

Introducing Biomimicry to Students

At the heart of biomimicry is the ability to observe nature, discern how nature works and apply lessons from nature to human design challenges. Biomimicry offers excellent opportunities for students to develop STEM competences and link into Business Studies.

The best way to introduce biomimicry to students is to let them 'have a go.' Provided below are two suggested sessions for introducing biomimicry. The sessions will introduce students to the general idea of biomimicry and how it can inspire human design. They will also introduce students to some key terms and biomimicry skills they will meet on the NatEnt platform – function, strategy and Nature's Unifying Patterns. Introducing these now will pay dividends when students work on a biomimicry challenge of their own.

Session 1

The purpose of this session is to:

- introduce students to the term biomimicry;
- demonstrate how biomimicry involves looking at nature in a new way;
- become familiar with key biomimicry terminology; and
- become aware of some ways biomimicry has helped solve human design challenges.

Activity 1 – Seeing Nature Through New Eyes

This activity can be done outside ideally, or within the classroom.

Ask students to individually collect a natural object (stick, seed, leaf, etc) – prepare these in advance if working in the classroom.

Students should carefully observe the object and reflect on the question you provide – 'what does your natural object do?' or 'what is its purpose?' Elicit feedback from your students and probe them to think further. For example, a twig might have the purpose of transporting liquids and providing strength and structure ... you could ask 'how does it do this?' Maybe you could add 'What do you feel when you see or touch this?'

To help, collect a green leaf to use as an example. Holding the leaf up you could share that:

- Redundancy – observe the veins in a leaf closely and you will see an interconnected network of veins all leading to the mid-rib. Because the veins are interconnected, liquids can move following different pathways, so if part of the leaf becomes damaged, liquids can find

alternative routes. The same is true with our electricity system. Power lines are organised so that electricity can flow from A to B following a number of different routes. So, if one power line is closed for repair or due to damage, electricity can still flow.

- Murray's Law – this predicts the thickness of branches in a transport network and has been learnt from observing how vascular plants size the radii of veins to be most efficient for moving liquids (balancing volume vs energy required). Murray's Law has been adapted for sizing pipes within industrial plants to the same effect.
- Dye Sensitised Solar Cells – these are solar cells inspired by photosynthesis, and are much more environmentally benign than silicon solar cell due to the reduced toxicity in their construction materials and reduced energy in manufacture.
- Surface Structure – leaves have deep wrinkles in their surface structure which help trap light more efficiently. Creating wrinkles and deep folds onto the polymer surface of photovoltaics has resulted in big increases in efficiency.
- Building Mass – trees create their mass mainly through taking carbon from the atmosphere as part of photosynthesis, rather than mining it from the ground as humans do to create building materials. Prototype building bricks are now available which mimic this process and used carbon from the air as part of the process.

The activity shows that we can learn about nature – we can name things, but we can also learn from nature i.e. how nature does things. Finish by introducing the terms function and strategy which are defined below. These are key terms which students need to understand to complete the Natural Entrepreneurs project.

Function

In biomimicry a function refers to an organism's adaptation which helps it survive and thrive. For example, the purpose of bear fur is to keep warm, in technical terms its function is to conserve heat (insulation). Often, 'designs' in nature have more than function. A leaf can photosynthesise (convert energy from the sun into sugar) and it can distribute water (through its veins). Human products also have functions; a kettle has the functions to both contain water and heat water. In brief, a function is 'what it does.'

Strategy

Organisms meet functional needs through biological strategies. This is a characteristic, mechanism or process which performs the function for them. In the bear example, fur is the strategy for delivering insulation. In a kettle, electrical energy is transferred into heat energy which increases the kinetic energy of the water molecules and therefore the temperature of the water. In brief, a strategy is 'how it does it.'

Finish with this definition of biomimicry.

Biomimicry

Biomimicry is a practice that learns from and mimics the strategies found in nature to solve human design challenges—and find hope.

Biomimicry is about valuing nature for what we can learn, not what we can extract, harvest, or domesticate. In the process, we learn about ourselves, our purpose, and our connection to each other and our home on earth.

From the Biomimicry Institute (<https://biomimicry.org/what-is-biomimicry/>)

Activity 2 – Solved by Nature

This is a simple card matching game – the cards are provided as a downloadable resource in a print ready format (see Planning Delivery on the NatEnt platform). You could provide one set of cards to a group of students and ask them to match as many examples as they can. Or, provide one card per student and ask them to find their match with students moving around the classroom.

The cards include:

- A set of cards with an image of an organism and a clue as to what is special about it (double-sided).
- A set of cards with problems for which one of the organisms is a solution (single-sided).

Once you have used the cards, and students start to realise how nature has inspired human design solutions, you might wish to show short video clips from the Biomimicry Institute – the [Biomimicry in Action Case Studies](#) are best.

Activity 3 – Find it Out for Yourself

By now students will have a clearer understanding of biomimicry. If time, or as homework, ask students to find three examples of biomimicry online which interest them. For each example, ask them to describe:

1. The organism and what human design it has inspired.
2. What the human design is mimicking i.e. the function.
3. How this works i.e. the strategy.

Session 2

The purpose of this session is to:

- provide students opportunity to practice identifying functions;
- explore how functions can inspire design ideas; and
- understand the principles which underpin nature as a sustainable system.

Activity 1 – Function Scavenger Hunt

This activity comes from Ask Nature. Students are invited to search the school grounds for as many examples of the listed functions as they can find. They should collect examples (as long as they do not damage living organisms) to bring back to the classroom to share.

Discuss what they have found and why. If appropriate, ask if students can think of ideas for applying the functions into human design.

A list of functions can be downloaded [here](#).

Activity 2 – Nature’s Models

In this activity students focus on a single organism. Ask them to search for an organism they are interested in from the school grounds, or prepare some in advance (plants and insects work well). You might need to provide some collecting boxes, nets and pooters for students to safely capture their selected organism.

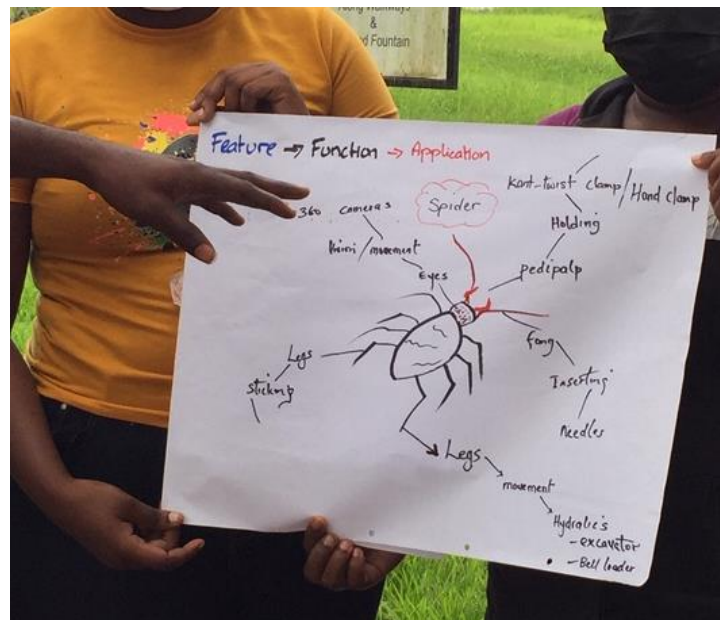
Ask students to closely observe their organism, and then to draw it onto a piece of flipchart paper. They should then label their drawing with features they are interested in.

For each feature, they describe the Function it delivers. Note here that a Function is always an active verb. The Biomimicry Institute has created the [Biomimicry Taxonomy](#) which will help you. Look at the diagram on the third page – this provides a helpful list of possible Functions. They start with general terms in the centre, and then get more specific as they radiate out. Read through the Identify Functions stage on the NatEnt platform for more information.

Finally, ask students to think of any applications in the human world for the Functions they have identified in their chosen organism.

Students can report back their findings to the group. It can be helpful to provide students with flipchart paper which has the descriptors feature, function and application on the top as a reminder.

To debrief, you could describe the process they have just undergone is called Biomimicry from Biology to Design. In the NatEnt platform, they will use a similar process called Biomimicry from Challenge to Biology. The difference is, on the NatEnt platform students will start by identifying a Challenge they are interested in and then search nature for solutions.



Activity 3 – Nature’s Unifying Patterns

Nature’s Unifying Patterns have been developed by the Biomimicry Institute and are offered as the ten most important lessons nature can offer designers. Here’s what they say about it:

“Nature’s unifying patterns is our attempt to identify the 10 most essential lessons from the natural world that should be considered as part of a design process. We call them “nature’s unifying patterns” because examples of the patterns can be found broadly across the majority of life on Earth.

Consider these patterns at the start of any design process and return to them throughout the process as an evaluation tool”.

[Biomimicry Institute](#)

Provide students with a copy of Nature’s Unifying Patterns downloaded from the NatEnt platform. Ask them to search, either online or in the school grounds, for examples from nature where one or more of Nature’s Unifying Patterns can be observed.

When students select a Challenge from the NatEnt platform, they will also be asked to consider which of Nature’s Unifying Patterns might be most helpful for them. This activity will have prepared them for this.