Bundle Up!

Objective:

Explain what a 100-year winter storm is and how we can keep ourselves safe.

Overview:

Participants will learn how communities can prepare for cold weather.

Each group will model how insulating layers protect us from the cold and simulate the probability of a 100-year winter storm.

Materials:

- Fridge
- Cooler with hot water bottles

Per Group:

- 2 oranges (mandarin oranges can be used for large groups)
- 1 sock
- Thermometer
- Sharpie
- Bag of 100 beads (99 of one color, 1 of a different color)

Recommended Ages: 10+

Content Areas: Earth Science, Life Science, Physical Science, Environmental Education, Structural Engineering

Duration: 30-45 minutes

Group Size: 2-5 participants per group

Predicted Cost: $10-$40 (variation based on purchase of heat lamp and thermometer)

Setting: Indoors

NGSS Disciplinary Content: LS2, ESS 2, ESS3, PS3, ETS1

Key Terms: Extreme Heat, Urban Heat Island, Evapotranspiration

Background:

Natural Hazard: Winter Storms

Winter storm: Precipitation is mainly snow, sleet, or freezing rain

- Cover tens of thousands of square miles
- Range from hours of snowfall to blizzards lasting a day or more
- Often include strong winds and below-freezing temperatures

"Winter weirding": Winter weather events becoming more intense and fast-moving

- Shifting polar vortexes cause colder-than-average temperatures in new areas
- Result: weather systems that normally stop in Rocky Mountains can jump and merge with humid air masses from the South
- Pressure changes generate strong winds

Winter Storms and Well-Being

Hypothermia:

- Occurs as high as 40°F
- Symptoms include shivering, confusion, difficulty speaking, and exhaustion

Frostbite:

- Skin turns yellow-grey, feels firm or waxy, and goes numb.

Winter Storms and Infrastructure

50°F is the temperature of most homes if they lose heat. At that temperature:

- Blood flow to the brain falls by 20%
- Extremities (fingers, legs, head) temperature decreases ~3.5°F
- Blood pressure and heart rate increase

100-year storm: 1 in 100 (1%) chance of occurring in any given year. Communities should be prepared for a 100-year storm even if one was recently recorded because that probability resets every year.

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Preparation:

1. Store the oranges in the cooler with at least one hot water bottle so that they are warm at the beginning of the activity.

Procedure:

1. Hand two oranges to each group. Have groups write their names on their oranges and, if time, personalize them. The oranges model how human bodies react to the cold.
2. Groups will insert their thermometer into each orange, then place one orange in the sock. Collect the temperatures in a whole group data table like the example in the resources section.
3. Put all oranges in the fridge and leave them there at least 15 minutes.
4. While waiting, simulate the probability of a 100-year winter storm with their beads:
    a. Group members take turns pulling out beads and record how long it takes for the different colored bead to appear. See example data table in resources.
    b. When the different color bead appears, a 100-year storm has occurred. All beads return to the bag, and the group starts a new trial.
    c. Groups continue doing trials until the oranges are chilled enough.
5. Return oranges to groups and instruct them to quickly take the temperature of both oranges before they can warm up. They should measure in a different spot than the first time. Add the temperatures to the whole group data table.
6. As a whole group, discuss the results of the orange test and the 100-year storm simulation.

Discussion Questions

- If it's called a 100-year storm, does that mean it can only happen once every hundred years? What did this activity show?

  A 100-year storm has 1 in 100 (1% probability) of occurring in any given year, but the probability resets the next year so it is possible for winter storms to happen more frequently (e.g., two years in a row).

- What do we notice about the temperature of the orange in the sock vs. outside of it? Why is this happening?

  The sock is insulating the orange, which allows for the heat to be trapped in the sock and orange and not transferred to the air around it in the freezer.

- What can happen to your body when it gets cold?

  Hypothermia can occur above freezing, as high as 40 degrees F.

- What can we do on a community level to prevent winter storms from making an impact on the community?

  Clear roads, snow fences, buried power lines, prune trees, avoid flat roofs if heavy snow, roadway heating, and use insulation.

Extensions and Modifications

This activity can be separated into its individual components – orange test and 100-year storm simulation – to adjust time or fit with other event activities

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Example Data Tables:

Table 1: Orange Temperature Results

Group	Temperature Before Refrigeration		Temperature After Refrigeration	
	With Sock	Without Sock	With Sock	Without Sock
Group 1				
Group 2				
Group 3...				

Table 2: 100-year Storm Simulation

Trial	Beads pulled until winter storm
1	1, 2, 3, 4, 5, 6, 7, 8, W
2...	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, W

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