

Coulomb's Law Electric Forces Inquiry

This lab uses the [Coulomb's Law](#) simulation from PhET Interactive Simulations at University of Colorado Boulder.

Learning Goals: Students will be able to

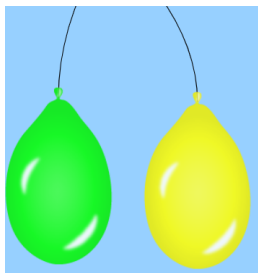
- A. Determine what makes a force attractive or repulsive
- B. Explain Newton's third law for electrostatic forces
- C. Relate the electrostatic force magnitude to the charges and the distance between them
- D. Use measurements to determine Coulomb's constant

A - Review your understanding:

1. Open the [Balloons and Static Electricity](#) simulation and observe the behavior of a balloon that is rubbed on a sweater. Write your observations below:

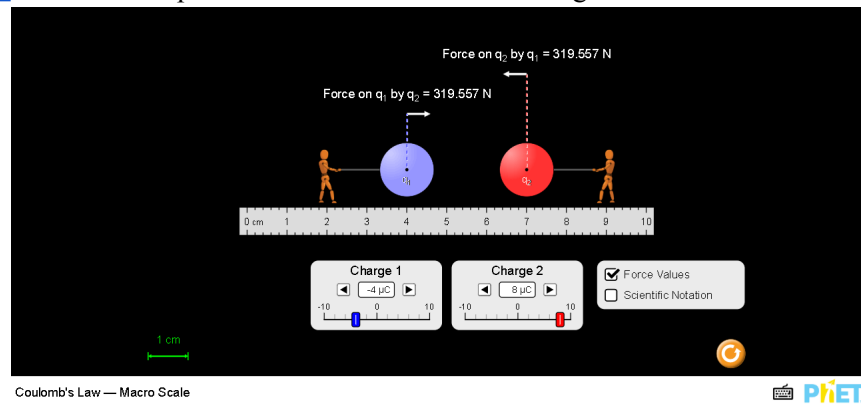
2. Explain why the balloon stuck to the sweater in the simulation. Use words like “electrons” and “charge”.

3. Two balloons were rubbed on a sweater like in the [Balloons and Static Electricity](#) and then hung like in the picture below. Explain why you think they move apart and what might affect how far apart they will be.



B - Develop your understanding:

1. Open the [Macro Scale](#) screen and explore the forces between two charged bodies.



C - Explain your understanding:

1. By experiment, determine what makes a force attractive or repulsive. Describe your experiments and observations with some examples.

2. What evidence do you see that Newton's third law applies to electrostatic forces?

3. How does the value of the electrostatic force vary with the value of the charges?

4. How does the value of the electrostatic force vary with the distance between them?

D - Use your understanding:

1. Coulomb's equation is used for determining the force between 2 charged bodies separated by a distance:

$$F = k \frac{q_1 q_2}{r^2}$$

k (Electrostatic constant), q (charge of body in Coulombs, C), r (distance between bodies in meters), and F (electrostatic force in Newton, N)

- a. Use measurements to determine Electrostatic constant for at least 2 situations. Show your work.

- b. Using your value of k, determine the electrostatic force for these 2 situations:

- i. $-4\mu\text{C}$ charge is 3cm from a $5\mu\text{C}$ charge.

- ii. An electron has a charge of $-1.6 \times 10^{-19}\text{C}$ and a proton has a charge of $1.6 \times 10^{-19}\text{C}$. In a hydrogen atom, the distance between them is $5.3 \times 10^{-11}\text{m}$. Determine the electrostatic force between them.

- c. Use the simulation to check your work on (i). Describe how you used the simulation for support.

2. Explain how electric forces are like gravity.