Moving Objects Electrically

Student Activity

Name _____

Class _____

Open the TI-Nspire document *Moving_Objects_Electrically.tns.*

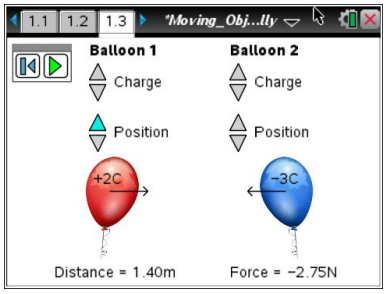
A lightning bolt is an example of electricity. The simplest form of electricity is an electric charge, and charges can be either positive or negative. In this activity you will explore Coulomb's law, which describes the electric force between two charged objects.

Move to page 1.2.

1. Read the information on page 1.2 before moving to the simulation on page 1.3. On the simulation page, there are two balloons and two sets of sliders next to each balloon.
   a. The slider marked "Charge" is for setting the amount of charge (indicated by a number) and whether the charge is positive or negative. By default the charge is set to zero.
   b. The slider marked "Position" is to change the distance between the two balloons.

Move to page 1.3.

2. The dashed arrows that appear next to the balloons represent the force they exert on each other. The unit of force is the newton (N). A play button on the screen allows the charges to move under the influence of the force. The reset button restores the page to its initial settings.



Answer questions 1–19 here on your activity sheet.

Q1. With both balloons having zero charge, press the play button. What is the force between the two balloons?

Q2. Select the reset button ( ). Give Balloon 1 a +5 charge and leave Balloon 2 as is. Select play and describe what happens. Repeat with a –5 charge. Describe what happens.

Q3. Select the reset button. Now give Balloon 1 a +1 charge and do the same for Balloon 2. What is the electric force between the balloons? What happens when you press play?

Q4. The dashed arrow that appears next to each balloon is an indication of the electric force. What happens as you increase the charge on each balloon from +1 to +5?

Q5. Now give both Balloon 1 and Balloon 2 a –1 charge. What is the electric force between the balloons? What happens when you press play? What happens as you increase the charge?

Q6. Describe the directions of the forces when both balloons have the same type of charge.

Q7. Give both balloons a charge of +1. Separate the balloons by a distance of 1 m. Record the magnitude of the force. In the next several questions, you will compare other forces to this one.

F_1 = _____ N

Q8. Change the charge of Balloon 1 to +2. Record the new force as F_2. Calculate the ratio of F_2:F_1.

F_2 = _____ N $\qquad \frac{F_2}{F_1}$ = _____

Q9. Change the charge of Balloon 2 to +2. Record the force as F_3. Calculate the ratio of F_3:F_1.

F_3 = _____ N $\qquad \frac{F_3}{F_1}$ = _____

Q10. Give Balloon 1 a charge of –3, and give Balloon 2 a charge of +4. Record the force as F_4 and calculate the ratio of F_4:F_1.

F_4 = _____ N $\qquad \frac{F_4}{F_1}$ = _____

Q11. Based on your observations in the previous questions, summarize the relationship between the magnitude of the force and the values of the charges.

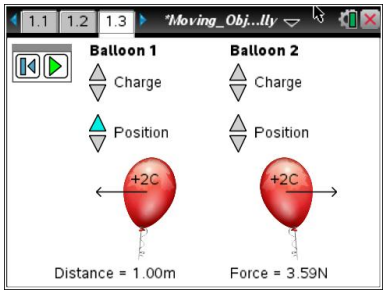
Q12. Change the charge on both balloons back to +1. Move the balloons so that the separation between them is 2.0 m (twice the original distance). Record the force as F_5, and calculate the ratio F_5:F_1.

F_5 = _____ N $\qquad \frac{F_5}{F_1}$ = _____

Q13. Move the balloons so that the distance between them is now 3.0 m (three times the original distance). Record the force as F_6, and calculate the ratio F_6:F_1.

F_6 = _____ N $\qquad \frac{F_6}{F_1}$ = _____

3. Reset the simulation and change the charge on each balloon to +2 and the distance between them to 1 m. Try to get your screen to look like the picture to the right. Then press the play button.



Move to page 1.4.

4. You will see a graph displayed.

Q14. What two variables are graphed?

Q15. What is the relationship between these two variables?

Q16. Is this a linear graph or a nonlinear graph? How can you tell?

Q17. What happens to the force between the balloons as they move apart? How is this shown on the graph?

Q18. Return to the simulation on page 1.3. Select the reset button to clear the data. Give Balloon 1 a charge of +2 and Balloon 2 a charge of –2. Set the distance to 2.3 m. Select play and then immediately switch to page 1.4. Describe the graph.

Q19. What happens to the electrical force between the balloons as they come closer together? How is this shown on the graph?

Move to page 1.5.

After you answer the questions on this activity sheet, answer the questions on pages 1.5 – 1.8 in the .tns file to review what you have learned.