Activity: Too much power through a resistor

I do this demo on the first lab class, just as we have talked about Ohm's Law and the passive sign convention. In this demo you will need a cord that's got an un-grounded wall plug at one end and alligator clips at the other. I have heard this cord called a cheater cord or a widowmaker. It also works well as an outreach activity for middle and high school students if you scale down the questions or lead them through the calculations.

Initial questions
In today's demo we'll use three resistors: a 10k Ohm, a 1k Ohm, and a 100 Ohm resistor. We will supply power to the resistors using a 2 prong to alligator clip cord that plugs into the wall. *Use of this cord is very dangerous, so DO NOT try this on your own.*

1) The voltage from the wall is 120 V. Use P=IV to calculate the power that each resistor will dissipate if it's plugged into wall power.
2) The maximum amount of power each resistor can handle (the power rating) is 250 mW. What do you think will happen to each resistor when it's plugged into wall power? Why?
3) The current rating of the lab's circuit is 20 A. We cannot draw more than 20 A of current, or the circuit breaker turn everything off. Do we need to worry?

The demo
Assemble students so they are >2 m from the resistor but can see. Starting with the 10k Ohm resistor, place it in a breadboard, attach both alligator clips to the leads, and then plug in the cord to complete the circuit. Smith has an acrylic box about the size of a fish tank to put the breadboard in, in case something goes flying.

Note: When the resistor pops, you get a surprising amount of magic smoke. I strongly recommend a well-ventilated room or outdoors. I typically play up the theatrics during the demo by wearing a face shield, acting scared, asking for a student volunteer to help me, etc.

Wrap up questions
1) What happened to each resistor? Did different resistor values behave differently? Why?
2) Why did our calculations tell us the 10k Ohm resistor would pop, when it didn't? Can you estimate the highest resistance that would pop?

The demo/activity is great for encouraging students to make safety calculations before they plug something in. Throughout the semester I refer back to this activity if I see students simply "trying stuff" to get a lab to work.