Exploring Sunflower Seeds

A Thematic Approach to Science Inquiry

Ashley Roseno, Eugene Geist, Virginia Carraway-Stage, and Melani W. Duffrin

Early childhood is a critical period for jump-starting science literacy (Blake 2009). During this time, children naturally develop science concepts (e.g., collecting and organizing data) to answer day-to-day questions about their world. It is important that early childhood educators foster young children's natural science inquiry (Blake 2009). Research studies suggest that young children learn best when they are actively engaged in their environments and seeking answers through exploration and investigation (Blake 2009; Bosse, Jacobs, & Anderson 2009). Providing young children with frequent opportunities to experience science through active engagement may promote long-term interest in science and science-related fields (Blake 2009; Brenneman 2009; Gerde, Schacter, & Wasik 2013). Teachers employing a constructivist, inquiry-based approach can help children make sense of scientific knowledge using scientific reasoning and critical thinking by enabling children to construct new knowledge based on previous experiences. This approach gives young children opportunities to explore scientific concepts and expand their cognitive development through active engagement (Piaget 1973; Yoon & Onchwari 2006; Blake 2009; Brenneman 2009; Halpenny & Pettersen 2014).

Research emphasizes the importance of supporting mathematics and science in the preschool years (Greenfield et al. 2009). Children explore their world and construct early mathematics and science concepts using play-based investigative processes (Furtado 2010; Cook, Goodman, & Schulz 2011), such as planting seeds. This kind of developmentally appropriate inquiry is the basis for many preschool curricular approaches like Reggio Emilia (Inan, Trundle, & Kantor 2010) and Montessori (Lillard 2013). Additionally, the Next Generation Science Standards (NGSS 2013) recognizes encouraging children's natural inquiry process as an effective method for introducing

science concepts. The use of the inquiry learning cycle to engage children in the investigation process can be applied to support the 3-D learning model as suggested by the NGSS (Bybee 2013).

The Food, Math, and Science Teaching Enhancement Resource (FoodMASTER, www.foodmaster.org) Initiative, a project funded by the National Institutes of Health Science Education Partnership Award (SEPA), creates and implements curricula that use food as a tool to teach mathematics and science concepts to children of all ages. A team of researchers from the FoodMASTER Initiative partnered with Head Start schools to implement hands-on, food-based preschool lessons that used seeds as a foundation. The research team included the FoodMASTER assistant director, undergraduate research assistant, and undergraduate volunteers.

The FoodMASTER/Head Start curriculum

Researchers chose sunflower seeds for the project because they are considered a healthy snack option, appropriate for children beginning around 4 years of age (AAP 2015). Sunflower seeds and sunflower seed products are considered an allergy-safe alternative to peanuts. Although few cases of allergic reactions to sunflower seeds have been reported (Lavine & Ben-Shoshan 2015), it is important to be aware of children's allergies before bringing food into the classroom. Because seeds are relatively novel to 4-year-olds, the researchers thought that the children would be intrigued by the investigation process. The researchers also provided opportunities for sensory activities with sunflower seeds in the form of sun butter. All activities were conducted in Head Start classrooms and led by the undergraduate research assistant, Ashley Roseno, who was assisted by volunteers and teachers.

The research team chose the 5E learning cycle to implement science education activities because it is an inquiry-based approach. This model, which has five phases—Engage, Explore, Explain, Elaborate, and Evaluate—provided the structure for our weeklong learning experience (Yoon & Onchwari 2006). Our inquiry consisted of four hands-on, seed-based activities focusing on science and mathematics concepts. Each activity began with circle time to find out the children's existing knowledge. Later, during discovery time, the children engaged in the hands-on portion of the lesson. The hands-on exploration, which comprised most of the day's activity, ended with circle time—during which the children summarized their findings and sang a song about the life cycle of seeds, called "Planting Time." The children, at their leisure, explored the seeds throughout the week to learn more about the sunflower's growth stages from seed to flower.

Activity 1: Engage

The first activity was designed to stimulate the children's interest in seeds. In a constructivist activity the goal is to develop and encourage inquiry and discussion among the children. For instance, teachers can bring in books about seeds for the children to look through until they see a seed resembling the ones they are examining.

> The children gather for circle time. Ashley, the research assistant, asks them, "What is your favorite snack?" "Goldfish!," says Perry. "Carrots!," says Fernanda. Once all the children have answered, Ashley introduces them to a mystery box—a paper-wrapped shoebox with a hole cut in the top to allow a child's hand to fit through. One by one each child reaches into the box to feel the items inside without seeing them. Ashley asks the children to think about what they felt in the box and then draw a picture of it, but not to tell anyone else what they think it is. She encourages the children to be creative with their drawings. After everyone has taken a turn and drawn their guess, the children eagerly talk about what is in the box. They agree that seeds are the mystery item, but are not sure what kind. Ashley reveals the edible roasted sunflower seeds and offers the children a chance to taste them. Most of the children try them, but a few are hesitant. Marquis asks, "Will eating the seeds make a flower grow in my belly?"

About the Authors

Ashley Roseno, MS, RDN, LDN, is a registered dietitian and project coordinator for the NIH Science Education Partnership Award-funded Food, Math, and Science Teaching Enhancement Resource (FoodMASTER) Initiative at East Carolina University, in Greenville, North Carolina. Her research and career interests are grounded in nutrition education. rosenoa@ecu.edu

Eugene Geist holds a BA in History and an MEd in child development and early childhood education from the University of Cincinnati. He received his PhD from the University of Alabama at Birmingham in early child development and education with a specialization in Piaget's constructivism. He teaches in the Patton College of Education at Ohio University, and his areas of expertise include child development, constructivism, and the development of mathematical knowledge in young children. geist@ohio.edu

Virginia Carraway-Stage, PhD, RDN, LDN, is a registered dietitian and director of the Food-based Evaluation and Education Development (FEED) project. FEED's mission is to develop integrative curricular and evaluation resources for preschool through 12 learning environments. carraway-stagev@ecu.edu

Melani W. Duffrin, PhD, RDN, LDN, is a registered dietitian and professor of nutrition science at East Carolina University. Her area of expertise lies in food and nutrition education. duffrinm@ecu.edu

Marquis's question reveals a common scientific misconception. According to Piaget, children make mistakes, get the wrong answer, or have misconceptions not because they are ignorant, but because they are thinking (Piaget 1970). In this case, Marquis applied what he learned about seeds and came to a logical conclusion about what would happen if he ate them. Several other children nodded their heads at Marquis's question, showing that they thought his assumption was correct. Using Piaget's theory, the authors considered Marquis's prediction that seeds would sprout in his stomach logical and quite advanced.

Treating misconceptions can frequently provide opportunities to encourage more conversations between children. Marquis's comment prompted us to ask questions such as "Have any of you ever eaten any other seeds?" and "Have you ever seen anyone walking around with plants growing out of them?" to encourage further discussion, and allow the children to reflect and consider their thinking for weeks after the activity has ended.

The activity concluded with circle time. A few children stood up to tell their classmates about their drawings; then they all learned a new song, "Planting Time" (www.preschooleducation.com/sgarden.shtml). The children enjoyed singing and looked forward to the next activity.

Activity 2: Explore

The goal of the second activity was to further explore sunflower seeds by discovering other uses for them.

The children sit in circle time with Ashley. She asks them questions about the previous sunflower seed activity, helping them to recall what they learned. Ben says, "I liked the sunflower seeds. What other seeds can I eat?" Ashley replies with a question, "Have you ever toasted the seeds from your Halloween pumpkin?" Ben says, "Yes! My mom and I baked the seeds from my pumpkin last Halloween." Shayna exclaims, "That's another seed you can eat!" Several children nod in agreement.

"How can the seeds be transformed into something else?," Ashley asks the children. Rubbing his hands together, Victor suggests "smushing them." Ashley smiles at the response and holds up a jar of sun butter—a spread similar to peanut butter made from sunflower seeds. "This is sun butter," Ashley says. "Would you like to taste it? See if it tastes like any food you have had before."

Seated at tables in small groups of four and five, the children watch Ashley hold up two measuring spoons, a tablespoon and a teaspoon. To introduce the mathematical concept of measurement, Ashley asks, "Which one is bigger?," "Have you seen these before?," "Where have you seen these?," "What are these called?," and "What do you use them for?" After the children discuss the answers, Ashley explains that the children will measure the amount of sun butter they want to eat using the measuring spoons. She lets each child choose a measuring spoon to scoop the sun butter out of the jar.

Ashley and the volunteers encourage the children to explore the texture using their hands to "smush," spread, rub, and taste the sun butter on their plates. Many hesitate to try it, so Ashley gives them ample time to be creative and become familiar with this new food. As they experiment with the physical properties of the sun butter, the children become more comfortable with it and begin to explore the taste and smell. Ebony says, "It smells good." Hari says, "It feels sticky and tastes nutty." "It's kind of like peanut butter," Cameron remarks. Most children agree.

The volunteers hand out tortillas and crackers to let the children spread the sun butter on a familiar food. The circle time conversation that follows focuses on how sunflower seeds are transformed into sun butter.

Activity 3: Explain

Ashley asks the children questions about previous circle time activities, such as "Can you think of other things we can do with sunflower seeds?" After some discussion about what they can do with seeds, Ashley and the children talk about planting seeds. Skylar says, "One seed can grow into something else like a flower or something we can eat."

The children sit at tables while Ashley and the volunteers give each of them a small, clear plastic cup with three sunflower seeds—ones to plant, not eat. Ashley asks them, "What do seeds need to grow?" "Seeds need dirt," says Charlie. Piper adds, "And water and the sun." Ashley asks the children where in the classroom they think the plants will get the most sun. Together they decide that the best place is near the window. Everyone gathers for circle time and Marya, a volunteer, reads *To Be Like the Sun,* by Susan M. Swanson. Afterward, Ashley and the children review what they learned during the activity and everyone sings "Planting Time."

Activity 4: Elaborate and evaluate

During circle time for the fourth and final activity, Ashley introduces the mathematical concept of weight to elaborate on and evaluate information about sunflower seeds covered in the previous activities.

Ashley shows the children one cup and one-half cup dry measuring utensils. She asks, "Have you seen these before?," "Where have you seen these?," "What do you use them for?," "What are they called?," and "Which one is bigger?" She invites the children to find seats at their tables.

Two kitchen scales sit in the middle of each table. Ashley tells the children that they will use the scales to

weigh the sunflower seeds. First, the children compare the weight of one cup of sunflower seeds to the weight of one-half cup of sunflower seeds. Ashley and the volunteers help with the children's exploration of the scales. Ashley asks them, "Which measure weighs more?" and "How can you tell if one item weighs more than another item?" Kayla says, "When one is farther down than the other." Susan asks, "Which container of seeds do you think is heavier, the half-cupful or the cupful?" Willie says, "The bigger one weighs more." The children test their predictions by placing the seed-filled measuring cups on different scales and comparing the weights.

Ashley asked the children what would happen if they put two half cups of sunflower seeds on one scale and the one cup of sunflower seeds on the other scale. The children thought the two half cups would weigh more and were excited to discover that the two half cups and the one cup weighed the same.

Piaget theorized that children will not change their answers when the direct teaching method is used. That leap of logic occurs only when children have had recurrent interactions with their environment. For that reason, in the one cup versus two half-cups activity, Ashley did not attempt to encourage the children to say the correct answer, but instead used questioning techniques to help the children be mentally active during the activity and to promote conversation among them. According to Piaget, children will come to the logical conclusion if provided with adequate time to discuss a given topic (Piaget 1973; Halpenny & Pettersen 2014).

Ashley and the children concluded the activity in a circle time by discussion of the things they had discovered about sunflower seeds throughout the week. Some children shared their planted seeds and drawings from the first day. Most of the children were excited to share what they learned with their peers. Jalen, who was usually very quiet, stood up and told everyone, "My seed is growing like me!," indicating he understood that the seeds were living organisms that grow just like humans.

Conclusion

Educators who provide hands-on, inquiry-based activities for young children can promote a lifelong interest in science (Blake 2009; Brenneman 2009). Teachers need not be experts in the subject matter; rather, teachers can be coinvestigators with children, drawing on the children's innate scientific thinking to bring out their inner scientists.

In addition to inspiring scientific curiosity and guiding preschoolers' science explorations, inquiry-based methods such as the 5Es framework can be used to introduce new foods to children (Contento 2011).

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