



URBAN SCIENCE.
ENGAGING SCIENCE,
CREATING SUSTAINABLE CITIES
LEARNING MODULES



BIOMIMETIC SHELTER

Learning module
from the series SDG challenges in my city



Developed in the project
Urban Science
Engaging science, creating sustainable cities
co-funded by the Erasmus+ Programme of the European Union.

This module was created and first piloted by teacher members of the Hungarian Research Teachers' Association.

Disclaimer: This learning module was developed for teachers' use. It can be freely used for educational purposes and it can be also edited but in case of sharing and publication including training purposes or teachers' reflection, reference must be made to Urban Science project.



In partnership with
UN Environment





URBAN SCIENCE.
ENGAGING SCIENCE,
CREATING SUSTAINABLE CITIES
LEARNING MODULES



The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

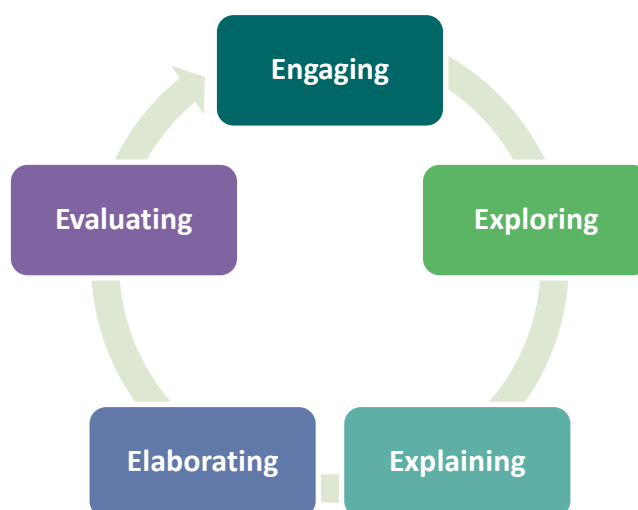
LEARNING MODULE

BIOMIMETIC SHELTER

"This module challenges empathy, values, equity – topics that are not often mentioned in Biology classes, while it provides real science learning opportunities too."

(Szilvia, science teacher from Hungary)

Activities in this module are organised around the 5E instructional model of inquiry-based learning.



This module is an adaptation of the Biomimetic shelter project by Torrey McMillan.

Challenges linked to Sustainable Development Goals

- Strong links to **SDG 1**: End poverty in all forms everywhere, **SDG 7**: Ensure access to affordable, reliable and modern energy for all, **SDG 9**: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation, **SDG 10**: Reduce inequality within and among countries; **SDG 11**: Make cities and human settlements inclusive, safe, resilient and sustainable and **SDG 12**: Responsible consumption and production **SDG 16**: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Disclaimer: This learning module was developed for teachers' use. It can be freely used for educational purposes and it can be also edited but in case of sharing and publication including training purposes or teachers' reflection, reference must be made to Urban Science project.





**URBAN SCIENCE.
ENGAGING SCIENCE,
CREATING SUSTAINABLE CITIES
LEARNING MODULES**



This module can be used individually or within the Storyline introduced by the module Back to the Future: Climate Change.

The scores for gamification are suggestions that teachers may modify according to their preferred pedagogical scenarios.

Introduction

Cities are not providing equal chances to all their inhabitants. Every winter, homeless people freeze to death in Hungary. Every summer, there are problems with heatwaves, and the less wealthy cannot afford air conditioning.

In natural habitats, animals cope with similar challenges. They evolved in a way to find solutions to some of these problems. Biomimicry is a discipline that studies nature's best ideas and then imitates these designs and processes to solve human problems.

The learning module challenges students to see how biomimetic design can offer sustainable solutions for creating inclusive cities.

Learning objectives

- raising students' attention to the relevance of inclusion
- seeking solutions to providing shelters in the city
- establish an understanding of biomimetic design processes
- developing science competences: data collection, data processing, comparing data, causality
- developing cognitive skills in social inquiry competences: problem-solving, critical thinking, creativity
- developing communication inquiry competences: forming evidence-based statements and expressing opinions, communicating results
- developing civic competence elements in sustainability competences: responsibility, civic participation, transdisciplinarity, agency
- using a design cycle in inquiry-based science learning
- encourage students to use nature as inspiration for problem-solving
- articulate the rationale behind the use of biomimetic design
- design a shelter using a target region and species for inspiration

Learning outcomes

Disclaimer: This learning module was developed for teachers' use. It can be freely used for educational purposes and it can be also edited but in case of sharing and publication including training purposes or teachers' reflection, reference must be made to Urban Science project.





**URBAN SCIENCE.
ENGAGING SCIENCE,
CREATING SUSTAINABLE CITIES
LEARNING MODULES**



- students recognise the relevance of inclusion
- students gain knowledge about basic ecological concepts such as environment, habitat, niche
- students gain knowledge about biomimicry
- students gain knowledge about basic climate and weather challenges
- students develop self-efficacy in data processing
- students practice design principles
- students practice working with scientific data
- students practice presenting and communicating their ideas
- students develop empathy towards others
- students develop agency in acting for sustainability

Time needed to implement the Learning Module

135/180 minutes (3 or 4x45 minutes) –alternatively longer with outdoor observation in step1

Activities in detail

(according to the 5E model)

Engaging

Introduction:

We are still in city S. (Any city name can be used, optionally also the real name of the city where the school is located.) If your teams work well during this module, your city can take more steps towards being sustainable. If your teams fail; everything will stay as it was in the beginning of this module.

(Teams can be the same throughout the whole Urban Science learning journey: in this case, individual points in this game's parts add to those team points.)

Story:

Today we will help 2020 cities to provide better shelters for all in need. Your teams are architects, designers and construction professionals who will provide advice for the city leaders with plans.

Take a minute to choose a name for your designer studio and also choose a head in charge of your time management and quality of work.

Before we start, let's see what we know about shelters and those in need.

Students watch videos about animals and their shelters. – 5 minutes

Students read press cuttings about recent cases with weather/ people in need for shelters. – 5 minutes

Students reflect on their impressions in pairs then in plenary. – 5 minutes

(Alternatively, this part can be introduced by

(a) a longer outing, where students may observe shelters in natural habitats

Disclaimer: This learning module was developed for teachers' use. It can be freely used for educational purposes and it can be also edited but in case of sharing and publication including training purposes or teachers' reflection, reference must be made to Urban Science project.





**URBAN SCIENCE.
ENGAGING SCIENCE,
CREATING SUSTAINABLE CITIES
LEARNING MODULES**



Co-funded by the
Erasmus+ Programme
of the European Union

(b) a walk in the city after which students are challenged to observe needs for shelters.)

Exploring

Students watch videos about biomimicry and then reflect on them: <https://biomimicry.org/what-is-biomimicry/> or <https://www.richardvanhooijdonk.com/en/blog/architecture-engineering-construction-inspired-nature/> or <https://www.stem.org.uk/resources/elibrary/resource/34059/give-me-biomimetic-shelter> – 5 minutes

Then in teams they establish challenges for themselves to use biomimetic solutions to design shelters for people. – 5 minutes

Explaining

Students get acquainted with the design principles. – 10 minutes

See resource <https://toolbox.biomimicry.org/methods/process/>

They discover steps needed in their work. They split team responsibilities. – 5 minutes

They make a list of data necessary for their work. They work with concepts such as environment, habitat, species, population, niche. – 15 minutes

Elaborating

Students design biomimetic shelters for a chosen season. They see weather graphs, extreme weather challenges, climate change prognosis, comparing those with specific characteristics of chosen species that they use as inspiration.

They design a shelter and establish its place in the city so that it is accessible for people in need.

They use the design cycle tool for that. (Downloadable from: https://toolbox.biomimicry.org/wp-content/uploads/2017/10/Design.Spiral-Diagram_10.17.pdf) After the first design is ready, they take a walk to visit places appropriate for shelter, then revisit their designs based on their observations. – 70/ 115 minutes (based on walk and distances)

Evaluating

Students present their findings and get evaluation from their peers with tips and tops and using a self-evaluation rubric. – 20 minutes

Ideas:

<https://www.stem.org.uk/resources/elibrary/resource/34059/give-me-biomimetic-shelter>

Disclaimer: This learning module was developed for teachers' use. It can be freely used for educational purposes and it can be also edited but in case of sharing and publication including training purposes or teachers' reflection, reference must be made to Urban Science project.



In partnership with
UN Environment





**URBAN SCIENCE.
ENGAGING SCIENCE,
CREATING SUSTAINABLE CITIES
LEARNING MODULES**



Co-funded by the
Erasmus+ Programme
of the European Union

Resources

<https://www.stem.org.uk/resources/elibrary/resource/34059/give-me-biomimetic-shelter>

<https://asknature.org/resource/biomimetic-shelter-project/#.Xh7qnv5KiUk>

<https://asknature.org/resource/sharing-biomimicry-with-young-people/#.Xh7qCP5KiUk>

https://bci-learning.teachable.com/p/biomimicry-basics/?product_id=96530&coupon_code=TB-AN

https://toolbox.biomimicry.org/wp-content/uploads/2017/10/Design.Spiral-Diagram_10.17.pdf

Disclaimer: This learning module was developed for teachers' use. It can be freely used for educational purposes and it can be also edited but in case of sharing and publication including training purposes or teachers' reflection, reference must be made to Urban Science project.



In partnership with
UN Environment





**URBAN SCIENCE.
ENGAGING SCIENCE,
CREATING SUSTAINABLE CITIES
LEARNING MODULES**



Table of points:

Activity	Individual point	Team point	Individual extra	Team extra
Reflections on shelters	1 for each statement	Sum of individual points	sensible question: 3 sensible design question: 10	If the sum of individual points exceeds 80% of the total achievable: 2x
Establishing design challenge	Same points for everyone in the small group or the overall points are divided by the group members based on their contribution to the results in a way that the sum of individual points equals the team points.	Question posed: 3 Question not too narrow: 1 Questions not too wide: 1 (Overall: 5)		If ready on time: + 1 x team points If +10% ready on time: +0,5 x team points Otherwise: 0
Data search		Appropriate list: 2 Terms researched: 3 (Overall: 5)		
Design task	Same points for everyone in the small group or the overall points are divided by the group members based on their contribution to the results in a way that the sum of individual points equals the team points.	Well established question: 1 Design linked to question: 1 Biologisation of question: 2 Discovering strategies: 2 Analysing strategies: 3 Developing own solution: 5 Evaluating solution: 2 Self-reflection: 1 Respectful work: 1 Clear references: 2 Using scientific evidence: 2 Using science language: 2 Clear presentation: 4 (Overall: 30)	Presenting the team's work: 10	If ready on time: + 1 x team points If +10% ready on time: +0,5 x team points Otherwise: 0

Disclaimer: This learning module was developed for teachers' use. It can be freely used for educational purposes and it can be also edited but in case of sharing and publication including training purposes or teachers' reflection, reference must be made to Urban Science project.

