

Physics 20 eLab Measuring Force

Background:

Force is measured in newtons, but what does a "Newton" feel like? How many newtons does it take to perform everyday tasks? The answers to these questions can be investigated with the use of a force sensor.

In this activity, a force sensor is used to measure the amount of force necessary to perform everyday tasks.

The Question:

How much force is required to perform everyday tasks?

Variables:

This experiment involves these variables: tasks involving force, measured force. Identify and state the manipulated, responding and controlled variables in this investigation.

Materials:

- force sensor with hook
- mobile data unit, such as an Xplorer or GLX (alternatively, you can connect your force sensor directly to a computer, but all tasks must then be done within reach of the sensor)
- hooked mass set

Procedure:

Step 1:

Connect your force sensor to you mobile data collection unit (such as an Xplorer or GLX).

Alternatively, you can connect your force sensor directly to the computer with a USB link, but then you will not be able to roam far from the computer.

If you choose the USB link, configure the data collection software to show a digital readout of force.

Step 2:

Create a data table with 3 columns: hanging mass or task, predicted amount of force in newtons, and actual amount of force in newtons.

Use the hooked masses (recommended are: 10, 20, 50, 100, 250, 500 and 1000 g) that you have available to hang from the end of the force sensor. Hold the force sensor steady while recording. Record the amount of newtons associated with each of the hanging masses in the actual amount column of your table.

Step 3:

Now start measuring the force that it takes to perform tasks. Do this by hooking the force sensor to objects, or pushing the hook against objects. **Do not exceed the maximum force of the sensor, you could damage it.** If the hook does not work to connect to your object, improvise by using some string.

Be creative in the tasks you choose, and do as many as you want. Before you measure any task, be sure to predict how many newtons you think it will take to perform the task.

If you find it difficult to get a steady reading of force, repeat the task several times and then take an average of your readings.

Here are some suggestions for tasks:

- moving your desk
- moving your chair
- pushing your textbook across a table
- pulling open a door
- pulling open a drawer
- lifting various objects

Step 4:

Record the newton values from the sensor for each task in your table.

Analyzing and Interpreting:

1. Create a bar graph that compares the forces used to lift the masses you tested and perform the tasks you chose.

Forming Conclusions:

2. What task required the greatest amount of force? Why? What task required the least? Why? Discuss the force results illustrated in the graph you created.
3. In cases where you pushed or pulled an object, what force created the resistance to movement?
4. In which case was your prediction furthest off the actual amount of newtons needed? Why do you think you were so far off?

Applying and Connecting:

Explain the reason for each of these situations using what you have learned from this lab.

5. Elevators are safety rated to lift a limited amount of mass or only a certain number of individuals.

Extending:

6. Draw free-body diagrams to represent each of the situations you tested in step 3.