



# MARVELLOUS MODELS

Introduction module to practice skills  
for nature-inspired learning



Erasmus+



## AGE RANGE

12–14



## DURATION

**Preparation:**

20 min.

**Activity:**

100 min. / 2 lessons



## SUBJECT(S)

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



## KEYWORDS

Research; formulating questions; biology; nature

## SUMMARY

Learning from nature to address a challenge or opportunity starts with asking the question “how does nature manage a similar challenge?” This introductory module focuses on the basic skills that are needed to be able to learn from nature.

## BIOMIMICRY PRINCIPLES

The 9 principles will not be addressed in the module because this is a basic introduction to skills.

## LEARNING OBJECTIVES

- Students understand that besides learning about nature, they can learn from nature.
- Students understand the importance of asking the right questions.
- Students develop a different way of looking at nature.

## LEARNING OUTCOMES

- Students critically observe different organisms and ask questions to learn more about each organism.
- Students choose one organism as their model and work out what they can learn from it.
- Students identify specific features and functions of an organism, and consider how these can be adapted for different uses.

## BIOLEARN COMPETENCES

- Students can 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 can use analogical thinking to innovate, using biological models to inspire solutions to design challenges.
- Students can work in groups.
- Students are more motivated in learning STEAM and experience that knowledge of STEAM can be widely used.

## SUMMARY OF THE ACTIVITIES

Activity Name	Description	Method	Duration	Location
<b>LESSON 1. Star bursting</b>				
1 Observing animals	Students undertake investigations about different animals	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Research</li> </ul>	15	Indoor
2 Domains	Students investigate the domains of animals	<ul style="list-style-type: none"> <li>• Research</li> </ul>	15	Indoor
3 Observation in nature	Students go outside to observe and investigate nature	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Research</li> <li>• Synthesis</li> </ul>	20	Outdoor
<b>LESSON 2. Your marvellous model</b>				
4 Choosing and observing model	Students choose a model from nature and undertake research about it	<ul style="list-style-type: none"> <li>• Research</li> </ul>	10	Indoor
5 Learning from your model	Students learn more about their chosen organism and produce a poster about it	<ul style="list-style-type: none"> <li>• Research</li> <li>• Hands-on activity</li> </ul>	15	Indoor
6 Poster presentations	Teams present their posters to each other	<ul style="list-style-type: none"> <li>• Student presentation</li> </ul>	15	Indoor
7 Applying the ideas	Students think more about what they can learn from their model	<ul style="list-style-type: none"> <li>• Design activity</li> </ul>	10	Indoor

## OUTLINE OF THE MODULE

## BACKGROUND FOR TEACHERS

In biology you learn *about* nature. For example, how animals live and what a food chain is. In nature-inspired learning the approach is different. We see nature as a model and as a mentor. As a model because plants and animals have many ingenious solutions that we as humans also have. As a mentor biomimicry always asks “how would nature solve that?” In BioLearn we learn from nature and that requires a different way of looking. In this module students will learn to observe like a biologist does and students will explore what they can learn from well-known organisms. Students start brainstorming what they can learn from it and apply this to solve a challenge.

## ACTIVITY DETAILS

### LESSON 1. Star Bursting



**LOCATION**  
Indoor

#### 1 | OBSERVING ANIMALS

» DISCOVER 



**TOOLS AND MATERIALS**

Student worksheet: [W1.1](#)

This activity asks students to start closely observing animals. It guides them to learn about plants and animals by asking different questions. They will choose an animal and look for answers to different questions about it. Students work in pairs using student worksheet [W1.1](#).



**LOCATION**  
Indoor

#### 2 | DOMAINS

» DISCOVER 



**TOOLS AND MATERIALS**

Student worksheet: [W2.1](#)

In this activity students choose two domains they want to investigate further for their chosen animal. They ask questions about each domain. Students continue working in pairs using student worksheet [W2.1](#).



**LOCATION**  
Outdoor

#### 3 | OBSERVATION IN NATURE

» DISCOVER 



**TOOLS AND MATERIALS**

Student worksheet: [W3.1](#)

Students continue working in pairs with the help of student worksheet [W3.1](#). They go outside and search for living creatures to observe. They ask numerous questions about the creature using the star questionnaire.



**PREPARATIONS**

Outdoor: find a place with some trees, plants, and preferably insects and other animals to be seen. This activity could also be done at home. Any place where you can find these elements of nature is suitable for this activity.

## ACTIVITY DETAILS

## LESSON 2. Your marvellous model



## LOCATION

Indoor

## 4| CHOOSING AND OBSERVING MODEL

» DISCOVER



## TOOLS AND MATERIALS

- student worksheet: [W4.1](#)
- books on flora and fauna of your country/ neighbourhood
- computer or smartphone with internet access

In this activity students select one organism to work with as a 'model' from nature. Over the following 4 activities students will expand their understanding of their chosen organism and use it as a model to inspire new ideas. Using student worksheet [W4.1](#), students work in pairs to research their chosen organism with the help of internet, books or interviews.



## LOCATION

Indoor

## 5| LEARNING FROM YOUR MODEL

» DISCOVER



## TOOLS AND MATERIALS

- student worksheet: [W5.1](#)
  - poster paper
  - flip chart (if available)
  - markers, scissors and glue per group

Students continue working in pairs using student worksheet [W5.1](#). They observe and research their organism, identifying key features and characteristics about it. They produce a poster describing key features of their organism, then carry on to explore what functions these features provide and what we can learn from that for other uses.



## PREPARATIONS

Indoor: arrange the classroom with space for students to prepare posters.

## ACTIVITY DETAILS



## LOCATION

Indoor

## 6 | POSTER PRESENTATIONS

» DISCOVER 

## TOOLS AND MATERIALS

Student worksheet: [W6.1](#)

In their pairs, students prepare a presentation using the questions on student worksheet [W6.1](#) to help them. After each presentation they discuss the topic.



## PREPARATIONS

Indoor: prepare the room for poster presentations by groups.



## LOCATION

Indoor

## 7 | APPLYING THE IDEAS

» DISCOVER 

## TOOLS AND MATERIALS

Student worksheet: [W7.1](#)

In groups of 4 (two pairs), students put together the new understanding and knowledge they have gained during the two lessons. Using student worksheet [W7.1](#) to help, they identify new ideas which have arisen and new applications for these. After the group work, they discuss together what they have found.



## PREPARATIONS

Indoor: arrange the classroom for group work.

## W1.1 OBSERVATION OF ANIMALS

TEAM MEMBERS:

&

### Practising



In this lesson you will learn more about plants and animals by asking different questions. About which of these animals do you want to know more?



*Heron (the Netherlands)*



*Monitor Lizard (Costa Rica)*



Just have a good look at the physical appearance of your animal. Can you tell something about the food it is eating? Does it have teeth? A beak? Can it run fast? What do you think it will eat?

Now look at the environment it is living in. Warm? Cold? What kind of skin and protection do you see? What does that tell you?



## W2.1 DOMAINS

Choose two domains that you want to investigate further for your animal. Try to write three or more questions for two of these domains:

1. Environment
2. Food
3. Physical characteristics
4. Reproduction (life cycle)
5. Threats and survival

DOMAIN	YOUR QUESTIONS
	<ol style="list-style-type: none"><li>1.</li><li>2.</li><li>3.</li></ol>
	<ol style="list-style-type: none"><li>1.</li><li>2.</li><li>3.</li></ol>



## W3.1 OBSERVATION IN NATURE



### For real

Go out and choose an organism that you find in nature. If it runs away, you can carefully place it in a box to observe it. You can also find a picture of it on the internet. Ask yourself the following questions:

1. What animal did you choose?
2. Try to come up with 10 questions at each point of the star. Observe carefully without trying to answer your questions.
3. Take another look at your questions. Are they specific and as concrete as possible? If necessary, rephrase your questions.
4. Go back inside and discuss the questions with your teacher. Are they well formulated?
5. Save the questions for the next assignment, they will come in handy!

#### QUESTIONS ABOUT FOOD

1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. ....
8. ....
9. ....
10. ....

#### QUESTIONS ABOUT ENVIRONMENT (HABITAT)

1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. ....
8. ....
9. ....
10. ....

#### QUESTIONS ABOUT PHYSICAL CHARACTERISTICS

1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. ....
8. ....
9. ....
10. ....



#### QUESTIONS ABOUT LIFECYCLE

1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. ....
8. ....
9. ....
10. ....

#### QUESTIONS ABOUT THREATS AND SURVIVAL

1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. ....
8. ....
9. ....
10. ....

## W4.1 CHOOSING AND OBSERVING MODEL



What organism is your model for this lesson?

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### RESEARCH

You are now going to search as much information about your model as you both can. You can look on the internet, in the library or ask around by conducting interviews.

1. What striking external features are there?
  - Where does it live (what kind of area)?
  - How does it live (sources of energy, mode of reproduction)?
  - What capabilities does this organism have?
2. Go back to the questions in the 'star bursting' exercise. Can you find some more ideas for questions to ask yourself?

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3. Do a second round of research.
4. Make the first draft of a leaflet (1 A4 page) with characteristics and a picture of your model.

## W5.1 LEARNING FROM YOUR MODEL



### Selecting a special quality or feature

What particular characteristic strikes you about this organism? Is there something your organism is particularly good at? What is something that is very obvious (green plants can absorb light, elephants have big ears)?



### Create a poster

Now create a poster about your organism with the following components:

- A picture of the organism.
- General description.
- Habitat challenges, specific physical features and adaptations.
- A special feature the organism has that you want to learn from.



### Discussing the models

Discuss in pairs why this model is so skilled:

Think of a unique part of the organism such as: the animal can turn their head in 180° (owl) or the plant has flowers that open and close during twilight (evening primrose) or the animal can adapt the colour of its skin to the colour of the background (octopus).



What can we learn from your organism? Fill in the table below:

Feature	What function does this feature provide?	How does it work?	What can we learn from that?	Can we apply this for a different purpose?

Go and see the teacher and discuss your results and if sufficient, add this to your poster.

## W6.1 POSTER PRESENTATIONS

You are going to present your findings. All groups will give a presentation and explain what they learned from their marvellous model. Use the following questions to create a 7-minute presentation:

1. What did you choose as your model?
2. Describe the three most striking features of your model.
3. What can we learn from your organism?
4. How and where can we apply these ideas?

After the presentations, your fellow students will have the opportunity to ask questions.

## W7.1 APPLYING THE IDEA'S

During the presentations you have learned about the ideas of other groups. You have also heard about possible applications. Maybe some groups had the same model, or they had a very exiting plant or animal that intrigues you. Now you are going to learn from the other teams.



### Combining ideas

Sit together in groups of 4 (two pairs) and explain how you want to apply the wisdom of your model in practice. Now brainstorm together:

- Do you have more ideas?
- Can you combine ideas?
- Are there new fields of application?

	Model 1	Model 2
New ideas to learn from		
New fields of application		