The Insect (Arthropod) Exoskeleton

Appropriate Grades: 2-6

Think Ahead Time: none but to purchase bread, fruit, cucumbers

Objectives: 1. Students will be able to state that insects, and other arthropods, have an external support system called an exoskeleton, which provides support to their body much the same way bones support ours.

2. They will also be able to state that, in addition, the exoskeleton provides waterproofing to keep insects from drying out, protection from enemies and injurious activities, and may lend color to the insect.

Justification: Critical to understanding the success of the Phylum Arthropoda and the Class Insecta is an appreciation of the structure and function of the exoskeleton. It is unique in the animal kingdom and overcomes many of the difficulties associated with success as a terrestrial organism. It also poses certain obstacles which had to be overcome, such as molting.

Materials:

- shed skin of some insect : cicada works very well
- caterpillar (alive) large enough to be handled
- paper towels
- plastic containers with lids (Glad® or other brand)
- plastic bags
- hand lotion(s)
- waxed paper
- adult moths if available
- waxed cucumber
- white petroleum jelly (Vaseline type)
- cling wrap
- newly molted insect (alive or dead)
- eye dropper with colored water (food coloring)
- eye dropper with cooking or mineral oil (any kind)
- freezer paper
- bread
- cockroach (alive) slow enough to be handled (Madagascar is good)
- beetle big enough to be handled (may be dead)
- European style cucumber (often plastic wrapped)
- Lemons (2 or more), Apples, or other fruits/veg.
- aluminum foil

Preparation: none

Experiment Time: 45-60 minutes

Preassessment: Each student will demonstrate knowledge by correctly answering all of the following questions:

1. What is the covering on the outside of your body? Skin.
2. What are the purposes of it? Keeps water in (waterproofs us). Helps to keep heat in body (insulation). Protects us from bacteria and other bad guys.

Procedure:

1. Pass around the shed exoskeleton of a cicada or other insect.
2. Ask students to speculate on what it is and why it is the way it is.
3. To students in small groups (size depending on amount of supervision needed) pass around a cockroach, a caterpillar, and a beetle. ***Caution students about squeezing and/or dropping.***
4. Ask students to notice how the insects feel as compared to their own outside body covering (skin).
5. When certain characteristics are noted, hard, rigid, slick, dark, colored, warm, cold, wet, dry, ask why these characteristics might be important, i.e. what good are these characteristics, why are they needed for.
6. Students should rub a few drops of cooking oil in a spot on a paper towel in a circular area about 1 inch in diameter. Be certain they label it "cooking oil". Next they should make a spot with the petroleum jelly. Finally they should make a spot(s) of one or more hand lotions and label each. Set the paper towel aside until needed.
7. Next, they should carefully lay, **not drop,** a drop of colored water on the back of a hand or arm. Observe and record what happens. They should draw a picture of what the drop looks like from the side.
8. Then they should lay, **not drop,** a drop of colored water on the back of a caterpillar or a cockroach. Observe and record what happens. They should draw a picture of what the drop looks like from the side.
9. Then they should lay, **not drop,** a drop of food-colored water on the paper towel in an area other than on the oil or hand lotion spots, and then one drop on the center of the oil spot, petroleum spot, and each

hand lotion spot. Then they should observe and record what happens. They should draw a picture of what the drop looks like from the side.

10. Finally students should lay, **not drop,** a drop of cooking oil on the back (exoskeleton) or a cockroach and/or caterpillar and observe and record what happens. They should draw a picture of what the drop looks like from the side.

11. Ask students to compare what happens with the paper (both areas) versus the hand or arm and the caterpillar. That is, why does the spot behave one way on skin, insect skin, oil paper, differently on paper towel, and somewhat differently on the cooking oil, petroleum jelly, and hand lotion? Why does the oil behave the way it does on the insects' exoskeleton?

Application: Why do we use "hand lotion"?
Why are bread and certain other food items wrapped at the market?
Besides waterproofing, what other things does the exoskeleton of insects do?
Why is some bread (French bread) not wrapped at the supermarket? [a foreign exposure topic]
Why are some cucumbers wrapped at the supermarket, and why do some feel waxy?

1. Give each student or group of students a paper sandwich bag, a zipper-lock plastic bag and slices of fresh bread. Additionaly you may use any number of wrappings: paper towels, petroleum jelly saturated and wiped paper towels (be careful to get off the excess so it doesn't add to the bread weight), Tyvek material, cling wrap "Saran-type", freezer paper, plastic containers, aluminum foil, etc. You could test all the different brands of food containers: Glad, Rubbermaid, Tupperware, etc.

2. Ask them what they think will happen, and why, if one slice is left in the open, one in the paper bag, and one in the plastic bag. Hopefully they will predict the bread will get hard (dry out) when left in the open or paper bag. The bread in the plastic bag should remain fresh; other wrappings "exoskeletons" will retain moisture depending on their porosity.
3. Students should label their bags and leave them with the bread for 2 or 3 days to see what happens.
4. If you desire, you can weigh the bread at the beginning and at the end of the period to see how much water was lost. If you are real lucky, the bread unbagged will have mold growing on it, but it probably won't. If it did it would help to reinforce the concept that not only does skin and the exoskeleton provide waterproofing, but helps protect from disease organisms. More likely the bread in the plastic bag will have mold because the moisture that is retained inside the bag = waterproofing.

Alternative:

Pass around a waxed cucumber and an wrapped cucumber. Ask students why they feel and look the way they do. Ask what would happen if you remove the covering(s). Washing the wax from a cucumber will not be easy but with lots of soap you can remove a significant amount of the food wax. De-wax the cucumber and weigh it. Set it aside for a day or two and re-weigh it. You can do the same with the wrapped "European" style cucumber.

Alternative:

Pass around a lemon. Ask students why it feels and looks the way it does. Ask what would happen if you remove the covering (peel). Washing the wax from a cucumber will not be easy but with lots of soap you can remove a significant amount of the food wax. De-wax the cucumber and weigh it. Set it aside for a day or two and re-weigh it.

5. Pass around for the students to examine a newly molted insect (cockroach, milkweed bug) or a brightly colored insect such as a butterfly or beetle. The former is better because of the lack of color in the newly molted form. Ask students what they conclude about the color of insects.
6. They should understand that the exoskeleton is the source of coloration of many insects.

Assessment:

1. They should decide that the water can't penetrate because the skin is waterproof.
2. They should also conclude that the exoskeleton of an insect must be waterproof.
3. They may conclude that the petroleum jelly, the oil, and, to a lesser degree, the hand lotions make the paper non absorbent.
4. They should conclude that hand lotions are used to keep moisture in the skin.
5. When they place a drop of cooking oil on an insect exoskeleton and on human skin they should see that immediately the oil spreads on the "oily" waterproof surface of both. This is the same with us and the insects. They may notice that the exoskeleton of the cockroach is more oily than the exoskeleton of the caterpillar.
6. They should conclude that wrappings are placed on some foods to prevent moisture loss and/or to protect from external contamination.
7. They should conclude that the peel or "exoskeleton" of fruits and vegetables slows down the drying out.

Standards Met:

Second Grade

Science

2.1.1 Manipulate an object to gain additional information about it.
2.1.2 Use tools, etc.
2.1.3 Describe, etc.
2.1.4 Make new, etc.
2.1.5 Demonstrate, etc.
2.1.6 Use tools, etc.
2.2.2 Make quantitiative estimates, etc.
2.2.5 Draw pictures, etc.
2.3.1 Investigate by observing
2.3.4 Investigate by observing
2.4.1
2.4.2
2.4.3
2.4.5
2.5.3
2.5.5
2.5.6
2.6.3

Mathematics

2.1.11
2.1.12
2.6.4

Local and Regional Community

Standard 5: Individuals, Society, and Culture

2.5.4 Explain how changes in technology have influenced various traditions, e.g. baking bread every day, storing vegetables.

Writing

2.5.2
2.5.5
2.6.1
2.6.4

Third Grade