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Watersheds Lesson 8

Grade 8, Science and Technology

Critical Learning

- No matter where you live, you live in a watershed.
- Watersheds are necessary to support the habitats of plants and animals, and to provide drinking water for humans and wildlife.
- In everyday activities, people allow harmful materials such as motor oil, paint products, pet waste, fertilizers, and pesticides to enter storm drains and pollute the watershed. This degrades the environment, harms wildlife habitats, impacts the economy, and ultimately affects the health of humans.
- Protection of natural resources such as watersheds is essential to maintain the health and well being of all living things, both now and in the future.
- It's cheaper to protect groundwater than having to clean it up.

Guiding Questions

- How do watersheds assist in water management and planning?
- What are some local issues regarding water supply in my area? Why have they become issues? How are they currently being addressed?
- What should know others about their local water supply and how it is managed?

Curriculum Expectations

Developing Investigation and Communication Skills

2. investigate factors that affect local water quality

2.4 use scientific inquiry/research skills to investigate local water issues

Understanding Basic Concepts

3. demonstrate an understanding of the characteristics of the earth's water systems and the influence of water systems on a specific region.

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

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

Learning Goals

Students will be able to:

- identify factors that affect local water quality
- describe how watersheds relate to water management and planning
- explain how human and nature factors can change the water table

Instructional Components and Context

Readiness

- Collaborative skills
- Model building
- Reliable and accurate observation and recording
- Scientific Habits of Mind

Terminology

- Interconnectedness
- Watershed
- Closed Watershed
- Open Watershed
- Ripple Effect
- Stewardship

Materials

- Modeling clay (2 colors)
- Waterproof trays
- Water
- Plastic cups with holes
- Measuring cup
- Paper towels
- Sand
- Pea gravel
- Cotton balls
- Food colouring
- **Local Conservation Authority**
- **Everybody Lives Downstream** - a fact sheet from Conservation Ontario

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Minds On (Elicit and Engage)

Whole Group → Introducing Watersheds

Remind students of their personal water audits. Pose the following: *Where does the water that we use every day come from?* Tell students that water comes from a watershed and display **cross-section diagram**. Students examine the diagram and list what they see. Discuss what the components of the diagram mean, (e.g., different types of arrows).

In a **Think-Pair-Share**, students talk about what a watershed is. Volunteers share with the class. Reach a consensus, record and post the definition.

Share today's learning goals.

Investigation and Research Teams → Interpreting a Watershed Map

Students locate their community watershed on a **watershed map**. Preview the map and provide **guiding questions** to scaffold location and interpretation of information.

Display and discuss examples of effective flow charts. Model how to create a flow chart. Teams (1) create a flow chart to represent: the path water travels from their community to the lake/ ocean, and (2) predict and mark the location of **potential negative impacts** on their community watershed.

Debrief, emphasizing the interconnectedness inherent in these relationships.

Action! (Explore and Explain)

Investigation and Research Teams → Model Building and Observing

Discuss the role of models in science, noting that unlike the water cycle model, today's model will be used for active demonstration and that reliable results from today's investigation depend on accuracy of construction, observation, and recording. Note (1) what makes a "good" model, (e.g., it has to function), and (2) how models help you see what you might not otherwise be able to observe firsthand. Explain the purpose of today's model – to discover how watersheds function when (1) in a natural state, and (2) altered by human factors,(e.g., housing, industry, dams, and pollution).

Refer students to relevant **anchor charts**, (e.g., collaborative norms, criteria for effective models, scientific habits of mind, guidelines for observing and recording).

Students build their **watershed model** and record their hypothesis/revised hypotheses and observations in their Water Portfolio.

Investigation and Research Teams → Communicating and Drawing Conclusions

Discuss the importance of clear communication and sharing of findings in the scientific community. Use a **RAFTS strategy** to clarify the task and help students plan. Teams summarize and post their findings and make a brief oral report.

Whole Class → Discussion

Facilitate a discussion of (1) common themes and contradictions in the data across groups, (2) the impact of human activity on the watershed, (e.g., How does the addition of a dam affect the flow of water?) and (3) possible conclusions.

Consolidation (Elaborate, Evaluate, Extend)

Whole Class → Video Viewing

Introduce concept of the "ripple effect" to consolidate and prepare for video and reflection. Using the title and producer of the video **The Ripple Effect from Conservation Ontario**, students to make predictions about what they will see and hear.

Display and review **question prompts for taking a critical literacy stance**. Give groups responsibility for 1-2 questions each as a lens for viewing. Facilitate a discussion about the responses.

Individual → Reflection in Portfolio

Students write a reflection in the *Why do I care?* Water Portfolio on (1) how investigation predictions were confirmed or adjusted, (2) what it's like to think in response to critical questions, (3) what the interconnections are between over-use of water, the impact of human activities on water quality, and access to clean, safe drinking water.

Record unanswered or arising questions and introduce the concept of "stewardship."

Pause and Ponder

A for L Note students' ability to read and interpret the cross-section of a watershed (graphic text), and to extrapolate that into a verbal explanation of "watershed." Use this information to inform instruction and plan guided practice.

QuickTip
See **Building Academic Knowledge** and **Reading Strategies**, including strategies for Reading Graphic Text, p. 84

QuickTip
See **Ontario watersheds** and **investigation**.

A for L Provide feedback based on **Technological Problem Solving Skills Continuum**.

A for L Check for understanding and provide oral feedback.

QuickTip
Remind students of scientific habits of mind and the importance of accuracy. Be explicit about group work expectations and hold students accountable for effective group work.

QuickTip
See the **Listening Guide** for active listening strategies.

QuickTip
See (1) the **Critical Literacy Guide** and (2) **Differentiated Instruction–Literacy Cards** for an explanation and examples of questions and strategies.

Minds On

Think-Pair-Share

Bennett and Rolheiser (2001) describe Think-Pair-Share as "one of the simplest of all the tactics" (page 94). As pointed out by Bennett and Rolheiser and Think Literacy (page 152), students require skills to participate effectively in Think-Pair-Share, for example:

- active listening
- taking turns
- asking for clarification
- paraphrasing
- considering other points of view
- suspending judgement
- avoiding put-downs

These skills can be modeled and explicitly taught. During group work, teachers can provide oral feedback and reinforce expectations.

Bennett and Rolheiser (2001) note additional considerations:

- the level of thinking required in a Think-Pair-Share
- accountability and level of risk, e.g., are all students expected to share with the whole group? (page 94)

See **Think Literacy Cross-Curricular Approaches, Grades 7-12**, pages 152-153.

Bennett, Barrie, and Rolheiser, Carol (2001). *Beyond Monet: The artful science of instructional integration.* Ajax, ON: Bookation.

Building Academic Knowledge

Students are required to learn considerable specialized academic vocabulary in science. Many of these words are multi-syllabic and rarely are used in daily conversation. Knowing a definition is not synonymous with knowing a word or concept. The following are guidelines for effective vocabulary instruction:

- Be selective about terms. Focus on key concepts and words students will be using during the unit of study. Include proper names.
- Vocabulary building is incremental. Introduce words a few at a time.
- Match correct pronunciation to the written word so that what students hear is reinforced by what they see.
- Pair words with visual symbols, (e.g., on word walls).
- Incorporate words into instruction so that students hear words used in context.
- Using words frequently: students require hearing and using words at least half a dozen times.
- Use research-based vocabulary building activities, (e.g., semantic maps that identify related words, word parts, what it's not, examples of how it's used).
- Cluster words,(e.g., in word walls and concept maps), to show students how words are related to one another.
- Incorporate activities that focus on words, (e.g., Share One, Get One).

Reading Strategies

Maps are graphical texts that need to be explicitly taught, just like other kinds of text. A mini-lesson could serve the following:

- Increase students' awareness of kinds of maps, (e.g., topographical, thematic, abstract - subway system maps).
- Increase students' awareness of the structure of maps. Point out that maps are examples of intersected lists, i.e. each location is found at the intersection of 2 axes. Use this structure to locate specific information on the map.
- Orient students to maps as you would for any text, (e.g., pointing out features and conventions like titles and symbol keys).
- Consider whether or not the map is "considerate" (helpful to a reader) or "inconsiderate" (complex or poorly designed). Anticipate what will be challenging to students about this map and model and explicitly teach strategies for coping with these challenges.
- Readers and users of maps interpret them. Use comprehension strategies similar to other kinds of text, (e.g., access prior knowledge, make and adjust predictions, use strategies such as graphic organizers or jot notes to hold thinking, make inferences, monitor comprehension).

Cross-section diagrams are another type of graphical text that needs to be explicitly taught. Students need time to become aware of and practise constructing meaning.

- Orient students to the convention of the cross-section, using an analogy, (e.g. showing a slice of layer cake).
- Prompt students to make connections with prior knowledge, (e.g., of the water cycle).
- Labels can be challenging because they often include specialized vocabulary and because their hierarchical relationships need to be made explicit, (e.g., title, headings, subheadings, details).
- Cross-section diagrams are often complex and challenging because they are abstract and representative, (e.g., not only does the sample in this lesson include a lot of detail, it also represents abstract processes).
- This cross-section diagram shows representative details, (e.g., rural, urban and natural landscapes).

See **Think Literacy: Cross-Curricular Approaches, Grades 7-12,** *Reading Strategies*.

Examples of **guiding questions**

- What is the name of your watershed?
- Into what body of water does it drain?
- In what ocean watershed is it located?

Examples of **potential negative impacts**

- factories that might produce heavy metals
- run-off from crop and forest land
- failing septic systems
- construction sites
- irrigation drainage systems
- automobile exhaust
- industrial pollution
- residential use of pesticides

Action!

Ontario Watersheds

In Ontario most of us live in a closed watershed – the water from our watershed drains into an inland body of water. In an open watershed, the water drains directly into an ocean.

Teachers could research the local community to provide information not easily inferred from the cross-section and map.

Investigation

The next step is to use problem solving, rather than pre-prepared instructions, to build a model. Provide parameters, (e.g., students must slope "land" towards a large body of water, must include plant life).

Explanation: This investigation demonstrates how the water cycle and how watersheds work. It also offers opportunities for explanations, such as:

- what paths precipitation takes from cloud to upper watershed to river to estuaries and finally the sea
- how the land and lakes dry up
- how flowing water takes the path of least resistance
- what erosion is and how it occurs
- what happens when the flow of water is altered
- how the water cycle affects the landscape

Suggestion: In addition to discussing concepts separately, show how they are interconnected.

Elaboration: Discuss real-world issues, such as:

- how the creation of dams and cities on the watershed and the addition of pollutants show anthropogenic effects on the watershed scale
- the costs and benefits of water retention in reservoirs and the production of energy by hydroelectric dams
- the effects of pollution on a watershed

Evaluation: Provide a formal description of the scientific method, (e.g., in a checklist), so students can self-assess the degree to which their investigative process has demonstrated the method.

Instructions for Building a Watershed Model

Technological Problem Solving Skills Continuum

See **The Ontario Curriculum, Grades 1-8: Science and Technology** (Revised, 2007), pages 17-18, for a technological problem-solving skills continuum. The continuum describes the development of skills such as making a plan for a design solution and testing the model.

Anchor Charts

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.

RAFT

RAFT (Role, Audience, Format, Topic) or **RAFTS** (Role, Audience, Format, Topic, Strong Verb) is a graphic organizer used for planning. Students use this tool to explore the role they will take on as creators, the audience they will address, the varied formats for their product, and the topic.

A RAFT establishes a context for writing by focusing on the dynamic connections between author, audience, topic, form, and purpose that are at the heart of communication. As with other graphic organizers, RAFT provides a framework to consider the various components (i.e., Role, Audience, Format, and Topic) as well as the relationships between them. RAFT can be used as a planning tool for media, written, and oral communication.

See **Student Success DI Package 2007, DI Cue Cards: Structures – RAFTs**.

See **Think Literacy Subject-Specific Examples**, *Language/English, Grades 7-9, Generating Ideas: Setting the Context*, pp. 32-37.

RAFTS

Role	Member of scientific research team
Audience	Research community, i.e., classmates, who have also conducted investigations on watershed models. They will have background knowledge.
Form	Chart paper summary • Visible to the whole class • Legible • Clear topic, e.g., title • Concise and organized summary of findings, e.g., table, with labels Oral report • Identification of team • Identification of topic and purpose of investigation • Hypotheses • What the data means
Topic	Communication of watershed investigation findings
Strong Verb	Communicate!

Consolidation

Question Prompts for Taking a Critical Literacy Stance

- Who produced the video? What are their credentials? How credible is the video?
- Whose interests does it serve?
- What information is included? What information is omitted?
- Whose perspectives are included? Whose are missing?
- What values and beliefs do the producers seem to have?
- What view of the world do they present?
- What techniques do they use to influence their audience?

Making a Watershed

Objective: To learn about watersheds and the water cycle

Time Allotment: 100 minutes

Materials:

Modeling clay (2 colors)	Waterproof trays	Water
Plastic cup with holes	Measuring cup	Paper towels
Sand	Pea gravel	Cotton balls
Food colouring	Newspaper	

Questions to Ponder:

- What can happen in a community when there is a major precipitation event?
- What do you think causes all the flooding?
- Why doesn't it normally flood in your community when there are storms?

Instructions for Building Your Model

1. Using the waterproof container as your base, heap the pea gravel at both ends of the container, sloping towards the "ocean" in the middle. Use sand and crumpled up newspaper to construct hills, valleys, and ridges in your model. Cover the model with clear plastic. Tape the plastic to the sides of the container to prevent water from running down the insides.
2. Use the modeling clay to cover part of the plastic on one side of the container. Use a marker on the plastic cover to add lakes and rivers. You can add plastic houses and trees.
3. Make sure that the landscape generally slopes down towards the ocean.
4. Add sand and gravel to some low points to represent an ocean beach.

Be Prepared!

Have paper towels handy to prevent mess and to clean up the modeling clay.

Instructions for Conducting Your Investigation

1. Hypothesize what will happen to water that "rains" down on the model. Record your hypothesis.
2. Use a spray bottle, or a cup with four holes poked through the bottom as a "rain maker." "Rain" a measured amount of water, i.e. 400 ml, onto the landscape by pouring the water into the 'rain maker' and then moving the cup over the landscape to simulate a rain cloud.
3. Observe what happens to the rainwater, to the land, and to the modeling clay dyes. Record your observations.
4. Remove the water from the container.
5. Revise your hypothesis, if necessary, and record your revision.
6. Use a different color of modeling clay to construct a dam and a small town. Add one or two cotton balls soaked in food dye to represent pollution/contaminants.
7. Use a measured amount of water and the rainmaker to create a second rainstorm. Observe what happens to the water, land, and dyes.
8. Repeat, using the same amount of water as for the first storm.
9. Observe and record what happens to the water, land, and dyes.
10. Revise your hypothesis, if necessary.

Interpreting your data

- Look for patterns in the data.
- Look for anomalies.
- Make connections with what you already know.
- Draw and record conclusions.