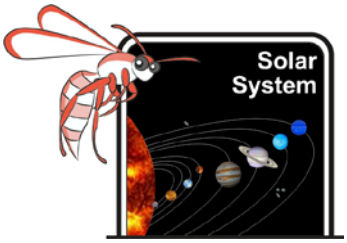


Earth's Lifeguards – Teacher Notes

Our Sun is a star, and like all stars its heart is a giant thermonuclear reactor, which smashes small atoms together to make larger atoms. Almost all of Earth's heat and light comes from the left over energy created by this reaction in the Sun. We call this outward flow of electromagnetic radiation from the sun a *solar wind*. This wind "blows" out into the Solar System until somewhere beyond Neptune and Pluto it loses energy where its flow is countered by incoming cosmic radiation from other stars; this place in space is called the *heliopause*. All planets, moons, comets, and asteroids in our solar system are bathed in this solar wind.

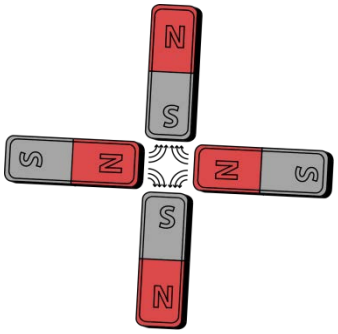
To support life, planets need to be just the right distance away from their star: far enough away so they don't get too hot, and close enough so don't get too cold. This distance from a star is called the *Goldilocks Zone*, after the story about Goldilocks and the Three Bears.

Life also needs planets which have shields to protect life from most of the solar wind; too much solar wind can damage plants and animals. Earth's shield is called the *magnetosphere*, and it sits outside our atmosphere deflecting the solar wind from reaching the surface.

Earth's magnetosphere extends beyond the atmosphere and is the first of two shields that protect life on Earth. The magnetosphere shields our home planet from radiation from our sun and from other stars. The magnetosphere also protects our atmosphere from erosion by solar wind. We can use the lines of magnetic force and a compass to find our way about the Earth. The magnetosphere is produced by the liquid outer core of the Earth, which is made of mostly nickel and iron.

Magnetic fields are energy fields. They cannot be seen themselves but can be inferred by their effect on something else. The North Magnetic Pole and South Magnetic poles wander about a bit and sometimes even exchange locations or flip. The geographic north and south poles remain constant.

Task 1: Making the invisible magnetic field visible



Note: Iron filings are very difficult to remove from magnets. If the magnets are first wrapped in plastic, then, after roughly removing filings with fingers, unwrap the plastic and move it away from the magnet. The plastic parcel will hold the remaining filings ready for disposal. The magnet remains clean.

Earth's Lifeguards – Teacher Notes

Materials

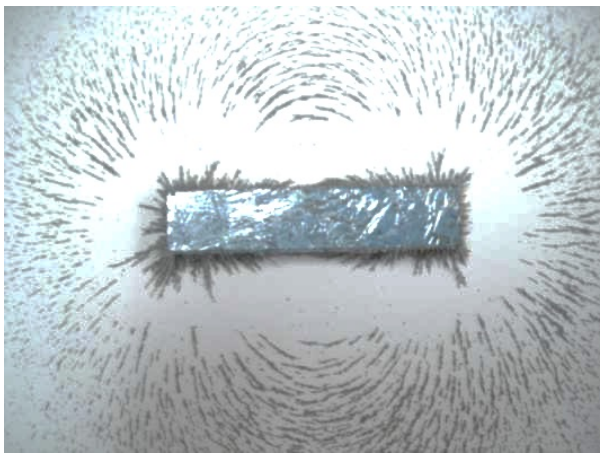
- 1 bar magnet (preferably wrapped in Cling wrap plastic)
- Iron filings - can be bought from hardware shops. They usually come in shakers but a teaspoon will work as well
- A sheet of white A4 paper

Method

1. Place the magnet on the desk and cover with the paper. The magnet should be centrally placed under the paper.
2. Gently shake the filings over the general area of the magnet.
3. Note the pattern formed by the filings under the influence of the magnetic field. This represents the magnetic field around Earth
4. Sketch this in the space provided below.
5. Return the filings to their container.

Observations

Sketch the pattern of the iron filings made by the magnet below:



Discussion

Can you see the magnetic field?

No, but we can infer where it is because of its effect on the filings.

Earth has a force field round it just like the magnet.

Task 2: Earth's magnetic field diverts incoming radiation from the Sun

Note: The north poles of magnets are usually marked with an "N", a coloured dot or an indentation.

Materials

- Two bar magnets.
- A sheet of white A4 paper.
- Iron filings.

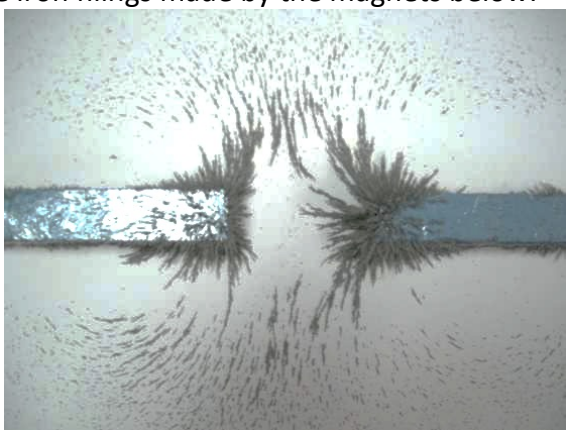
Earth's Lifeguards – Teacher Notes

Method

1. Align the magnets with their north poles facing each other.
2. Sprinkle the iron filings over the magnets.
3. Note the effect of the magnetic field of the magnets on each other.
4. Sketch this in the space provided below.

Observations

Sketch the pattern of the iron filings made by the magnets below:



Discussion

Can we see the magnetic fields?

No but we can infer where it is because of its affect on the filings.

What effect did the opposing magnetic fields have on the iron filings?

They were repelled.

Earth's magnetic field repels most of the solar wind round the planet and off into space.

Spectacular science: the Aurora Borealis and the Aurora Australis

Tourists travel towards the north and south poles during winter to see amazing natural light shows in the night sky. Near Earth's magnetic poles, the magnetosphere is weaker, and lets ionized particles enter the upper atmosphere, which produces spectacular light displays. The displays are a bit like watching a huge gas fire, as sheets of blue, green and yellow colours pass across the sky like billowing curtains. The Aurora Australis is occasionally visible from the southern half of Western Australia.

Earth's Lifeguards – Teacher Notes

The ozone layer: Earth's atmosphere as a shield

Our upper atmosphere has a layer of ionized oxygen (O_3) that repels some of the ultraviolet radiation emitted by the Sun. This radiation can cause cancers and other mutations in living things. UV radiation penetration increases towards the magnetic poles where ozone is thinnest. In the late 20th century, CFCs (chlorofluorocarbons) synthetically made by people for use in refrigerators and aerosols damaged the ozone layer. A global reduction and ban on the use of CFCs in refrigerants and aerosol propellants has slowly reduced the size of the hole in the ozone layer.