Introduction to our place in Space

Teacher background information

The Sun, Moon and Earth

The Earth is a planet in orbit around the Sun. This orbit takes slightly more than one year — 365½ days — so we add an extra day to our calendar, 29 February, in every fourth year, which we call a leap year.

As the Earth slowly orbits the Sun, it rotates on its axis once every 24 hours (a day). The rotation of the Earth causes the apparent rising and setting of the Sun and is the reason we experience alternating night and day. The tilt of the Earth’s axis does not change as it goes around the Sun. This causes the seasons.

The Moon is a satellite of the Earth. It orbits the Earth once a lunar month. The method of reckoning a lunar month varies from culture to culture and depends on the frame of reference, but the most common way of measuring (from New Moon to New Moon) is about 29½ days. Since calendars count full days only, most calendar months are around 30 days in length.

We always see the same face of the Moon from the Earth because the Moon spins on its axis once each time it goes around the Earth. We see the Moon from the Earth because the Moon reflects light from the Sun. The Moon itself does not emit light. The Sun is the only body in our Solar System that emits light.

The Solar System and beyond

The Sun, Earth and Moon belong to the Solar System, which includes all the space objects that are in orbit around the Sun. A ‘space object’ (or celestial body/heavenly body/space body) refers to naturally occurring objects in Space, such as planets, asteroids and comets. Space objects in the Solar System are visible because light from the Sun reflects off them to reach our eyes.

The Sun is the largest object in the Solar System, containing 99 per cent of its total mass. The Sun is so massive that the planets and asteroids of the Solar System are attracted to it and revolve in orbit around it. The whole Solar System is moving at great speed through the Galaxy. Our Solar System is part of the Milky Way Galaxy, which contains tens of billions of stars. Our Universe comprises billions of galaxies.

Nature of Science

As the Australian Curriculum: Science states, ‘Science investigations are activities in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem’. Theories can be tested through direct investigations, but also through comparing their explanatory power. The theory of space objects spinning around the Earth explained the apparent movements of the Sun, Earth and Moon, but as our observations improved, increasingly complicated addendums had to be invented to explain them.

The theory that the Earth is part of a system of planets rotating around the Sun provided simple explanations for all the observations and could accurately predict observations not yet technically possible.
When comparing theories about things that are too large to observe like the Solar System, or too small to observe like atoms, scientists use models to test their theories. The models might be:

- verbal descriptions, such as ‘The Earth travels around the Sun’
- 2D descriptions, for example, the drawing Eratosthenes makes for his companion
- 3D models, for example, the orreries that students create during the unit
- computer simulations, for example, the Stellarium and Celestia programs that can provide simulations of the sky for your particular region at different times.

All models are simplifications of reality, and their advantages and limitations need to be carefully judged before they are used to test theories. The use of models to test theories is different from creating communication devices to simply provide information.

Asking students to generate their own representations and then test them against observations is a very powerful teaching approach, particularly when students are introduced to other theories and the way those theories explain our observations. This is because students tend to centre on evidence that confirms their current beliefs, a common human fallacy called ‘confirmation bias’. Students do not consider the evidence that might also confirm other models, and do not seek to compare the models to identify the one that provides the greatest explanatory power.

**Students’ conceptions**

Taking account of students’ existing ideas is important in planning effective teaching approaches that help students learn science. Students develop their own ideas during their experiences in everyday life and might hold more than one idea about an event or phenomenon.

Students might think that the Earth is the centre of the Universe. They might believe this because the Earth feels like it is staying still while the Sun appears to move across the sky. However the Earth is spinning on its axis as it orbits the Sun. We do not feel these movements because gravity pulls everything towards the centre of the Earth.

Students might think that the Solar System is only made up of the Sun, the Moon and the planets. There are many other ‘space objects’ in the form of naturally occurring objects, such as asteroids and comets, and human-made objects, such as space stations, satellites and rockets.

Some students might think that the stars they see at night are a part of the Solar System. The Solar System consists of objects that orbit the Sun (‘solar’ comes from the Latin term for Sun). Many other stars have their own systems of planets and/or asteroids that orbit them. Space objects from our Solar System, such as planets and moons, are visible because they reflect light from the Sun. Stars are visible because they, like the Sun, produce their own light powered by nuclear fusion.

Many students hold non-scientific ideas about the size of objects in Space and the distance between them. For example, some students might believe that the Sun and the Moon are about the same size because they appear to be the same size in the sky. The Moon is actually much smaller than the Sun, but it is also much closer to Earth. These non-scientific ideas about size and distance in Space are often reinforced by representations, for example, in books and 3D models that are not made to scale.