Introduction:
In this exercise, students use data collection equipment to determine voltage and current curves of a capacitor, two capacitors in parallel, and two capacitors in series. They will compute both the theoretical and actual charge stored in the capacitors.

Experimental goals:
After completing this experiment, students will be able to collect current and voltage data from a charging capacitor. They will be able to predict whether a single capacitor, two capacitors in parallel, or two capacitors in series will store more charge for a given voltage.

Equipment:

- Electronics Trainer
- Vernier interface
- (2) voltage probes
- iBook computer
- Multimeter
- Component Box

Keywords:
Capacitance, Voltage, Current, Parallel Circuits, Series Circuits.

Notes:
No particular cautions with this lab. If things aren’t working right, have the other lab partner check the circuit step-by-step. If the voltage and current reading are fluctuating, try wiggling the components and jumpers to make better contact with the breadboard. The calculated values for stored charge should be close to the “counting
squares” values, but keep in mind that the “counting squares” process is rather inaccurate.

**ANSWER KEY:**

*Characteristics of a single capacitor*

1. In general, capacitors in parallel will store more charge than single capacitors, while capacitors in series will store less charge than single capacitors. Capacitor voltage should increase with time until the capacitor is “filled”.

2. None of the curves should be linear.

3. Capacitor current decreases with time. As charge is stored, it becomes harder and harder to add more like charges to a plate.

4. No, the change is not linear.

5, 6, and 7. Student answers will vary.

8. \( q=470\mu F(5V) = 2350\mu C \)

9. Measured values may be slightly different than theoretical values; measured values will depend on the voltage and resistance of each set of equipment.

*Two capacitors in parallel*

10. It should take longer for capacitors in parallel to reach 5V than it takes a single capacitor to reach 5V. Thus, the parallel run is slower than the first run.

11, 12. Student answers will vary.

13. \( q=4700\mu C \)
14. Actual values should be close to theoretical values, but may vary depending on experimental set-up and methods.

15. Yes, approximately twice as much charge is stored in two capacitors in parallel than in a single capacitor.

*Two capacitors in series*

16, 17, 18. Student answers will vary.

19. \( q = 1175 \mu C \)

20. Actual values may vary from theoretical values, but ideally they would be within 10% accuracy.

21. Two capacitors in series do not store more charge than a single capacitor.