

# Frostbite

Integration: Health (Personal Health, Safety and First Aid); Science

Grade Levels: 4-6

Time: 2-3 class periods

Materials:

- Piece of frozen chicken (or other meat)
- Piece of thawed chicken (optional)
- Latex or rubber glove (plastic sandwich bags may be worn in place of gloves)
- *Explorer's Clothing* handout
- Poster board
- Crayons, markers, colored pencils, etc.

Objectives:

Students will:

1. Describe frostbite, its causes, and its effects.
2. Describe the risk of frostbite that Antarctic explorers face.
3. Discuss the safety precautions necessary to reduce the risk of frostbite.

Lesson:

Full group

1. Tell students that you will be discussing a type of injury that is caused by cold temperatures.
2. Ask students what happens and what does it feel like if they go outside in the cold and are not protected properly.
  - a. They feel cold
  - b. They begin to shiver
  - c. Their extremities (noses, cheeks, ears, fingers, and toes in particular) start to turn red.
  - d. They may begin to feel numbness in their extremities.
3. Tell students that cold weather can be dangerous. It can cause injuries. One such injury is called frostbite. Ask if students have had experience with frostbite or can explain what it is. Allow them to share their experiences.
4. Introduce the causes and the effects of frostbite.
  - a. Frostbite is the freezing of either the skin or the skin and tissues of the body.

- b. Frostbite occurs when the temperature is cold, but may be aggravated by:
    - a decreased blood flow to the area (because there is less warm blood present the area is more susceptible to freezing). Tight watchbands, clothes, or a confining space may present a risk of frostbite.
    - Touching metal or liquids that are cooled removes heat from the body and increases the risk of frostbite.
    - Moisture and wind remove heat from the body during evaporation. The more heat removed, the greater the risk of frostbite.
5. Ask students why frostbite is dangerous. What are the effects?
- a. When frostbite occurs, the fluid between the cells in the tissue freezes. When it freezes, it forms ice crystals that pull more water out of the cells. When this water is removed the cells become dehydrated (without water). (If students are not familiar with cells, tell them that cells are like tiny compartments filled with fluid that make up their bodies).
  - b. The dehydration of the cells affects how the cells function. They need fluid to perform properly. Damage is also caused by the rubbing together of the ice crystals. Ice crystals have sharp edges that act like glass.

ALTERNATIVE: When the skin or muscles of the body are frozen they cannot work properly. Blood can't flow through the body and this can cause injuries.

- c. Frostbite is not life threatening but the tissues can be permanently damaged and in the most serious cases, the tissue may have to be amputated.
6. Tell students that there are different stages of frostbite. The longer the body is exposed, the worse the condition gets.
7. Write the following words on the board and discuss the definitions (optional with younger students).
- a. **Frostnip** is the condition when only the outer layer of skin is frozen. It looks white and waxy or gray.
  - b. **Superficial frostbite** is the condition when the skin is frozen and the underlying tissue is beginning to be affected. The skin is white or gray and feels hard while the tissue underneath feels soft.
  - c. **Deep frostbite** is when the frostbite extends down to the tissues and muscles. It looks like frostnip and superficial frostbite but the area is hard.
8. Investigate frozen muscle tissue using frozen chicken (or other meat). Prepare by allowing frozen chicken to thaw slightly.
- a. Allow students to see the change in the texture, the appearance of ice crystals, and to feel (with gloves) the frozen muscle tissue.
  - b. Remind students that the frozen chicken is an extreme case of deep frostbite. Allowing the frozen specimen to thaw slightly may provide better results.
  - c. Comparisons of frozen and thawed specimens are also valuable.

ALTERNATIVE: Discuss what frozen meat looks and feels like. Compare this to the frozen tissue that occurs with frostbite.

9. Ask students to give suggestions for how frostbite can be prevented.
  - a. Wear layers of clothes.
    - Layers of clothing are important because they can be added or removed as necessary to avoid being too cold or too warm.
    - Loose layers are important because they allow for a pocket of air between the layers. The air helps to insulate against the cold.
  - b. Keep extremities covered.
  - c. Stay indoors.
  - d. Keep dry.
    - The evaporation of moisture produces the loss of body heat.
    - The moisture in the form of sweat increases the chance of frostbite.
  
10. Introduce the Bancroft Arnesen Expedition and the explorers' risk of frostbite (Frostnip and frostbite can occur quickly if the explorers are not careful.). Have students brainstorm the factors that contribute to the explorers risk of frostbite.
  - a. the temperature of Antarctica
    - the average temperature will be  $-30$  degrees Fahrenheit.
  - b. the winds of Antarctica
    - The wind on Antarctica is constant and it gusts up to 100 mph.
    - Wind increases the amount of body heat lost.
  - c. the amount of time spent outside (all); the amount of time exposed (not in a tent; needing to take off gloves, etc.)
    - Ann and Liv will spend essentially all of their time outside (not in a building)
    - They will be exposed for 8-14 hours a day skiing.
    - The rest of their time will be spent in a tent.
  - d. Strenuous exercise that could lead to perspiration.
  
11. Have each student or groups of students make a list of the items that they would wear if they were on an expedition to Antarctica.
  
12. Distribute the list of clothing items on the *Explorer's Clothing* handout.
  - a. Have the students compare the lists.
  - b. The explorers wear layers of lightweight clothing that *wick* away (remove) the moisture from their bodies, so they stay dry.
  - c. The amount of clothing depends on where they are (outside or inside a tent), what activity they are performing (resting vs. skiing vs. sailing), and what the weather conditions are.
  
13. Students should conclude that the explorers make certain that they are protected from the cold and moisture and try to reduce the risk of frostbite.

## Small Group

14. Divide the students into small groups.
15. Each small group will create a poster to teach others how to prevent frostbite. The groups will present their posters and what they have learned to each other and, if time permits, to other classes.
  - a. Each poster should have an illustration
  - b. Each poster should have a slogan

EXTENSION: Have a doctor or someone from an organization such as the American Camping Association speak to the students about the dangers of frostbite.

## Assessment:

Teachers will assess:

1. The students' understanding of the causes and effects of frostbite.
2. The students' ability to explain the factors contributing to the explorers' risk of frostbite.
3. Whether the students know how to prevent frostbite.