UW-MADISON EXTENSION

Science with Kids, Science by Kids

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Teaching Science through Inquiry

"If a single word had to be chosen to describe the goals of science educators during the 30-year period that began in the late 1950's, it would have to be INQUIRY." (DeBoer, 1991). From a science perspective, inquiry-oriented learning engages youth in the investigative nature of science. As Novak (1964) suggested, "Inquiry is the set of behaviors involved in the struggle of human beings for reasonable explanations about which they are curious." In essence, inquiry-oriented teaching engages students in hands-on investigations to satisfy their curiosity and construct mental frameworks that help explain their experiences. The challenge is how to stimulate curiosity and provoke wonder, for there is no meaningful learning if there is not an inquiring mind seeking an answer. (Haury, 1993). Here is one youth development educator's approach to help staff and volunteers teach "science with kids" using the cycle of inquiry.

Coaching Approach to Doing Science with Kids

Invite kids to become a scientist. Scientists are skeptical and empirical. This means they test ideas about what's happening in nature. A cycle of inquiry best describes how kids become scientists as they do hands-on experiments, form hypotheses, experiment and/or explore some more, and observe and make conclusions.

Science volunteer – "If you talk to a child you might be able to keep his/her attention for 2 minutes. If you talk with *a child, ask questions, encourage guessing and testing, you can keep his attention for an hour."*

Begin with a Hands-on Puzzle

Within the first minute, if not in the first moment, put something intriguing in kid's hands or something puzzling in their minds. Ask broadening questions to prime the pump for their observations.

- A *narrowing* question asks, "What could be causing this?" This question is "narrowing" because it implies only one cause.
- A *broadening* question asks, "How many different things can you think of that could be causing this?" This is a broadening question because it invites the learner to come up with many possible explanations, not just one.

Form Hypotheses

Create hypotheses (or testable explanations) through questions, such as, "Could it be…?" and "If so, then what would I expect to see?" As the kids do the hands-on science puzzle, invite them to describe what they're seeing and then come up with testable explanations for what they see. Now the hypothesis questions begin. The hypothesis is the possible explanation from which you can draw testable predictions and the scientist tests using experiments to see which hypothesis better explains what is seen in the experiment. The key questions for a hypothesis are: How do you know that? How do you show that? How do you *test* that?

Science volunteer – "Keep them thinking and they will think of answers that you haven't! Don't underestimate them!"

Use some "if-then" thinking: If the hypothesis is valid, then can you pull out predictions and then test to see if the predictions come through?

Experiment & Explore

Experiments are fair comparisons between two or more ways of doing things – fair in the sense that you try to make there be only one difference in how one batch is treated compared to another batch. Any differences in the batches are then likely to be a result of the one difference in how the two batches were treated. For example: one loaf of bread has yeast and the other loaf of bread does not; otherwise, they're treated the same. Is this a fair way to test for the effects of yeast on bread dough?

> *Science volunteer – "Kids love to get their hands in, measure things, like to take something home."*

Observe & Conclude

This is active observation: encourage the learner to see what is, but also to ask, "What happens when you try this or that? What could be explaining this?" (narrowing question). Or better yet, ask, "How many different possible explanations can you imagine and test?" (broadening question). Invite an action by the learner to see and explore.

The cycle of inquiry repeats itself as new observations or conclusions create more hands-on science puzzles, hypotheses, experiments, and yet more observations/conclusions.

Simple Science Teaching Tips

- Coaching science skills is about asking questions and designing investigations and experiments, not just giving answers.
- As the kids are offering what is happening from their science puzzle, they may share different results and different ideas. This is okay – diversity is a key to figuring out what is going on.
- When inviting and coaching the kids, keep the directions and responses to their questions short and simple. The kids learn information and skills as they keep exploring.
- Small groups of kids working together are best so they can learn from one another, build science skills together along with teamwork.
- As you get to know the kids and their interests, relate it to their lives. Life skills are developed when identification is made between the work they are doing on the science puzzles and their own lives. For example, confidence emerges as the science skills become more comfortable; teamwork is achieved when working together with the science puzzle; critical thinking develops as questions and observations take place.

> *Science volunteer – "Be enthusiastic yourself and have fun! More than anything else, the kids can sense that. If you enjoy this stuff, they know it's neat and they can enjoy it, too. Be a kid. Learn more than they do. Teach them what you know through coaching and coaxing their own explorations, but don't forget to learn from them!"*

Science Inquiry Models

Different sciences and views of science use different models and analogies. Here are three models as examples of science inquiry:

- ***Cycle***
  Some puzzles will have fewer factors to consider, so the inquiry is less complicated. In this model the cycle has specific defined steps and a sequence is prescribed. See illustration on pg. 4.

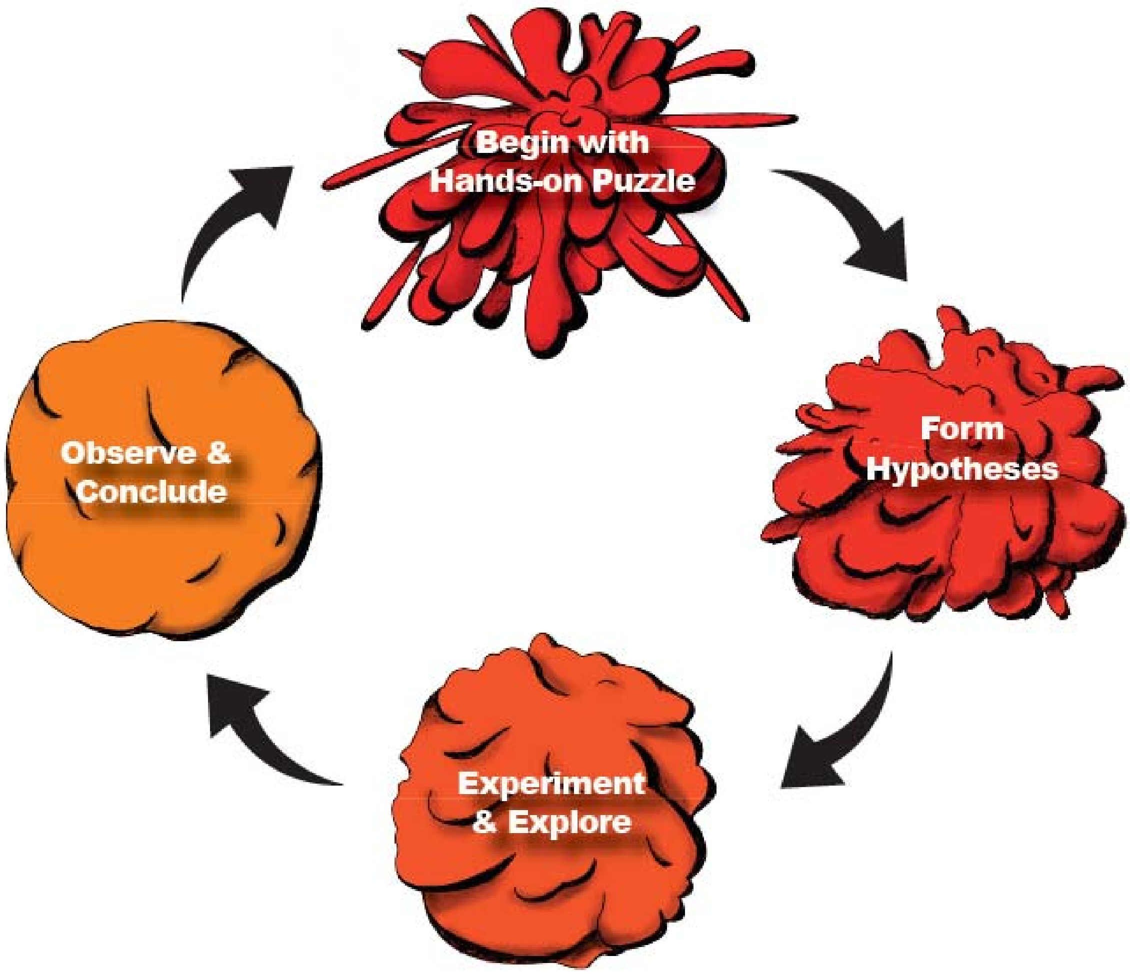
- ***Web***
The web model encourages testing at every level of science inquiry. Each puzzle and hypothesis allows for factors to be tested with the investigations going in different directions. This is the most common inquiry method where you can enter the inquiry model anywhere on the web. Neither specific steps nor a prescribed sequence occur. See illustration on pg. 5.

- ***Helix***
In this model one idea feeds and builds upon the other. This model is more linear with progress for observing, testing, and evaluating ideas. The science inquiry moves from point A to point B. See illustration on pg. 6.

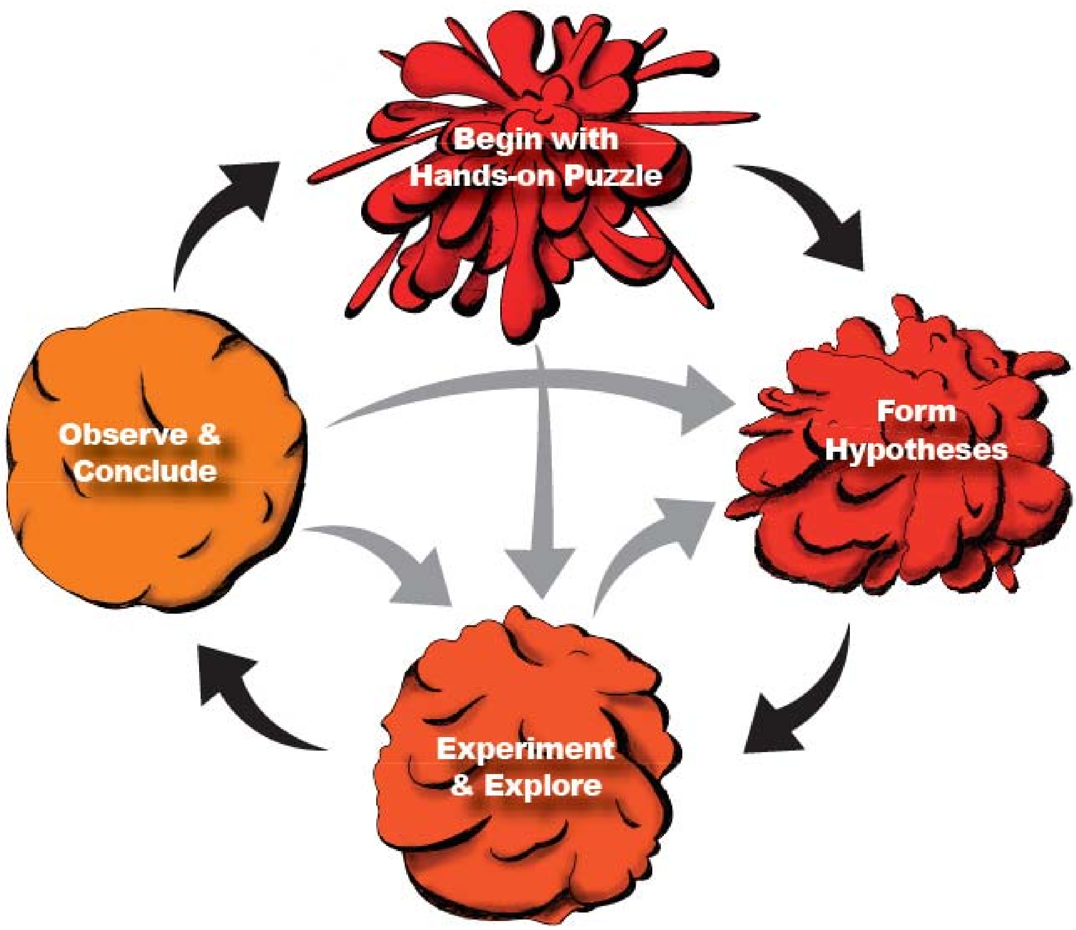
Bibliography

- DeBoer, G. E. (1991). *A History of Ideas in Science Education*. New York: Teachers College Press.
- Haury, D. L. (1993). *Teaching Science through Inquiry*. ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Columbus, OH. ED359048.
- Novak, A. (1964). "Scientific Inquiry." *Bioscience*, 14, 25-28.

Science Inquiry Model: Cycle



Science Inquiry Model: Web



Science Inquiry Model: Helix