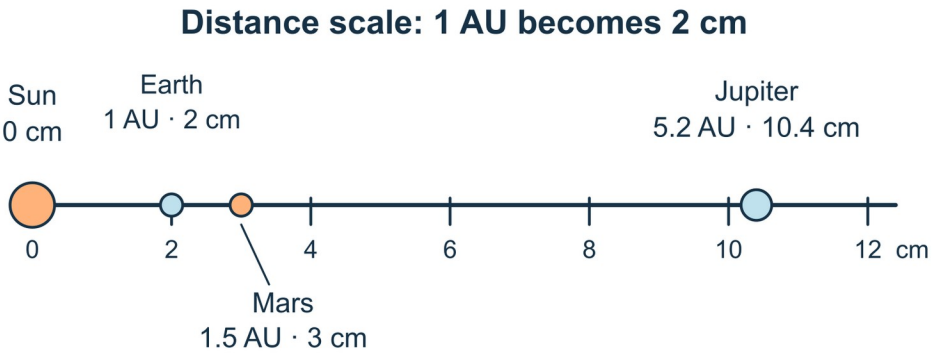
A space map with honest scale labels

Which comparisons can one small Solar System drawing show accurately?

Use rounded orbital-distance values to make a labelled scale line, and show which parts are not to scale.

Make | 15–25 minutes, or one calculation | The supplied example, read or heard, Optional scrap paper and a pen or pencil

Start here Use these rounded average distances from the Sun: Earth 1 AU, Mars 1.5 AU, Jupiter 5.2 AU. Let 1 AU occupy 2 cm on a model line.



One scale for rounded average Sun distances

1 Convert the values

Multiply each supplied AU value by 2: Earth 2 cm, Mars 3 cm and Jupiter 10.4 cm. A labelled sketch is enough if no ruler is available.

2 Place the markers

Start at a Sun reference mark 0. Put each distance marker the calculated distance along a single line. Treat this as a comparison of distances, not a picture of current planet locations.

3 Make simplifications visible

Use readable planet symbols and label ‘symbol sizes not to scale’. The supplied averages are rounded; planets travel around orbits rather than staying in this line.

4 Check one claim

Explain why Jupiter’s marker is farther along than Mars’s. Do not call the 1 cm gap between Earth and Mars markers their actual separation in space.

Worked scale 1 AU becomes 2 cm

This constructed distance line uses rounded NASA average values. It is not an observation of a real alignment.

• Earth: 1 × 2 = 2 cm; Mars: 1.5 × 2 = 3 cm.

• Jupiter: 5.2 × 2 = 10.4 cm from the Sun reference.

• All marks use one distance scale; their symbol sizes and current directions are not represented.

What this example can show The difference between two average Sun-distance markers is not a general Earth-to-planet distance. This line is not a sky chart or an observing instruction.

A different way

Use the printed line and compare labels, or explain just Earth and Mars aloud. A ruler, telescope and outdoor observation are unnecessary.

If you want to go further

Change the distance scale to 1 AU = 1 cm. Predict and calculate all three new positions; keep planet symbol sizes separately labelled.

Something to notice

Which distances share a scale, and which visual details are only symbols?

Read or explore more

Horizon topic Astronomy

https://launchhorizonhq.com/learn/astronomy/

Horizon topic Orbits Solar System

https://launchhorizonhq.com/learn/orbits-solar-system/

Horizon topic Galaxies Cosmic Scale

https://launchhorizonhq.com/learn/galaxies-cosmic-scale/

NASA Science Mars Facts

https://science.nasa.gov/mars/facts/

NASA Science Jupiter Facts

https://science.nasa.gov/jupiter/jupiter-facts/

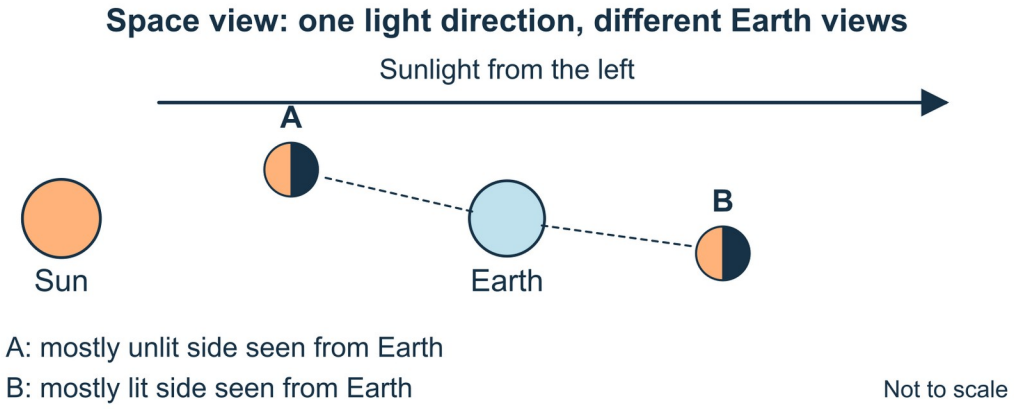
Read a Moon phase model

What can a labelled paper model explain about the Moon's changing appearance?

Read a space-view model to explain how our view of reflected sunlight changes as the Moon moves.

Explore | 10-20 minutes, or one explanation | The supplied example, read or heard, Optional scrap paper and a pen or pencil

Start here In the supplied model sunlight comes from the left. Mark the Sun-facing half of each Moon as illuminated, wherever the Moon is placed.



One light direction, two Earth views

1 Separate light from viewpoint

The Moon reflects sunlight. In this simple model its Sun-facing half is lit. That is different from how much of the lit half an observer on Earth can see.

2 Compare two positions

At A the Moon is on the Sunward side of Earth, so Earth sees mostly its unlit side. At B it is on the far side, so Earth sees mostly its lit side. Trace a line of sight from Earth.

3 Name what ordinary phases mean

Explain the change using viewpoint and reflected light. Ordinary phases are not caused by Earth's shadow; that is a different eclipse situation.

4 Add an honest label

Label the drawing 'space view, not to scale'. Its staggered positions are schematic; it does not show a real eclipse alignment, a date or how a phase is rotated in the Australian sky.

Constructed space view one light direction

The sketch places two possible Moon positions around one Earth. They are comparisons, not two Moons present at once.

• Sunlight travels from left to right; the left half of both Moon symbols is lit.

• A is on the Sunward side: the Earth-facing view contains mostly unlit surface.

• B is on the far side: the Earth-facing view contains mostly lit surface.

What this example can show The sketch omits orbital tilt, scale, dates and sky orientation. It explains a relationship, not tonight's phase or an eclipse prediction.

A different way

Point to the illuminated halves or have the model described aloud. No torch, dark room, ball or sky observation is required.

If you want to go further

Add a position roughly to one side of Earth's Sunward direction and explain why the view could show about half of the Moon's face lit. Keep sky orientation unspecified.

Something to notice

Did I keep the illuminated half separate from the part visible to the observer?

Read or explore more

Horizon topic Moon Phases

https://launchhorizonhq.com/learn/moon-phases/

Horizon topic Models Explanations

https://launchhorizonhq.com/learn/models-explanations/

Horizon topic Astronomy

https://launchhorizonhq.com/learn/astronomy/

NASA Science Moon Phases

https://science.nasa.gov/moon/moon-phases/

Science Education Resource Center, Carleton College What is a Model?

https://serc.carleton.edu/teachearth/teaching_methods/models/WhatIsAModel.html

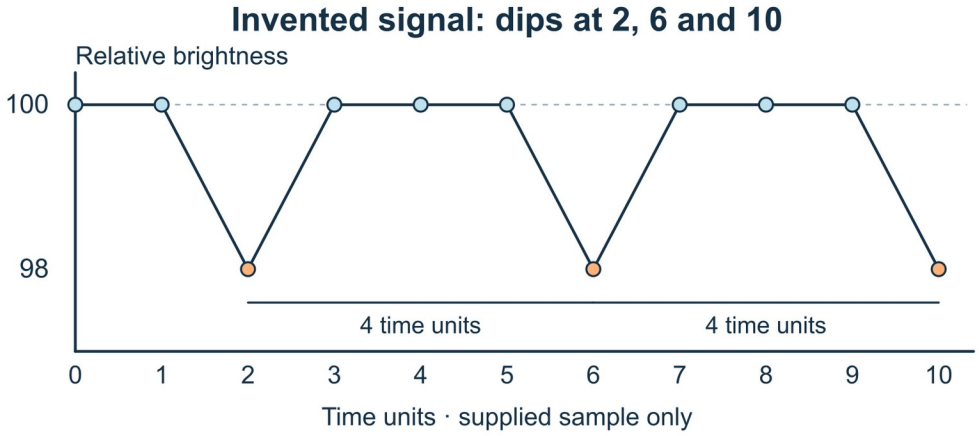
Find a pattern in an invented star signal

What might a repeated dip suggest, and what would still need checking?

Read a complete invented brightness series, identify a recurring gap and distinguish a pattern from a confirmed planet.

Investigate | 15–25 minutes, or three data points | The supplied example, read or heard, Optional scrap paper and a pen or pencil

Start here Use times 0 to 10. Brightness is 100 units at every time except 2, 6 and 10, where it is 98 units. These numbers form an invented signal.



Two equal gaps in an invented signal

1 Put the numbers on a graph

Draw time on the horizontal axis and relative brightness on the vertical axis, or read the supplied graph. Include every time 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

2 Find what repeats

Mark the three low readings. The gaps are 6 − 2 = 4 and 10 − 6 = 4 time units. Say ‘two equal gaps in this sample’, rather than claiming an endless pattern.

3 Make a conditional prediction

If the same spacing continues, the next dip would be at 14. Mark this as a prediction outside the supplied data, not another measured point.

4 Keep cause open

A transit can cause a dip in a real star’s measured light, but this invented pattern cannot confirm a planet. Name a next check, such as more readings and independent checks of the signal.

Invented data three dips

The complete series for times 0 through 10 is 100, 100, 98, 100, 100, 100, 98, 100, 100, 100, 98. Units are arbitrary.

• Low readings occur at 2, 6 and 10.

• The observed sample gaps are 4 and 4 time units.

• 14 is the next predicted dip only if that pattern continues; no value at 14 is supplied.

What this example can show The dataset is made up, so it is not a discovery. Repeating dips in actual observations would still need investigation and confirmation.

A different way

Compare only the labelled low readings or explain the pattern aloud. No calculations beyond the two gaps are required.

If you want to go further

Replace the final low-reading time 10 with 11 in a newly labelled dataset. Explain which equal-gap conclusion changes and why.

Something to notice

Where did my description of supplied data become a prediction?

Read or explore more

Horizon topic Exoplanet Detection

https://launchhorizonhq.com/learn/exoplanet-detection/

Horizon topic Stars Starlight

https://launchhorizonhq.com/learn/stars-starlight/

Horizon topic Statistics Data

https://launchhorizonhq.com/learn/statistics-data/

NASA Science What's a transit?

https://science.nasa.gov/exoplanets/whats-a-transit/

NASA Science Exoplanets: In Depth

https://science.nasa.gov/exoplanets/facts/