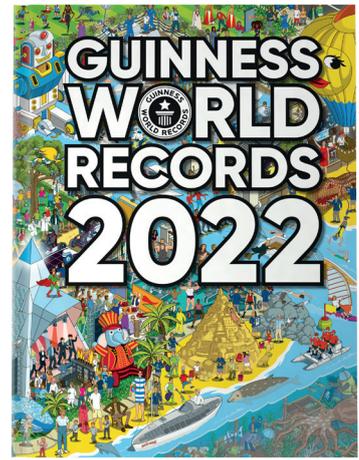


ECOSYSTEM ENGINEERS



LESSON 1 Explore

Lesson objectives

- To understand what an ecosystem engineer is and list some examples of ecosystem engineers
- To describe the effects that ecosystem engineers have on their environment, and what certain ecosystems might look like without their influence
- To apply understanding of ecosystem engineers to a case study of the role of beavers in reducing flooding and to apply this to other ecosystem engineers

Curriculum links

Science:

- Ask relevant questions and use different types of scientific enquiries to answer them
- Identify differences, similarities or changes related to simple scientific ideas and processes

Art and design:

- Use a range of materials creatively to design and make products
- Use drawing, painting and sculpture to develop and share their ideas, experiences and imagination
- Select from and use a wider range of tools and equipment to perform practical tasks (for example, cutting, shaping, joining and finishing), accurately

Equipment list:

Tin foil river and dam:

- Tin foil
- Water
- A sloped surface
- Materials to create a dam e.g. natural materials like grass, sticks or leaves, or man-made materials like Lego, clay or plasticine

Wetland activity:

- 2 litre plastic bottles with lid
- Coarse and fine sand
- Rocks
- Grass
- Scissors

Lesson explanation

An ecosystem is a community of living and non-living things that work together - it is a bit like a neighbourhood with lots of different homes for plants and animals to live. These different homes are called habitats - a habitat is the area where a plant or animal naturally lives. Ecosystem engineers design and shape their environment, creating resources for other wildlife and sometimes even changing the landscape they live within. Beavers are a great example of ecosystem engineers - they cut down trees to create the dams they live in, slowing water flow and creating new habitats, such as wetlands. In this lesson, your students can explore three types of ecosystem - rivers, dams and wetlands.

Step by step

The Ecosystem of a river: The first ecosystem your students should look at is a river. This activity can demonstrate how water flows and moves and how the shape of rivers affects how water flows. The instructions to create your tin foil river are as follows:

1. Start by rolling out a long stretch of tin foil. The river can be as long or as short as required by unrolling the foil.
2. Fold the tin foil in half so that it is half of its original width, and the foil is a double layer. Then, fold up either side so that the foil river has banks to keep the water inside.

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3. Find a place for the foil river, ideally outside. A good place for the river to go is on a slope, so that your students can watch the water flowing downwards. They could use books or other materials to prop the river up and create a slope if your river is indoors.
4. Place a bucket or bowl at the bottom end of the river, to catch the water.
5. Use a hose, a jug or a watering can to pour some water at the top, and watch it flow down the tin foil river!

The ecosystem of a dam: Now, begin thinking about changes to ecosystems. Dams can change the way rivers work and create different habitats. Beavers create natural dams, changing river ecosystems, by limiting the flow of water by blocking its path. Beavers make leaky dams which have holes in them. This allows the water to escape and allows fish and other invertebrates to continue to move up and downstream. Encourage your students to experiment with a range of materials and see which is the best at blocking or slowing the flow of the water. The instructions to build a dam in the tin foil river are as follows:

1. Ask your students to collect their chosen materials and pick which point on the river they want to create their dam. It needs to be somewhere in the middle, so that the water has space to pool upstream and they can see what happens downstream.
2. Once they have chosen their spot and materials, begin building the dam! The aim of a dam is to slow down the water in its journey downstream, but not stop it altogether. Task your students with building different types of dam using different materials and watching to see how it affects the water flow!

The ecosystem of a wetland: Finally, ask your students to have a go at creating a wetland. Wetlands are ecosystems that occur upstream when beavers build dams. Wetlands are vitally important habitats and are home to a wide range of species. They are also called the 'kidneys of the landscape' because they clean and store water. The wetlands and pools beavers create also help to reduce flooding, particularly if they are introduced upstream of cities and towns, as they slow down water flow and help to store more water, reducing flooding. The instructions to create a wetland are as follows:

1. Assist your students in cutting their bottles in half lengthways. Make sure the opening of the bottle (also known as the neck of the bottle) stays whole. Remove and recycle the top half of the bottle.
2. They should then stuff the grass into the bottle opening - fit in as much as they can!
3. Then, they should pour a layer of coarse sand into the bottom of the bottle, about 2cm deep. Then, they should add a 1cm layer of fine sand on top, then place their stones at the fatter end of the bottle, about 3cm away from the base.
4. Rest the fat end of the bottle on the bottle lid to create a slope, with the fat end higher than the neck. They should ensure the neck of the bottle is on a plate.
5. Finally, they should pour some water over the rocks and watch it travel down your bottle onto the plate. Wetlands filter water to make it cleaner - they can test this by mixing a tablespoon of soil with 250ml of water and stirring it well. They can then pour this water over the rocks and watch as the water becomes cleaner as it passes through the wetland!

Scaffolding and stretching

You could scaffold this lesson by providing pre-made tin foil rivers and providing photos of pre-made dams or instructions for how to build a dam.

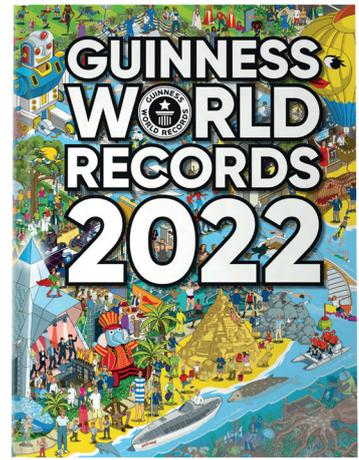
You could stretch this lesson by challenging students to make multiple rivers of different shapes and sizes and trialling different dam structures. Students could compare the effect of water flow across similar rivers with different dam materials, or across different river shapes and sizes with the same dam across each. You could also challenge your students to hypothesize what might happen with each change, testing their theories and reporting on their findings!

Climate links

Climate change is causing an increase in extreme weather events and rising sea levels, both of which contribute to more frequent floods. Beavers act as ecosystem engineers by altering rivers through the creation of dams. A secondary result of this is that wetlands are created, which reduce flood risk, particularly around cities and urban areas.



ECOSYSTEM ENGINEERS



LESSON 2 Challenge

Lesson objectives

- To explore your local area and map out different habitat types
- To understand how they can make an impact on your local area
- To reflect on the impact you were able to have and demonstrate what you could do next to improve the environment for yourself, other people and other animals and plants

Curriculum links

Science:

- Identify differences, similarities or changes related to simple scientific ideas and processes
- Use straightforward scientific evidence to answer questions or to support their findings
- Recognise that environments can change and that this can sometimes pose dangers to living things
- Report and present findings from enquiries, including conclusions, and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations

Equipment list:

- OS maps, maps of the school, digital maps
- Pencils and paper for planning

Lesson explanation

Just like beavers, we shape and change the world around us. However, often this has a negative impact, through removing important habitats and taking food and space away from wildlife. It's important that we think about this impact and act to help restore balance in ecosystems. Your students' actions could be as big or as small as they choose, for example spending time in nature or using natural materials in art or planting wildflowers and even building mini ponds! This lesson will help your students to plan out their actions and tailor them to the local area, providing an opportunity to consider their impact on nature and what other changes they could make to keep influencing the world around them for the better.

Step by step

1. Begin this lesson by investigating the local area. Find an OS map or print an online map of the area you want to look at with your students - this could be your school and school grounds, local village or community, or the area surrounding where they live. Then mark out all the different areas, including where there are buildings, where there is grass, where there are trees, where there are rivers or ponds, or anything else you can see.
2. Eco-Engineer Challenge ideas: look at the different areas you've marked out with your students and ask your students to think about how they could improve them. This could be planting some wildflower seeds in a grassy area in the school grounds, creating a mini pond, or even just adding a houseplant or some greenery to the classroom. We've given some examples of changes they could make below:

Starter Eco-Engineer challenges:

- Plant a window box with pollinator friendly species such as lavender, thyme, rosemary, and poppy. Or create a mini herb garden in a window, planting tasty plants like basil, mint, or parsley!
- Create a leaf or log pile in a spot of greenspace, to help create a new habitat for animals to live!

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- Learn about the benefits of leaving lawns and grass to grow long and how this provides spaces for nature to thrive! See if you can encourage people to participate in no-mow May or leave a patch of their garden long.
- Build a bug hotel - this can be a large group bug hotel, made from wood pallets and bricks and stuffed full of dried leaves, old twigs, cardboard, slate tiles, and other natural materials! They could also be small, individual bug hotels, made from plastic bottles or tin cans filled with dried sticks and leaves.
- Paint nature landscapes or create pictures from natural materials. Studies show that pictures of nature can make us feel good and connect us to nature, so why not try creating your favourite habitats or landscapes and showcase them up in the school or in your home.

Advanced Eco-Engineer challenges:

- Make your own mini pond from an old container, such as a tyre, sink, trough, or bucket. If you have the space, you could dig your own! Make sure to use standing water to fill your pond and try to include some nice aquatic plants to help wildlife!
- If you have an open space, you could plant some trees or your own wildflower meadow! Try to pick species that are native to your area and make sure to research the maintenance that will be required to manage your trees or meadow. You can also plant your seeds directly or create your own seed bombs from seeds, clay, mud, and water!
- If you know hedgehogs are local to your area, why not try building hedgehog homes, or you could create your own bird boxes to put up by buildings or on trees!

3. An important part of this activity is to record the changes being made and monitor the effect that they have! Students could write, draw, or present how the change made them feel, what impacts they saw, what other people might have said about it. Now the students have made one change to a local ecosystem, what could be done next? If they started with an easy challenge, students could work their way up to a harder one, maybe involving the help of friends or family to take more action over a larger scale!

Scaffolding and stretching

You could scaffold or stretch this lesson by choosing activities with more or fewer steps, or that are simpler or more complex. You could extend this activity by asking students to mark their actions onto a map or to conduct formal monitoring of the effects of their actions, such as doing a wildlife search before and after they make their change.

Climate links

It is widely recognised that humans have had a large impact on the planet and understanding how we can and do have an impact on our environment will allow us to make changes for the better. By encouraging young people to act for nature and the environment, we help them to establish a connection to nature, which will make them more likely to act positively for the planet.



ECOSYSTEM ENGINEERS

LESSON 3 Communicate

Lesson objectives

- To understand the benefits that beavers provide to other animals through engineering ecosystems
- To demonstrate understanding of ecosystem engineers through a creative writing task
- To share an understanding of ecosystem engineering with others

Curriculum links

Science:

- Recognise that environments can change and that this can sometimes pose dangers to living things
- Report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions

English:

- Explain and discuss students' understanding of what they have read, including through formal presentations and debates, maintaining a focus on the topic, and using notes where necessary
- Participate in discussions, presentations, performances, role play, improvisations, and debates
- Consider and evaluate different viewpoints, attending to and building on the contributions of others

Equipment list:

- Paper
- Pens/pencils/art/colouring materials

Lesson explanation

Beavers have a huge impact on their landscapes. A scientific study of the impact of beavers found that they increased the variety and suitability of habitats for a great number of species - that's a lot of species and spaces that wouldn't exist without beavers. In this activity, your students should consider some of the species that benefit from beavers. They will be thinking from the point of view of these animals and plants to create thank-you letters or cards for the beavers!

Step by step

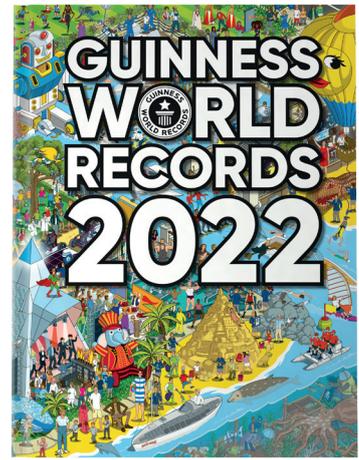
1. Take a look at the information provided for each of the species that benefits from the beavers. Once they have read them all, ask your students to pick which species they would like to write from the perspective of!

Bog stitchwort

My name is bog stitchwort and I am a type of plant. I like to live in shallow wetland, where I can keep my roots nice and wet, but keep my flowers up into the sunshine. Beavers make sure I have enough shallow water to live in by slowing the flow of the water by building their dams.

Wigeon

I am a type of bird, and I recently moved in after the beavers made the open wetlands which I like to live in. I breed in the spring and summer, having my babies in nests near to water. I like to eat plants, either from under the water or from the edges of shallow water. In the winter it gets too cold for me, so I fly south to Southern Africa and Asia. But I need to know that my home is being kept safe as it's a long way for me to fly



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back, so beavers help by providing safe and suitable homes for us.

Otter

I love to live and play in the land and water, so the ecosystems that beavers engineer are perfect for me! These ecosystems have land where I can build my home and help my babies grow up, and water where I can hunt fish to eat, and play and swim. I absolutely hate dirty water, so I especially like how the wetlands that beavers make clean the water for me, so I don't have to worry about getting sick from dirty water.

Great Crested newt

I am a type of amphibian and so like a mixture of land and water to live. I hide underground during the day in warm dry weather and come out to find food when its darker and damper. In spring, I breed and lay my eggs in ponds. Beavers make sure there are lots of places for me to hide, and open ponds for me and my babies in the spring and summer. These ponds are also a great place for plants to grow and insects to live, both of which provide food for me to eat!

2. Once they have chosen their species, your students should begin thinking about what they would like to include in their thank you letter. They can use some of the questions below to help:

- What is your name and what species are you? You could introduce yourself at the start of the letter or write this at the bottom of your card or letter to show who is sending it.
- How do beavers help you? Do they provide you with food or water? - if so, how? Why is this important?
- Do beavers protect you from predators, either by scaring them off or making sure there are lots of good hiding spaces for you?

3. If they have anything else they want to thank beavers for, they can include that in their letter also! Once all of the letters are written, your students could post them to friends or family to show what they have learnt about ecosystem engineers or create a display of them - you could even put them up on the wall in the shape of a beaver!

Scaffolding and stretching

You could scaffold this lesson by encouraging students to use the guiding questions, or by providing sentence starters and key words for students. You could also scaffold this activity by asking students to create thank you cards instead of letters, drawing descriptive pictures that show what they are thankful for.

You could stretch this lesson by asking students to compare the different effects that beavers have on different species. They could also create a short play or song about beavers and the effect they have on ecosystems!

Climate links

Species rely on each other in lots of ways, including for food and habitats. Climate change is causing the loss of species as they struggle to cope with the changes that are happening as a result. This has knock on effects on other species that depend upon those that are lost.

