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Exploring Alternative Conceptions in our Environmental Education Classroom

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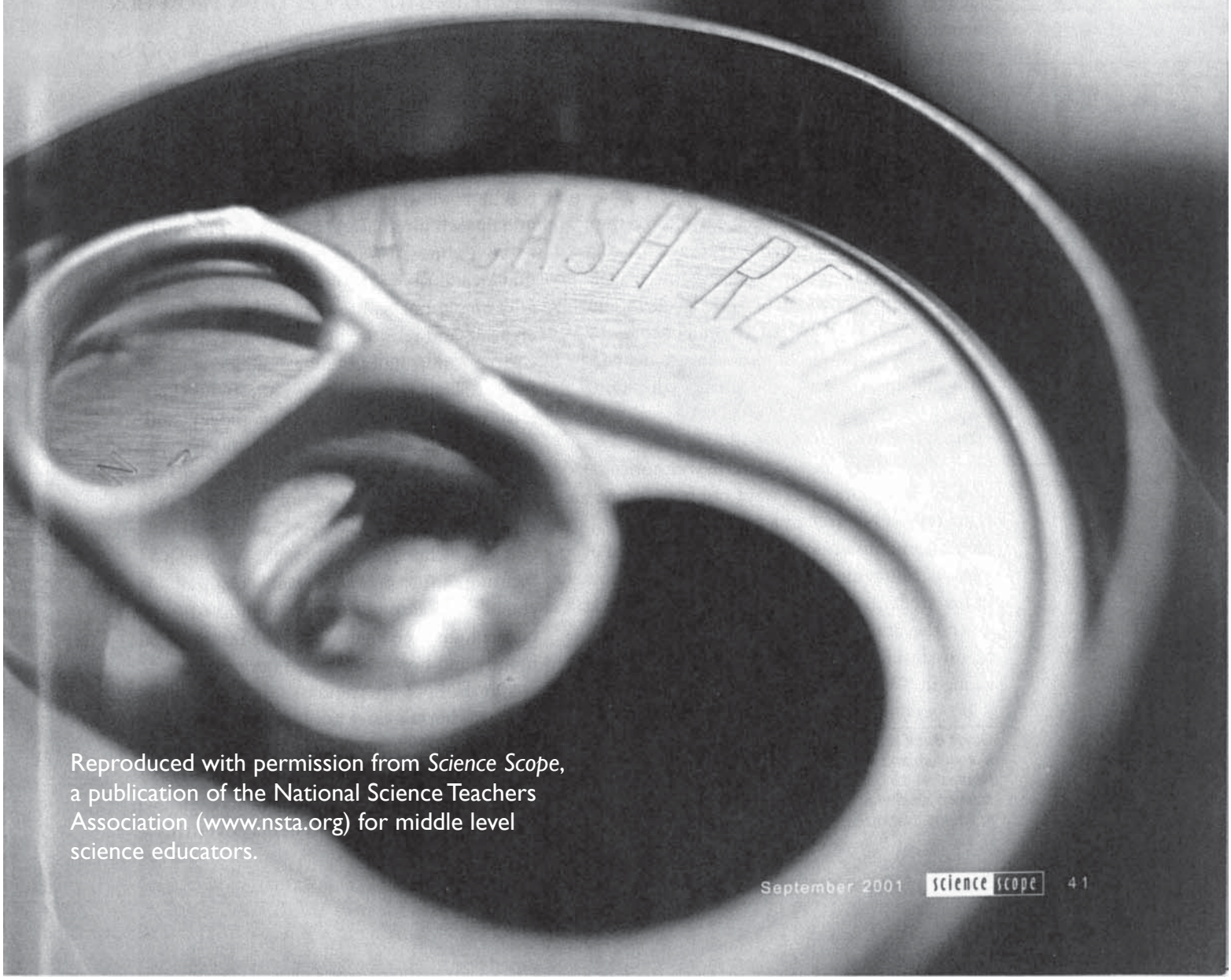
by Gayle Buck and Patricia Meduna



Teaching is an inexact science. Even experienced teachers have difficulty assessing the effectiveness of their lessons and students' mastery of concept. Teachers must be particularly careful to avoid introducing or reinforcing student misconceptions. The following describes how we scrutinized and modified our own environmental education teaching practices to ensure that our students were learning what we were teaching.

Clarifying conceptions

As middle level science teachers, we had encountered many misconceptions in our teaching and were well aware of their consequences. However, not all of our students' incorrect conceptions were scientifically incorrect. For example, some students perceived environmentalists as "tree-huggers" and "nerds." These are value statements; and, although we cannot say they are scientifically incorrect, they do go against the aim of our educational practices.

After doing a little research, we located the term *alternative conceptions*, "experience-based explanations constructed by a learner to make a range of natural phenomena and objects intelligible" (Wandersee 1994). This term encompasses misconceptions; however, it also includes ideas that are counter to the goals of education.

Analyzing understanding

Gayle first recognized an alternative conception while looking over a set of photographs that showed her students surrounded by mounds of containers they had collected to recycle. She remembered a comment that one of her students had made about dumping soda down the drain so that he could gather the required number of aluminum cans. She thought, "What am I teaching my students?"

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This initial question soon led us to listen more closely to other statements our students were making.

Several similar comments provoked us to take our inquiry further. Through interviews and questionnaires, we explored our students' understanding about the environment and environmental education. (For a more detailed description of the initial study upon which this inquiry was based, please see Arhar and Buck 2000.)

WE DID NOT REALIZE THAT STUDENTS WERE CREATING AND REINFORCING THESE ALTERNATIVE CONCEPTIONS FROM OUR ENVIRONMENTAL SCIENCE LESSONS.

When we analyzed our results, we found several alternative conceptions that were prevalent in our students1 responses. As teachers, we were aware that students might attach such alternative conceptions to science-based lessons. However, we did not fully understand the roots of their beliefs. Additionally, we did not realize that students were creating and reinforcing these alternative conceptions from our environmental science lessons. That is, we did not understand this until we started to listen to our students and take a critical look at our own practices.

Making changes

From what we heard, we realized that we needed to change our approach. We began focusing on incorporating four sequential components into our environmental education curriculums. See Figure 1 for the results of our inquiry and how we changed our practices.

On the opposite page, you will find an activity that we used to reinforce our new method of teaching. In part one, each group of students draws a poster that illustrates the cycles of matter that are present in their own backyards. In part two, students cover this

The environment in your backyard

Objectives

1. To understand how the natural cycles work together
2. To understand how you fit into the natural cycles
3. To understand the effects of pollution on the natural cycles

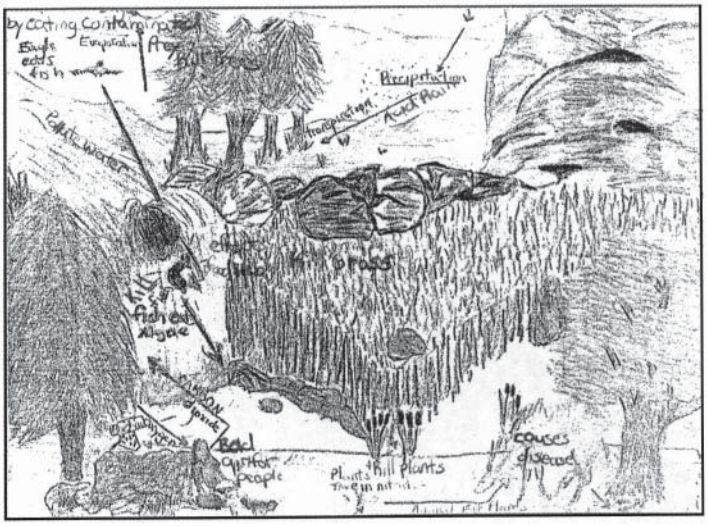
Materials (per group of four or five students)

- colored pencils
- white poster board (55 cm x 70 cm)
- pencil or pen
- scratch paper
- four pieces of notebook paper
- clear plastic wrap
- tape
- black permanent marker

Procedure

Part one (group work)

1. Pretend that your house is on the edge of a wooded area with lots of wildlife.
2. Use colored pencils to design a group poster of what you see when you face the woods. Include a drawing of yourself and at least one plant and one animal.
3. Use scratch paper to brainstorm ideas on how to illustrate the cycles of matter—water, carbon, oxygen, and nitrogen—on your poster. Be sure to include all the living things you have drawn in each of these cycles.
4. On your poster, draw and label these cycles.
5. Present your poster to the class and explain what you have drawn.



ILLUSTRATIONS BY ADAM OSBORN AND SOPHIA SKRDLA

Part two (group work)

1. Cover your cycle of matter poster with clear plastic wrap and tape the ends of the wrap onto the back of the poster.
2. Using the permanent marker, illustrate how pollution affects different aspects of the cycles of matter. Be sure to include how people affect pollution and how pollution affects people.
3. As a group, present your poster to the class and explain what you have drawn.

Part three (individual work)

On loose-leaf paper, answer the following:

1. Explain each of the cycles of matter that your group illustrated. Be sure to include how you are part of the cycles.
2. Demonstrate how a food web is illustrated in your poster.
3. Discuss how the animal populations stay balanced naturally. Be sure to explain thoroughly.

FIGURE 1 How we fought the battle against alternative conceptions

Our students' alternative conceptions	A critical look at our teaching approach	Our new approach to environmental science
The environment is separate from us Students believed that they are not part of the environment and that they have very limited connections to it. They believed that hunters are the only people who get their food from the environment, and that most people have to travel to see an environment. In all. the students perceived the environment as something that is "wild."	*The environment is separate from us* We emphasized environments as small sections of the world far from where our middle school students lived. Our lessons highlighted such places as Brazil's rainforests and Africa's disappearing lakes. Additionally, we seldom taught students about the people of these places and how their lives are connected to those environments. Overall, we failed to show our students how each of them is part of an environment.	*Step 1: We are all part of the environment* Now, we concentrate on fostering a more detailed and complex understanding of students' own environments and how each student is a part of the Earth's systems. We accomplish this by focusing on the cycles or matter (water, carbon, oxygen, and nitrogen) and the complex webs of life in students' own backyards and on how people, plants, and animals fit into those cycles and webs.
Nature will collapse without human management Students believed that, without human management, the environment could not function. Initially, these beliefs did not surprise us: Many of our students participate in hunting programs sponsored by wildlife management organizations, which advocate deer-population control. However, our students* also believed that trees could not grow if people did not nurse them, and that. without wildlife management, all life on Earth would cease because animal populations would overrun the planet, eat all the plants, and consume all the air.	*Nature will collapse without human management* We often emphasized the need for people to "save" the Earth. Therefore, students believed the environment, if left alone, literally would collapse. Additionally, during our wildlife management unit. we covered methods for controlling animal populations in and near towns. However, we seldom pointed out the reasons—such as human population growth and predator reduction.	*Step 2: The environment is self-monitoring; humans must monitor their own actions* We build on students' understanding of the Earth's cycles and webs by studying the balance of the Earth's systems—how they interact and how people fit into these systems. We concentrate on the effects that people's lifestyles have on the systems we study. Students explore local environmental concerns and human management techniques. Additionally, students learn how humans have to change the way they interact with the environment, not how humans have to save the environment We continue to teach about wildlife management; however, now we investigate reasons for animal population control.
The more you buy, the more you help the environment Although our students did not label themselves "environmentalists." they did believe that recycling is a means to improve the world. We were not surprised to hear this. However, students also thought that their families should buy more products so they could produce more recyclables and. therefore, help the environment more. Our students did not make many. if any, connections to reducing or reusing.	*The more you buy, the more you help the environment* During our unit on recycling, we portrayed it as a good thing. We taught students how to recycle and showed them what happened to their recyclables. In earlier grades, students had earned prizes for bringing in the most recyclables. They learned that more is better. However, we realized that we barely mentioned the concepts of reduce and reuse.	*Step 3: It is Important to reduce, reuse and recycle* We continue to teach our students about recycling; however, we emphasize that it is one part of the conservation strategies that should become part of everyone's lifestyte. We focus on reducing our level of consumption and reusing materials that we frequently discard. Like our recycling lessons, we emphasize these concepts through hands-on activities.

Our students' alternative conceptions	A critical look at our teaching approach	Our new approach to environmental science
People who are interested in nature are not "cool"	*People who are interested in nature are not "cool"*	*Step 4: The environmentalist next door*
Students had a very poor impression of people who care for, or even about, the environment. They pictured a person that hugged trees and did not take baths—a person very few middle school students admire. Additionally, we realized the extent of peer pressure not to be concerned about the environment: Because students perceived environmentalists as outcasts, students felt that they would be stereotyped that way if their peers thought they were environmentalists.	During our unit on environmentalists, we were highlighting people who went against the mainstream of human culture. However, we realized that most of our students do not identify with people who make great self-sacrifices and stand apart from the crowd.	Many great people have made sacrifices to learn about and improve the environment. To spotlight those people who would be good role models for middle school boys and girls, now we highlight local individuals who have jobs that involve the environment.

poster with plastic wrap and illustrate the affects of pollution. Finally, in part three, students work individually to answer follow-up assessment questions about their posters.

Conclusion

Our inquiry into students' alternative conceptions about the environment was a very enlightening experience for both of us. The process revealed some beliefs that surprised us. However, the real surprise came when we realized that our own lessons reinforced (and sometimes formed) many of our students' alternative conceptions. With our new insights, gained from listening to our students, we developed a better way to teach environmental education.

References

Arhar, J., and G. Buck 2000. Learning to look through the eyes of our students: Action research as a tool of inquiry. *Educational Action Research* 8(2).

Martin, R., C. Sexton, K. Wagner, and J. Gerlovich. 1998. *Science for all children.* Boston: Allyn and Bacon.

National Research Council. 1996. *National science education standards.* Washington. D.C.: National Academy Press.

Wandersee. J., J. Mintzes, and J. Novak. 1994. Research on alternative conceptions in science. In *Handbook of research on science teaching and learning,* ed. D. Gabel. New York: Simon & Schuster Macmillan.

Our approach meets the following National Science Education Standards:

- Unifying concepts and processes
- Systems, order, and organization
- Change, constancy, and measurement
- Evolution and equilibrium
- Form and function
- Life science regulation and behavior
- Populations and ecosystems
- Science in personal and social perspectives
- Personal health
- Populations, resources, and environments
- Risks and benefits
- Science and technology in society