

Curriculum-Embedded Performance Task

Middle School Science

Content Standard 8.1



Shipping and Sliding

Student Work

Connecticut State Department of Education
2011 Edition

NAME: _____

Shipping and Sliding

A Guided Exploration of Factors Affecting Friction

Many products we use are made or grown in other countries and sent here by plane, boat or truck. Some companies that make televisions, for example, put them in wood crates that are stored in the cargo rooms of freight ships. When ocean waves cause the ship to tilt from side to side, the crates can slide across the cargo room floor and damage the televisions packed inside. Increasing the friction in the cargo room may solve the problem.

Friction is a force between objects that opposes the relative motion of the objects. In this project, you will be studying *kinetic friction* (also called *sliding friction*). When two objects are moving relative to one another, kinetic friction converts some of the kinetic energy of that motion into heat. You can feel the heat of kinetic friction if you rub your hands together. Think about what happens if you rub your hands against a smooth, polished surface, like wood furniture, compared to a surface with a rougher texture, like denim cloth. Which surface produces more kinetic friction?

First, you and your partners will design and conduct experiments to find how friction is affected by different crate and floor **materials**. Next, you will identify and explore **another variable** that may also affect friction. Then, you will analyze your experimental findings to make recommendations to the television manufacturer or the shipping company.

Gather a variety of different textured materials that might be useful for **reducing** sliding. You may choose to experiment with **floor** materials (such as felt, carpet, sandpaper or tiles), or you may choose to test different **crate** materials such as plastic, metal, wood or different papers. These can be attached to a model shipping crate or a cargo room floor. .

Observe the different materials. Notice different properties such as texture, luster, hardness, etc. **Record** your observations in a chart below.

PROPERTIES OF FLOOR MATERIALS

What factors do *you* think will act to increase or decrease kinetic friction? Consider your observations and your experiences. Factors that might affect friction include:

Choose one factor to investigate and write a scientific question:

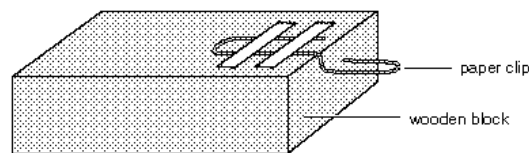
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Investigation 1: Effect of Properties of Materials on Friction Force

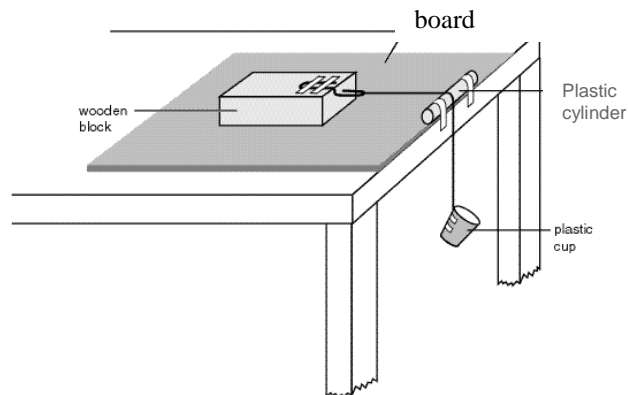
In this investigation, you will explore the effect of floor and crate materials on the amount of friction force. A simple way to measure friction is described below:

A Method for Testing Friction:

1. Construct a model shipping crate like the one in the diagram below. The paper clip will allow you to pull the crate with a measured amount of force:



2. Use a piece of cardboard as a model of a cargo room floor.
3. Tape a plastic cylinder along the edge of your work table. Place the cardboard shipping floor on your work table near the plastic cylinder.
4. Tie a loop at one end of the string and attach the loop to the paper clip. Drape the string over the plastic cylinder and use tape to attach the plastic cup to the other end of the string (see diagram below).



5. By adding small washers to the plastic cup, you can measure the pulling force needed to start the crate moving. The more force needed to start the crate moving, the greater the friction between the floor and the crate materials.
6. You can keep track of the number of washers, or you can find the mass of a single washer and keep track of the total mass needed to start the crate moving.

Conclusion: My hypothesis was _____ because _____

Sources of Error: *Name AND Explain 2*

What factors caused you to get different numbers than other groups?

What factors changed during the experiment that you could not control?

Investigation #2: EFFECT OF OTHER FACTORS ON FRICTION FORCE

In addition to the properties of the surface materials, what other factors do you think might affect friction? What about the size or weight of an object? Consider your observations, your research and the data you collected in Investigation 1. Factors that might affect friction include:

Choose one factor from your list to investigate and write conduct another experiment to test this new variable.