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The primary teacher has a fundamental task in science education. The responsibility today is greater than ever to perform the science education task carefully, with specific curriculum goals clearly and sequentially mapped out. Primary teachers work with very impressionable material — young students. They lay the foundation of formal learning. No structure is sound or lasting if it has a weak or unsound foundation. The same is true of the education of young students and their introduction to organized science processes and knowledge. The foundation must be laid with care and strength of purpose. Primary teachers have the fascinating task of laying this foundation and setting the mood for nine or more years of formal science education.

What are the student attributes desired from this formal learning? Our society desires and needs a general literacy in reading ability, math skills, social knowledge and behavior, science processes, and science knowledge and skills. Clearly imperative is the need to increase science understanding and awareness of available technology, problems present and future, and the effect of decisions on the individual and the environment.

The primary child is a bottomless well of curiosity, questions, and desires to make sense of the world. So the primary teacher is challenged again and again to help make sense of the world, satisfy the curiosity, and guide the child to answers. This responsibility becomes overwhelming if not shared with the child.

Primary teachers usually are not experts in science nor are they expected to be. Primary teachers are usually generalists in many instructional areas, including science. They must not plan nor expect to offer the students all the answers. Encouraging the interest and teaching the value of science with the appropriate science concepts and processes for the students' maturity level will enhance the long-term goal of producing scientifically literate citizens. Primary teachers have the responsibility of opening the doors of science processes, knowledge, applications and values, in addition to helping the students learn how to cause the doors to swing even wider for desired knowledge.

Science is a process in which we are all constantly learning, discovering and reapplying knowledge and skills. The teacher has a key role in building positive attitudes to science. This can be done by nurturing and sharing the children's curiosity, teaching careful observation, and encouraging them to explore, compare, classify, investigate and test. An effort should be made to include opportunities for students to record observations. This should be followed by discussions and the formulation of explanations based on the observations and record. Students also need opportunities to think critically and to practice communication.

In the primary classroom, science questions and activities can provide excellent reasons to read. Science can and will provide situations and reasons to apply and practice skills learned in math — measuring, graphing, counting, etc. Science also can provide the inspiration needed for willing practice and use of oral and written language skills. To find time to teach and provide frequent practice, teachers must integrate the science unit and skills into the other curriculum areas, or integrate the other practice needs into science units.

Primary science can be stimulating and enjoyable for the teacher and the students because children observe, investigate, test, explore and try to explain what they have learned from all their activities whether spontaneous or planned. Thus the primary teacher must decide how to capitalize upon this natural interest and activity. When choosing and guiding a primary science activity, three questions should be addressed:

Will it be structurally spontaneous or formal?

Will it be teacher directed or independent?

Will it be isolated or integrated into other curricula and into the children's interests and needs?

The trick is to organize and manage the curriculum and materials available to best advantage. Primary science education should be as *concrete* and *hands-on* as is possible. Equally important is striking a balance between concept teaching and process skills application. Use of the discovery/process approach helps children apply and practice the concepts and process skills, and therefore, understand them better.

Research shows the need for greater teaching and practicing of skills in critical thinking (divergent and convergent), and problem-solving. The study and application of science to the child's world provide opportunities to practice these skills in very personal ways.

The following activities provide opportunities for primary students to think critically and solve problems at a concrete level.

Example one: Give the students a problem related to preserving and protecting the environment. To set up the problem situations, explain that a class such as theirs took a field trip to the rocky bank of a stream. The bank was covered with rocks and pebbles. The class spent time in the area observing and recording some data about the rocks covering the stream bank. Now pose this problem to the class: The stream bank was covered with about 500 rocks and pebbles. But before the 25 students left the area, each student decided to toss five rocks into the stream. Illustrate with the class' help and some type of counters what this decision did to the number of rocks on the stream bank. Show that the rocky bank was depleted by one fourth due to the decision. Then ask how many classes could visit and also choose to toss in five rocks each before there would be no more rocks to observe on a field trip to the stream bank? Continue to demonstrate with counters.

This convergent thinking/problem-solving activity should help each student realize the end result of an action he or she might choose in relation to a given environmental setting. Once understood in these simple, concrete terms, this idea of personal choice and its effect can be applied in other contexts.

Example two: To give the students a visual experience with undesirable personal choices that cause environmental pollution, try this discussion/demonstration. First pose the question of what happens to the "stuff" — trash — a thoughtless, uncaring person might toss into a stream or lake after eating a picnic lunch while taking a hike? Does the water swallow it? Does it sink out of sight? It's gone, isn't it? These are interesting questions to ask and then visually demonstrate to primary students. Use a large institutional-size mustard, pickle, or mayonnaise jar — gallon size or larger. Fill it with clean water and name it "Freshwater Lake." You may even wish to let it stand a day or two prior to the environmental pollution lesson. Then discuss with the class what a person might pack in a sack lunch to eat on a hike. Have ready some of the food items the students are sure to name and their wrappers or peelings. Show the trash left over from just such a lunch — orange peelings, banana peel, or an apple core; sandwich wrapper with a bit of sandwich left in it; a wrapper from a candy bar or dessert item; a bite or two of some crisp vegetables such as celery or carrots; possibly some cookie, cake, or corn chip crumbs; an empty juice or pop can, and the brown paper sack. As each lunch leftover is discussed, carelessly toss it into "Freshwater Lake." Be sure to crumple the juice or pop can, and you might even blow up and explode the paper sack for an additional display of bad manners. Then lead the students in discussion of what might happen to this trash now hidden in the water of "Freshwater Lake." Ask the students what effect it has and might have on the lake. Suggest that the class can observe the "Freshwater Lake" over a period of days and record what they see happening. Also be sure to discuss how the water dwelling creatures and plants in a lake or stream may or may not like the changes in their environment caused by trash.

What the students observe happening in the "Freshwater Lake" jar will help them to understand some of the effects of pollution, and point out the need of each person doing his or her share in making choices to keep the environment unpolluted for all. Hopefully this demonstration will increase awareness and an understanding of society's need to maintain a clean, healthy environment free of even hidden pollutants.

Example three: For a primary lesson demonstrating the effect of a lack of a personal conservation of a scarce resource and the resulting effect on others, try the following simple, yet dramatic, activity. Use a bowl of peanuts, candies or marbles. Have students sit in a circle. Hand the bowl to the first student and say, "Help yourself, then please pass it on". Do not make any other comment except to repeat the statement. If the bowl gets only part way around the circle before becoming empty, begin the discussion of the obvious problem, its cause, and the feelings and needs of those left out. Relate this lack of consideration and taking only what was really needed to the choice of using and wasting more energy than is necessary. Discuss the effect of wasteful energy choices on people who come after us and who will also need the things we need, including energy, but who might be without due to our present greediness (overconsumption).

As teachers we have the opportunity, even at the primary level, to help students develop the important science attitudes of objectivity, humility, a healthy skepticism, respect for life and the environment, and a sense of personal responsibility. Teachers must seize every opportunity to put science into the context of daily events. We can show how science provides the technology that we enjoy and use daily. Looking at science instruction from this viewpoint provides ideas for demonstrating and applying the impact of the students' choices on the immediate and total environment.

Primary teachers have the opportunity to show naturally curious students that science is all around us in daily life. They can also show that science helps us to understand what affects us and what we affect. Not only can teachers excite students about science, but they can also help them become confident in exploring problems and seeking answers. Science knowledge and questioning will help today's students come closer to being the science literate citizens needed for our increasingly complex world.

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