Plants, Alike and Different

LAYING THE FOUNDATION TO HELP PRESCHOOLERS UNDERSTAND INHERITANCE OF TRAITS

By Kathy Cabe Trundle, Katherine N. Mollohan, and Mandy McCormick Smith

Young children are filled with natural curiosity and ask many questions. An adult might step over an army of ants in sidewalk cracks, but a child will likely stop and observe the work of these insects. They wonder what the ants are doing, where they sleep, whether the insects are family members (e.g., brothers and sisters), and why they vary in size and color. We capitalize on this natural sense of wonder to develop children's inquiry skills and help them learn life science concepts, including foundational concepts like inheritance of traits. At the preschool levels, inheritance of traits means beginning to recognize that living things of the same type are alike and different based on physical properties.

A Framework for K–12 Science Education (NRC 2012) includes inheritance as a core idea within the life science framework. For example, life science core idea 3A (LS3.A) states that by the end of second grade, children's knowledge should include the ability to recognize and investigate physical differences and similarities among the same kind of organisms (e.g., plants and animals) and that offspring resemble their parents and each other. State and local science standards also include these concepts.

Preschoolers innately observe and notice differences and similarities among the people around them. They typically notice similarities and differences in skin color, hair color, eye color, and size. They also naturally compare animals to one another, like pets at home or school (e.g., dogs' fur color). As a team, we planned investigations and taught these science lessons. Through these lessons, we help children extend natural comparisons of physical properties of humans and familiar animals to include observations and comparisons of the physical properties of plants and insects, laying a foundation for future understanding of inheritance of traits.

Preschool Learning Cycle Model

We use a learning cycle model to teach how plants and insects are alike and different. The learning cycle we use is a three-phase, ongoing process (Figure 1). We begin with play, move to exploration, and then discuss the concepts children explored. Play is the key component for implicit learning (i.e., learning that happens in an incidental manner without intention or awareness that learning is taking place), which provides children opportunities to engage with new materials. During exploration we build on the children's questions and begin explicit learning (i.e., active development of skills or construction of knowledge or understanding with awareness). With discussion we summarize patterns and label the learning with young children. From discussion the children return to play and apply what they learned back to the classroom materials. This article provides examples of the learning cycle lessons we use to help preschool children develop the abilities to recognize and verbalize how animals, plants, and people are alike and different based on physical properties.

Phase 1: Engaging in Play

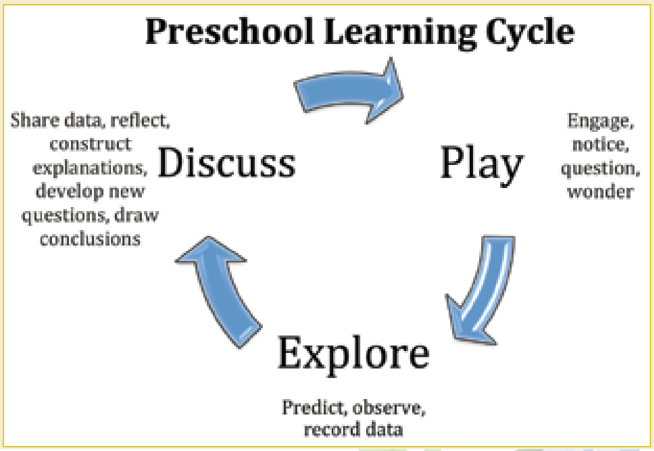
To engage children and provide opportunities for implicit learning, we introduce them to properties of plants by having silk flowers and other plants in the dramatic play area. Unstructured playtime allows the children to become familiar with different types of plants and their physical properties as they begin to notice how plants are alike and different. Children often pretend to plant and tend a flower garden. They also enjoy pretending to pick flowers for bouquets. This time provides an opportunity for children to wonder and pose questions about plants.

To begin the intentional learning, we meet young children at their developmental level. Young children are egocentric, so they see similarities and differences by comparing other people to themselves, usually noticing differences in size and gender first. This effort focuses on the concept of how living things are similar to and different from other living things of the same type, in this case humans. To develop children's observational skills, we focus their attention by asking them to look at a friend sitting nearby and compare their appearance to how their friend looks. For example, we ask: *How do you look alike and different from your friend? What color are your eyes? What color are your friend's eyes? Is your eye color alike or different from your friend's eye color?* We use this opportunity to discuss similarities and differences in children with differing physical abilities. Based on the level of diversity in the class, we use books to broaden children's thinking about differences among people (e.g., skin color, mobility; see Print Resources).

Next, we transition from traits of animals (e.g., humans) to properties of plants by stating *Now that we've had the chance to observe how people are alike and different, we are going to do the same thing with plants.* This statement serves as a bridge for students, indicating that they will use the same observational skills and apply them to other kinds of living things. We link the intentional learning back to play as we

Figure 1.

The preschool learning cycle.



Students examined and drew the parts of a pansy plant.

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build on and extend observations to include plants, which children do not usually consider when thinking about how living things are related to one another. When we ask young children to draw a rose, which most children have previously observed, they usually produce a red flower. When asked to draw another, the only difference might be the color of the rose. Beyond color and size, children usually do not think about other similarities and differences among plants. When looking at living things of the same kind or species, a prevalent misconception is that members of the same species vary only in color and size because they are the same type of organism.

Phase 2: Exploration of Plants

We use common annual plants (e.g., marigolds, pansies, or coleuses) from the local garden center to build on the children's basic knowledge and teach genetics concepts. These types of plants provide interesting comparisons (flower size; number of flowers per plant; leaf shape, color, and texture; stem length and shape) for children. For example, we use three different types of marigold plants. The African marigold has tall or long stems reaching a height of 3 ft. and large, single-color flowers (up to 3 ½ in. in diameter); the French marigolds have shorter stems (5–18 in.), smaller flowers (1–2 in. in diameter), and the flowers can be bicolored; and the Signet marigold has a different flower shape with single petal blooms—they emit a lemony scent. The stem and leaf colors, fragrances, and shapes on African and French marigolds are similar. We ask children to observe similarities and differences in the marigold plants. Later, we repeat these observations with two types of pansies and two different coleus plants.

With pansies, we select plants with different flower sizes (3–4 in. vs. 1–2 in. diameters) and different color patterns (monkey-faced with dark centers vs. clear-faced with a single color). Again the leaves of the pansies are similar in color, size, and shape. Coleus plants provide opportunities for children to observe variations in leaf margins or edges (serrated vs. scalloped), leaf colors (variegated with bright colors like pink, yellow, dark purple, and green vs. solid colors like yellow or dark red), and leaf textures (smooth vs. hairy). Because the coleus plant is a member of the mint family, the shape of the stem is square, which is interesting to young children because it is different from the stems of marigolds and pansies. Children can easily feel the shape of the stem by gently rolling it back and forth between their fingers. These square stems have four distinct corners (right angles) in contrast to the rounded, smooth stems of pansies and marigolds. The coleus flowers are small and similar on each plant.

CAUTION

We always begin the exploration part of our lessons by reminding children of safety. Our basic classroom rules include keeping all materials away from our own and friends' faces. We also remind children to keep their hands away from their eyes and mouths as they work with materials. After each interaction with plants or insects we have children wash their hands. We do not allow children to put the organisms in their mouths because flowers from greenhouses might be covered with pesticides or herbicides and insects might bioaccumulate harmful chemicals. Although allergic reactions to the materials used in our lessons are rare, special consideration must be given to children with severe allergies. If any child in our class is at risk of an allergic reaction to the materials, we use digital images rather than actual plants.

After reviewing safety, the children make and record their observations through drawings, which have several advantages for science learning. The drawing process focuses children's observations and provides a mechanism for young children with emerging literacy skills to document their data. Also, some concepts (e.g., leaf shapes) are more easily communicated through drawings than written descriptions. For young children who are developing their fine motor skills, they may do rubbings or trace leaves to record the shapes of the plants being observed.

Once drawings are complete, they provide a visual representation that children can use to identify patterns in the natural world. By comparing their own "data" (i.e., drawings) with other students', children will begin to see patterns such as marigold plants have leaves that are alike (e.g., color and shape), but the flowers can be different (e.g., size, color, number of petals). Children's drawings provide insights into their understanding. Last, drawing is an integral part of the science process. For example, field scientists like geologists, botanists, and entomologists routinely record sketches in their field notebooks.

As children draw, we ask specific questions such as *What color are the petals?* to focus their observations on important details they might otherwise overlook. Some educators might question the developmental appropriateness of using drawings with young children, but teaching children to record their observations through drawing is central to the project approach, which has been successfully implemented with young preschool children (Helm and Katz 2010), as well as learning in the Reggio Emilia preschools (Edwards, Gandini, and Forman 1998). Both involve children as young as two and three years old in making drawings from their own observations. In fact, detailed drawing activities are a daily occurrence in the schools and the projects and preschoolers are more comfortable than adults with representing ideas through drawings.

Phase 3: Sharing and Discussing Data

Next, we use a data chart in the classroom to record and share additional data (Table 1, p. 56). Data charts can be effectively used by young children and can be a great way to represent their thoughts in a graphic organizer. Depending on the age and ability levels of the children, the data chart can be completed individually, with a partner, or with a teacher's guidance and support. To encourage the sharing of ideas and discussion among our preschool students, we use the data chart, transferred onto poster board, during circle time. We revise the chart based on the types of flowers being used. Table 1, page 56, compares two types of marigolds, but it can easily be modified to use when comparing pansies or coleuses. This encourages young children to think about how shapes, colors, and numbers compare among plants as they discuss their scientific observations. We ask preschoolers to pick a color square that best matches the color of the flower. Children then tape the color to the poster board in the appropriate column. During this time, we also remind students to use the evidence they previously collected as they make discussion points. For example, when counting petals, if there is a disagreement, students can count them again to




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reach an answer. With young children we often use relative comparisons and identify which flower has more petals and which plant has more flowers. This reliance on evidence helps children begin to understand a key component of the nature of science—science is evidence-based.

Finally, children compare data for their plant with data from another plant of the same kind (e.g., two types of marigolds, two types of pansies, or two types of coleuses). A final comparison between the plants can be made by asking some guiding questions such as *What looks the same on the plants? What looks different between the plants?* Such questions encourage children to uncover patterns of similarity and difference in plants of the same type. Children's responses typically include *Some plants have flowers that are big and some are little* or *Both plants have green leaves*. We display these class data charts as a visual record or graphic organizer to which the children can refer as we continue our discussions of alike and different. For a second lesson on the differences between parents and offspring, see the NSTA Connection. This extension allows children to apply what they learned and begin a new cycle of exploration. To extend these concepts beyond plants and insects, we have the children bring pictures of pets to class and compare similarities and differences among animals of the same type. Children can bring in stuffed bears to make observations about what is the same and different about their bears or they can bring in photographs of themselves and other family members and describe how they are alike and different from their own family members.

Assessing Student Understanding

Assessment occurs throughout the learning cycle. For example, we assess the development of children's process skills during exploration and discussion. There are several learning outcomes for students with these lessons, including (a) the ability to observe and explore physical differences and similarities among the same kind of organisms, and (b) the ability to recognize that offspring resemble their parents and each other. Over the course of the lesson the children's drawings will become more detailed and less imaginative, illustrating what they've learned. See the NSTA Connection for a rubric to assess children's progress in representing their observations through drawings.

Examining how student drawings change over time can help in assessing student understanding.

Table 1.

Data chart for plant observations.

	Marigold 1	Marigold 2	Alike?	Different?
Stem color				
Stem shape (round or square)				
Leaf color				
Leaf texture (smooth, bumpy, hairy)				
Flower color				
Number of petals per flower (many or few)				
Smell				

Assessing young children's science progress can be difficult because science requires time for students to observe, collect evidence, and make conclusions based on their observations. No single assessment method or model will work for evaluating every child because each has his or her individual strengths. We assess students' understanding of genetics concepts by careful monitoring of all children's work and their participation in group activities. When assessing children's science learning, we focus on the following outcomes:

- Student drawings in his/her science workbook. Are the drawings moving from imagination- to evidence-based?
- Participation in class discussions. Are the students able to link their reasoning back to the evidence observed in class?
- Students ask new questions as they arise from the evidence. Are the students able to expand on the ideas introduced in class (i.e., crossover of human family traits to plant family traits)?
- Improvement over time. Young children can have such varied abilities. We aim to meet each student where they are developmentally and move them forward in their scientific understandings of genetics.

Assessments should relate to the identification of students' strengths, areas for growth, and careful observation and monitoring of their work over time. With young children, we document this progress with their science notebooks or by including their drawings with our comments in their student portfolios. We have also seen this assessment model effectively implemented using a unit checklist incorporated into each child's classroom portfolio. We mark off the concepts mastered and note which concepts still need improvement or remediation. These records provide great evidence-based discussion points during parent–teacher conferences.

Conclusion

Children enjoy learning about themselves and the world around them. The alike and different investigation described in this article lays a foundation for understanding more advanced concepts involving heredity, providing a basis on which to build future learning. ■

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Print Resources

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Connecting to the Standards

This article relates to the following National Science Education Standards (NRC 1996):

Content Standards

Grades K–4

Standard C: Life Sciences

- The characteristics of organisms

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academies Press.

NSTA Connection

For a lesson on the similarities and differences between parents and offspring and a blank rubric, *visit www.nsta.org/SC1302.*