10 Effective DAP Teaching Strategies

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An effective educator chooses a strategy to fit a particular situation. It's important to consider what the children already know and can do and the learning goals for the specific situation. By remaining flexible and observant, we can determine which strategy may be most effective. Often, if one strategy doesn't work, another will.

1. **Acknowledge** what children do or say. Let children know that we have noticed by giving positive attention, sometimes through comments, sometimes through just sitting nearby and observing. *("Thanks for your help, Kavi." "You added a lot of detail to that space helmet."*)
2. **Encourage** persistence and effort rather than just praising and evaluating what the child has done. *("You're thinking of lots of things you can see in the sky. Let's keep going!"*)
3. **Give specific feedback** rather than general comments. *("Bear's shadow is really short when you hold the flashlight that way. Let's try moving it this way and see what happens."*)
4. **Model** attitudes, ways of approaching problems, and behavior toward others, showing children rather than just telling them *("Hmm, that didn't make the shadow go away and I need to think about why." "I'm sorry, Ben, I missed part of what you said. Please tell me again."*)
5. **Demonstrate** the correct way to do something. This usually involves a procedure that needs to be done in a certain way (such as using scissors or looking through binoculars).
6. **Create or add challenge** so that a task goes a bit beyond what the children can already do. For example, children are using recycled materials to build a space rover. To add challenge, you could give them a "mission" to Mars to discover what makes Martian rocks red. This involves discussing some of the properties of the environment. Children then incorporate the information into their creative construction, perhaps adding "scoopers" or "cans" for collecting rocks.
7. **Ask questions** that provoke children's thinking. *("Why might astronauts need a helmet on the Moon? What else might they need to wear?"*)
8. **Give assistance** (such as a cue or hint) to help children work on the edge of their current competence *("Rovers move around on Mars. How do you think they do that? How do we get around here on Earth?"*)
9. **Provide information**, directly giving children facts, verbal labels, and other information. *("I see you are holding the Sun high up in the sky and Bear has a very short shadow. Do you know what we call the time of day when our shadows are the shortest? That's called noon. Can you say "noon"? Noon is about the time when we eat lunch!"*)
10. **Give directions** for children's action or behavior. *("To turn the flashlight on, push this button." "Listen closely when you're inside the tent. What do you hear?"*)

Science Practices for Young Children in Astronomy

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One of our goals in the *My Sky Tonight* project is to support informal science educators in engaging young children in the *practices of science* through astronomy. Science practices describe how scientists engage in the process of science by continually extending, refining, and revising the current body of scientific knowledge (NRC, 2007). For children, engaging in science practices is a way for them to learn more about their world and begin to develop scientific habits of mind that will eventually help them become scientifically literate citizens. Some practices of science include: looking for patterns in their observations, making predictions about events, asking questions, recording observations, and developing claims.

Young children have the capacity to engage in scientific reasoning (Gelman et al., 2010; NRC, 2007, 2012). They are curious about the world around them and are often referred to as "scientists-in-waiting" (Gelman et al., 2010). Asking questions and conducting their own investigations of their world are a natural part of young children's everyday lives. Supporting young children in the practices of science is an opportunity to deepen their understanding of scientific content and provide them with the capacity to extend their learning after they leave an informal science setting.

Methods of Engaging Children in Science Practices

The use of the term "science practices" moves us away from a generic use of "skills" and towards recognition that doing science involves a fusion of content and action. Thus, when we talk about engaging children in the practices of science, this is always in the context of a specific area of science. In particular, it is helpful to think about how children are engaged with specific scientific phenomena. For example, when planning to engage children in meaningful exploration of astronomy, we first must consider how we can connect them with an important phenomenon, such as the changing position of the Sun throughout the day or the changing appearance of the Moon from day to day. Sometimes children can directly access phenomena, such as observing the shift in their shadow over time. However, in astronomy we often must use second-hand experiences with the phenomena, such as photographs, video, and models.

And while children may have the natural capacity to engage in doing science, they need support to further develop these abilities. Adults can play an important role in helping young children engage in science practices by helping to direct children's attention, regulate the complexity of information, and provide opportunities for experiential learning (NRC, 2007; NSTA, 2014). When adults engage young children in doing science collaboratively, they begin to model the importance of culture and community in science practices. At every level of doing science, from young children in a museum to astronomers at an observatory, science is a process of working as part of a community to answer interesting questions (NRC, 2007, 2009).

Science Practices in Astronomy

Like all of science, doing astronomy is a *process of reasoning about evidence* (NRC, 2007, 2009). Unlike experimental fields that test and manipulate variables and conduct experiments, such as physics and chemistry, astronomical investigations often rely on making sense of

observations of objects in the sky rather than trying to manipulate the world to see how it works. Thus, investigations of astronomical phenomena begin with observations for young children and for astronomers. But at the same time, it is important to consider how engaging children in multiple science practices can provide them with a richer experience with astronomical phenomena. For example, rather than only making observations, children should have the opportunity to answer interesting questions by comparing different observations. In doing so, children have the opportunity to engage in meaningful sense-making practices that can move them further along their own personal trajectory of understanding astronomy.

Below are some of the important science practices that can be supported and encouraged through the *My Sky Tonight* activities.

Asking questions about the world: Children are naturally curious about the world around them and seek explanations for what they notice (Callanan & Oakes, 1992). They need opportunities to ask questions about what they are notice in their world. Questions are an important avenue towards learning and are often the first step towards a scientific investigation. Thus, it is important to encourage children to raise questions. Research has shown that children are more likely to continue to ask questions if their initial questions are answered with an explanation rather than "I don't know" or "because" (Frazier, Gleman, & Wellman, 2009). At the same time, as an educator, it is important to recognize that some questions children pose are can lead them to engage in other science practices, such as making observations or using a tool, while other questions may only be answerable by consulting an expert, such as by reading a book (Cavanass, 2004). While many of the questions children ask will be of the second kind, an educator can help children learn to ask questions ready to investigate by modeling this type of question-asking themselves, posing questions that can be answered by making observations.

Observation: Engaging young children in *observation* helps them develop new knowledge and use new explanations based on evidence. However, "[to] observe scientifically requires much more than sensory perception and using one's senses" (Eberbach & Crowley, 2009, p. 40). Scientific observation relies on one's knowledge of a particular domain to notice salient features of a phenomenon. Therefore, when we think about engaging young children in observing, it is important to keep in mind that what children *notice* is dependent on their prior knowledge. For example, when asking children to observe the Moon, whether they observe the Moon is a different shape than the last time they observed it depends on whether they realize the shape of the Moon is important to consider. Adults can help children notice in new ways, such as focusing on the shape of the Moon or that the shadows outside don't always point the same way. Parents and educators can support children by asking questions that engage them in conversation around their observations.

Analyzing data: Astronomers answer scientific questions by making sense of observations recorded of astronomical phenomena. This "making sense" of observations is a process of analyzing data. Analyzing data for preschool-age children can include any attempt to make sense of their observations, including **comparing** observations, **contrasting** observations, and **looking for patterns** in observations. Children's observations could include their own personal first-hand observations, such as seeing the Moon in the sky or observing shadows outside or

caused by a flashlight indoors. Observations could also include second-hand data, such as pictures of the phases of the Moon, or physical models, such as a tub of sand to represent the surface of the Moon. An educator could engage a child in this practice by asking the child to compare observations of what a model of a star (a ball) looks like when it is near to them or far. A child could also compare their observations, such as looking at photographs of the Moon's surface and our own Earth's surface then looking for similarities and differences between these surfaces.

Constructing explanations: One of the central goals of science is to develop evidence-based explanations. Young children can start with this practice by **making a claim** using their observations as evidence to answer a scientific question. For example, after observing images of the day sky and the night sky, children can begin to make claims about what objects appear in the day sky and what objects appear at night. They should be encouraged to use their observations to make claims, though a spontaneous verbal connection between a claim and evidence may be rare. Children can make claims based on their own personal observations as well. For example, after investigating how different shaped objects make different shaped shadows, children can start to make claims that reflect their new understanding that shadows appear in the same shape as the object that makes them. These opportunities for *sense-making* from observations is an important way children learn about astronomy.

Using tools to gather information: Astronomers rely heavily on tools, such as telescopes and cameras, to help them gather and analyze data. As children engage with the *My Sky Tonight* activities, they can learn how tools can be used to extend their senses in ways that help them gather more information about their world. Any tool that enhances their own abilities helps them start to see how astronomers work. Children can engage in first-hand investigations with tools when they use magnifying glasses or binoculars to change how they observe objects, both near and far. Children can think about how scientists might use tools when they think about how scientists create machines that go into space to explore new worlds. Robotic space explores require specialized tools to collect send information back to scientists on Earth.

***Representations and models*:** Astronomy is rich with representations and models that help astronomers reason about evidence or explain new phenomena. The scientific practice of developing representations and modeling should be based on empirical evidence and for the purpose of communicating or testing ideas. Young children can start using representations or models to communicate explanations. For example, a child could be encouraged to draw a picture showing how a light on an object forms a shadow. Her drawing and verbal explanation can help her explain what she thinks and can use her own observations of how shadows are made. Children can also use models to come up with new explanations. For example, a child could use model of the surface of the Moon (such as a bin full of sand) to investigate how craters are made on the Moon (by throwing objects at the sand) or how astronauts might travel across the Moon (using figures representing astronauts).

Thus representations and models can include drawings and physical representations. They can also include other physical creations, such as gluing pictures of astronomical objects on a piece of paper to show what is in the day sky and what is in the night sky. Such a representation could be used to communicate the child's ideas to a parent; it could also be a tool to make predictions

about future observations and a source of conversation as the child and adult compare future observations to their original representation.

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