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The Solar System

The Solar System is a collection of eight planets, more than 180 moons and millions of rocky comets and asteroids, all circling a star called the Sun. The Sun is so enormous that its gravity pulls smaller objects towards it – just like gravity on Earth keeps us pulled to the ground and makes objects fall. The Sun's gravity stops planets drifting off into space. Instead, the planets move around the Sun in roughly circular paths known as 'orbits'.

The four planets nearest to the Sun are Mercury, Venus, Earth and Mars. They are called rocky planets because they are made of rock and metal. A wide asteroid belt separates the rocky planets from the planets beyond them. These are the gas giants, Jupiter, Saturn, Uranus and Neptune. These enormous planets are called gas giants because they have no solid surface, as they are surrounded by layer after layer of clouds.

The Solar System is about 4.6 billion years old. It started as a cloud of gas which collapsed and started to spin. The gas and dust spread out, like pizza dough being spun in the air, and the Sun formed in the centre. The rest of the gas and dust made the planets and moons around it.

Key to plate

1: **The Sun**

2: **Mercury**
Distance from the Sun: 0.4AU (An Astronomical Unit (AU) is the distance from Earth to the Sun). Orbital period (the time it takes to orbit the Sun once): 88 Earth days

3: **Venus**
Distance from the Sun: 0.7AU
Orbital period: 224.7 Earth days

4: **Earth**
Distance from the Sun: 1.0AU
Orbital period: 365 Earth days

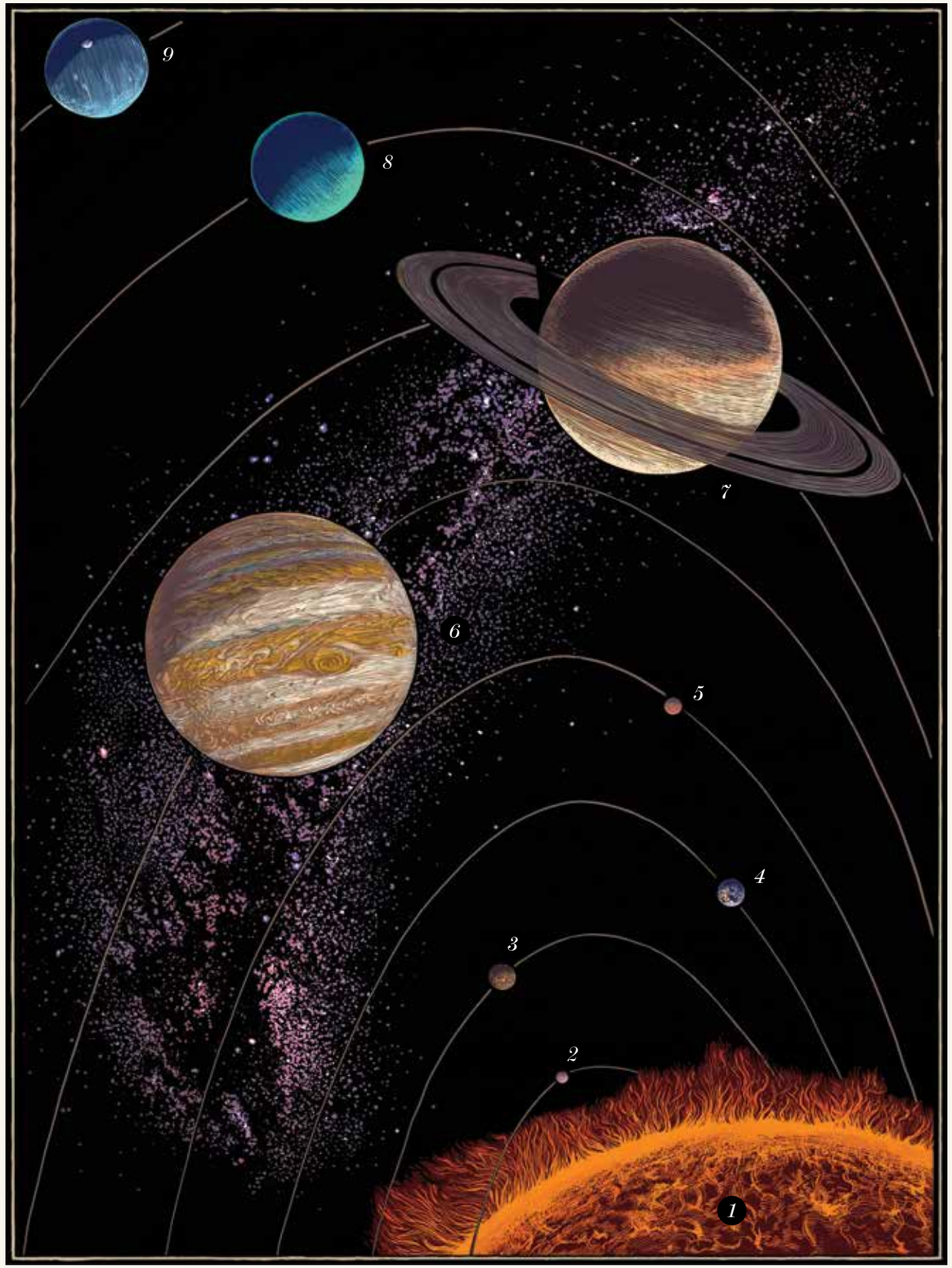
5: **Mars**
Distance from the Sun: 1.5AU
Orbital period: 1.8 Earth years

6: **Jupiter**
Distance from the Sun: 5.2AU
Orbital period: 11.9 Earth years

7: **Saturn**
Distance from the Sun: 9.6AU
Orbital period: 29.4 Earth years

8: **Uranus**
Distance from the Sun: 19.2AU
Orbital period: 84.1 Earth years

9: **Neptune**
Distance from the Sun: 30.1AU
Orbital period: 164.8 Earth years



The Sun

At the centre of our Solar System is the Sun, a star which has been shining for 4.6 billion years. It is constantly emitting heat and light, burning with as much energy as 100 billion tons of dynamite exploding every second. It is also the largest object in the Solar System, so big that Earth would fit inside it 100 times.

Because it is so far away and so hot, nobody has ever been able to visit the Sun. Everything we know about it comes from carefully watching its surface. For instance, astronomers listen to the 'music' of the Sun by studying the sound waves which bounce inside it. The reflection of these sound waves makes the Sun's surface vibrate very slightly, and the rising and falling of this layer can be measured. From this, we know that the Sun has lots of different layers beneath its surface.

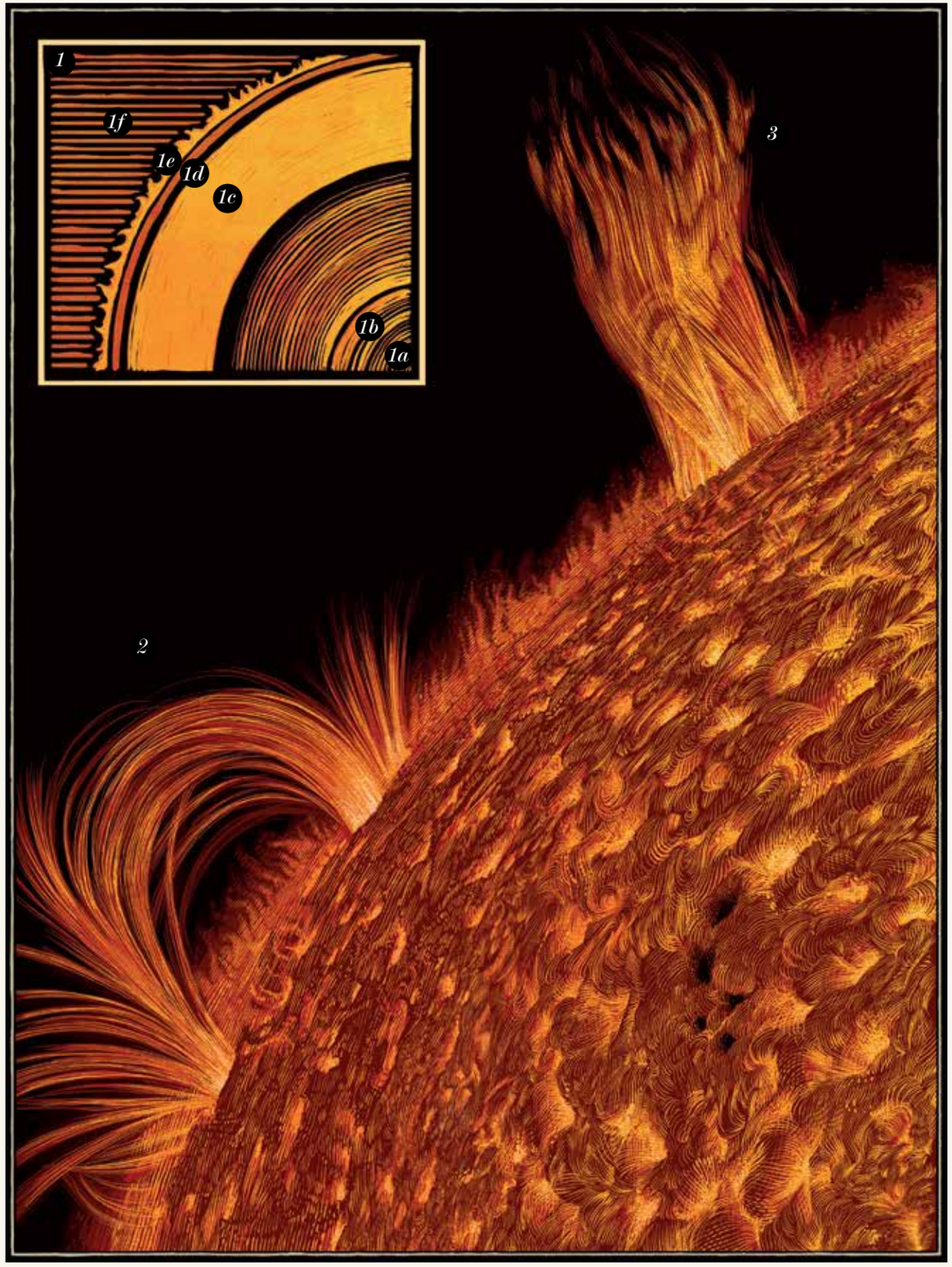
The layer of the Sun that we see, the photosphere, is an incredible 6000°C. But the deeper you go into the Sun, the hotter it gets. Its innermost region (the core) is an incredible 15 million°C. Here, it is so hot and the pressure is so great, that hydrogen atoms fuse together to make helium. This process, called nuclear fusion, releases lots of energy – and it is this that makes the Sun shine.

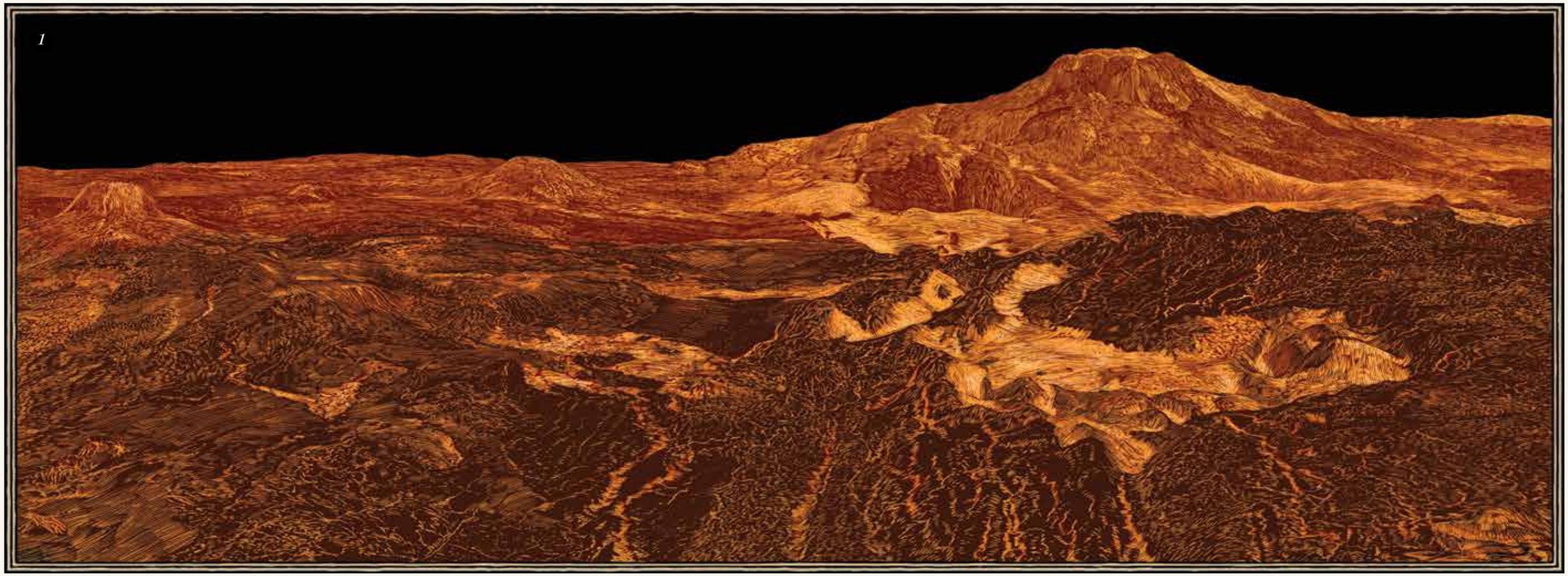
Key to plate

1: **Layers of the Sun**
a) The core – the innermost part of the Sun
b) The radiative zone
c) The convective zone
d) The photosphere: the visible surface of the Sun
e) The chromosphere – this cannot easily be seen due to the brilliant light from the photosphere
f) The corona – a thin atmosphere of very hot gas

2: **Coronal loops**
Coronal loops are loops of hot gas that arc from the Sun's photosphere.

3: **Solar flares**
Eruptions on the Sun's surface are called solar flares.





Venus

Venus is the second planet from the Sun, and the hottest planet in the Solar System. It is surrounded by a layer of thick, poisonous clouds. These act like a greenhouse, trapping heat from the Sun so that it builds up, making temperatures of up to 462°C – hot enough to melt metal.

It would be impossible for humans to survive on Venus. The planet's terrific surface pressure would crush anyone who landed on it, the carbon dioxide atmosphere would be deadly to breathe, and the intense heat would boil you alive!

Venus is the second brightest object in our skies, but looking at it through a telescope we can only see its cloud cover, and none of its actual surface. In order to see beneath the clouds, we rely on spacecraft called probes, which can fly close to planets. The Magellan and Venus Express spacecraft have both been around Venus. They used radar (bounced radio waves) to reveal its features, including old volcanoes, giant sand dunes, wide plains and high mountains.

Key to plate

1: **Venus**
Diameter: 12,104km
Orbital period (year): 224.7 Earth days
Rotation period (day): 5832.5 hours
Known moons: None
Venus was named after the Roman goddess of love.
This illustration is based on images taken by space probes, showing large volcanoes on Venus's surface.

Earth

Our home planet is the only place in the Solar System where life is known to exist. When it formed 4.6 billion years ago, it was just a boiling hot ball of rock, but today it contains rich habitats from jungles to deserts, and supports around two billion different species.

Earth is unique in the Solar System for its oxygen-rich atmosphere, and for all the water covering its surface. Without Earth's atmosphere we could not survive. It contains the oxygen we breathe, but also acts as a shield against harmful rays from the Sun, and burns up meteors as they approach. Earth's liquid water is also crucial for life on our planet. Scientists think it was brought here billions of years ago by icy comets from the edge of the Solar System.

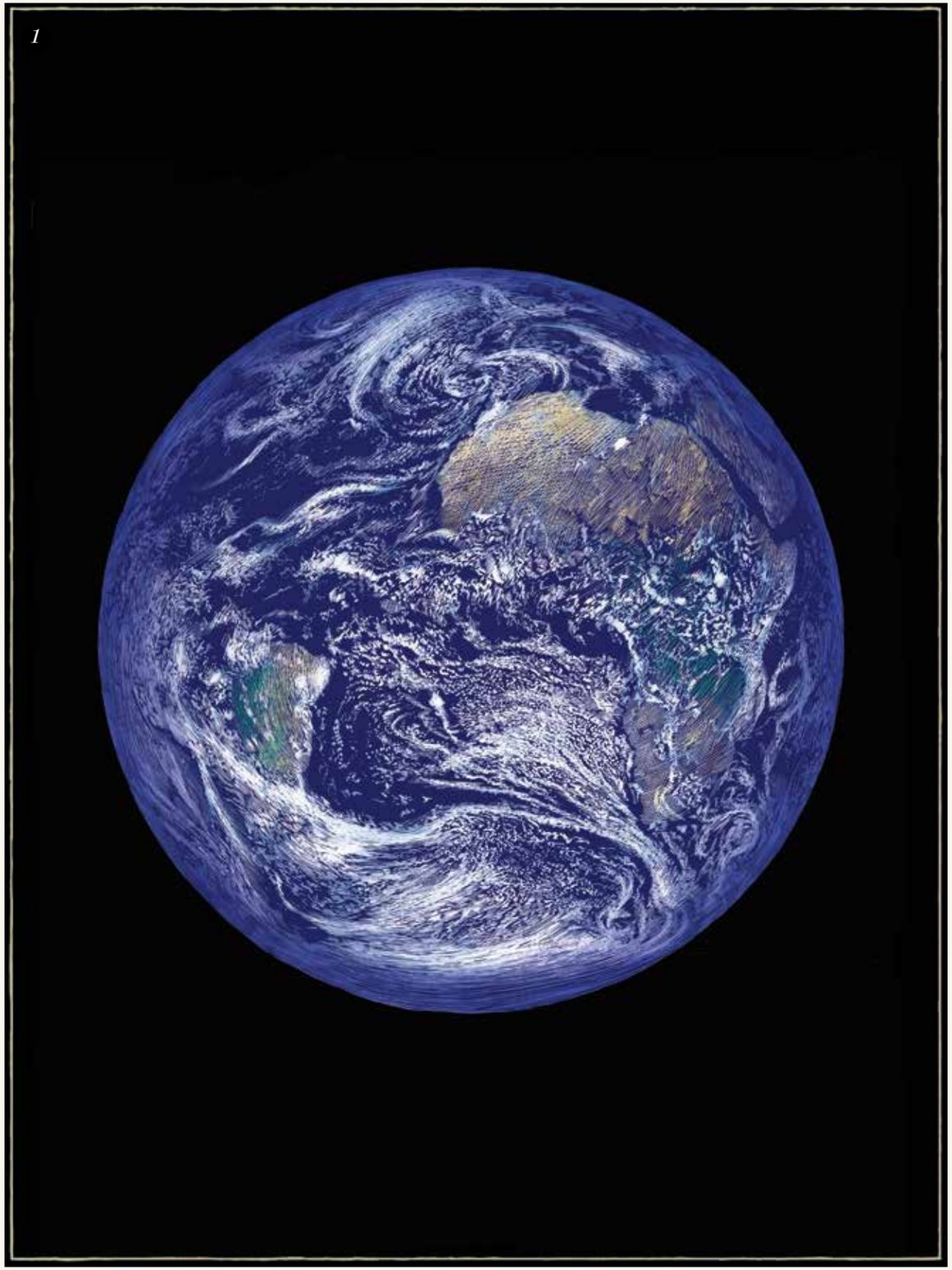
Beneath Earth's surface, its interior is split into several layers. In the very middle is its core, a solid ball of iron as hot as the Sun's surface. Above this is the outer core, where whirlpools of molten iron make Earth's magnetic field (an invisible force field stretching around the planet). Above the core is Earth's thickest layer, the mantle, formed of rock so hot that it starts to flow like a liquid. And last of all is the fine outer layer of the crust.

The crust and part of the mantle form huge slabs called tectonic plates. These shift over the molten part of the mantle, moving just a few centimetres a year. This slow movement is responsible for volcanic eruptions, earthquakes and for the slow growth of new mountains.

Key to plate

1: **Earth**
Diameter: 12,756km
Orbital period (year): 365 Earth days
Rotation period (day): 23.9 hours
Known moons: One

In images taken from space, Earth is sometimes called a 'blue marble'. It appears this way because blue light from the sky is reflected off its watery surface. Almost three-quarters of Earth's surface is covered with water, most of it in the planet's oceans.



The Moon

Our planet has just one natural satellite – a rocky object we call the Moon. Our Moon is covered in powdery soil, craters, dead volcanoes and wide flat plains. From Earth, the plains appear as shadowy areas, whereas the mountains appear much brighter. The lunar plains are known as *maria*, which is the Latin word for 'seas'.

When the Moon appears to shine, it is in fact reflecting the Sun's light back at us. Viewed from Earth, different amounts of its surface are lit up as the Moon orbits, creating the phases of the Moon. Although this makes our view of the Moon appear to change through the month, we only ever see one side of it. This is because the Moon takes exactly the same time to spin on its axis (middle) as it takes to complete a single orbit of the Earth (around 27 days).

Beyond Earth, the Moon is the only object in space where humans have set foot. Only six manned Moon landings have taken place, starting with Neil Armstrong and Buzz Aldrin in July 1969 and ending with Eugene Cernan and Harrison Schmitt in December 1972. The rest of us can only imagine what it would be like to stand on the Moon and watch our planet from a distance.

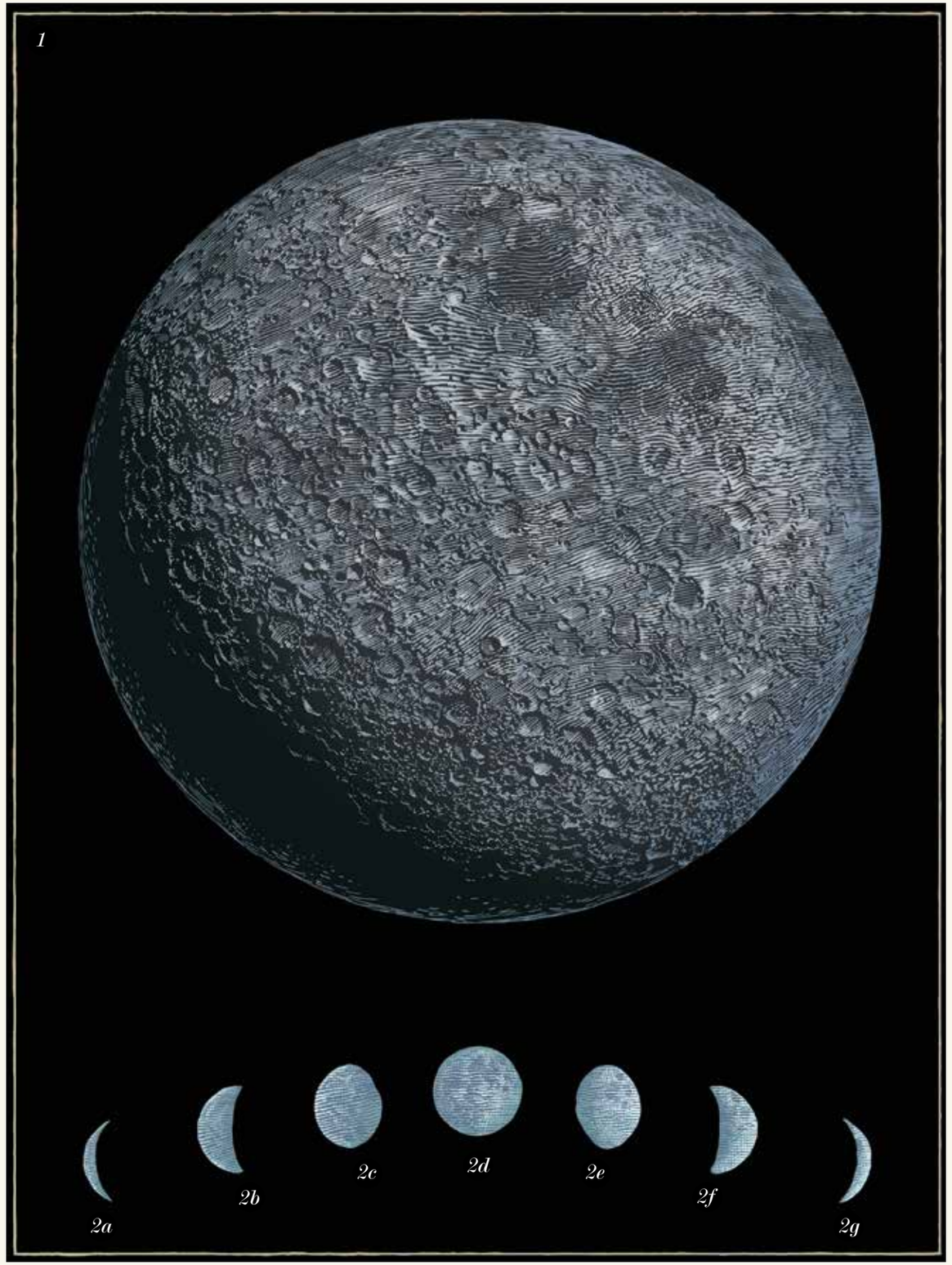
Key to plate

1: **The far side of the Moon**
This image shows the far side of the Moon, which is never seen from Earth. It is covered in many more craters than the side that we can see from Earth.

2: **Lunar phases**
The Moon's appearance from Earth constantly changes as it orbits our planet. These changes are known as lunar phases. During the first phase, the new moon, the Moon reflects no light so is invisible to us. After this we see:

a) Waxing crescent
b) First quarter
c) Waxing gibbous
d) Full moon
e) Waning gibbous
f) Last quarter
g) Waning crescent

This cycle ends with a return to a new moon, and takes an average of 29.5 days to complete.



Saturn

Saturn is the sixth planet from the Sun. It is a huge gas giant surrounded by beautiful, bright rings. Although the rings look solid from a distance, up close they are made of billions of ice particles, along with fine dust and house-sized boulders. Scientists think the rings formed when a moon drifted too close to Saturn and was broken up by the planet's gravity.

Like the other gas giants, Saturn is a huge ball of gases and liquids. It is mostly made up of hydrogen and helium, which are some of the lightest gases in the Universe. In fact, Saturn would float in water if you could find a bathtub big enough to hold it!

Saturn is surrounded by more than 60 moons. Its moon Titan is the second largest moon in the Solar System. Scientists are very interested in this moon because it looks a lot like Earth did at the time when life first appeared on our planet – it might even be home to extraterrestrial life.

Key to plate

1: **Saturn**
Diameter: 120,536km
Orbital period (year): 29.4 Earth years
Rotation period (day): 10.7 hours
Known moons: 62
The Romans named Saturn after the father of Jupiter in mythology.
a) The planet viewed top-down
b) The planet viewed edge-on