INVESTIGATING LOCAL WATER
AN INQUIRY FRAMEWORK FOR TEACHERS

TEACHER RESOURCES:

A. Classroom Resources for Learning About Water

- Wonder Center
- Water Journals
- Water Questions
- Vocabulary
Wonder/Knowledge Building Center

The wonder center will be the hub of classroom inquiry and group theory building. The center is a place where students can do research, update the large map of the school grounds, build on ideas posted on the knowledge board, enter data on a weather chart, or record questions they may have that were not addressed during small-group work or class discourse. This is also a space where students can go to work independently.

Such a center should have a number of resources for students to learn more about water. The wonder center should help students launch their imaginations and extend their inquiries, taking them beyond the classroom environment in their thinking about water. Possible resources stationed in the center are:

- The large classroom map of the school grounds
- A board or chart paper to record ideas and track changes in thinking (knowledge building board)
- A growing library of water-related books, including poetry, non-fiction, fiction and artwork
- Materials such as journal pages and art materials
- A blank class notebook marked with the prompts “I wonder” and “I notice”
- A running list of new vocabulary words
- A bulletin board to display student artwork, poetry and photos taken at school or at home
- A place to display current event information related to the topic of water
- A place to display hands-on science experiments such as water evaporating from a dish.
Water Journals

There are many advantages to using journals as a tool for tracking changes in student thinking. Journal prompts may include the use of scientific, literary, mathematical, or artistic skills to ensure that the study of water encompasses different academic disciplines. Recording information in their journals will help students to develop close observational skills, and teach them about effective ways of recording data. They are extremely flexible tools, which may be student-made booklets that grow over the course of the investigation, or simple spiral notebooks. Teachers can choose from prompts provided here, or create their own pages. Overall, the goal is to have students construct a physical record of how their thinking about water is changing over the course of their learning adventure.

In order to create such a record, students should write observations, ideas, and questions in their journals, either during their learning adventures or shortly afterwards. These journals offer students a chance to reflect on what they saw, and the theories that they have begun to build alone or in groups. With careful scaffolding, journaling will exemplify a journey in meta-cognitive exercises. Students will build an awareness of the group’s emerging theories and an understanding of how they solved the problem posed by the learning adventures. Teachers will be able to assess student growth based on the quality and development of these journal entries.

We have complied a list of several possible aspects to include in water journals:

- Record date, time, location, and weather for outdoor explorations
- Notes from investigations: prompt may be open-ended (“I notice”) or guided (specific questions)
- Student questions to follow up with research and/or creative expression (“I wonder”)
- Drawings, maps, and other visual representations of investigations and theories
- Sensory descriptions (“I See, I Hear, I Feel, I Smell, I Taste”)
- Reflective writing focused on idea development (“What we learned from the investigation”)
- Meta-cognitive prompts such as: ‘I used to think / Now I think…’
- Poetry (original or a reflection on a water-themed poem)
- Interesting statistics or news headlines about water
- Photos taken on the school grounds, along with captions or explanations
- Recording and using vocabulary words

Runoff

Precipitation.
Runoff goes to the ocean.
It evaporates.

Karielys, 5th Grade
Sullivan Elementary School, Holyoke, MA
Water Questions

Big questions about water:
- Where does water come from?
- Where does water go?
- Can the Earth get more water? Why or why not?
- Who owns water?
- Who owns fish in the river?
- Who is responsible for keeping a river clean?
- Why is hydrology and what do hydrologists do?
- What are some of the ways scientists determine the health of a river, lake, or ocean?
- How can dirty water get clean?
- Who decides how much water people can use?
- What actions can all of us take to keep our water clean? To conserve water?
- “All of the water of the world, is all of the water of the world”: What do you think this means?
- Why is water important?
- What are some different forms of water?
- How does water move? Where does it go?
- How does rainwater get to rivers?
- How does water shape land?
- Where is water stored?
- How does water act differently when it’s hot versus when it’s cold?
- What happens to the water in your pipes if one of your pipes is leaking?
- Why does water evaporate when the sun comes out? When/where have you seen evaporation?

Observation Questions for Outdoor Investigations:
- How does water move?
- Where do you see water or signs of water on the school grounds?
- Where does water go after it rains? What reasons do you have for thinking this?
- Does it matter where rain lands? Why or why not?
- Does it make a difference if it’s pouring or drizzling?
- Why does water sometimes bounce when it hits the ground? Where do you see this?
- Why are there puddles? What happens to puddles?
- Why are there wet spots? Where are there wet spots (on the playground) and why?
- What surfaces soak up water?
- What surfaces does water run off?
- Where does rain water collect?
- When water flows what moves with it? When have you seen water carry things?
Water Questions (cont’d)

Questions about stormwater runoff
- What is stormwater runoff?
- What is polluted runoff?
- What is nonpoint source pollution?
- What causes polluted stormwater runoff?
- Why do we need to manage stormwater and polluted runoff?
- How are stormwater and runoff "managed"?
- Why all the recent fuss about stormwater?
- If it only affects streams and creeks, why should I care?
- What is a stormwater fee and why do I have one?
- How does this benefit the average taxpayer?
- What can I do to reduce the amount of stormwater pollution I contribute?
- How else can I help reduce stormwater pollution in my area?

Questions about watersheds:
- Who lives in a watershed?
- Is every place in the world part of a watershed?
- What’s your “watershed address”?
  · (Surf your watershed http://cfpub.epa.gov/surf/locate/index.cfm)
- What are the stories in your watershed?
- Where does your community’s drinking water come from?
- Where does your community’s stormwater go?
- Where does your community’s wastewater go?
- How can surface water become polluted?
- How are groundwater and surface water connected?
- How can groundwater become polluted?
- How does the water cycle relate to weather?
- What actions can all of us take to keep our water clean? To conserve water?
- What role do forests and wetlands play in a watershed?
Aquifer: (noun) a layer of rock, sand, or earth that contains water or allows water to pass through it

Evaporation: (verb) to change from a liquid into a gas

Combined Sewer Overflow (CSO): (noun) the discharge from a combined sewer system that is caused by snowmelt or storm water runoff

Combined Sewer Systems: (noun) sewer systems that are designed to collect storm water runoff, domestic sewage, and industrial wastewater in the same pipe and bring it to the publicly owned treatment facilities. During rain events, when storm water enters the sewers, the capacity of the sewer system may be exceeded and the excess water will be discharged directly to a waterbody (rivers, streams, estuaries, and coastal waters).

Condensation: (noun) the process by which a gas cools and becomes a liquid

Connecticut River: (proper noun) largest river in New England flowing from Northern New Hampshire, through Vermont, Massachusetts, and Connecticut to the Long Island Sound

Flow: (verb) to move in a steady and continuous way

Freshwater: (adjective) of, relating to, or living in water that is not salty

Groundwater: (noun) water that collects below the surface of the earth

Groundwater Contaminant Plume: (noun) A mixture of waste chemicals and groundwater, usually in solution form

Infiltration: (noun) (of water) to flow slowly down into the earth from the earth’s surface, for example, through cracks in rocks

Layers: (noun) a thin sheet of a substance on top of a surface, or a level of material that is different from the material on either side

Pollution: (noun) damage caused to water, air, etc. by harmful substances or waste:

Precipitation: (noun) water that falls to the ground as Rain, Hail, Sleet, or Snow

Runoff: (noun) water from rain or snow that flows over the surface of the ground into streams

Saltwater: (adjective) of, relating to, or living in salt water

Septic Systems: (noun) method for collecting, treating, and disposing of sewage from rural and suburban homes.

Spring: (noun) a place where water flows out from the ground:

Storm Drain: (noun) a drain carrying waste water other than sewage from a building to a storm sewer

Surface Water: (noun) water that is on the Earth’s surface, such as in a stream, river, lake, or reservoir

Toxic Waste: (noun) chemical compounds produced by industry, which if they are ingested or breathed in by humans, can cause physiological damage

Underground Storage Tanks: (noun) one or a combination of tanks that have 10% or more of their volume below the surface of the ground in which they are installed

Water Table: (noun) the layer below the earth’s surface where water is found

Well (drinking water): (noun) an artificial excavation put down by any method for the purposes of withdrawing water from the underground aquifers.

Watershed: (noun) an area of land in which where all of the water that falls in it and drains off of it goes into the same place.
Sources of Water Pollution in Connecticut River Watershed:

- Toxic Waste
- Sewage
- Trash and Litter
- Pesticides
- Fertilizers
- Road Sand and Salt
- Animal (especially dog) scat

Fish of the Connecticut River:

[Images of fish species]

Sea Lamprey (parasitic phase)  Sea Lamprey (mouth)

Shortnose sturgeon

Sources:


Hughes, S. Environmental Geology 306/506: Groundwater Contaminant Plumes. Pocatello: Idaho State University, n.d. PDF.


"Where Does Your Water Go?" Vocabulary
Enchanted Circle Theater Page 2 of 2
TEACHER RESOURCES:

B. Inquiry and Collaboration Tools

- B.R.A.V.E. Rubric for Group Talk
- Knowledge Building Discourse & Principles
- Visible Thinking Routines
  - ‘I Used to Think,… Now I Think’
  - ‘Think/Puzzle/Explore’
- Visual Thinking Strategies
**B**uild on others’ ideas

**R**isk a half-formed thought

**A**sk good questions – especially about reasons

**V**alue others’ contributions

**E**use Evidence to support what you say

---

**Words of Power**

- what would happen
- why
- I think...
- what if
- suppose
- because
- I wonder
- reasons
What is Knowledge Building (KB) Discourse?

Another key component of the inquiry process is Knowledge Building Discourse, a communal activity in which learners come together to pose questions, posit theories, and to revisit, negotiate, and refine their ideas. The collective goal is ‘idea improvement’. Knowledge Building Discourse “serves to identify shared problems and gaps in understanding and to advance the understanding beyond the level of the most knowledgeable individual” (Scardamalia, 2002, p. 12).

Knowledge Building Discourse builds upon a long tradition of classroom discussion, with a focus on deepening students’ understanding through increased exposure to the diverse perspectives and ideas of the class. It is a class discussion time that is specifically reserved for working out students’ emergent questions and ideas, rather than a teacher-directed forum for eliciting ‘correct’ answers to curriculum-based questions. What typically emerge from Knowledge Building Discourse are students’ new/unresolved questions or theories, which in turn serve as entry points for further investigation.

Knowledge Building Discourse differs from traditional classroom discussion in several important ways as outlined in Table 2.

Table 2: The Unique Role of Knowledge Building Discourse in Inquiry-based Learning

<table>
<thead>
<tr>
<th>Discourse, rather than content delivery, shapes the direction and manner of learning.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The teacher does not necessarily know in advance all of the questions and answers that may emerge from student discourse.</td>
</tr>
<tr>
<td>The teacher nurtures student engagement by asking open-ended questions such as: “Did anyone notice/read/find out something that might help us understand our question?”</td>
</tr>
<tr>
<td>Students attempt to reconcile their own theories and ideas in light of new sources of information. Teachers support them in this process by asking questions such as: “How does that information support your theory? Have you changed or added to your theory?”</td>
</tr>
<tr>
<td>The teacher models and facilitates multi-directional dialogue to help students internalize and practise it themselves. “Does anyone have something to build onto Joseph’s idea? Joseph, please pass-on to another student.”</td>
</tr>
<tr>
<td>Table 1: The 12 Principles of Knowledge Building</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><strong>Real Ideas, Authentic Problems</strong></td>
</tr>
<tr>
<td>Knowledge problems arise from efforts to understand the world. Ideas produced or appropriated are considered as real as concrete objects that are touched and felt. Problems are ones that learners really care about — they are usually very different from problems presented in textbooks and puzzles.</td>
</tr>
<tr>
<td><strong>Improvable Ideas</strong></td>
</tr>
<tr>
<td>All ideas are treated as improvable. Participants work continuously to improve the quality, coherence, and utility of ideas. For such work to prosper, the learning culture must assure psychological safety, so that individuals feel safe in taking risks, revealing ignorance, voicing half-baked notions, and giving and receiving criticism.</td>
</tr>
<tr>
<td><strong>Idea Diversity</strong></td>
</tr>
<tr>
<td>Idea diversity is essential to knowledge advancement, just as biodiversity is essential to the success of an ecosystem. To fully understand an idea is to understand the ideas that surround it, including those that stand in contrast to it. An environment of diverse ideas and perspectives enables new and more refined ideas to evolve.</td>
</tr>
<tr>
<td><strong>Epistemic Agency</strong></td>
</tr>
<tr>
<td>Participants set forth their ideas and negotiate how they “fit” or compare with the ideas of others. They seize upon contrasting or different ideas to help them deepen their understanding instead of depending on others to chart that course for them. They take responsibility for issues (such as goal-setting, motivation, evaluation, and long-range planning) that are normally left to teachers or managers to resolve.</td>
</tr>
<tr>
<td><strong>Community Knowledge, Collective</strong></td>
</tr>
<tr>
<td>Contributions to the organization’s shared, top-level goals are prized and rewarded as much as individual achievements. Team members produce ideas of value to others and share responsibility for the overall advancement of community knowledge.</td>
</tr>
<tr>
<td><strong>Democratizing Knowledge</strong></td>
</tr>
<tr>
<td>All participants are considered legitimate contributors to the shared goals of the community. All take pride in the knowledge advances achieved by the group. The group’s diversity and divisions do not translate into hierarchies of “knowledge haves and have-nots” or “innovators and non-innovators”.</td>
</tr>
<tr>
<td><strong>Symmetric Knowledge Advance</strong></td>
</tr>
<tr>
<td>Expertise and knowledge are exchanged within and between communities. Symmetrical knowledge advancement results from this “give-and-take” of knowledge.</td>
</tr>
<tr>
<td><strong>Pervasive Knowledge Building</strong></td>
</tr>
<tr>
<td>Knowledge building is a pervasive, continuous process of learning, both in and out of school, rather than an activity relegated to particular occasions or subject areas.</td>
</tr>
<tr>
<td><strong>Constructive Uses of Authoritative Sources</strong></td>
</tr>
<tr>
<td>Up-to-date knowledge of a discipline requires continuous learning and reassessment. This can be achieved through the respectful use of, and critical stance toward, authoritative sources of knowledge.</td>
</tr>
<tr>
<td><strong>Knowledge Building Discourse</strong></td>
</tr>
<tr>
<td>The discourse of Knowledge Building Communities results in the sharing, refinement and transformation of knowledge. The explicit goal of these discursive practices is to advance the learning community’s knowledge.</td>
</tr>
<tr>
<td><strong>Embedded, Concurrent and Transformative Assessment</strong></td>
</tr>
<tr>
<td>Learning communities embed assessment in their day-to-day workings in order to identify problems in knowledge advancement. Through rigorous, finely-tuned assessment, they are able to achieve transformative outcomes that exceed the expectations of external assessors.</td>
</tr>
<tr>
<td><strong>Rise Above</strong></td>
</tr>
<tr>
<td>Creative knowledge building entails working toward more inclusive principles and higher-level formulations of problems. It means learning to work with diversity, complexity, and messiness, and from that, achieve new syntheses. By moving to higher planes of understanding, knowledge builders transcend trivialities and oversimplifications and reach beyond current best practices.</td>
</tr>
</tbody>
</table>

*Source: Scardamalia (2002)
I USED TO THINK..., BUT NOW I THINK...
A routine for reflecting on how and why our thinking has changed

Remind students of the topic you want them to consider. It could be the ideal itself—fairness, truth, understanding, or creativity—or it could be the unit you are studying. Have students write a response using each of the sentence stems:

- I used to think....
- But now, I think...

Purpose: What kind of thinking does this routine encourage?
This routine helps students to reflect on their thinking about a topic or issue and explore how and why that thinking has changed. It can be useful in consolidating new learning as students identify their new understandings, opinions, and beliefs. By examining and explaining how and why their thinking has changed, students are developing their reasoning abilities and recognizing cause and effect relationships.

Application: When and where can it be used?
This routine can be used whenever students’ initial thoughts, opinions, or beliefs are likely to have changed as a result of instruction or experience. For instance, after reading new information, watching a film, listening to a speaker, experiencing something new, having a class discussion, at the end of a unit of study, and so on.

Launch: What are some tips for starting and using this routine?
Explain to students that the purpose of this activity is to help them reflect on their thinking about the topic and to identify how their ideas have changed over time. For instance:

*When we began this study of ________, you all had some initial ideas about it and what it was all about. In just a few sentences, I want to write what it is that you used to think about ________. Take a minute to think back and then write down your response to “I used to think...”*

*Now, I want you to think about how your ideas about ________ have changed as a result of what we've been studying/doing/discussing. Again in just a few sentences write down what you now think about ________. Start your sentences with, “But now, I think...”*

Have students share and explain their shifts in thinking. Initially it is good to do this as a whole group so that you can probe students’ thinking and push them to explain. Once students become accustomed to explaining their thinking, students can share with one another in small groups or pairs.
THINK / PUZZLE / EXPLORE
A routine that sets the stage for deeper inquiry

1. What do you think you know about this topic?
2. What questions or puzzles do you have?
3. What does the topic make you want to explore?

Purpose: What kind of thinking does this routine encourage?
This routine activates prior knowledge, generates ideas and curiosity and sets the stage for deeper inquiry.

Application: When and where can it be used?
This routine works especially well when introducing a new topic, concept or theme in the classroom. It helps students take stock of what they already know and then pushes students to identify puzzling questions or areas of interest to pursue. Teachers can get a good sense of where students are on a conceptual level and, by returning to the routine over the course of study, they can identify development and progress. The third question is useful in helping students lay the ground work for independent inquiry.

Launch: What are some tips for starting and using this routine?
With the introduction of new topic—for example, earth, leaves, fractions, Buddhism—the class can engage in the routine together to create a group list of ideas. Between each phase of the routine, that is with each question, adequate time needs to be given for individuals to think and identify their ideas. You may even want to have students write down their individual ideas before sharing them out as a class. In some cases, you may want to have students carry out the routine individually on paper or in their heads before working on a new area.

Keep a visible record of students’ ideas. If you are working in a group, ask students to share some of their thoughts and collect a broad list of ideas about the topic on chart paper. Or students can write their individual responses on post-it notes and later add them to a class list of ideas.

Note that it is common for students to have misconceptions at this point—including them on the list so all ideas are available for consideration after further study. Students may at first list seemingly simplistic ideas and questions. Include these on the whole class list but push students to think about things that are truly puzzling or interesting to them.
Basic VTS at a Glance
by Abigail Housen and Philip Yenawine

Starting the Lesson

Introduce the VTS: it allows students to examine art, to think, to contribute observations and ideas, to listen, and to build understandings together. Ask students to recall these aspects of the process often.

Call students’ attention to the first image. Always give students a moment to look in silence before you invite them to speak.

Asking the Questions

After they have examined the image, ask the question, What’s going on in this picture? Once students have learned this question, use variations.

Whenever students make a comment that involves an interpretation (a comment that goes beyond identification and literal description), respond first by paraphrasing, and then ask, What do you see that makes you say that? Once students understand the point of this question, begin to vary it.

In order to keep students searching for further observations, frequently ask them, What else can you find? Again, variations are useful once students are familiar with the point of the question.

Responding to Students’ Comments

Listen carefully to students, making sure that you hear all of what they say and that you understand it accurately.

Point to what they mention in the slide. Be precise, even when it is a comment that has been repeated.

Use encouraging body language and facial expressions to nurture participation.
Paraphrase each comment. Change the wording, but not the meaning of what is said. In rephrasing, demonstrate the use of proper sentence construction and rich vocabulary to assist students with language.

Accept each comment neutrally. Remember that this process emphasizes a useful pattern of thinking, not right answers. Students are learning to make detailed observations, sorting out and applying what they know. Articulating their thoughts leads to growth even when they make mistakes.

Link answers that relate, even when there are disagreements. Show how the students’ thinking evolves, how some observations and ideas stimulate others, how opinions change and build.

Concluding the Lesson
Thank students for their participation. Tell them what you particularly enjoyed. Encourage them to think of viewing art as an ongoing, open-ended process. Avoid summaries; linking throughout is enough to show how conversations build.
TEACHER RESOURCES:

C. **Maps of School Grounds** (Jackson Street School)

- Contours
- Drainage
- Impervious Surfaces