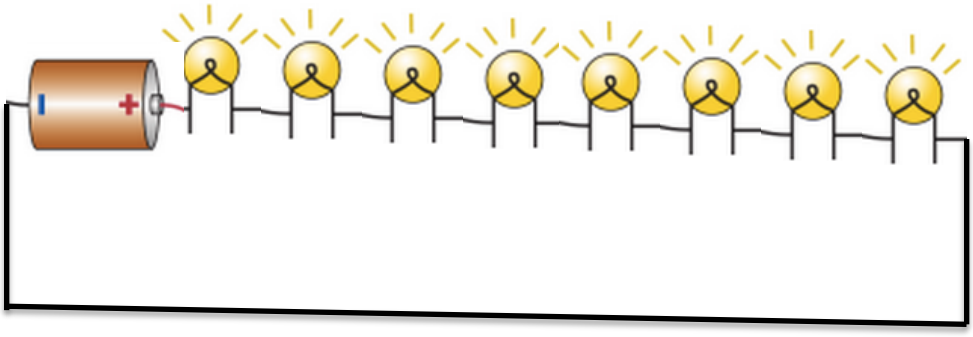
Circuit Design Challenge

Our scene opens with Albert and Isaac having a discussion about circuits.

Albert: Why is it, in a circuit with light bulbs in series, all of the bulbs burn with the same brightness?

Isaac: What circuit, exactly, are you talking about?

(Albert draws the following diagram:)



Isaac: (frowning) That's a nice drawing, but I'm not sure what you said is actually true. Wouldn't the bulbs get increasingly dim?

Albert: No, I don't think so. Look: the bulbs are all connected one after the other, so they should all feel the same current. If they all feel the same current, and they're identical bulbs (say, all 40 Watt), they'll dissipate energy at the same rate, and therefore burn equally bright. Like the long string of lights on a Christmas tree.

Issac: (brightening) I was born on Christmas!

Albert: (unimpressed) Yeah, congratulations.

Isaac: But think of it another way. The energy source is the battery, of course. Electric current flows out of the battery directly into the first bulb, which uses up some of the energy before the current flows into the second bulb, which uses up some more energy, and so forth. Since the current is most energetic when it goes through the first bulb, the first bulb will burn brightest. The second bulb will be next brightest, and so on.

Albert: But isn't it the negative charges that are actually moving? By your reasoning, wouldn't it be the bulb at the far right that gets the electricity first?

Isaac: OK, maybe. But my point is that the bulbs will not burn equally brightly.

Albert: Not like a Christmas tree?

Isaac: Forget the Christmas tree!

Albert: Yeah, well, I still think the lights will burn equally brightly.

Your challenge is to design a demonstration, using our available circuit materials, to determine who is right, Albert or Isaac. Ideally this demonstration would be convincing to your own students.