Worms, Ramps, and a New Chair for Baby Bear

Preschool Science & Engineering

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Children learn best when THEY do the work of exploring, building, trying, failing, and trying again. Just watching a teacher or peer "do" STEM isn't enough to build habits of mind such as problem solving, reasoning, connecting, and communicating about our thinking.

SCIENCE INVESTIGATIONS AND OBSERVATIONS

Leaf Matching

Materials: paper bag for each child

1. Take a nature walk to collect leaves.
2. Choose a leaf from your bag and ask, "Look into your bags and see if you have a leaf that matches this one."
3. Ask: Is it just like mine? Does it have a sharp point like this one? It almost matches. Who found one with a sharp point?
4. Point out that all leaves from the same tree will have the same general shape.
5. Repeat the activity with other leaves, flowers, and insects.

The Need for Seed

Materials: seed pods from daylily, iris, milkweed, snow peas

1. Show a large seed pod (daylily, iris, milkweed) preferably still attached to the stalk.
2. Ask children what they notice and wonder about the pod.
3. Tell children each kind of plant must make seeds for new plants just like it. Some seeds are protected by covers we like to eat.
4. Show some fruits and vegetables (peas, green beans). Have children predict then investigate if they are seed covers.
5. Save seeds for bird feeders.

Dirt Dough

Materials: dirt, flour, oil, bowl, wooden spoon, muffin tins, cookie cutters

- Recipe: Mix 3 cups dirt, 3 cups flour, 1 cup oil.
- Dough can be shaped with cookie cutters, place in muffin tins, etc.
- Dirt dough can be used to sculpt in the home center or sensory center.

Rock Washing

Materials: rocks, foam paint brush, cup of water, poster labeled before and after

Investigate how the rock's properties are affected by water.

1. Describe changes to the
   - Color
   - Hardness
   - Size
   - Shape
   - Texture

2. Make a before and after poster.
3. Show and tell a friend what was different about the rock when it was wet and dry.

Rock Sorting

Materials: rocks, paper plates labeled with sorting criteria (small/medium/large—shiny/dull—smooth/rough)

1. Use a hand lens to observe properties of the rocks.
   - Color
   - Hardness
   - Size
   - Shape
   - Texture
2. Complete Sorting Activities based on the attributes of the rocks.

Rock Hard

Materials: rocks, pumice, pennies, sorting mat labeled hard and soft

1. Ask children if all rocks are the same hardness. Are some rocks soft enough for a penny to scratch them?
2. Children investigate which rocks can be scratched by a penny and put them on the Soft side of the sorting mat.
3. Children put rocks that cannot be scratched by a penny on the Hard side of the mat.

Where Does Soil Come From?

Materials: pieces of crumbly rock (limestone, shale, soft sandstone), hammers, newspaper, sieve, thick fabric, empty can or bucket

1. Go outside. Put piece of rock between two layers of thick fabric and let children take turns pounding it.
2. Place newspaper on ground. Pour the contents of the bag through the sieve into the bucket, catching spills on newspaper.
3. Continue process until children are tired.
4. Examine the pulverized rock in the can. How does it compare to soil found in the flowerbeds?

Can You Break It?

Materials: thick fabric, hammer, safety goggles, rocks, geodes

1. Break open rocks by placing them between two layers of thick fabric such as a discarded pair of blue jeans.
2. Children use two hands to whack the rock with a hammer. Be sure to wear safety goggles.
3. Discuss: What kinds of rocks broke easily? What did they look like inside? Why do you think some rocks look different on the inside than on the outside?

Living and Non-Living Photobook

Materials: paper, glue, magazines, scissors

1. Children search magazines for examples of Living and Nonliving things.
2. They cut out and paste pictures into a booklet or on a class chart labeled Living and Nonliving.
3. What criteria can they use to tell if something is living?
   - Living things need air, food, water, and shelter.
   - Nonliving do not need those things. Nonliving things cannot move on their own without wind or some other external force.

Using the Sensory Table and the 5 Senses to Learn Science Concepts and Processes

Sound at the Sensory Table

1. Children make shakers by filling empty playdough cans with a variety of stuff (metal washers, cotton balls, rubber pencil erasers, paper clips, etc.) and comparing the sounds.
2. Children slide vibrating and nonvibrating objects down a metal toilet paper holder and compare the sounds.
3. Children use paper towel tubes, pencils, and wooden spoons to beat on empty oatmeal (cardboard), peanut butter (plastic), and soup (metal) and compare the sounds.

Scent at the Sensory Table

1. Children dig for craft sticks scented with peppermint extract, vanilla, orange extract and vinegar hidden among unscented sticks. They add their own descriptive words to a poster for each scent.
2. Children squeeze mostly-empty lotion containers to get a whiff of scents.
3. Children dig in scented rice to find themed objects. For example, rice scented with peppermint extract containing holiday miniatures.

Taste at the Sensory Table

1. Children use tweezers to pick up ingredients for a custom-made trail mix of raisins, dry cereal, chocolate chips, mini marshmallows, and banana chips. Eat!
2. Children use eye droppers to fill a small cup with juice to taste. Try unusual juices such as carrot, pickle, pear, prune, and grapefruit. Sip!
3. Children use eye droppers to add lemon juice to a cup of sweetened water. Repeatedly tasting the lemonade, children decide when it has just the right flavor for them. Slurp!

Sight at the Sensory Table

1. Children practice visual discrimination by sorting dry pasta shapes (bowtie, rigatoni, shell, etc.) into muffin tin cups.
2. Children match up nuts and bolts and screw them together. Then put an eye patch over one eye and have them repeat the activity to observe how the eyes work together for depth perception.
3. Children use eye droppers filled with vinegar to squirt ice cubes made with baking soda and observe the fizzy chemical reaction.

Touch at the Sensory Table

1. Children compare and sort strips of sandpaper, fabric, ribbon, and crepe paper by width, color, or texture. Add a laundry basket with holes for children to weave ribbon through.
2. Children use plastic hammers to break ice and free objects frozen in ice cube trays or ice cream buckets.
3. Children squish water beads and shaving cream between their fingers.

Observation Station Ideas for Preschoolers

1. Worms—Children use plastic spoons to dig worms from school yard. Place in clear plastic tub so children can see from beneath.
2. Playdough—In cooking center, make a different playdough recipe each day for a week and observe the differences in texture.
3. Pumpkin planter—Hollow out some of the seeds and flesh. Fill with moist dirt and place in sunny spot. Observe how a new pumpkin plant begins to sprout.
4. Frozen squid or fish—Order a squid from the butcher counter at the grocery store. Place the frozen squid in a bin of cold water. Whole frozen or fresh fish are available year-round in the meat department. Children observe anatomy, texture, and scent!
5. Rotting food—Children compare the decomposition of bread, bananas, and fruit snacks.
6. Butterfly feeder—Place feeder outside classroom window for quick observations multiple times a day.

7. Melting ice—As a class, create an ice sculpture with colored water and forms such as bowls and bundt pans. Children observe changes to the sculpture as the ice melts.
8. Pond water—Children use digital magnifier (available at school supply stores or online for about $40) to project the image onto a laptop, projector, or tablet.
9. Tree cookies—Children make an observational drawing of a set of tree cookies and compare the number of rings.
10. Leaves—Children gather leaves from the playground and observe color, shape, texture, size, scent.
11. Sunscreen Handprints—Find a sunny spot and place construction paper on the ground. Weigh down the paper with rocks so it doesn't blow away. Spread a thick layer of sunscreen on hands. Make handprints on paper. Come back in 4 hours and check the results.
12. Crayon Art—What happens when crayons are left in a sunny spot of the playground? Hot glue old crayons to a posterboard. Hang on a fence in a sunny spot and observe every few hours.
13. Sun Prints—Children use plastic forks, magnetic letters, and other classroom objects with distinctive shapes to make sun prints. Children locate a sunny spot on the playground and place their objects on a sheet of construction paper. After about 4 hours, the sun has faded the sheet. After removing the objects, a dark imprint shows their shape.

ENGINEERING

Children identify a problem then use stuff to make stuff that does stuff to solve the problem. (Heroman, 2019).

Engineering Design Challenges and Tips for Preschool Engineering Centers

1. Block Center

a) Supply ample blocks and ramp pieces. A good rule of thumb is 200 unit blocks for a group of 3-year-olds, 300 for 4-year-olds, and 400 to 600 for 5-year-olds.
b) Introduce balls and marbles of varying weights to test ramps.
c) If children do not seem to be visiting the block center, paste children's photos on blocks to encourage social-dramatic elements such as a castle for Lily and Max to live in or a racetrack for Emily and Carlos to speed around.
d) Use a tabletop fan to test the stability of structures.
e) Take photos of children's structures and include them in a book that is kept in the center. Children can look through the book to find structures to re-build.
f) Build ramps in the block center. Be patient and allow children to figure out how to use the ramps on their own. Begin with only one type of marble to facilitate comparisons between ramp structures.

2. Math/Science Center

a) Provide children with squeezable condiment bottles and an assortment of items. Challenge children to find out which 3D shapes can be blown across a finish line by squeezing the bottles.
b) Construct a maze by taping obstacles on a tabletop. Blow air to move a ping pong ball through the maze. Use thicker and thinner straws and compare the ease of blowing.
c) How far can you blow the ping pong ball UP an incline? Build a ramp and tape a ruler or number line to the side to measure. Graph the results of ten trials.

3. Sensory Table

a) Design a scoop to dig for treasure.
b) Design a pan balance to compare the weights of treasure finds.
c) Design a boat that can carry a plastic animal across the water.

4. Dramatic Play Center

a) Engineering Theme: Design and create a toolbox with either a handle that can support the weight of five pounds or a drawer that works.

b) 3 Bears Theme: Design and create a chair that can support the weight of a 5-lb bag of sugar.

c) Pet Store: Design and create a pet carrier for an animal of their choice that can support 5 pounds. Refine the pet carrier design to include a working door and a usable handle.

DESIGN CHALLENGES FOR FAIRY TALES

1. Three Little Pigs--Build a house of straw with drinking straws, a house of sticks with sticks from the playground, and a brick house with wooden blocks. Use a fan to see if the houses can withstand the big bad wolf's huffing and puffing.
2. Three Little Kittens—Design a device to keep mittens in pairs when they are put in the washing machine. Try out the device by shaking the paired socks in a closed box to model the agitating washing machine.
3. Goldilocks and the Three Bears—Design a chair for baby bear that can support a five-pound weight. Use repurposed items, recyclables, and only a limited supply of tape.
4. Three Little Pigs—Design a mask for the big bad wolf so that he cannot blow the pigs' houses down. How will you get the mask to stay on? Test the mask by having a friend try it on and blow as hard as he/she can. Refine your design.
5. The Gingerbread Man—Make a playdough gingerbread man that can float. How thin does the gingerbread man need to be to float on top of the water?
6. The Elves and the Shoemaker—Design a trap for the elves. The trap must have a pulley that opens and closes the door. How will you keep the door from closing before the elves come at night?
7. Thumbelina—Thumbelina needs a new home. Design and create a hanging home made from recycled soda bottles. The home must have an opening large enough for Thumbelina but too small for the sparrow to enter.
8. Little Red Riding Hood—Design and create a basket for Red to put Grandmother's goodies in. The basket must be large enough and strong enough to hold a loaf of bread and five cookies.
9. Jack and the Beanstalk—Design a ladder for a beanstalk measuring 24 inches. The ladder must support the weight of a plastic toy figure.
10. Princess and the Pea—Design a bed for the princess that has enough padding that she can't feel the pea or design a ramp for the pea to roll down from the bed to the floor. The ramp must have at least three changes of direction.

<u>Questions to Ask During Engineering Design Challenges</u>

- What do you predict will happen?
- What other way could you do it?
- Why do you think that happened?
- Can you tell me about it?
- Can you show your friend?

NSTA Position Statement:
Early Childhood Science Education

Introduction

At an early age, all children have the capacity and propensity to observe, explore, and discover the world around them (NRC 2012). These are basic abilities for science learning that can and should be encouraged and supported among children in the earliest years of their lives. The National Science Teachers Association (NSTA) affirms that learning science and engineering practices in the early years can foster children's curiosity and enjoyment in exploring the world around them and lay the foundation for a progression of science learning in K–12 settings and throughout their entire lives.

This statement focuses primarily on children from age 3 through preschool. NSTA recognizes, however, the importance of exploratory play and other forms of active engagement for younger children from birth to age 3 as they come to explore and understand the world around them. This document complements NSTA's position statement on elementary school science (NSTA 2002) that focuses on science learning from kindergarten until students enter middle or junior high.

Current research indicates that young children have the capacity for constructing conceptual learning and the ability to use the practices of reasoning and inquiry (NRC 2007, 2012). Many adults, including educators, tend to underestimate children's capacity to learn science core ideas and practices in the early years and fail to provide the opportunities and experiences for them to foster science skills and build conceptual understanding (NRC 2007, p. vii). Also underestimated is the length of time that young children are able to focus on science explorations. Effective science investigations can deeply engage young children for extended periods of time, beyond a single activity or session.

NSTA supports the learning of science among young children that will create a seamless transition for learning in elementary school.