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Preventing Hypothermia

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Concepts: Hypothermia occurs when a warm-blooded animal, such as a person, becomes extremely cold, and loses control of his or her body's core temperature. This is much more likely to happen when a person wet than dry. Hypothermia can cause death. Oftentimes it is difficult to know when someone starts to go into hypothermia. It is even difficult to know when you yourself are experiencing the beginning signs.

Background: I am very sensitive to the dangers of hypothermia from a real life experience involving my best friend in high school who almost died on a back packing trip in the Sierra Nevada mountains. It wasn't very cold, about 40˚F, but it was raining. Her clothing was completely soaked. She was tired and hungry from physical exertion. She went through an episode of shivering, then the shivering stopped and she thought she was fine. That's when she slipped into unconsciousness. Her hiking partners acted quickly. They stopped immediately, set up a tent and warmed her up with their own body heat. She was lucky.

Materials: Desk fan. Thermometer with exposed bulb. Cotton or gauze. Bowl of water. Socks or fabric consisting of a variety of materials including cotton and wool. Perhaps a magnifying glass. Big paper doll with a wardrobe of paper clothing both appropriate and inappropriate for cold weather activity.

Prelude: As an introduction to these activities I sometimes read from Laura Ingalls Wilder's *The Long Winter*. See a related PUMAS example: Hypothermia in the Little House.

Activity #1: Cooling by evaporation. Hold up the thermometer. Have volunteers come up to read the temperature. Get several readings. Next, turn on your desk fan. Hold the thermometer in the “wind” produced from the desk fan. Have several volunteers read the temperature. The temperatures should be the same as before. Then, dip the cotton gauze in the bowl of water. Hold the wet gauze on the thermometer bulb and hold the thermometer in the "wind" from the fan. This time when the kids come up to read the temperatures they will find that the temperatures are dropping.

What is happening? The water next to the thermometer bulb is evaporating, and evaporation causes cooling. The reason that evaporation cools is that the gas state of water molecules is more active and at a higher energy level than the more organized liquid state. It takes energy to get those molecules up and moving. The energy that goes into the water to make gas from liquid has to come from the environment surrounding the water. The environment loses energy and cools when

the water gains energy and turns from liquid to gas. The moving air accelerates the evaporation allowing liquid to turn into gas more quickly.

Why didn't the wind cause a cooling? What about wind chill? Wind chill only affects warm bodies that manufacture their own heat. A warm body conducts heat into the air layer that directly touches the body. That warm layer of air, in part, insulates the body from the colder air beyond. If a wind comes along and moves those warmer air molecules away and replaces the warmer air molecules with colder molecules, the warm body has to go to work again to warm up the insulating air layer. The reason it feels colder to you with a wind than without is because your body has to work harder repeatedly heating up the air molecules that are in direct contact with your body. The thermometer doesn't manufacture its own heat therefore it is the same temperature as the air in the room and doesn't lose heat in warming up the air around itself.

Moral of this lesson: Don't get wet when its cold!

Activity #2: Have the kids dip different fabrics in the bowl of water. I use socks. Note carefully which socks get soaking wet immediately and which stay dry on the inside. Note when you see air bubbles. Cotton absorbs water right away. Wool produces a lot of air bubbles and stays dry for a long time. Examine wool fiber closely, maybe with a magnifying lens. Wool fibers are squiggly.

Clothing keeps you warm because 1) it keeps you dry and 2) it traps an insulating layer of air around your body. The squiggly wool fibers trap a lot of air. Even when you dunk wool in water, it doesn't lose all the air trapped in the fibers. Wool will keep you warm a long time. Cotton will not. Your denim blue jeans are made from cotton, and will get wet right away. They'll cause evaporation against your skin right away and will make your body work hard at keeping warm.

Moral of this lesson: Don't wear cotton. Wear wool. (Man-made fibers vary. Some are like wool and some like cotton.)

Activity #3: Choosing clothing. I made two paper dolls, one a boy, one a girl. They are about 12 inches high and come with a variety of color-coordinated clothing. It took me about 90 minutes to make each doll with its wardrobe. Each doll has thermal underwear, denim pants, wool pants, wool socks and cotton socks, canvas tennis shoes, boots, mittens, wool sweater, short sleeve T-shirt, long sleeve cotton shirt, hooded cotton sweatshirt, rain pants and a rain poncho, ear muffs, a wool ski cap and a baseball hat.

The kids and I spend some time dressing him or her for winter activity. I might say, “It’s cold and rainy.” Then I would expect the clothing choices to include boots, rain pants and the poncho. I might say, “It’s snowing.” Then the poncho is less important and the wool sweater is more important. The ski cap is essential and the baseball hat and the ear muffs are useless. (You lose most of your body heat through your head and neck.) I emphasize layering, protection from wet, and a head covering. Canvas tennis shoes are bad. Wool is better than cotton. Make sure your thermal underwear isn't all cotton. The idea is to let the kids make the choices, and to guide them into making the right choices. Its a nice application of science into everyday life.