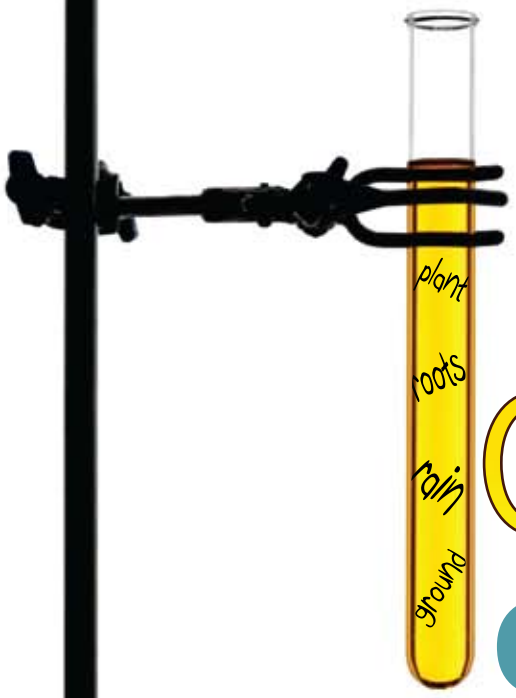


A laboratory of words

Using science notebook entries as preassessment creates opportunities to adapt teaching.

By Jeanne Clidas

"Living things move and make a sound. For example, a cat moves its feet to make it go from place to place and it says meow. A tree is a living thing too. So are people, dogs, plants, and bugs."

This is an entry from one of my student's science notebook in which he responded to my question, "How do you know if something is alive?" Like his fourth-grade classmates, this student brings a wealth of knowledge to each new science inquiry. The background knowledge of my students varies depending on their past experiences, but each one usually has something to contribute to a new science inquiry. Not all of the ideas presented in their science notebooks are accurate, however, so I wondered how the children acquired them and what role they would play in learning.

Although I had always used science notebooks as a place to record observations, data, and conclusions, I decided to add a step that would bring students' existing ideas out for examination. Before each lesson, the children wrote what they knew about the topic in a "quick-write." A quick-write entails me asking an open-ended question and having the students write all they know in three minutes. When the quick-writes are finished, the students discuss their thoughts with a partner or in small groups.

As students record what they already know before each science inquiry and then document the inquiry process (i.e., data, observations, and questions), there is opportunity to revisit and reflect on how the old and the new relate. Science notebooks in my classroom are a laboratory of words that support conversations and continued inquiry.

Assessing Prior Knowledge

To assess what students already know, before each inquiry experience I ask them to do a quick-write consisting of a simple question or directive (Figure 1). When we studied the seasons, I asked them to write what they believed caused the different seasons. When we explored the ecology of the Norwalk River, I asked them to write what they knew about how water moves. I wanted to know what the students believed and understood, but I also wanted to know where the class's knowledge would support new learning and where it might need clarification or challenging.

For example, at the beginning of our inquiry into plants, Tara wrote "A plant is a living thing that does not move. A plant reproduces itself. A plant is a flower with leaves. Some plants look ugly, some look nice. There are all kinds of plants." In assessing Tara's ideas, I can build on her understanding that a plant reproduces itself when we investigate seeds and experiment with other ways plants propagate, but I need to challenge her idea that plants have flowers because not all do (Figure 2).

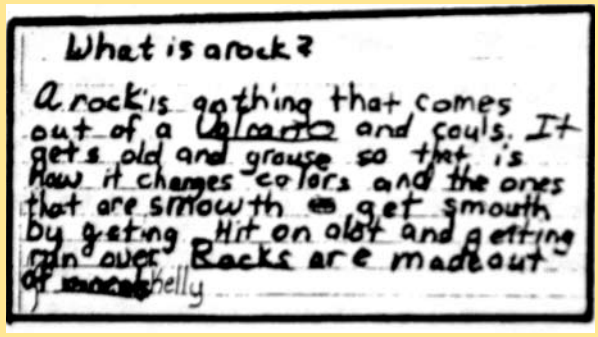
Unfortunately, many of the ideas students bring to science inquiry are incomplete or incorrect because they have never been shared, discussed, or challenged. These misconceptions are tenacious and resistant to change. Because the quick-writes bring the misconceptions out to be examined, they are less likely to interfere with new learning.

All inquiry starts with a question, but to generate a question a student must have some prior knowledge about the subject. Writing one's own ideas offers the learner time to think, organize, and choose the ideas with the most personal meaning and connection. The individual quick-writes allow me to assess where the similarities and differences in student knowledge are. I can also see which students have a deeper understanding of the topic and which have a more surface or limited understanding.

Composing a Quick-Write

Students first need to know how to successfully compose a quick-write. At the beginning of the year, I model this process by asking an open-ended question about our topic and have the students orally contribute some ideas. I show them how I would write their ideas in sentences and name the process a *quick-write*.

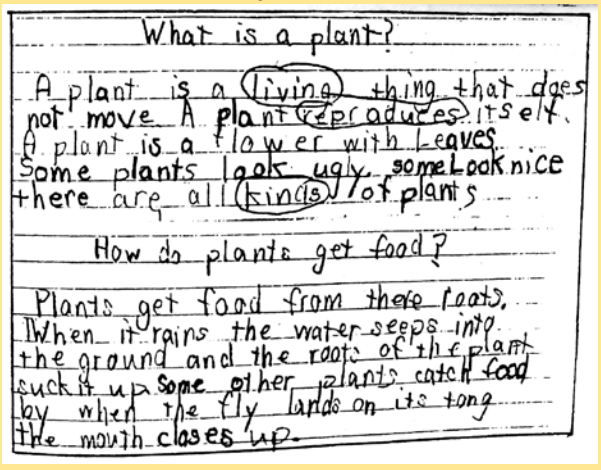
Figure 1.
A student example.



We read the quick-write together and discuss how it states what we currently know. I point out the key-words and circle them so it is obvious my sentences are specific and not general. It is important for students to know that quick-writes are personal and unique to each individual, so I give them another open-ended question about the same topic and have them share their response with a partner. This gives every student a chance to contribute. It also encourages discussion and negotiation of key ideas. For example, the following was overheard as the children shared:

- "Tell me what you know about photosynthesis." (Teacher)
- "It is something plants do. It is also green and needs light." (Student 1)
- "I think it's when plants make food. The food is green and we can eat it." (Student 2)
- "It needs sunlight. It needs water. Only plants with flowers do photosynthesis." (Student 3)

Figure 2.
A student example.



"I discovered I needed open-ended, higher-level questions to use as prompts for the quick-writes. The best questions require more than a simple "yes" or "no" answer. Explanations often occur as a result of good questions. Open-ended questions also allow the students to focus on the personal connections they can make rather than on the "correct" answer."

- "Plants do it. They use Sun and water. Flowers can do it too." (Student 4)
- "It's what makes plants green." (Student 5)

Not all the responses will be completely accurate or comprehensive, but the students are telling me what they know. This provides the starting point. I use the students' ideas to write a sentence that all the students can see and read: "I think photosynthesis is something green plants do when they use sunlight to make food." This sentence is a model for what they will do. The class discusses these ideas and there is often a debate as to whether the sentence is correct. Because there is agreement that photosynthesis has something to do with plants, I asked the students to respond in writing to a new question: "What is the relationship between plants and photosynthesis?" The students are given three minutes to write down their answer. This maximizes the time on task and time to uncover the most commonly held ideas. Some of the students' quick-writes included:

- "I think photosynthesis is what plants do when they mix sunshine and water to make food."
- "I think plants do photosynthesis to make food."
- "I think only green plants use photosynthesis."
- "Photosynthesis is when green plants make food."

When the quick-writes are complete, it is time to share, analyze, and consider the value/accuracy of what is believed. Figure 3 presents the steps for writing and analyzing the quick-write entries. As I walk around and listen, I am able to discern what the class knows or believes about the topic. I use the information from the quick-writes and discussions as the foundation for future instruction. As our investigation, research, and inquiry proceed, I direct the students' attention back to this entry so new knowledge and ideas can be compared to what was originally thought or believed. I have found this to be an important step. Reminding the students where their ideas started from helps them decide which new ideas to add to their existing knowledge and which ideas in the quick-write can be abandoned or modified.

Figure 3.
Steps for using science notebooks for assessing background knowledge.

1.	Present an open-ended question or directive statement related to the science topic.
2.	Tell the students to write their response in their science notebooks. Allow 3–5 minutes.
3.	Have students read their quick-write to a partner and compare their ideas.
4.	Ask students to choose an idea from their quick-write they think other children also have written.

Composing Writing Prompts

I discovered I needed open-ended, higher-level questions to use as prompts for the quick-writes. The best questions require more than a simple "yes" or "no" answer. Explanations often occur as a result of good questions. Open-ended questions also allow the students to focus on the personal connections they can make rather than on the "correct" answer. The students know there are many possible ideas related to the question and so feel encouraged to record their ideas rather than what they think the teacher wants. Student's responses to the question, "How does the water in our river move?" included:

- "The water is strong and so it pushes over the rocks and moves down the river." (Josh)
- "The water in the river comes from a pond up in the mountains. It falls out of the pond and flows down the mountain. Where we see it, the water is going fast because a lot of water has come together and runs fast." (Mariah)
- "Water moves from high places to low places. At the river site, we had to walk up a hill to see part of the river. The end of the trail was lower so I know it was going downhill. It goes fast because of all the rocks that are in the way." (Dante)

- "Sometimes the water doesn't move. I think it moves most when it rains and the river gets full. The water pushes around the rocks in the water." (Katie)

I know many of their ideas are based on our experience at the river site, which gives me a context into which to put our inquiry. I also know which ideas will need to be explored or examined. For example, I asked Josh to explain *strong* to understand more about his idea. One of my favorite questions is "Help me understand where your idea comes from?" It is important to know what is behind the students' ideas before judging them as incorrect. The assessment of the students' ideas drives my instruction and allows me to differentiate based on the range of correct, incorrect, and incomplete notions.

Using the Quick-Writes

After listening to students discuss their ideas about how water moves, I decided to have them revisit the observation notes they wrote during our first two visits to the river and look for any notes related to the movement of the water. They found some interesting ideas:

- The river is fastest and has more bubbles where it gets narrow.
- The wider parts of the river don't look like the water is moving very much.
- The water moves faster at the bottom of the hill.
- There are foam and bubbles around the rocks.
- In the winter, the water moves under the ice.

Using the information from the quick-writes and the observation notes, the students generated the question "What variables affect the flow of water?" An inquiry activity in which students tested their ideas about the questions allowed them the opportunity to explore their quick-write ideas and their observation notes. Using simple materials, the students created channels through which water could flow. The students tested variables such as the width or incline of the channel. At this point, it was my role to observe. The students' ideas guided their inquiries. In this way they were confirming, challenging, clarifying, and extending their own ideas about the movement of water. During their inquiry, they recorded their thoughts, questions, observations, and processes.

Because the notebooks contain quick-writes which indicate a starting point, observation notes, drawings, diagrams of what was seen or discovered, questions that arise during inquiry, and summaries, the students have many opportunities to revisit and compare their ideas. The new information collected through inquiry is added to their laboratory of words.

Notebooks Become Record

Students are using the tools of scientists when keeping a science notebook. They are also keeping track of their thinking and the changes to their original ideas. Because the original ideas are always available for revisiting, the students can refer to the quick-write when they encounter new or different ideas. The students use their writing skills to play with and learn the science vocabulary and concepts. Their inquiry is supported by the writing process as the notebooks become a record of how they developed deeper understanding of new science concepts. ■

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Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996):

Content Standards

Grades K–8

Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

National Research Council (NRC). 1996. National science education standards. Washington, DC: National Academies Press.