Science Shorts

Classic classroom activities that emphasize science-process skills

When someone asks you about the solar system or the water cycle, what pops into your mind? Chances are it's a diagram. Powerful images like these help us understand, communicate, and remember important concepts in science. Learning how to read them is a critical part of scientific literacy.

Encouraging Visual Literacy

By Tracy L. Coskie and Kimberly J. Davis

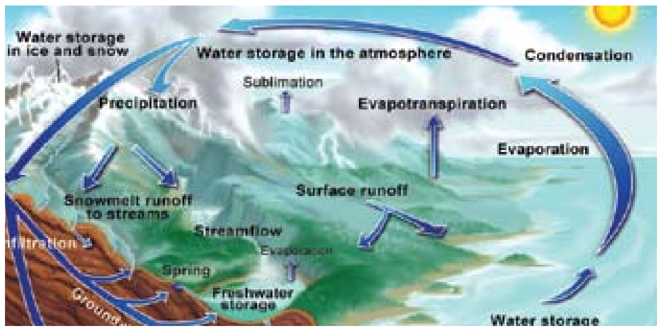
Being literate in today's world increasingly requires us to process a wide variety of images, maps, diagrams, tables, and text features in addition to words. Readers today encounter many texts with visual elements that make them complex and multilayered. Children need explicit instruction in how to manage this type of reading and writing, but it is often neglected in the curriculum. Fortunately, science provides an appropriate venue for helping students develop the necessary analytical and critical-thinking skills for visual literacy.

In science such visual images are included in a larger category called models. A model is "a system of objects or symbols that represent some aspect of another system, called its target" (Gilbert and Ireton 2003, p. 1). Models can be such a powerful means of understanding and making predictions about our world that the *National Science Education Standards* (NRC 1996) includes the use of models in one of the five "unifying concepts" in science, while the *Benchmarks for Science Literacy* (AAAS 1993) describes models as one of the four "common themes" in science.

Visual Science Models

There are a variety of model types that scientists use, including mathematical formulas, computer simulations, theoretical analogies, concrete three-dimensional models, and scale models. Diagrammatic models are visual models that include graphs, maps, flow charts, and pictures or photographic images. Pictures and diagrams are used frequently in the classroom to represent systems and processes, particularly when those systems and processes are difficult to observe directly—the water cycle, the internal structure of a tree, or volcanic action, for example.

Helping children foster a critical, flexible understanding of such visual models is difficult. Models are, by nature, artificial, simplified, and imperfect representa-



tions that sometimes require a good bit of interpretation. Making incorrect interpretations or focusing on the wrong aspect of models can create misconceptions that are hard to fix. For example, diagrams of the solar system that may be designed to show orbits rarely show the scale of distances between planets. Students who don't understand this may develop a flawed understanding of the relationships between planets.

In order for children to become critical readers of pictures and diagrams, they need lots of opportunities to interact with and produce them. The following activity is designed to help students begin to interpret and question visual models and can be easily adapted for use in a variety of units. It is best suited for use following students' investigations so that they can draw on their scientific knowledge to think about what they see in the models.

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Reading Visual Models

What does a diagram or picture tell us? What doesn't it tell us?

Materials:

For the teacher:

- Enlarged diagram/map of school to project for students to see
- Enlarged photograph of school to project for students to see
- Chart paper

For the students:

- Enough copies of a simple diagram from the unit of study (e.g., a river delta)
- Enough copies of a photograph related to the same phenomenon (e.g., aerial photo of the Mississippi River Delta)

Note: Diagrams and photographs can come from any unit you might be working on. For example, volcanoes, simple machines, human body, tornadoes, plants, insects, salmon life cycle, etc. Copies can be made to fit in students' science notebooks so they can include them as well as their notes from the activity.

Objectives:

To develop a critical approach to scientific models

Process Skill: Modeling

Grade Level: 4–6

Engage:

Show students the map of the school. Ask them to make a statement about the school based on the map alone (e.g., the library, cafeteria, gymnasium, and auditorium are all in the central section of the school.). Have students make a prediction or inference based on the map (e.g., whether it is a high school or an elementary school or how many students attend).Then tell students that they know a lot about their school. Ask them what they can tell about the structure of the school that is not on the map but could be added to it (e.g., the classrooms in the wing to the right of the front doors are preschool and kindergarten classes). Chart a few of their responses to each.

Now show students the photograph or drawing. Ask students to make statements and predictions or inferences based on that (e.g., The school is made mostly of bricks. There are a lot of visitors.). Ask students how they could take a different picture that would show another important aspect of the school that is not indicated in the photograph. On a new list, chart students' responses (e.g., the delivery bay at the back of the school that shows food and supplies are delivered regularly).

Explain to students that models such as charts, graphs, maps, and images (like those they've just looked at) can help us learn about science, too, but they don't tell us everything. Now ask students to look at the diagram and photograph of the river delta (or whatever diagrams and images are appropriate to your unit of study), and let them know that the challenge will be to use what they've learned in the unit to discover what the different models can and cannot tell us. *How could we change the models to tell us more or tell us something different?*

Explore:

Organize students into partners. Give half of the pairs copies of the simple diagram of the river delta and the other half copies of the photograph.

Have students paste their visual model on the left page of their science notebook, and write their statements about the model on the right side.

Student should work with their partners to come up with five important statements based on their diagram or picture alone. For example, students looking at the diagram might say, "A delta forms where the river meets the sea or other body of water" or "Where deposits are made the river channel breaks up into tributaries." Students must agree on the statements before writing them in their notebooks.

Ask students to write a prediction or inference they can make using what they already know and what they can tell from the diagram or picture. Students might, for example, predict that the river shape could change from new deposits being made or that there will likely be farmland nearby.

Remind students that diagrams are often not complete and that photographs only show us one view at one point in time. Now ask the pairs to come up with three recommendations for improving or changing their model. Students with diagrams may consider additions, labels, cross-sections, etc., while students with photographs might consider different perspectives or times. Their statements should include reasoning (e.g., We would add a label for _________ because ______________).

Discussion:

As a whole group, discuss what students discovered about their models. Ask students to list some of the benefits of a diagrammatic model (e.g., you can tell what the parts are, it shows what's important instead of details, its easy to remember). Ask students to list some of the benefits of a photographic model (e.g., you can see details, shows colors, it seems real). Have students list some of the ways they changed the diagram (e.g., added more labels, included an important detail, used an arrow to show a relationship). Then have students list some other ways to photograph (e.g., show at another time of year, show at another time of day, show something more close-up, take a different angle). Ask students if they could pick only one model for this unit, which one would it be and why? Keep the charts and use them again in a later unit. As you encounter new diagrams, photographs, or other kinds of models, refer to the charts to help students think about them in new ways.

Assessment:

Challenge students to compare various visual models independently rather than in pairs and review their work as an assessment of their ability to make statements and suggestions about important aspects of the model. Teachers will want to check for the following to start:

- Are students attending to or suggesting important aspects of the model or irrelevant details?
- Do their statements about the model make sense? Are they simple (e.g., telling the parts) or more complex (e.g., explaining relationships).
- Can students make reasonable inferences or predications using the model?
- Are there any inappropriate inferences or erroneous statements based on the model?

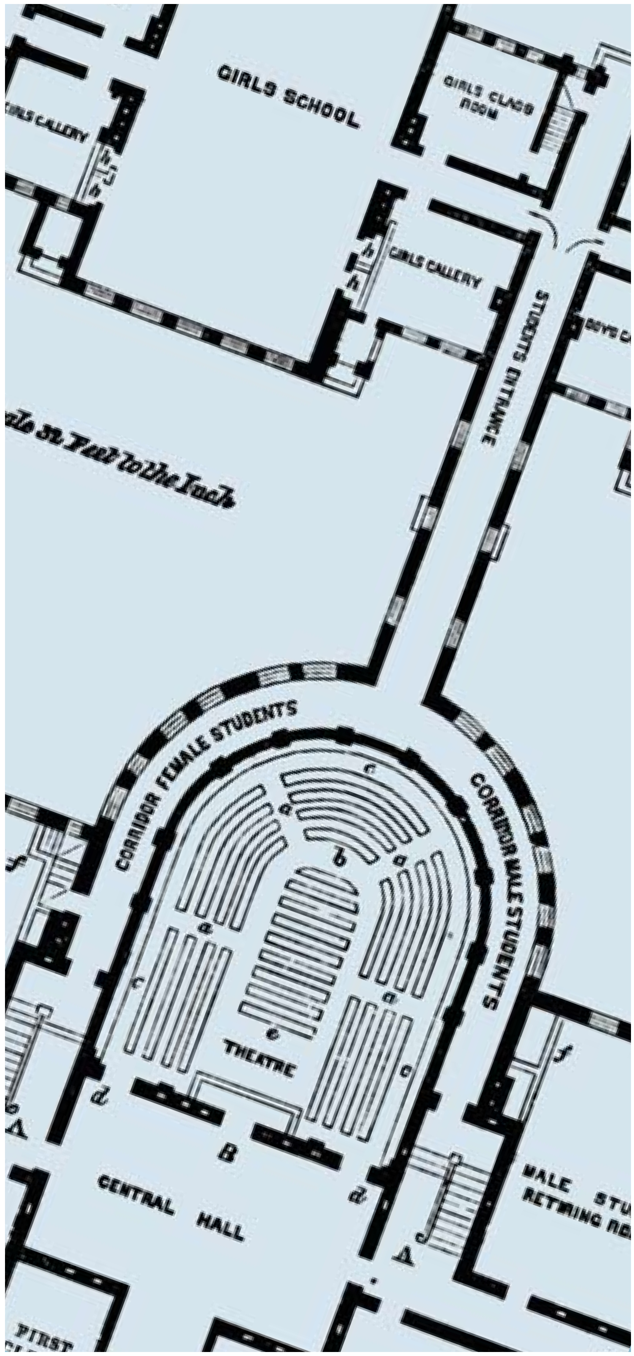
K–3 Adaptation:

At the primary level, complete this activity as a whole group using only one model at a time. Students can work together to come up with a list of statements about a diagram and then the class can make decisions about how to improve the model. When possible, teachers should actually change the model in front of students.

References

American Association for the Advancement of Science. 1993. *Benchmarks for science literacy.* New York: Oxford University Press.

Gilbert, S.W., and S.W. Ireton. 2003. *Understanding models* in Earth and space science. Arlington, VA: NSTA Press.



Connecting to the Standards

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

Content Standards

Grades K–8

Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

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