National Aeronautics and Space Administration

Think Like a Scientist: The Little Black Box

Grades 1 – 6
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Objectives:

- Students will be able to define Observe as "To take notice."
- Students will be able to define Infer as "To conclude based on reasoning."
- Students will be able to observe several discrepant events and make an inference based on their observations.
- Students will be able to explain that scientific investigations often have more than one right answer, and that a "good" answer is one that is based on observations and reasoning.

National Standards:

Content Standard A: As a result of their activities in grades 5-8, all students should develop an understanding of:

> Thinking critically and logically to make the relationships between evidence and explanations.

Vocabulary:

- Observe
- Infer

Materials:

- Tricky Tracks images
- Discrepant event items (See ideas below)
- Small boxes, one for each group
- Random items to go in the boxes
- Worksheets

Background Information:

In this activity students learn about the nature of science by dissecting two of its key elements: Observation and Inference. Scientists must make observations, or collect unbiased data before making conclusions about their hypothesis. Often scientists never actually get confirmation that their answer is the "right" one, rather a "good" answer is one that is based on evidence. During the mystery box activity there will be many teachable moments to discuss this idea.

Content:

Predict: (Engagement and assessing prior knowledge)

Have students watch a discrepant event. Tell them to watch what happens, and take notes in their journals/worksheets.

Possible discrepant events to show them:

- Ice cubes in a beaker of water, next to ice cubes in a beaker of rubbing alcohol.
- Drop a small weight down a copper tube, drop a strong magnet down a copper tube.
- Squeeze a Cartesian Diver.
- Fill a plastic cup half way with water. Place an index card on top of the cup, covering the opening. Hold the card on, turn the cup upside-down and let go.

ASK: students to read some of the things they recorded.

Method: (Body of the lesson)

Tell students that there are two very important terms that they need to know if they are to do authentic science experiments: Observe and Infer.

ASK: Have students try to define each one. Ask questions to lead them to the correct answer, then have students write the definitions in their notebooks.

Have students practice telling the difference between the two by asking them questions, for example:

> "Is this statement an observation or an inference: 'The table is red'?" (Observation)
> "Is this statement an observation or an inference: 'Ms. Smith is a good teacher'?" (Inference)

Tell students that they are going to practice making observations and inferences by examining a series of images. Tell them they are to ONLY make observations, and then at the very end they will be allowed to make inferences. Show students the Tricky Tracks images.

ASK: them to share their observations. This is a good time to catch students who still can't tell the difference, point out that observations are what you see/hear/feel/etc… and inferences are more like opinions – what they think based on what they observed. After observing the last image have students make inferences – what do they think happened in that scene? Encourage thinking outside the box, for example, the bird may have flown away, or is sitting in a tree, or the fox may have given it a ride rather than eaten it.

Live-It: (Application assignment)

Hand out mystery boxes. Tell students that they are to make observations about the contents of the mystery box with their group, record it in a data table, then infer what is on the inside.

When students ask if their inferences are correct, if they "got it right," ask them if scientists doing research have a teacher that they can ask for the answer. This usually drives them nuts, but it's a good teachable moment to show them that there isn't always a right answer, and if there is there isn't always immediate confirmation.

Have students trade mystery boxes with the group next to them and see if they come to the same conclusion about its contents. This is also an opportunity to discuss scientists repeating an experiment to confirm the results.

Have students answer this question:

How is the mystery box activity similar to real scientific research?

Image 1

Image 2

Image 3