ENGINEERS IN THE CLASSROOM: SHORT ACTIVITIES ELEMENTARY

These activities for students in grades 3-5 focus on measurement, scale and proportion (nanoscale, microscale), and nanotechnologies. These brief activities can be used in a classroom setting as well as informal education settings.

Playing with Perspective

Grades: 3-5

Time: 5 to 15 minutes

Objective: Students will understand that objects look different at different magnifications.

Next Generation Science Standards: DCI: PS1.A; CC: Scale, Proportion, and Quantity

MATERIALS:

- Sample of coffee grounds
- Sample of mechanical pencil lead
- Electron microscope images of coffee grounds and mechanical pencil lead (Find images at http://education.nationalgeographic.com/education/media/around-house-microscopic-images/?ar_a=1)
- Prepared microscope slides of coffee grounds and mechanical pencil lead
- Microscope
- Magnifying glass
- Ruler

PREPARATION:

Set up a cart with all the listed materials. Group the electron microscope images with prepared slides and samples of the same material.

ACTIVITY:

1. Invite students to observe the electron microscope image of either the mechanical pencil lead or the coffee grounds. Then have them look at the slide of the same item under the microscope. Ask students:
   - *Do you think you were looking at the same thing each time? Why or why not?*
   - *What do you think you were looking at?*
2. Tell students what they were looking at (mechanical pencil lead or coffee grounds), and then have them look at the same object with a magnifying glass and then with their naked eye. Ask:
   - *How do these look similar to the magnified object you saw before? How do they look different?*
   - *All of these things that you looked at are the same thing (mechanical pencil lead or coffee grounds). What makes them look so different?*
3. Explain that each time they looked at the object, they saw it at a different magnification. The higher the magnification, the closer up they are seeing the object. Ask:
   - *Which view do you think had the highest magnification (the most close-up view)?* (The first one—the electron microscope image)
   - *Which view do you think had the lowest magnification?* (The actual object, which isn't magnified at all)
4. Give students the ruler and ask them to measure the real object. Ask them to find a 1 millimeter (mm) length of the object. Explain that the piece of the object in the electron microscope image is so small it is measured in nanometers (nm) and that there are one million nanometers in a millimeter. So, the object in the electron microscope image is actually so small they couldn't see it just using their eyes, but it looks bigger to them because it is magnified.

Too Small

Grades: 3-5

Time: 15 minutes

Objective: Students will understand that technology can aid in observing processes too small to be seen with the naked eye.

Next Generation Science Standards: DCI: PS1.A - Structure and Properties of Matter

MATERIALS:

- Sets of the Too Small Cards (Use 3X5 cards upon which the Too Small statements have been printed. Print enough sets to accommodate several small student groups—one set per group.)
- Sets of the Number Cards (As with the Too Small Cards, use 3X5 cards upon which the numbers have been printed. Print enough sets to accommodate several small student groups—one set per group.)
- Timer, stopwatch, or clock
- Ruler

PREPARATION:

- Prepare the Too Small Card and Number Card sets. If possible, laminate them for durability.
- Print sufficient copies of the answer key.

ACTIVITY:

1. Ask students how we measure objects we can see. Show them a ruler and point out one meter, then one centimeter. Ask them how a centimeter relates to a meter. (There are 100 centimeters in a meter.) Show them a millimeter and ask how it relates to a meter. (There are 1,000 millimeters in a meter.) Ask how a millimeter relates to a centimeter. (There are 10 millimeters in a centimeter.) Explain that objects on the nanoscale (those too small to be seen by the human eye) can also be measured. Though we can't actually see the measurements used, we can understand them by relating them to measurements we can see. Introduce the micrometer and the nanometer as measurements used for things that are too small for us to see. Show students the millimeter again and explain that there are 1,000 micrometers in a millimeter and 1,000 nanometers in a micrometer. Give students some examples of things measured in nanometers and micrometers. For example, a strand of hair is 100 micrometers wide and a buckyball, a spherical carbon molecule, is 4 nanometers wide.
2. Explain to students that they are going to play a game to challenge their concept of nanosize.
3. Arrange students into two teams, and assign one student as a host for each team. Place one set of statement cards and its corresponding set of number cards face down in front of each team. Supply the hosts with a list of correct answers.
4. Explain to students that each statement card matches a number card. They will have two minutes to match as many statements and numbers correctly as they can. They can ask their host to check and tell them how many they have correct at any point during the two minutes, but the host cannot otherwise help. They can continue to make changes up until the two-minute point. The team that gets the most right the fastest wins.
5. Call out "go." Students can turn over the cards and start matching them. Call "stop" at two minutes or when one team has matched all the cards correctly.
6. After the game, discuss the cards with students. Ask:
   - *Was it challenging to think about such small sizes?*
   - *Would this game have been easier if all the items were things big enough to see?*
7. Note: This activity can be used as a station with about 10 students at a time.

Too Small Cards

STATEMENTS:

- The number of buckyballs that could fit in the width of a human hair.
- The number of strands of DNA that would fit down the length of a bacterium if they were laid side by side.
- The number of buckyballs that would fit down the length of an ant.
- The number of nanotubes that would fit across the diameter of a raindrop if they were laid side by side.
- The number of bacteria that would fit across the width of a human hair if they were laid end to end.

NUMBERS CARDS (TO MATCH WITH STATEMENTS):

- 2,500
- 1,000
- 1,000,000
- 2,500,000
- 40

ANSWER KEY

- The number of buckyballs that could fit in the width of a human hair. *2,500*
- The number of strands of DNA that would fit down the length of a bacterium if they were laid side by side. *1,000*
- The number of buckyballs that would fit down the length of an ant. *1,000,000*
- The number of nanotubes that would fit across the diameter of a raindrop if they were laid side by side. *2,500,000*
- The number of bacteria that would fit across the width of a human hair if they were laid end to end. *40*