



# BIG BIOMIMICRY CHALLENGE

A nature-inspired response to some of life's biggest challenges



Erasmus+



## AGE RANGE

13–15



## DURATION

### Preparation:

10–20 minutes/activity

### Activity:

150 min / 3 lessons



## SUBJECT(S)

- Science – *Biology, Chemistry, Physics*
- Design, Engineering and Technology



## KEYWORDS

Problem/challenge-based learning; group work; presentations; evaluation of designs

## SUMMARY

This module takes students through the process of nature-inspired design, and a structured design task, involving individual and group work. The module is designed to stand alone, or as part of a large scheme of work. While many of the concepts are relevant to Design Technology and Biology, the module will also appeal to teachers looking to develop study skills including team work and presentation competencies in students.

## BIOMIMICRY PRINCIPLES



- 1 – Nature runs on sunlight
- 2 – Nature uses only the energy it needs
- 3 – Nature fits form to function
- 4 – Nature recycles everything
- 5 – Nature rewards cooperation
- 6 – Nature banks on diversity
- 7 – Nature demands local expertise
- 8 – Nature seeks balance
- 9 – Nature taps the power of limits

## LEARNING OBJECTIVES

- Students understand that working with nature can help to address sustainability challenges.
- Students develop a knowledge of a variety of sustainability challenges and how they affect society.
- Students develop their presentation skills, learn to give and receive feedback.
- Students engage with and discuss sustainability challenges, on a variety of scales.
- Students are able to apply biomimicry principles to address a design / challenge.

## LEARNING OUTCOMES

- Students apply biomimicry principles to solve a design challenge.
- Students collaborate with others to solve problems as a group.
- Students engage with group work, presentations and feedback.
- Students make use of evaluation processes to improve their design.

## BIOLEARN COMPETENCES

- Students are able to abstract principles of sustainability from the way the natural world functions.
- Students are able to identify functional design in nature, develop greater awareness and appreciation for design excellence in nature, and appreciate how nature works as a system which is elegant and deeply interconnected.
- Students are able to identify important needs and opportunities that can be addressed through design innovation for products, processes and systems.
- Students are able to use analogical creativity to innovate, using biological models to inspire solutions to design challenges.
- Students are able to assess the consequences of applying biomimicry solutions (values).
- Students are able to work in groups.

## SUMMARY OF THE ACTIVITIES

Activity Name		Description	Method	Duration	Location
<b>LESSON 1: Big Biomimicry Challenge</b>					
1	Choose a project	Identifying a challenge making use of biomimicry to help solve it	• Group work	15	Indoor/ outdoor
2	My Design Challenge	Use nature to help design a solution in a group	• Group work	15	Indoor/ outdoor
3	How would nature...?	Present ideas to other groups and adapt design based on feedback	• Presentations / Group work	15	Indoor/ outdoor
<b>LESSON 2: Collaboration and group work</b>					
4	Using inspiration from nature	Identifying functions in nature	• Exploration	20	Indoor/ outdoor
5	Sketch of the design	Students work on the sketch of their design	• Group work	25	Indoor/ outdoor

	Activity Name	Description	Method	Duration	Location
<b>LESSON 3: Mini group presentations and feedback</b>					
6	Discussion in pairs	Evaluation of the plans	• Discussion	15	Indoor
7	Group Collaboration	Different groups of students improve previous plans	• Presentation • Discussion	20	Indoor
8	Let's get thinking!	Students think further on their plans and the usage of biomimicry	• Discussion	10	Indoor

## OUTLINE OF THE MODULE

## BACKGROUND FOR TEACHERS

This module takes students through the process of nature-inspired design, a structured set of design tasks, involving individual and group work. The module in large part follows the worksheets. The module can be easily adapted to suit a range of time-allocations, and might be delivered in different arrangements – for example:

1. Lessons 1–2: Introduction to Biomimicry
2. Lessons 1–5: Introduction to Biomimicry + Biomimicry challenge
3. Lessons 1–8: Introduction to Biomimicry + Biomimicry challenge + Presentation of design

The module utilises accompanying presentations which contain detailed teaching notes, in order that different teaching staff can deliver each lesson. More straightforward teaching notes are included in this guide under each lesson/activity overview below.

During the lessons, students will become familiar with the terms function and strategy. It is important to be clear about these terms and we offer the following definitions:

*Functions:* In biomimicry a function refers to an organism's adaptations which help it survive. For example, the purpose of bear fur is to keep warm, in technical terms its function is to conserve heat (insulation).

*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.

Also see in Glossary.

## ACTIVITY DETAILS

### LESSON 1: Big biomimicry challenge

This lesson guides students through the process of identifying a challenge and making use of biomimicry and nature-inspired thinking to help solve the challenge. The accompanying worksheets take students through a structured step-by-step process culminating in the development of a design as a solution to their challenge. This activity prepares the students for the following two lessons which encourage collaboration and discussion.



#### LOCATION

Indoor / Outdoor

## 1 | CHOOSE A PROJECT

» DISCOVER 



#### TOOLS AND MATERIALS

- pens, paper
- [W1.1](#)–[W1.7](#) student worksheets



#### PREPARATIONS

Indoor or outdoor activity.

Classroom to be arranged for group work. Pens and paper available on each table.

Print the worksheets for groups.

Work in groups of 3–4 and use [W1.1](#) for the whole lesson. Choose an existing design challenge (five to choose from – teachers may wish to reduce this number to suit the group) – See: [W1.2](#)–[1.6](#) (also detailed in accompanying [Big Biomimicry Challenge ppt](#)).

Students then use the worksheet to link their challenge to the Sustainable Development Goals. They might also wish to use the decision tree ([W1.7](#)) to help break the challenge down into manageable chunks.

## ACTIVITY DETAILS



**LOCATION**  
Indoor / Outdoor

## 2 | MY DESIGN CHALLENGE

» DISCOVER 



**TOOLS AND MATERIALS**

- [W2.1](#) student worksheet



**PREPARATIONS**

See in Activity 1

For the chosen challenge, students follow the process below to help you to focus your design.

Students follow the worksheet [W2.1](#) to:

- Give a simple explanation of what you want their design to achieve or do (see prompts on worksheet).
- Describe some of the factors (e.g. location, resources, and users) that are important to consider.
- Using the information above, students phrase their challenge as a question. Remind them to be careful to clearly describe different elements if necessary. e.g. How might we make urban cyclist more visible to drivers at night?



**LOCATION**  
Indoor / Outdoor

## 3 | HOW WOULD NATURE...?

» DISCOVER 



**TOOLS AND MATERIALS**

- [W3.1](#) and [W3.2](#) student worksheets



**PREPARATIONS**

See in Activity 1

Next, help students to consider how nature might solve this. To begin with, prompt them to turn their '*how might we*' question into a simpler '*how would nature*' question. Fill in responses on the [W3.1](#) worksheet.

For example, rather than asking "How does nature make cyclists more visible at night?" we ask "How does nature enhance visibility in low light conditions?" This simplified question expresses what the design is trying to do.

If students require help or inspiration, give them sheet [W3.1](#) which contains useful links and websites.

### Homework task (optional):

To help prepare students for the next lesson, they can look for functions in nature which relate to their challenge. They can use the [W4.1](#) for this task. Begin by listing the functions which they need, and then look outside for examples of where nature achieves these functions.

## ACTIVITY DETAILS

### LESSON 2: Collaboration and group work

In this lesson students start to apply biomimicry approaches to problem solving by looking to nature for inspiration. To achieve this, they are prompted to consider the functions that nature provides, and think how this might be applied to their own challenge. Students continue to work through the worksheets in groups, and conclude the activity by sketching and labeling their design, in preparation for the next activity.



#### LOCATION

Indoor / Outdoor

### 4 | USING INSPIRATION FROM NATURE

» CREATE 



#### TOOLS AND MATERIALS

- pens, paper
- [W4.1](#) student worksheet

Remind students of their main challenge / problem (see [W1.1](#)), and ask them to look over answers on [W3.1](#). Ask them to about the function they want to achieve, where in nature you might find this function, and then think about how this might be applied to the challenge).



#### PREPARATIONS

Classroom to be arranged for group work. Pens and paper available on each table.

Print the worksheets for groups.

Students work in groups to fill in the table of [W4.1](#) to identify the function, consider where this might be found in nature, and think about applying it to their challenge.



#### LOCATION

Indoor / Outdoor

### 5 | SKETCH OF THE DESIGN

» CREATE 



#### TOOLS AND MATERIALS

- [W5.1](#) student worksheet

Students sketch out their design – use imagination to think about what it might look like. Annotate and label it. Use the space provided on the [W5.1](#).



#### PREPARATIONS

See in Activity 4

## ACTIVITY DETAILS

### LESSON 3: Mini group presentations and feedback

In this lesson, students form new groups in order to present their design, and its underlying nature-inspired problem solving to others. The task involves both presenting and listening, concluding with a chance to adapt the designs based on feedback, and an opportunity to consider the future based on their designs.



**LOCATION**  
Indoor

#### 6 | DISCUSSION IN PAIRS

» CREATE 



**TOOLS AND MATERIALS**

- pens, paper
- [W6.1](#) and [W6.2](#) student worksheets



**PREPARATIONS**

Classroom to be arranged for group work. Pens and paper available on each table.

Print the worksheets for groups.

Ask students to:

- Discuss your sketch from last lesson with your partner.
- Describe and explain your design.
- Discuss how nature helped you come up with your design?

Provide students with [W6.1](#) and [W6.2](#).

Students use the biomimicry principles ([W6.1](#)), alongside the evaluation wheel and associated questions on worksheet ([W6.2](#)) to evaluate their design.



**LOCATION**  
Indoor

#### 7 | GROUP COLLABORATION

» CREATE 



**TOOLS AND MATERIALS**

- [W7.1](#) and [W7.2](#) student worksheets



**PREPARATIONS**

See in Activity 6

- Each member of the group should have a copy of the sketch/ design.
- They work on [W7.1](#).
- Students get into groups of 3–4 with members of different groups (there should not be two people from the same group in the 'new groups'. Each student takes a copy of the feedback evaluation wheel ([W7.2](#)).
- Students take it in turns to explain their design to the 'new group'. Following each presentation, the group together fills in [W7.2](#) for the student who presented.



## ACTIVITY DETAILS

When presenting to the new group, students should aim to answer the following questions (you may wish to provide them with five minutes of preparation time before forming groups):

- What was your design challenge?
- Why did you choose this design challenge?
- Which aspect of biomimicry aided you in your design?
- How does your design solve the challenge you chose?

## EXTENSION

Following the collaborative presentations, provide students with time to return to their original groups and adapt their design based on their collaboration. They might use the evaluation wheel to help them with this.

Based on the design solutions, ask students to consider what the future will look like in 30 years.

*Challenge:* If you can, answer this question on a local, national and international level. Can this be linked back to the Sustainable Development Goals in Activity 1. Students discuss this in their groups for 5 minutes.

Some follow up questions:

- How do the designs you have seen in the lesson today link to the sustainable development goals?
- Do you think sustainable development is possible?
- How could the use of biomimicry enable us to come up with sustainable solutions to development?

**LOCATION**  
Indoor

## 8 | LET'S GET THINKING!

» CREATE **PREPARATIONS**[See in Activity 6](#)

Let students think in groups about the task: How could biomimicry act as a tool for thinking and planning for the future of our planet?

After discussing in groups talk about it as a whole class.

## ACTIVITY DETAILS

## LITERATURE, ADDITIONAL INFORMATION

Below are a range of useful website links and book references.

## WEBSITES

*Ask Nature* – <https://asknature.org/>

The key resource for exploring biomimicry examples; a rich resource to delve in to. Their resources area ([https://asknature.org/?s=&p=0&hFR%5Bpost\\_type\\_label%5D%5B0%5D=Resources](https://asknature.org/?s=&p=0&hFR%5Bpost_type_label%5D%5B0%5D=Resources)) offers teaching resources, videos and articles to explore.

*Biomimicry Toolbox* – <https://toolbox.biomimicry.org/>

Great resources explaining the core concepts of biomimicry and a step-by-step approach to applying a biomimicry approach to design.

*Packaging Innovation Toolkit* – <https://synapse.bio/blog/2017/10/11/biomimicry-packaging-innovation-toolkit>

Resources to expand ideas around packaging based on biomimicry thinking.

*Genius of Place* – <https://synapse.bio/blog/ultimate-guide-to-genius-of-place>

In the Genius of Place process, biomimics look to native organisms and eco-systems to provide guidance, models, and metrics for how to be generous and resilient as we design for a particular place.

## BOOKS &amp; JOURNALS

*Biomimicry Resource Handbook*

The key resource for biomimicry thinking, processes and applications. A huge amount of information and ideas; expensive but well worth it.

Baumeister, Dayna (2014). *Biomimicry Resource Handbook 2014: A Seed Bank of Best Practices*. Biomimicry 3.8.

*Biomimicry: Innovation Inspired by Nature*

The book by Janine Benyus which first brought biomimicry to wide attention. Lots of good examples to use and descriptions of the nine principles of biomimicry. Benyus, Janine (2002). *Biomimicry: Innovation Inspired by Nature*. HarperCollins.

*Zygote Quarterly*

Showcases examples of science, technology and creativity in the field of biologically inspired design.

<https://biomimicry.org/zygote-quarterly/>

## W1.1 CHOOSE A PROJECT

### The project

Working in groups of 3–4, choose a design challenge (five to choose from).

**HINT:** You might like also to have a look in the local press for an issue which interests you.

**Q:** What is your challenge?

.....

.....

.....

### Sustainable Development Goals

The Sustainable Development Goals (SDG's) are global goals which provide a broad focus for development, design and innovation which enables both people and planet to thrive. Most problems (and solutions) can link to at least one SDG.

For your chosen area of interest use the diagram below and circle up to 3 SDG's which link to your challenge.

**Which SDGs does your challenge link with?**



**Q:** How do these goals link with your chosen challenge? Make some notes here:

.....

.....

.....

## W1.2 CHOOSE A PROJECT

### SDG 16: Peace, justice and strong institutions – Justice and Equality



## JUSTICE AND EQUALITY

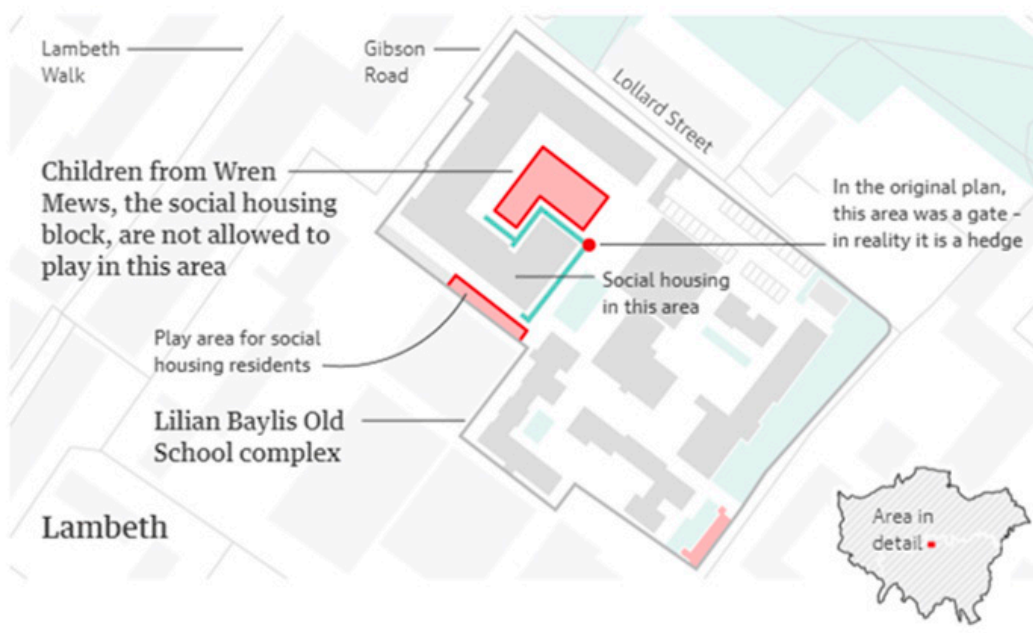
**ISSUE:** Children living in social housing in London are blocked from using a playground which other children enjoy.

**CHALLENGE:** How can we create shared play spaces for all children to enjoy regardless of their backgrounds? Come up with a solution to this problem, through a design or idea, using nature to help you. Some things to focus on include: how to encourage cooperation and sharing; how to improve access; how to protect vulnerable people; how to link communities together; how to improve communication between people?

**USE NATURE TO HELP:** How does nature do these things? Are there examples from nature we can copy?

*How does nature work together, cooperate, communicate, share and look after others?*

### Social housing residents have been blocked from using shared play spaces at a 149-home development in south London



Article link here: <https://www.theguardian.com/cities/2019/mar/25/too-poor-to-play-children-in-social-housing-blocked-from-communal-playground>

Use the decision tree (W1.7) to help you to break the problem down into manageable chunks.

## W1.3 CHOOSE A PROJECT

### SDG 12: Responsible consumption and production



### RESPONSIBLE CONSUMPTION AND PRODUCTION

**ISSUE:** We are producing vast quantities of waste from packaging of goods.

**CHALLENGE:** How can we package goods using fewer and eco-friendly materials, while reducing and recycling waste?

Come up with a solution to this problem, through a design or idea, using nature to help you.

Some things to focus on include: packaging and materials, turning waste to resources.

**USE NATURE TO HELP:** How does nature do these things? Are there examples from nature we can copy?

*How does nature create protection from damage and dirt, store things, and cycle waste into a resource?*



Use the decision tree (W1.7) to help you to break the problem down into manageable chunks.



## W1.4 CHOOSE A PROJECT

### SDG 6: Clean water and sanitation – Water use and efficiency



### WATER USE AND EFFICIENCY

**ISSUE:** During times of drought we face water shortages and this is set to get worse with climate change.

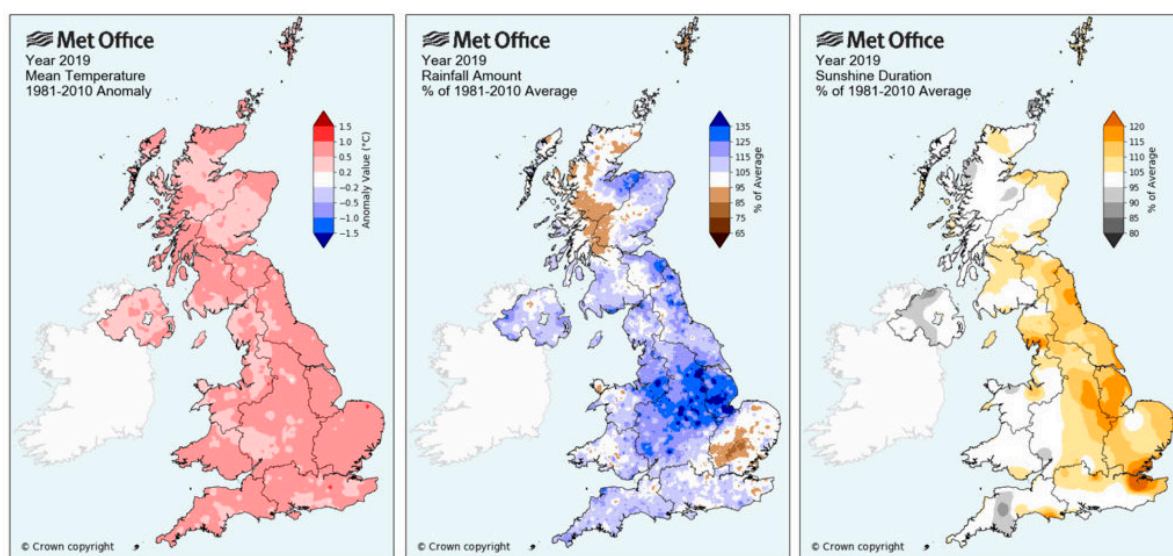
**CHALLENGE:** Design a system for collecting water when it rains and storing it for times of drought.

Come up with a solution to this problem, through a design or idea, using nature to help you.

Some things to focus on include: water collection; water filtration; purification; distribution; efficient use of water; reusing wastewater.

**USE NATURE TO HELP:** How does nature do these things? Are there examples from nature we can copy?

*How does nature collect, store, filter and transport water?*



News article here: <https://www.carbonbrief.org/guest-post-a-met-office-review-of-the-uks-weather-in-2019>

"Last year was warmer, wetter and sunnier than average for most of the UK, and finished as the 11th warmest, 11th wettest, and 15th sunniest year on record."

Use the decision tree (W1.7) to help you to break the problem down into manageable chunks.

## W1.5 CHOOSE A PROJECT

### SDG 11: Sustainable cities and communities – Sustainable Buildings



#### SUSTAINABLE BUILDINGS

**ISSUE:** The majority of the world's people live in cities. Finding sustainable ways to live in urban environments is essential.

**CHALLENGE:** How can we build healthy and sustainable buildings which do not rely on scarce materials and damaging processes?

Come up with a solution to this problem, through a design or idea, using nature to help you.

Some things to focus on include: building materials, construction techniques, strong shapes, cooling and heating processes.

**USE NATURE TO HELP:** How does nature do these things? Are there examples from nature we can copy?

*How does nature create strong structures, create materials without mining, cool down and heat up?*



Use the decision tree (W1.7) to help you to break the problem down into manageable chunks.

## W1.6 CHOOSE A PROJECT

### SDG 11: Sustainable cities and communities – Dining Hall Challenge



#### DINING HALL CHALLENGE

**ISSUE:** The school canteen needs updating. It needs to serve multiple functions (e.g. social, eating, meeting, working, play) and be sustainable and a beautiful pleasant place to be.

**CHALLENGE:** How can we use nature to help us to redesign this space? How can we create a dining space to fulfil multiple functions while not relying on scarce materials.

Some questions you might like to focus on:

- Can you think of a good way to encourage *social interaction* in this space? (How does nature share space?)
- What would be a good way of *cooling and heating* this space? (How does nature keep structures warm/cool?)
- How does food, energy, water, etc. move in and out of the space – where does it come from and where does it go? *Flows and cycles*.
- Materials – How does nature create *sustainable materials* without mining?

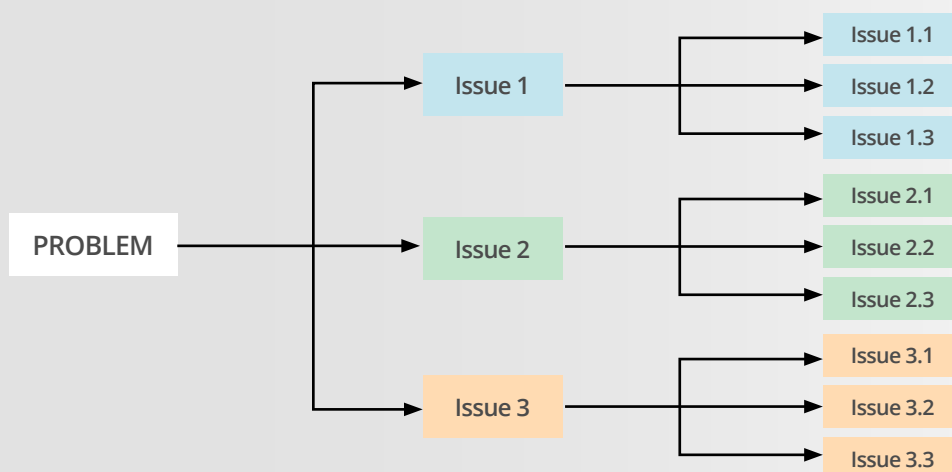


Use the decision tree ([W1.7](#)) to help you to break the problem down into manageable chunks.



## W1.7 CHOOSE A PROJECT

### Decision tree



*from complex* ..... *to simple*



## W2.1 MY DESIGN CHALLENGE

### Steps

Follow the process below to help you to focus your design.

#### a. Frame your challenge

Give a simple explanation of what you want your design to achieve or do by completing the following:

The challenge my design will solve is... (add a description of the problem)

.....

.....

.....

To solve this challenge, my design will...

.....

.....

.....

#### b. Consider the context

Describe some of the factors (e.g. location, resources, and users) that are important to consider.

.....

.....

.....

.....

#### c. Design a question

Using the information above, phrase your challenge as a question. Be careful to clearly describe different elements if necessary. e.g. How might we make urban cyclist more visible to drivers at night?

How might we .....

.....

.....

.....

.....

## W3.1 HOW WOULD NATURE...?

### Questions

Now that you have identified and focused in on a challenge to work on, have a go at thinking about how nature might solve this. To begin with, turn your *'how might we'* question into a simpler *'how would nature'* question.

For example, rather than asking "How does nature make cyclists more visible at night?" we ask "How does nature enhance visibility in low light conditions?" This simplified question expresses what the design is trying to do.



#### The following online resources might help you:

Five tips and suggestions to help you can be found here:

<https://toolbox.biomimicry.org/methods/biologize/>

<https://thekidshouldseethis.com/?s=nature+based+solutions>

<https://thekidshouldseethis.com/?s=circular+economy>

Ask Nature: <https://asknature.org/>

Using **2c** from **W2.1** as a starting point, add some questions below, beginning with *'how would nature...'*:

1. How would nature .....
2. How would nature .....
3. How would nature .....

## W3.2 HOW WOULD NATURE...?

### Student Research Sheet

Starting points for researching your challenges:

#### How does nature encourage social behaviour and efficient use of space?

- Bees and hexagons (space efficiency) – <https://thekidshouldseethis.com/post/why-do-honeybees-love-hexagons>

#### How does nature heat and cool spaces?

- Microclimates in burrows – [https://www.desertmuseum.org/books/nhsd\\_adaptations\\_birds.php](https://www.desertmuseum.org/books/nhsd_adaptations_birds.php)
- Termite mounds and Zebra Stripes – <https://ecolutionalert.wordpress.com/2016/10/13/natural-air-conditioning/>

#### How does nature make strong structures?

- Sea urchins prevent cracking and breaking – <https://asknature.org/strategy/sea-urchin-shell-effectively-prevents-cracking-and-breaking/>
- Making cement the way that coral does – <https://www.youtube.com/watch?v=fa96YajCTVc>

#### How does nature collect and store water?

- Webs which collect water from clouds – <https://asknature.org/strategy/web-continuously-collects-water-from-air/>

You can look up more articles and videos on these websites:

- <https://thekidshouldseethis.com/>
- <https://asknature.org/>

**TIP:** Try searching for key words linked to your challenge.

## STUDENT WORKSHEETS

[illegible]



## W5.1 SKETCH OF THE DESIGN

### Ideas

Now you are equipped with nature's inspiration, use the space below to plan, sketch and draw your idea. Use your imagination to consider how it might look and work. Add labels and annotations in the space around the edge so that others can see what you have in mind!

## W6.1 DISCUSSION IN PAIRS

### What is Biomimicry?

Janine Benyus describes biomimicry as “learning to live gracefully on this planet by consciously emulating life’s genius. It’s not really technology or biology; it’s the technology of biology. It’s making a fibre like a spider, or lassoing the sun’s energy like a leaf.” Designing for sustainability is also important to biomimicry thinking.

It’s this kind of thinking that’s inspired some remarkable designs in recent decades, including a Japanese bullet train partially modelled after the aerodynamics of the kingfisher bird; a shopping center in Harare, Zimbabwe that mimics the cooling strategies of a termite mound; and a synthetic surface called Sharklet that inhibits bacterial growth through texture alone, inspired by the bacteria-repellent skin of a shark.

Here are the **nine Basic Principles of Biomimicry** that we are working with. They are very simple, but once you unpack them you discover they lead everywhere. It is possible to use these principles as starting points for design, or as a way of checking our design work and then making improvements.

#### 1. Nature runs on sunlight

Nature uses sunlight as the main source of energy. Organisms use heat and UV radiation from this never-ending source. We can say that nature is powered by sunshine. Humans use fossil fuels, these sources are not renewable, and burning them creates CO<sub>2</sub> which is one of the gases causing climate change. Why don’t we do the same and prevent the climate crisis? A wise person would mimic nature and rely on renewable power.

**Where does the energy come from to power your product? Can it generate its own energy?**

#### 2. Nature uses only the energy it needs

Nature takes only what it needs. Why do we not do the same? Our economy is focused on maximizing output and is a big energy consumer. We transport food around the world because that is economically cheaper. Only money seems to count in a lot of decisions, not energy consumption and impact on the natural world. How can we learn to optimize the performance of goods and services to sip energy rather than gulp it?

**How does your design minimise energy use?**

#### 3. Nature fits form to function

A tree is rooted in the ground to draw water and nutrients from the soil; it spreads its branches and leaves wide to increase surface area and absorb sunlight to produce energy and grow. Seeds are lightweight and some even come equipped with a sort of umbrella so they can float in the air. Nature creates designs for the function they provide, so should our buildings, transportation systems and schools.

**How does your design compliment the context/situation in which it will be used?**

#### 4. Nature recycles everything

There is no ‘away’ to throw things. Everything produced in nature is biodegradable, there is no waste. There can still be abundance, look at all the blossom on a cherry tree; but that all

serves a purpose and will be food and nutrients for others. Once the natural life of a pinecone has come and gone, it breaks down into essential elements that are repurposed into new life.

**Is your product made using life-friendly chemistry? Can it be mended, recycled or reused in a different way?**

#### 5. Nature rewards cooperation

We see competition in nature, but only when it is impossible to avoid; in general competition costs too much energy. On the other hand, very little in nature exists in isolation. Plants cooperate with pollinators to disperse seeds, and the pollinators feed on nectar. Ladybirds feed on aphids and help plants to stay healthy. Nature favours cooperation because it maintains the health of the whole system.

**How does your product link positively with other services and products?**

#### 6. Nature banks on diversity

Diversity is one of nature’s best insurance policies. When one food source is unavailable, others can be found. Plants use several different strategies to spread seed or defend against predators. We know that species with limited genetic diversity have more difficulty adapting to environmental change, and that ecosystems rich with diversity are more stable.

**Does your product create greater or lesser diversity? Does it impact biodiversity?**

#### 7. Nature demands local expertise

Nature’s systems are inherently local. Certain species thrive under specific conditions; local and regional weather patterns matter, as do other conditions such as soil, air quality and water temperature. Relationships are created locally and local resources are used. Of course, some birds travel long distances but have you seen them take their food with them?

**Does your design make good use of local conditions? It is designed to work within local conditions (e.g. climate)?**

#### 8. Nature seeks balance

Ecosystems try to keep in balance. More mice? Then you will see more owls to feed on the mice and keep the population in balance. Forest fires are a great example of a natural phenomenon that renews and refreshes, reducing excessive growth and allowing for regeneration. Every natural system has a tipping point, a carrying capacity or a state of disequilibrium that triggers a change to a different state.

**Are feedback loops designed into your product to ensure you can monitor any unintended consequences?**

#### 9. Nature taps the power of limits

Unlimited growth on a finite earth is not a good idea. All living things are governed by limitations; age, climate, population density and many other factors determine how species and systems develop. Nature has found ingenious ways to work within these limits to be as productive as possible over the long run.

**Is your product really needed?**

## W6.2 DISCUSSION IN PAIRS

### Improving your design: Group Evaluation Wheel and Questions

DESIGN OR PROJECT NAME: .....

DESIRED FUNCTION / CONCEPT: .....

**Q1:** Based on the nine principles of biomimicry, this is close to how nature would design this product/project.

STRONGLY AGREE	AGREE	NEITHER AGREE NOR DISAGREE	DISAGREE	STRONGLY DISAGREE
----------------	-------	-------------------------------	----------	-------------------

**Q2:** Looking at your design and comparing it to the nine principles of biomimicry, which areas are the strongest? **Why is this the case?**

.....

**Q3:** Which areas are the weakest? **Why is this the case?**

.....

**Q4:** Think of one practical way you can improve your design.

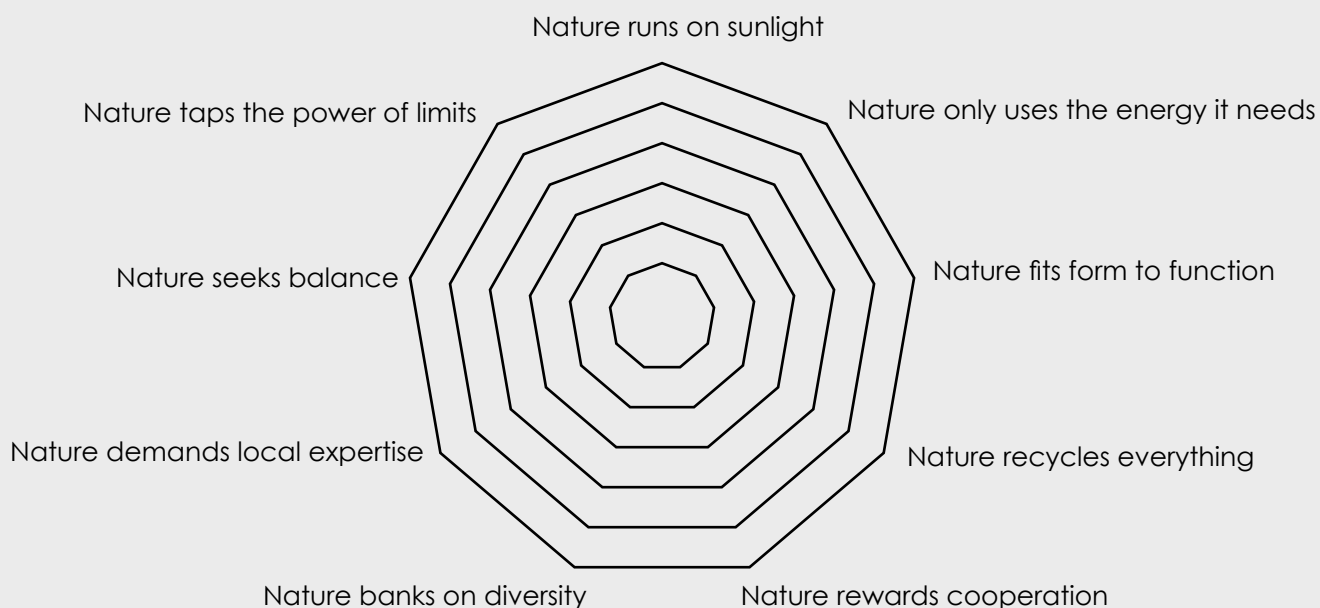
.....



#### Improving your design

*Consider how you might use the nine principles of biomimicry to improve your design. How might nature go about designing the product or function you are trying to produce?*

**TASK:** Use the diagram below to plot how your product achieves in relation to each biomimicry principle of design. Use this to consider the strengths and weaknesses of your design.





## W7.1 GROUP COLLABORATION

### Designing in groups

In this exercise you will form new groups – consisting of a member from each of your original group. You will take it in turns to present your design to the new group.

- Each member of the group should have a copy of the sketch/design.
- Get into groups of 3–4 with members of different groups (there should not be two people from the same group in the 'new groups').
- Take it in turns to explain your design to the 'new group' – see questions below.

When presenting to the new group, the presenter should aim to answer the following questions. Make some notes beforehand below:

#### What is your design challenge?

.....

.....

#### Why have you chosen this design challenge?

.....

.....

#### Which aspect of biomimicry aided you in your design?

.....

.....

#### How does your design solve the challenge you chose?

.....

.....

#### Reflection



If your designs were all put into action or made – How might it positively improve your community, region, country in the future?

Discuss with your group and note the key points below.

.....

.....

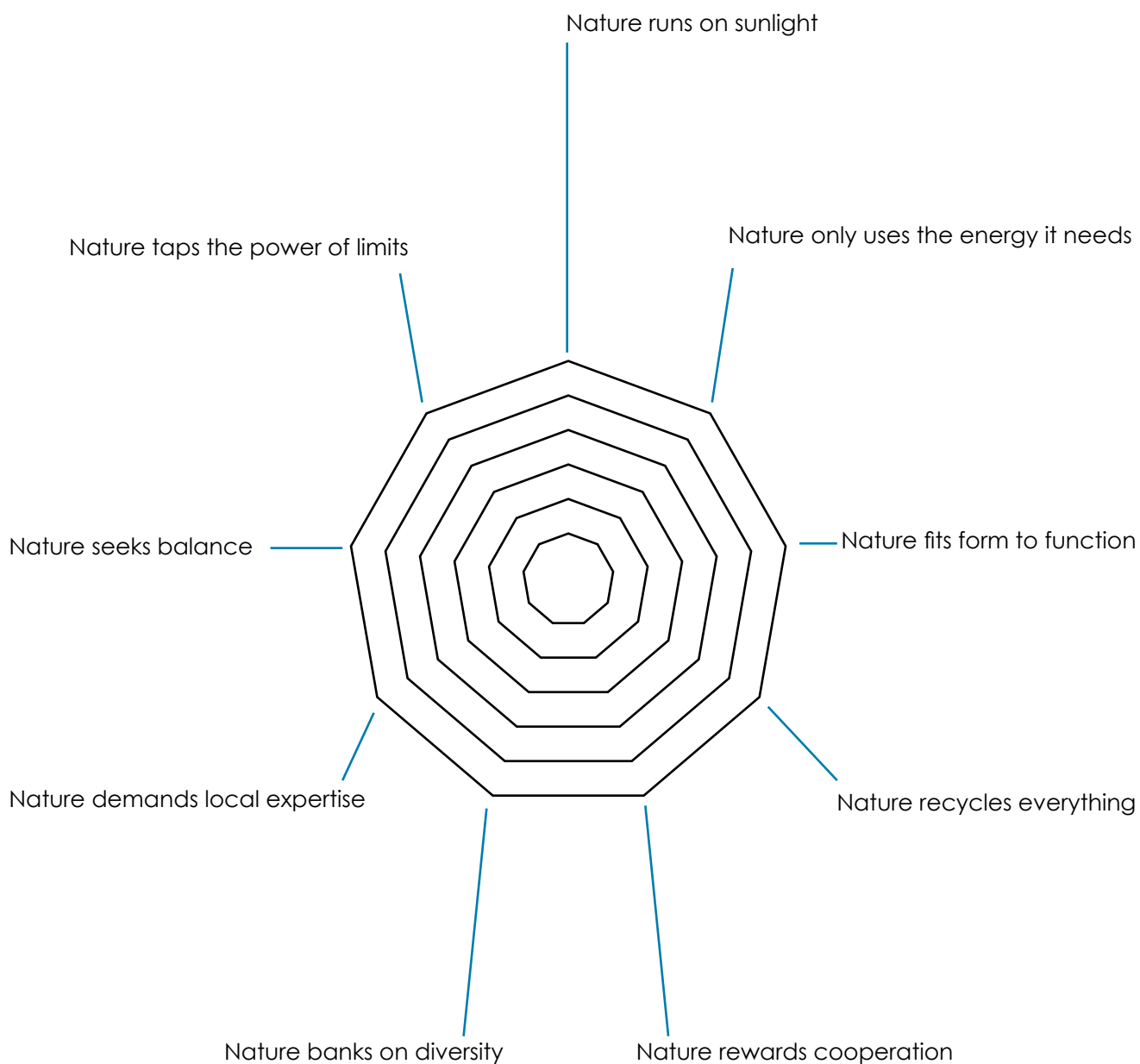
.....

**Let's get thinking!** *How could biomimicry act as a tool for thinking and planning for the future of the planet upon which we depend?*

## W7.2 GROUP COLLABORATION

### Evaluation of Design Presentations – Feedback Evaluation Wheel

NAME / DESIGN: .....



**HINT:** Make notes on the diagram above to collect feedback given during presentations so that you can improve your design.