PH170: Waves and Electromagnetics Laboratory (0-0-2:1)

Laboratory 4

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CAPACITOR : Ability to store energy in the form of electrical charge

$$Q = CV,$$

$where\ Q = charge, C = capacitance\ and\ V = Potential\ difference\ across\ the\ plates$

CAPACITANCE : ratio of the amount of electric charge stored on a conductor to a difference in electric potential

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

$where, \varepsilon_0 = permitivity\ of\ free\ space, A = area\ of\ plate, d = distance\ between\ plates$

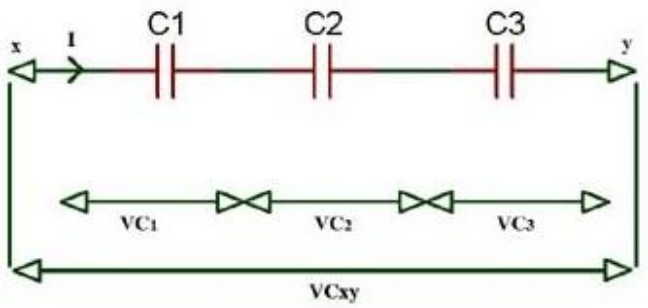
DIELECTRIC INSIDE A CAPACITOR

$$C = \frac{k\varepsilon_0 A}{d}, where\ k = dielectric\ constant$$

ENERGY STORED IN A CAPACITOR : $E = \frac{1}{2}CV^2$

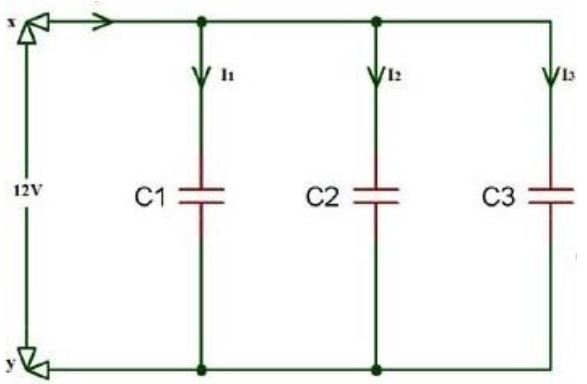
COMBINATION OF CAPACITORS

SERIES

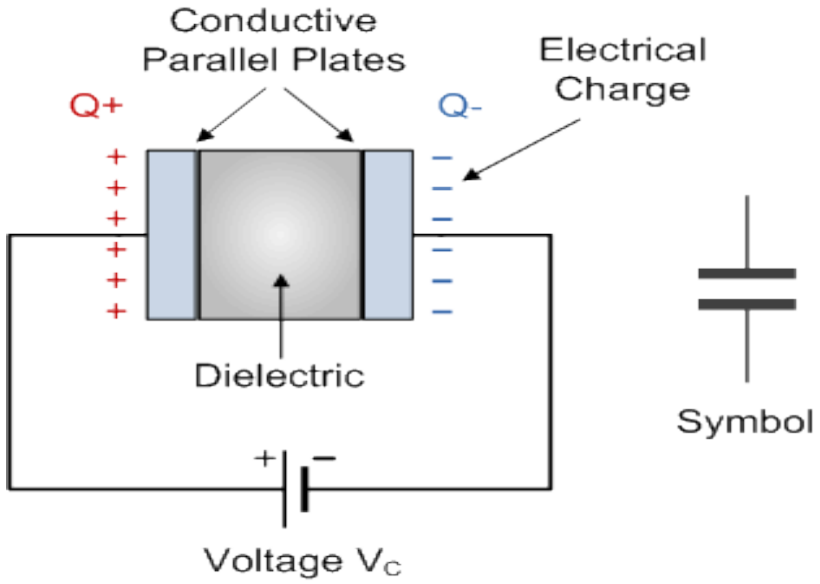


$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3}$$

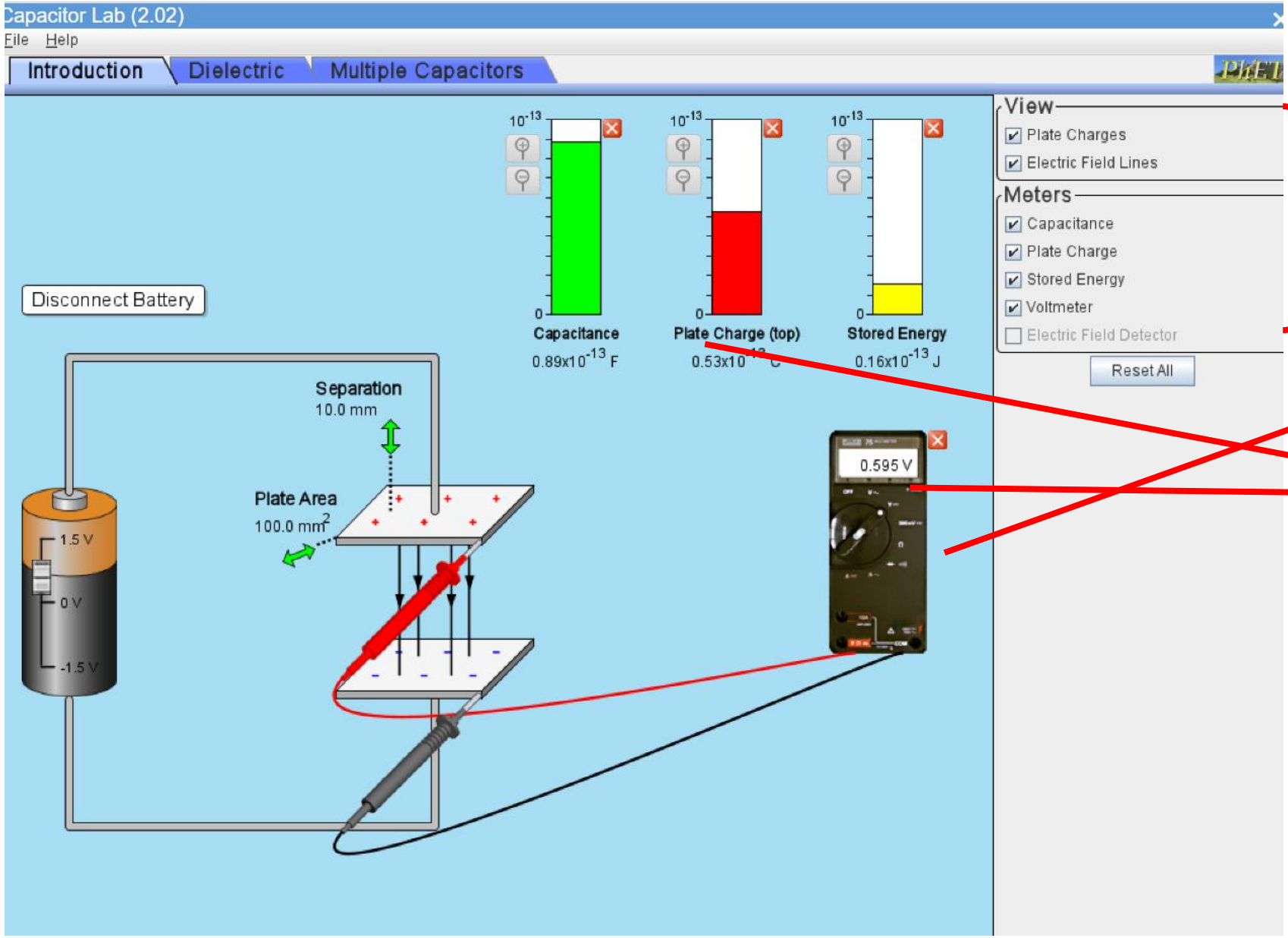
PARALLEL



$$C = C1 + C2 + C3$$



AIM 1 : Determine the relationship between charge and voltage for a capacitor.



Select the parameters

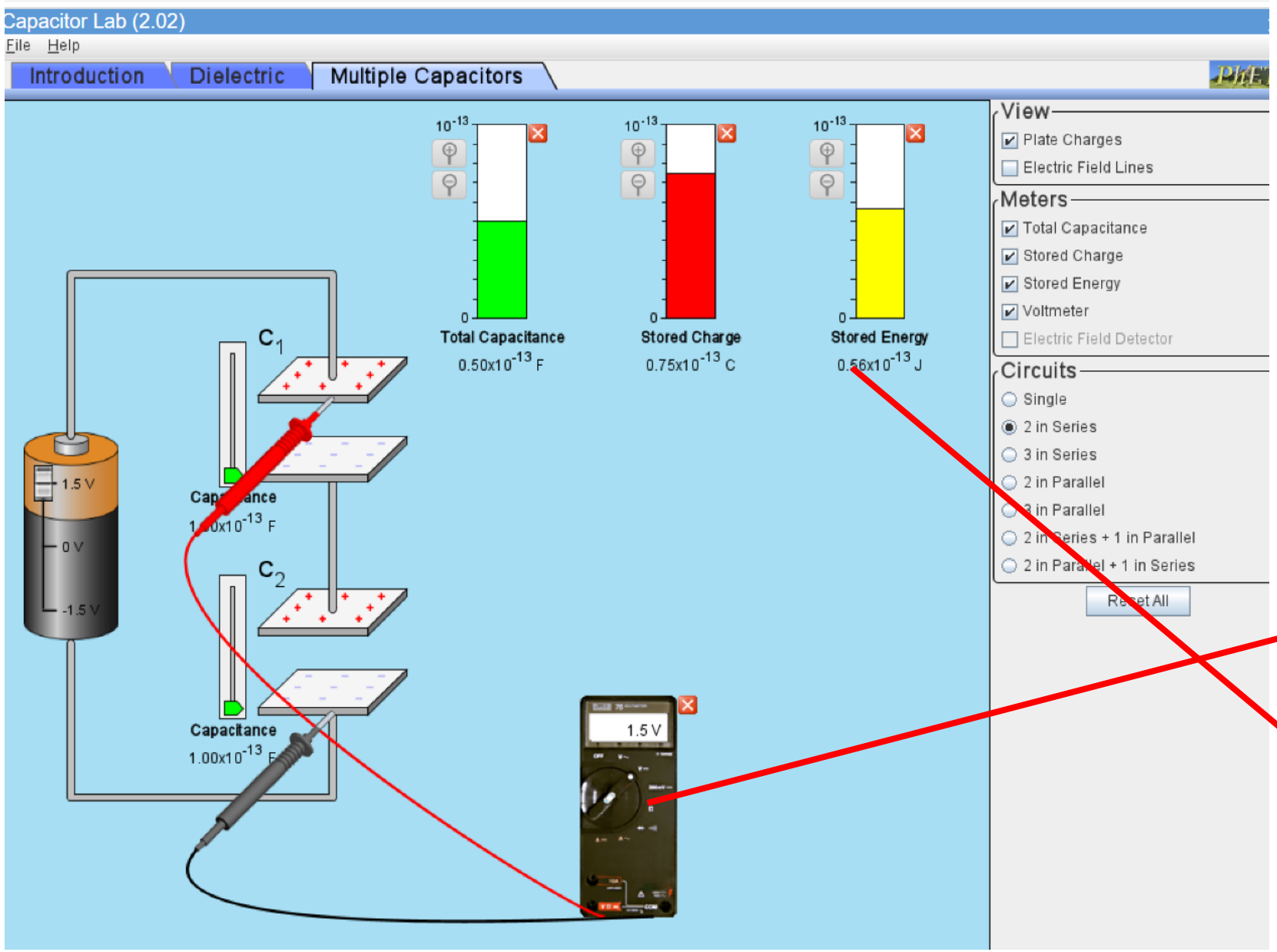
Connect Voltmeter

Measure charge and voltage

Voltage (V)	Charge (C)

** Plot graph between V and charge.

AIM 2 : Determine the energy stored in a capacitor or a set of capacitors in a circuit.



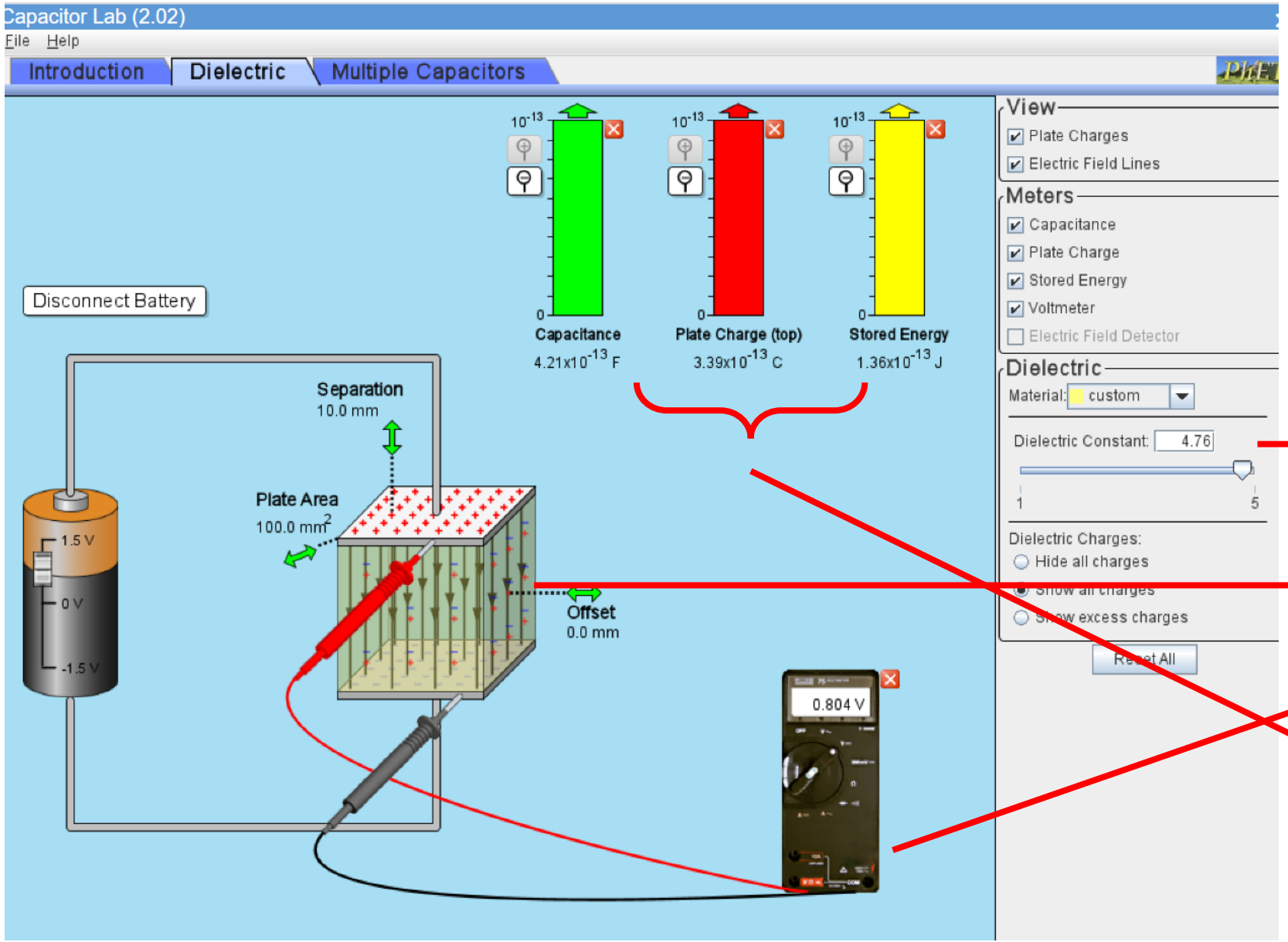
Select the parameters

Select the combination

Connect Voltmeter

Measure the energy stored

AIM 3 : Explore the effect of space and dielectric materials inserted between the conductors of the capacitor in a circuit.



Select the parameters

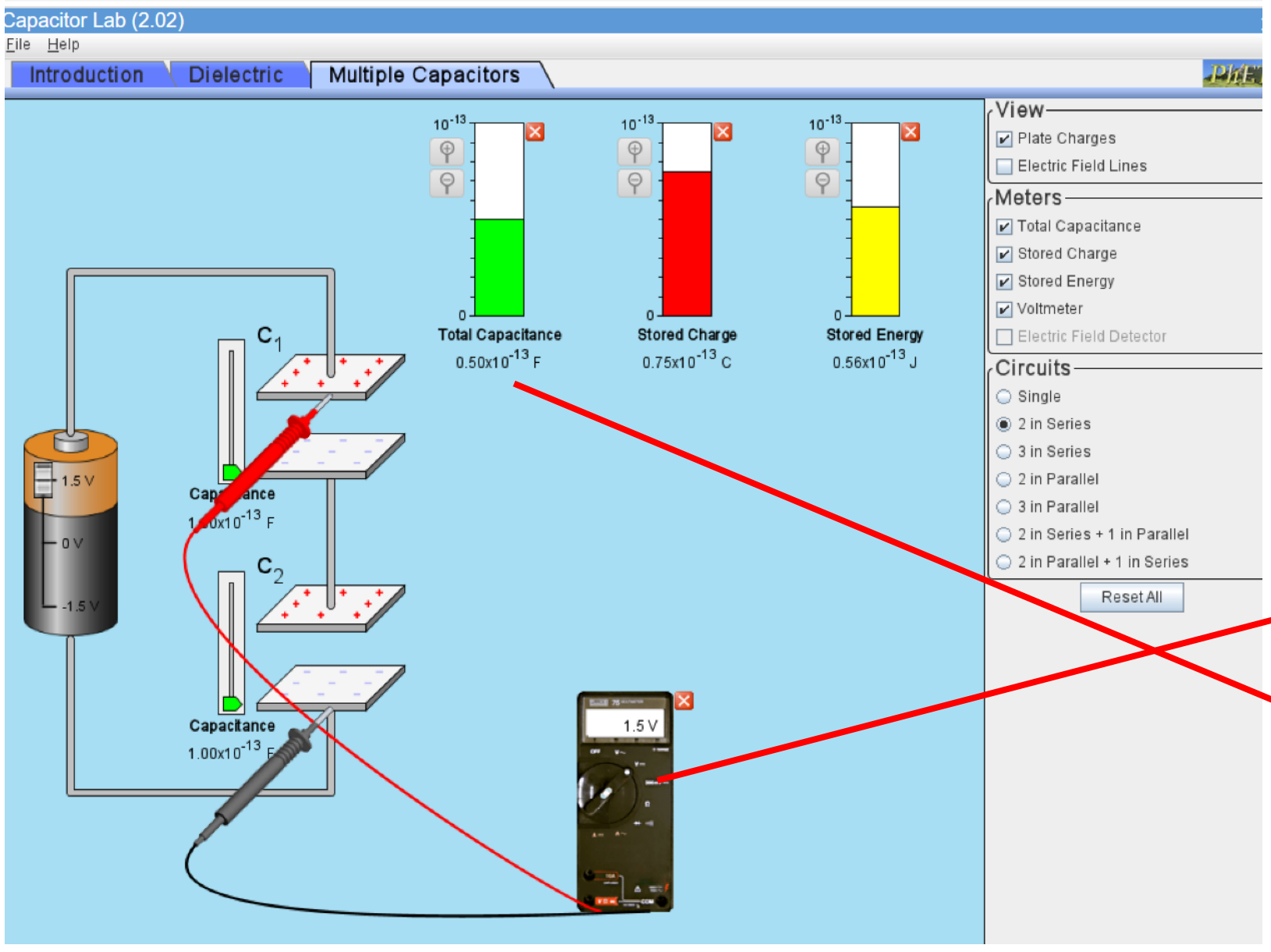
Choose the dielectric material/ dielectric constant

Insert the dielectric

Connect Voltmeter

Note the results

AIM 4 :Determine the equivalent capacitance of a set of capacitors in series and in parallel in a circuit.



Select the parameters

Select the combination

Connect Voltmeter

Measure the equivalent capacitance

To determine the effect of space and dielectric materials inserted between the conductors of capacitors in a circuit

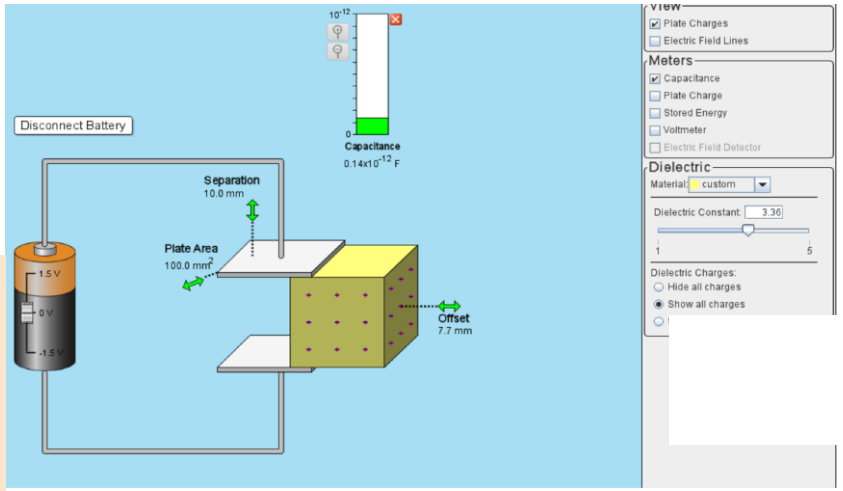
For a parallel plate capacitor, the capacitance is given by the following formula:

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

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

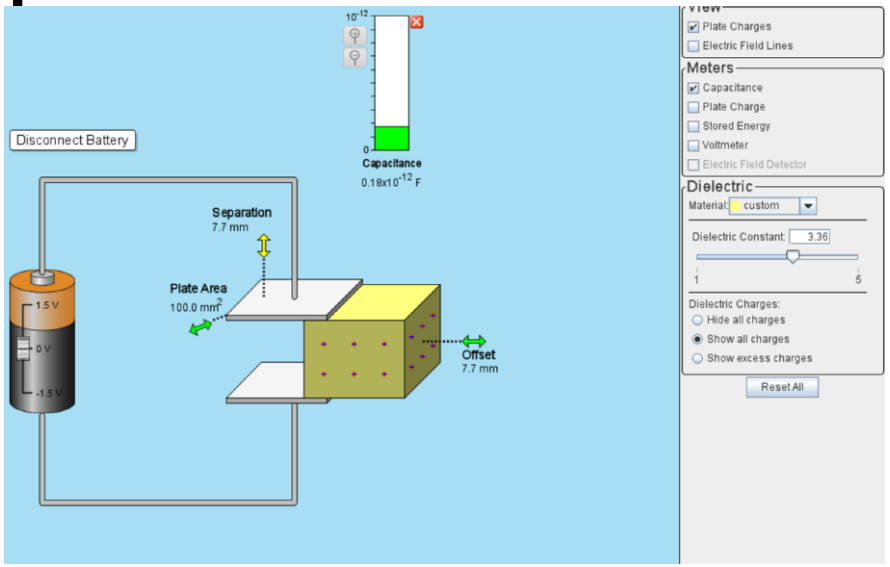
Where C is the capacitance in Farads, εo is the constant for the permittivity of free space (8.85x10 -12), A is the area of the plates in square meters, and d is the spacing of the plates in meters.

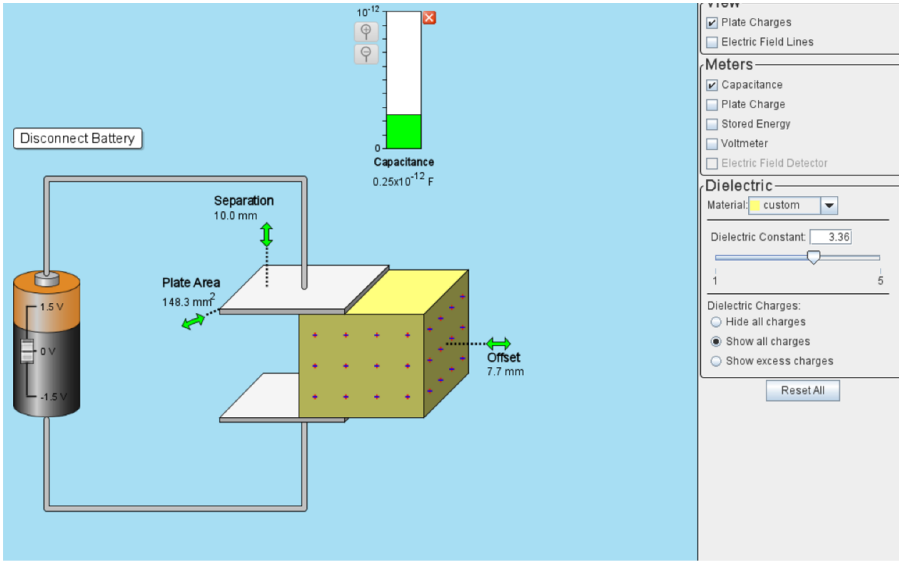
εr is the value of dielectric constant.



By changing the dielectric constant of the dielectric

Now by not changing the dielectric constant and changing the plate separation and surface area of plates.





We can draw the graphs between capacitance and dielectric constant, plate separation, and surface area and then see the relationship between them.

Determine the relation between charge and voltage for capacitor

Determine the energy stored in a capacitors in a circuit

Obs. No	Charge	Voltage	Capacitance	Energy
1				
…				
10				

Explore the effect of space and dielectric materials inserted between the conductors of the capacitor in a circuit.
** can be performed by analyzing the parameter value

Determine the equivalent capacitance of a set of capacitors in a series and in parallel in a circuit.
** can be performed by calculating the formula

Thank You

Laboratory 4

https://phet.colorado.edu/en/simulation/capacitor-lab

1. Determine the relationship between charge and voltage for a capacitor.

2. Determine the energy stored in a capacitor or a set of capacitors in a circuit.

3. Explore the effect of space and dielectric materials inserted between the conductors of the capacitor in a circuit.

4. Determine the equivalent capacitance of a set of capacitors in series and in parallel in a circuit.