Hole Punch Earth

Create a scale model of the earth and sun using a hole punch as the Earth! Thanks to Coral Clark, who shared this idea with me.

Materials: (per pair)
- a hole punch circle (what you normally discard when you use a hole punch)
- metric ruler or meter stick
- large square of butcher paper (about 1 meter x 1 meter)
- 1 pair of scissors
- about 50 cm string
- 2 pencils
- calculator

To Do and Notice:
Provide students with the following information:

Earth's Diameter:	**12,756 km**
Sun's Diameter:	**1,392,000 km**
Earth - Sun Distance	**149,600,000 km**

Give each pair of students a hole punch circle, explaining that it represents the planet earth. Students measure the diameter of the circle. Students find the correct scaling factor or set up a proportion to determine the diameter of the sun.

Scale Factor Method: For example, if the hole punch has a diameter of 1 cm, the following would be a way to find the scaling factor:

$$\frac{1\text{ cm}}{12{,}756\text{ km}} = \frac{1\text{ cm}}{12{,}756\text{ km}} \bullet \frac{1\text{ km}}{100{,}000\text{ cm}} = \frac{1}{1{,}275{,}600{,}000}$$

This scaling factor (which has no units) can be multiplied by the actual diameter of the sun to find the size of the scaled down version.

Proportion Method: To set this up as a proportion, we can compare the two size/distance ratios and solve for the unknown diameter of the scaled down sun, *x*. Simplify the ratio of the two diameters as shown.

$$\frac{1\text{ cm } \textit{(scaled dia. of earth)}}{x\text{ cm } \textit{(scaled dia. of sun)}} = \frac{12{,}756\text{ km } \textit{(diameter of earth)}}{1{,}392{,}000\text{ km } \textit{(diameter of sun)}}$$

$$\frac{1\text{ cm } \textit{(scaled dia. of earth)}}{x\text{ cm } \textit{(scaled dia. of sun)}} = \frac{\sim 13{,}000 \textit{ (diameter of earth)}}{\sim 1{,}300{,}000\text{ km } \textit{(diameter of sun)}}$$

Once the students have found the scaled down sun's diameter, they can draw it on the butcher paper. Show them how to use two pencils and string as a giant compass. Remind students of the definitions of radius and diameter. Students cut out their suns, which should be about 100 times the diameter of their hole

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punch earth. If you have the time and space (large outdoor area), have students then determine the correct scaled distance between the earth and sun. After they have made their calculations, they can measure or pace the distance outside.

What's Going On?
The sun is much larger and farther away than most people realize. The sun is about 100 earth diameters across and about 100 sun diameters away from earth. If the hole punch "earth" is .7 cm in diameter, then the correctly scaled sun should be about 70 cm in diameter. The correct distance for this particular earth/sun model would be about 70 meters!

What about volume?
If the earth/sun diameter ratio is 1 to 100, then the volume ratio must be cubed, or 1 to 1,000,000.

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