

Is there life beyond Earth?

with Dame Dr Maggie Aderin-Pocock

Royal Institution Christmas Lectures Activities

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In this year's CHRISTMAS LECTURES from the Royal Institution (Ri) supported by CGI, Dr Dame Maggie Aderin-Pocock will take us on an epic voyage through time and space.

Scientists in 2025 detected the 'strongest hint yet' of biological activity outside our solar system on exoplanet K2-18b, sparking growing excitement about the real possibility of extraterrestrial life. In this series of lectures, Maggie sets out on a journey to find it.



Life Beyond Earth

Aimed at KS2, this resource will prompt pupils to consider what conditions are required for, and can be monitored by scientists to predict, life beyond Earth. Taking inspiration from extremophiles (organisms that can survive in harsh environments) found on Earth, pupils will use their imagination to design their own extraterrestrial organisms and the conditions in which they thrive.

Learning objectives

- To learn what factors/conditions make Earth habitable and how scientists can use this knowledge in their search for extraterrestrial life
- To learn how the discovery of extremophiles can redefine what we understand to be habitable conditions
- To design your own extraterrestrial organism and define what habitat it lives in

What is required for life to exist?

Earth is full of life; animals, plants, bacteria and fungi are all living things that are found outside in nature or even inside our homes. But Earth is special in this way. Out of the millions/trillions of planets that scientists have identified in our universe, so far Earth is the only one that supports life. This is because of the unique combination of environment, elements, and other conditions on Earth that isn't found on other planets.

Activity 1 – What conditions do the following organisms need to survive? There are some ideas in the list below:

- Sunlight
- Water
- Warmth
- Oxygen/air

- Food/nutrients
- Gravity
- Soil
- Marshmallows



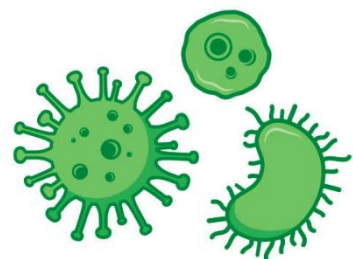
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What do scientists look for on planets when searching for life?

1. **Water** – almost all chemical reactions for life depend on liquid water
2. **Light** – to act as an energy source
3. **Protection from excessive radiation** – if solar radiation is too high, critical molecules for life such as DNA will be damaged
4. **Chemical elements** – elements such as carbon, nitrogen, oxygen, phosphorus and sulphur are needed to build molecules required for life

Do you remember the fairytale ‘Goldilocks and the Three Bears’ where Goldilocks is on a search for the perfect bowl of porridge? Well, Goldilocks’ quest is not dissimilar to scientists’ search for planets with the perfect set of conditions to support life. In fact, scientists have coined the phrase ‘Goldilocks zone’ to describe the exact distance a planet must be from its star to have the perfect levels of warmth, light and protection from solar radiation to support life.

What do you think this creature needs to live?



If you haven't seen this creature before, meet the tardigrade!

Tardigrades, or 'water bears', are so small that we can only see them through microscopes. If you do have a microscope handy, you may be able to find them in wet moss and lichen in your local park.

The most exciting thing about tardigrades is that they can survive in conditions when other organisms cannot. They can survive boiling, freezing, exposure to high levels of radiation and the vacuum of space as well as other conditions believed to be uninhabitable prior to tardigrades' discovery. The discovery of tardigrades and other extremophiles (creatures that thrive under extreme conditions) have challenged scientists' assumptions of the conditions required for life and have made scientists rethink their criteria when searching for life beyond Earth.

So, we don't always find life where we expect! Now, it's your turn to predict what living things might look like on faraway planets.

Activity 2 – Design your own extraterrestrial organism!

Name of organism:

Living conditions of extraterrestrial organism:

.....
.....
.....

Answer sheet

Activity 1 – Consider what conditions the following organisms need to survive

Bear

- Light – to see surroundings, hunt, protect young, enable some chemical reactions within the body etc.
- Warmth – to maintain optimal temperature for chemical reactions within the body
- Water – to enable chemical reactions within body
- Food/nutrients
- Air/oxygen/carbon dioxide
- Sound (atmosphere for sound to travel through)

Sunflower – to provoke the idea of photosynthesis/alternative methods of gaining energy to eating food

- Light – to generate energy via photosynthesis
- Warmth
- Water
- Food/nutrients
- Air/oxygen/carbon dioxide – to generate energy via photosynthesis and respiration
- Soil – to grow in and extract nutrients from
- Optimal pH

Mushrooms/fungi – contrary to the two examples so far, fungi do not need light to live raising new possibilities about where life may be found

- Optimal temperature
- Food/nutrients
- Water
- Air/oxygen
- Optimal pH

Bacteria/germs – although many of the requirements for bacterial life are similar to other organisms, they tend to be more varied between species and to be found in harsher environments

- Warmth – optimal temperatures vary between species
- Water
- Food/nutrients
- Air/oxygen – although some species do not need oxygen to survive e.g. E. coli (living in human gut) do not require oxygen, but benefit from its presence
- Optimal pH

Activity 2 – Design your own extraterrestrial organism

- Space is provided for organisms to be drawn, painted, or stuck on, or 3D models may be made for a more arts and crafts session
- Prompting questions may include: how will the organism retrieve food? move? See? What habit does the organism live in? What does it eat? What temperature does it need to survive? Does it hunt prey? Does it need water? Does it live in the light or darkness?