If the Sun Were Made of Coal

How long would it last?

Calculation 1 was done at end of class Wednesday 3/25. Calculation 2 at beginning of class 3/27.

The energy density of coal, that is how much heat and light is produced if you burn it, is roughly 24 MJ/kg.

Calculation 1: How long could the Sun produce power if it were a burning lump of coal?

Inputs to calculation:

The Sun produces energy at the rate of 3.85×10^{26} W.

The Sun's mass is 1.99×10^{30} kg.

Power = Energy / Time

We got 5,000 years when we did this in class with a bit of rounding. It is good practice to repeat the calculation.

It was a great mystery in the late 1800s as to why the Sun hadn't burned out already. The mystery wasn't solved until Einstein discovered that matter itself can be a power source. Einstein's paper saying that $E = mc^2$ where m is the mass of the matter that is turned into energy and c is the speed of light came out in 1905.

Calculation 2: How many kilograms of coal has to be burned to light a 100W bulb on for one year?

Calculation 3: What is 24MJ in kWh

Note that a real coal power plant, you don't actually get 6.7 kWh of electrical energy for each kg of coal burned, because about 60% of the power plant's power goes out the smokestacks as hot air and steam. Only about 40% goes into the power lines as electrical energy.)