

Predicting Charges

Earlier, you learned how objects made from different materials can become charged by friction when rubbed, or touched, together. This causes electrons to be transferred from one object to the other, producing a charge imbalance in the objects. For example, experiments show that a vinyl strip becomes negatively charged when rubbed with wool, while the wool becomes positively charged. This means that electrons are transferred from the wool to the vinyl.

As you learned in Section 11.1, a pith ball electroscope (Figure 1) can be used to detect a charge imbalance. When a charged object is brought near the pith ball, the pith ball moves in response to the charge on the object. It is important to note that, unless they touch, both the object and the pith ball keep their respective charges because no electrons transfer between them. If the pith ball and the object come in contact, electrons will be transferred between the pith ball and the object until both have the same type of charge.

In this investigation, you will use an electrically charged pith ball to explore charge interactions. You will then use the Law of Electric Charges to determine the overall charge on several test objects.

SKILLS MENU

- Questioning
- Hypothesizing
- Predicting
- Planning
- Controlling Variables
- Performing
- Observing
- Analyzing
- Evaluating
- Communicating

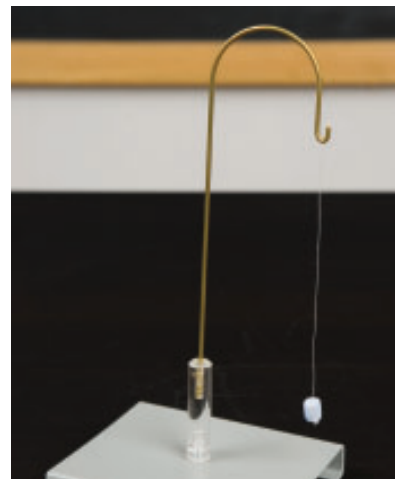


Figure 1 A pith ball electroscope has a small pith ball hanging from a thread.

Testable Question

How can the Law of Electric Charges be used to determine the charge on an object?

Hypothesis/Prediction

Read the Experimental Design and Procedure, and then formulate a hypothesis based on the Testable Question. Your hypothesis should include a prediction and reasons for your prediction.

Experimental Design

Working with a partner, you will observe charge interactions. You will begin by charging a test object by rubbing it with an object made from a different material. You will then use a pith ball electroscope to observe charge interactions and to determine the overall charge on several other test objects charged by friction with a variety of materials.

Equipment and Materials

- pith ball electroscope or pith ball on a thread
- ring stand (optional)
- test materials (vinyl strip, acetate strip, glass, wood, ebonite)
- rubbing materials (wool, paper, polyester)

Procedure



1. Copy Table 1 into your notebook. Add any additional objects to test provided by your teacher.




Table 1 Charges Placed on Objects

		Rubbing materials		
		wool	paper	polyester
Objects to be charged	vinyl			
	acetate			
	glass			
	wood			
	ebonite			

2. Set up a pith ball electroscope on the lab bench. Otherwise, suspend a pith ball from a ring stand with a string. Ground (remove the charge from) the pith ball by touching it with your hand.
3. Rub a vinyl strip with wool. The strip is now negatively charged. Record the charge of the vinyl strip in Table 1.
4. Bring the charged vinyl strip close to the pith ball. Do not allow the strip to touch the pith ball. Record your observations in your notebook.
5. Ground the pith ball with your hand to ensure it is not charged.
6. Rub the vinyl strip again with wool. Charge the pith ball by touching it with the vinyl strip. Be careful not to accidentally ground the pith ball.
7. Make a prediction about what would happen if the charged vinyl strip were brought near the charged pith ball without making contact. Try it. Record your observations in your notebook. Be careful not to accidentally ground the pith ball.
8. Next, rub an acetate strip with wool. Bring the strip close to the charged pith ball. (Recharge the pith ball with the charged vinyl strip if necessary.) Record your observations in your notebook. Use your observations to determine the charge on the acetate strip. Record the charge in Table 1.
9. Test each pair of materials given in Table 1. Record the charge of each object in your table.

Analyze and Evaluate SKILLS HANDBOOK 3.B.7., 3.B.8.

- (a) Review the Testable Question and your hypothesis. Explain whether your results support your hypothesis. Remember to state your evidence. 
- (b) Explain your observations in step 4. 

- (c) Explain your observations in step 7. 
- (d) Summarize how the charged pith ball electroscope is used to determine the charge on an object.  

Apply and Extend





- (e) What would happen if a charged strip is placed between two electrically neutral pith balls hanging side by side as shown in Figure 2? 
- (f) Predict what would happen if the following combinations of charged strips are used to simultaneously touch the pith balls in Figure 2 and then are taken away. Justify your prediction in each case. 
 - (i) two negatively charged strips
 - (ii) two positively charged strips
 - (iii) one negatively charged strip and one positively charged strip



Figure 2 A double pith ball electroscope consists of two neutral pith balls hanging side by side.