



Science Unit: *Force and Motion*
Lesson 3: *Sledding and Friction*

School Year: 2011/2012
Developed for: Sexsmith Elementary School, Vancouver School District
Developed by: Ingrid Sulston (scientist); Mari Matsuo and Carole Murray (teachers)
Grade level: Presented to grades K-3; appropriate for grades K – 7 with age appropriate modifications
Duration of lesson: 30 minutes
Notes: This lesson was conducted at Mount Seymour sledding hill

Objectives

1. Experience with the whole body, the force of friction.
2. Experiment to understand why friction can vary.
3. Learn to predict how surface texture affects friction.

Background Information

Friction is a complex idea that is tricky to reproducibly demonstrate (based on my experiences of in-classroom friction experiments). Friction depends on the texture of the surface, large and small scale, and can also vary with the material the surface is made from. There are also two kinds of friction: static (the friction that resists things starting to move) and kinetic (the friction once things are moving), which are sometimes quite separable with some surface combinations.

Sledding on cloths with different surface roughness seems to be quite a reproducible method of demonstration how friction varies, and the full body experience makes this force real. It can also be part of a very memorable field trip.

Vocabulary

Friction: the force that slows objects down as they rub together

Materials

- sledding hill, with an area where a short hill can be made for several students to sled side by side
- plastic sleds, several of the same kind. We used magic carpets, rented at Mount Seymour sledding hill.
- squares of material, roughly 0.5m x 0.5m, of varying roughness. We used smooth imitation-leather and rough felt-like cloth (they were two sides of the same material). Also snow pants can be used.

In the Classroom

Introductory Discussion

We are going sledding! And we'll experiment with friction, a force that slows things down.



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Brief description of science experiments:

- Students freely play with sleds on a hill. Before too long they will be doing their own experiments. Discuss ideas that are brought to you, and prompt discussion on any variety of the science of sledding.
- Sled on different materials to experience the varying effects of friction.

Processes of science that the students will focus on: mental data collection, prediction/hypothesis testing.

Brief description of safety guidelines: Prevent students from tobogganing into each other.

Science Experiment

Experiment Title: The friction of sleds

Purpose of Experiment: Test different materials in their “sled-ability”, and conclude the reason for these differences

Experimental Treatments: Cloth materials varying in roughness/smoothness

Control treatment	plastic sled
Test treatment	smooth cloth, rough cloth, snow pants

Prediction or Hypothesis: After sledding down a small hill on their plastic sled, students predict whether a smooth cloth/rough cloth will take them down faster or slower than their sled.

Methods and Instructions:

Set-up prior to experiment: build up snow to make a short, wide slope where half a class of students can sled side by side. This mini hill should be near the main area where they are sledding, so students can walk over in groups, but separate enough that the noise and visuals of the main area is not disruptive.

Students work on their own.

1. A group of students (half a class or smaller) leave the main group to do the friction activity.
2. Ask the students to sled down the mini hill on their plastic sleds to make the run smooth. Describe and practice walking up the side of the hill to get back to the top.
3. Distribute squares of other sledding materials. Ask the students if they think they will sled down on each material faster or slower than on their sled.
4. Students sled down the hill multiple times, to get an accurate impression of whether the provided material is faster or slower than the sled. They may want or need to do the run on their sled again to compare.
5. Students exchange sledding materials until they have all tried all kinds.
6. Students can record results on the suggested worksheet, though we worked from our memories to avoid the complexities of writing in the snow. (The worksheet following this lesson was made for grades 2/3 and can be adapted for younger ages).

Closure Discussion

Sit as a group in the snow, and material by material hear the results the students found, then look at the material and discuss why it is faster/slower than their sled. Following are common results (though if your cloth type is different, your results may be different - then discuss according to your results).



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- The rough felt-like cloth should barely move at all. It has a very bumpy surface which gets caught up in the snow, generating a lot of friction (the surfaces get stuck in each other and stop them from moving past each other so easily).
- The smooth fake-leather cloth will move a little, but not as fast as the sled. It has more ridges on it than the sled, which get stuck on the snow, generating some friction which slows it down.
- Snow pants vary a lot as they are not so rigid. In interpreting results, you might want to discuss the folds in the pants, the smooth material that they are made of, the bumps of the seams in the cloth - in general more bumpy (little or large bumps in the cloth) slow things down i.e. make more friction.
- Some magic carpet sleds have a rough and a smooth side. Students should be able to predict which side will go faster, then can test this out when they return to the main hill.

References

Niz, Ellen Sturm. 2006. Friction. "First Facts" book by Capstone Press. [A picture book about friction suitable for primary grades.]

Friction tests: sledding on different materials


Materials tested:

(e.g. plastic sled, smooth side of cloth, rough side of cloth, snow pants)

Sled on pairs of materials and compare how fast they are:

Fastest material	Slowest material

Rank the materials you tested:

Fastest	
	
Slowest	

The **slowest** material has the **most** friction because _____

The **fastest** material has the **least** friction because _____
