Inductive Reactance

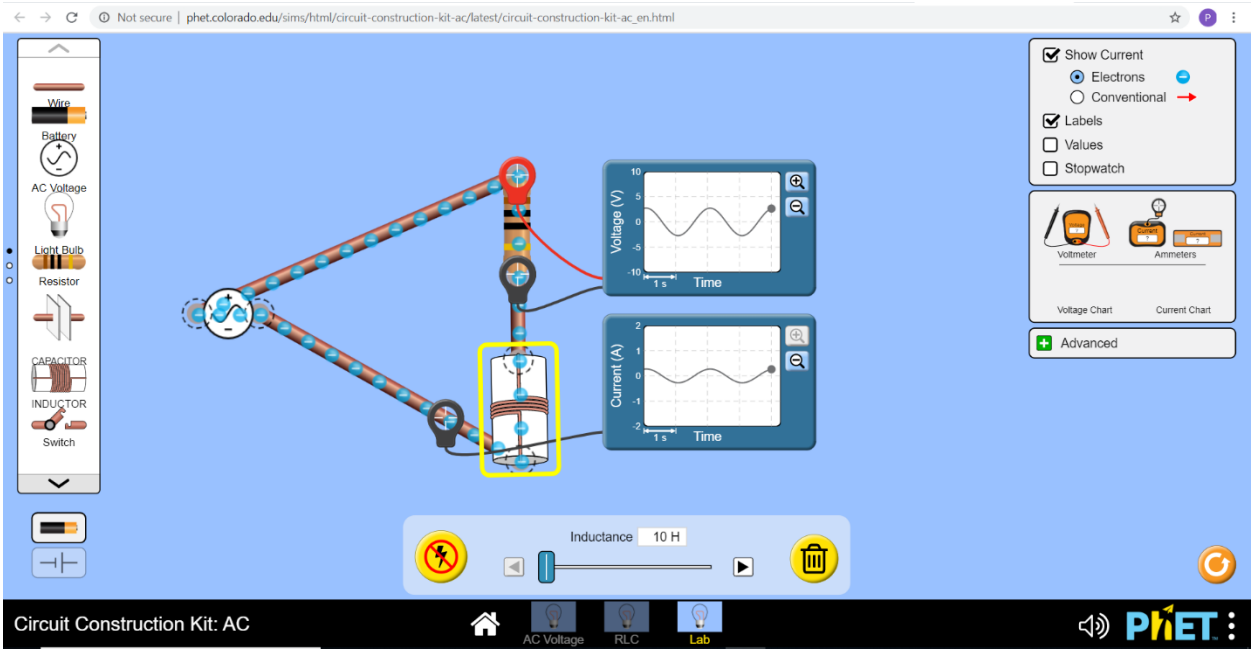
March 26, 2020

Once again, we'll start with

http://phet.colorado.edu/sims/html/circuit-construction-kit-ac/latest/circuit-construction-kit-ac_en.html

Click twice on the Lab icon to return to the empty lab screen.

Set up a circuit with the AC source and the resistor and inductor in series. Drag out the voltage and current charts and make sure the inductance is set to its lowest value – 10 H (or 10 Henries).



We can ask some of the same questions we asked about the circuit in which the resistor and capacitor were set up in parallel. Do the amplitudes of the voltages across the resistor and the inductor add up to the amplitude of the voltage delivered by the AC source? Is the voltage across the inductor in phase with the current? And therefore…are the voltages across the resistor and the inductor in phase?

And…how does the reactance of the inductor depend on the frequency? To answer that, change the frequency and see if the amplitude of the voltage across the inductor or the amplitude of the current changes. If either one changes, then the value of the inductive reactance – the X_L in

$V_L = I X_L$

changes. If the amplitude of the current decreases, then X_L is increasing.

What does the AC Circuit Cheat Sheet say? It says that $X_L = \omega L$; that is, the inductive reactance should increase with frequency.

The Cheat Sheet also says that the current and the voltage across the inductor should be a quarter of a cycle apart, as in the case of the capacitor. In an inductor, the current lags the voltage by a phase angle of $\pi/2$, while the opposite is true in the case of a capacitor (the current leads the voltage by $\pi/2$). Nevertheless the voltage and the current are out of phase for both circuit components.