615-4730 (10-220) Simple Form Capacitor

Warranty and Parts:
We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

How to Teach with the Simple Form Capacitor:
Concepts Taught: Capacitance; Conductors; Dielectric Constants; Electric Fields; Electricity

Curriculum Fit: Electricity and Magnetism

Additional Materials Needed:

- 6 V battery
- 100 M Ω charging probe
- 1 Banana plug cable, black, approximately 120 cm, with one alligator clip (for ground lead)
- 1 Banana plug cable, black, approximately 60 cm, with two alligator clips (for battery)
- Cable with BNC at one end, 2 alligator clips at other end (for electrometer)
- Electrometer
- **615-4735 Digital Multimeter**
- Caliper

Theory: Explore the principle of capacitance with our economical unit. Simply charge the plates with a dielectric, air, in between and measure the V. Plot 1/V versus 1/d to verify that capacitance is proportional to 1/d.

Experiment 1: Preparing the Simple Form Capacitor:

1. Measure the parallel plate area and record its value below.

   Plate area (A) = ____(cm^2)

2. Set the two parallel plates 1 cm apart and calculate the capacitance, C. Use calipers to verify the distance is 1 cm.

   $$C = \frac{K\varepsilon_0 A}{d}$$

   K = dielectric constant of material between electrodes
   ε_0 = permittivity of space = 8.854 x 10^{-12} F/m
   A = area of parallel metallic plate
   d = distance between plates

   Note: Air has a K value of 1.00054.

C = ____ (pF)

3. Connect your 6 V battery as follows:

   a) One terminal is connected to the charging probe
   b) The other terminal is connected to a banana plug cable

4. Verify that the capacitor plates are parallel. Move the plates to the minimum separation.
5. Connect the banana plug cable from step 3 to one of the binding posts on the simple form capacitor. To charge your electrode, touch one of the capacitor plates momentarily with the probe.
6. Adjust the electrometer so that it is on a 30 V scale.
7. Connect the output of the electrometer (two banana plugs) to the input of the multimeter (two more banana plugs). Choose the 20 V DC scale on the multimeter. Note: Because you are using a 30 V scale on the electrometer and a 20 V scale on the multimeter, you will need to multiply your results by 10.

Experiment 2: Measure potential voltage versus separation distance

1. Position the parallel plates for a separation of 5 mm.
2. Banana plug leads should be attached to the two binding posts of the simple form capacitor. The other ends should be connected by means of a coaxial cable to the electrometer.
3. Apply a charge to an electrode using the two leads attached to the battery (one is a banana plug, the other is the probe).
4. After applying the charge, remove the leads from the binding posts.
5. Measure the potential indicated by the electrometer, by reading the value from the multimeter display. Record value in Table 1 below.
6. Repeat steps 1-5 for the following distances: 6, 7, 8, 10, 12, 15, 20, 25, 30, 40, 50, 65, 80, and 100 mm. You will apply a fresh charge each time as per step 3 when the electrodes are positioned at 5 mm, and then move the distance to 6 mm – 100 mm as required by the experiment.

Table 1

Potential (V)	Distance (mm)
	5
	6
	7
	8
	10
	12
	15
	20
	25
	30
	40
	50
	65
	80
	100

7. Make a plot of V versus d.
8. Calculate 1/V and 1/d for each of the values. Make a plot of 1/V versus 1/d. The plot should be a straight line. Note: A straight line indicated that C is proportional to 1/d for the capacitance of two parallel plates separated by a distance d.

Related Products:

Science First® *manufactures many low-cost items that can be ordered from most science education distributors. For more information, please contact us.*

615-3095 Faraday Cage - Demonstrate that charge cannot exist inside a conductor cage. Study the lightning rod effect. Includes: cage with stand and cover; mounted point, instructions. Interior dimensions are 10.5 inches high and 4.75 inches in diameter.

615-3085 Electrostatic Demonstration Kit - Charge electroscopes, show electrostatic attraction, duplicate Faraday's ice pail experiment, and more! Includes: 2 electroscopes with flasks; 2 ball and disc terminals; Faraday cage; 6 different friction rods, labeled; electrophorus with charge plate and handle; neon lamp; ice pail; acetate and polyethylene cloth; charge transfer ball; electrically conducting ball; 12 pith balls; mounted point; instructions.

615-3090 Electrostatic Studies - Make electricity by friction; store and transfer it, demonstrate the principle of the electrophorus and proof plane. Includes: electrophorus with charge plate and handle; 6 different friction rods, labeled; acetate cloth; polyethylene film; proof plane with transfer ball; neon lamp; graphite ball with hook; 12 pith balls, instructions.

615-3075 Electroscopes Kit - Detect and identify electrical charges, experiment with electrostatic induction. Includes: 2 foil leaf electroscopes with 250 mL flasks; 2 ball terminals; ice pail; 2 discs.

615-0330 Lenz' Law Hoops - This great demonstration teaches Faraday's Law of Induction as well as Lenz's Law. Show how passing a magnet through a complete loop causes the device to move. No movement at all occurs when using the split loop.

615-3170 Electric Field Apparatus - Our Electric Field Apparatus is designed to show the lines of an electric field produced by a large electrostatic charge, such as the one generated by a Van de Graaff Generator or Wimshurst Machine. The cost effective apparatus is great for classroom use because it can be placed on an overhead projector for viewing by an entire class.