Where in the World Does Our Water Go? Lesson 5

Grade 8, Science and Technology

Critical Learning

- Life on Earth is dependent on water and variations in its availability.
- Earth's water cycle controls the distribution of water, which is always in movement and always changing states from liquid to vapour to ice and back again.
- The water cycle, along with other physical, chemical, and biological processes, helps to sustain ecosystems. It also influences climate.
- Human activities have an impact on the natural distribution system and the quality of water within the Earth's systems.

Guiding Questions

- In what states does water exist?
- If there is never any new water, how can we explain melting and evaporation?
- How do large bodies of water, like the Great Lakes or Hudson Bay, influence the climate of surrounding places?

Curriculum Expectations

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

3.1 identify the various states of water on the earth's surface, their distribution, relative amounts, and circulation, and the conditions under which they exist (e.g., water is a solid in glaciers, snow, and polar ice-caps: a liquid in oceans, lakes, rivers, and aquifers: and a gas in the atmosphere)

3.5 explain changes in atmospheric conditions caused by the presence of bodies of water (e.g., differences in temperature near large bodies of water; microclimates; storms off coastal areas)

Learning Goals

Students will be able to:

- identify the various states of water and how they are distributed around the world
- describe how lakes and oceans affect the weather in places close to them

Instructional Components and Context

Readiness

- Active listening strategies
- Read-Alouds
- Think-Pair-Share
- Vocabulary strategies
- Making predictions/hypothesis
- Particle theory of matter:
- States of matter
- Solid
- Liquid
- Gas
- Organizing information using a graphic organizer
- Observation protocols

Terminology

- State, especially as contrasted to cyclic "process" and "phase"
- Groundwater
- Water cycle vocabulary:
  - Transpiration
  - Respiration
  - Evaporation
  - Condensation
  - Precipitation
  - Infiltration
  - Collection

Materials

- Access to computers and the Internet
- Picture book related to the water cycle
- Word cards for the word wall
- Templates for vocabulary strategies
- Sample types of science text forms, e.g., schematic and table

For each group:

- Model building instructions cut into strips and put in an envelope
- A large cue card
- Glue sticks
- A blank piece of paper
- A jar, e.g. large canning jar

For each jar:

- enough small rocks to cover the bottom of the jar
- sand
- a small plant
- water

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Minds On (Elicit and Engage)

Whole Class/Pairs → Conceptualizing the Water Cycle

Students refer to notes on states of water they noted in their home. Revisit pictures posted in the room from Lesson 1, noting water states illustrated, e.g., liquid in lakes and from taps; solid in glaciers and hail; gas in clouds and steam. Challenge students to estimate how much of the earth's fresh water is solid (77%), and how much liquid is in groundwater and the soil (22%). Students share thinking in a **Think-Pair-Share**.

Emphasize that "there is no new water;" rather, water constantly changes state. Students use a Think-Pair-Share or a **KWL** strategy to access prior knowledge about the water cycle. **Read-aloud** a **picture book**, e.g., *The Snowflake: A Water Cycle* Story by Neil Waldman, to (1) review states of matter and (2) identify water cycle components and process. Refer to illustrations/images to scaffold understanding. Facilitate a **discussion** of the effectiveness of this form for communicating science information.

Show and juxtapose prepared samples of various kinds of text about the water cycle, e.g., table and schematic for parts of the water cycle. Discuss how these graphic forms differ, e.g., in purpose and convention. Review water cycle vocabulary using **academic vocabulary strategies** and add vocabulary to the **Word Wall**.

Show students a model car or airplane. **Discuss** what a model is and why models are important in science and technology, e.g., to see what you wouldn't otherwise be able to observe. Share learning goals.

Pause and Ponder

QuickTip Use information from reading inventories or teacher-student conferences to inform how much explicit teaching of text forms is necessary.

Consider the **Strategy Implementation Continuum** as an instructional planning framework.

Action! (Explore and Explain)

Investigation and Research Teams → Building the Model

Distribute an envelope containing the model-building **instructions** cut into strips, a large cue card, and a glue stick to each team. Teams sequence strips using verbal cues and general knowledge. They draw what the model will look like based on the instructions. Discuss **criteria for model building**. A volunteer shares a sketch of the model so students can confirm their understanding and check their instruction sequence. Briefly discuss which clues signaled the correct order. Using their understanding of water states and the water cycle, teams develop a hypothesis about what will happen to their model as it warms in the sun.

Teams build their models with the materials provided and place in a warm, preferably sunny, location. Students write their hypothesis and reasoning in their What do I care? Water Portfolio.

Individual → Representing Understanding

Students search the Internet for three diagrams of the water cycle. Referring to all three sources, they represent the cycle in one of the following: (1) flow chart, (2) story of a water drop, (3) list of steps, using vocabulary from the word wall, (4) graphic organizer, e.g., using software such as Smart Ideas or Inspiration, or (5) **storyboard**. These choices can be presented in a **Choice Board**. Encourage students to use their group members as resources and add their representation to their Water Portfolio.

QuickTip
See **Reading strategies** and the **Inquiry/Experimentation Skills Continuum**.

A for L Provide feedback on students' conceptual understanding, ability to develop a reasoned and informed hypothesis based on prior knowledge, and ability to consolidate relevant information from multiple sources. Note students requiring guided practice. Collect and assess for learning.

Consolidation (Elaborate, Evaluate, Extend)

Investigation and Research Teams → Summarizing Information

Students collaboratively summarize what they have learned about the water cycle on the **graphic organizer Water Changes of State** for their portfolio (each completing a copy). Teams discuss the relevance of the lesson to their topic/couplet.

QuickTip
Adjust methods of representation and consolidation to reflect forms in which students are interested for the performance task.

See **sample consolidation and extension activities**.

Next Lesson Connection

Teams record observations of their model in their portfolio over several days. Remind students of guidelines for careful, accurate observation and scientific habits of mind. Cue students to compare their predictions and observations, consider what agreement or discrepancies might mean, and revise as necessary.

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:

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

KWL

The **K**now-**W**ant to **K**now-**L**earned (KWL) strategy (Ogle, 1986) is linked to the before, during, and after framework. The "Know" column prompts students to activate and inventory prior knowledge. The "Want to Know" column prompts students to generate inquiry questions that provide a purpose for reading. The "Learned" column prompts students to summarize and consolidate their learning. KWL's can be completed individually or collaboratively.

Variations include:

- reconfiguring the usual 3-column organizer as a 3-part square, with "Know" across the top and "Want to Know" and "Learned" juxtaposed beneath
- adding columns, e.g., "Future" ("How I will apply this learning in the future")

Whatever the format, it's important to recognize that the three parts are dynamically related. "Want to Know" questions arise out of what is known (implies what is yet to become known) and "Learned" summaries represent what has been discovered and understood in response to those questions.

The KWL strategy reflects key Literacy GAINS principles, e.g., exposing and evoking students' thinking in order to respond with appropriate levels of challenge and support. The strategy also supports an inclusive classroom environment and differentiated instruction by permitting a range of access, or entry, points for students along a continuum of difficulty, depending on the questions asked.

Online resources include the following:
Instructional reading strategy: **KWL (Know, Want to Know, Learned)**. L517: Advanced Study of the Teaching of Secondary School
KWL. North Central Regional Educational Laboratory. Learning Point Associates.
Strategies for Reading Comprehension: K-W-L. ReadingQuest.org.

Read Aloud

A Read-Aloud is a planned oral reading of a text that relates to the topic of study.

Read-Alouds:

- share the joy of reading and create a shared experience
- engage students, e.g., those for whom narrative is an entry point
- build background knowledge
- model fluent reading, e.g., phrasing, pronunciation, emphasis
- model, in a Think-Aloud, use of reading comprehension strategies
- introduce concepts
- increase vocabulary
- build listening skills
- make abstract concepts and explanations concrete
- expand students' familiarity with a range of texts
- can serve as a springboard to discussion, writing or hands-on experiments

Suggestions for incorporating Read-Alouds into instruction include:

- rehearsing reading aloud text to maximize fluency and expression
- introducing the story by title, author and topic
- creating an atmosphere conducive to listening
- pre-planning the focus of instruction, i.e., the purpose for reading aloud that particular book
- pre-planning open-ended questions to stimulate imagination and critical thinking
- sharing illustrations
- controlling the pace so that students can absorb what they're hearing
- encouraging students to talk about the book after the reading, in order to make connections to their own knowledge and experience

Sample Instructional Decision Making Think-Aloud

"One of my instructional goals is to provide students with a range of entry points to my lessons. Narrative is more familiar to students than informational writing and is therefore more accessible to more students. This is especially true for students who either respond particularly well to narrative or who are struggling with informational text.

A Read-Aloud also allows my students to experience the power of narrative. By selecting the Read-Aloud text carefully and rehearsing, my reading can model enjoyment of text and also pronunciation, phrasing, emphasis, and reading for meaning. My reading can enhance the beauty of language.

It's also important to understand the range of ways we can represent and communicate our knowledge and understanding, and can write for different purposes and audiences.

Finally, by introducing narrative we lay some groundwork for student choices in the culminating performance task."

Picture Books

River Story by Meredith Hooper uses iridescent watercolors and lyrical text to tell the story of a river's journey from mountain to sea. A good student shelf book for the elementary classroom. ISBN 0-7636-0792-4

The Drop In My Drink: The Story of Water On Our Planet by Meredith Hooper and Chris Coady combines water and earth history nicely to give students a perspective of the lasting nature of the water from our faucet that we often take for granted. ISBN 0-670-87618-6

Tomas Locker's ***Water Dance*** is a beautiful picture book with an unusual introduction to the water cycle. Using free-verse narrative and full-page paintings, the book follows water through various forms: "I am rain," "I am lake," "I am clouds." The book concludes with four pages of each painting in miniature accompanied by text explaining each form of water or phase in the water cycle. The book is a wonderful integration of literature (poetry) and the water cycle. It is an excellent read-aloud book. ISBN 0-15-201284-2

The Water's Journey by Eleonore Schmid uses majestic paintings and simple poetic text to take readers on a journey from melting mountain snow to the ocean. A nice read-aloud for the elementary classroom. ISBN 1-55858-013-1

Before-Read-Aloud Sample Script

Identify activity, title, and author.	"I'm going to read you a story about water called *The Snowflake: A Water Cycle Story* by Neil Waldman.
Cue • purposes for listening • listening strategies, and • use of visualization strategy	We're reading this story in order to connect to what you already know and to build understanding of the water cycle. Select 1 or 2 listening strategies from our anchor chart to practise. As I'm reading, I'll show you the illustrations. Your job is to see in your mind's eye water in its various states and in its transition phases.
Cue awareness of alternative forms of representation and communication (in preparation for culminating performance task).	Also, consider how the illustrator chose to depict the science of water in this beautiful book. Imagine other ways we might communicate the science of the water cycle."

Discussion

- Which listening strategies did some of you practise? (minimizing distractions, consciously focusing attention, listening with a purpose, 'listening' to the reader's voice and body language as well as to the words, monitoring your understanding)
- Were you able to visualize the water cycle? What helped or hindered your visualization?
- Did you find yourself paying more attention to the words or to the illustrations or to both together? What does this suggest to you about strategies you can use to support your learning?
- How well did the picture book help you understand the water cycle? Does it make the information memorable? Why?
- Do you think a picture book is an appropriate way to learn? Is it appropriate for a science lesson? Why or why not?
- How is a picture book similar to or different from a science textbook? For example, with respect to:
    - the author's purpose
    - the way information is organized
    - the kind of words and expressions used
    - techniques for making the information interesting and memorable
    - the way visuals are used
    - the strategies you use to understand
- What ways, other than words and sentences, do science writers use to represent, summarize and communicate information? (schematics, cross-section diagrams, flow charts, photographs, various kinds of graphs, maps and tables).
- What kind of text do you prefer? (story, information, or persuasion, words and sentences, graphs, tables or graphics)

Academic Vocabulary Strategies

Students are required to learn a lot of specialized academic vocabulary in science. Many of these words are multisyllabic and rarely 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.
- 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.

Resources

Allen, Janet (1999). *Words, Words, Words: Teaching Vocabulary in Grades 6-12.* Stenhouse.

Marzano, Robert J. (2004). *Building Background Knowledge for Academic Achievement.* Alexandria, VA: ASCD.

Marzano, Robert J.; Pickering, Debra J.; and Pollock, Jane E. (2001). *Classroom Instruction that Works: Research-based strategies for increasing student achievement.* Alexandria, VA: ASCD.

Word Wall

A word wall is an organized array of words important to the topic being studied. To be effective, word walls must be:

- visible
- accessible
- selective
- incremental, adding only 5-7 words at a time
- explicitly taught

A word wall can serve as:

- a focus for vocabulary building
- a scaffold for conversation and reading and writing activities
- a visual map to show relationships among words

Teachers need to incorporate words regularly into instruction, cue students to use the word wall, and integrate the word wall into vocabulary building activities. In other words, the word wall is interactive, more than a display. It is possible to maximize this aspect of word walls by creating laminated word cards that can be moved around, removed, and used.

See **Think Literacy Subject-Specific Examples: Science and Technology**.

Action

Instructions

- Fill the bottom of the jar with small rocks.
- Add a layer of sand on top of the rocks.
- Add a small plant to the sand.
- Fill a small container with water and place it in the jar beside the plant.
- Put the lid securely on the jar.
- Place the model in a sunny window.
- Observe what happens.

Criteria for Model Building

- Students have a labeled plan and/or a design drawing for the model.
- The drawing shows all the required elements of the model.
- Materials used in the model show consideration for the environment, e.g., use of recycled/recyclable materials, disposal of materials.
- The model respects the constraints of the project, e.g., amount and types of materials used, dimensions, etc.
- The model is complete and is a realistic, accurate representation of the intended object.

Reading Strategies

Even though the instructions are simple, this activity uses a number of reading strategies:

- engages students in productive talk
- provides an opportunity to collaboratively construct understanding
- increases awareness of signal words that cue them to text organization (an important aspect of making meaning)
- prompts students to visualize, and
- establishes a mental set before beginning model building

Inquiry/Experimentation Skills Continuum

The continuum describes the development of skills such as hypothesizing and drawing conclusions based on observations.
See **The Ontario Curriculum, Grades 1-8: Science and Technology** *(Revised, 2007)*, pages 13-14.

Story Board

Storyboards are a visualization and organizational tool used, for example, for planning video or film productions. Storyboards juxtapose visual image and word text. They help with the "flow" of information and so are suited to process or action. There are many forms of storyboards, but a simple approach could look like this:

Series of visual images, or verbal descriptions of images	Audio, e.g., sound effects or music	Word text, e.g., a narrator's voice over

Choice Boards are an instructional strategy for differentiating instruction. Students self-select from a menu of options. Choice is related to motivation, because it allows students to select according to their interests, learning preferences, and degree of challenge. It also helps develop self-regulated, independent learners who have some control over their learning process. For this activity, options may include ICT, e.g., Inspiration or Smart Ideas. Choice Boards are most effective when both the choice board strategy and each of the options have been explicitly taught and practised and when students are enabled to make informed choices, e.g., based on understanding of their learning preferences. Each choice must have clear assessment criteria. They are closely related to assessment as learning.

Consolidation and Extension Activities

Water Cycle Changes of State Organizer

Phase	Description – what happens in this phase of the water cycle? Is water rising, falling, etc.?	Is heat added or removed?	State of Water (solid/liquid/gas) Starts as …Changes to
Transpiration			
Respiration			
Evaporation			
Condensation			
Precipitation			
Infiltration			
Collection			

Share One-Get One (version 2):

Purpose: To review water cycle vocabulary

Method: Students get or draw a nine-by-nine grid. In the top three squares, they put three facts or ideas from the lesson, reading, or other sources. Students circulate, comparing notes with a series of partners and recording facts or ideas from others in the blank squares. No student may contribute more than one idea to a given student, and no student may repeat any ideas in his/her squares. Cue students to use scaffolds, e.g., pictures from lesson 1, picture book, word wall, and water cycle notes.

Share One-Get One

Table Bingo

Purpose: To review concepts

Method: Display a blank Water Cycle Changes of State table on an overhead projector or interactive white board.

Display question words or provide students with a question matrix. (See, for example, Sandi Zwaan and Carol Koechlin (2006), Q-Tasks: How to empower students to ask questions and care about answers. Markham, ON: Pembroke.)

Place a disk counter or other marker on a cell of the table.

Students generate a question to elicit the information that would be in that cell.

Depending on readiness, students might generate questions in teams that the other team, consulting to come to consensus on a response, has to answer.

Conversation Starters

Purpose: To increase awareness of the unique nature of water and perfect balance of the water cycle on earth

Method: Prepare a set of cloud-shaped mini-posters with "fun" facts and questions about water on them. Use these to initiate exploratory discussion about states of matter:

- What would happen if water froze at 10 degrees Centigrade instead of 0 degrees Centigrade?
- How can we explain that we might be drinking the same water as dinosaurs drank millions of years ago?
- Water is the only substance on earth that naturally occurs in all 3 states.
- Water dissolves more substances than any other liquid.
- Much more fresh water is stored under the ground in aquifers than on the earth's surface.
- The earth is a closed system, similar to a terrarium, meaning that the same water that existed on the earth millions of years ago is still present today.