Beyond the Classroom Walls: Relating Science to Children's Everyday Lives

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Abstract

Children have a natural tendency to investigate and explore the world around them. They do not usually interpret this as being scientifically aware. Through a series of classes that illuminate the science in the kinds of activities and play they engage in regularly, we help children to see that science is a part of their daily life. Placing science firmly in this context enables them to explore and learn without fear. This paper describes a series of hands-on classes designed to accomplish this objective with children ages four to twelve.

1.0 Introduction

Children have a natural love of discovery and investigation, and science is a natural subject of excitement for kids. Unfortunately, science is not a subject emphasized heavily in elementary schools. In some states, like North Carolina, elementary teachers are judged primarily on reading and math test scores. Bonuses and even employment rely heavily on these end-of-grade tests. Science, therefore, becomes a subject taught when time allows.

This paper describes a series of classes that expose children ages four to twelve to the science in their everyday play worlds. Taking science beyond the classroom walls puts it in the kids' point of view. Activities that allow children to see the science in their everyday lives will help them to realize that science, like math and reading, is a subject not to be reserved for specially allotted class time, but something that can be explored at will everyday.

2.0 Implementation

These ideas are implemented through a series of one to two hour classes. Nearly any childhood area of interest can be adapted to a science lesson, and children are often amazed to see the science in those play areas they love[1,2]. These classes have been used in the context of extracurricular science camps, and some have been used as a part of public school outreach programs. Example sessions include Bubble Reasoning, the Science of Pirates, the Wild West, amusement parks, toys and candy. A brief description of each session follows.

2.1 Bubble Reasoning

Bubble Reasoning represents an opportunity to teach kids the concept of scientific reasoning. This session is designed to get the children thinking like scientists. First, several different brands of bubble gum are distributed to the class members. The children are asked to begin chewing, but to NOT attempt to blow bubbles initially. Then we begin our discussion about scientific thinking. The idea is to lead the class toward the scientific method as it applies to blowing bubbles. The instructor asks the class several questions, starting with "What are the variables in blowing bubbles?" It does not take long for the children to identify most if not all of the variables (kind of gum, length of time chewed before blowing, experience of the bubble blower are a few).

The next natural question is how will we measure the end product? Most will agree that holding a ruler up to the bubble or removing the gum from the mouth and then measuring the bubble would be some ways to measure. This leads to a discussion about accuracy and repeatability, demonstrated by the instructor asking questions like "What if Sue dropped the gum, and Sally laid it carefully on the table?" and "How do we know that Will and Joe are going to hold the ruler the same way?" The purpose of this discussion is to illustrate how important it is in science to be able to repeat processes and measure them accurately.

Finally, we attempt to apply the scientific method to the bubble blowing process. Each step of the process is explained and then input is gathered from the students addressing each area. It is very useful for the instructor to write the parts of the process on the board, and then also note the answers. Applying the process after the preceding discussions will make this part of the class go much faster, and will increase the students' knowledge of the way scientists think. One of the last steps requires requesting the class members to blow bubbles with their gum. After several attempts, the instructor leads the class to a vote to determine whether this question—"Which bubble gum blows the best bubbles?" lends itself to good scientific procedure.

2.2 The Science of Pirates

In "The Science of..." classes, the children begin in a very familiar venue and are then encouraged to see the science present there. The format of the sessions is consistent, and the activities are adjusted for one or two hour sessions. We begin with one or two books, usually one fiction and one factual. The remainder of the class involves rotating groups through several hands-on activities, including preparing a snack in keeping with the theme of the day.

In the two-hour session of The Science of Pirates, the children explored the world of the buccaneer by first listening to a story about several notorious pirates. Next, the instructor shows the class a picture book detailing pirate gear, ships and other lore[3]. This is important because several of the hands-on activities relate directly to these facts, and children who are not as familiar with the subject may not understand what they are exploring. Some hands-on activities for pirates might include:

- One-eyed vision: Using eye patches to cover one eye, the children toss beanbags into buckets placed about 6 feet away. The children learn here about how their eyes work together to allow 3-D vision and how the eye can fool you!
- Walk the plank: An eight foot 2x10 board is used (with the help of several instructors!) with concrete blocks as the fulcrum. The children experiment with moving the fulcrum and experiencing the results. They are told if they can keep the plank from tipping (being out of balance), they will be spared! This requires the rapt attention of several adult supervisors!
- Sextant/the night sky[3]: First, the children make a simple sextant. Then, using a dark hallway and glow in the dark stars set up ahead of time, they learn about navigation in the open sea.
- Buoyancy: A baby pool is used to experiment with boat building. The materials are simple: aluminum foil, clay and toothpicks. The goal is to build the biggest seaworthy (i.e. stays afloat!) boat.
- Treasure map: Using treasure maps prepared by the instructors beforehand, the children go outside to find buried treasure. Armed with a compass and divided into teams, each map uses compass directions and paces to direct the group through a series of steps to find a bag of buried gold (chocolate coins).
- Make a snack: Depending on time, either the children can make their own snack (buried treasure cookies for example), or eat a purchased treasure snack, such as Popsicles with gumballs hidden on the inside.

2.3 The Science of the Wild West

The Wild West becomes a scientific playground in the next session. The class opens with a fiction story set in the old American West. Next, non-fiction works depicting the equipment and lifestyles of both cowboys and Native Americans are shared with the children. Hands-on activities for this class include:

- Clothing/Dying[4]: Several examples of types of materials used for clothing are examined, such as leather and furs. Next, the children are divided into groups to explore outside and gather grasses, leaves, barks and berries to make dyes. Spices are also used, and the children experiment with both hot and cold water solutions while attempting to dye white cotton cloth.
- Equipment: In this activity center, the children learn about lassos and bows and arrows. The whole idea of throwing a lasso successfully is consuming to the children. Experimenting with shooting arrows (or darts) at a target is not just a lesson in gravity air resistance, but a challenging and fun activity.
- Housing[5]: Here the children explore the many different kinds of shelter used by those of the old west. Supplies are available to experiment with building sod houses, wigwams, teepees, long houses, log houses and frame houses. Much is learned about construction techniques. During the building activity, the instructors engage the children in the questions of why one type of shelter might work better than another in different areas.
- Landscape: In this center, the children can build a small model landscape of desert, mountain or prairie using common craft items like Popsicle sticks, Spanish moss, rocks, sand, etc. Again, the building activity is augmented with an informal discussion of different landscapes and how people lived in them, from finding water to growing food, etc.

- Make a Snack: Somewhat surprisingly, this activity is a favorite with the children. Different groups mix and make johnnycakes, trail mix and homemade lemonade for the entire group. Their willingness to try these mostly new foods would be a surprise to parents!

2.4 The Science of Amusement Parks

The Science of Amusement Parks takes us behind the scenes at a child's favorite place. When this class is over, the children are smug in their newfound knowledge of the science behind their favorite thrill rides. Many concepts of physics are introduced here, but this class relies heavily on hands-on experimentation to explain the science[6].

The structure of this class is slightly different—instead of dividing into small groups, the concepts are introduced and demonstrated to the entire group first. Then, the children move freely about the room trying different rides before coming together for a final small group activity.

One of the concepts demonstrated here is centripetal motion, shown using a turntable and marble. The idea that an object moves faster depending on its proximity to the center of rotation is shown using a washer tied to the end of a string. The instructor first spins the washer above her head using 1-2 feet of string. She then pulls the string through her palm, shortening the length of the string from her hand (the center) to the washer. It is quite obvious to the children that the shorter string spins much faster.

Centripetal force is an important concept to clarify, given its extensive use in amusement park rides. The children are usually amazed that this concept comes into play in so many ways. A bucket of water spun over the head is a great way to introduce the subject. Lego and K'Nex toy models of various amusement park rides are then used for free experimentation.

Finally, the group is divided into teams and given a ten-foot length of clear plastic tubing and some ball bearings. The team is instructed to build a roller coaster that will allow the ball bearings to move from start to finish under their own power. This is a fun experiment for the kids and requires teamwork to accomplish. Some of the children are stationary, just holding their section during the experimentation. Some are variable, moving their sections higher and lower to see what works best. A director usually emerges to choreograph the entire operation. The teams are VERY excited to successfully spit out a ball bearing at the end of the line!

2.5 The Science of Toys

As stated earlier, science can be found and demonstrated in nearly every childhood pursuit. Using toys, for example, children can observe and experiment with scientific principles. Interlocking building blocks lead to construction prowess. Magnetism is the principle behind popular erasable drawing boards. Tops are a lesson unto themselves, and their motion is easily shown using spinning marker tops that leave an ink trail showing their paths of motion. Aerodynamics is explored via Frisbees, footballs, soccer balls and baseballs. Bicycles can be used to show centripetal motion, as well as human body ideas like balance and coordination. The possibilities relating toys and science are numerous.

2.6 The Science of Candy

Another area of great potential lies in candy. Beginning with a reading of Charlie and the Chocolate Factory, the class can begin by making chocolate. Then, using an electric skillet with simmering water and some small glass dishes, differences between different kinds of chocolate can be demonstrated by melting them. Taking this idea further, the children can experiment with what happens if you heat chocolate too long, or if water gets into the mixture while melting. Hard candies are also good for experiments.

The particular candies discussed are usually chosen at the whim of the instructor, considering the ages of the children. Popular science kits for making gumdrops and bubble gum are widely available. Taffy and various other cooked candies are great lessons in thermodynamics and chemistry. Safety is an important concern where heat is used, and some of the ingredients can be dangerous for small children. Children ages four through six are usually given some hard candy in a Ziploc bag to crush and then arrange on a piece of greased aluminum foil to make stained glass windows, while older kids can easily participate in taffy pulling. Asking the children to predict what will happen during the various stages of candy making can include scientific reasoning.

3.0 Conclusion

Science is an area that many people fear because they see it as something different and more complicated or involved than other subjects. Children have a natural love of discovery and exploration. By taking science beyond the classroom walls and moving it to natural children's venues, much of the mystery about science is dissipated. Children will learn to look at their daily activities and consider the science in them a natural occurrence, as familiar as reading game instructions or counting spaces on a board game. This approach is yet one more way to make the general population, especially underrepresented groups, more comfortable and less fearful of science. The long-term expectation is that more children will choose careers in science, math or technology as a direct result of feeling more at ease and very familiar with science in everyday life.

[1] Laura J. Bottomley and Elizabeth A. Parry, "The Physics of Sports," Proceedings, ASEE Annual Conference 1999 Conference, Charlotte.

[2] Laura J. Bottomley and Elizabeth A. Parry, "Playground Physics," ASEE Preconference Workshop, ASEE Annual Conference 1998, Seattle.

[3] Platt, Richard, Pirate, Eyewitness Books.

[4] Liles, J. N., The Art and Craft of Natural Dyeing: Traditional Recipies for Modern Use.

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[6] Wiese, Jim, Roller Coaster Science: 50 Wet, Wacky, Wild, Dizzy Experiments About Things Kids Like Best, Wiley, 1994.

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