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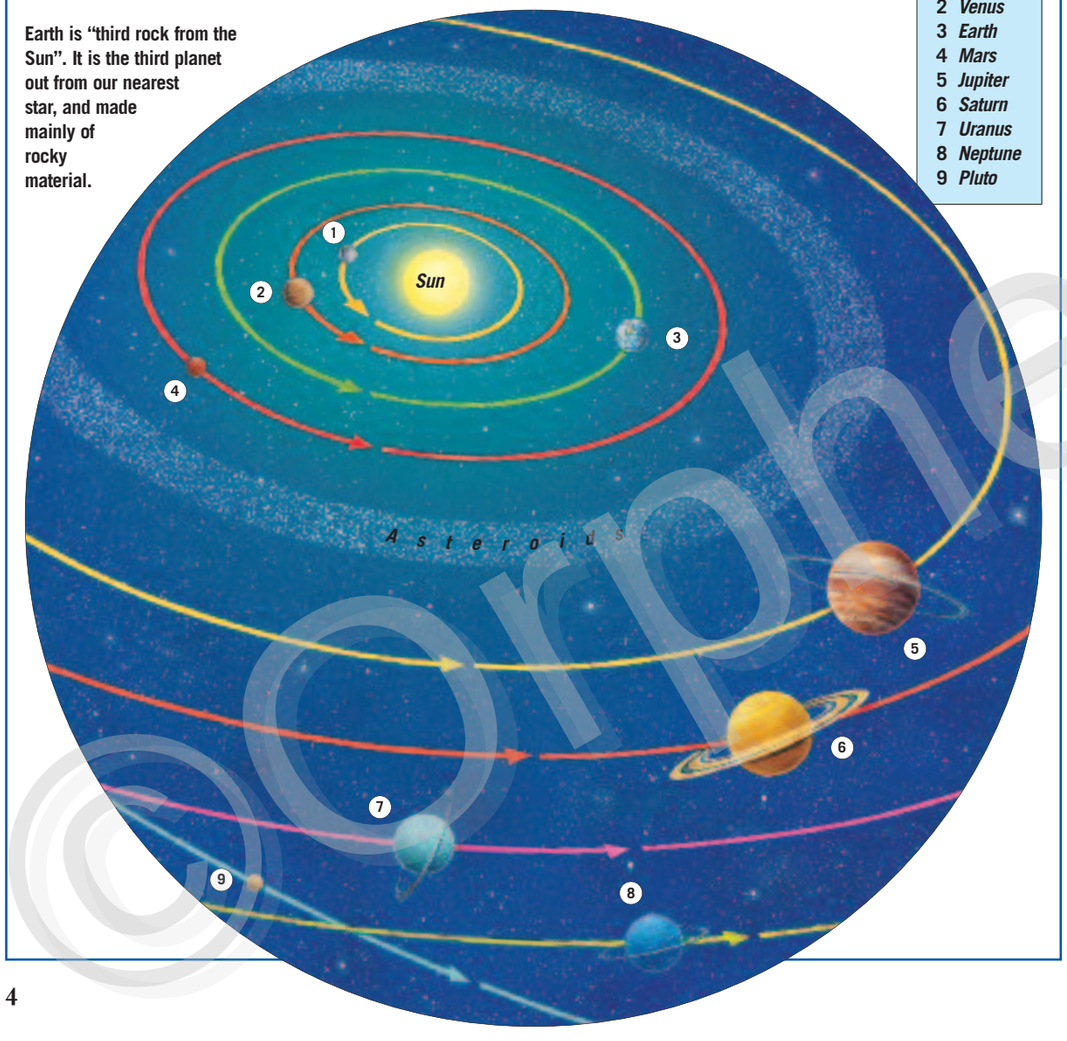
PLANET EARTH

OUR PLANET EARTH is the fifth largest of the eight planets which go around, or orbit, our nearest star—the Sun. The Earth speeds through space at about 30 kilometres every second, taking one year to complete one orbit. In addition the planet spins round like a top once every 24 hours. This makes the Sun appear to rise at dawn, pass across the sky and set at dusk, giving us day and night. The Earth is not quite a perfect ball or sphere shape. It is 12,756 kilometres across its Equator (middle) and 12,714 from Pole to Pole (top to bottom). The distance around the Equator is 40,075 kilometres, and 40,008 from one Pole around to the other and back again.

Earth's closest neighbour in space is the Moon. It is 3475 kilometres across, about a quarter the width of Earth. Its volume is around one-thirtieth that of Earth. The rocks which make up the Moon are not as heavy or dense as Earth rocks, so the Moon weighs only one-eightieth as much as the Earth.

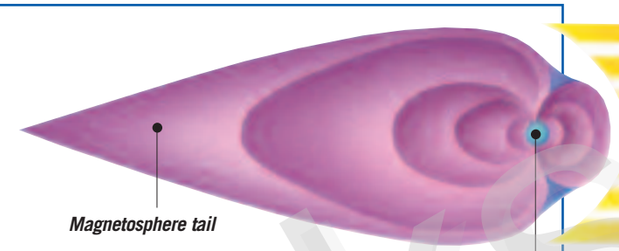
Earth is "third rock from the Sun". It is the third planet out from our nearest star, and made mainly of rocky material.



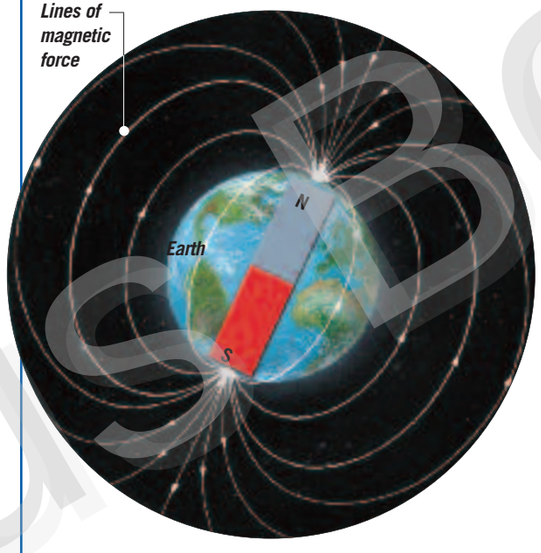
KEY
1 *Mercury*
2 *Venus*
3 *Earth*
4 *Mars*
5 *Jupiter*
6 *Saturn*
7 *Uranus*
8 *Neptune*
9 *Pluto*

MAGNETIC EARTH

THE EARTH has its own magnetism—an invisible field of magnetic force all around us. Too weak to notice in daily life, the magnetic field affects iron-based materials and other magnets. We can detect it using a magnetic compass. The compass needle is a long, thin magnet that lines itself up with Earth's magnetism to point north-south. This helps us to read maps and find our way in remote places.



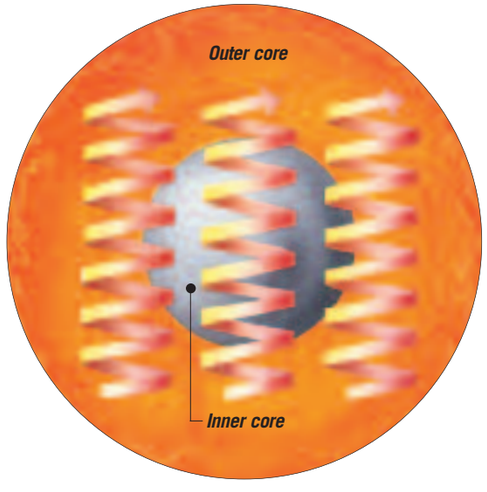
Earth's magnetism extends into space as the magnetosphere. High-energy particles from the Sun, the solar wind, "blow" against one side and make it teardrop-shaped.



The Earth's magnetic field is strongest at two places, the North and South Magnetic Poles, where it is directed straight down into the ground. It is as though there was a giant bar magnet inside the planet.

The Earth's magnetic field is probably created by forces produced in the outer core, a layer of iron that lies some 2900 kilometres below the surface *(see page 6)*. Because of extreme pressure at this depth, it is incredibly hot—more than 4000°C. At this temperature, the iron is liquid. Heat currents cause the liquid metal to swirl around. The currents are themselves twisted by the spinning motion of the Earth into corkscrew-like patterns, called "rollers". These giant movements make electricity which, in turn, creates a magnetic field.

The magnetic field stretches into space and protects us from the Sun's high-energy particles. Some are attracted by the magnetic poles, however, and produce giant curtains of glowing light in the night sky, known as aurorae *(above)*.



Scientists believe that massive amounts of flowing heat energy inside the Earth, combined with the planet's daily spinning motion, make the semi-liquid rocks flow in spiral patterns. These generate electricity, producing a magnetic field.

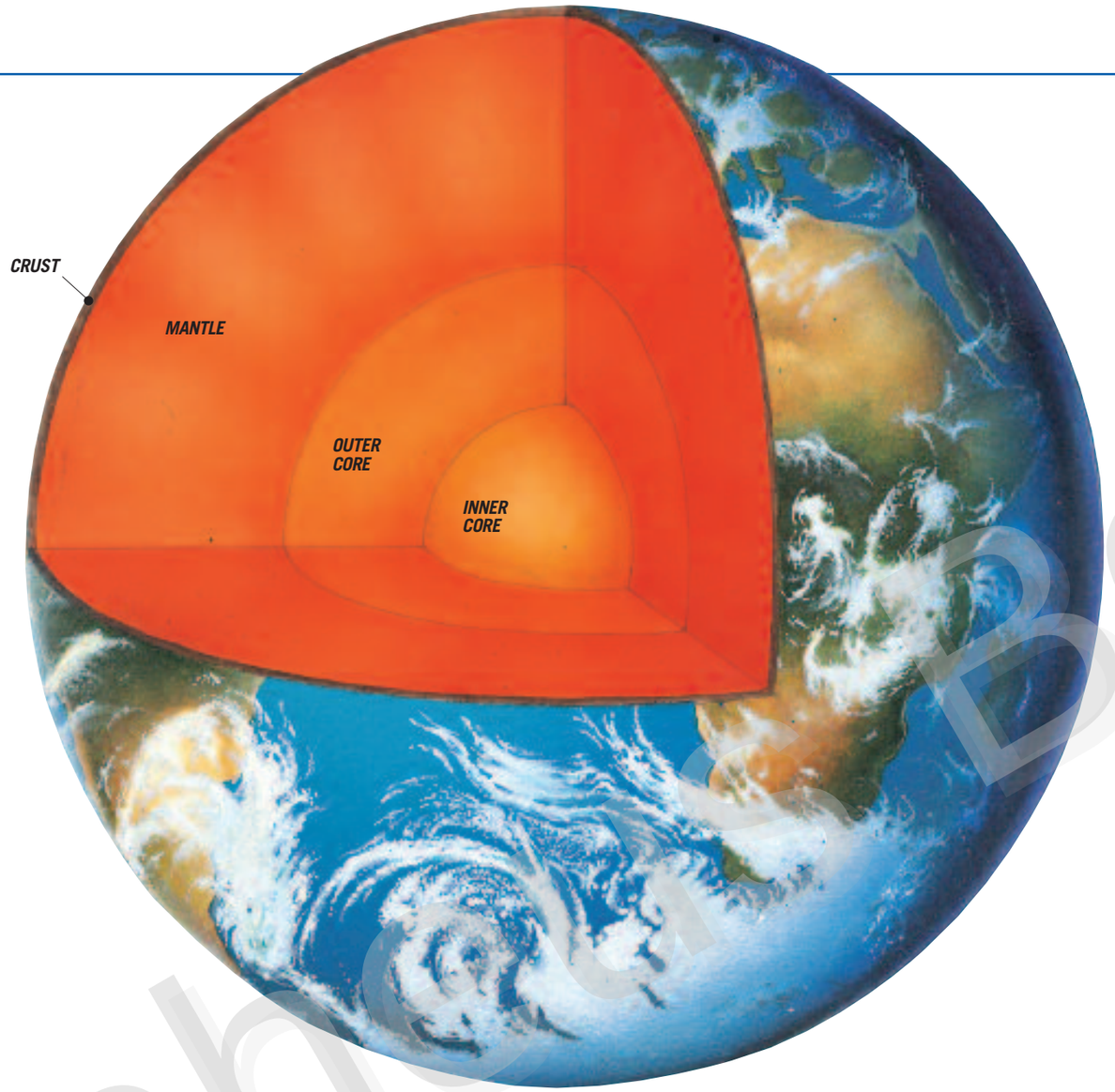
EARTH

Inside the Earth

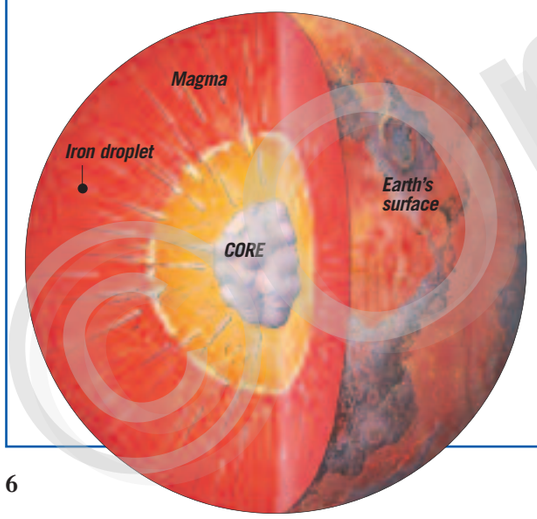
ON THE OUTSIDE, the Earth seems hard and solid. But if you could drill a deep hole almost 6400 kilometres down to the centre of the planet, you would notice many changes as you descend. It becomes warm, then hot. The average increase in temperature is about 3°C for every 100 metres of depth. Soon it is so hot that the rocks are not solid but melted or molten. You pass through the various layers of rocky material, from the hard crust on the outside, through the very thick mantle, to the liquid outer core. When you reach the inner core at the centre there is no rock at all. The core is made of almost solid metal.

The Crust

No-one has bored a hole nearly this deep. The farthest we have drilled down is about 15 kilometres, which is part way through the crust. The crust is thinner in proportion to the whole Earth than the skin on an apple. The crust itself is solid rock and varies in depth. Under the oceans it is about 5-10 kilometres thick (with the ocean above) and made mainly of basalt-type rocks. Under the main land-masses or continents it is 35-70 kilometres thick and chiefly granite-type rocks. The taller the mountains above, the deeper the crust below. The crust is not one solid ball-shaped shell. It is cracked into large slowly-moving plates *(see page 8).*



The four main layers of the Earth *(above)* are the crust, mantle, outer core and inner core. At the base of the crust is a boundary called the Moho (Mohorovicic discontinuity). This separates the crust from the mantle and the temperature here is about 1500°C. The mantle is about 2900 kilometres thick. The next layer is the outer core which is 2200 kilometres thick. At the centre is the inner core, a solid ball of iron with a radius of about 2500 kilometres.



Some 4600 million years ago the Earth (along with the Sun and other planets) formed from clouds of gas and dust in space. Some of this matter clumped together to form the early Earth, which warmed up and glowed red hot. Iron was the heaviest substance so it began to sink through the molten magma as droplets. These collected into drops, then larger blobs. Gradually they clumped at the centre of the young planet to form the inner core *(left).*

The Mantle

The mantle also has two layers. Its outer part is about 600 kilometres thick and made of crystals of rock with molten or liquid rock between them. Its temperature is about 2000°C and the molten rock, known as magma, can flow like hot tarmac. It is under great pressure and sometimes bursts out of holes or cracks at weak points in the surface of the crust, as the red-hot lava of volcanic eruptions. The pressure in the inner mantle is so great that the rock here is solid—but not completely rigid. It is "plastic" and, very gradually, moves.

The Core

At the base of the mantle, there is a sudden change. The material is no longer rock, but metal—mainly iron plus small amounts of nickel. In the outer core, the temperature rises with depth to more than 3000°C near the boundary with the inner core. The iron of the outer core is liquid, and flows in giant corkscrew-like currents or "rollers". These probably produce the magnetic field of the Earth *(see page 5)*. The temperature rises still more at the inner core, to perhaps up to 7500°C at the centre of the planet. But the enormous pressure—several million times that at the surface—means that the iron crystals are squashed into a solid ball.

How do we know about the Earth's interior, if no-one has ever drilled deep into the Earth? Evidence comes from the way that shock waves from earthquakes pass around and through the Earth *(see page 13),* and from studying meteorites. Some earthquake shock waves do not travel through the outer core, telling us that this part is liquid. We know the core must be made of iron because we can compare it with the composition of iron meteorites, thought to be the remnants of the core of an ancient, Earth-like planet which broke up long ago.

Heat flows within the Earth, and slowly from the centre to the outside, by the movements of the molten and "plastic" rocks in the mantle. These flow in giant circles, called convection currents. Their motion causes continental drift and seafloor spreading *(see page 8).*