Oh! My Aching Back!
How Ramps Make Lifting Easier

Is your backpack heavy? Have you ever tried to find ways to help you move it around more easily? Force is a measure of how hard you have to work to move something. In this activity, you will compare the force needed to lift your backpack straight off the ground to the force needed to pull the backpack up a ramp.

OBJECTIVES

In this activity you will

- Lift your backpack to a chair in two different ways.
- Measure the force needed for each way of lifting.
- Make observations.
- Think of ways ramps are used to help people move things more easily.

MATERIALS

computer with Logger Lite software installed
Go!Link interface
Vernier Dual-Range Force Sensor
student backpack with 2 text books inside
student's chair
Ramp- a piece of wood?
piece of rope about 1 meter long

KEY QUESTION

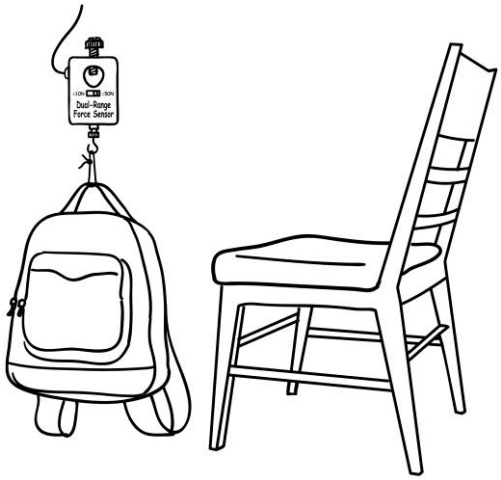
What difference do ramps make in moving heavy things to a higher level?

PREDICTION

A ramp will make it _____ (easier or harder) to lift heavy things.

PROCEDURE

1. Do the following to get the Force Sensor ready to collect data:
   a. Make sure the Force Sensor is connected to the Go!Link and that the Go!Link is connected to the computer.
   b. Set the switch on the Force Sensor to the +/- 50 N setting.
2. Start Logger Lite on your computer.
3. Open the file for this activity by doing the following:
   a. Click the Open button, .
   b. Open the file called "Elementary Science."
   c. Open the file called "30 Aching Back."
4. Put the rope through the top loop of the backpack, and tie the two ends of the rope in a knot to make a large circle.
5. Put the Force Sensor hook into the knot and make sure it is secure.



6. Watch the computer monitor as you lift the backpack a few times by pulling up on the Force Sensor. What do you notice as you pull? The numbers in the live reading tell how much force (push or pull) you are exerting. Notice how the numbers change as you lift the backpack and then slowly set it on the floor.
7. Stand next to a chair with the backpack. Click Collect, wait about two seconds, then slowly and smoothly lift the backpack straight up and set it on the chair.
8. Store your data by clicking the Store button, .

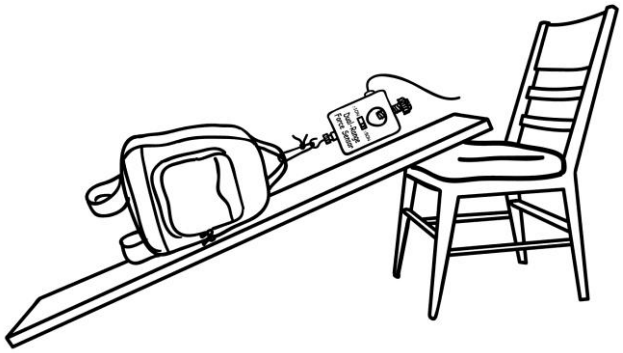
9. Record your observations about the direct lift on the Observations Sheet, below:

Observations Sheet
Direct Lift
Ramp Lift

Prediction

Click the Predict button, , and then draw on the graph on the screen to show what you think will happen when you use the ramp to lift the backpack.

10. Now set the board up as a ramp to the same chair. (You can brace the end against the wall or a table leg so that it will not slide.) Place the backpack on the lower end of the ramp. Click Collect, wait about two seconds, then slowly and smoothly pull the backpack up the ramp until it is on the chair.



11. Record your observations about the ramp lift on the Observations Sheet. Describe the difference between the two lifts.

12. To examine and record data do the following:

    a. Click the Examine button, , and the Examine box will appear.

b. Move the cursor over the graph to read the values in the Examine box to find the highest typical force value for each lift. Write the values in the Data Table.

Data Table		
Highest force without ramp	**Highest force with ramp**	**Difference**
N	**N**	**N**

ANALYZE YOUR DATA

1. How did it feel to lift the backpack directly? Use your experience and the data to describe how it felt to lift it without the ramp.

2. How did it feel to pull the backpack up the ramp? Use your experience and the data from the graph to describe that part of the activity.

3. Are the highest force values for the two runs different? If so, which one is greater? Find the difference between the two values and record the difference in the Data Table.

4. Write about where you see ramps in your everyday life. Can you think of places where ramps are needed? Can you think of other situations in which you would need a ramp?

Good job!