Water Testing Lesson 12

Grade 8, Science and Technology

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.science.ca/scientists/scientists.php**
- **http://www.nrc-cnrc.gc.ca/eng/education/index.html**
- **http://www.cln.org/themes/famous.html**

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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.

Pause and Ponder

QuickTip
Extend activity by examining media texts, such as their science textbook, science magazines, clip art, and by recalling television programs, e.g., *Bill Nye the Science Guy* or *Mythbusters*.

A as L Anchor charts and checklists help students self-assess and regulated learning.

QuickTip
See **Strategy Implementation Continuum** for a description of the gradual release model. By this point, students should be ready for guided or independent practice.

QuickTip
Brainstorming is an intense problem-solving strategy used by creative teams that rapidly generates ideas without editing or evaluating them. Model effective brainstorming.

A for L Provide oral feedback, (e.g., on safe lab procedures, methodical approach to lab instruction) and extent to which students are thinking like scientists. Probe to ascertain understanding, and cue students to match their work to Level 3 criteria on the rubric.

A as L Checklists and coaching rubrics can help students develop self-assessment skills

A as L Students reflect on their performance in reference to previously generated criteria.

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

Bennett, Barrie and Rolheiser, Carol (2001). *Beyond Monet: The Artful Science of Instructional Integration.* Ajax, ON: Bookation. p. 289.

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.

See Bennett, Barrie and Rolheiser, C. (2001). *Beyond Monet: The Artful Science of Instructional Integration.* Ajax, ON: Bookation. For an explanation and examples of concept maps and distinctions between concept and mind maps.

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:

Document Use at Work (Combines *Document Literacy* & *Language of Documents* in one publication). SkillPlan: BC Construction Industry Skills Improvement Council. See **Resources, Publications**.

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

A Quality Data Table…

Looks like	Sounds Like

➜

Canadian Scientists

Match the scientist to his/her contribution.

Scientist	Match	Contribution
1. Sheila Watt-Cloutier		A. First woman to receive an Electrical Engineering degree in Canada and the first woman aircraft designer in the world.
2. Dusanka Filipovic		B. Invented the automatic lubricator for locomotive trains, the folding ironing board, and an automatic sprinkler
3. George John Klein		C. First woman geologist in Canada, expert in Palaeozoic formations.
4. Helen Hogg		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**.
5. Elijah McCoy		E. The first person in the world to make a meal using electricity in 1892.
6. Thomas Ahearn		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.
7. Willard Boyle		G. Canadian Inuit environmental activist. Most recent focus is persistent organic pollutants and global climate change.
8. Alice Wilson		H. Co-inventor of the Blue Bottle$_{TM}$ process which recovers, reclaims, and recycles halogenated hydrocarbons, such as CFCs, for reuse.
9. Douglas Cardinal		I. International authority on "globular star clusters," which are the oldest objects in our galaxy, the Milky Way.
10. Elsie Gregory MacGill		J. Invented the first camcorder, the CCD (Charge coupled device) which is at the heart of most digital cameras, camcorders, and telescope imaging systems.

Canadian Scientists-Matches

Scientist	Contribution
1. Sheila Watt-Cloutier	Canadian Inuit environmental activist. Most recent focus is persistent organic pollutants and global climate change.
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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: _________________

	Test:		
	Prediction	Results	Conclusion
Tap water			
Salt water			
	Test:		
	Prediction	Results	Conclusion
Tap water			
Salt water			
	Test:		
	Prediction	Results	
Tap water			
Salt water			
	Test:		
	Prediction	Results	Conclusion
Tap water			
Salt water			
	Test:		
	Prediction	Results	Conclusion
Tap water			
Salt water			
	Test:		
	Prediction	Results	Conclusion
Tap water			
Salt water			

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

Mystery liquid	Temperature	Test 1 __________		Test 2 _________		Test 3 _________	
		Prediction	Results	Prediction	Results	Prediction	Results
A							
B							
C							
D							
E							

LAB RUBRIC

Expectations	Criteria	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding Understanding of Content	Does this mean that students understand what certain results mean?	Demonstrates limited knowledge of content: identifying water samples based on previous testing	Demonstrates some knowledge of content: identifying water samples based on previous testing	Demonstrates considerable knowledge of content: identifying water samples based on previous testing	Demonstrates thorough knowledge of content: identifying varying water consumption practices based on previous testing
Thinking and Investigation Thinking and Inquiry. The use of critical and creative thinking skills and inquiry and problem-solving skills and/or processes.	What inquiry and thinking processes are used to determine what type of water sample each is? E.g., Is this about accurate prediction?	Uses inquiry and thinking processes, with limited effectiveness when determining water samples; few samples accurately predicted	Uses inquiry and thinking processes, with some effectiveness when determining water samples; some samples accurately predicted	Uses inquiry and thinking processes, with considerable effectiveness when determining water samples; most samples accurately predicted	Uses inquiry and thinking processes, with a high degree of effectiveness when determining water sample all samples accurately predicted
Communication Expressing and Organization of Ideas Use of Conventions, Vocabulary and Terminology in Written Form	What is the format? What is expected for organization? What are the conventions, vocabulary and terminology?	Expresses and organizes ideas and information with limited effectiveness when following assigned lab format Uses data table conventions, vocabulary and terminology with limited effectiveness	Expresses and organizes ideas and information with some effectiveness when following assigned lab format Uses data table conventions, vocabulary and terminology with some effectiveness	Expresses and organizes ideas and information with considerable effectiveness when following assigned lab format Uses data table conventions, vocabulary and terminology with considerable effectiveness	Expresses and organizes ideas and information with a high degree of effectiveness when following assigned lab format Uses data table conventions, vocabulary and terminology with a high degree of effectiveness
Application Application of Knowledge and Skills	What are the criteria (or sample criteria) for safe and skillful?	Uses lab equipment and technology in a safe and skillful manner with limited effectiveness	Uses lab equipment and technology in a safe and skillful manner with some effectiveness	Uses lab equipment and technology in a safe and skillful manner with considerable effectiveness	Uses lab equipment and technology in a safe and skillful manner with a high degree of effectiveness