Student Experience 07: What's in the Bag?

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Student Experience LESSON:
What’s in the Bag?

Materials
- 10 - brown paper lunch bags
- 10 - quart plastic bags with twisties
- 10 - film canisters (1 per bag)
- 50 – popcorn kernels (5 per bag/in film canister)
- 10 – lemons (1 per bag)
- 20 – baby potatoes (2 per bag)
- 40 - dry lima beans (4 per bag)
- 30 – paper clips (3 per bag/linked)
- Various magnets to use during observations
- Observation data table

Background
Deductive reasoning is not necessarily intuitive; it is something that must be learned. Students will find it a challenge to use reason to figure out what an object is simply based on sound, touch, and smell. The following lesson (and extension: Ob-scertainers) is a type of “black box” activity. The lesson focuses on having students make observations using some of their senses to describe properties of a variety of unknown objects contained in a paper bag and hypothesize what these objects are using evidence from their observations. Although this version of the lesson is written for a lower or intermediate elementary classroom, it works equally well at most levels. It was even used by Albert Einstein with his graduate students. Einstein never told his students what objects were contained in the bags he gave them, and most 8-12 grade students can deal the suspense of not knowing what is inside their bags (or what the inside of the Ob-scertainer looks like), if you teach K-7th grade students, you will need to use your best judgment to decide whether you will you show your students, and/or how long you will wait before show them the contents of their bags.
Student Experience LESSON: What’s in the Bag?

Suggested procedure
Before the expedition the teacher will:

1. Draw different colored question marks on each bag and then place all the materials listed, first into plastic bags closed with a twist-tie, and then into the paper bags. Be sure to put the 5 popcorn kernels in each film canister. Make sure the each bags’ contents are identical. Tape the paper bags securely so that the contents of the bags are not visible. (The plastic bags help to secure the contents, and can add some mystery to the contents!)

2. Tell the students that as they learn how to be scientists throughout the year they will do many activities that mirror the ways scientists think and work. This lesson is to be one of the first in that journey. Ask the students: How do scientists gather information about the world? They observe! Scientific Observing is defined as: Looking/watching things with a purpose.

3. Ask the students: What do we use to observe? Guide the discussion such that the students realize that they use their five senses. Older students may be prompted to discuss different tools used to extend the senses, such as microscopes, magnets, and types of modeling.

4. Briefly explain that scientists record and illustrate the properties of objects and phenomena so that they may remember what they found. For this lesson, a property is defined as an objective physical description of what is observed such as sounds, textures, colors, numbers, sizes, shapes, and smells.

A. Taste is a sense that has limited use when observing new objects. Ask the students why they think this is true. Guide the students to realize that there are safety issues to tasting unknown things, and for this lesson we will not be using our sense of taste in our observations.

B. It would also be wise to discuss the way to smell an unknown object also. One should fan the air over the unknown object towards their nose first to see how strong the scent is, and then carefully take stronger sniffs. Unknown smells also have the possibility of being harmful, so using smell should be done with caution.

5. Explain that they will be using a table to record their observations. Draw the table (shown below) on some sort of visual projection and have students copy it into their science notebooks (or have copies ready for them to use). Their tables should have at least 7 spaces for observations. For younger students, you might choose to use the student sheets at the end of this lesson.
Observations (Evidence)

Example: The object felt round and smooth

6. Describe the difference between a hypothesis (defined scientifically as an explanation that can be tested and used to investigate a scientific question) about an objective and the properties we observe that lead us to those conclusions. This will lead you to a discussion about the difference between an observation and an inference. Observing is recording properties, Inferring is using reasoning to draw conclusions.

In an activity like this, an inference about a smooth round object could be recorded as an inference in this way: A student may say “I have a large marble in my bag.” In this example, the student has used past experience to infer that the smooth, hard, round object was a marble, when in fact it could have been something else – such as a wooden or plastic bead, a gob-stopper (candy), a round rock, a super-ball, or, for that matter, a glass eye! Explain to the students that they will get to make informed explanations (or hypotheses) about the objects later on, and they will base these on their observations (which then becomes their evidence). This is a difficult distinction, and will have to be continually revisited.

7. Bring out one bag and tell the kids the name of the lesson: What’s in the Bag? Explain that Einstein taught this lesson to his graduate students in an effort to demonstrate to them how scientists find out new things. (Students will be impressed to know they will experience a lesson used by a great scientists on his own students.)
Student Experience LESSON: What’s in the Bag?

8. Tell the students that they have to figure out what is in the bag, but there is one rule: they cannot look in the bag. They can use any other form of observation (with the obvious exception of taste!). Students will be expected to let you know if their bag is ripping while they make observations. Younger students might be instructed to shout “Tear Alert” when the bags begin to rip so you can repair their bag with tape.

9. Divide the students into groups of 2-3 students – distribute bags and have students begin making observations. Students should write down any properties they observe and be prepared to report these back to the class. Provide enough time for students to think of new ways to observe. (For example, dropping the bag on ground may eliminate the option of glass) Be prepared to tape bags when they tear. Stop the action periodically to start naming student’s the manipulations as hypothesis testing and list them on the board. Use scientific language as you interact with the students. Encourage new and unusual methods of observation. You can either list the properties observed, or hypotheses tested on board as they happen, or stop periodically to list them, or wait until the end of the observation period.

10. Stop activity when you feel students have collected enough data. Collect the bags/ or move them aside before you begin the discussion so that students are able to focus. Begin a whole-group discussion by asking for additions to the list on board Have each group report the properties they found. Make a list on the board as the groups share so that the properties can be compared and contrasted. Make sure that the properties being listed are not of the objects themselves, but of qualities and quantities of the objects. Explain that they will get to develop hypotheses using their observations as evidence next, but for this portion of the lesson, they need to only record their observations. Some students may realize that they are using different terms to describe similar qualities or properties. Try to group these together in the main lists to show their similarities.
11. After this discussion, make or pass out a new table:

<table>
<thead>
<tr>
<th>What could the object be?</th>
<th>Which of your observations that make you think this?</th>
<th>Did any of your observations conflict?</th>
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</thead>
<tbody>
<tr>
<td>(Hypothesis)</td>
<td>(Explanation)</td>
<td>(Evaluation)</td>
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12. Point out the two (three) new terms on this chart; Hypothesis, Explanation, and (Evaluation). Explain that scientists develop hypotheses based on evidence gathered and their own past experiences. (Sometimes the evidence conflicts with their evidence, and they need to evaluate whether or not their observations or other factors might lead them to change their hypotheses.) Note: Evaluation is a difficult skill and may need to be used as an extension for younger students or those who are new to scientific thinking.

13. Have students take some time in their groups to hypothesize what they think is in the bag. Be sure to encourage and guide students give clear evidence (they may even need to conduct some “tests” and collect more data) to support their hypotheses. For example, if someone thinks that there are tacks in a film canister, you would want to guide them to mention the shape of the container and the sound that the objects within the container make as their evidence. Another student could hypothesize something else, like seeds, based on the lack of metal sound to the shaking.

14. Give students time to look back at their observations and choose a limited number of objects from their bags and develop hypotheses about what they believe these objects are. Recommendation: have younger students choose only 2-3 objects. Older students could do more (perhaps all of their objects) if there is time. Have them record these hypotheses and evidence in the new tables. They can have their bags back for this session, if they wish, but remove them again for the next discussion.

15. When each group has completed hypotheses for at least 2 objects, bring them back to a large group and talk about scientific reporting. This is where scientists use information and communicate it to others. This is a VERY important step, which is often missed in the classroom because of time constraints. However, in order for students to make the connections, and for the concepts to become secure, this step is critical.
16. Have each group share at least one of their hypotheses and the evidence they based it on. If there are groups that disagree, support them in a constructive discussion about the differences. Talk about how new evidence can change hypotheses, and often does.

17. Do not let the students look in the bag until the end of the school day (if it is more than 2 hours after this lesson is completed) or next morning. Einstein did not ever let his graduate students look in the bag. For the younger students, this is a real tease and some will not be able to handle it. It works best to use Einstein’s rule for approximately 24 hours and then let the students see inside the bag. If you want, you could let the students vote on whether they want to open the bag. Always a few don’t want to. This can lead to a great discussion topic about why Einstein never let his students open their bags.

Suggested Procedure
The next day use the following questions to wrap up:

1. Pose the question: What do you think that Einstein want his students to learn?

2. Pose the question: Why do you think that Einstein did not let his students open the bag?

3. Use the ingredients from the bags to make: pop corn, lemonade, and fried potatoes. Students can plant the bean seeds and begin a seed study.

4. Play this again with parents at curriculum night but this time allow students to choose what goes in the bag.

5. Read a story about Einstein as a boy. He was not a traditional student. For younger students, try the first listing, for older students, the second may be more appropriate.

   - Odd Boy Out: Young Albert Einstein, by Dan Brown
   - Ordinary Genius: the Story of Albert Einstein, by Stephanie Sammartino McPherson

6. Apply these ideas throughout the year’s science curriculum: questioning, observing, hypothesizing, experimenting, recording, and communicating results.
Extensions:

Inquiry Skills Checklist:

In *Inquiry and the National Education Science Standards* (NRC, 2000), many of the following skills are proposed as those that elementary and middle level students need to learn in order to make sense of scientific processes. These skills are learned over time through a multitude of lessons, activities, and experiences. It is not necessary (or even recommended) that all the skills be used in any given activity or lesson. As students gain experience with the skills and the accompanying vocabulary, they will be better prepared to put them to use in all aspects of their lives.

The following checklist can be used to identify which skills were used in any lesson. After completing a STaRRS lesson, review this list with your students and help them to identify and check off the different skills used.
STaRRS Lesson or Activity
Title:_____________________________________________________________________

What did you do in this activity?

- Observing: Using senses or instruments to observe objects or phenomena with the purpose of understanding them better
- Inferring: Using reasoning and past experience to draw conclusions
- Questioning: Formulating questions based on observations, curiosity, knowledge, and background
- Counting: Understanding quantity, one-to-one correspondence
- Sequencing: Putting objects or ideas in a particular order
- Patternining: Forming and/or following a set pattern
- Measuring: Using standard and nonstandard units to define objects or phenomena
- Comparing and Contrasting: Noting and recording differences and similarities
- Classifying: Sorting objects into definite categories
- Defining: Developing and enhancing vocabulary; clarifying meaning
- Hypothesizing: Making an informed guess (based on evidence)
- Predicting: Thinking ahead about what might happen
- Modeling: Using a representation of an object, phenomenon, or system to help think about and test the ideas of the object, phenomenon, or system. They can be physical—like a globe, mathematical—like $a^2 + b^2 = c^2$, or conceptual—such a model of the water cycle
- Recording: Writing or drawing gathered information
- Reporting/Communicating: Describing and sharing information with others

Extension:

**Ob-scertainers:**

Ob-scertainers are circular, flat lack plastic containers that resemble old-time movie film canisters. Inside each container, there are walls in various configurations. They might look something like the following pictures:

They contain a single ball bearing, which can be manipulated by students by moving the Ob-scertainers. Since they are not allowed to open the containers to look inside, students use their senses of hearing and touch to figure out the location/configuration of the walls.

Ob-scertainers can be ordered through the following website: [http://www.lab-aids.com/catalog.php?item=100](http://www.lab-aids.com/catalog.php?item=100).

Sometimes local Area Education Associations or district teacher support centers will have them for teachers to check out. The Ob-scertainers lesson does not include the naming of properties, but duplicates in the set allow students to work in pairs to compare observations and defend their own conclusions.
Observation

Without opening the bag, use your senses and your best powers of observation to find out information.

The properties I see:

The properties I hear:

The properties I feel:

The properties I smell:
Hypothesis

Considering the different properties I found, this is what I think is in the bag. Draw what you think is in the bag – add the property of color. Then name and label what you have drawn.

Label what you drew in the bag here:

__________________________

__________________________

__________________________

__________________________

__________________________

__________________________

__________________________

__________________________
What do you think Albert wanted us to learn from the “What’s in the Bag” experiment?

- Love science
- Use all your senses to observe
- Don’t always follow the other person
- Trust your own ideas and theories
- Ask questions
- Never give up
- You never know what you might find out
- Be patient
- Observe things
- Don’t give up
- Try your best
- Theories aren’t always right; when someone finds evidence for a new theory, they try to convince others that their theory explains something better
- Scientists don’t always agree
- Don’t say “This is!” say “I think this is…” otherwise you are stating a fact or a personal theory
- Don’t laugh at weird ideas, they might be correct

“He wanted his students to keep learning and not stop.”
References:


This lesson did not originate with, but was revised and passed along by Jean Trabue Kosky. She designed the worksheets, question sets and written descriptions of the lessons.