

Our Fun Sun

Subject: Science, Math

Grades: 7th – 8th

Rational or Purpose:

Students will develop an easy tool in which they are able to look at the sun and find out what its diameter is by a simple arithmetic formula. They will also find how much they would weigh on the sun and other planets and discuss what makes some planets have more gravity than others.

Materials needed: (For each group)

- 2 shoe boxes
- Meter stick
- 2 pieces of cardboard (10cm X 20 cm)
- box cutter
- Tape
- Small piece of aluminum foil
- Calculator
- Scale (share if necessary)
- Transparency of Table of Force Factors
- Transparency of Table of Planetary Diameter

Lesson Duration: 1 hour

Source:

“Measuring the Diameter of the Sun,” The Educator’s Reference Desk
“Enchanted Learning”

TEKS:

7th: 2(b), 2(c), 3(a)

8th: 2(b), 2(c), 3(a), 13(a)

Background Information:

Our sun is the only star in our solar system that is bigger than anything else near earth. The earth is about 150,000,000 km away from the sun. Since this value is known, a simple optical tool can be constructed to find how large the sun’s diameter is. From this tool, we can use a simple algebraic problem shown below in order to approximate the diameter of the sun.

$$\frac{\text{Diameter of sun (km)}}{\text{Distance to the sun (km)}} = \frac{\text{diameter of the sun's image (mm)}}{\text{distance between the two cards (mm)}}$$

The diameter of the sun is approximately 1,391,000 km. Earth's diameter is only about 12,750 km. Comparing the Sun's diameter to other celestial bodies, you can see that the sun is huge.

Scientists have also approximated the mass of the sun which can help find the gravitational force that the sun exerts on an object. This force factor is 27.9 times larger relative to the earth's gravitational force. This force will determine how much something would weigh on the sun. You can see that the mass of the object will always remain the same, but the weight changes due to different forces of gravity. The different values of gravitational force on the celestial bodies do not depend on the size of the body, but instead on how much mass the body has. A table is given with the known gravitational force for each planet, as well as its diameter. Consider the planet Uranus. Uranus has a larger diameter than Earth, but still has a much smaller gravitational force factor relative to Earth. Uranus has less mass since it is a gas planet. This is also true for Jupiter, Saturn, and Neptune since they too are gaseous bodies, but they do have a smaller gravitational force factor compared to the Earth.

Activity:

Students will be able to develop an optical tool in order to help find the sun's diameter. They will discuss how much an object would weigh on the sun as well as satellites. Students will be able to explain what causes gravity to increase, and explain the difference between mass and weight. Finally, they will use algebra to find the sun's diameter.

Procedure:

1. Tell the class that today they are going to be looking at the sun, some of its characteristics, and comparing them to the planets. They will find out how big the Sun's diameter is and why it is the center of our solar system.
2. Ask the class to gather into their designated groups (groups of 3 or 4), to build an optical device for viewing the sun and find to its diameter.
3. Each group needs to gather the materials needed to make the "shadow telescope".
4. Tape the lids of both the boxes shut securely.
5. Cut slits in the smaller sides of each box, directly opposite of each other. Make each slit in the shape of a capital "I", and make them large enough to fit a meter stick through snugly.
6. Tape one box securely on to one end of the meter stick and leave the second box free to slide.

7. Cut a 5 cm X 5 cm hole in one of the pieces of cardboard, and cover the hole with the aluminum foil provided.
8. Tape the foil in place and punch a very small hole in the center of the foil with a sharpened pencil or a push pin.
9. Tape the foil covered cardboard to the front face of the stationary box (as if it was the front lens of a telescope). Make sure it is secured to the top side of the meter stick so you are able to hold the device and read the measurements.
10. Draw two parallel lines (horizontally) exactly 8.0 mm apart near the center of the second piece of cardboard.
11. Tape the second cardboard piece to the face of the sliding box. (Note: Be certain that both cards are perpendicular to the meter stick as possible.)
12. Go outside to find the diameter of the sun.
13. Point the end of the meter stick that holds the foil-covered card toward the sun. **CAUTION: Do not look directly at the sun!**
14. Adjust the telescope until the shadow from the foil cardboard in front appears on the back cardboard piece. There will be a bright image of the sun in the middle of the shadow.
15. Adjust the sliding box until the bright image of the Sun exactly fills the space between the parallel lines.
16. Measure the distance between the two cardboard cards on the meter stick. Record the distance in mm.
17. Once everybody has their distance recorded, go back inside to see the class results.
18. Write the formula on the board for the groups to find the diameter. What can we tell by looking at the diameter how big is the sun if the Earth's diameter is 12,750 km? Asks the students to write down the formula and solve the problem in their notebook.

Weight on the Moon.

1. Start the introduction with some questions: Can someone tell me what weight is? What causes weight? What about mass? Is there a difference with your weight if you were on a different planet? How about the sun?

2. Talk about each of these questions and how they relate to each other. Scientists have found what we will call gravitational force factors for each celestial body in our solar system. Place the table with the force factors on the overhead.
3. Asks the students to go back to their groups and begin weighing each other. Record this in your notebook and use each of the force factors to see how much you would weigh on the sun, moon, and other planets.
4. Write down the two places where you would weigh the most and where you weigh the least, and discuss their findings.
5. Ask the class if there is a correlation to the size of the celestial body and the force factor.
6. Project both tables with all the diameters of celestial bodies in our solar system as well as the gravity factors. What can they find from this? Use Uranus and Earth as examples, if they cannot see the difference.
7. Is there a correlation between gravity and density? We can find the volume from the diameters known and look at the average density of the elements found on the planets to correlate with how much mass each planet has.
8. Give out the quiz for the students to answer.



Tables shown:

Diameter of the Planets	
Celestial Body	Diameter in KM
Mercury	4,880
Venus	12,104
Earth	12,756
Mars	6,794
Jupiter	142,984
Saturn	120,536
Uranus	51,118
Neptune	49,532
Pluto	2,274
Sun	1,391,000

Celestial Body	Gravitation Factor Relative to Earth
Sun	27.9
Mercury	0.38
Venus	0.91
Earth	1
Moon	0.17
Mars	0.38
Jupiter	2.54
Saturn	1.08
Uranus	0.91
Neptune	1.19
Pluto	0.06

Name: _____

Date: _____

Class Section: _____

Sun Fun Quiz

1. What is the Sun's diameter in km?
2. What is the second largest celestial body after the sun?
3. Does your weight change if you went to another planet? How about your mass? Why or why not?
4. On which planet would you weigh the most?
5. On which planet would you weigh close to the amount you weigh on Earth?
6. Does the size of the planet determine the gravitational force factor of the planet? Why or why not?