Activity 2: Scientific Convention

Overview

In this activity, the class holds a "scientific convention," similar to meetings scientists hold to focus on a particular topic or discuss findings. Their lab investigation yielded a number of different properties and observations. Now, students reflect upon, debate, and cooperatively refine their initial observations and perceived properties. Together, in a teacher-facilitated discussion, they critique and refine one statement about Oobleck at a time until there is agreement that it can be called "A Law of Oobleck."

See page 21 for a sample teacher-facilitated discussion about Oobleck.

As noted in the sidebar on page 19, some teachers prefer to use terms other than "law." Also, on page 74, in the Background for the Teacher section there are definitions of scientific facts, laws, and theories that may be helpful.

It can be an eye-opening experience for students to discover how challenging it is to craft even one accurate statement. Students learn from other students as they consider and reconsider how best to express something they experienced. This classroom discussion stimulates the development of language and communication skills. English language learners often become so deeply involved in the discussion about Oobleck that they may overcome initial hesitancy to speak because they want to make sure everyone understands what they observed and their explanations for it.

Through this activity, students get a firsthand sense of the meticulous and exacting nature of refining scientific statements and ideas. They also learn that one of the greatest strengths of science is that it invites critique and refinement based on evidence. This kind of discussion, where students reflect on what they've experienced and learned, is an accurate reflection of what scientists actually do. Not only do scientists hold meetings to discuss and debate findings, the development of scientific knowledge is driven by the constant exchange of experiences and communications among scientists to arrive at the most accurate conclusions and expand human understanding of the natural world.

The most exciting phrase in science, the one that heralds new discoveries, is not "Eureka" (I found it!) but "That's funny..."

— Isaac Asimov, author

Learning Objectives for Activity 2

- Provide students with direct experience in communicating, refining, and generalizing observations—based on evidence.
- Deepen student understanding of the nature of science—especially that scientists ask questions, query, and critique each other's findings in order to advance mutual understanding.

What You Need

For the class:

- ❑ 1 (or more) bowl of Oobleck, for testing ideas
- ❑ a few old newspapers
- ❑ water
- ❑ paper towels
- ❑ lists of properties from Activity 1
- ❑ chalkboard, white board, or overhead projector
- ❑ chalk, or marker for white board or projector
- ❑ 1 roll of tape

Getting Ready

1. **Use tape to post the lists of properties on the wall.** Optionally, you could arrange the students' chairs in a semicircle so everyone can see the lists and each other.

Note: If you are using sentence strips, gather all the strips with stars on them and display them in a single central location. You may want to arrange the rest of the sentence strips into clusters of statements organized by topic.

2. **Keep one or more bowls of Oobleck and newspaper on hand in case they are needed for further testing.**

Setting the Scene

1. **Explain to your students that professional scientists in most fields and disciplines come from all over the world to attend meetings called *scientific conventions.*** The topic of one meeting might be "Heart Disease," while other meetings might concern "The Planet Mars" or "Earthquake Prediction."

2. **Point out that during a convention, scientists listen to each other's experimental results and research findings and critically discuss them.** The goal of the convention is not to prove each other right or wrong, but to *arrive at the most accurate scientific statement and to state it as clearly and completely as possible.*

3. **Tell the students that they are about to hold a scientific convention on Oobleck.** The starred properties listed on the board are the scientific results they will first discuss, according to the following rules:

a. Only one property of Oobleck will be discussed at a time. First, one lab team explains or demonstrates the experiments or procedures that led to the property they starred. This is the **evidence** for their statement of the property.

b. Students who wish to agree or disagree with the property being discussed are invited to raise their hands to **explain** why. They can refer to their own experience for evidence to support their position. In doing so, students are **making explanations based on evidence**, an essential science inquiry ability.

c. Encourage students to find ways to change the wording of a property so everyone can agree on it.

d. After fully discussing a property, vote on whether or not it is really a property of Oobleck. If three-quarters of the class votes for a property, it is called a "Law of Oobleck." To illustrate what is meant in this case by a "law," tell the students that most scientists would agree that "water turns from liquid to solid below 32 degrees Fahrenheit," so it could be called a "law" of water. (Note: To be completely accurate, water turns from a liquid to a solid at 32 degrees Fahrenheit—at 1 atmosphere of pressure.)

Facilitating the Discussion

1. **The scientific convention can be one of the most exciting parts of the Oobleck experience because students act like scientists when they debate their views and refine their statements of properties in order to seek the most accurate scientific statement.**

2. **Your role as discussion facilitator is critical to its success.** Here are some suggestions for moderating a successful discussion:

   - The process used to arrive at a "Law of Oobleck" can take some time. Some groups start squirming in their seats after 20 minutes. Other groups are still going strong after 45 minutes. If your students are deeply involved in the discussion, you may want to continue it the following day so they can further refine their communication skills. Above all, be aware of the interest level of your class, and end the discussion when you think it is appropriate.

   - One way to maintain interest in the discussion is to break to allow one group to test a particular property of Oobleck using the bowl you saved for this purpose, demonstrating for the class, then sharing the results in a class discussion.

Some students may be familiar with the quite elevated use of the word "Law" in science, as in the Laws of Motion, or the 2nd Law of Thermodynamics. These are general statements about physical forces and processes. Technically speaking a "law" in science has been defined as ***a descriptive generalization about how some aspect of the natural world behaves under stated circumstances.*** *Taking Oobleck as an "ospect of the naturol world" your students are indeed coming up with "descriptive generalizotions" about one or more of its properties/behaviors "under stated circumstances." However, scientists themselves differ on definitions. For many, the freezing point of water would not usually be considered a "law," but a property that has been demonstrated by considerable evidence. Althaugh the refined statements your students come up with may or may not be "laws," the use of the term adds status and motivotion to their quest for scientific occurocy. There are some teachers who prefer to use terms such as " scientific fact" or "accurate statement" or "hypothesis" or "class praperty." The use of the term "foct" can be problemotic because in everyday languoge it implies unchonging "truth."* ***Scientific fact*** *should be defined as in o Notional Acodemy of Sciences publication, with our emphasis on the last sentence: "If something has been observed mony times by many different scientists, ond no evidence has ever been found thot it is not true, then it is considered to be o scientific fact.* ***A scientific fact is always apen to being changed or eliminated if new evidence disproves it."***

While the ideal is for each group to present their starred property to the class, discussing and voting to come up with one or two "lows" may be sufficient to highlight the importance of communication and debate in science.

- Disagreements are starting points for fruitful discussions. After the first group has read their starred property and explained their choice, ask if anyone disagrees with that property or any part of it. If no one challenges it, ask if anyone can think of a case where that property would **not** be true.

- Once you've provoked disagreement, challenge students to find ways of *changing the wording* so everyone can agree on a statement of the property and/or pursue one or more of the options below.

If you are in the unusual situation where all groups could have quick access to Oobleck, and it would not be too disruptive, then all groups could test the disputed property.

3. **Here are some common ways of resolving problems that you might suggest to students to help them refine their findings.**

   a. **Add a phrase.** For example, in one class a team listed this property: "Oobleck dries out when left on paper." A student objected, saying this is not true when Oobleck is put on paper for just a few seconds. The teacher asked how to resolve the disagreement. The students added,. "for more than ten minutes." Adding such qualifiers is the essence of good scientific reporting.

   b. **Define terms.** One team listed the property: "Oobleck is sticky." When challenged to define *sticky,* they realized there are different kinds of "stickiness." After a brief debate, they changed the property to read: "Your finger will get stuck if you try to pull it out fast." A discussion like this highlights the importance of using precise terms that are agreed on by every scientist who works in a given field.

   c. **Do Another Test.** In some cases, further testing can best resolve disagreements. By keeping bowls of Oobleck on hand during the convention, you can have two or three students do the test. For example, one team proposed that contact with air made Oobleck "liquidy." Another student suggested putting Oobleck into a plastic bag where it could not touch the air. It turned out to be just as "liquidy" in the bag as it was in the bowl. After this test, the students voted not to make that particular property a "Law of Oobleck." Similarly, professional scientists sometimes report initial findings that later experiments show to be erroneous.

One teacher likes to tell students that a true sign of an intellectual—especially a scientist— is the ability to change his or her mind when presented with evidence that proves their original idea to be inaccurate.

4. **Throughout the scientific convention, ask questions and probe for student reasoning.** It is of tremendous importance that the teacher model respect and acceptance of all ideas while facilitating the discussion. One of the most important components of science learning is the chance to discuss and reflect upon an experiment or experience, both individually and as a group. This is a chance for you and your students to engage in scientific "discourse," to encounter different ideas, confront them, consider evidence, and, when possible, arrive at a new level of understanding that encompasses observations and findings more accurately.

Here is an excerpt from the scientific convention of one class:

(**T** = teacher, **S** = student).

T: Will someone from the first lab group read their most important property (the one with the star in front)?

S1: It's hard when you hit it.

T: Please explain what your group's evidence is that makes you think this is true.

S1: Well, at first it's runny, but then when you hit it, it feels hard... your hand doesn't go in.

T: Does anyone have a comment on this statement?

S2: What if you hit it lightly? See (getting a bowl to demonstrate), if I hit it slowly, my hand goes in.

S1: Slowly isn't hitting, it's something else, like just touching.

S3: It gets hard when you rub your hond over the top. You don't even have to hit it.

S4: And when you try to pick it up.

T: Can anyone suggest a word that is better than *hitting?*

S5: What about *pressing?*

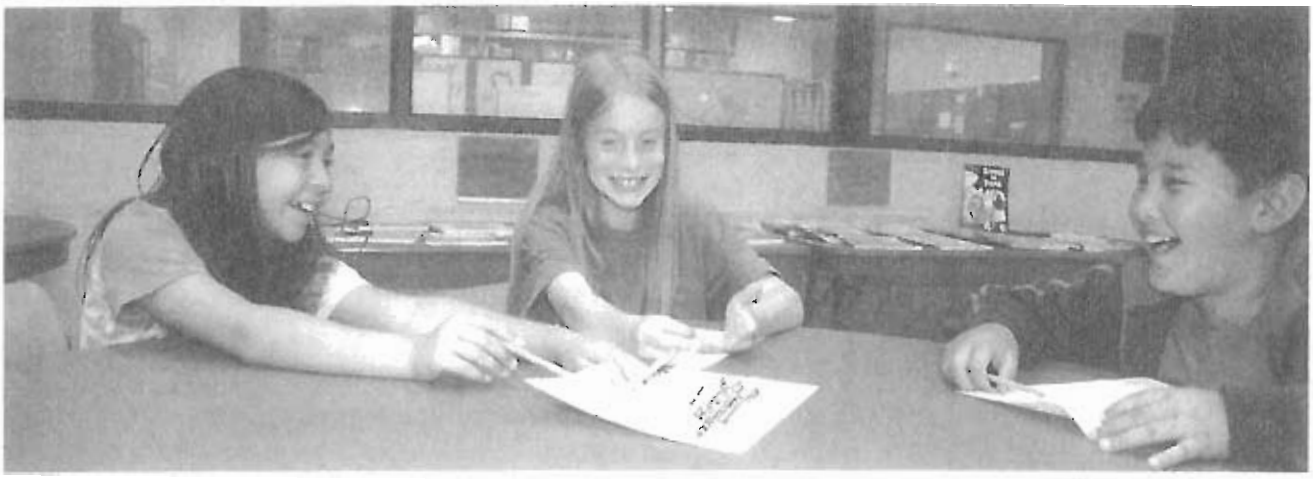
S6: You'd have to say "pressing hard" or "pressing fast."

T: (to S1) Is it okay with your lab group if we change the property to read, "Oobleck feels solid when you press it hard and fast?"

S1: (after consulting with classmates) Okay, I guess that's whot we meant by *hitting it.*

T: All those who agree that "Oobleck feels solid when you press it hard and fast," raise your hands... Opposed?... Abstentians?... Okay, that's 25 in favor and two opposed, so we'll call it a "Law of Oobleck." (Teacher makes change on list and circles it.) Those of you who disagree may want ta think of a test to try tomorrow that may convince the rest of the class.

T: Will someane from the second graup pleose read their most important property?...



Chris grade 4