Electric Circuit Model: Strictly DC

Conductors, Insulators, Resistors:

Conductors have charges that are free to move around the circuit; non-conductors (***insulators***) do not have free charges at all. The objects we call ***resistors*** are conductors that do not conduct as well as those objects we call conductors. Our model of conductors is that atoms forming solids, such as in copper wire, have a nucleus which is stationary and have one or more electrons which are relatively free to move. Therefore, the negatively charged electrons move around the circuit. Tests show that electrons actually drift very slowly around the wire, but the signal moves very fast (at the speed of light).

Electric Current and Circuit Elements

Electrical current is the flow of charges around a circuit, through circuit elements. Circuit elements are objects like wires, batteries, bulbs, etc. In describing the conductivity board (series circuit), the battery provided the energy (potential difference) to push the electrons through the conducting wires and bulb. The bulb is the load, has resistance, and converts the electrical energy into light and heat energy. For a series circuit (every circuit element in a single path from one side of the battery to the other):

- Charge is not created nor destroyed (conservation of charge). If a wire branches into two wires, the sum of the current into the junction is equal to the current leaving the junction. This is similar to the number of cars moving into an intersection being equal to the number leaving the intersection.
- The battery does not create charges; it only moves them around the circuit.
- If the current doesn't flow in one part of a circuit, it will not flow in another part.
- Circuit elements, in series with each other, have the same current. They have the very same electrons flowing.
- The strict definition of current (I) is that one monitors a single location in the circuit (a point in the wire), determines the amount of charge that flows by in a specified time, and calculates the ratio of charge to time. In other words, I = q/t and has units of Coulomb/sec, which is named Amperes or Amps in honor of Andre' Ampere.

Circuit Model: Analogy to Water Flow Circuit

The water or air circuit analogy has good predictive power (is a good model) for many circuit phenomena. However, like all models, it has limitations and can lead to false conclusions in unusual situations. The following items in the left column represent those in the right column.

battery	pump
voltage	pressure
current	water flow rate (gallons/minute)
wires	huge pipes
resistors	constrictions in the pipe
charge	amount of water
capacitor	bucket or (air tank-like container)