

ARCTIC ECOSYSTEMS TEACHER INSTRUCTIONS

See lesson plan for all activity materials.

Permafrost Activity

This activity is adapted from www.pbs.org.

Before activity:

- Mix and freeze small gravel, dirt, water, and moss in an aluminum pan (one for each group). Make sure you have two layers of permafrost: a lower layer of frozen sediment, rocks, and moss, and a top layer of more sediments, rocks, and moss.
- Gather materials for one house per group (clay and 10 toothpicks).

Procedure (Part 1):

1. Define permafrost as ground (soil and rock) that remains at or below 0° for at least 2 consecutive years. Explain that one of the obstacles faces in building the Alaska pipeline and other structures in the arctic was the unstable nature of permafrost. Permafrost freezes solid in winter, but warm surface temperatures in summer melt the upper layer, resulting in a soft, wet, spongy environment. For those building structures in such an environment, serious consideration must be given to the behavior of permafrost. For example, all heated buildings in Prudhoe Bay are built on concrete stilts to prevent the thawing of permafrost.
2. Give each group an aluminum pan with frozen permafrost. Have each group construct a small clay house with toothpicks as corner supports so that the structure will rest on permafrost.
3. Have students predict what will happen to the structure when placed on melting permafrost and enter predictions into student lab books.
4. Place the clay house on toothpick supports on top of permafrost and place near a window or heat source to allow the surface of frozen permafrost to be heated. Sunlight is low heat but the safest option. This should work overnight.

Procedure (Part 2):

5. Have students observe and record what happens to the permafrost and the small clay house in their lab books over time. They will record observations at the end of the first day, the start of the next day, and again at the end of the second day.
6. Wrap-up questions:
 - a. What happened to the permafrost as it warmed up?
 - b. What happened to the house as the permafrost warmed?
 - c. How did this compare with your hypothesis?
 - d. Discuss the hazards of building structures in locations with permafrost, such as the arctic.

Caribou Carrying Capacity

1. Define carrying capacity as the maximum population size of a particular species that can be supported by a certain area in terms of food, space, predation, etc.
2. Have students work on the worksheet in their lab books.
3. An average caribou is 189 kg and eats 2% of its body weight per day. Have students calculate the mass of food one caribou eats in a day (189×0.02), one month ($189 \times 0.02 \times 30$) and one year ($189 \times 0.02 \times 365$). Discuss where these numbers are coming from (i.e., 0.02 is 2%, etc.).
4. Have students calculate the mass of food one herd of caribou (50 individuals) eats in one day. Is that a lot of food?
5. Have students record the results in their lab books and graph the results in a line or bar graph.
6. Wrap-up questions:
 - a. How much does one caribou have to eat every day? How about the whole herd?
 - b. Compare pictures of a caribou grazing and a cow grazing. Cows also eat about 2% of their body weight per day. Is there any difference in the amount of forage in these two environments? (Try to show that the tundra is not as productive. Prompt them by asking how the two habitats differ: quality and quantity of forage available, weather, etc.) What does this mean for how many animals it can support? Do you think the same number of cows could live in the grasslands as the caribou in the arctic?
 - c. What does this mean for how sensitive the arctic is as a habitat for animals like caribou?

Blubber, Feathers, and Fur: Measuring and Testing Insulation

This activity is a modification of “Blubber Bags” from the Marine Mammal Center in San Francisco.

See lesson plan for materials.

Procedure:

1. Students will be working in their lab books. Ask students to predict which adaptation that they think protects an animal best from the cold: blubber, feathers, or fur.
2. Students select a covering for their water bottle “animal” (fur, feathers, or blubber) and record it on their worksheet. Younger students (K-2) can work in pairs.
3. Each student receives a small, sealed plastic water bottle filled with water ranging from around 90-100°F. Aim for 98°F (mammal body temperature).
4. Students measure the temperature of the water in their "animal" and record the temperature on the data log sheet. Younger students can measure the temperature using temperature strips like those used on aquariums. These strips show temperature in whole numbers and use color codes, found at any pet store or through many educational supply stores. Older students (grades 3-5) use thermometers.
5. While students are taking these measurements, distribute the rest of the materials to make the bags. For younger students, you could prepare the bags in advance, but older students can make the bags themselves. Each student receives their chosen "covering" and two snack-size bags.
6. In one bag, students place either a small piece of fur, enough feathers to fill the bag, or about 2 tablespoons solid vegetable shortening.
7. Students turn the second snack-size bag inside-out and place the inside-out bag into the bag with the covering so that the fur, feathers, or blubber is sandwiched between the two bags.
8. Students add the water bottle, representing the animal, to the inner bag and seal the two bags together. Finally, students put this sealed "animal bag" into a larger (quart-size) sealable plastic bag containing a few rocks. The rocks ensure that the "covered animal" will be totally submerged when it is later placed in a tank of ice water.
9. Keep one water bottle without a covering as a control.
10. Students place their "covered animal" in the tank with ice water, submerging it for 30 seconds.
11. When the time is up, they remove the animal and again measure the temperature of the water inside the bottle, recording this information on their data log sheet. In general, students can tell just by feeling the bottle that something happened to the water.
12. After collecting data, they calculate how much heat their “animal” lost when it was submerged in the ice water. Students record the differences in temperatures

on their individual data log sheet as well as on a class data log sheet drawn on the board or poster paper.

13. Using the data from the class log, students then calculate the average heat lost for each covering. For younger students, you can calculate this number. Remember to tell students that all animals are different, and some animals will lose a little more or less heat than others, but this average number is the value that represents what the group of animals lost. With kindergarten students, you can look at the change in color on the thermometer strips, which usually go from red to green, and give them the temperature value for those colors.
14. Together as a class, create a graph depicting the average temperature change for each type of covering. As you discuss the graph, explain that the average heat loss for the animals from the class data is a more accurate picture of how much temperature is lost than an individual student's data for their animal. Discuss that the actual amount of heat lost depends upon the initial temperature of the water in the bottle. Also, during the class period, the water temperature decreased in the bottles. Discuss why this happened, and that this is the reason scientists repeat experiments before they draw conclusions.

Blubber Mitten Activity

This activity is from www.library.thinkquest.org.

Procedure:

1. Fill one zipper bag about 1/3 full of shortening, then turn the remaining zipper bag inside out. Place it carefully inside the bag with the shortening so that you are able to zip one bag to the other, creating a “blubber mitten” for students to put their hand in.
2. Students place their bare hand in the bowl of cold water to see how cold it is.
3. Next, they can place their hand in the “blubber mitten” and into the water.
4. Ask students the following questions:
 - a. How cold does the water feel with the mitten on?
 - b. Do you think a layer of blubber would be a good protection against the cold?
 - c. Can you think of some animals that have layers of blubber to keep them warm?
(walrus, whales, seals)