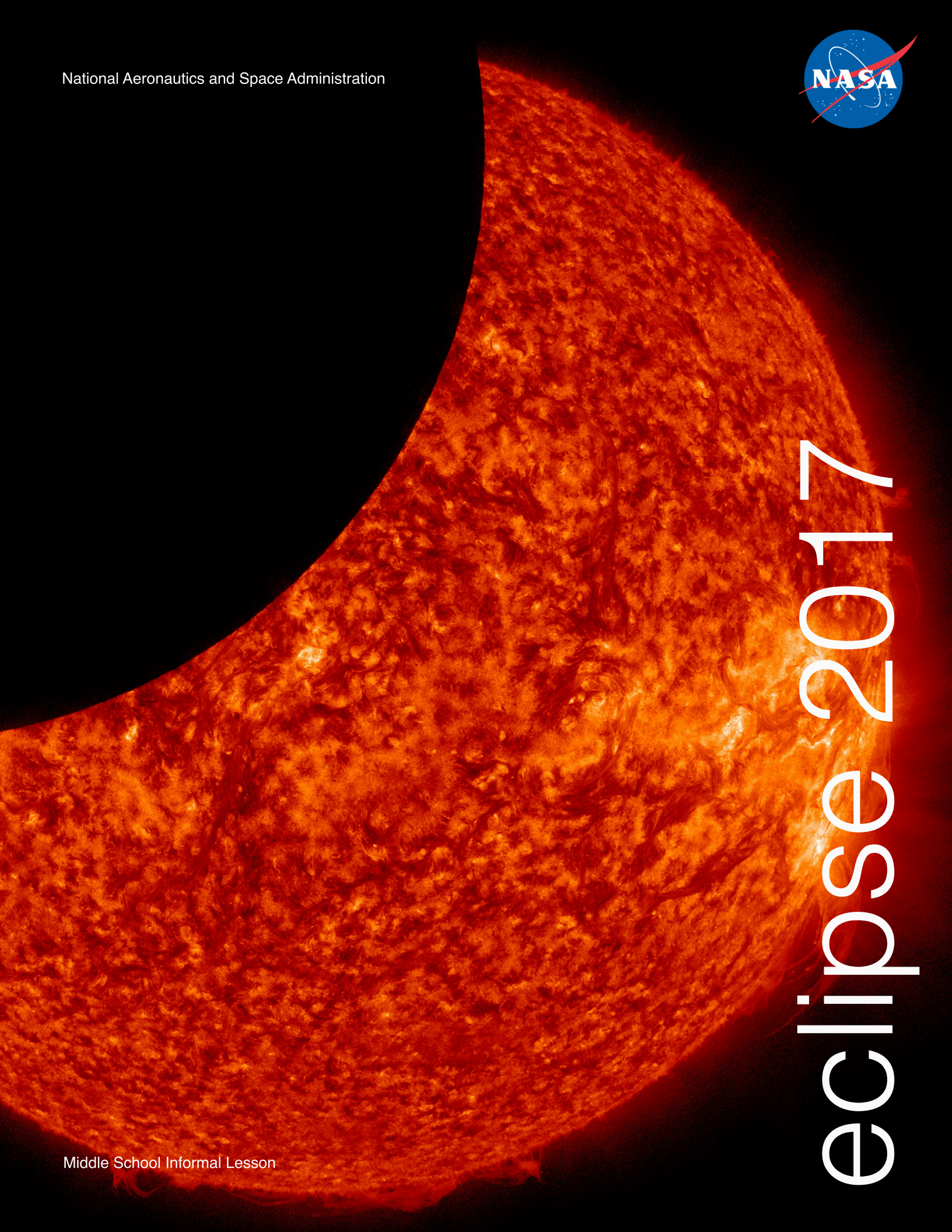
National Aeronautics and Space Administration



eclipse 2017

Middle School Informal Lesson

Path of Totality

Grades: 6-8 Prep Time: ~5 min Lesson Time: ~30-40 min

WHAT LEARNERS DO: Use a model to explore the path of totality during a total solar eclipse.

Learners will explore how the Moon's shadow is cast upon the Earth during a total solar eclipse. They will discover why this event is so unique as they plot the path of totality and understand what a rare event this will be! Upon completion, learners will earn a limited edition Eclipse 2017 coin to commemorate this event.

NRC FRAMEWORK/NGSS CORE & COMPONENT QUESTIONS

WHAT IS THE UNIVERSE, AND WHAT IS EARTH'S PLACE IN IT?

NGSS Core Question: ESS1: Earth's Place in the Universe

What is the universe, and what goes on in stars?

NGSS ESS1.A: The Universe and its Stars

What are the predictable patterns caused by Earth's movement in the solar system?

NGSS ESS1.B: Earth and the Solar System

INSTRUCTIONAL OBJECTIVES (IO)

Learners will be able to

IO1: Explain what causes the size and location of the path of totality during a solar eclipse.

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Last edited: April 25, 2018

1.0 Materials

Required Materials:

Please supply:

- Computer or Laptop – 1 per learner
  - Supported Browsers: Chrome; Edge; Firefox; Safari

Please Print:

From Learner Guide

(A) Upcoming Total Solar Eclipses – 1 per learner

Optional Materials:

From Alignment Document

(N) "Eclipse 2017" NGSS Alignment Rubric

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2.0 Lesson Timeline

***Eclipse 2017* Lesson Timeline**:

Time:

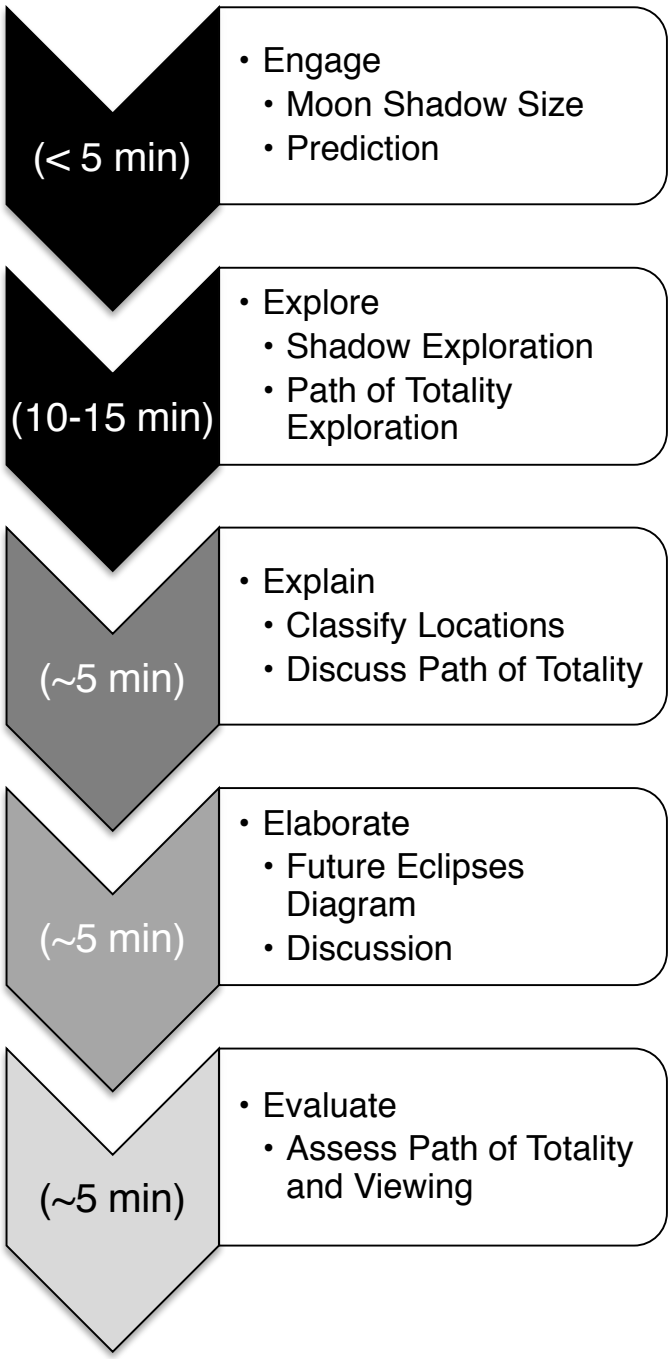
- 30-40 minutes

Materials:

- Learner Guide page
- Computer/Laptop

5-E Inquiry Process:

- The arrow color represents the 5-E step learners will be primarily engaging in for that class session



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3.0 Vocabulary

astronomical	relating to astronomy; extremely large
corona	the outermost layer of the Sun that cannot be seen with the naked eye, but can be observed during a total solar eclipse
explanation	logical description applying scientific information
model	a simulation that helps explain natural and human-made systems and shows possible flaws
partial solar eclipse	an eclipse where the Moon does not completely block the Sun, allowing some sunlight to still reach the observer (partiality)
path of totality	the track of the Moon's shadow across Earth's surface, caused by the total solar eclipse, the moon's revolution (orbit), and the rotation of Earth beneath the shadow
predict	to declare or state what will happen based on reason and knowledge
rotation	to spin on an axis
solar eclipse	an event where the Sun is blocked out by the Moon as viewed from Earth
total solar eclipse	an eclipse where the Moon completely blocks the Sun, preventing direct sunlight from reaching the observer (totality)

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4.0 Procedure

PRIOR KNOWLEDGE & SKILLS

A. Arrangement of Earth, Moon, Sun during eclipse
B. Solar Eclipse
C. Moon Phases

PREPARATION

A. Visit https://infiniscope.org/lesson/where-are-the-small-worlds/ for access to the digital learning experience, standards alignment documents, and additional resources.

B. Reserve computers or laptops for Exploration Day

C. PRINT THE FOLLOWING:

- **Learner Worksheet (A)** – 1 per learner

STEP 1: ENGAGE (< 5 minutes)
Solar Eclipse Totality Prior Knowledge

A. Hand out or assign computers and ask students to access the Path of Totality digital learning experience at https://infiniscope.org/ and choose "***Explore***" to launch the experience.

1. During the experience, learners will demonstrate their prior knowledge of total solar eclipses in regards to shadow size and totality before exploring these elements.

STEP 2: EXPLORE (10-15 minutes)
Moon Shadow Size and Path of Totality

A. Learners most likely have a misconception regarding the size of the Moon's shadow on Earth's surface. This misconception is addressed here in the exploration.

B. Learners will measure the diameter of the Moon and then predict the size of the shadow that will be cast upon Earth's surface.

C. Learners will then place location pins south and north of Alliance, Nebraska, searching for the shadow range of the total solar eclipse and therefore, the size of the Moon's shadow on Earth.

D. When learners have discovered the actual size of the Moon's shadow cast upon Earth, they will then be tasked with exploring how such a small shadow (only 100 km diameter) can be produced by the Moon.

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E. You can recreate this shadow learning activity simply by using a smartphone with a flashlight app installed, a lollipop, and a dark room. (Use the flashlight app for a larger light source and the camera flashlight for the smaller light source).

F. Now that learners see how small the shadow is, they can apply this understanding to where on Earth will someone see the total solar eclipse. They are given specific times during the eclipse and will plot the path of totality.

- **Teacher Tip:** If learners seem to be stuck in the activity, it isn't responding in a way that seems correct, or if an error occurs, click the "Restart" button located in the upper right corner of the screen. "Restart" will clear all of their progress and bring them back to the start screen. Hitting the browser's "Refresh" or "Back" button will not restart the activity.

- **Teacher Tip:** Learners should never hit the browser's "Refresh" or "Back" button.

- **Teacher Tip:** Learners are expected to learn from their failures. This failure model is commonly found in the fields of science and engineering. Failure should not be viewed as a value judgement, but as an example of a **F**irst **A**ttempt **I**n **L**earning. It's an example of what doesn't work and learners should keep exploring to find what does work.

- **Teacher Tip:** If you would like to analyze learner interactions in this activity, you can sign up to join the ***Infiniscope Teaching Network*** (https://infiniscope.org/join/) and enroll your class into the activity. By enrolling, you will gain access to the analytics of the activity by learner to see how learners progressed through the activity. You also have the ability to adopt the activity and adapt it to the specific needs of your classroom, school, or community.

STEP 3: EXPLAIN (~ 5 minutes)

Discuss Results

A. Learners are given a series of locations in the United States, including their own location, and asked to determine if the location falls along the path of totality, partiality, or in an area of no eclipse.

B. Ask Learners:

1. Why is the Moon's shadow so much smaller than the size of the Moon?
    - *The size of the Sun causes the small shadow. The larger the light source, the smaller the shadow.*

2. What is the path of totality?
    - *The track of the Moon's shadow across Earth's surface during a total solar eclipse.*

3. What causes the path of totality?
    - *The moon's revolution (orbit) and the rotation of Earth beneath the Moon's shadow.*

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STEP 4: ELABORATE (~ 5 minutes)
Upcoming Total Solar Eclipses

A. Complete at the conclusion of the learning experience: Hand out ***(A) Upcoming Total Solar Eclipses*** to learners. This diagram shows the path of totality for all total solar eclipses up through 2028.

B. Ask learners:

1. When will the next total solar eclipse happen and where will it be seen?
   - *July 2, 2019 in South America (Chile and Argentina)*
2. When will the United States see it's next total solar eclipse?
   - *April 8, 2024*
3. Based on that information, why is the 2017 eclipse such a big event?
   - *Total solar eclipses are rare events due to the size of the shadow, the revolution (orbit) of the Moon around the Earth, and the rotation of Earth. Only 2 total solar eclipses will be seen in the United States in the next decade.*

STEP 5: EVALUATE (~ 5 minutes)
Determine Totality for Other Locations

A. Ask learners to explain how the path of totality is created and where will the eclipse be viewed?
- *Responses should describe the small moon shadow, the revolution (orbit) of the Moon, and the rotation of Earth will create the path of totality. Only those individuals along the path of totality will see the total solar eclipse.*

5.0 Evaluation/Assessment

Use the *(N) Path of Totality NGSS Alignment Rubric* as a formative assessment, allowing learners to improve their work and learn from mistakes during class. The rubric evaluates the activities using the Learning Outcomes identified in the Alignment Documents for the activity.

6.0 Extensions

A. Visit these sites for additional information and resources:

1. http://eyes.jpl.nasa.gov/eyes-on-eclipse.html
2. https://eclipse.gsfc.nasa.gov/eclipse.html
3. http://eclipse.montana.edu/

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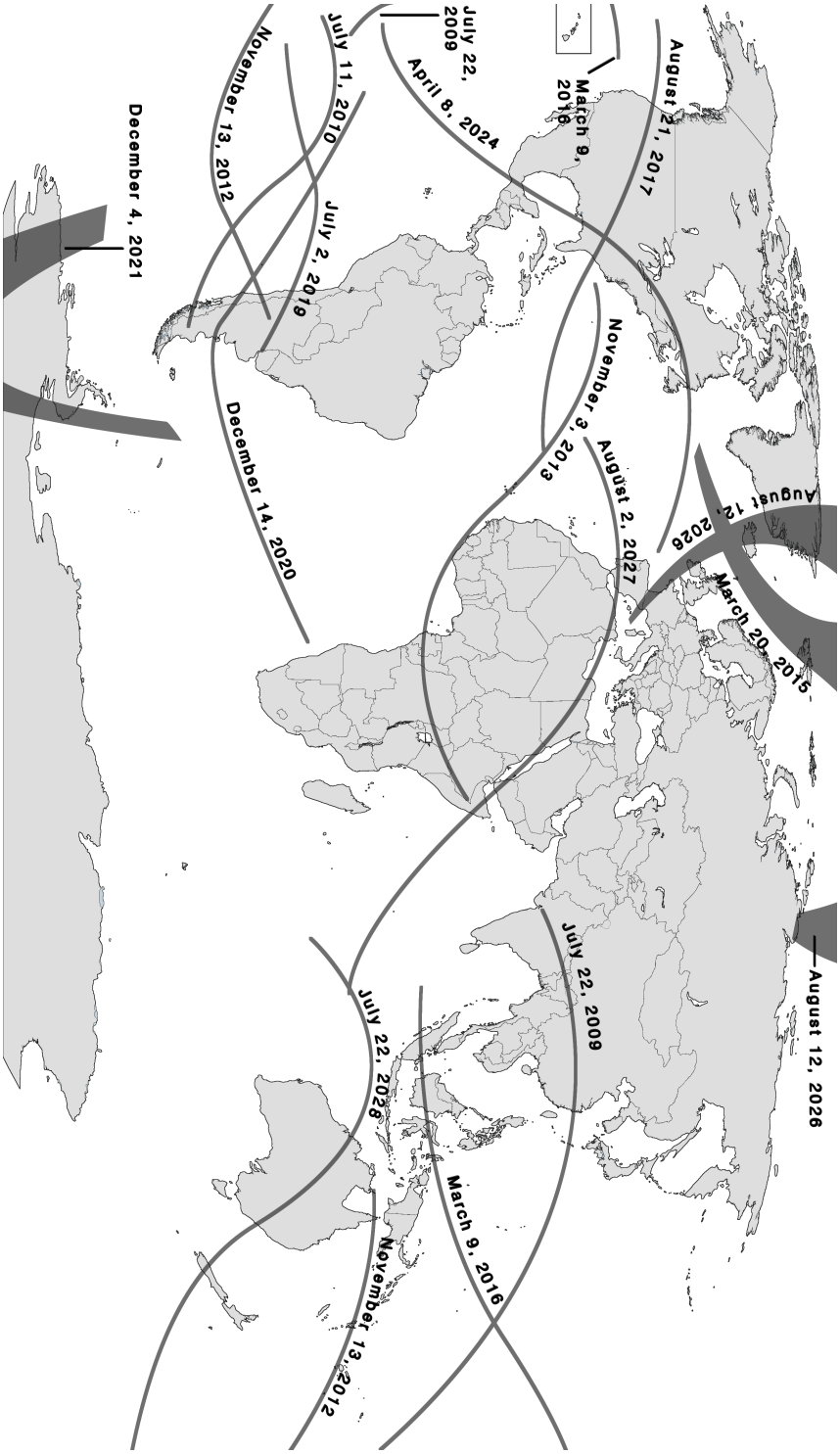
(A) Upcoming Total Solar Eclipses



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