Simple Science in Your Classroom

Using Keys, Worms, and Pennies

by Deborah A. Moberly and Jennifer Fruend

Have you ever looked for a science workshop that will give you quick, practical, and very do-able ideas for your classroom science projects? Do you feel confident and have the resources to teach science? Chances are you feel like many other teachers: science is not an area of the curriculum where you excel, but you know it must be offered as an integral part of your curriculum and it is essential to the children.

Why Have Science in the Classroom?

Science inquiry and constructivism go hand-in-hand, because children are naturally curious and keen observers. They construct knowledge through repetitive actions, and, in the right environment, they can become expert problem solvers. Children want to make sense of the chaos in their world: they want to know why and how things work, grow, and are used.

Aligned with NAEYC and accreditation, the National Science Teachers Association (NTSA) (2002) believes children should experience the process of investigation through active experiences that are planned considering children's multiple learning styles.

While national standards and well-intentioned teachers are essential ingredients, it does not mean children will be offered enriched opportunities in science.

Challenges to Teaching Science

We expect teachers of young children to be 'expert generalists'; they must possess an ability to teach a broad range of academic subjects, and teach them well. With science, however, teachers are prone to bringing feelings and attitudes that pose challenges in implementing a strong and effective science-oriented

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Summary of NAEYC Science-Related Criteria

Infants and toddlers have opportunities to use their senses in learning about objects, causing something to happen (cause and effect), and solving simple problems.

Processes of inquiry and documentation are opportunities for young children to:

1) Use their senses for exploration of science concepts/problems
2) Use tools to observe and investigate
3) Collect data and documenting learning
4) Reason
5) Use materials that foster using scientific terminology and vocabulary.

Topics for investigation are living and non-living things, lifecycles of organisms, earth and sky, and characteristics of matter and material.

curriculum. For example, teachers' unfamiliarity or lack of teaching confidence in science will often manifest itself attitudinally in what teachers offer in the context of a science learning center in their classroom. In our 15-plus years of experience in helping early childhood programs prepare for NAEYC accreditation, we have made the following observations about teachers and science curriculum:

- What was referred to as a classroom science center was often composed of a single plant and/or fish bowl; and on some occasions, we found the plant to be plastic. Routinely, the teacher's rationale was that he thought the children would destroy a live plant.
- Teachers' two primary science activities for children were limited to:
  - collecting colored leaves in the fall season
  - planting vegetable seeds in the spring season.

While teachers demonstrated many appropriate teaching practices in which children constructed knowledge, it appeared they permitted their lack of science knowledge and competencies in science to adversely influence what they offered to children in their classroom. Teachers' feelings of incompetence in science are often expressed as a hesitancy to answer children's science-related questions. Many teachers, including elementary teachers, do not believe they are qualified to teach science. The tandem feeling of not personally enjoying scientific inquiry, nor excelling in school themselves, is common among teachers (Weiss, 1994).

We all remember our first experience of dissecting a frog in biology class, along with the accompanying odors, the textures of the frog, and feelings of anxiety about using instruments to dissect a once-living creature extracted from a pool of liquid preservative. Accumulation of these feelings, memories, and early experiences of unease in science may result today in many teachers experiencing anxiety and lower self-efficacy (Bandura, 1994). All of these factors lead to teachers providing less science instructional time and opportunities (Guskey, 1988; Wilkins, 2008).

Using Animals to Teach Science

One outcome that we observed was children who exhibited an extreme reluctance, if not genuine fear to engage dogs, soon gained self-confidence and began leading Pete in the play yard. Another outcome was the children developed numerous class books about Pete describing his growth, development, care, and behaviors as he became an integral part of the children's 'science' curriculum and a tool for scientific exploration.

Rabbits are another example. They can make delightful classroom pets and can be trained (fortunately) to use a litter box. Children can assume responsibility for the care of a pet as well as the various science concepts associated with the care and observation of a living creature. With respect to selecting rabbits for a classroom, they should be purchased from a reputable breeder or a rescue organization with the animal's temperament being a key factor.

We found teachers may not react as favorably, however, to worms, spiders, newts, or snakes. Many of us have adverse predispositions or otherwise 'ick' reactions to such creatures, which left unchecked, can readily be conveyed unintentionally to children, who then may adopt similar attitudes (Lester, Field, Oliver, & Cartwright-Hatton, 2009). In fact, research clearly demonstrates there are physical changes that take place in the brain as we empathize with a person who has a fear or experiences anxiety (Olson, Nearing & Phelp, 2007). Teachers who inadvertently convey their fears and inhibitions to children are very likely to influence how children then feel about these animals and, therefore, limit opportunities for children to construct knowledge, conduct scientific inquiry, and appreciate nature.

Who Has the Time to Teach Science?

Having interacted with hundreds of early childhood teachers about integrating science into the curriculum, we found many clearly recognize and admit to shortcomings in offering meaningful science activities. Importantly though, they also recognize their responsibility to offer activities that foster development of the whole child. Certain subject areas, such as science, unfortunately do not receive the attention they warrant.

A master preschool teacher we have worked with for seven years brought her golden retriever puppy, Pete, to the child development lab school daily. Pete literally grew up with the center's children: He took naps in his crate at rest time alongside the children; they fed and groomed Pete, made him dog biscuits, and exercised him in the adjacent play yard; they weighed him weekly, and the children charted his growth. Initially, Pete was weighed on an infant scale, which he quickly outgrew. As Pete got older the children developed other means to track his weight gain, which prompted the children's interest in charting their own weight and height as they grew. They first gave Pete a bath in a small plastic tub, which, again, he soon outgrew; that presented another challenge for them to solve. Pete's veterinarian was invited to visit the center. The children soon began dramatizing the various activities the veterinarian completed in their presence as he conducted his examination of Pete. This evolved into dramatizing their experiences with their own physicians.

Overcoming the Challenges to Teaching Science

Professional development in the science curriculum arena must not only identify activities, but also provide the underlying science concepts and terminology. All too often, we implement a science activity solely because children may find it fun or we think it's a good thing to do, without recognizing the objectives of the experience. Teachers who have more confidence in their science knowledge — and ability to convey it to children — are more likely to implement a broader variety of science-related activities for children than are their more fearful peers. Overcoming the fear that he will be unable to answer a child's science-based question increases the likelihood a teacher will offer a broader variety of relevant and in-depth science activities in the classroom. For example, when a teacher responds to children's' questions by saying, "I don't know, but, *let's find out together*," he conveys a very important message to children. This line of inquiry offers children an opportunity to learn how to engage in research, regardless of age.

Understanding the integrated nature of the science curriculum provides teachers viable and practical pathways to become more efficient in planning and implementing curriculum. Rich investigations in science present opportunities for meaningful language, reading, writing, mathematical learning, and skill development. Administrators can support teachers in overcoming challenges to teaching science by providing encouragement and relevant professional development opportunities, which should include facilitating teachers taking more risks in teaching science.

Who Has the Money?

Admittedly, inclusive science classroom kits are expensive. Our belief, though, is that by taking full advantage of the opportunities provided in the natural environment as well as our common household materials, we can provide children with much of what is necessary for building a relevant and meaningful science curriculum.

Forming partnerships with families can help children gather more nature materials, as well as extend children's science learning, in the home environment. Here is a list of possible materials for the science center:

The Science Center

- Magnets and assorted metal items — those that do and do not attract
- Magnifiers and rocks of varying sizes and types
- Leaves, mealworms, plants, shells, dirt, sand
- Paper, pencil, tape
- Clipboards to take along for observation notes, drawings
- Plastic tub (for sink/float), plastic tubs, lids, sacks, plastic droppers
- Clocks, flashlights, screwdrivers

How Things Work

Sometimes children have to literally disassemble an object in order to satisfy their curiosity and understand how something works (Duckworth, 1987). Children could construct knowledge by understanding the way the gears, sprockets, chain, and pedals propel a bicycle forward. Keeping this relatively simple idea in mind may help teachers acquire more patience when, for example, they find a disassembled object in the classroom. The experience of disassembling clocks, flashlights, VCRs, and other objects can offer children insights into the all-important concepts of why and how something works.

Science Activity: Not a One-time Occurrence

While a science activity can be offered as a single event, the nature of children's learning is that they want and will need to repeat the activity many times over to bring additional clarity and understanding to the experience. Science investigations and scientific inquiry can last for an extended period of time as is the case of mealworms — which can become a year-long project. Certainly, science is explored when a child brings to class their first caterpillar 'find' of the season. In that context, science can be both a planned curriculum, as well as a spontaneous activity, that may be quickly coordinated with children's interests and what children find on a given day and/or by season. Katz and Chard (1989), in their book, *Project Approach: Engaging Children's Minds*, describe more long-lasting projects. Topics such as rocks, dirt, and trees offer children opportunities to literally 'drive' the scientific investigation. Concept webs help to organize children's and teachers' thinking about the investigation. Also, holding spontaneous 'brainstorming' sessions with children about a topic or timely question can reveal misconceptions they may hold. Concepts concerning habitats are often found in state education standards. Investigating the neighborhood habitat can include studying the behaviors, movements, and/or food consumed by squirrels, birds, and worms.

Early childhood educators bring to curriculum planning a wealth of information about young children, the way they construct knowledge, add to schema, and are naturally curious. The field of science offers us an opportunity to close the critical achievement gap as children learn to think scientifically (e.g., organize their ideas, repeatedly test concepts, and add information to their foundation of how things work, operate, and function in the world). This type of thinking and learning is transferable to other situations and subjects, providing a way to enable children to achieve in other academic areas (Trundle, 2009).

Wonderful Ideas

Children do have 'wonderful ideas' (Duckworth, 1987). It is up to us to support, encourage, and stimulate children's ideas, provide opportunities and materials, the environment for inquiry, and the construction of scientific knowledge.

Activities and Resources

What follows is a sample of science-based experiences that can be planned and completed for the children in one day and then repeated as long as children remain interested. Each experience offers meaningful opportunities for children to participate in writing and reading experiences, whether children are dictating what an adult should write or using the experience in a beginning writing context. Included are some ways teachers can assess children's learning so that the subsequent appropriate and differentiated experiences might be planned, developed, and offered.

A good starting point for teachers is to gather baseline data about what the children already know and understand. A **KWL chart** (e.g., what we **K**now, what we **W**ant to learn, and what we **L**earned) can facilitate and guide the scientific investigation process for children. Child assessment then commences through teacher conversations with children, coupled with children's questions and work samples. Work samples may include documentation or graphing their observations and findings. We encourage teachers to stretch their own comfort zones by implementing more activities and curriculum using science concepts, vocabulary, and terms.

One possible follow-up activity can be children surveying their family about where mealworms can be found, and their family members' reactions about whether the (mealworm) insect is viewed as a pet or pest, as well as the various uses for mealworms.

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Pennies

Pennies are another favorite with children for applying scientific concepts, and counting and weighing. Pennies can also be used with a glass or plastic glass filled to the top with water. Children can predict how many pennies may be dropped into the water before the water overflows the glass. As pennies are dropped into the water, the water top surface forms a dome. Actually, the water molecules are attracted to each other as well as glass and plastic (e.g., the scientific processes of adhesion and cohesion). The pennies appear magnified and larger than they actually are in the water, which might be another science question to explore.

A second type of water activity using coins can occur by placing individual drops of water on a single penny, with estimates and results being recorded. This science activity typically prompts more questions from the children such as how many drops of water can a nickel, dime, or quarter hold?

Children learn vocabulary and scientific processes

Scientific concepts and terms: metal, molecules, adhesion, cohesion

Scientific inquiry processes: observation, estimates, documentation

Keys

Children consistently express fascination with keys because they see others using and holding keys. Few keys, however, are alike; therefore, as a potential science project, they can be categorized by shape, size, color, and even weight. The mass of keys, for example, can be an activity that uses multiple integrated learning opportunities for children. While balance scales can be expensive, we often recommend literally making a scale with the children by using a string (which can be hung from any piece of furniture or the ceiling), a plastic ruler, with a hole in the middle for the string, and holes at each end for tying two plastic bowls or food storage containers. This weighing activity becomes integrated with mathematics. As with many of these activities, children's estimates and predictions become not only critical science opportunities, but also meaningful mathematics and literacy events. Then, children have opportunities to compare the estimates and predictions with the results and use their preferred method of documentation.

Children's follow-up questions might include:

- Why do we have keys?
- What keys do you have at home?
- What kinds of keys open padlocks, mailboxes, doors, and start cars?
- Why are keys different sizes and shapes?
- What keys does the director/principal have and why?

Also, sorting keys by their use and trying keys in various types of locks can become a science project that is repeated and extended as children become aware of the older versus newer methods of locks and locking systems. For these students, it would be interesting to take apart an old doorknob and deadbolt. Once they observe the inner workings, they can spend some time with leftover materials and invent their own locks, keys, and similar mechanisms.

Recording the differences in locks and key systems can be a viable springboard for inviting a locksmith as a resource person to demonstrate the functionality of locks and locking systems. Charting questions to ask the locksmith and the information gained from such a classroom visit could culminate in a class book.

Children learn vocabulary and scientific processes

Science concepts and terms: balance, weight, heavy, light, even, mass, matter, metal

Scientific inquiry processes: estimation, observation, repetition, documentation, invention

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The Case for Mealworms

Mealworms are really perfect classroom 'pets' because they demonstrate how living creatures 'change over time.' They are relatively inexpensive to purchase and typically live for one year or longer and require minimal daily care. Mealworms are actually the larvae of beetles in the second stage of their life cycle (metamorphosis). The mealworm habitat can consist of a jar, plastic box, or a shoebox. They cannot crawl out of anything taller than one or two inches. The adult form cannot fly. Children can participate in feeding mealworms a diet consisting of bran, whole-wheat flour, corn meal or oat meal, and a slice of fruit or vegetable for maintaining moisture. They can simply be given a few crunched crackers or cereal Os with an apple slice.

Children can also observe mealworms grow and shed their hard outer covering (exoskeleton) and count the exoskeletons deposited on the bran or oats. During periods of warmer temperature, children can observe the speed (2-3 weeks) that the larva change into the pupa, and ultimately evolve into an adult beetle. The adult beetle then mates and produces eggs. In two weeks the eggs turn into tiny new mealworms, and the cycle repeats itself.

Children learn vocabulary and scientific processes

Science concepts and terms: mealworm, larva, pupa, eggs, metamorphosis, exoskeleton, and insects

Scientific inquiry processes: observation, testing, repeating tests, estimating/predicting, and recording data

As children investigate and observe mealworms, they can actually see a mealworm grasping onto a toothpick in reaction to stimuli, such as light (from a flashlight) and/or the presence of strong scents (like vanilla or vinegar). Stimulus reactions in each stage of the metamorphosis and the movement of mealworms and beetles all can be observed by the children and documented in a scientific fashion.