## Critical Learning
- Understanding the complex process of water testing is essential for developing awareness of potential hazards in our water.
- Many factors must be considered when testing water to ensure that it is safe for human consumption.
- Science labs and experiments bring the scientific method to life in authentic contexts. Meaningful science and technology experiences result from using and making connections with the process scientists follow.

## Guiding Questions
- Why is it so important for municipalities to conduct water testing?
- What are potential ramifications of not testing water intended for human consumption?
- What can individuals do to keep water clean and safe?

### Curriculum Expectations

#### Developing Investigation and Communication Skills

2. investigate factors that affect local water quality
   - **2.1** follow established safety procedures for the use of apparatus and chemicals (e.g., when using water-testing equipment and water-testing chemicals)
   - **2.3** test water samples for a variety of chemical characteristics (e.g., pH, salinity, chlorine, hardness, and turbidity)
   - **2.6** use appropriate science and technology vocabulary, including: experiment, fair test, pH, salinity, chlorine, water hardness, concentration, density, dissolve, temperature, hypothesis, conclusion
   - **2.7** use a variety of forms (e.g., lab report) to communicate with different audiences and for a variety of purposes (e.g. using appropriate scientific conventions, complete a lab report that includes: purpose, hypothesis, apparatus/materials method, observations and conclusion)

#### Learning Goals
- Students will be able to:
  - complete water tests to determine the nature of a water sample
  - use lab materials safely, (e.g., test-tubes, beakers, chemicals, droppers)
  - complete a data table of water sample test results
  - discuss and analyze the findings related to the nature of water and the tests
  - identify a specific sample based on information gathered from previous test results

### Instructional Components and Context

#### Readiness
- Generating hypothesis/hypotheses and drawing conclusions
- Ability to measure accurately
- Methods for recording data collected
- Making and recording observations
- Qualitative and quantitative testing
- Entering data into tables

#### Terminology
- Experiment
- Fair test
- pH
- Salinity
- Chlorine
- Water hardness
- Turbidity
- Water density
- Dissolve
- Temperature

#### Materials
- Various water samples
- Canadian Scientists Chart
- Lab 1 instructions and table
- Lab 2 instructions and table

#### Related Website Resources
- [http://www.cln.org/themes/famous.html](http://www.cln.org/themes/famous.html)
Water Testing  Lesson 12

Minds On (Elicit and Engage)

Whole Group ➔ Exploring Attributes of Scientists

Students share what they know about scientists, guided by prompts:
- What does a scientist do, (e.g., think, observe, try, test, talk, share, write, guess, predict)?
- How do scientists work, (e.g., alone, with a partner or in groups)?
- What do all scientists need to know, (e.g., how to work safely and to ensure that work spaces are safe for themselves and others)?

Facilitate a discussion to compare to results and address misconceptions.

On the Canadian Scientists chart, draw students’ attention to the fact that the scientists listed are both male and female and representative of diverse cultures and backgrounds. Students test their general knowledge by matching scientists’ names with their achievements. Provide correct matches so students can self-assess.

Pose the question: What are the critical attributes and habits of mind of a scientist? Tell students that they will assume the role of scientists to work in the same way, with the same habits of mind as scientists. Create an anchor chart of attributes for reference. Discuss how lessons in this unit have engaged students in scientific inquiry.

Share learning goals.

Action! (Explore and Explain)

Individual ➔ Representing Understanding

Review the choice of strategies for consolidating understanding, summarizing information, and supporting recall, (e.g., mind map, concept map, Venn diagram, or combined list). Students select a strategy to represent their understanding, using each other as resources, if necessary. Students post their work and do a Gallery Walk.

Pairs or Small Groups ➔ Lab #1

Review safety procedures and proper use of lab materials and equipment. To review criteria of a good data table or observation table, students brainstorm a list of criteria, (e.g., using a T-Chart with labels “Looks like…” and “Sounds like…”). Use suggestions to create a checklist with which to assess the data tables. Remind students about scientific habits of mind, collaborative norms, accuracy of observation and recording.

Students complete Lab 1, recording their findings on their tables. Teachers who wish to do so, may test for density using mass and volume. Debrief Lab 1, focusing on the usefulness of qualitative versus quantitative data when making comparisons. Provide further clarification of terms and of expectations before students complete Lab 2, recording findings in a second set of tables.

See Lab Rubric.

Consolidation (Elaborate, Evaluate, Extend)

Whole Group ➔ Pulling It All Together

Facilitate a discussion of the lesson’s guiding questions. Students write a double-entry journal in their Water Portfolio: one side summarizing the lesson and discussion, the other reflecting on how well they thought and acted like scientists.

Home Connection or Next Lesson Connection

Students work on the Water Gallery Performance Task, using their Water Portfolios and team members as resources.
Minds On

Anchor Chart
An anchor chart is a strategy for capturing students’ voices and thinking. Anchor charts are co-constructed. By making students’ thinking visible and public, they “anchor,” or stabilize and scaffold learning. Anchor charts should be developmentally appropriate and clearly focused, accessible, and organized.

Scientific Inquiry
In scientific inquiry, students engage in activities that allow them to develop knowledge and understanding of scientific ideas in much the same way as scientists do. Like scientists, students must develop skills in the two major components of scientific investigation: experimentation and research.

Experimentation involves conducting “fair tests” to determine whether changing one factor in the experimental set-up affects the results, and, if so, how.

Research includes both primary research, done through first-hand, direct observation of objects and processes; and secondary research, done by reviewing the work and the findings of others. (See The Ontario Curriculum, Grades 1-8: Science and Technology, 2007, Ministry of Education of Ontario, pages 12-13.

In this lesson, students have the opportunity to conduct a variety of experiments related to water testing.

Action!

Strategy Implementation Continuum
When introducing options, show examples, model how to complete them with a Think-Aloud, and provide explicit explanations. Students need shared and guided practice before creating these independently.

See the Strategy Implementation Continuum for the gradual release model.

Mind Map
Bennett and Rolheiser (2001) identify critical attributes of mind maps:
1. a central image representing the subject
2. main themes radiating like branches from that central image
3. a key image or key word for each branch
4. connections between the image and branches
5. use of colour


To create a mind map for this activity:
• Create an image for the centre of the page to represent the topic: “Science and Technology Safety Rules.”
• Add 4-6 curved lines radiating out from the centre, each ending with a key word from the safety rules of your classroom, (e.g., eye protection, ear protection, long hair, jewelry).
• Add a branch from each key word to paraphrase the rule that goes with that key word, (e.g., if you have long hair tie it back before coming into the lab).
• Add images to support words.
• Use colour to render key ideas distinct and memorable.

Concept Map
A concept map is a visual representation of relationships among concepts, ideas or words.

Unlike mind maps, which usually radiate out from a single, central concept, concept maps are hierarchical, branching downwards from the central concept. Unlike mind maps, which include images and colour, concept maps are limited to words and lines (branches).

Unlike mind maps, which use curved lines, concept maps are linear.

**Combined List**

Effective readers recognize and use knowledge of text structure to construction meaning. Graphic organizers, (e.g., KWL and comparison matrix), often incorporate lists or provide a graphic version of a list.

A **simple list** groups related items under a label. These lists may be verbal or graphic; horizontal, vertical or spatially arranged; organized or random. An example of a simple list would be a list of materials for a lab or a list of instructions.

A **combined list** places two or more simple lists side-by-side so that corresponding items are side-by-side. An example of a combined list would be a list of states of water with corresponding explanations and percentage.

An **intersected list** is a matrix or a table, which arranges labels along 2 dimensions, (e.g., across the top and down the left-hand side). Intersected lists are an efficient way of summarizing information in 3 simple lists. To located information in an intersected list, students locate the appropriate labels and follow the column and row to where they intersect. Examples of intersected lists are schedules or maps.

For information on lists, see the following:


**Safety Procedures**

Teachers must model safe practices at all times and communicate safety expectations to students in accordance with school board and Ministry of Education policies. To carry out their responsibilities with regard to safety, it is important not only that teachers have concern for their own safety and that of their students, but also that they have:

- the knowledge necessary to use the materials, tools, and procedures involved in science and technology safely
- knowledge concerning the care of living things – plants and animals – that are brought into the classroom
- the skills needed to perform tasks efficiently and safely

Note: Teachers supervising students using power equipment such as drills, sanders, and saws need to have specialized training in handling such tools. Students demonstrate that they have the knowledge, skills, and habits of mind required for safe participation in science and technology activities when they:

- maintain a well-organized and uncluttered work space
- follow established safety procedures
- identify possible safety concerns
- suggest and implement appropriate safety procedures
- carefully follow the instructions and example of the teacher
- consistently show care and concern for their safety and that of others

Taken from *The Ontario Curriculum, Grades 1-8, Science and Technology*, 2007.

**Sample criteria**

- Maintain a well-organized work space.
- Follow established safety procedures.
- Identify possible safety concerns.
- Suggest and implement appropriate safety procedures.
- Carefully follow teacher examples.
- Consistently show care and concern for safety of self and others.

**T-Chart**

<table>
<thead>
<tr>
<th>Looks like</th>
<th>Sounds Like</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Quality Data Table...</td>
<td></td>
</tr>
</tbody>
</table>
## Canadian Scientists

Match the scientist to his/her contribution.

<table>
<thead>
<tr>
<th>Scientist</th>
<th>Match</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sheila Watt-Cloutier</td>
<td></td>
<td>A. First woman to receive an Electrical Engineering degree in Canada and the first woman aircraft designer in the world.</td>
</tr>
<tr>
<td>2. Dusanka Filipovic</td>
<td></td>
<td>B. Invented the automatic lubricator for locomotive trains, the folding ironing board, and an automatic sprinkler</td>
</tr>
<tr>
<td>4. Helen Hogg</td>
<td></td>
<td>D. His inventions include key contributions to the first electric wheelchairs for quadriplegics, the first microsurgical staple gun, the ZEEP nuclear reactor which was the precursor to the CANDU reactor, the international system for classifying ground-cover snow, aircraft skis, the Weasel all-terrain vehicle, the STEM antenna for the space program, and the Canadarm.</td>
</tr>
<tr>
<td>5. Elijah McCoy</td>
<td></td>
<td>E. The first person in the world to make a meal using electricity in 1892.</td>
</tr>
<tr>
<td>6. Thomas Ahearn</td>
<td></td>
<td>F. Created a unique “organic style” of architecture. His company was a leader in the industry’s use of computers and computer-assisted drawing technology in architecture.</td>
</tr>
<tr>
<td>7. Willard Boyle</td>
<td></td>
<td>G. Canadian Inuit environmental activist. Most recent focus is persistent organic pollutants and global climate change.</td>
</tr>
<tr>
<td>8. Alice Wilson</td>
<td></td>
<td>H. Co-inventor of the Blue Bottle\textsubscript{TM} process which recovers, reclams, and recycles halogenated hydrocarbons, such as CFCs, for reuse.</td>
</tr>
<tr>
<td>9. Douglas Cardinal</td>
<td></td>
<td>I. International authority on “globular star clusters,” which are the oldest objects in our galaxy, the Milky Way.</td>
</tr>
<tr>
<td>10. Elsie Gregory MacGill</td>
<td></td>
<td>J. Invented the first camcorder, the CCD (Charge coupled device) which is at the heart of most digital cameras, camcorders, and telescope imaging systems.</td>
</tr>
</tbody>
</table>
# Canadian Scientists-Matches

<table>
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LAB 1

Your teacher will provide 2 water samples, (e.g., tap water and salt water). These will be compared.

You will conduct the following tests:

- **pH** – Use pH paper/pool test kit to indicate acidic and neutral samples
- **Chlorine** – Use pool test kit to indicate qualitative results
- **Hardness** – Mix dilute soap solution and water sample to indicate qualitative mineral concentration (Calcium Carbonate). Higher amounts of soap bubbles can be observed in soft water, i.e., water low in mineral concentration.
- **Turbidity** – Shake sample and quantitatively measure the residual cloudiness of the sample after 1 minute.
- **Salinity** – Make a highly concentrated salt water solution of 30% concentration by mixing 30 grams of salt in 1000 mL of water. Allow a sample to evaporate from a glass slide on a CSA approved hotplate. A mineral crust ring will form on the slide. Higher concentrations of salt will leave more precipitate on the slide. (Note: If you do not have access to a hot plate, simply leave the slide out in the air to dry overnight.)
- **Density** – Conduct a stick test by placing a piece of doweling/wood into a graduated cylinder that contains the water sample. Greater density samples will indicate a higher floating point (buoyancy). It’s also possible to use quantitative method using mass and volume.

Record your data on the table on the observation page.

Report one of the following:
1. Qualitative data
2. Quantitative data, based on measurements.

In the Conclusions column, summarize your findings, (e.g., Sample A produces more bubbles and better lather than Sample B).

Evaluate the validity of qualitative and quantitative measures when comparing your results.
## Lab #1 Observations

**Name:** ______________________________  **Date:** ___________________

<table>
<thead>
<tr>
<th>Test</th>
<th>Prediction</th>
<th>Results</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt water</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<tbody>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt water</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lab 2

**NOTE:** Take temperature of all water samples at the beginning of the lab.

You will be given up to 5 different samples of water. These could include: local tap water, bottled water, distilled water, water with dilute acid/base content, salt water, hard water, brackish water, melted snow, pond water—or others!

Determine the nature and type of water sample by conducting a variety of tests from Lab 1 and predicting results. Record test results on the observation table for Lab 2.

**Lab #2 Observations**

<table>
<thead>
<tr>
<th>Mystery liquid</th>
<th>Temperature</th>
<th>Test 1 _______</th>
<th>Test 2 _______</th>
<th>Test 3 _______</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Prediction</td>
<td>Prediction</td>
<td>Prediction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Results</td>
<td>Results</td>
<td>Results</td>
</tr>
<tr>
<td>A</td>
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<td>E</td>
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</tr>
<tr>
<td>Expectations</td>
<td>Criteria</td>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
</tr>
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<td>---------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Knowledge and Understanding</strong></td>
<td>Understanding of Content</td>
<td>Demonstrates limited knowledge of content: identifying water samples based on previous testing</td>
<td>Demonstrates some knowledge of content: identifying water samples based on previous testing</td>
<td>Demonstrates considerable knowledge of content: identifying water samples based on previous testing</td>
</tr>
<tr>
<td><strong>Thinking and Investigation</strong></td>
<td>Thinking and Inquiry.</td>
<td>Uses inquiry and thinking processes, with limited effectiveness when determining water samples; few samples accurately predicted</td>
<td>Uses inquiry and thinking processes, with some effectiveness when determining water samples; some samples accurately predicted</td>
<td>Uses inquiry and thinking processes, with considerable effectiveness when determining water samples; most samples accurately predicted</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>Expressing and Organization of Ideas</td>
<td>Expresses and organizes ideas and information with limited effectiveness when following assigned lab format</td>
<td>Expresses and organizes ideas and information with some effectiveness when following assigned lab format</td>
<td>Expresses and organizes ideas and information with considerable effectiveness when following assigned lab format</td>
</tr>
<tr>
<td></td>
<td>Use of Conventions, Vocabulary and Terminology in Written Form</td>
<td>Uses data table conventions, vocabulary and terminology with limited effectiveness</td>
<td>Uses data table conventions, vocabulary and terminology with some effectiveness</td>
<td>Uses data table conventions, vocabulary and terminology with considerable effectiveness</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Application of Knowledge and Skills</td>
<td>Uses lab equipment and technology in a safe and skillful manner with limited effectiveness</td>
<td>Uses lab equipment and technology in a safe and skillful manner with some effectiveness</td>
<td>Uses lab equipment and technology in a safe and skillful manner with considerable effectiveness</td>
</tr>
</tbody>
</table>