Royal Academy of Engineering

THIS IS ENGINEERING

IN THE NATURAL WORLD

Biodiversity

3 GOOD HEALTH AND WELL-BEING

13 CLIMATE ACTION

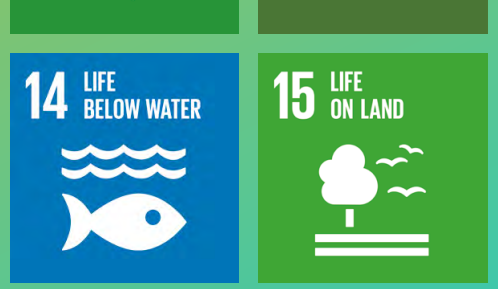
14 LIFE BELOW WATER

15 LIFE ON LAND

LUCY USES FISH WASTE TO CREATE A UNIQUE ALTERNATIVE TO PLASTIC.

She developed MarinaTex, using scales and skin to form a bioplastic material that is more environmentally friendly.

Learn more about how engineers are finding ways to protect the planet by scanning the QR code or visiting the This is Engineering website.



ACTIVITY 1
BIODIVERSITY

BIODIVERSITY IS THE VARIETY OF ALL LIVING THINGS AND THE WAY THEY INTERACT WITH EACH OTHER SUPPORTING ALL LIFE ON EARTH.

This includes animals, plants, microorganisms, and the habitats they exist in, such as forests, deserts, oceans, and urban areas.

Biodiverse ecosystems change over time and are essential for the health of our planet. They provide us with clean air and water, pollination of crops, climate control, and medicine.

Engineers play an important role in creating new technologies and the infrastructure for a 'greener' future, which we need to live a healthy life.

LINKING TO THE CURRICULUM

Science

Biology: pupils learn about ecosystems, habitats and the variety of life forms. Topics include the classification of living organisms, adaptation and the impact of human activity on biodiversity.

Technology and innovation

Sustainable design: pupils learn about sustainable materials and design practices that minimise environmental impact and promote biodiversity.

Maths

Data handling: using real world data related to biodiversity, such as population surveys of different species, to teach statistical analysis, graphing and interpretation.

ACTIVITY 1.1 INVASIVE SPECIES

Invasive species can have a negative impact on native plants and animals, causing environmental, health and economic problems to our eco-system.

TIME TO INVESTIGATE

Watch this Ted-Ed video on '**the threat of invasive species**' (4.45 minutes).

- Why do you think invasive species are a problem? Think of some examples.
- How has human intervention escalated the spread of invasive species?
- What do you think this problem has to do with engineers and engineering?

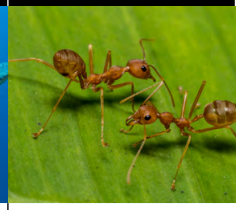
Watch this Ted-Ed video about '**The threat of invasive species**'.

TIME TO PLAY — THE UNSTOPPABLE FIRE ANT GAME

The goal of the game is to collect as much food as possible while understanding the impact of an invasive species on native species in an ecosystem.

Group setup

- Play the game in groups of five players.
- Each player chooses an animal species to represent. There are four native species and one invasive species (the fire ant).

Native species				Invasive species
Sea bird chick	**Beetle**	**Dragonfly**	**Sea turtle**	**Fire ant**
				
● ● Pom-poms	○ ● Pom-poms	● Pom-pom	○ Pom-pom	● ● ○ Pom-poms
X1 spoon	X1 pair of chop sticks	X1 tweezers	X1 fork	X1 hand

Aim of the game

Invasive species should try and eliminate native species, and native species should aim to avoid extinction.

The game continues for a set number of rounds. At the end of the final round, count the food collected by each species. The player with the most food collected wins.

MATERIALS

- Three bags of different coloured pompoms (representing food) randomly distributed around a table.
- A cup for each species to collect their food. Each cup must stay upright and in a fixed position.
- Assigned tools for each native species to collect food with one hand.

Initial rounds (rounds one to three)

- Only native species participate.
- Each round lasts 30 seconds (adjust the time as needed).
- Native species use their tool with one hand to collect as many assigned coloured pompoms as possible, placing them in their cup.
- After each round, the collected food from native species is returned back to the ecosystem (spread the pompoms around the table again).

Invasive species arrives (round four and onwards)

- The invasive species (fire ant) joins the game.
- Each round lasts 30 seconds (adjust the time as needed).
- Native species return all collected food back to the ecosystem.
- The invasive species (fire ant) returns only half of the collected food back to the ecosystem (round up if there is an odd number of pompoms).
- Each species starts off with three lives.
- Once a species is out of lives, they become extinct. That player rejoins the game as an invasive fire ant.

TIME TO REFLECT

1. How were you able to compete with the other native species for resources necessary to your survival?
2. What made the invasive fire ant so successful?
3. What could the consequences be to organisms entering an ecosystem that have a competitive advantage over the native species?

ACTIVITY EXTENSION

For every three pompoms beyond the first five, the native species gains an extra life. For example, if a dragonfly collects nine pompoms after round one, it does not lose a life and gains one extra life for having three additional pompoms.

Adjust the number of rounds before the invasive species arrives. Vary the collection methods to increase difficulty. Change the amount of food returned by the invasive species to observe different impacts.

ACTIVITY 1.2 HOW RICH IS YOUR HABITAT?

MEASURING AND MODELLING BIODIVERSITY

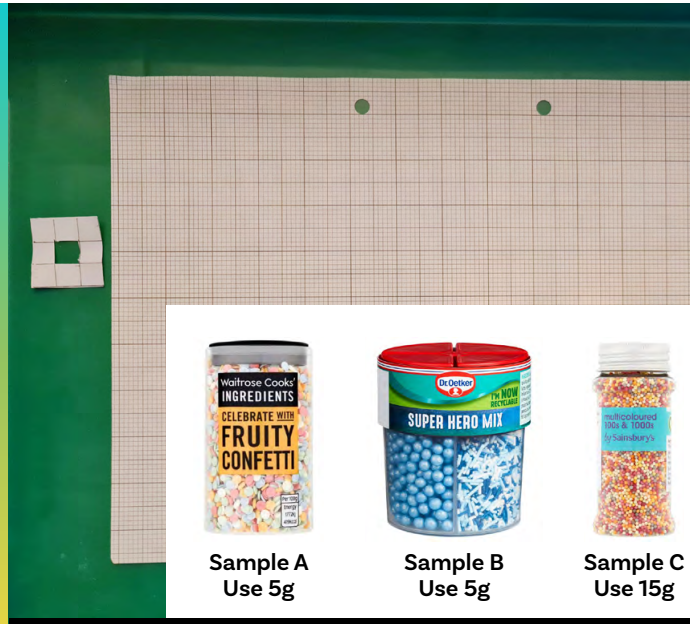
Scientists and engineers carry out studies to find out what is happening in the environment and with biodiversity. They do this out in nature, or they create models to replicate the real world.

They will also use 'samples' for information rather than gathering data about an entire area.

MEASURE BIODIVERSITY... IN CAKE SPRINKLES!

MATERIALS

- Materials
- Tray
- Tweezers (in the kit)
- One square frame 3cm x 3cm with a 1cm x 1cm square hole in the middle. This is your model *quadrat*.
- Glue stick
- Three different types of cake sprinkles
- Calculator
- A4 Graph paper
- Possibly magnifying glass/microscope



Sample A
Use 5g

Sample B
Use 5g

Sample C
Use 15g

You can use different cake sprinkles, but each sample must be different from the other two.

Setup

1. Lay the graph paper on a flat surface.
2. Number along the x-axis and y-axis starting from 1 in the top left hand corner.
3. Use a random number generator to tell you where to take your sample.

Habitat A – river

4. Using a glue stick, create a 'model' freshwater habitat by covering a strip of graph paper with glue roughly diagonally across the sheet from bottom left to right. This will represent a stream or river. This will be **habitat 'A'.**
5. Lay the sheet of paper in the tray provided.
6. Pour sample A over the paper so the pieces stick to the 'river'. Ensure the river is completely covered.
7. Collect any loose balls and add them back to your container.

Habitat B – trees and shrubs

8. Apply about 7 or 8 blobs of glue, each about 1 cm^2, to remaining parts of the graph paper. These will be **habitat 'B'.**
9. Pour sample B over the blobs of glue until they are completely covered.
10. Collect any loose balls and add them back to your container.

Habitat C – meadow or grassland

11. Pour sample C gently over the remaining graph paper. This will be **habitat 'C'**.

Take samples of habitats A, B and C

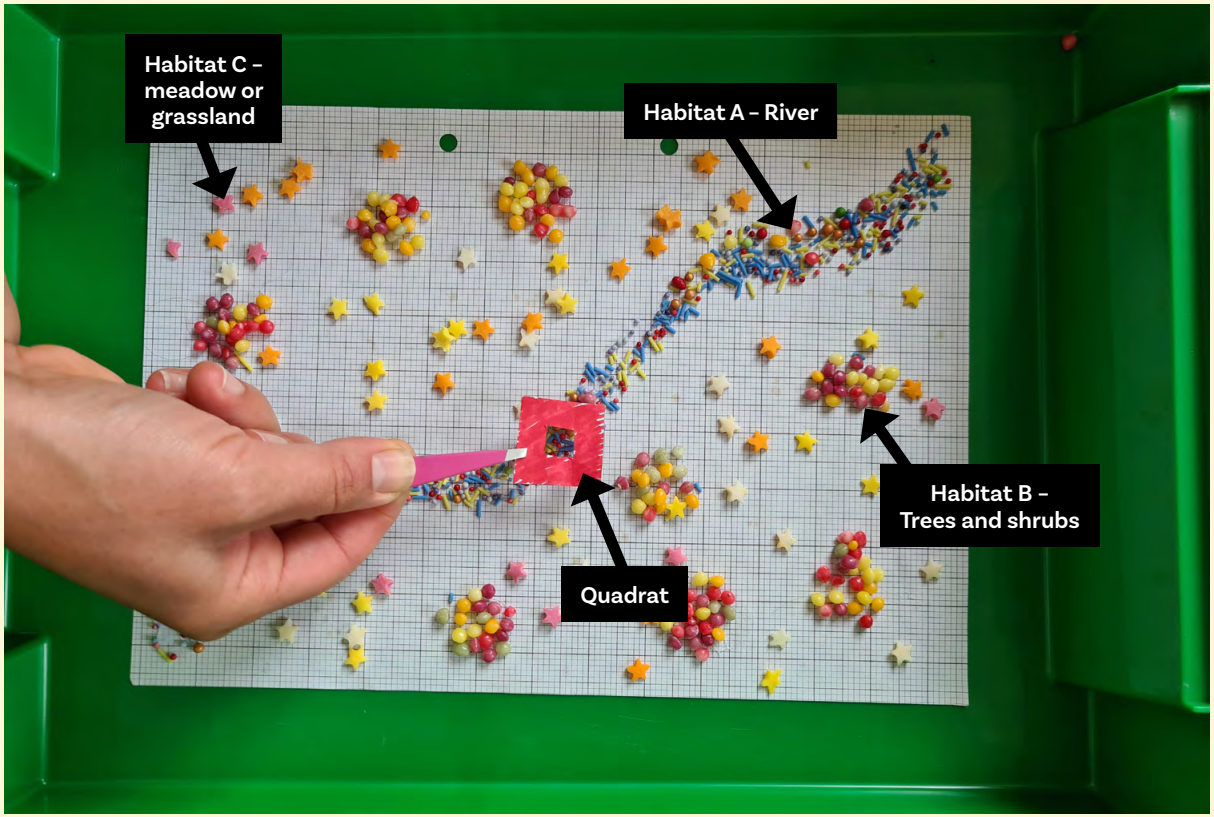
What colours are present in each habitat?

Using your quadrat, cover sections of habitat A, B and C. Use the tweezers to pick up and put down your quadrat.

Count how many of each 'species' are present in the quadrat. This is your sample. Collect 5 samples for each habitat.

TIME TO RECORD YOUR FINDINGS

Create a record on your findings on the habitat sample sheets.



What does each sample of sprinkles represent?

- a population
- a community
- a habitat
- an ecosystem?

Have a go at pollution, water system contamination, or invasive species on your biodiversity model?

This activity has been adapted from **'How rich is your habitat?' by the Linnean Society**.

A quadrat is usually square and used to mark out a small area. It is used to sample a larger area.

Sample	Grid reference	Habitat A					
		Number in sample					
		White	Red	Green	Grey	Blue	Yellow
1	(4, 5)	3	6	0	5	4	5
2							
3							
4							

Sample	Grid reference	Habitat B					
		Number in sample					
		White	Pink	Yellow	Red	Orange	Grey
1	(6, 2)	1	3	1	3	1	0
2							
3							
4							

Sample	Grid reference	Habitat C			
		Number in sample			
		Pink	Yellow	Orange	White
1	(4, 12)	1	2	1	0
2					
3					
4					

ACTIVITY EXTENSION

Carry out a study to measure and analyse biodiversity within a specific real life environment, using a variety of ecological and statistical methods.

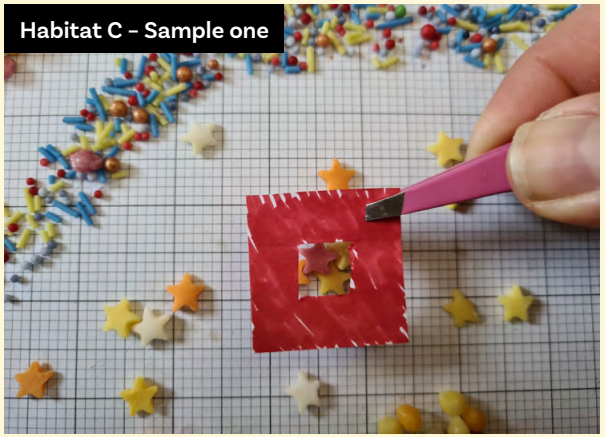
Choose a specific location such as a local park, forest, wetland or school grounds and define the boundaries of the study area using GPS coordinates.

Gather information on the ecosystem type, climate and known species in the area. Collect data on species presence and record environmental variables (for example, temperature, humidity, soil pH) that may influence biodiversity.

Use statistical software to analyse the data and create visual representations to present the study to the class.


Habitat A – Sample one


Habitat B – Sample one


Habitat C – Sample one

Royal Academy of Engineering

The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

Together we're working to tackle the greatest challenges of our age.

What we do

Talent & diversity

We're growing talent by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession.

We're developing skills for the future by identifying the challenges of an ever-changing world and developing the skills and approaches we need to build a resilient and diverse engineering profession.

Innovation

We're driving innovation by investing in some of the country's most creative and exciting engineering ideas and businesses.

We're building global partnerships that bring the world's best engineers from industry, entrepreneurship and academia together to collaborate on creative innovations that address the greatest global challenges of our age.

Policy & engagement

We're influencing policy through the National Engineering Policy Centre – providing independent expert support to policymakers on issues of importance.

We're engaging the public by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers.

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