Q&A: Guided Inquiry

We recently asked Laura Florence, Michigan Sea Grant education specialist, about inquiry-based learning and instruction. What is it? Read on to find out.

WHAT IS INQUIRY-BASED INSTRUCTION?

Teachers often struggle with using inquiry-based instruction in formal education classrooms. This is completely understandable, since just defining inquiry can be confusing! In general terms, inquiry can be defined as seeking information or knowledge through questioning. This is something that all of us do, every day. Scientific inquiry refers to both the ways in which scientists study the natural world and the ways in which students develop knowledge and understanding of science. Guided inquiry is often defined as a teaching technique; according to the National Science Education Standards, inquiry instruction involves active learning that emphasizes questioning, data analysis and critical thinking. The degree of complexity in an inquiry activity varies, and activities can be seen on a continuum along which students can progress as they move toward deeper scientific thinking.

WHAT DO YOU MEAN WHEN YOU SAY "THE INQUIRY CONTINUUM"?

Most students need practice to develop their inquiry abilities. The continuum focuses on how much information is provided to students and how much guidance the teacher provides. A four-level continuum—confirmation, structured, guided, open—is helpful in classifying the levels of inquiry activities. At the first level, confirmation inquiry, students confirm a principle through an activity in which the results are known in advance. In structured inquiry, students investigate a teacher-presented question through a prescribed procedure. In guided inquiry, the teacher provides the question, but students design and select the procedures. In the highest level, open inquiry, students formulate the questions in addition to designing and selecting the procedures.

WHAT MAKES IT A VALUABLE EDUCATION TOOL?

A Chinese proverb says, "Tell me and I forget. Show me and I remember. Involve me and I understand." Inquiry-based approaches teach science concepts by directly involving students in the process of "doing science." Methods used by scientists to conduct their research are, at their core, inquiry. Students who actively make observations, collect, analyze and synthesize information and draw conclusions based on their data are developing critical problem-solving and high-level thinking skills.

> *"Tell me and I forget.*
> *Show me and I remember.*
> *Involve me and I understand."*
>
> *– Chinese proverb*

CAN ALL STUDENTS LEARN SCIENCE THROUGH INQUIRY?

Yes, definitely! Some teachers perceive inquiry-based activities to be best suited for bright students, but students at all levels can benefit. It's important, though, to keep the inquiry continuum in mind when choosing activities. If activities are too challenging, students will not learn the content effectively. But, if the activities are too easy, students will not develop higher-level thinking skills. In a classroom, this means that all students may not be doing the same version of an activity at the same time.

CAN YOU PROVIDE AN EXAMPLE OF AN INQUIRY-BASED ACTIVITY?

The Great Lakes provide endless opportunity for scientific inquiry. Take overland and over the lake surface temperatures, for example. Teachers could have students select locations throughout the Great Lakes, and then go online to find temperature data for all of the Great Lakes from 1882-2007 on the *Teaching with Great Lakes Data* website (www.greatlakeslessons.com). Students then compare temperatures at given time periods and draw conclusions about differences across different regions and lakes.

HOW CAN IT BE USED INSIDE AND OUTSIDE THE CLASSROOM?

Successful inquiry-based instruction is about more than just curriculum materials. The teacher is the key element in the classroom. Key things teachers can do to promote inquiry include:

- Ask open-ended questions: What are you thinking? What do you think would happen if…? What is the evidence for that?
- Make changes slowly, allowing gradual transitions to more open-ended activities.
- Have students create their own data tables, rather than providing pre-constructed ones. Provide some of the lab procedures, but encourage them to write others themselves.
- Attempt the activity before the lecture, then help students connect the results of the activity to the subject matter being taught.

ABOUT LAURA

Laura Florence joined Michigan Sea Grant in 2010. Laura provides support and coordination for Michigan Sea Grant's education programs. She works on the *Great Lakes Lessons: Teaching with Great Lakes Data* website, organizes workshops and presentations for teachers, contributes educational content to Sea Grant communications and print materials, and is part of the Sea Grant Education and Communications Services team in Ann Arbor. She can be reached at: (734) 647-9730 or via email at lwelsh@umich.edu

WHAT RESOURCES ARE AVAILABLE FOR TEACHING SCIENCE USING INQUIRY?

Among the many free resources, a good place to start is *Teaching with Great Lakes Data* at www.greatlakeslessons.com. The website is a terrific resource for inquiry-based teaching. It contains formal lessons that guide teachers and students though structured inquiry activities. These lessons cover a broad range of topics, including storm surges and seiches, Great Lakes climate and weather, dead zones and fisheries. The website also contains Great Lakes data sets, perfect for open inquiry. Teachers can easily access real data that has been formatted for classroom use, along with inquiry tools for supporting students as they move from structured to more open inquiry.

SOURCES

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PUTTING THE "S" IN STEM

A group of Alcona Community High School students regularly trade their classroom for a visit to a local state park boasting eight miles of undeveloped Lake Huron coastline — Negwegon State Park. The activities were part of a project to document the park's history, natural resources and eco-tourism potential.

"As a result of this project," said environmental science teacher Brian Matchett, "students gained valuable skills in communication, research and sign development, all while meeting many of the Biology standards required by the State of Michigan. My students learned the importance of working with agencies such as Michigan Sea Grant, the Michigan Department of Natural Resources (DNR) and the National Forest Service to develop their knowledge of Negwegon's unique ecosystems."

Matchett said the project stoked the students' enthusiasm, renewing interest in science and community. "Students were excited to come to class each day and work on their portion of this service learning project."

The project first gained momentum in 2008 when the students toured the park with DNR and Michigan Sea Grant staff. The students divided into themed "investigation teams" and paired up with resource experts and/or technical advisors to explore the park with the charge to not only learn, but to also consider

an appropriate educational or interpretive product they would eventually develop for the park. The students explored the park's diverse shoreline habitat and fish species; they studied interior woodland and wetland habitats; they learned about wildlife interactions and food webs; and they photo-documented historical sites and archaeological artifacts. Michigan Sea Grant staff, including Schroeder, served as advisors for the group, providing expertise in water quality and fisheries, coastal shoreline habitat and wildlife.

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