WHAT CAN WE SEE IN THE DARK IN PEMBROKESHIRE COAST NATIONAL PARK?

SUPPORT MATERIALS

If you need further support on specific aspects of outdoor learning these materials can enhance the engaging experiences you are providing. They can support you as you design, plan and implement your curriculum. Outdoor learning is a great way to develop learners' integral skills (creativity and innovation, critical thinking and problem-solving, personal effectiveness, planning and organising). You will want to focus on why learning matters and ensure you are meeting your learners' needs.
These materials show a path that could be taken through the activity. This is not meant to be prescriptive. You should adapt your approach depending on your learners' needs and interests and your local area.

OVERVIEW

Learners find out more about the stars and planets in our solar system and make a scaled model of the solar system outside. They find out about different star constellations and the stories behind them. Learners explore light pollution in Pembrokeshire Coast National Park and its Dark Skies Discovery Sites, before going outside in the dark to view planets and constellations of stars. They then explore two types of natural phenomena that make plants and animals glow – biofluorescence and bioluminescence – and take photographs of biofluorescent flowers and organisms to use in a digital presentation. Finally, learners find out about bioluminescent organisms living in the Twilight Zone before producing artwork of these organisms.

CURRICULUM FOR WALES

Areas explored:

- Health and Well-being
- Humanities
- Languages, Literacy and Communication
- Mathematics and Numeracy
- Science and Technology

Activity also incorporates aspects of cross-curricular skills outlined in the LNF and DCF.

RESOURCES

Internet enabled device and internet access.
Means of measuring, e.g. ruler, metre rule, sports measuring tape, pedometer.
Print out of constellation – Task 2 screen 13.
Possibly Star Gazing Guide leaflet – downloaded or printed.
Possibly downloaded free apps such as:

- Star Chart app on Android or iPad
- Night Sky app on Android or IOS
- SkyView Lite on Android or IOS
- GoSkyWatch Planetarium on iPad.

Means of taking photographs (e.g. smart phone, tablet, camera).
UV torches - with a wavelength at or near 365nm.
Cardboard boxes to create darkness around flowers.
Black paper and luminous pens of varying colours.

DOING THE ACTIVITY

- Most tasks require learners to work in pairs or groups.
- Encourage learners to share their ideas, and through open questioning, explain and justify their ideas when possible. Focus questions have been suggested to guide learners through the tasks.
- When taking learners outdoors, it is essential that the Countryside Code is adhered to and any relevant risk assessments have been carried out with risks mitigated.

TASK 1

WHAT DO WE KNOW ABOUT STARS AND PLANETS?

Explain to learners that this task should help them to find out more about the stars and planets in our solar system. Then, they should be able to make a scaled model of the solar system.

Screen 3

Invite learners to consider the questions posed.

Focus questions

- What are stars?
- Which is the closest star to Earth? Why do you think this?
- What are planets?
- Which planets do you know?
- What do you know about each planet?

Then note their answers in the table on the next screen.

Screen 4

Ask learners to try to complete the table with their ideas and use the key below to rate each answer as to how confident they are that they are correct.

1 = confident

2 = slightly confident

3 = not at all confident or don't know

Screen 5

Tell learners that they are going to use the internet to check their answers on the previous screen.

Ask them to think about the points about internet searches.

Before researching think about...

- What search terms could you use? Which are the best? Why?
- What type of sites will be the best to use, why?

When assessing information/data think about...

- Could the information/data be biased? Why do you think that?
- How reliable do you think the information/data is? How could you find out?

Screen 6

This screen shows learners' completed tables so that they can review their answers. Ask learners to check the answers they rated 2 and 3 and to update the table with their findings.

Screen 7

Learners have been working in pairs up to this point. However, putting them into small groups for the rest of the task will be more manageable. Invite learners to do more online research to find out the answers to these questions:

Focus questions

- What planets are in our solar system?
- What order are the planets in from the Sun outwards?
- How far is each planet away from the Sun? Why does this change?
- What is the diameter of each planet?
- What is the diameter of the Sun?

A table is provided on the next screen so they can type in their answers.

Screen 8

This screen gives the table to complete from the previous screen.

Screen 9

Ask each group to think about how they could represent our solar system to scale. Then, to make a scaled model of our solar system they can show others outside.

The mathematics involved in scaling the model requires the use of large numbers which are better represented in standard form. Some of your learners might well be able to manipulate such numbers. However, others might struggle. To support the mathematics, you could ask learners to access Student Project: Make a Scale Solar System - NASA/JPL Edu which gives detailed guidance on how to build a scaled solar system model from thinking about what type of model to make to where the model will be shown to the calculations required.

Screen 10

Invite learner to build their solar system model outside.

TASK 2

WHICH STARS AND PLANETS CAN WE SEE IN THE NIGHT SKY?

Explain to learners that in this task they will learn about star constellations and the stories behind them. They will find out about light pollution in Pembrokeshire Coast National Park and its Dark Skies Discovery Sites, before going outside in the dark to view planets and constellations of stars.

Screen 3

This screen gives information about stars. Ask learners to discuss the questions posed.

Focus questions

- Why can you see stars in the night sky?
- Why can't you see many stars in the daytime?
- Why can you see some planets in the night sky?
- Why can you see different stars at different times in the night sky?

Screen 4

This screen gives information about light pollution in Pembrokeshire. Ask learners to discuss the question posed.

Focus question

- Where do you think the six main sources of light pollution are in Pembrokeshire?

Then, ask them to use the map to find these six places and type their ideas in the box provided.

Screen 5

An image showing the eight Dark Sky Discovery Sites in Pembrokeshire is given here. Ask learners to use the image to try and work out where each site is in Pembrokeshire. Then, to record their answers in the box provided.

Focus question

- What are the names of each of these sites in Pembrokeshire?

Screen 6

Learners' ideas as to where each site is in Pembrokeshire from the previous screen are shown here. Invite learners to use the map to check their ideas and amend them as necessary.

Screen 7

Learners' ideas as to the Dark Sky Discovery Sites in Pembrokeshire are given again here, with the answers so that learners can check how many they had correct.

1. Poppit Sands
2. Sychpant (Preseli Hills)
3. Garn Fawr (Fishguard)
4. Newgale (near St David's)
5. Martin's Haven
6. Kete (Dale)
7. Broad Haven South
8. Skrinkle Haven

Screen 8

An image of the Milky Way from Garn Fawr, near Strumble Head, north Pembrokeshire is shown on this screen. Ask learners to discuss the questions posed.

Focus questions

- What is the Milky Way?
- When have you seen the Milky Way? Where were you?
- Why do you think the Milky Way is so clear from Garn Fawr?

N.B. *The Milky Way is the galaxy that includes the Solar System, with the name describing the galaxy's appearance from Earth: a hazy band of light seen in the night sky formed from stars that cannot be individually distinguished by the naked eye.*

Screen 9

This screen gives information about how the star constellations were named, with an image of Perseus and Andromeda.

Screen 10

A Welsh perspective is taken here, with how Perseus and Andromeda are named Lleu Llaw Gyffes and Blodeuwedd in Welsh mythology and a revised image.

Screen 11

Explain to learners that sometimes it is difficult to see why star constellations were turned into such complex images. For example, the Pegasus (flying horse) star constellation looks like this.

Ask learners to think about:

- Where are the wings?
- Where are Pegasus' rear legs and tail?

Screen 12

A wider perspective is given on this screen, from the Ojibwe, indigenous people of North America, who use their constellations to give life lessons.

Screen 13

Ask learners to think about how they might use the star constellation diagram (of Scorpio) to draw some type of mythical person or beast by linking the stars. You can print off the image so that learners can draw on the constellation. Invite learners to invent a story about their mythical person or beast and to tell it to others in the class.

Screen 14

Inform learners that they are going to go outside to see which star constellations they can identify.

There are many ways they can use to identify the constellations, e.g. an app, a leaflet or a printed sky map. The image on the screen can be printed – this gives the constellations in the northern hemisphere. You may wish to download the Star Gazing Guide leaflet or download a free app such as:

- Star Chart app on Android or iPad
- Night Sky app on Android or IOS
- SkyView Lite on Android or IOS
- GoSkyWatch Planetarium on iPad.

Screen 15

As learners to complete the quiz before they go outside, so they can get the best experience of viewing the night sky.

Screen 16

Introduce learners to the webpage Night Sky Map & Planets Visible Tonight. From here you can identify planets in the night sky at different times of the year. Ask them to type in their location. The webpage will tell them the planets they can see tonight.

Focus questions

Using the website ask them to discuss:

- Which planets could you see tonight?
- Which planet(s) could you see at midnight?
- Why can you see different planets at different times in one night?
- Why can you see different planets at different times of the year?

Screen 17

Invite learners to go outside to identify some star constellations and planets.

TASK 3

WHAT ELSE CAN WE SEE IN THE DARK?

Explain to learners that this task will explore two types of natural phenomena that make plants and animals glow – biofluorescence and bioluminescence.

Screen 3

This screen tells learners that light from the Sun is a mixture of different types of light.

We use 'visible light' to see but some organisms use light from different parts of the light spectrum.

Screen 4

Show the video How Bees Can See the Invisible (about 3 minutes). Ask learners to discuss the questions posed.

Focus questions

- What surprised you in the video? Why did it surprise you?
- Why is it important that bees and other insects can see UV light?
- What might happen eventually if insects could not see UV light?
- Why do you think electric fields might help pollination?

Screen 5

Explain to learners that there are two types of natural phenomena that make plants and animals glow – biofluorescence and bioluminescence.

Biofluorescent organisms reflect light in a different colour than the one they absorbed, usually as a response to UV light, e.g. flowers.

Bioluminescent organisms are able to generate their own light through a chemical reaction.

Screen 6

Tell learners that they are going to go outside and use a UV light torch to view biofluorescent flowers and take photographs. Ask small groups of learners to discuss the questions posed.

Focus questions

- Which sorts of flower might give the best photographs? Why do you think this?
- How will you make sure that visible light doesn't interfere with your photograph?
- What other equipment will you need? Why?
- What safety precautions should you take when using a UV torch? Why?

Please note: *to use UV torches safely make sure that learners do not shine UV light directly into people's eyes. If you wish to be very cautious, learners can also wear effective sunglasses. In addition, some UV torches can cause skin damage if used for a prolonged time directly on skin.*

Screen 7

Invite learners to go outside and take some photographs of flowers using UV light.

Screen 8

Ask learners to read the article and watch the video at Biofluorescence: Unseen world of the Celtic rainforest revealed by UV - BBC News.

Then, tell them that they are going to go outside to take some more photographs. This time they will compare organisms under visible light and UV light. Ask learners to discuss the questions posed.

Focus questions

- What equipment will you need? Why?
- Which organisms might look different under UV light? How might you find these organisms?
- What safety precautions will you take? Why?

Screen 9

Invite learners to go outside and take some photographs of organisms under visible and UV light.

Screen 10

In their groups, ask learners to review all their photographs. Then, to select photographs that show how organisms look different under visible and UV light. Following some research on biofluorescence, ask learners to create a digital presentation to showcase their findings.

Screen 11

Ask pairs of learners to interrogate the image on this screen by using the question starters to pose questions to help them find out more about the image.

Screen 12

Join up pairs to small groups and ask each pair to share their questions about the image and discuss possible answers to the questions.

Screen 13

Explain to learners that bioluminescent organisms are able to generate their own light through a chemical reaction and that they are more common in the sea than on the land.

Bioluminescence is extremely advantageous in the cold, dark waters of the deep ocean due to light being so rare. Below 1km, also known as the Twilight Zone, there is absolutely no sunlight and organisms must adapt to living in complete darkness. Ask pairs of learners to discuss the questions posed.

Focus questions

- Why do you think it is an advantage for organisms to luminesce in the Twilight Zone?
- What might organisms use bioluminescence for?

Screen 14

Invite learners to imagine they are diving deep into the Twilight Zone (below 1km). Ask them to research on the internet to find out about the organisms that live in the Twilight Zone. You might wish to show them: What Lurks in the Midnight Zone? - Blue Planet II - BBC Earth (just over 8 minutes).

Then, to draw, using luminous pens on black paper, what they might see around them in the dark.

You could make a Twilight Zone class display to show all the brightly coloured luminous organisms.