve their investigation methods and the quality of their data</li> <li>• Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled</li> <li>• Demonstrate an awareness of assumptions, question information given, and identify bias in their own work and in primary and secondary sources</li> <li>• Consider the changes in knowledge over time as tools and technologies have developed</li> <li>• Connect scientific explorations to careers in science</li> <li>• Exercise a healthy, informed skepticism, and use scientific knowledge and findings to form their own investigations to evaluate claims in primary and secondary sources</li> </ul>	

Learning Standards (continued)

Curricular Competencies	Content
<ul style="list-style-type: none"> <li>• Consider social, ethical, and environmental implications of the findings from their own and others' investigations</li> <li>• Critically analyze the validity of information in primary and secondary sources and evaluate the approaches used to solve problems</li> <li>• Assess risks in the context of personal safety and social responsibility</li> </ul> <p><b>Applying and innovating</b></p> <ul style="list-style-type: none"> <li>• Contribute to care for self, others, community, and world through individual or collaborative approaches</li> <li>• Co-operatively design projects with local and/or global connections and applications</li> <li>• Contribute to finding solutions to problems at a local and/or global level through inquiry</li> <li>• Implement multiple strategies to solve problems in real-life, applied, and conceptual situations</li> <li>• Consider the role of scientists in innovation</li> </ul> <p><b>Communicating</b></p> <ul style="list-style-type: none"> <li>• Formulate physical or mental theoretical models to describe a phenomenon</li> <li>• Communicate scientific ideas and information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations</li> <li>• Express and reflect on a variety of experiences, perspectives, and worldviews through place</li> </ul>	

## BIG IDEAS

Elements and compounds have specific properties.

An object's motion can be predicted, analyzed, and described.

Forces interact within fields and cause linear and circular motion.

Astronomy seeks to explain the origin of the universe and interactions of celestial bodies.

## Learning Standards

Curricular Competencies	Content
<p><i>Students are expected to be able to do the following:</i></p> <p><b>Questioning and predicting</b></p> <ul style="list-style-type: none"> <li>Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal, local, or global interest</li> </ul> <p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>What prior knowledge do you have about the beginning of the universe?</li> <li>What is dark matter? What is the difference between dark matter and dark energy?</li> <li>Explore a First Peoples technology and narratives of astronomy.</li> </ul> <ul style="list-style-type: none"> <li>Make observations aimed at identifying their own questions, including increasingly abstract ones, about the natural world</li> </ul> <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>How could you investigate the age of the universe?</li> </ul> <ul style="list-style-type: none"> <li>Formulate multiple hypotheses and predict multiple outcomes</li> </ul> <p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>Predict the motion of a celestial object based on Newton's laws.</li> <li>Predict the age of a sibling who travels to Mars at half the speed of light and returns a few years later.</li> </ul>	<p><i>Students are expected to know the following:</i></p> <ul style="list-style-type: none"> <li>model of the atom (adapted from Chemistry 11)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>behaviour of atoms in outer space</li> <li>quantum mechanics</li> <li>energy levels</li> <li>ground state</li> <li>excited state</li> <li>photons</li> </ul> <ul style="list-style-type: none"> <li>atomic spectra (adapted from Chemistry 11)</li> </ul> <p><i>Sample topic:</i></p> <ul style="list-style-type: none"> <li>role of spectroscopy in astronomy</li> </ul> <ul style="list-style-type: none"> <li>periodic table (adapted from Chemistry 11)</li> </ul> <p><i>Sample topics:</i></p> <p>formation of elements:</p> <ul style="list-style-type: none"> <li>on Earth (e.g., artificially created, through radioactivity)</li> <li>on other celestial bodies (e.g., through fusion)</li> </ul>

**Learning Standards (continued)**

Curricular Competencies	Content
<p><b>Planning and conducting</b></p> <ul style="list-style-type: none"> <li>• Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative)</li> </ul> <p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– How would you apply Newton’s law of universal gravitation on Earth or other planets?</li> <li>– Use a spectroscope to examine the photons emitted by spectral tubes of different elements and compare the results.</li> <li>– Investigate how the law of conservation of energy applies to satellite orbits.</li> </ul> <ul style="list-style-type: none"> <li>• Assess risks and address ethical, cultural, and/or environmental issues associated with their proposed methods</li> <li>• Use appropriate SI units and appropriate equipment, including digital technologies, to systematically and accurately collect and record data</li> </ul> <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– What criteria could be used to select appropriate instruments for different astronomical investigations?</li> </ul> <ul style="list-style-type: none"> <li>• Apply the concepts of accuracy and precision to experimental procedures and data: <ul style="list-style-type: none"> <li>– significant figures</li> <li>– uncertainty</li> <li>– scientific notation</li> </ul> </li> </ul> <p><b>Processing and analyzing data and information</b></p> <ul style="list-style-type: none"> <li>• Experience and interpret the local environment</li> <li>• Apply First Peoples perspectives and knowledge, other ways of knowing, and local knowledge as sources of information</li> </ul>	<ul style="list-style-type: none"> <li>• translational and rotational equilibrium (adapted from Physics 11)</li> <li>• apparent weight (adapted from Physics 11 and 12)</li> <li>• gravitational field and Newton’s law of universal gravitation (from Physics 12)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– vector field</li> <li>– interactions with mass through gravitons</li> <li>– attraction only</li> </ul> <ul style="list-style-type: none"> <li>• gravitational potential energy (from Physics 12)</li> <li>• orbital and celestial mechanics: <ul style="list-style-type: none"> <li>– uniform circular motion (adapted from Physics 12)</li> </ul> </li> </ul> <p><i>Sample topic:</i></p> <ul style="list-style-type: none"> <li>▪ orbits of celestial objects (e.g., planets and stars)</li> </ul> <ul style="list-style-type: none"> <li>– gravitational dynamics and energy relationships (from Physics 12)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>▪ planetary motion, satellite motion</li> <li>▪ law of conservation of energy, principle of work and energy (e.g., satellite orbits, launch velocity, escape velocity)</li> </ul> <ul style="list-style-type: none"> <li>– Newton’s laws of motion (from Physics 11)</li> <li>– Kepler’s laws of planetary motion</li> </ul>

**Learning Standards (continued)**

Curricular Competencies	Content
<ul style="list-style-type: none"> <li>• Seek and analyze patterns, trends, and connections in data, including describing relationships between variables, performing calculations, and identifying inconsistencies</li> </ul> <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– How can you use multiple sources of data to support theories or conclusions about the universe?</li> </ul> <ul style="list-style-type: none"> <li>• Construct, analyze, and interpret graphs, models, and/or diagrams</li> </ul> <p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– Interpret a Hertzsprung-Russell diagram.</li> <li>– Calculate and interpret the area under a curve to show that the work done moving an object from the surface of a planet to infinity gives it gravitational potential energy.</li> </ul> <ul style="list-style-type: none"> <li>• Use knowledge of scientific concepts to draw conclusions that are consistent with evidence</li> <li>• Analyze cause-and-effect relationships</li> </ul> <p><b>Evaluating</b></p> <ul style="list-style-type: none"> <li>• Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions</li> </ul> <p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– Compare an experimental result to a theoretical result and calculate percent error.</li> <li>– Identify sources of random and systematic errors.</li> </ul> <ul style="list-style-type: none"> <li>• Describe specific ways to improve their investigation methods and the quality of their data</li> </ul>	<ul style="list-style-type: none"> <li>• conservation of energy and momentum (adapted from Physics 11 and 12)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– formation of planets</li> <li>– solar thermal equilibrium</li> <li>– linear and angular momentum, rotation of the Earth</li> </ul> <ul style="list-style-type: none"> <li>• applications of relativity (adapted from Physics 12)</li> </ul> <p><i>Sample topic:</i></p> <ul style="list-style-type: none"> <li>– moving in a gravitational field, moving near the speed of light</li> </ul> <ul style="list-style-type: none"> <li>• formation of the universe</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– big bang theory</li> <li>– expansion of the universe</li> <li>– oscillating universe theory</li> <li>– Hubble’s law</li> </ul> <ul style="list-style-type: none"> <li>• astronomical objects</li> </ul> <ul style="list-style-type: none"> <li>– solar system (the sun, planets, moons, asteroids, comets)</li> </ul> <p><i>Sample topic:</i></p> <ul style="list-style-type: none"> <li>▪ age of the solar system: clues from meteorites, clues from comets</li> </ul> <ul style="list-style-type: none"> <li>– outside the solar system (stars, stellar groups, planets, galaxies, nebulae)</li> <li>– interstellar medium, interstellar radiation field</li> </ul>



**Learning Standards (continued)**

Curricular Competencies	Content
<ul style="list-style-type: none"> <li>Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled</li> <li>Demonstrate an awareness of assumptions, question information given, and identify bias in their own work and in primary and secondary sources</li> <li>Consider the changes in knowledge over time as tools and technologies have developed</li> <li>Connect scientific explorations to careers in science</li> <li>Exercise a healthy, informed skepticism, and use scientific knowledge and findings to form their own investigations to evaluate claims in primary and secondary sources</li> <li>Consider social, ethical, and environmental implications of the findings from their own and others' investigations</li> <li>Critically analyze the validity of information in primary and secondary sources and evaluate the approaches used to solve problems</li> <li>Assess risks in the context of personal safety and social responsibility</li> </ul> <p><b>Applying and innovating</b></p> <ul style="list-style-type: none"> <li>Contribute to care for self, others, community, and world through individual or collaborative approaches</li> <li>Co-operatively design projects with local and/or global connections and applications</li> </ul> <p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>How are new technologies being used to extend the reach of human investigations into space?</li> <li>How have technologies developed for use in space exploration and the study of astronomy been used for other purposes?</li> </ul> <ul style="list-style-type: none"> <li>Contribute to finding solutions to problems at a local and/or global level through inquiry</li> </ul>	<ul style="list-style-type: none"> <li>characteristics and classification of stars           <ul style="list-style-type: none"> <li><i>Sample topics:</i> <ul style="list-style-type: none"> <li>surface temperature</li> <li>luminosity</li> <li>chemical composition</li> <li>size</li> <li>mass</li> <li>interstellar medium</li> <li>motion</li> <li>distance (stellar parallax)</li> <li>gravitational collapse (formation of structure in the universe)</li> <li>Hertzsprung-Russell diagram</li> </ul> </li> </ul> </li> <li>characteristics and classification of planets           <ul style="list-style-type: none"> <li><i>Sample topics:</i> <ul style="list-style-type: none"> <li>terrestrial planets</li> <li>Jovian planets</li> </ul> </li> </ul> </li> <li>stellar evolution (life cycles of stars)           <ul style="list-style-type: none"> <li><i>Sample topics:</i> <ul style="list-style-type: none"> <li>nebula</li> <li>nuclear fusion</li> <li>brown dwarf (dead star)</li> <li>main-sequence star (dwarf star)               <ul style="list-style-type: none"> <li>red dwarf (low mass)</li> <li>yellow dwarf (mass comparable to the sun)</li> <li>orange dwarf</li> </ul> </li> </ul> </li> </ul> </li> </ul>

**Learning Standards (continued)**

Curricular Competencies	Content
<ul style="list-style-type: none"> <li>• Implement multiple strategies to solve problems in real-life, applied, and conceptual situations</li> <li>• Consider the role of scientists in innovation</li> </ul> <p><b>Communicating</b></p> <ul style="list-style-type: none"> <li>• Formulate physical or mental theoretical models to describe a phenomenon</li> <li>• Communicate scientific ideas and information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations</li> </ul> <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– How can you create models to clearly communicate ways of knowing about the universe?</li> </ul> <ul style="list-style-type: none"> <li>• Express and reflect on a variety of experiences, perspectives, and worldviews through <b>place</b></li> </ul> <p>Place is any environment, locality, or context with which people interact to learn, create memory, reflect on history, connect with culture, and establish identity. The connection between people and place is foundational to First Peoples perspectives.</p>	<ul style="list-style-type: none"> <li>– red giant</li> <li>– white dwarf, black dwarf (in the case of low- or medium-mass stars)</li> <li>– red supergiant, supernova, neutron star, black hole (in the case of massive stars)</li> <li>– pulsar, magnetar</li> </ul> <ul style="list-style-type: none"> <li>• space technologies</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– telescopes</li> <li>– spectroscopes</li> <li>– satellites</li> <li>– space probes</li> <li>– rovers</li> <li>– manned missions</li> <li>– International Space Station</li> <li>– space shuttles</li> </ul>

**Big Ideas – Elaborations**

- **Elements and compounds have specific properties.**

(adapted from Chemistry 11)

*Sample questions to support inquiry with students:*

- How do scientists study the elements and compounds that are outside of planet Earth?
- How are atoms formed in stars?

- **An object's motion can be predicted, analyzed and described.**

(from Physics 11)

*Sample question to support inquiry with students:*

- What causes the predictable and observable patterns of Earth, the moon, and the sun?

- **Forces interact within fields and cause linear and circular motion.**

(adapted from Physics 12)

*Sample question to support inquiry with students:*

- How might light travel differently on different planets?

- **Astronomy seeks to explain the origin of the universe and interactions of celestial bodies.**

(adapted from Earth Sciences 11)

*Sample questions to support inquiry with students:*

- Why is Earth the only planet in our solar system that supports life?
- How has technology expanded our understanding of Earth, the moon, and the sun?
- How does Earth's motion compare to other bodies in the solar system?

## Example 2: SCIENCE — Specialized Science (Fisheries) (Environmental Science, Chemistry, Anatomy and Physiology, Life Sciences, Topics in Fisheries)

### BIG IDEAS

Biodiversity is dependent on the complex interactions and processes between biotic and abiotic factors.

Human activities have implications in the local and global environments.

Elements and compounds have specific properties.

Organ systems work together to maintain homeostasis.

Health of aquatic ecosystems is critical to sustainable fisheries.

### Learning Standards

Curricular Competencies	Content
<p><i>Students are expected to be able to do the following:</i></p> <p><b>Questioning and predicting</b></p> <ul style="list-style-type: none"> <li>Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal, local, or global interest</li> </ul> <p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>Consider the impact of a fisheries collapse in your local community.</li> <li>Predict the effects of global sea rise on local fish stocks.</li> </ul> <ul style="list-style-type: none"> <li>Make observations aimed at identifying their own questions, including increasingly abstract ones, about the natural world</li> <li>Formulate multiple hypotheses and predict multiple outcomes</li> </ul> <p><b>Planning and conducting</b></p> <ul style="list-style-type: none"> <li>Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative)</li> </ul>	<p><i>Students are expected to know the following:</i></p> <ul style="list-style-type: none"> <li>species and ecological roles (adapted from Environmental Science 11 and Life Sciences 11)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>food chains</li> <li>food webs</li> <li>competition</li> <li>symbiosis</li> <li>parasites</li> <li>producers</li> </ul> <ul style="list-style-type: none"> <li>taxonomic principles for classifying organisms (from Life Sciences 11)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>taxa: kingdom, phylum, class, order, family, genus, species</li> <li>phylogenetic tree (cladogram)</li> <li>dichotomous key</li> <li>morphology</li> <li>habitat</li> </ul>

**Example 2: SCIENCE — Specialized Science (Fisheries)**  
**(Environmental Science, Chemistry, Anatomy and Physiology,**  
**Life Sciences, Topics in Fisheries)**

**Learning Standards (continued)**

Curricular Competencies	Content
<p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– Collect data about water conditions at spawning grounds to compare with optimal conditions or to track changes in conditions (e.g., seasonal differences).</li> <li>– Compare and contrast various local fish-harvesting methods.</li> <li>– Build and monitor a small-scale aquaponics system.</li> <li>– Collect data on factors that change (e.g., oxygen concentration) during an algal bloom and relate them to fish viability.</li> </ul> <ul style="list-style-type: none"> <li>• Assess risks and address ethical, cultural, and/or environmental issues associated with their proposed methods</li> </ul> <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– Collect data to assess the environmental risks associated with various types of fish-harvesting methods in a local community.</li> </ul> <ul style="list-style-type: none"> <li>• Use appropriate SI units and appropriate equipment, including digital technologies, to systematically and accurately collect and record data</li> <li>• Apply the concepts of accuracy and precision to experimental procedures and data:           <ul style="list-style-type: none"> <li>– significant figures</li> <li>– uncertainty</li> <li>– scientific notation</li> </ul> </li> </ul> <p><b>Processing and analyzing data and information</b></p> <ul style="list-style-type: none"> <li>• Experience and interpret the local environment</li> <li>• Apply First Peoples perspectives and knowledge, other ways of knowing, and local knowledge as sources of information</li> </ul>	<ul style="list-style-type: none"> <li>• aquatic ecosystem functions and services (adapted from Environmental Science 11 and 12)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– freshwater</li> <li>– marine</li> <li>– zones</li> <li>– biotic and abiotic components</li> <li>– nutrient cycling</li> <li>– ecosystem services</li> <li>– productivity</li> </ul> <ul style="list-style-type: none"> <li>• organic compounds (from Chemistry 11)</li> <li>• chemical analysis techniques (adapted from Chemistry 11)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– water quality (e.g., dissolved oxygen, phosphorus, nitrogen, pH)</li> <li>– colour and turbidity</li> <li>– organic components</li> </ul> <ul style="list-style-type: none"> <li>• shifts in equilibrium driving chemical processes (adapted from Chemistry 12)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– pH</li> <li>– nitrogen levels</li> <li>– salinity</li> <li>– dissolved gases</li> <li>– effects of pollution</li> <li>– nutrient loading</li> </ul>

**Learning Standards (continued)**

Curricular Competencies	Content
<p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– Research First Peoples knowledge and understanding of fish in the local environment in the past and present (e.g., migration patterns, spawning grounds, ocean temperatures).</li> </ul> <ul style="list-style-type: none"> <li>• Seek and analyze patterns, trends, and connections in data, including describing relationships between variables, performing calculations, and identifying inconsistencies</li> </ul> <p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– Compare annual fish stock numbers to patterns in ocean temperature, water acidity, or bioindicators.</li> <li>– Analyze historical data for the methylmercury levels in fish (e.g., Grassy Narrows, Ontario; Minamata, Japan).</li> </ul> <ul style="list-style-type: none"> <li>• Construct, analyze, and interpret graphs, models, and/or diagrams</li> </ul> <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– Graph water temperature and fish stock numbers over time.</li> </ul> <ul style="list-style-type: none"> <li>• Use knowledge of scientific concepts to draw conclusions that are consistent with evidence</li> <li>• Analyze cause-and-effect relationships</li> </ul> <p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– Analyze the effect of chemicals in waste water on fish (e.g., estrogens causing feminization; other chemicals causing slow heart rate, physical deformities).</li> <li>– Investigate how the effects of climate change (e.g., ocean acidification, rising sea temperatures) modify fish distribution in B.C. and globally.</li> </ul>	<ul style="list-style-type: none"> <li>• the body’s internal regulation (adapted from Anatomy and Physiology 12)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– homeostasis</li> <li>– osmoregulation</li> <li>– thermoregulation</li> <li>– buoyancy</li> </ul> <ul style="list-style-type: none"> <li>• organ systems of fish and other aquatic species (adapted from Anatomy and Physiology 12)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– sensory</li> <li>– respiratory</li> <li>– reproductive</li> <li>– muscle</li> <li>– skeletal</li> </ul> <ul style="list-style-type: none"> <li>• human impact on local and global ecosystems (adapted from Environmental Science 11 and 12)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– harvesting (e.g., techniques, over exploitation, by-catch, aquaculture, commercial fishing, recreational fishing)</li> <li>– habitat loss and degradation (e.g., infilling of lakes, wetlands, or streams; habitat fragmentation; urbanization; clearing of vegetation)</li> </ul>

**Learning Standards (continued)**

Curricular Competencies	Content
<p><b>Evaluating</b></p> <ul style="list-style-type: none"> <li>Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions</li> </ul> <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>What other variables or explanations could impact/influence/alter your findings on water quality in local waterways?</li> </ul> <ul style="list-style-type: none"> <li>Describe specific ways to improve their investigation methods and the quality of their data</li> <li>Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled</li> <li>Demonstrate an awareness of assumptions, question information given, and identify bias in their own work and in primary and secondary sources</li> <li>Consider the changes in knowledge over time as tools and technologies have developed</li> <li>Connect scientific explorations to careers in science</li> </ul> <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>Investigate present and future employment in the fishing industry.</li> </ul> <ul style="list-style-type: none"> <li>Exercise a healthy, informed skepticism, and use scientific knowledge and findings to form their own investigations to evaluate claims in primary and secondary sources</li> <li>Consider social, ethical, and environmental implications of the findings from their own and others' investigations</li> </ul> <p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>How do the bioaccumulation and biomagnification of chemicals in fish affect your dietary choices?</li> </ul>	<ul style="list-style-type: none"> <li>flow alteration (e.g., dams and other impoundments; water diversion; water extraction for agricultural, industrial, or municipal uses)</li> <li>aquatic invasive species</li> <li>climate change (e.g., rising sea level, acidification, rising temperatures)</li> <li>pollution (e.g., bioaccumulation, biomagnification, microplastics)</li> </ul> <ul style="list-style-type: none"> <li>First Peoples concepts of interconnectedness with land and place (adapted from Environmental Science 11)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>cultural connections</li> <li>traditional harvesting methods</li> <li>conservation practices</li> <li>important aquatic systems in B.C.'s First Peoples communities (e.g., Fraser, Skeena)</li> </ul> <ul style="list-style-type: none"> <li>Traditional Ecological Knowledge (TEK) (adapted from Environmental Science 11)</li> <li>fisheries and aquatic resource management (adapted from Environmental Science 12)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>regulations</li> <li>opening and closing seasons</li> <li>enforcement</li> <li>allowable catch and other quotas</li> <li>stock management</li> <li>angling licenses</li> </ul>

**Example 2: SCIENCE — Specialized Science (Fisheries)**  
**(Environmental Science, Chemistry, Anatomy and Physiology,**  
**Life Sciences, Topics in Fisheries)**

**Learning Standards (continued)**

Curricular Competencies	Content
<ul style="list-style-type: none"> <li>– Examine the current environmental, cultural, and economic safety factors of current fisheries in B.C.</li> <li>– Investigate the impacts of fishing and ocean resources on global development and international relations.</li> </ul> <ul style="list-style-type: none"> <li>• Critically analyze the validity of information in primary and secondary sources and evaluate the approaches used to solve problems</li> <li>• Assess risks in the context of personal safety and social responsibility</li> </ul> <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– Evaluate safety issues within the fishing industry.</li> </ul> <p><b>Applying and innovating</b></p> <ul style="list-style-type: none"> <li>• Contribute to care for self, others, community, and world through individual or collaborative approaches</li> </ul> <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– How do fisheries connect or contribute to other industries/sectors?</li> </ul> <ul style="list-style-type: none"> <li>• Co-operatively design projects with local and/or global connections and applications</li> </ul> <p><i>Sample opportunities to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>– Create a PSA (public service announcement) to inform consumers about the differences between farmed and wild fish.</li> <li>– Investigate the risks and benefits of ocean seeding with iron to increase phytoplankton levels and increase fish stocks.</li> </ul> <ul style="list-style-type: none"> <li>• Contribute to finding solutions to problems at a local and/or global level through inquiry</li> </ul> <p><i>Sample opportunity to student inquiry:</i></p> <ul style="list-style-type: none"> <li>– What technologies are being used to improve fish supplies or fish habitat? How scalable are these applications?</li> </ul>	<ul style="list-style-type: none"> <li>– commercial harvesting</li> <li>– recreational fishing</li> <li>– Acts and international treaties (e.g., Pacific Salmon Treaty)</li> </ul> <ul style="list-style-type: none"> <li>• sustainable resource practices (adapted from Environmental Science 11 and 12)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– First Peoples fishing methods</li> <li>– harvesting technologies (e.g., hook and line, rod and reel, spear fishing, cast net)</li> <li>– certifications (e.g., Marine Stewardship Council [MSC], Aquaculture Stewardship Council [ASC], Ocean Wise)</li> <li>– imports and exports</li> <li>– conserving fish stocks</li> </ul> <ul style="list-style-type: none"> <li>• restoration and stewardship practices in local and global environments (adapted from Environmental Science 11)</li> </ul> <p><i>Sample topics:</i></p> <ul style="list-style-type: none"> <li>– restoration (e.g., habitats [wetlands, streams, lakes, ocean], fish refuge or rearing structures, instream rock or natural wood structures, instream sediment management, barrier removal for fish passage, spawning gravels and shoals, water flow, aeration)</li> <li>– stewardship (e.g., storm drain marking, riparian plantings, fish ladders, shoreline clean-up, invasive species removal, livestock exclusion fences, water conservation)</li> </ul>



**Learning Standards (continued)**

Curricular Competencies	Content
<ul style="list-style-type: none"> <li>Implement multiple strategies to solve problems in real-life, applied, and conceptual situations           <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>Engage in a project to increase public awareness about sustainable practices for offering seafood in restaurants.</li> </ul> </li> <li>Consider the role of scientists in innovation</li> </ul> <p><b>Communicating</b></p> <ul style="list-style-type: none"> <li>Formulate physical or mental theoretical models to describe a phenomenon           <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>What tools and technologies can you use to determine your local ecological footprint?</li> </ul> </li> <li>Communicate scientific ideas and information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations           <p><i>Sample opportunity to support student inquiry:</i></p> <ul style="list-style-type: none"> <li>How can you share the findings about water quality in local waterways and its effect on fish stocks with your local community?</li> </ul> </li> <li>Express and reflect on a variety of experiences, perspectives, and worldviews through <b>place</b> <p>Place is any environment, locality, or context with which people interact to learn, create memory, reflect on history, connect with culture, and establish identity. The connection between people and place is foundational to First Peoples perspectives.</p> </li> </ul>	

**Big Ideas – Elaborations**

- **Biodiversity is dependent on the complex interactions and processes between biotic and abiotic factors.**

(adapted from Environmental Science 11)

*Sample questions to support inquiry with students:*

- How do local harvesting methods of wild stocks help to sustain the fishing economy?
- How can you assess the importance of fisheries in British Columbia and Canada?

- **Human activities have implications in the local and global environments.**

(adapted from Environmental Science 12)

*Sample question to support inquiry with students:*

- What are the principles of sustainable fishing?

- **Elements and compounds have specific properties.**

(adapted from Chemistry 11)

*Sample questions to support inquiry with students:*

- What are the effects of pollutants on local aquatic environments?
- How does the chemical composition of the water column compare in different healthy ecosystems?

- **Organ systems work together to maintain homeostasis.**

(adapted from Anatomy and Physiology 12)

*Sample questions to support inquiry with students:*

- How do salmon maintain osmotic pressure as they go from fresh water to salt water?
- How do current and past spawning locations compare?

- **Health of aquatic ecosystems is critical to sustainable fisheries.**

*Sample questions to support inquiry with students:*

- What challenges do local fishers face in harvesting, storing, processing, and marketing their resource?
- How does the health of an aquatic ecosystem affect a local fishing industry?