Teaching Notes

Aliens!
Instruction Sheet and Guidance

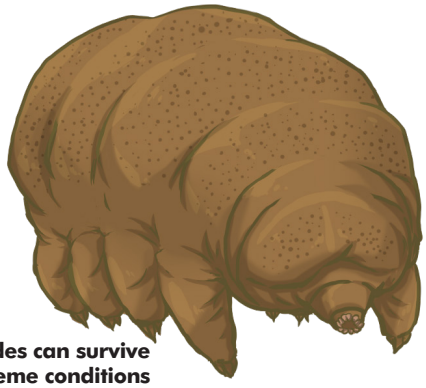
These notes accompany the section titled 'Aliens!' to support teachers in carrying out the activities. They provide background information, tips for advance preparation, opportunities for cross curricular links and a suggested reading list and useful website links for enrichment.

Background information

Scientists have long believed that it is possible that life exists or once existed on Mars. Its surface shows evidence of liquid water at some time in the past and so microorganisms may once have thrived. Due to the lack of atmospheric pressure, water cannot remain in liquid form, except when buried under ice. There is a permafrost layer just a few centimetres below the surface and salty water below that. No proof of life has yet been found but ExoMars's high-tech new rover Rosalind Franklin may uncover new evidence. The new rover is special because it can drill two metres below the surface; this is far enough down for life to be protected from the intense radiation above the surface. Many people are excited about this new mission as it gives us the best chance so far of finding alien life!

Bacteria called exoelectrogens have been discovered that make electricity and they could help humans to live on Mars. They connect with one another and grow on rocks by producing very thin wires called nanowires through a slimy biofilm. A biofilm is a slimy mix of fats, proteins and sugars in which bacteria live together. Dental plaque is an example of this.

Astronauts conduct experiments on the International Space Station



Tardigrades can survive extreme conditions

Activities

Pupils age 5 to 7 are introduced to a selection of extreme environments on Earth and learn that extremophiles are living things that can survive such places. They investigate life that can be found under the soil in the local habitat, and take part in a comparative investigation involving earthworms. Finally, they learn about the geography and features of Mars, and consider what kind of living things would survive on the red planet.

Pupils age 7 to 11 discover that some microorganisms are able to produce electricity and they could be useful for future Mars exploration. They investigate materials that conduct electricity, including smart materials such as electric playdough as 'nano wires' and light emitting diodes, and use them to complete a circuit.

Experiments on growing bacteria are being conducted on the International Space Station (ISS). Bacteria grown in space in a microgravity environment exhibit a number of different behaviours. These include a higher growth rate and enhanced biofilm formation. The bacteria also become better at infecting or damaging hosts and are less affected by antibiotics.

phys.org/news/2018-06-electricity-producing-bacteria-power-future-space.html

Video introductions to exoelectrogens and the ISS:

www.youtube.com/watch?v=KhsCg7pmv0o&feature=youtu.be

www.space.com/38922-extraterrestrial-bacteria-international-space-station.html

www.nasa.gov/mission_pages/station/research/experiments/983.html

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Activity for 4 to 7 year olds

You may wish to spend some time during the start of the lesson or during the plenary, to tour some of the geographical surface features of Mars using this links:

Video showing features and facts about Mars: www.mrnussbaum.com/space/mars/

Teacher support materials

Website filled with games, activities and video clips, including exploring a Mars map and geographical features: mars.nasa.gov/participate/funzone

These images show bacteria growing in slime called a biofilm:

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcSgAo41wyyOrXQCMjVsXTycn4_fOX7sBokVMA2Z-MwddeCLqf4W

https://3c1703fe8d.site.internapcdn.net/newman/csz/news/800/2018/couldelectri.jpg

Advanced preparation

Watch the Paxi video animation (see useful links on page 4). You may wish to use just a short section.

Prepare the materials for the worm investigations. To collect worms, thoroughly water a patch of soil or grass. Worms will come to the surface to breathe. Alternatively, try covering a patch of grass or soil with cardboard. Worms may gather under the cardboard.

If you decide to involve the children in the collecting of worms from the school garden and looking at life under the surface, you may wish to do this as a separate lesson the day before the investigation. Keep the worms overnight in a cool, dark place in a container with a lid with air holes, filled with damp soil.

> ***Health and safety:*** *Ensure that the children either wear disposable gloves when handling soil or thoroughly wash their hands after the activity.*

When investigating conditions preferred by worms, place two or three worms in the centre of the tray to start, begin timing, observe the worms moving and stop after a set time. Five minutes should be long enough. The children could draw the positions of the worms at the end of the set observation using Activity sheet 1a.

Crater Rim on Mars

Further activities: Setting up a wormery

You will need:

- A clear plastic container such as a sweet bottle (or plastic bottle with top section cut off)
- Sand
- Gravel
- Soil
- Leaves
- Water
- Grass clippings

What to do:

1. Put a layer of gravel or small stones at the bottom of the container and then alternate layers of soil and sand.
2. Water lightly, gently add a few worms and then place leaves, grated carrot, vegetable peelings and grass clippings on the top.
3. Screw on the lid (or replace the top cut off section of the bottle, adding a slit to allow the top to slip over the bottle) after ensuring there are holes in it to allow the worms to breathe.
4. Keep in a cool place out of sunlight. You could wrap the container in black paper to keep out the light.

What you should see:

The soil and sand layers should mix up and the leaves and grass should be pulled down into the soil. Return the worms to the garden after one week.

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Cross curricular links

English:
- Writing for a range of purposes and in different forms (including worm shaped poems, diaries, reports, stories)

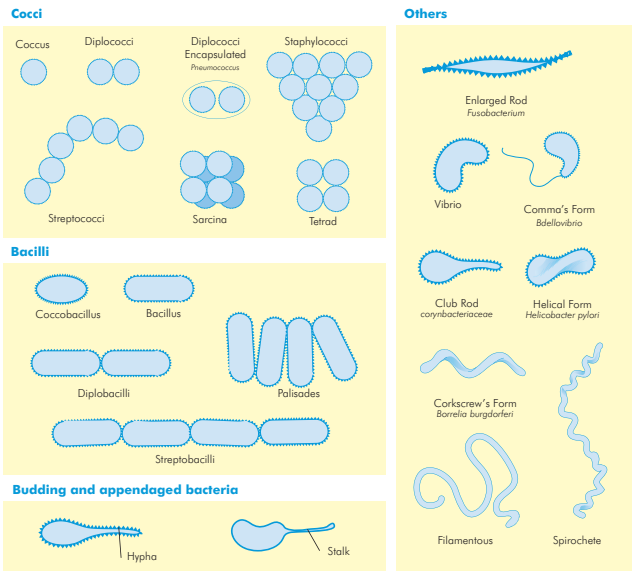
Computing:
- Make video clips of the investigations, undertake research about worms, using interactive games and video clips to learn about planet Mars

Design technology:
- Design a home for worms, evaluate and revise designs

Geography:
- Comparing and contrasting geographical features on Earth and Mars

Activity for 7 to 11 year olds

LEDs have one long leg and one short leg. Current can only travel through them in one direction, through the long leg and out through the short leg. In a series circuit, the positive or long leg of the LED is placed nearest to the positive terminal of the battery and the current travels through the LED, through conducting playdough to the next LED which must also be placed correctly.



Advanced preparation

Prepare playdough and test out the circuits with the LEDs before the lesson. Read the Health and Safety information from CLEAPSS on batteries and circuits here: http://science.cleapss.org.uk/Resource-Info/GL225-Batteries-for-general-practical-circuit-work.aspx

Bought Playdough will conduct electricity. Modelling clay such as plasticine will act as an insulator.

For powering a small LED circuit, a zinc carbon PP3 battery is suitable.

Activity

Make sure that the children do not make direct connections across both power supply terminals (eg by connecting each end of a cylindrical battery directly with a wire) causing a short circuit as this can drain the battery and cause heating. Emphasise that only certain kinds of bacteria, not all, produce electricity.

Further activities

One of the further activities involves additional research into different kinds of bacteria. The children might enjoy making their own models of bacteria; a sample is shown in the image below. Pour a thin layer of PVA adhesive into a petri dish. Bacteria of different kinds may be modelled by using rice for bacilli, small pompoms or peppercorns as cocci, twisted pasta could be used for spiral shaped bacteria.

This site has a good set of colourful images of main types of bacteria: http://ib.bioninja.com.au/standard-level/topic-1-cell-biology/12-ultrastructure-of-cells/types-of-bacteria.html

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Cross curricular links

English:
- Writing for a range of purposes and in different forms (including reports, instructions, information posters)

Maths:
- Shape
- Measurement

Design technology:
- Use of materials, designing and model making

Computing:
- Research, PowerPoint presentations, video and photographic evidence of activities, reports, programming, 3D printing

STEM clubs

Many of the activities here can be used as flexible STEM topics for after school science clubs, including: gardening, mini beast hunts and building wormeries, investigating circuits, testing a variety of conductors and model building

Useful links

ESA Paxi video animations: www.esa.int/spaceinvideos/Videos/2016/05/Paxi_-_Do_Martians_exist

NASA space place website: https://spaceplace.nasa.gov/all-about-mars/en

Interesting article about searching for life in outer space: www.airspacemag.com/space/life-in-universe-special-what-is-life-180958432

ESERO-UK, the European Space Agency's UK education resource office, has a wide ranging selection of free online resources: www.stem.org.uk/elibrary/resource/30199

Is There Anyone Out There? Activities for primary children based on searching for life on Mars: www.stem.org.uk/esero

Primary resources to support a wide range of topics including habitats, living things and electricity can be found on the stem e-library: www.stem.org.uk/primary-science

Books