Best Practices

Young children are naturally inquisitive and curious about the world around them. They want to know how things work, what things do, and what will happen next. Educators can build upon children's natural curiosity by guiding them in hands-on science explorations. When children engage in hands-on science, they acquire scientific knowledge and learn the processes and practices of science. They are introduced to the concepts and big ideas that are central to science.

Educators can make these experiences more meaningful for children by being intentional in their planning so that they understand the science concepts, guide and support children's explorations, and help children make connections and express their thinking in multiple ways.

Prepare Ahead

Meaningful science exploration can happen when an educator takes the time to carefully and thoughtfully prepare. Being well prepared fosters intentional teaching.

- **Identify the learning goals**. Know the underlying science ideas and concepts and what you want children to learn from the experience. For example, learning goals could include having children begin to understand how things grow or begin to understand what all living things need to thrive.
- **Plan the curriculum**. Plan activities that connect to the science ideas and concepts you are introducing. Know the steps of the activity and the strategies you will use to support children's learning.
- **Try the activity yourself**. It's important for educators to see themselves as learners and experience the same science phenomena children will experience later. Dig in and engage in the exploration.
- **Recognize potential challenges**. Are there any parts of the activity that will be difficult for some or all children? Plan ways to scaffold instruction during the exploration. For example, when exploring liquids and solids with "goop," there may be a child who has some discomforts with messy activities. If so, provide that child with a t-shirt or smock.
- **Formulate open-ended questions**. Plan *what, why,* and *how* questions to ask that will support children's reasoning and problem-solving. Questions like these have the potential to encourage higher-level thinking.

- **Gather materials and supplies** that will be needed for the exploration and think through logistics. For example, if doing an exploration on sounds, choose an appropriate space without extraneous noise or interruptions.
- **Share ideas and work together with other educators**. Educators can prepare to lead hands-on science explorations independently, but if the opportunity allows, work with another educator. You'll have an opportunity to support and learn from each other.

What kinds of things can educators do to prepare to lead hands-on exploration?

- Learn the basic science ideas related to the topic. (For example, a concept such as "What do plants need in order to grow?")
- Consider the learning goals. Ask yourself, *What can young children learn from this exploration?* If children are planting seeds, ask, *What should children learn about plants and living things from this activity?*
- Try the activity.
- Think ahead and recognize children's potential interests and questions, as well as challenges they might encounter. This will help you to plan meaningful questions and troubleshoot any possible problems.
- Gather materials for the group and make sure the exploration areas are well-equipped with all of the items children will need.
- Plan ways to scaffold instruction for children at different levels.
- Formulate open-ended questions that will draw children's attention to the science phenomena being explored. For example, ask, *What do you notice about how the grass seed looks and feels?* rather than*, What color is the grass seed?* These kinds of questions will encourage children to think more deeply and keep exploring.

Why is it important for educators to try the activity first?

- Participating as a learner allows educators to:
    - Experience what is involved in carrying out each step and to see what actually happens (e.g., how long it takes the grass to sprout?)
    - Anticipate challenges for children.
    - Make modifications to materials.
    - Think of ways to individualize instruction.

- Formulate open-ended questions to help children think critically, like scientists.
- Plan ways to model the steps of the activity for the children.

How does being well-prepared lead to a more meaningful experience for children?

- Being well-prepared fosters intentional teaching which leads to more meaningful learning experiences for children. It allows educators to:
  - Know the basic science concepts to avoid teaching misconceptions and to identify science that is too abstract for young children to understand. For instance, common misconceptions include the ideas that plants get their food from the soil (plants make their own food through photosynthesis) and that heavy items sink. Items sink when their density is greater than the density of water.
  - Plan for unexpected occurrences, such as seeds not sprouting or taking longer to sprout than expected.
  - Plan a curriculum with activities that relate to one another, so that children can make connections between explorations from day to day. For example, if you know how fast the grass will grow, you can plan for how and when children will observe and measure their growing plants.

Guide Children's Explorations

As children investigate scientific phenomena (such as seeds sprouting) related to important concepts (a plant's life cycle), they need to explore on their own and talk about their work just as scientists do. This is how they process their experiences and develop deeper understandings. Educators can foster this exploration and help them begin to build their understanding of concepts with thoughtful guidance.

- **Work alongside children**. As the children explore, so should you. Express what you are doing, what you are thinking, and what you are wondering about as you do it. This models scientific inquiry for children, and provides examples of how to explore, ask questions, and engage in discussion.
- **Watch and listen**. Observe children to determine what they understand, what ideas they have, what they are wondering about, and what problems they are trying to solve.
- **Ask open-ended questions**. Prepare and ask questions that draw children's attention to phenomena related to the science concepts you are introducing. When possible, ask questions that provoke their problem-solving abilities.

- **Encourage peer discussion**. Learning for young children is a social process, so provide opportunities for children to explain their thinking to their peers. *(What do you think might happen to the "goop" when we add more water? Turn and tell your partner what you are thinking.)* Encourage children to compare their observations and ideas. *(How was that different from what you observed?)*
- **Inspire children to use the language of science**. As you guide children's explorations, use the language that scientists use. *(Let's* observe *the seeds. How many days do you* predict *it will take for the seed to sprout?)*

Why is it important for educators to guide rather than direct children's explorations?

- The best way to support children's science learning is to encourage, facilitate, and interact in ways that stimulate children's thinking rather than just reciting the facts. Questions and comments such as *I wonder what would happen if…* or *Why do you think…* can inspire children to make predictions, try things out, look closely, collect data, and draw thoughtful conclusions based on evidence from their own explorations.
- Facilitating exploration rather than directing it promotes conversation that can deepen children's understanding of what they observe and experience. It enhances their ability to describe, explain and share observations and ideas related to key science concepts.

How does an educator guide from the side?

- Ask questions that focus children in on the science phenomena they are observing related to key concepts.
    - Encourage children to use all of their senses and invite them to describe what they are doing and noticing. *(What do you notice about these seeds? How do they look, feel, and smell? How are they the same or different from other seeds we've planted?)*
    - Support problem-solving by asking questions beginning with *What do you think would happen if…* and *How do you think we could…*
- Observe what children are doing and saying, and how they use the materials as they engage in exploration in order to:
    - Assess what they are learning, and how their ideas are changing as a result of their experiences.
    - Support children according to their individual needs.

- Provide experiences that extend children's thinking. For example, if children are learning about seeds and plants, you might provide an opportunity for children to explore different kinds of indoor and outdoor plants at a nearby nursery or botanical garden.
- Document what children are doing and saying by jotting down notes and/or taking photographs so that you can notice patterns in their thinking. For example, if you notice that most children think that *big* items sink and *small* items float, you can introduce a big item that will float to challenge their thinking.
- Be a co-explorer. Come alongside children and dig in yourself. Talk about what you see, share your predictions and ideas, and talk about what you are wondering. Model the behaviors of a scientist.
- Look for teachable moments. Keep your eyes and ears open to opportunities that may emerge, unplanned, during the regular daily routine that you may be able to connect to children's science explorations.

What are open-ended questions and why do educators use them to guide children's exploration?

- Open-ended questions have many possible responses. These questions encourage children to articulate their own observations and ideas rather than give "correct" answers. The questions may begin with words like *how, what, what if, and why do you think….* Because they usually cannot be answered with just one or two words, open-ended questions are one of the most effective ways to encourage science talk.
- Open-ended questions help to develop children's abilities to observe, describe, and explain their observations and ideas, and to extend their investigations. These questions encourage children to reason and to develop their ideas based on evidence from their observations. (*What did you notice about…? Why do you think that happened? What do you think will happen if we…? How did you figure that out?)*

In addition to open-ended questions, what other kinds of intentional conversation and language strategies help guide children's science exploration?

- Use the language of science**.** Even very young children use the scientific process as they engage in exploration. Let them know it. Introduce science process words such as *explore, investigate, predict, notice, observe, sort, categorize, measure, compare, represent, discover, communicate, explain,* and *evidence.*
- Name children's actions in context. Young children learn best when content is taught in context, so the best time to introduce the language of science is when children are actively engaged in a hands-on exploration. For example, when children are exploring

things that sink and float, ask, *What do you* notice *about what the rock does in water compared to the piece of wood?* and *Let's make a* prediction*. What do you think will happen to the plastic ball when you put it in the water?*

- Facilitate science talks and provide frequent opportunities for children to share their observations and ideas with one another. Communicating supports children's reasoning and problem-solving skills and helps them make meaning from their hands-on explorations. Some of this will happen *during* the exploration itself, but be sure to plan time for discussion before and *after* exploration, too.
- Ask questions beforehand that draw out children's prior knowledge like *(What do you think it means to sink? To float? What things have you noticed sinking? Floating?)* Afterwards, encourage discussion with questions. *(What did you observe at the sink and float areas today? What did you notice about items with holes? Did they float or sink? Why do you think so?)*

Help Children Make Connections

To develop understanding of key science concepts, young children need to experience them in a variety of contexts. They need many opportunities to connect new knowledge with what they already know or have experienced. Educators can help children make these connections in different ways across the curriculum.

- **Give children opportunities to reflect on their predictions and express their observations and ideas in multiple ways**, such as talking about them with a partner or the group, and writing and/or drawing them.
- **Provide materials for different types of representing and recording of their observations**, such as charting what they observed, drawing and writing about their observations and ideas, or creating a collage.
- **Plan for time to help children make meaning from their observations and experiences**, such as a group reflection time at the end of the day.
- **Build on prior knowledge**. Think about other learning experiences children have had before and help them connect previous experiences to new ones.
- **Incorporate science concepts into daily activities** like Snack Time, Circle Time, or Outside Time. For example, read a related book before a hands-on exploration to introduce a new idea or after the exploration to extend the learning and provide context.

How can educators help children make connections to the science concepts and ideas that are central to their explorations?

- Engage children in direct science explorations and invite them to observe science phenomena on a topic in different settings, contexts, or venues (e.g., indoors, outdoors, in videos, at home) and across different domains (e.g., science, language, art).
- Help children make connections between their own hands-on science explorations and books about the topic. Choose quality fiction and nonfiction books that address the science concepts you are investigating, and read them before and/or after children's science explorations.
- Make videos or take photographs of children's explorations and invite children to view them to support their learning.
- Incorporate science talk into children's routines so that they become a frequent part of classroom conversations. For example, if children are learning about seeds, invite them to notice any foods that contain seeds during snack time or lunchtime.

What are some ways educators can encourage children to share their thinking and new learning?

- **I**nvite children to record their observations by drawing and/or writing them on classroom charts. This can be done *during* and/or *after* science explorations.
- Invite children to create drawings, labels, or diagrams to show others what they have observed or learned.
- Ask questions and provide opportunities for children to talk about what they observed and what they are wondering.
    - As educators ask questions and encourage peer conversation, children build science inquiry skills, discover new ways to express their thinking, and practice using language in different ways. *(What happened when we poured the warm water on the ice? How did that compare to what we thought would happen?)*

Glossary

concept: an idea or understanding about something

data: what has been observed or experienced

evidence: data that support an explanation or conclusion

model: to explicitly demonstrate a process, behavior, or task

open-ended questions: questions that require critical thinking, invite opinion or explanation, and result in more than a one-word answer

phenomenon(a): an object, material, living thing or event that can be directly observed

represent: to make a drawing or model of something that has been observed

scaffold: a temporary support that helps children learn; it may include prompts, hints, reminders, or models

science talk: words that are commonly used by scientists such as *compare, predict, measure, sort*

View the self-paced video workshop at http://resourcesforearlylearning.org/educators.

Produced by WGBH for the Massachusetts Department of Early Education and Care with federal funds from The Race to the Top – Early Learning Challenge Grant.