Interactive Lab Capacitors

Name_____ Block____

During this interactive you are going to explore a large capacitor formed in nature. This interactive exercise takes you back to the very first Olympiad in ancient Greece. It is the year 776 BC. You play Zeus, and your job is to use a lightning bolt to light the Olympic flame.

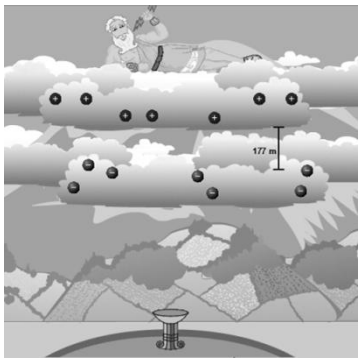
1. Why would separating charge across a capacitor store electrical energy?

_____

_____

_____

The source of lightning bolts can be modeled as a huge capacitor: regions of positive and negative charge in adjacent cloud layers. The exact process through which these charged regions arise is complex and subject to debate, but standard theories suggest that it is akin to common sources of everyday static electricity, atoms and molecules brushing by each other at the edges of powerful updrafts and downdrafts of air. Excess electrons congregate in one region, leaving a net positive charge in another. When the charge separation becomes great enough, electricity discharges between the clouds, or from a low hanging cloud to the ground (lightning!).



The cloud layers here form a capacitor of atypical proportions: two parallel plates, each with an interior surface area of 1.00 km^2 separated by a distance of 177 meters. You are asked to treat this as an ideal parallel-plate capacitor, and to analyze it as though there were a vacuum between the "plates."

2. What is the capacitance of the clouds? **Show all work and equations including substitution with units.**

3. Check your calculated capacitance by using the facts that there is an initial potential difference of 5.60×10^7 V across the clouds and the required charge on one "plate" is 2.80 C. **Show all work and equations including substitution with units.**

4. Calculate the potential difference across this capacitor needed to store 255 million joules of energy. **Show all work and equations including substitution with units.**

Open the shortcut **IL Cap** on one of the lab stations. Open the interactive contained in this section. Set the potential difference at your calculation from question 4, then press ZAP to see if you were correct.

If your solution worked great! If not, look at the banner for a helpful hint. Recalculate the potential difference needed using this new information. **Show all work and equations including substitution with units.**