

## Pass the Water Lab

### Teacher's Guide

**Topic:**

Newton's Laws of Motion

**The following information is provided to the student:**

**Question:**

Under what conditions is water most likely to spill from a pan when the pan is carried around an oval race track?

**Purpose:**

To carry a pan of water around an oval race track in an effort to determine the conditions under which the water is most likely to be spilled from the pan.

A complete lab write-up includes a Title, a Purpose, a Data section (which includes a diagram of the oval track and identified locations of water spillage), a Conclusion and a Discussion of Results. As usual, the Conclusion should answer the question proposed in the purpose of the lab. The Discussion of Results should include a discussion of the relationship between your findings and Newton's first law of motion.

**Materials Required:**

1-L graduated cylinders; shallow (and narrow) baking dishes; water; space for an oval track; table.

**Description of Procedure:**

This can be made into a relay race as follows. Students are grouped in teams of 3 to 5 students. Each team is given a graduated cylinder with 1000 mL of water and a container to hold the water. An oval race track is marked out - with some straight sections and some curved sections. With the container full of water, students race around the oval track trying not to spill the water. When they return to the starting line, which is the long table, they place the container down on the table, and the next member of the relay team fills it to the rim, replacing whatever water was spilled during the first leg of the race. Once approved, the next team member runs the relay race. When all members of the team have finished, the water is poured from the container back into the 100 mL graduate and the amount of water spilled is determined.

**Alternative Materials and Procedure:**

The containers used to hold microwave dinners make a suitable container for the carrying the water. A 1-L beaker would suffice for measuring the amount of water spilled (provided that there are markings every 100 mL or so). Student desks (if light and portable) make a good surface at the starting line.

**Safety Concern:**

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that the working environment is as safe as possible. Student *horseplay* and off-task behaviors should not be tolerated. Extreme caution should be taken to prevent the floor from becoming slippery. It should be dried thoroughly before and after the activity.

## The Laboratory

### Suggestions, Precautions, Notes:

1. Remind students to make careful observations of when the water is spilling and when they are tending to be most careful.
2. If the school administration approves of hallway labs, this is a great time for a hallway lab. Be sure to dry the floor before the period ends.
3. The activity can be made competitive by devising a scoring scheme: for example,  
**Team Score = Time (in seconds) + 2\* Volume (in mL) of Water Spilled**  
The low score wins. If making the activity into a contest, warn students to avoid bumping and aggressive behavior (disqualification and failing grades is a good description of the reward for such behaviors).
4. Make sure your race track has both straight and curved sections. Students will observe that the water is easy to carry on the straight sections but easily spilled on the curved sections.
5. Make sure every student has a full container of water before beginning. If the container isn't full, the water tends to be held in the container by the *unbalanced force* of the wall pushing inward.
6. Return to this lab experience when you arrive at the topic of circular motion. Students remember the pass the water lab.

### Auxiliary Materials:

None

### Scoring Rubric:

NL1. Pass the Water Lab	Score
____ Included, labeled and organized all parts of the lab report. ____ Data section includes an organized documentation of observations. ____ Observations are reasonably accurate and (most of all) clear. ____ Conclusion answers the <i>question</i> posed in the Purpose; <i>answer</i> is correct. ____ Discussion of Results relates the findings of the labs to Newton's first law of motion. Discussion is clear, thoughtful, and specific to the lab experience.	____/4

### Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/newtlaws/u2l1a.cfm>

<http://www.physicsclassroom.com/Class/newtlaws/u2l1c.cfm>

### Connections to Minds on Physics Internet Modules:

Sublevel 1 of the Newton's Law module is a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/mop/module.cfm>