

Coulomb's Law Lab

Teacher's Guide

Topic:

Static Electricity

The following information is provided to the student:

Question:

How many electrons are transferred from a balloon when rubbed 10 times with animal fur?

Purpose:

To use Coulomb's law and vector principles to determine the number of electrons which are transferred to a balloon as the result of 10 average-strength rubs on animal fur.

A complete lab write-up includes a Title, a Purpose, a Data section, and a Conclusion. The Data section should include a diagram of the experimental setup with measured variables clearly identified. A systematic collection of calculations should be shown. Work should be labeled clearly and the logic behind each step should be briefly annotated. The Conclusion should (as always) respond to the *question* raised in the Purpose.

Materials Required:

Large balloons; light string or thread; synthetic fur; meter stick.

Description of Procedure:

Two identical balloons are inflated. They are tied to threads and hung from a common point on the ceiling. Synthetic fur (or simply human hair) is used to charge the balloons by 10 vigorous back-and-forth rubs of each balloon. The balloons are observed to repel each other. Distance measurements are made of the arrangement in order to determine the repulsive force, the charge on each balloon and the number of electrons transferred to each balloon during the rubbing process.

Alternative Materials and Procedure:

Alternative materials and procedures are not recommended.

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.

Suggestions, Precautions, Notes:

1. The mathematics associated with this lab are complicated. Your most able classes can likely handle the lab on their own (especially if they have seen similar problems); other classes will need considerable guidance. The actual answer to the question (the number of electrons transferred) is quite interesting, making the lab a worthwhile experience.
2. The balloons are assumed to acquire an identical charge as a result of the rubbing process. This is a subtlety which might not be obvious to all students.

The Laboratory

3. This lab works as a demonstration lab or students can arrange their own set up at a lab station.

Auxiliary Materials:

None

Scoring Rubric:

SE6. Coulomb's Law Lab	Score
____ Included, labeled and organized all parts of the lab report. ____ Data section includes an informative and well-labeled diagram of the experimental setup. Calculations of the force, the charge and the number of electrons are shown; work is systematic, labeled and organized; rationale behind each step is briefly identified; work is accurate. ____ Conclusion answers the <i>question</i> posed in the Purpose; <i>answer</i> is correct.	____/____

Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/estatics/u8l3b.cfm>

<http://www.physicsclassroom.com/Class/estatics/u8l3d.cfm>

Connections to Minds on Physics Internet Modules:

Sublevel 9 of the Static Electricity module is a suitable accompaniment to this lab:

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