Science TODAY™ Teacher Edition

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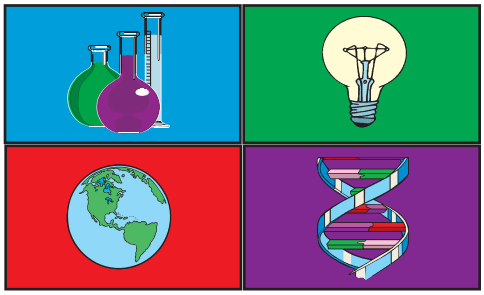
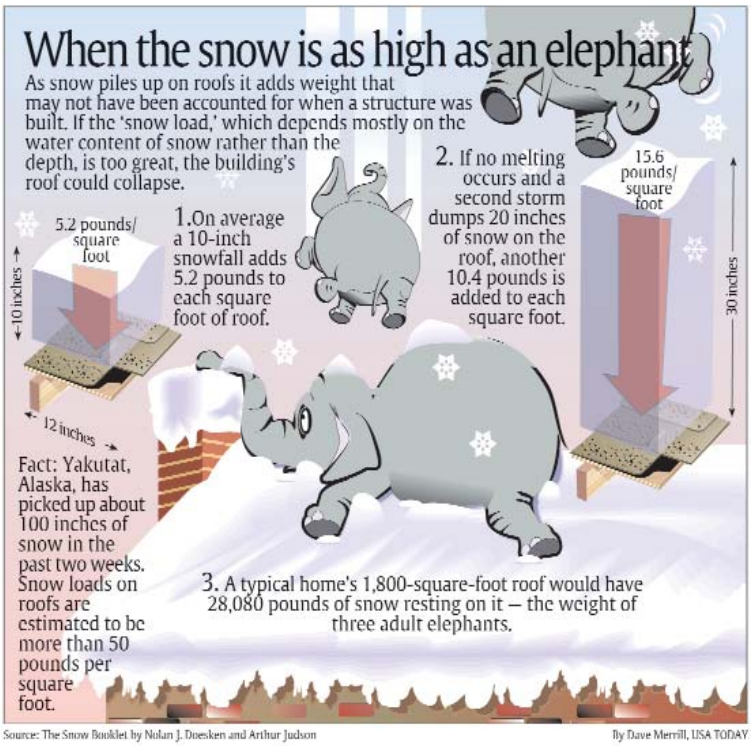


When the snow is as high as an elephant

By: Jeff Lukens



Activity Overview:

Using information from the USA TODAY Infograph, "When snow is as high as an elephant" and data from other sources, students will explore some of the effects and characteristics of snow. This activity asks students to examine topics such as "snow load," the potential effect that accumulated snow has on roofs of homes and other structures. Students will also compare snowfall to rainfall, in terms of moisture content. Additionally, students will use their graphing calculators to plot snowfall data, calculate mean values, convert percentages to raw data and do unit conversions.

Activity at a Glance:

- Grade level: 9-12
- Subject: Physical Science, Physics, Earth Science, Meteorology
- Estimated time required: 30-45 minutes

Materials:

- TI-83 Plus family or TI-84 Plus family
- Calculator for instruction/demonstration
- Student handout
- Transparency
- USA TODAY newspapers (recommended)

Prerequisites:

Students should be able to:

- enter data into the List Editor.
- graph data using Stat Plots.
- determine independent and dependent variables.
- do calculations on the home screen.
- convert percentages to raw data and vice versa.
- use the SciTools App.

This activity works with TI navigator A Classroom Learning System

This activity was created for use with Texas Instruments handheld technology.

When the snow is as high as an elephant

Concepts:

- Density
- Calculating mean values
- Unit conversions
- Rain vs. snow precipitation

Objectives:

Students will:

- graphically represent data from a table.
- convert SI units to English units by successfully using the SciTools App.
- convert English units to other English units.
- develop an understanding of "snow load" as it relates to household roofs.
- compare the density of water to the density of snow.

Background:

In most regions of the United States, winter brings a good chance of snow. In some areas, the snow season extends well beyond the "official" winter months. An impending snowfall can cause emotions ranging from excitement to dread, depending on your degree of playfulness and possibly your age. While several inches of snow motivates some people to have snowball fights, build snowmen or wax their skis, drivers and homeowners have more serious snow-related issues to consider. Besides the need to scoop and push snow from sidewalks and driveways, homeowners need to be aware of the amount of snow that accumulates on the roofs of their homes. Snow can be very heavy, and the roofs of residential structures are designed to handle only a certain amount weight. In this activity, students will calculate the snow load that roofs are able to handle. In addition, they will have the opportunity to investigate topics such as density, graphing and unit conversions.

Preparation:

- Provide one graphing calculator for each student.
- Each student should have a copy of the corresponding student activity sheet.

Classroom Management Tips:

- Students will have a better understanding of how to read the graphic and retrieve data if you use the transparency for a class discussion before the students start working.
- Remind students to read carefully all parts of the graphic before they start collecting data.
- Students can work individually or in small groups on this activity. Working in groups is especially helpful as they learn the various features of the calculator.

Data Source:

The Snow Booklet by Nolan J. Doesken and Arthur Judson

National Science Education Standards:

Grades 9-12: Science in Personal and Social Perspectives
Natural and Human-Induced Hazards

- Normal adjustments of earth may be hazardous for humans. Humans live at the interface between the atmosphere driven by solar energy and the upper mantle where convection creates changes in the earth's solid crust. As societies have grown, become stable, and come to value aspects of the environment, vulnerability to natural processes of change has increased.
- Some hazards, such as earthquakes, volcanic eruptions, and severe weather, are rapid and spectacular. Natural and human-induced hazards present the need for humans to assess potential danger and risk. Students should understand the costs and trade-offs of various hazards--ranging from those with minor risk to a few people to major catastrophes with major risk to many people. The scale of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations.

Additional Resources:

- TI Technology Guide, for information on the following: TI-83 Plus family or TI-84 Plus family, List Editor and SciTools App
- TI-Navigator™ Basic Skills Guide for information on using the TI-Navigator Classroom Learning System

When the snow is as high as an elephant

Activity Extension:

- Research USA TODAY for information on weather occurrences, including snowfall, and discuss or analyze the impact these occurrences have on businesses, individuals and society.
- Have students research the snowfall averages for their region, or areas of the country where they have friends or relatives. Use this data instead of, or in addition to, the data in the student edition of this lesson.
- If possible, have students gather some snow in a container that has volumetric measurements on it (a beaker, for example). After the snow melts, have them compare the original volume of the snow to the melted volume, then calculate the density of the snow.
- Compare the actual historical snowfall from one year to the next with the snowfall that was predicted by the Farmer's Almanac, or other sources.
- Research phenomena such as El Niño and have students note the snowfall amounts for so-called "El Niño years" as compared to "normal" years.
- The USA TODAY website, www.usatoday.com, has a significant amount of information on weather phenomena. Have students explore the weather section of the website.
- In a Physics class, have students model the effect of snow load by building structures on a smaller scale and testing the roof capacity by piling a substance like flour on it.
- Have students research snow-shedding and snow-melting of different types of roofing materials. They may want to research the reasons why people who live in very snowy, mountainous regions typically have sheet metal roofs on their houses.

Curriculum Connections:

- Algebra I
- Algebra II
- Statistics
- Chemistry

Teacher Notes:

When the snow is as high as an elephant

Assessment and Evaluation:

Q. What has been the average snowfall in Buffalo since 1990?
A. 100.9 inches

Q. In the graph that you produced, what is the independent variable?
A. Year (time)

Q. What is the dependent variable?
A. Snowfall (inches)

Q. Was there a predictable trend in the snowfall data? Why or why not?
A. Not really. Weather, especially precipitation, is normally cyclical. Long-term trends are not common.

Q. What is the density of water in lbs/ft^3?
A. 62.4 lbs/ft^3

Q. If a snowfall contained 9% of the moisture as rain, how many inches of snow would have to fall in order to equal 1" of moisture?
A. 11.1 inches

Q. What would be the load in lbs/ft^2 on a roof covered with 1" of water?
A. 5.20 lbs/ft^2

Q. Based on the data in the USA TODAY Infograph, what is the assumed moisture density of the snow?
A. 10%

Q. Based on the data in the USA TODAY Infograph, how much snow could a home's roof tolerate before the critical point of 20 lbs/ft^2 were reached?
A. 38.5 inches

Q. What factors could change your answer to #9?
A. Moisture content of the snow; the type of roof (shingles, metal, etc.); how much snow sticks to the roof; or how much snow melts.

Q. Paradise, Washington is at the base of Mount Rainier. Paradise averages 635" of snow each year. In the winter of 1971-72, Paradise received an amazing 1122" of snow! How many feet of snow is this?
A. 93.5 feet

Q. During the winter of 1971-1972, if all of the snow that fell on Paradise, Washington, accumulated on the roof of a building, how much pressure in lbs/ft^2 would be exerted on that roof?
A. 583.4 lbs/ft^2

If you are using the TI-Navigator Classroom Learning System, send the provided LearningCheck assessment to your class to gauge student understanding of the concepts presented in the activity. See the TI-Navigator Basic Skills Guide for additional information on how this classroom learning system may be integrated into the activity.