

Avalanche Modeling Project

The objective of this activity is to build a model of an avalanche using two variables, terrain (rocky vs. smooth) and slope for a snowpack that you will design. You will complete this project in groups.

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Part I: Snow Crystal Analysis

In order to simulate an avalanche, you must understand the size and shape characteristics of the substances you use to represent different types of snow. Knowing these characteristics can help you identify strong and weak layers in a snowpack.

Follow the steps below to analyze one of the substances that we will use to represent snow. You will share your results with the rest of the class.

1. Each group will analyze one of five substances: flour, sugar, borax, potato flakes, or Epsom salt. Make a slide of your substance and take it to the digital microscope. (If another group is already working on the digital microscope, move on to Part II: Build Your Terrain, and come back to this analysis when the digital microscope is free).
2. Place your slide on the stage of the digital microscope. Focus the microscope on your crystals. Pick out an average-sized crystal to measure for your analysis.
3. Click on the camera icon on the computer screen and then click on the "Snapshot" button to take a picture of your crystal. Once the picture is taken, click on the thumbnail-sized version and click on the "Transfer" button. Your picture should fill the background on the computer screen. Print out a copy of your picture and sketch or trace the picture into the "Sketch" section of the Snow Crystal Summary table on page 4 for your substance.
4. Now you will take a measurement of your crystal. Make sure that the Capture Control window reads "Measure Mode On." Then, click on the "Measure..." button at the bottom of the screen. Measure your crystal using the unit called microns (μm , thousandths of a millimeter). Use your mouse to

do the measurement. The cursor turns to a crosshair (+). Center the crosshair on one side of your crystal and click once. Move your cursor to the opposite side of the crystal and click once again on the edge. The diameter measurement will appear on the screen. Measure your crystal's diameter in 3 different places, write them below, and calculate the average diameter. (Note: if your crystal is more rectangular, measure length and width and take the average of the two measurements)

Diameter #1 _____ Diameter #2 _____ Diameter #3 _____

Average Diameter = _____

Write the average diameter of your substance in the "Crystal Size" section of your table.

5. Now find the snow classification that is closest to your crystal. Go to the next computer and look at the snow classification sheet on the screen. Pick out the shape that looks most like your crystal and write the name in the "Snow Classification" section of your table.
6. Share your findings with the class and complete your table with information from other groups.
7. In the "Rank size" category of the table, rank order the crystal types from smallest to largest (1 = smallest, 5 = largest)

Avalanche Model Snow Crystal Summary

Substance	Sketch	Crystal Size	Snow Classification	Rank size
flour				
sugar				
borax				
potato flakes				
epsom salt				

Part II: Build your terrain

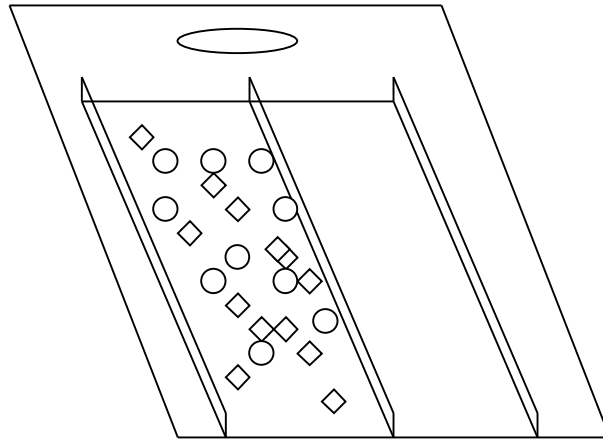
In this part of the lab, you will build your avalanche terrain on a whiteboard that will be covered in butcher paper. You will use the butcher paper to separate the terrain into two 6" wide avalanche chutes, one smooth and the other rocky.

Use the diagram below as a guide.

Use tape to attach the paper to the board.

When your chutes are ready, glue sand & rocks to one chute.

Leave the other chute plain.

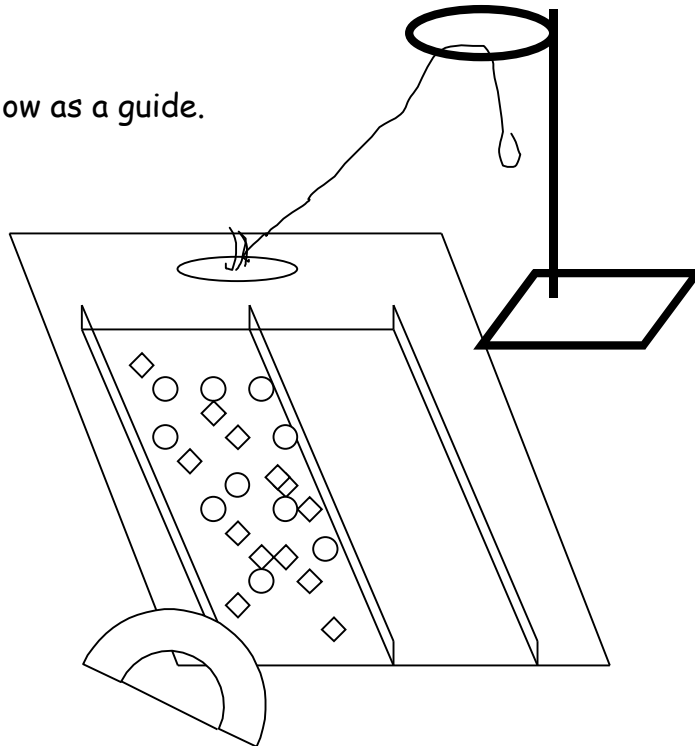


Part III: Changing the slope

In this part of the lab, you are building a mechanism for changing the slope of your avalanche terrain. You will need the following materials:

- Completed terrain board
- Ring stand (with ring)
- String
- 2 Large rocks
- Protractor

Use the diagram below as a guide.



1. Tie the string securely through the handle of the white board.
2. Lay the board flat on the table right in front of the ring stand, with the handle side closest to the ring stand.

3. Loop string around the ring on the ring stand. Leave at least 12" and tie a loop at the end. You should be able to increase the slope of your terrain easily by pulling the string.
4. Secure the base of your slope by placing large rocks at the end of the slope to prevent your terrain board from moving.
5. Attach a protractor to the table at the end of the terrain board as shown. Measure the maximum angle (in degrees) to which you can move your slope (your minimum slope is zero, of course). It should measure at least 35°.
6. Test your mechanism to be sure that it works well before adding your snowpack.

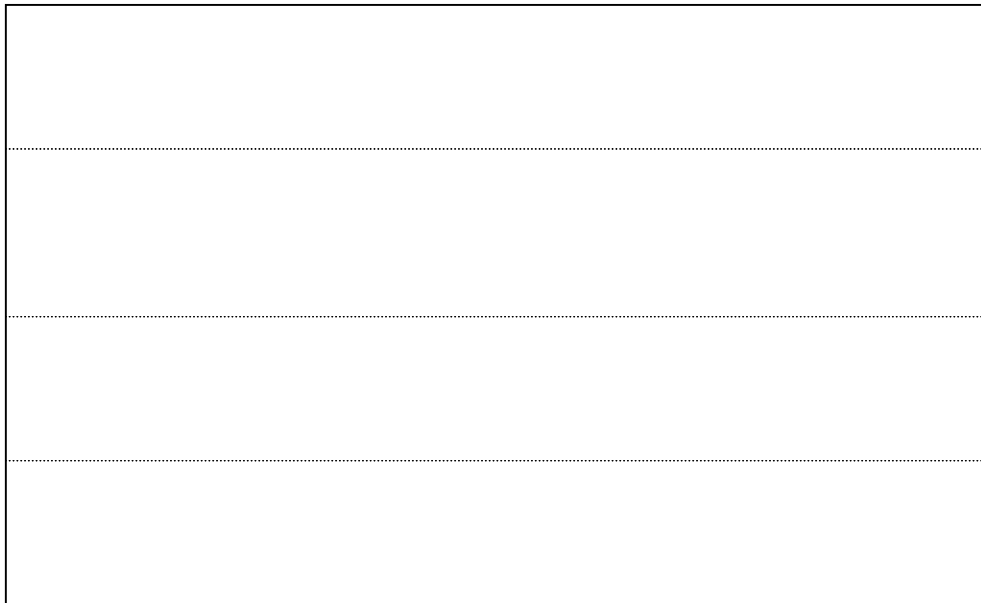
Part IV: Snowpack Design

Now that you have information about your snow substances, you will define the layers in your snowpack for the avalanche experiment. Each layer in your snowpack represents a different snowstorm with different snow characteristics. Choose 4 layers for your snowpack. You have 5 materials to choose from, and you need to use at least 2 different materials. Remember that the more densely-packed the crystals can become, the more stable the layer will be. So, smaller crystals should be more stable than larger crystals. Shape can also affect density and stability.

Refer to the table you completed about the characteristics of your "snow" and design a snowpack. Label the layers for your snowpack in the diagram below.

****Try to make the most stable snowpack possible!**

top



The diagram is a large rectangle with a solid border. It is divided into four equal horizontal sections by three horizontal dotted lines. The top-left corner of the rectangle is labeled 'top' and the bottom-left corner is labeled 'bottom'.

bottom

On your avalanche terrain whiteboard, build your snowpack just below the handle. Use the snowpack you just designed as a guide, starting with the bottom layer and working your way up.

Part V: Conducting your experiment

You will answer several questions to describe what happened in your experiment. You will conduct your experiment ONCE, so it's very important to read through the questions beforehand so you know what information to collect. Answer the following questions about your avalanche experiment:

1. What was the slope angle of your avalanche?

2. Which terrain avalanched first, rocky terrain or smooth terrain? Or did they both avalanche at the same time?

3. Which parts of the snowpack avalanched?
 - a. Did the entire snowpack avalanche at once?

 - b. Did only certain layers slide? If so, which ones?

4. Which layer was the weak link?

- a. What crystal substance was it?

- b. What was the size rank of the weakest crystal (refer to your Snow Crystal summary table)?

- c. Did crystal size matter? Was it smaller or larger than the other crystals in your snowpack layers?

- d. What was the general shape of the weakest crystal?

- e. Did crystal shape matter? How did the shape of the crystals in the weak layer compare to crystals in the other snowpack layers?

5. If you could change anything in your experiment to make the situation as stable as possible (in other words, no avalanche!), what would you change?

a. Terrain?

b. Snowpack layers?

Keeping these questions in mind, conduct your experiment.

- Raise the board *slowly*
- STOP as soon as the snow starts to slide down the board
- Hold the board in that spot while you can gather the information you need for your summary.