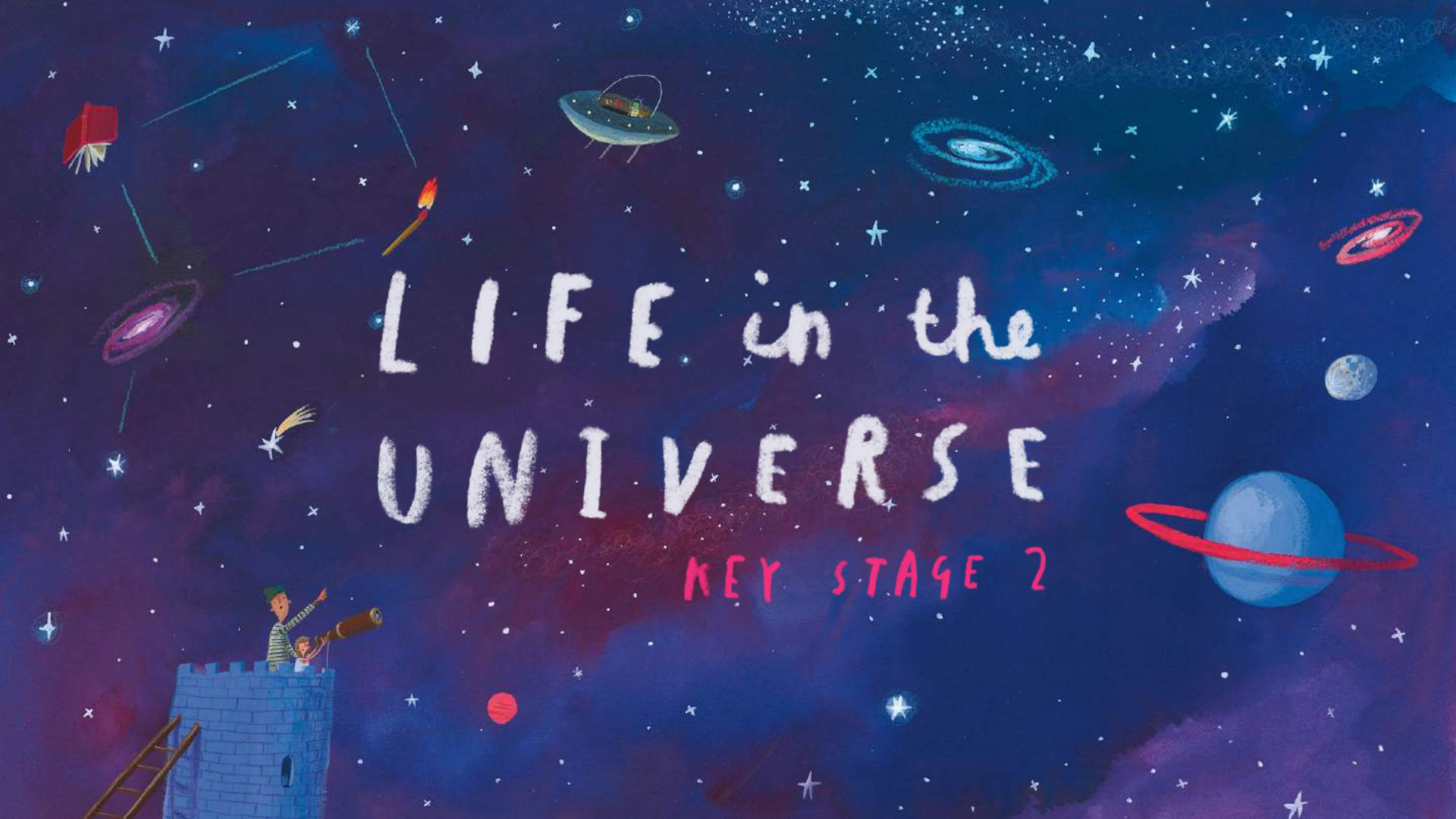

LIFE in the UNIVERSE
KEY STAGE 2

This series contains an overview of different types of life forms living in very unusual places. There are opportunities to learn more about the topics mentioned in this series through self-directed study and further research, although you can use this series as an overview in one lesson.

Series Three

If you would like help with any of the creative learning activities, please email the Learning team at: learning@ourplaceinspace.earth to arrange free training or workshop for your class.

Producers: Nerve Centre, SmarttScience
Science Advisor: Professor Stephen Smartt, Queen's University Belfast
Creative Learning Activities: Nerve Centre Creative Learning Centres
Design: Jeffers and Sons, Jonny Miller
Illustrations: Oliver Jeffers, John McCloskey

LIFE in the UNIVERSE

LESSON DESCRIPTION:

This lesson provides an overview of different types of creatures living in extreme environments.
It describes their ability to survive in the harshest conditions on Earth, and potentially other planets.
It also looks at modern technology and how this will affect the search for life elsewhere in the universe.

LESSON INTENTIONS :

1. Understand the different types of life forms surviving in harsh environments.
2. Understand the conditions required for life and where they might exist in the solar system.
3. Understand the effect new technology has on the search for life elsewhere in the universe.
4. Understand the possibilities of life on other planets in our solar system.
5. Demonstrate objectives 1-4 through the use of creative tasks and discussions.

LESSON OUTCOMES :

1. Be able to name life forms living in hostile environments.
2. Be able to explain what conditions make an environment hostile.
3. Employ ICT skills to express an understanding of the topic.

CORE SKILLS FOCUS:

(Citizenship / cross curricular skills)

Speaking and listening, co-operation and working with others, expressing viewpoints and respecting others, topical issues and debating, problem-solving and decision making, creative expression and innovation.

WORKING SCIENTIFICALLY:

Investigations and inquiry, asking questions and finding solutions, performing tests and recording answers, understanding scientific evidence and theories change over time.

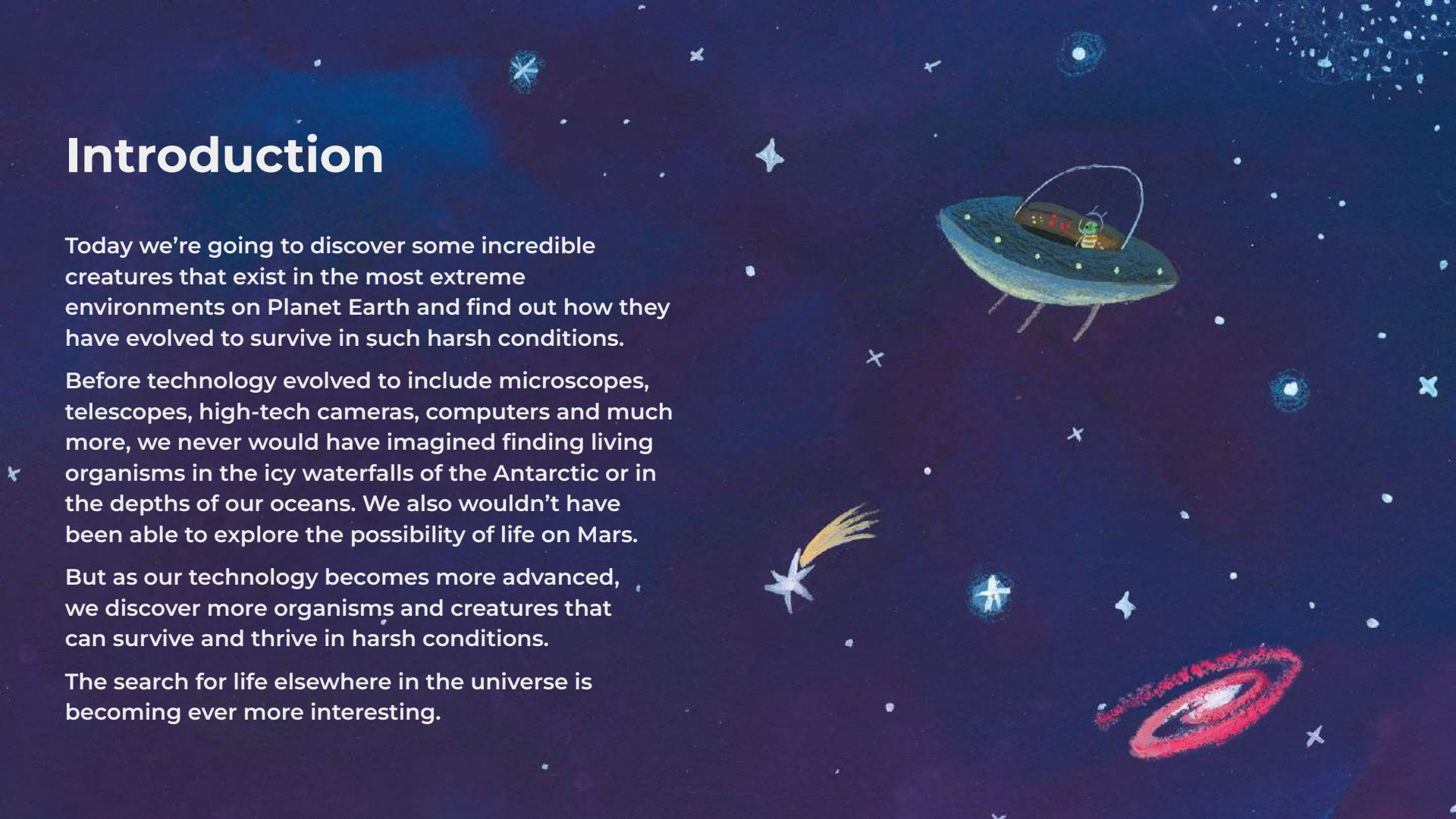
Introduction

Today we're going to discover some incredible creatures that exist in the most extreme environments on Planet Earth and find out how they have evolved to survive in such harsh conditions.

Before technology evolved to include microscopes, telescopes, high-tech cameras, computers and much more, we never would have imagined finding living organisms in the icy waterfalls of the Antarctic or in the depths of our oceans. We also wouldn't have been able to explore the possibility of life on Mars.

But as our technology becomes more advanced, we discover more organisms and creatures that can survive and thrive in harsh conditions.

The search for life elsewhere in the universe is becoming ever more interesting.



VIDEO

Life in the Universe

This video introduces life forms in the most weird and unusual places on Planet Earth, suggesting the possibility of life forms elsewhere in the universe.

- Press spacebar to play video.
- Press 2 more times to skip to next slide.

Video Link

TARDIGRADES

Not many people know about tardigrades, even though they have been on Earth for around 60 million years. We've known about them for over 200 years. There are around 1,300 species of tardigrade and they have been found in virtually every environment on Earth — from high up in the mountain tops, to deep down in our oceans, in tropical rainforests, the icy Antarctic and even inside mud volcanoes.

Tardigrades are also called water bears or moss piglets for their plump and stumpy appearance. They have four pairs of legs with claws and suction disks as feet.

Tardigrades are tiny animals. Even when they are fully grown they measure just 0.5 millimeters long.

Image Credit: iStock

TASK:

Use a ruler to measure 0.5 millimeters. Imagine a tiny Tardigrade on your ruler!

Back in 2007, scientists discovered that some tardigrades were able to survive 10 days in outer space! And in 2019, tardigrades made it all the way to the Earth's Moon, travelling on an Israeli spacecraft that crash-landed on the moon. Some scientists believe they might still be alive today.

HOW?

Tardigrades have what seems like a super power. One of the reasons they have survived for millions of years is their ability to adapt to different environments. This makes them incredibly resilient.

FUN FACT:

The eggs and cysts of tardigrades are so durable that they can be carried great distances on the feet of other animals.

Their main survival instinct is what's called **'tun' form.** They become a compact cellular fortress, like a tiny ball of cells, tucking in their legs and head and shrivelling up into a ball. They shed almost all of the water in their body and go into tun form, where they remain in the same state, sometimes for years.

In one experiment, scientists brought tardigrades out of their tun form after 30 years. They were alive, healthy, and even able to reproduce.

Image shows a tardigrade in an active state and tun form. When in tun form, they are a tiny ball of cells.
Image Credit: Eye of Science/Photo Researchers

CLASS DISCUSSION:

Imagine what it would be like to wake up after 30 years of being in tun form. If you were a tardigrade who lived in the Antarctic, would it look the same as it did 30 years ago? Would the temperature be as cold?

If you were a tardigrade who lived in the ocean, would the ocean bed look the same as it did 30 years ago? What might you find in the ocean that could be harmful to life forms?

CREATIVE TASK IDEA:

Make a Short Film about Tardigrades

Work in small groups to make a short animated film, 20-30 seconds in length. Imagine you are a tardigrade who has just woken up on the Moon after 30 years of being in tun form.

PLAN

Students will be supplied with search terms by the teacher and source appropriate images, videos, audio and information from the internet — e.g. Tardigrades, Moon, Extreme Environments, Adaptability, Climate Change.

Students will select information to use and save it appropriately in a dedicated folder with a meaningful file name. (These may be images or quotes to help them write their script).

Students will keep an account of the sites they have visited in a saved document.

Students will use the information and media they have sourced and construct a storyboard for the making of their film.

For your storyboard, describe how you got on the Moon. What would you need to come back to an active state? Would you be able to find water on the Moon? Where did you used to live — the Antarctic, a tropical rainforest, a volcano? What temperatures and environment are you used to? Describe your environment on the Moon and how you were able to survive. Do you plan to stay on the Moon or get back to Earth? How could you use your suction disks to help you get back to Earth?

DO

Students will import the various media items they sourced from the internet. For their animation assets students could print these from the internet or draw these themselves. Using their storyboards as a guide, students will construct their animation using an appropriate stop motion animation app. Once their animation is complete, students will then add their green screen backgrounds to their animations and then using an editing package (such as iMovie, others are available), students will use various editing tools (splitting, trimming, transitions, effects and captions/ titles) to compile and edit their animations.

Students will complete their project by exporting it in a suitable file format (e.g. WMV / MP4).

Encourage students to think about which roles they can play. Which student is moving the animation assets, which student is capturing the photographs, which student is directing the animation.

Encourage students to consider the size and style of fonts, the size of images, the effects / transitions used and the tools available to them within the software package.

Remind students to save their work in a dedicated folder with an appropriate filename.

REVIEW

Give students the opportunity to view each other's work. This may be done by viewing selected pieces of work or students may circulate the room.

Taking other students' feedback into account, ask students to justify their choices and decisions, including any difficulties they encountered in the creation of their animation. This may be completed in the form of a saved document.

LIFE IN HYDROTHERMAL VENTS

A hydrothermal vent is an opening in the seabed of the Earth which is super-hot and spews out chemicals at scalding temperatures. The vents can support entire communities of ‘alien’ looking organisms living deep at the bottom of the ocean.

Scientists didn’t even know these ecosystems existed at the bottom of the ocean before they directly observed them with modern technology.

The water that is spewed out of these vents ranges in temperature from 60 to 400 °C. We know that water boils at 100 °C. After this temperature, water turns into steam. However, because these vents are at the bottom of the ocean, under extreme pressure, the water can stay liquid. The deepest are at 5000 metres below sea level.

A Purple Holothurian (also known as Sea Cucumbers) going about its day at the bottom of the ocean

Image Credit: Ocean Exploration Trust

The range and diversity of life around hydrothermal vents is amazing — there is much more life here than the rest of the deep-sea ocean!

Most life forms need heat, light and / or oxygen to survive. Hydrothermal vents, however, survive through a process called chemosynthesis. The organism converts the chemicals in the water into energy. Before scientists studied these vents and discovered this, they thought that all life relied on the Sun to survive. These organisms live in complete darkness, all of the time.

Some scientists believe that the first life on Earth (and all of life's common ancestor) could have originated around a hydrothermal vent, billions of years ago!

The rare Squidworm Polychaete, found at hydrothermal vents, just above the ocean floor.
Image Credit: Ocean Exploration Trust

BLOOD FALLS

Don’t worry—there is no blood at Blood Falls! These gory red waterfalls in the Antarctic are one of the last places you’d expect to find life. But scientists have found salt and iron rich water below the ice which supports microbial life. The water is red because it contains iron. The iron in Blood Falls’ water turns red when it combines chemically with oxygen.

The red coloured water of Blood Falls comes from a salty lake buried beneath Taylor Glacier. A crack in the glacier allows the water from this lake to rise up and ooze into the icy Antarctic landscape.

The saltwater has a lower freezing point than pure water and releases heat as it freezes; it melts the ice, enabling the rivers to flow.

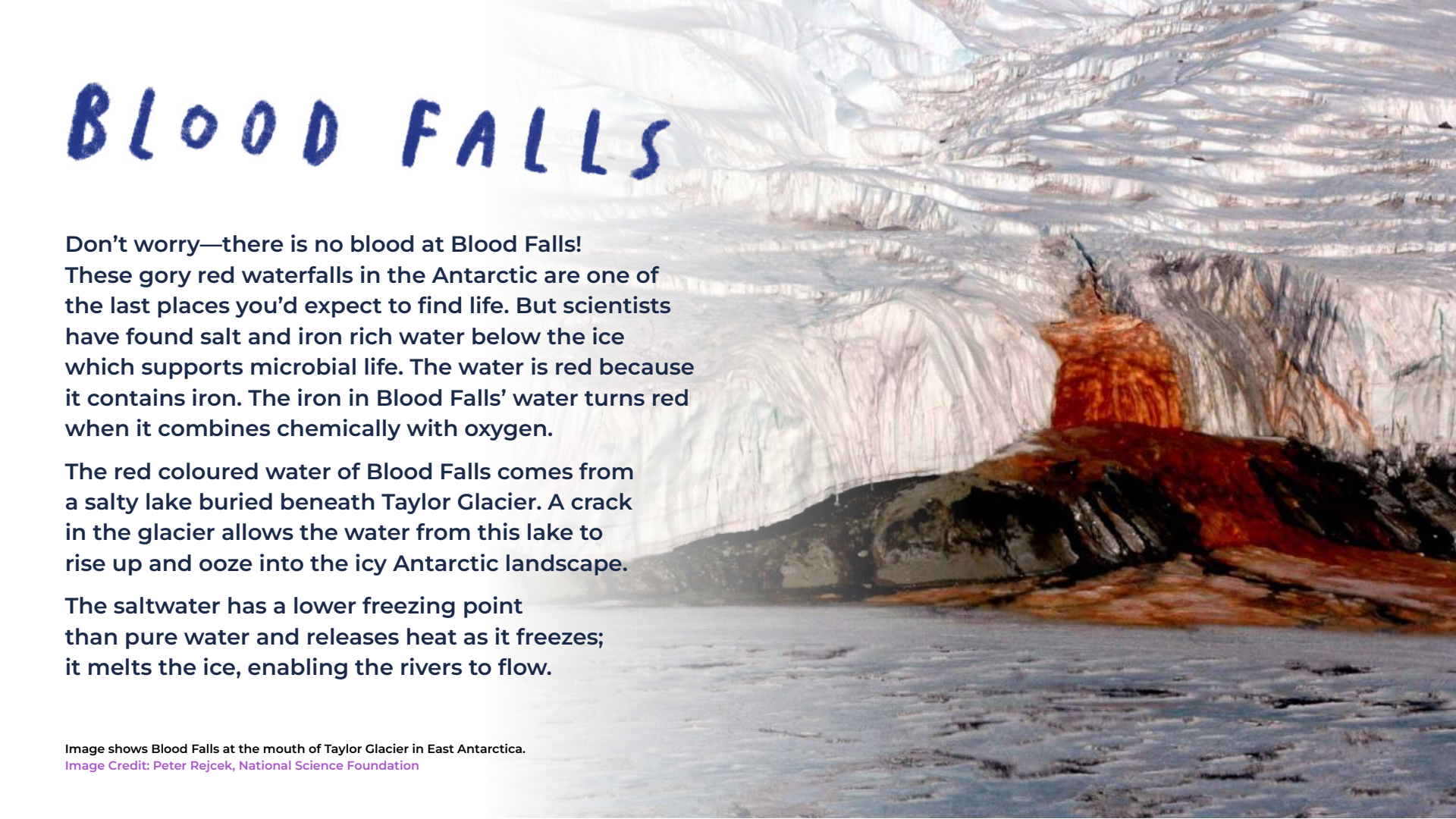
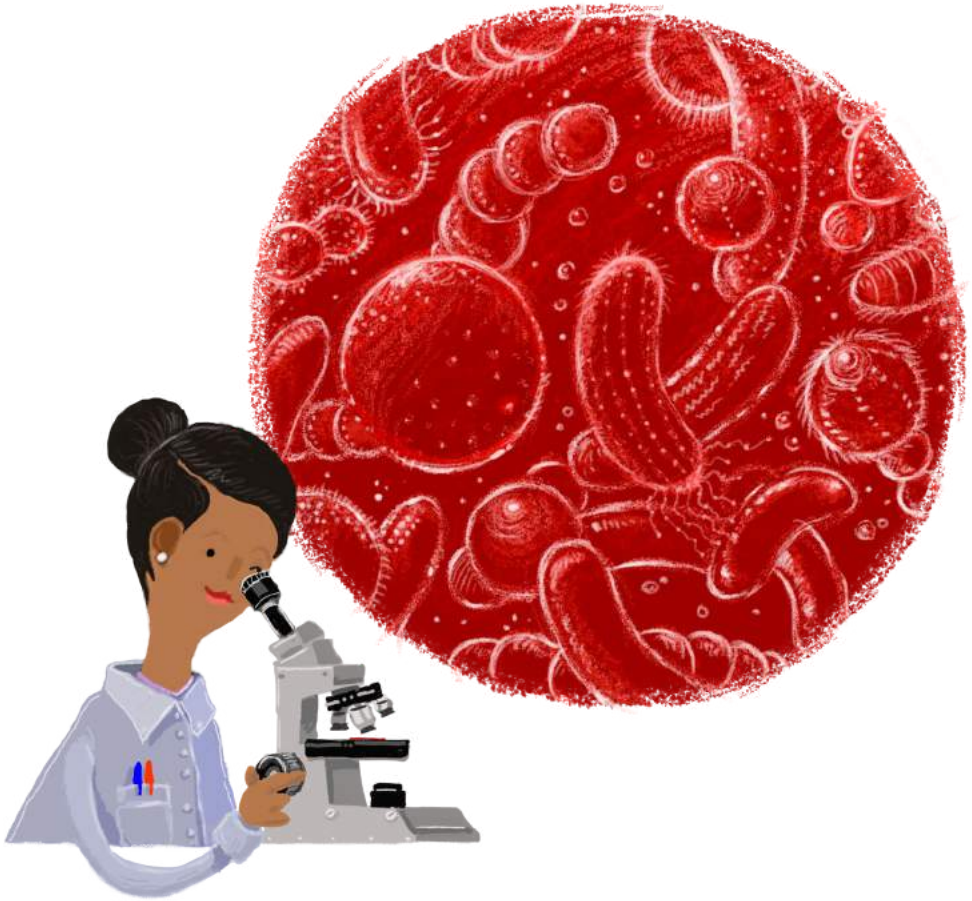


Image shows Blood Falls at the mouth of Taylor Glacier in East Antarctica.
Image Credit: Peter Rejcek, National Science Foundation



Blood Falls has lots of microbial life that has survived in this salty liquid habitat for two million years. Scientists say this form of survival has never been observed anywhere else on Earth.

Understanding how these organisms can survive in these conditions can help scientists understand the capacity for life early on in the formation of Planet Earth and also on other planets.

This gives hope to the search for life on Jupiter's Moon Europa, as a possible habitat for life below the ice. Scientists think that there may be an ocean underneath the ice. If these Blood Falls microbes can survive with no oxygen, and below freezing temperatures on our planet, why couldn't they survive elsewhere in the solar system?

QUESTIONS

QUESTION 1 :

A. What temperature does fresh water usually freeze at?

B. What temperature does salt water usually freeze at?

QUESTION 2 :

A. What temperature does water usually boil at?

B. Why does water from hydrothermal vents stay in liquid form rather than steam?

QUESTION 3 :

We know for a fact that life exists on other planets in our solar system or on exoplanets beyond.

True or **False**?

(Answers on the next slide)

ANSWERS

QUESTION 1 :

A. 0 °C

B. Around -1.8 °C

QUESTION 2 :

A. 100 °C

B. Water from hydrothermal vents stays in liquid form rather than steam because they are at the bottom of the ocean, under extreme pressure. The deepest are at 5000 metres below sea level.

QUESTION 3 :

False. Scientists have no concrete evidence of life on any other planet (or moon) in our solar system nor any other exoplanet, but are still looking.

DID YOU KNOW :

Did you know that while there is no concrete evidence that once upon a time there was life on Mars, its surface had water that could have been able to support microorganisms.

ATACAMA DESERT

Does this look similar to any planet you may have learnt about?

The Atacama desert in Chile has a similar environment to that of planet Mars. Although it is often hot during day time in Chilean summer, at night the high plains of the desert can be well below 0 degrees Centrigrade. Both Mars and the Atacama environments are extremely dry, with very little water.

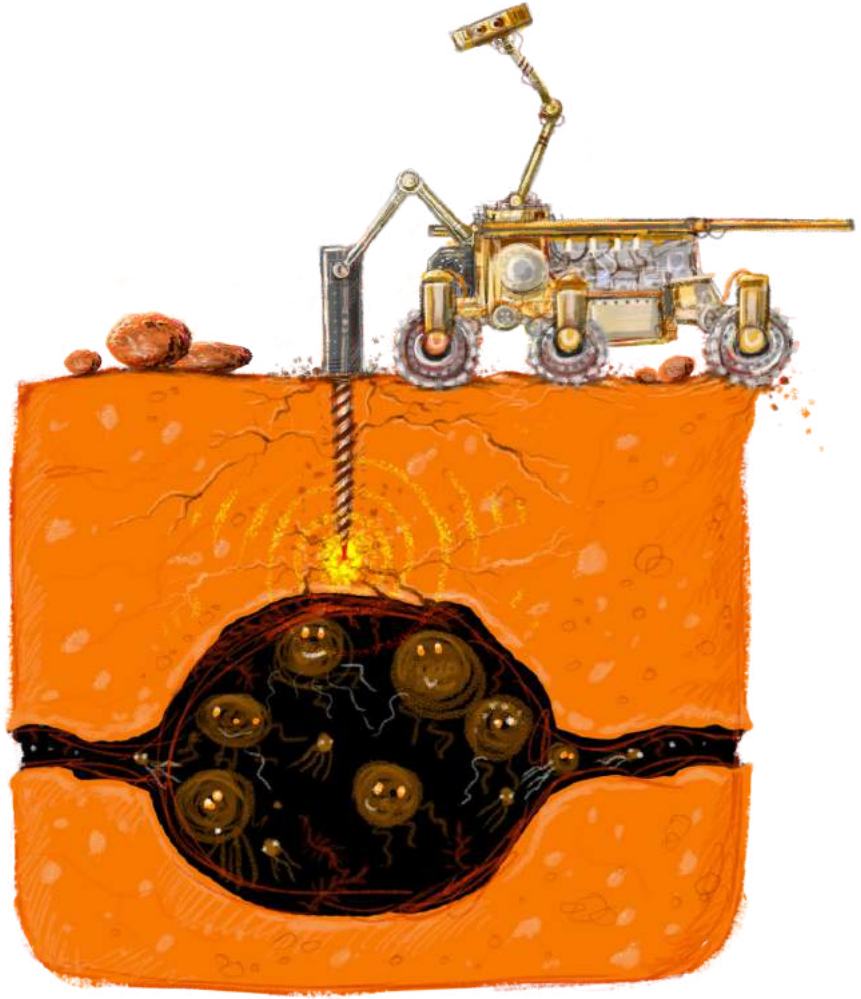
Image Credit: Shutterstock

Atacama Desert

They are so alike in fact, that scientists test equipment that is going to be used on Mars in the Atacama desert first. It has also been used to film movies which are set on Mars.

Scientists are almost certain that there is no life on the surface of Mars. However, microbial life has been found just 30 cm under the desert surface, showing that life underground on Mars is very possible.

The European Space Agency's ExoMars rover has a huge drill which is able to drill six feet down into Mars' surface. What will we find?



CREATIVE TASK IDEA:

Life on Another Planet

Write a short story about life on another planet. What type of life could exist on Mars? Is it likely to be microorganisms (microbial life) or more developed species? What is it called? How do they survive in such harsh conditions? (Tardigrades become a cellular fortress. Does this life form have special powers to protect themselves in space?) What do they eat? What do they look like? Does it have lots of arms and legs? Is it stubby like tardigrades or more slim, like a worm?

BONUS ACTIVITY :

Animate your life form with an app such as FlipAClip (others are available). Pick one action, e.g. jump, run, wave, yawn.

PLAN

Encourage your students to brainstorm concept ideas for their story. What is the planet they are on called? What type of life forms live there? What is that life form called? What does it look like? What does it hunt and eat? Encourage your students to draw this life form out on a large sheet of paper and write notes around it.

DO

Encourage your students to structure their story. Thinking about the beginning, middle and end. Make sure your students do not go off topic and that their story contains relevant and important information such as:

- What is the planet like
- Who lives on the planet
- What do they eat
- Where do they live

REVIEW

Give students the opportunity to view each other's work. This may be done by students presenting their work at the front of the class, reading out their stories and showing their drawings of the type of life form which lives on the planet.

Taking other students' feedback into account, ask students to justify their choices and decisions, including any difficulties they encountered in the creation of their story. This may be completed in the form of a saved document.

LIFE on MARS

Scientists are still debating whether there is or has ever been life on Mars.

Most scientists believe that the surface of Mars is far too cold to support life — the average temperature on the surface of Mars is -60 °C.

However, scientists are searching for signs of life that once existed on Mars, in the form of fossilized bacteria. This is the remains of ancient life that has been preserved beneath the outer layer of the planet.

Scientists suspect there might be a layer of ground under the surface of Mars that contains sediments and clays which may contain water. If there is any trace of life on Mars, this is probably where we would find it - below the surface in water and mineral rich deposits.

Image shows self-portrait of NASA's Curiosity Mars rover at the "Okoruso" drilling site on lower Mount Sharp's "Naukluft Plateau".
Image Credit: NASA/JPL-Caltech/MSSS

Video

Class Discussion

Watch the video below about Mars rovers and their search for life on Mars. Discuss why scientists are looking for life on Mars.

What do they expect life on Mars to look like and is there any evidence that they've found so far?

- Press spacebar to play video.
- Press 2 more times to skip to next slide.

Video Link

CREATIVE TASK IDEA:

Create an e-Book

Students will create an e-book about life on Mars. They will design a fictional human character and explain how they live on Mars. Thinking about where they get their food, where they live, how they breathe, what special clothing they have to wear etc.

PLAN

Images and information will be sourced from the internet and designed in the form of a storyboard.

- Students will be supplied with search terms by the teacher and source appropriate images and text from the internet — ask students to consider the reliability and objectivity of the information they find.
- Students will identify and select images / text to use and save them appropriately in a dedicated folder with a meaningful filename.
- Students will keep an account of the sites they have visited in a saved document.
- Students will use the images and information they have sourced and design their e-book on a storyboard.

DO

Use an app such as Book Creator for the iPad (others are available), or similar app for other tablets.

Students should create their e-book choosing and using the features and tools within the app.

Encourage your students to think about the images they are using, their suitability and size.

REVIEW

Students should be given the opportunity to show their e-book to the rest of the class. This can be done by students circulating the room, or by presenting their work at the front of the class.

Taking other students' feedback into account, ask students to justify their choices and decisions, including any difficulties they encountered in the creation of their e-book. This may be completed in the form of a saved document.

For further guidance see CCEA KS1+2 Using ICT e-Book exemplary task.

PITCH LAKE

The word pitch comes from an old word meaning tar.

Pitch Lake is the largest natural pool of hot liquid tar in the world — around 10 million tons! It is located in southwest Trinidad, although smaller tar pits can be found throughout the world.

There is no water or oxygen in Pitch Lake and the tar itself is extremely hot, with harmful gases bubbling to the surface. This makes it a very hostile environment.

However, amazingly, plant life has been swallowed up and spat out hundreds of years later, in perfect condition. Microbial life has also been found in the depths of the tar.

This has led scientists to rethink the possibility of life existing on Saturn's moon Titan as it is a very similar environment.

Image Credit: Richard Seaman

TITAN

Titan is the largest of Saturn's 82 moons.

The Cassini space probe was sent by scientists to study the planet Saturn, its rings and natural satellites. It reached Saturn in 2005 and ejected a robotic space probe called the Huygens Lander to land on Saturn's largest moon, Titan.

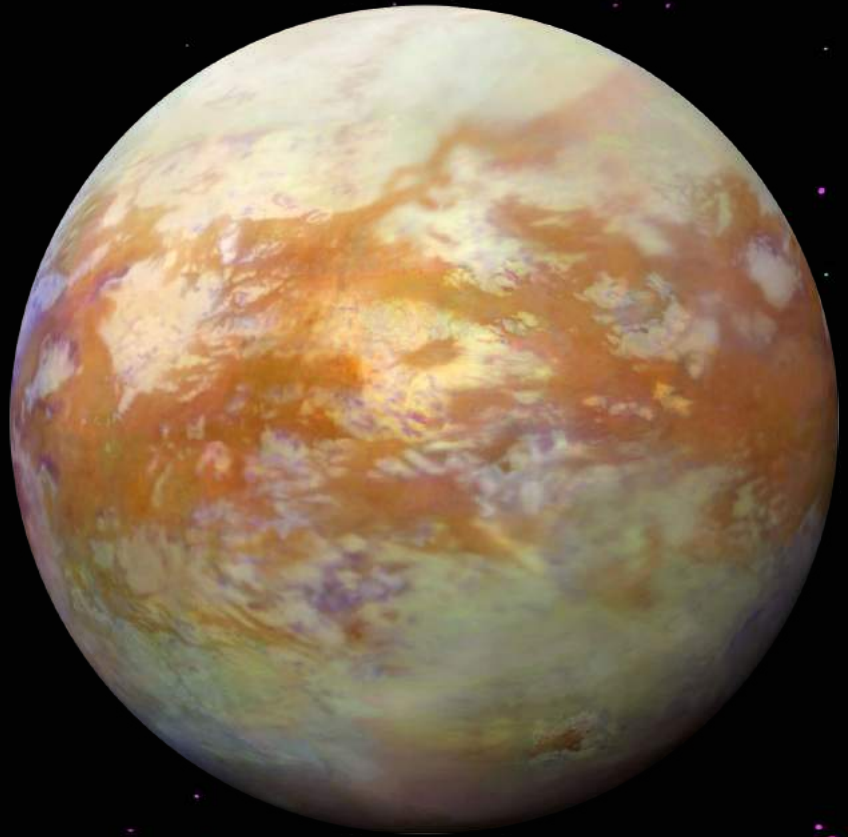


Image Credit: NASA/JPL-Caltech/Stéphane Le Mouélic, University of Nantes, Virginia Pasek, University of Arizona

Huygens Lander

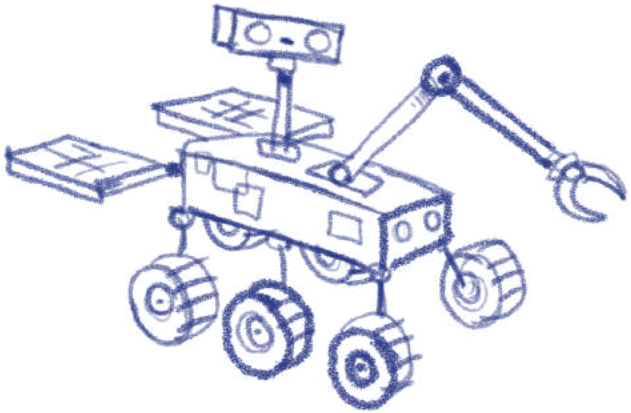
It took the Huygens Lander two hours to descend to the moon Titan, where it revealed an impressive landscape. It showed huge mountains set against an orange sky. Titan's atmosphere is mostly nitrogen, like Earth's. Titan has clouds, rain, rivers and lakes of liquid hydrocarbons like methane and ethan. It is possible that microbial life may exist there.

Image Credit: ESA/NASA/JPL/University of Arizona

CREATIVE TASK IDEA:

Design a Robotic Space Probe

Students will research and design a robotic space probe that will be used to land on one of Saturn's moons.



PLAN

Images and information will be sourced from the internet.

- Students will be supplied with search terms by the teacher
  E.g Cassini space probe, NASA, Mars rover and source appropriate images from the internet as inspiration — ask students to consider the reliability and objectivity of the information they find.
- Students will identify and select images / text to use and save them appropriately in a dedicated folder with a meaningful filename.
- Students will keep an account of the sites they have visited in a saved document.
- Students will use the images and information they have sourced and design their robotic space probe.

DO

Use an app such as Art of Weird for the iPad (others are available), or similar app for other tablets.

Students should create their design choosing and using the features and tools within the app.

Encourage your students to think about the functionality of their design. What features will their space probe need to have in order to safely land on one of Saturn's moons? Which moon will it land on? How will it get there? What materials will it be made of? Label the materials on your design.

REVIEW

Students should be given the opportunity to show their design to the rest of the class. This can be done by students circulating the room, or by presenting their work at the front of the class.

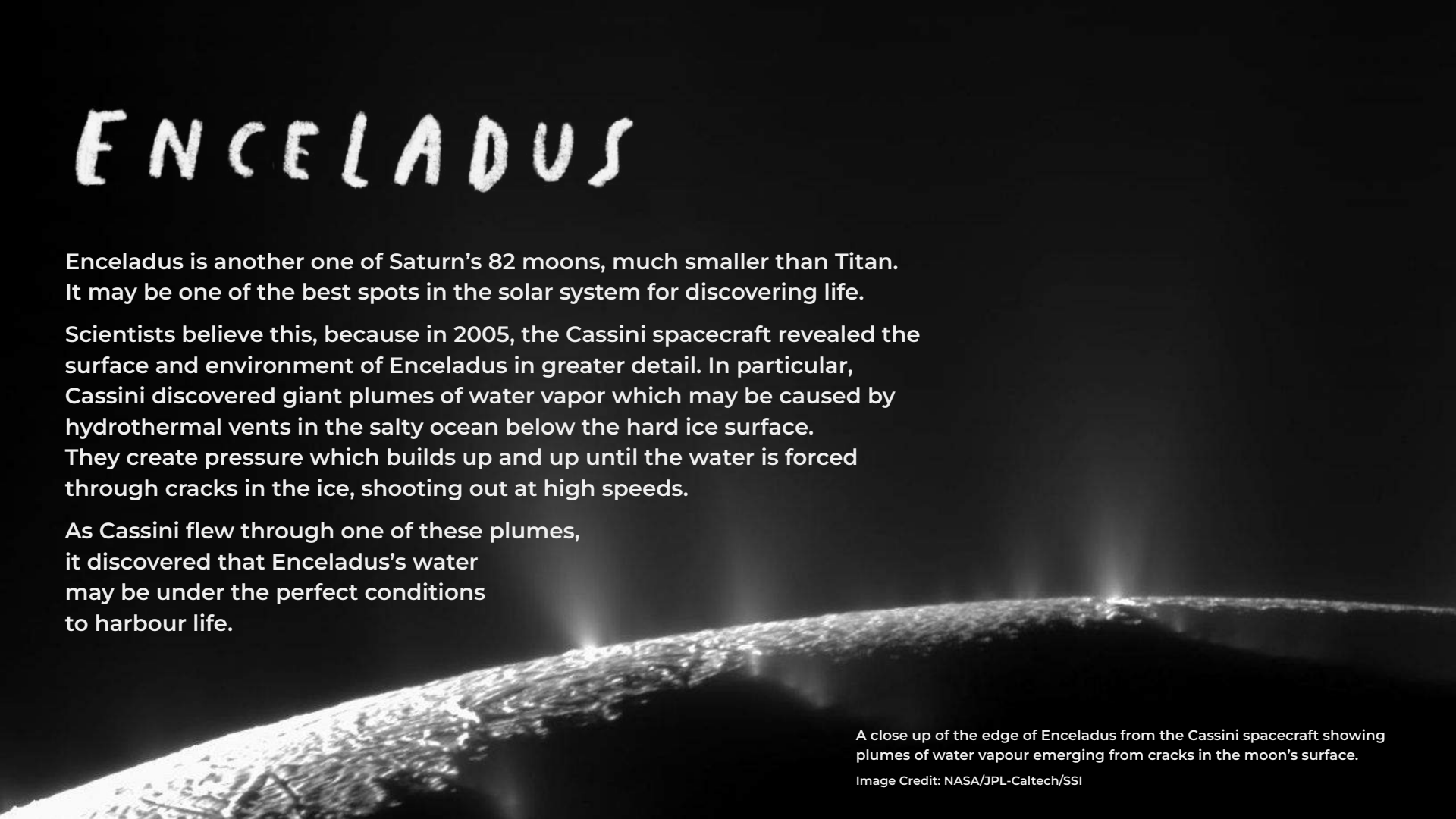
Taking other students' feedback into account, ask students to justify their choices and decisions, including any difficulties they encountered in the creation of their space probe. This may be completed in the form of a saved document.

ENCELADUS

Enceladus is another one of Saturn's 82 moons, much smaller than Titan. It may be one of the best spots in the solar system for discovering life.

Scientists believe this, because in 2005, the Cassini spacecraft revealed the surface and environment of Enceladus in greater detail. In particular, Cassini discovered giant plumes of water vapor which may be caused by hydrothermal vents in the salty ocean below the hard ice surface. They create pressure which builds up and up until the water is forced through cracks in the ice, shooting out at high speeds.

As Cassini flew through one of these plumes, it discovered that Enceladus's water may be under the perfect conditions to harbour life.



A close up of the edge of Enceladus from the Cassini spacecraft showing plumes of water vapour emerging from cracks in the moon's surface.

Image Credit: NASA/JPL-Caltech/SSI

EUROPA

Jupiter's moon Europa, like Titan, has plumes above its surface which erupt 190 km over the South Pole. This suggests there could be an ocean of liquid below the ice that occasionally pushes itself out to the surface.

NASA's Europa Clipper spacecraft will be launched in 2022. It will take seven years to reach Jupiter, and will perform a close fly-by of Europa too.

Hopefully it will give us some insights into Europa. For example, what elements is it composed of? (Hint: the Earth's Moon is not made of cheese!) What are the strange lines stretching the whole way across the planet? And finally, could it support life in oceans below the surface.

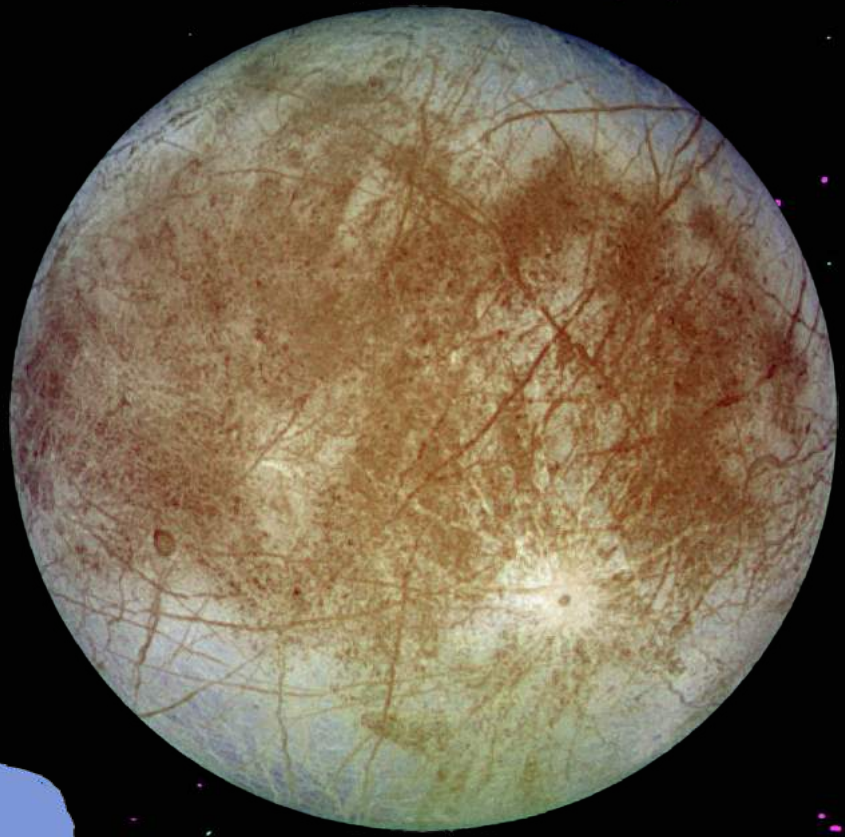


Image Credit: NASA

QUIZ :

Take our short quiz on Life in Extreme Environments.

NERVE CENTRE
PRESENTS

Commissioned by Belfast City Council as part of UNBOXED: Creativity in the UK

SPECIAL THANKS TO OUR EDUCATION ADVISORY GROUP

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