

Avalanche Lesson Plan

Subject: Science

Grades: 6-12

Authors:

Colleen Garrity (Arizona State University GK12 Fellow)

Anne English (Desert Eagle Secondary School Science Teacher)

Patrick Dwyer (Desert Eagle Secondary School Science Teacher)

Date: April 2003

Objectives:

Students will develop an understanding of avalanches as a natural hazard in alpine environments. They will gain knowledge about issues of snow stability in snowpacks. Students will also design and conduct avalanche experiments using flour, sugar, and other snow-simulating materials on a board.

Time (estimated):

- 1/2 hour - avalanche article warm-up activity
- 1 hour - video
- 1 hour – background visual activity
- 1 hour - experiment design
- 1 hour - experiment time
- 1/2 hour - finish write-up

Background Information for teachers:

A common demonstration of snow stability and instability (why avalanches happen) involves layering different materials such as flour and sugar onto a board until a “break point” is reached. In this lesson, students will design and conduct their own experiments to determine what conditions are most conducive to naturally triggered avalanches. They may also investigate how different types of terrain and slopes affect snowpack stability. As an added option, students may design experiments to investigate other avalanche triggers, such as human recreational activities.

Internet Resources:

Avalanche.org

www.avalanche.org

National Avalanche Center (U.S. Forest Service)

www.avalanche.org/nac

Cyberspace Snow and Avalanche Center

www.csac.org

AZ Standards:

- 1SC-P2 Compare observations of the real world to observations of a constructed model (e.g., an aquarium, a terrarium, a volcano)
P 01. Assess the capability of a model to represent a “real world” scenario.
- 1SC-P6 Identify and refine a researchable question, conduct the experiment, collect and analyze data, share and discuss findings.
P01. Construct a researchable question
P02. Employ a research design that incorporates a scientific method to carry out an experiment
P03. Analyze experimental data
P04. Communicate experimental findings to others
- 3SC-P4 Identify and describe the basic processes of the natural ecosystems and how these processes affect, and are affected by, humans
PO 1. Describe the basic processes of the natural ecosystems (e.g. water cycle, nutrient cycles)
PO 2. Explain how these processes affect, and are affected by, humans
- 5SC-P7 Demonstrate the understanding of gravitation as a universal force that each mass exerts on any other mass
PO 1. Use the universal law of gravitation to predict how the gravity force changes with a change of distance and/or mass
- 6SC-P6 Identify and compare the interactions between water and other earth systems including the biosphere, lithosphere, and atmosphere.
PO 2 Describe the interactions between water and the biosphere
PO 3. Describe the interactions between water and the lithosphere
PO 4. Describe the interactions between water and the atmosphere
PO 5. Compare the interactions between water and earth systems
- 6SC-P7 Investigate, analyze, and evaluate the factors that may influence weather; describe their effects on the environment and daily activities on earth
PO 4. Evaluate the effects of various weather factors on the environment and daily activities on earth.

Materials Needed:

- Avalanche video – many good videos about avalanches are available. Some examples include the following:
 - Avalanche! (NOVA Video #WG2418N, 1997, 1 hr.) Check your local PBS station for broadcast times or order through www.wgbh.org. Associated lesson plans may be found on www.pbs.org website.
 - Avalanche (Discovery Channel, 1 hr.). Check for broadcast times on Discovery Channel or order through Discovery Channel website.
 - Violent Planet (National Geographic Explorer Series, Fall 1995, 25 mins.). Order by calling 1-800-647-5463.
- Plywood boards (or similar...foam core boards, cardboard; anything that will be a flat surface that can both support the snow and surface simulation materials and be placed at different slope angles)
- Compass to measure slope angles tested
- Plastic tarp or newspapers (to keep mess to a minimum!)
- “Snow” materials: Flour, Sugar, Mashed potato flakes, and other substances that would simulate different snow characteristics.
- “rocks” and other materials that might simulate other surfaces
- glue or similar adhesive
- sifter

Procedures:

1. Avalanche Article Warm-Up Activity: Understanding Avalanche Hazards

Give students an article to read about a recent avalanche event and resulting deaths or injuries. Many such articles may be found on the websites listed in Internet Resources in the Background section of this lesson plan. Ask them to answer/discuss, written or orally, what caused the event.

2. Show a video about avalanches

Discuss with the students any physical processes of snowfall and snowpack development that occur in alpine environments that are shown in the video. Also, discuss the conditions that are conducive to avalanche hazards and avalanche triggering mechanisms.

3. Background/Visual Activity

- Terrain - Students will examine some photographs of the San Juan Mountains in Southwest Colorado to gain visual perspective of terrain that is conducive to avalanches. They should especially note the surface features (trees, rocks, avalanche chutes, etc.) and the steep slope angles of the mountains. The corresponding worksheet may be downloaded from the GK12 website (AvPhotosWorksheet).

- Snowpack stratigraphy - Students will use knowledge gained from video to discuss snowpack characteristics/stratigraphy in terms of weak and strong layers.

4. Experiment Design

Next, have the students design an avalanche experiment. They will be able to use the materials listed to conduct the experiment. Have the students identify a testable question and design the experiment, identifying dependent and independent variables and factors for which they will control. Before beginning the experiment, the students should begin their lab write-up, including the following components:

1. Testable question
2. Hypothesis
3. Materials
4. Procedure
5. Data Table

Some possible experiment categories are listed below:

- Design experiments to test snow stratigraphy characteristics for avalanches. What kinds of “snow” are stable or unstable?
- Experiment with slope; what slopes (in degrees) are most or least conducive to avalanches?
- Experiment with terrain; what types of terrain aid or inhibit the occurrence of avalanches?
- Experiment with avalanche triggering mechanisms; esp. weights and motion (animals, skiers, snowmobiles, etc).
- Other avalanche triggers can be tested, especially human triggers. For example, use remote-controlled vehicles to simulate snowmobiles or weights/popsicle sticks to simulate skiers.

5. Conducting the Experiments

When the students are ready to conduct their experiments, make sure they cover the testing area with a tarp or newspapers to facilitate cleanup. This can be a very messy experiment!

The students should collect data as they experiment and write down the results.

6. Write-Up

To complete the lab write-up, students should ensure that their data are organized, write a section for data analysis and a final conclusion section. Students should evaluate the model they created vs. the real world avalanche environment; how well does their

model represent the real world? What does their model take into account? What, if any, assumptions are made in the model? What would they change in their model?

Evaluation:

Rubric for experiment design (another document)

Extensions:

Microscopes – have students examine their “snow crystals” under a compound microscope and draw & label the shapes of the “crystals”. For example, students could look at the shapes of sugar vs. flour under a microscope to determine which might form weak or strong layers in their simulated snowpack.

Topographic Maps – Students can examine avalanche terrain slopes on topographic maps. Quadrangle (1:24,000 scale USGS topographic maps) names in the Silverton, Colorado, area include Ophir, Silverton, Howardsville, Telluride, and Ironton (among many other possibilities). For more information about topographic maps, see mapping.usgs.gov.

Online modules

- Interactive Backcountry Tour www.avalanche.org/%7Enac/
- A Day in the Backcountry (24 slides) www.avalanche.org/%7Enac/