Total Solar Eclipse Lesson Plans

Grades: 6 – 12

Lessons: Three inquiry-based lessons, each designed to be completed in a 1 hour class meeting

Developer: Mark LaPorte mark.laporte@mtsu.edu
Middle Tennessee State University
MTeach - Secondary Education Program in Math and Science
www.mtsu.edu/mteach
Department of Physics and Astronomy www.mtsu.edu/physics

Website: www.mtsu.edu/eclipse

7/20/2017

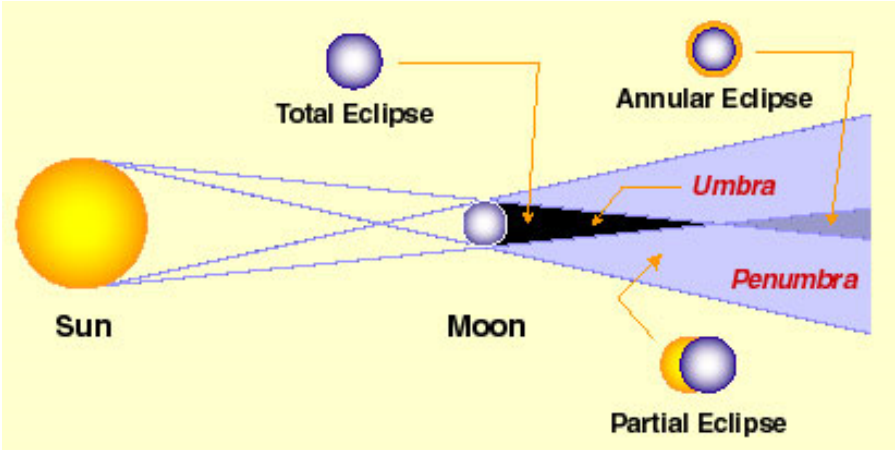
Helpful websites	**https://www.timeanddate.com/eclipse/solar-eclipse.html** **https://www.timeanddate.com/eclipse/solar-eclipse-myths.html** **https://eclipse2017.nasa.gov**

Activity #1 **Activating Strategy**	**Ancient Myths** In Vietnam, people believed that a giant frog was the cause of this strange event, while in ancient China, people thought a hungry dragon was responsible. In Europe, the Vikings blamed wolves. According to ancient Hindu mythology, the demon Rahu is beheaded by the supreme deity Vishnu for drinking the nectar of the gods. His head is responsible for this event. To scare Rahu away, it was common practice for people to bang pots and pans and make loud noises to scare the demon away. The Batammaliba people from Benin and Togo in West Africa have a legend that a fight is responsible. The only way to stop the conflict, they believe, is for people on Earth to settle their differences.
Essential Question	What event are these various cultures describing?

Activity #1 – Part 1	**Constructing a Model of a Solar Eclipse**
Problem	What are the positions of the Earth, Sun, and Moon during a solar eclipse?
Materials	Three spheres (per group) – tennis balls would work well
Exploration	1. Your group has been provided with three spheres. Arrange the three spheres in a configuration that models a solar eclipse. 2. Construct a diagram of your model. Label the Sun, Earth and Moon on your diagram.
Explanation	A. Based on your model explain what is happening during a solar eclipse. B. What is the phase of the moon during a solar eclipse? C. How often does this moon phase occur? Explain why this happens. D. Does a solar eclipse occur every time the moon is in this phase? Justify your answer.

Activity #1 – Part 2	**Scaling the Model**
Problem	What would your model look like if you scaled your solar eclipse based on the size of the sphere that represents the Earth?
Materials	Each group will need the following materials: sphere from Part 1 to represent the Earth, meter stick, calculator, string, and scissors
Exploration	1. Determine the scaled diameter of the moon and the sun based on the diameter of the sphere you chose to represent the Earth. Show all of your calculations and include all of your units. 2. Based on your calculations cut three pieces of string that represent the diameter of the Sun, Earth, and Moon. 3. Determine the distance from Earth to the Moon, and from the Earth to the Sun based on the diameter of the sphere you chose to represent the Earth. Show all of your calculations and include all of your units. 4. Place your strings representing the diameter for the Sun, Earth, and Moon in the correct positions in order to complete your scale model of a solar eclipse.
Explanation	A. How would a solar eclipse change if the moon had a larger/smaller diameter? Explain your reasoning. B. How would a solar eclipse change if the Earth had a larger/smaller diameter? Explain your reasoning.
Sample Data and Calculations	Diameter — Distance from Earth Earth 12,756 km Moon 3,476 km 384,400 km Sun 1,392,000 km 150,000,000 km <u>Scale Model Diameter</u> Using a tennis ball with a diameter of 6.7cm to represent the Earth: Scale Factors Moon $\frac{3476 \text{ km}}{\text{Earth } 12756 \text{ km}} = 0.2735$ Sun $\frac{1392000 \text{ km}}{\text{Earth } 12756 \text{ km}} = 109.1$ Scale diameter of the Moon 6.7 cm x 0.2735 = 1.8 cm Scale diameter of the Sun 6.7 cm x 109.1 = 730 cm <u>Scale Model Distance</u> Using a tennis ball with a diameter of 6.7cm to represent the Earth: Scale Factor $\frac{\text{Earth } 12756 \text{ km}}{\text{Tennis ball } 6.7 \text{ cm}} = 1900 \text{ km/cm}$ 1900 km of actual distance is represented by 1 cm on the model.

	Distance from the Earth to the Moon:	$\frac{384400 \text{ km}}{1900 \text{ km/cm}} = 200 \text{ cm}$
	Distance from the Earth to the Moon:	$\frac{150000000 \text{ km}}{1900 \text{ km/cm}} = 79000 \text{ cm}$

Activity #2	The Geometry of a Solar Eclipse
Problem	How would a solar eclipse change if the moon were closer/farther from the Earth?
Materials	Each group will need the following materials: picture with graphic provided, meter stick, calculator, string, scissors, light source, sphere, and screen. The students will need a light source to represent the sun, a sphere to represent the moon, and a screen to represent the earth's surface. The students should use the materials to create a mathematical model that relates the size of the moon's shadow on the Earth to the location of the moon.
Exploration	 1. Use the equipment provided to create a mathematical model that relates the size of the moon's shadow on the Earth to the location of the moon? 2. Draw a clearly labeled diagram and include a written statement explaining your findings.
Explanation	The distance from the Earth to the Moon is approximately 240,000 miles. A. How would a solar eclipse change if the distance from the Earth to Moon were 120,000 miles? B. How would a solar eclipse change if the distance from the Earth to Moon were 480,000 miles?

Activity #3	**Predicting a Solar Eclipse**
Problem	Do solar eclipses occur in a predictable pattern?
Materials	Data from past solar eclipses, world map
Exploration	 A map of the United States showing the path of totality for the August 21, 2017 total solar eclipse. Using the data provided determine a pattern that will allow you to predict the next 3 solar eclipses.

Date	Type	Location
21 Jun, 2001	Total Solar Eclipse	Angola, Zambia, Zimbabwe, Mozambique, Madagascar
14 Dec, 2001	Annular Solar Eclipse	Across Pacific Ocean, Central America
10 Jun, 2002	Annular Solar Eclipse	Australasia, Pacific Ocean, Mexico Coast
4 Dec, 2002	Total Solar Eclipse	Southern Pacific Ocean, Southern Australia
31 May, 2003	Annular Solar Eclipse	Scotland, Iceland, Greenland
23 Nov, 2003	Total Solar Eclipse	Antarctica, extreme south Pacific
19 Apr, 2004	Partial Solar Eclipse	South Africa
14 Oct, 2004	Partial Solar Eclipse	Eastern Russia, Japan, North-East China
08 Apr, 2005	Hybrid Solar Eclipse	South of New Zealand, North-East Pacific, Central America
03 Oct, 2005	Annular Solar Eclipse	Spain, Africa
29 Mar, 2006	Total Solar Eclipse	Eastern Brazil, Western Africa, Eastern Med, North-East Asia
22 Sep, 2006	Annular Solar Eclipse	Central America, Atlantic Ocean, Africa
19 Mar, 2007	Partial Solar Eclipse	Most of Asia
11 Sep, 2007	Partial Solar Eclipse	Southern South America, Parts of Antarctica
7 Feb, 2008	Annular Solar Eclipse	Antarctica, extreme south Pacific
01 Aug, 2008	Total Solar Eclipse	Northern Canada, Northern Russia, China
26 Jan, 2009	Annular Solar Eclipse	South Africa, Indian Ocean, Australasia
22 Jul, 2009	Total Solar Eclipse	India, China, Pacific Ocean
15 Jan, 2010	Annular Solar Eclipse	Central Africa, Indian Ocean, Southern Tip of India, China
11 Jul, 2010	Total Solar Eclipse	North-East New Zealand, Pacific Ocean, Southern End of Chile
04 Jan, 2011	Partial Solar Eclipse	Northern Africa, Middle East, Europe, Western Africa
01 Jun, 2011	Partial Solar Eclipse	Canada, Eastern Russia
01 Jul, 2011	Partial Solar Eclipse	Small Patch of Ocean Near Antarctica
25 Nov, 2011	Partial Solar Eclipse	Antarctica, Extreme South Africa and Tasmania
20 May, 2012	Annular Solar Eclipse	China, Japan, North Pacific, Western US

	13 Nov, 2012	Total Solar Eclipse	Northern Australia, South Pacific
	10 May, 2013	Annular Solar Eclipse	Northern Australia, Central Pacific
	03 Nov, 2013	Hybrid Solar Eclipse	Atlantic, East Florida, Central Africa
	29 Apr, 2014	Annular Solar Eclipse	Antarctica
	23 Oct, 2014	Partial Solar Eclipse	Most USA excluding eastern coast, Western Canada, Mexico
	20 Mar, 2015	Total Solar Eclipse	North-West British Isles, Faroes
	13 Sep, 2015	Partial Solar Eclipse	Southern Africa, Antarctica
	09 Mar, 2016	Total Solar Eclipse	Indian Ocean, Pacific Ocean, Indonesia
	01 Sep, 2016	Annular Solar Eclipse	Central Africa, Madagascar, Indian Ocean
	26 Feb, 2017	Annular Solar Eclipse	Southern South America, Atlantic, Southern Africa
	21 Aug, 2017	Total Solar Eclipse	Central US
Explanation	A. Explain how you were able to predict the next 3 solar eclipses. B. Why do solar eclipses occur at different locations? C. Suppose one of your classmates was absent from school. They send you a message on twitter asking you what they missed in class today. Your task is to respond with two twitter messages summarizing today's class. (a message on twitter is limited to 140 characters)		