

Eclipse Predictor

Mission: Indiana saw a total solar eclipse in April 2024, and people traveled from all over to see it. Use the Sun–Earth–Moon model to discover when eclipses happen and why they are so rare.

Big question: What has to line up for a solar or lunar eclipse to happen?

★ Warm-up: Two truths and a lie

Find the lie and fix it.

A. Solar eclipses happen at new moon. B. Lunar eclipses happen at full moon. C. Eclipses happen every month. ✓ **C: the tilted orbit makes them rare.**

A. It is safe to look at a solar eclipse without special glasses. B. A lunar eclipse can look red. C. Earth's shadow causes lunar eclipses. ✓ **A is false and dangerous: always use eclipse glasses.**

Key vocabulary

Solar eclipse	The Moon blocks the Sun (only at new moon).
Lunar eclipse	Earth's shadow covers the Moon (only at full moon).
Tilt	The Moon's orbit is tipped about 5° compared to Earth's orbit.
Umbra	The darkest part of a shadow.

1 Box 1

Find a solar eclipse

In the simulator: Change the time of year and Moon position until you make a **solar eclipse**.

What had to be true for the solar eclipse? Choose all.

Choose all that apply.

- ☐ New moon phase ☐ The Moon was in line (not above or below) ☐ Full moon phase
☐ Earth was between the Sun and Moon

✓ **New moon phase; The Moon was in line (not above or below)**

2 Box 2

Find a lunar eclipse

In the simulator: Make a **lunar eclipse**.

During the lunar eclipse, what was blocking sunlight from reaching the Moon?

- ☐ Earth ☐ The Moon itself ☐ The Sun

✓ **Earth**

3 Box 3

A near miss

In the simulator: Find a new or full moon with NO eclipse.

Why was there no eclipse this time?

- ☐ The Moon was above or below the Sun–Earth line because of its tilted orbit ☐ The Moon was too far away
☐ It was cloudy

✓ **The Moon was above or below the Sun–Earth line because of its tilted orbit**

4 Box 4

Remove the tilt

In the simulator: Turn OFF the tilt and check a new moon.

If the Moon's orbit were NOT tilted, how often would solar eclipses happen?

☐ Every new moon (every month) ☐ Never ☐ Once every 100 years

✓ **Every new moon (every month)**

5 Box 5

Sort eclipse facts

Sort each fact.

Sort: Happens at new moon · Happens at full moon · Moon's shadow falls on Earth · Earth's shadow falls on the Moon · Needs eclipse glasses to view · Moon can look red

Solar eclipse	Lunar eclipse
Happens at new moon Moon's shadow falls on Earth Needs eclipse glasses to view	Happens at full moon Earth's shadow falls on the Moon Moon can look red

6 Box 6

Legend: who can see it? 🏆 Legend only

Why can everyone on the night side of Earth see a lunar eclipse, but only a narrow path sees a total solar eclipse?

☐ Earth's shadow covers the whole Moon, but the Moon's small shadow only touches a small part of Earth
☐ Lunar eclipses last longer ☐ Solar eclipses happen at night

✓ **Earth's shadow covers the whole Moon, but the Moon's small shadow only touches a small part of Earth**

7 Box 7

Explain the rarity (CER)

Why don't eclipses happen every month?

Claim

Look for: Names the tilted orbit; at least 6 words

Evidence

Look for: Uses the near-miss evidence; Names the phases; at least 12 words

Reasoning

Look for: Explains alignment; at least 10 words

Exit ticket: answer the big question in your own words

What has to line up for a solar or lunar eclipse to happen?

Look for: A solar eclipse happens at new moon when the Moon passes directly between the Sun and Earth, casting its shadow on Earth. A lunar eclipse happens at full moon when Earth's shadow falls on the Moon. Because the Moon's orbit is tilted about 5°, the three usually don't line up exactly, so eclipses are rare.

Completion codes

Students see a code like **ABC-I3** when they finish. The first part must match below. The letter is the level (E = Explorer, I = Investigator, L = Legend), and the number at the end is how many stars they earned.

Level	Code starts with
 Explorer	1XJ-E
 Investigator	4OD-I
 Legend	12B-L

Watch for these misconceptions

- "There is no gravity in space." Gravity reaches across space; astronauts float because they are falling around Earth.
- "Moon phases are caused by Earth's shadow." Only lunar eclipses involve Earth's shadow.
- "Summer happens when Earth is closest to the Sun." Earth is closest in January. Tilt causes seasons.