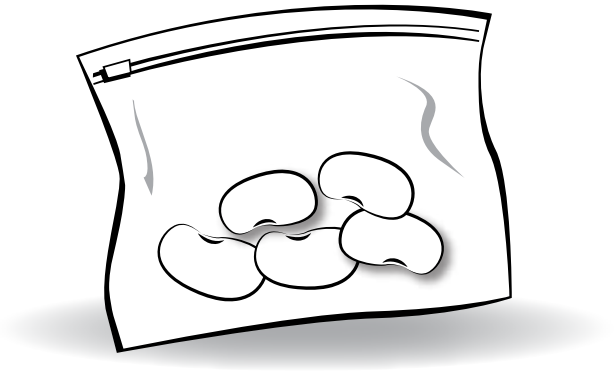
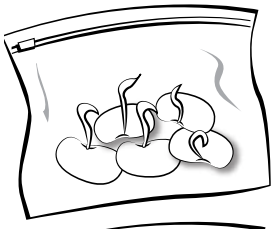
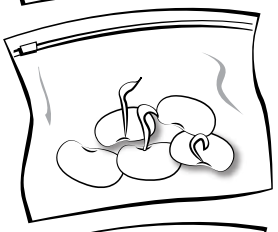
Seeds in a Bag



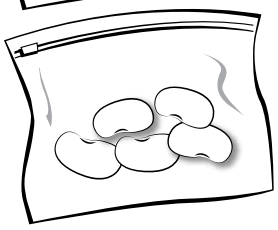
What will happen when the bag of seeds is put in soil?



All of the seeds will sprout.



Some of the seeds will sprout.



None of the seeds will sprout.

What are you thinking?

Seeds in a Bag

Teacher Notes

Purpose

The purpose of this assessment probe is to elicit children's ideas about the needs of seeds. The probe is designed to find out if students recognize that when seeds are planted in soil, they need to take in water from the soil in order to sprout. It also points out developing ideas students may have about open and closed systems.

Related Concepts

seeds, needs of living things, germination, closed system

Explanation

The best answer is "None of the seeds will sprout." The bag is a closed system that prevents the seeds from coming in direct contact with the water in the soil. Seeds encase a plant's embryo. Seeds need water, air, and the right temperature to sprout. Seeds need water (obtained from a moist environment) to sprout. Water is necessary for the metabolic reactions that result in the germination of the seed and its initial growth. Taking in water also leads to swelling inside the seed, which breaks the seed coat so that the seedling can emerge. Oxygen from the air is also needed for the cellular respiration that takes place in the cells of the plant embryo inside the seed and the emerging seedling. Because the bag is sealed, no water can get inside the bag and be taken in by the seeds. Students may think the seeds will sprout because they are planted in soil and/or need darkness and fail to recognize that the seeds need to be in direct contact with water.

Curricular and Instructional Considerations for Grades K–2

Investigating plant growth by observing and planting seeds under a variety of conditions is a common primary-level activity designed to help children understand that seeds need water, air, and the right temperature to sprout. Once they sprout, children learn that seedlings also need sunlight and air to grow. Children at this age also need opportunities to examine the conditions under which phenomena take place. The idea of an open or closed system—one of the crosscutting systems concepts that develop in sophistication from one grade level to the next—begins in early elementary grades by observing that some objects let things go in and out while others do not. Students need to recognize that the seeds must come in contact with water. Merely planting them in soil when they are in a sealed bag does not allow the water to reach the seed. This probe encourages students to think critically about the factors involved in germination.

Administering the Probe

Model this scenario for students by showing them some seeds in a sealed, zip-top bag. Make sure they understand the bag is sealed tight. Make sure they understand the inside of the bag is dry. Have students predict what they think will happen to the seeds if the bag is buried in soil and the soil is watered. Encourage students to explain the reasons for their prediction. Listen carefully to see if students recognize the bag as a closed system that prevents the seeds from coming in direct contact with

the water in the soil. Be aware that some students think the act of planting something in moist soil or watering the soil after the seeds are planted will sprout seeds without recognizing that the water must come in contact with the seeds. They may understand that seeds need water but not understand the seeds must take in the water. Refrain from giving students clues about the bag, as you will want them to think critically and discover the notion of the closed system not letting the water in after they have a chance to test their predictions. See pages xxviii–xxxiii in the introduction for techniques used to guide "science talk" related to the probe.

Related Ideas in *Benchmarks for Science Literacy* (AAAS 2009)

K–2 Flow of Matter and Energy

- Plants and animals both need to take in water, and animals need to take in food. In addition, plants need light.

Related Core Ideas in *A Framework for K–12 Science Education* (NRC 2012)

K–2 LS1.C: Organization for Matter and Energy Flow in Organisms

- Plants need water and light to live and grow.

3–5 LS1.C: Organization for Matter and Energy Flow in Organisms

- Animals and plants alike generally need to take in air and water, animals must take in food, and plants need light and minerals.

Related *Next Generation Science Standards* (Achieve Inc. 2013)

Kindergarten: From Molecules to Organisms: Structures and Processes

- K-LS1-1: Use observations to describe patterns of what plants and animals (including humans) need to survive.

Grade 1: Ecosystems: Interactions, Energy, and Dynamics

- 2-LS2-1: Plan and conduct an investigation to determine if plants need sunlight and water to grow.

Grade 4: From Molecules to Organisms: Structures and Processes

- 4-LS1-1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Related Research

- Some students fail to recognize a seed as a living thing; therefore, they do not recognize that seeds have needs similar to the needs of other living things (Driver, Squires, Rushworth, and Wood-Robinson 1994).
- Russell and Watt (1990) interviewed younger students about their ideas related to conditions for growth, focusing on germinations as well as vegetative growth. Of the 60 children interviewed, 90% identified water as necessary.
- A study found that students held strongly to the idea that light is always required by plants, even in the face of contrary evidence such as seedlings germinating in the dark (Roth, Smith, and Anderson 1983).
- Results from field-testing this probe indicate that many students think seeds will

sprout if planted in soil that has been watered. They fail to recognize that the seeds must come in contact with the water. The mere act of putting seeds in soil and adding water affected their thinking.

Suggestions for Instruction and Assessment

- A similar probe, "The Needs of Seeds" (Keeley, Eberle, and Tugel 2007), that addresses conditions necessary for germination can be adapted for this grade level.
- This probe can be used as a P-E-O (Predict-Explain-Observe) probe (Keeley 2008). Have students make their prediction, explain the reason for their prediction, then test the prediction by putting bean seeds in a sealed zip-top bag, covering the bag with soil, and watering the soil. Check the seeds several days later. Furthermore, compare seeds planted without being in a sealed bag with seeds in a sealed bag or seeds in an open bag. Conduct a class discussion to explain why the seeds in the open bag or no bag germinated and the seeds in the sealed bag did not.
- Start with the concept of a door to develop the idea of an open system. When the door is open, people in a room can leave and people outside a room can enter. Then develop the concept of a closed system. When the door is closed, people inside cannot leave the room and people outside the room cannot enter. After students have developed the idea of open and closed systems, ask them to think of how the seeds in a sealed bag are like the people in a room with a door. Ask them what things could get into or out of the bag when it is open versus closed.
- Show students what happens to a seed when it takes in water. Give students dry lima beans. Soak the lima beans overnight and compare the soaked lima beans to the dry lima beans. Discuss the evidence that the seed absorbed water. This can be further developed by weighing dry seeds and weighing them again after they have absorbed water.
- After students put the bag in the soil, they should water the soil. Challenge them to use the concept of open and closed systems to think about whether the seeds in the bag will absorb the water that is added to the soil. If students are reluctant to give up the idea that watering the soil will help the seeds sprout, confront them with a sealed bag of seeds submerged in water. Have them observe if the seeds come in contact with the water and how this might be similar to putting the sealed bag of seeds in wet soil.
- Some students may think the seeds did not germinate because they need light. Use caution when teaching the idea in the standards that plants need light. Once a seed sprouts to form a seedling, it needs light, but light is not necessary for germination. Students can further test this idea about seeds' need for light to sprout by placing seeds on a moist sponge or other substrate in the light versus in the dark.
- Provide students with opportunities to observe how water is necessary for seeds to sprout. Make observations of seeds with no water, little water, adequate water, and too much water to show that there is a certain amount of water that seeds need and that too much or too little water does not enable seeds to sprout.
- Challenge students to explain why seeds in seed packages do not sprout inside the package.

Related NSTA Resources

Ansberry, K., and E. Morgan. 2009. Teaching through trade books: Secrets of seeds. *Science and Children* 46 (6): 16–18.

Cavallo, A. 2005. Cycling through plants. *Science and Children* 42 (7): 22–27.

Keeley, P. 2011. Formative assessment probes: Needs of seeds. *Science and Children* 48 (6): 24–27.

Konicek-Moran, R. 2008. *Everyday science mysteries: Stories for inquiry-based science teaching*. (See "Seed Bargains," pp. 107–144). Arlington, VA: NSTA Press.

Ritz, W. 2007. *A head start on science: Encouraging a sense of wonder.* Arlington, VA: NSTA Press.

References

Achieve Inc. 2013. *Next generation science standards. www.nextgenscience.org/next-generation-science-standards.*

American Association for the Advancement of Science (AAAS). 2009. Benchmarks for science literacy online. *www.project2061.org/publications/bsl/online*

Driver, R., A. Squires, P. Rushworth, and V. Wood-Robinson. 1994. *Making sense of secondary science: Research into children's ideas.* London: Routledge.

Keeley, P. 2008. *Science formative assessment: 75 practical strategies for linking assessment, instruction, and learning.* Thousand Oaks, CA: Corwin Press and Arlington, VA: NSTA Press.

Keeley, P., F. Eberle, and J. Tugel. 2007. *Uncovering student ideas in science, vol. 2: 25 more formative assessment probes.* Arlington, VA: NSTA Press.

National Research Council (NRC). 2012. *A framework for K–12 science education: Practices, crosscutting concepts, and core ideas.* Washington, DC: National Academies Press.

Roth, K., E. Smith, and C. Anderson. 1983. *Students' conceptions of photosynthesis and food for plants.* East Lansing, MI: Michigan State University, Institute for Research on Teaching.

Russell, T., and D. Watt. 1990. *SPACE research report: Growth.* Liverpool, England: Liverpool University Press.