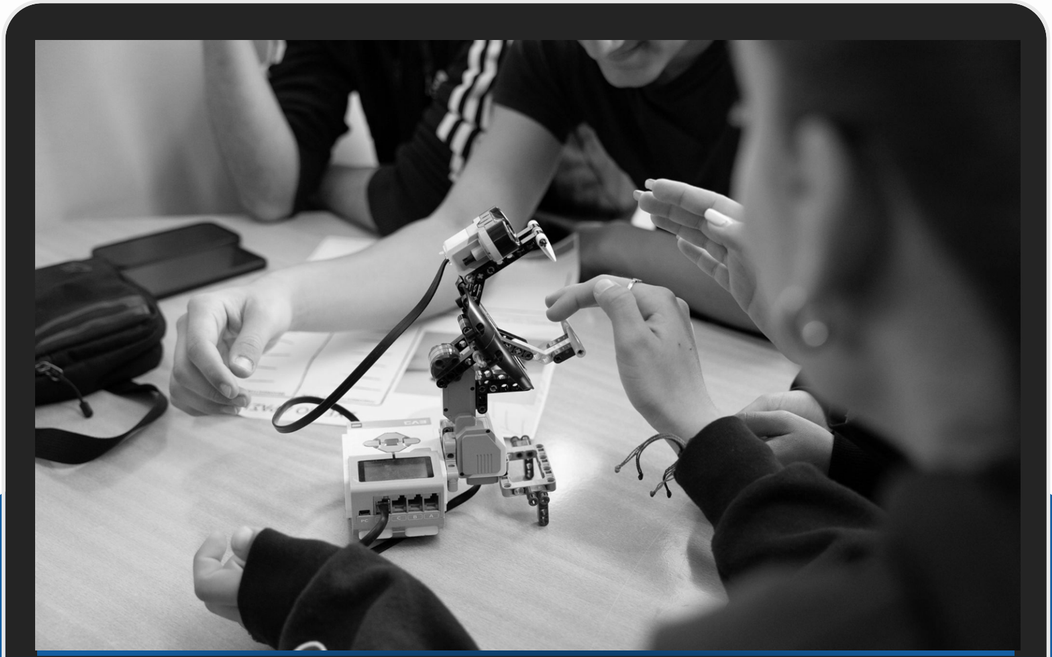
Lionfish

A Teaching and Learning Manual on Battling the Lionfish Invasion in the Mediterranean



For secondary education

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

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Introduction

The teaching & learning manual is designed for teachers and students (middle to early high school). The manual documents the pedagogical approaches used in the learning experience design, linking the "End of Line " 360VR film to further content drawn from the national curriculum, considering the audience’s age group and learning needs.

Why this Topic?

- Invasive species present unique challenges that are widely recognised these days.
- The lionfish has become a concerning presence in various marine ecosystems.
- The lionfish's rapid spread and impact on native species can affect the balance of underwater ecosystems.
- It's crucial for school-aged students to engage in a thorough exploration of the lionfish issue, fostering a professional and critical approach to understanding the ecological consequences and potential solutions.
- This way, students can develop a foundation for actively participating in addressing the challenges posed by invasive species in our marine environments.

Links to National Curriculum

This teaching & learning manual is linked to the national curriculum

01

The national curriculum for this age group includes topics: “The concept of habitat”, “Organisms interact with their environment”, “Interaction of organisms”, “Living organisms cooperate and compete”, “Species and habitat threats: examples from Cyprus”.

02

The national curriculum for this age group includes topics: “Competition between individuals of the same or different species”, “Study of organisms in their environment”, “Changes in the environment - Climate change and survival of species”.

Pedagogical approaches

This teaching & learning manual builds on pedagogical approaches that have been used extensively in the field of education, namely use of VR technologies as empathetic machines, design thinking & visual thinking techniques, STEM/STEAM transdisciplinary practice and problem based learning & project based learning as a general approach and philosophy to teaching and learning.

01 VR technologies as empathetic machines

02 Design thinking & visual thinking techniques

03 STEM/STEAM (STEM+)

04 Problem/Project based learning (PBL)

Pedagogical approaches

VR technologies as empathetic machines

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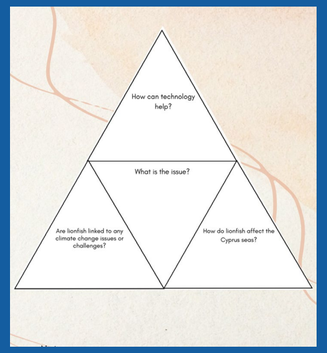
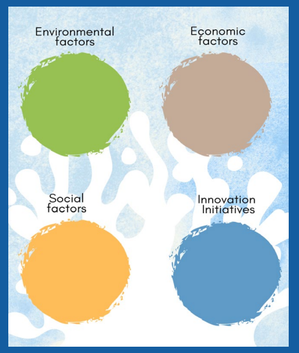
LIONFISH 360VR film

Pedagogical approaches

Design thinking & visual thinking techniques





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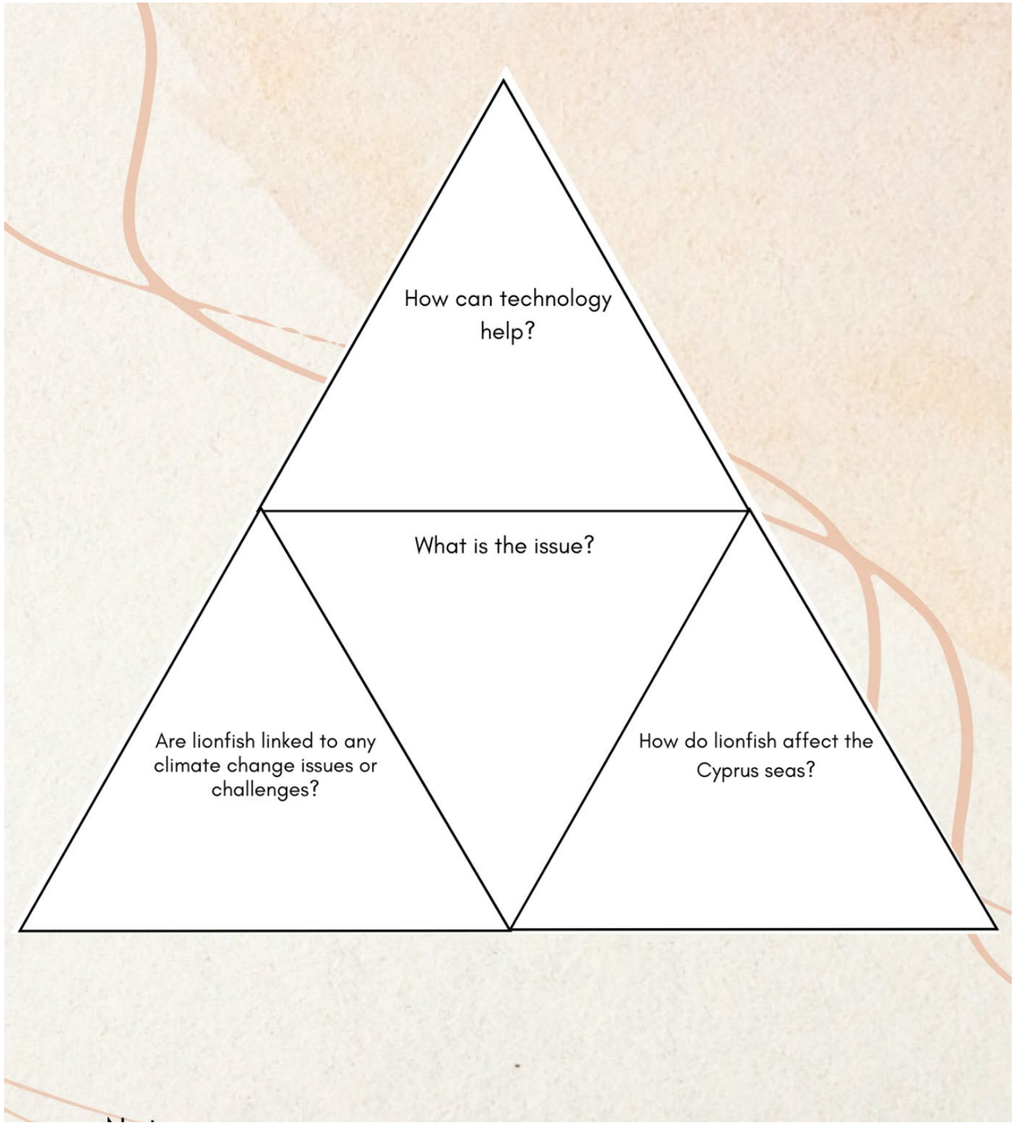
Triangular problem



Using the “Triangular Problem” visual canvas, inspired by the “Pentagonal problem” designed in the EU’s Climate-KIC project, the students must answer the following questions to conclude to a final response:

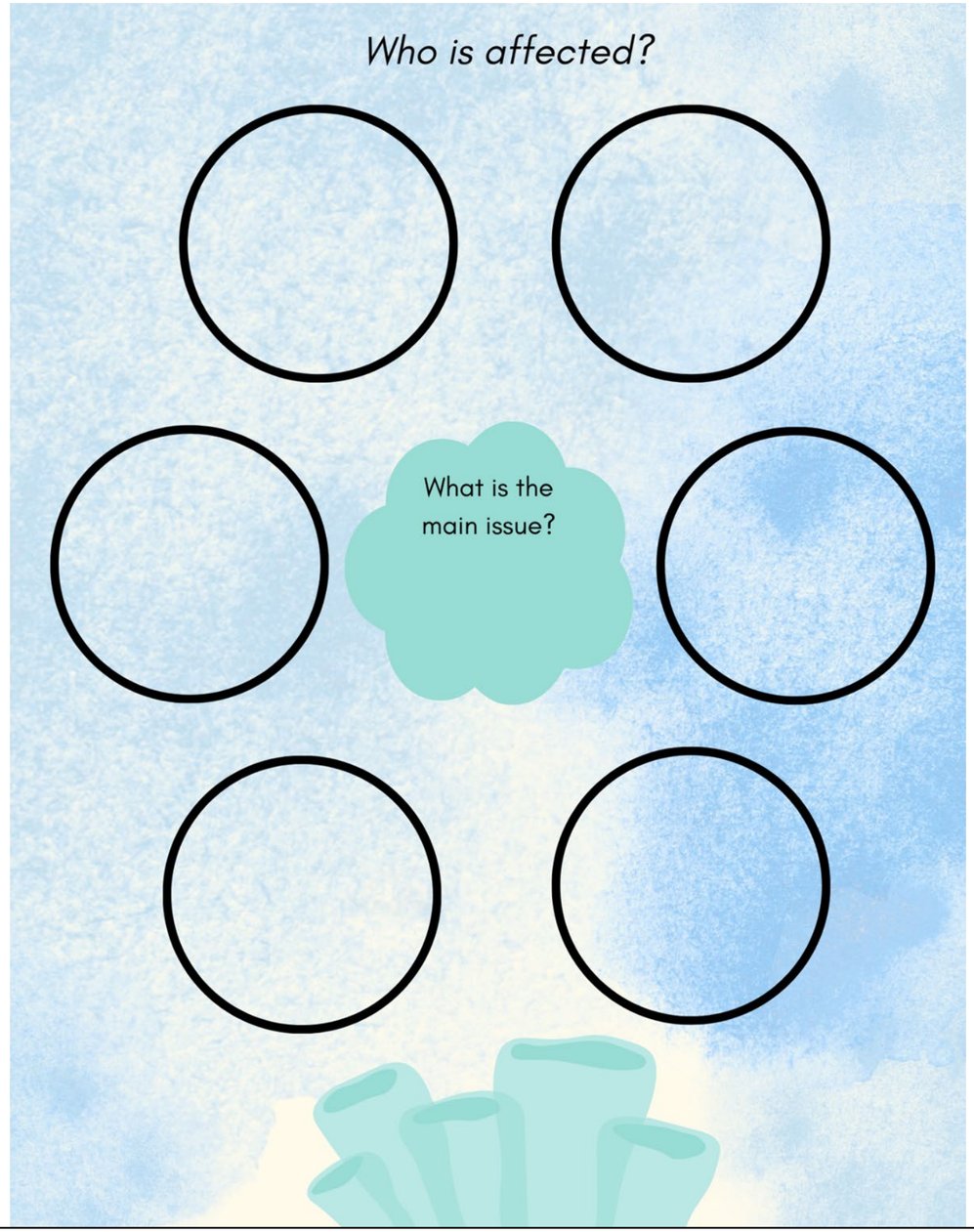
What is the issue? => Students write down the research question in the centre of the bubble. *“Do lionfish affect positively or negatively the Cyprus marine ecosystem?”*

How do lionfish affect the Cyprus seas? => Write down one, two, or three consequences of having the lionfish swimming in the Cyprus seas.

Are lionfish linked to any climate change issues or challenges? => Write down one or two environmental problems related to lionfish.

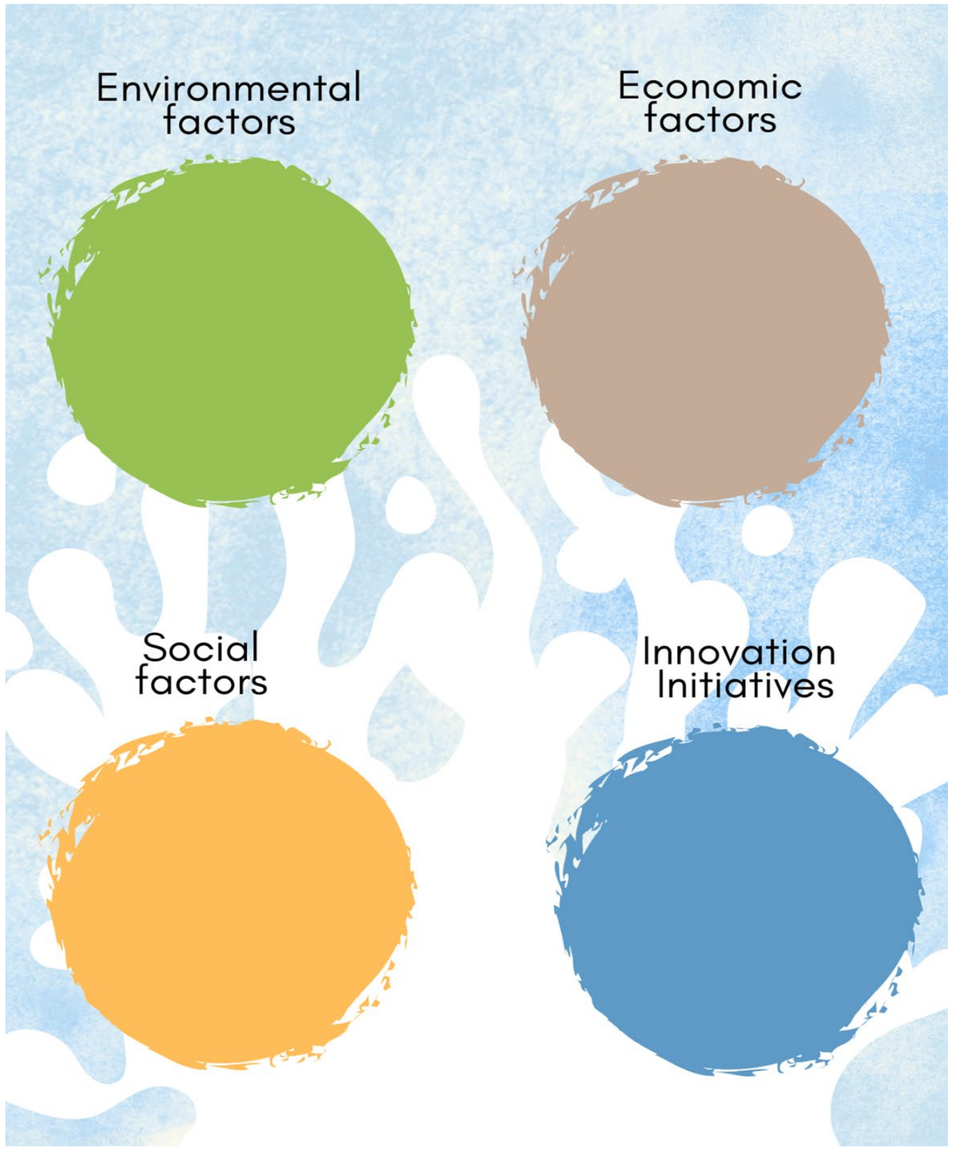
How can technology help with this issue? => Write down one or two technological solutions to this problem.

Perspective Matrix



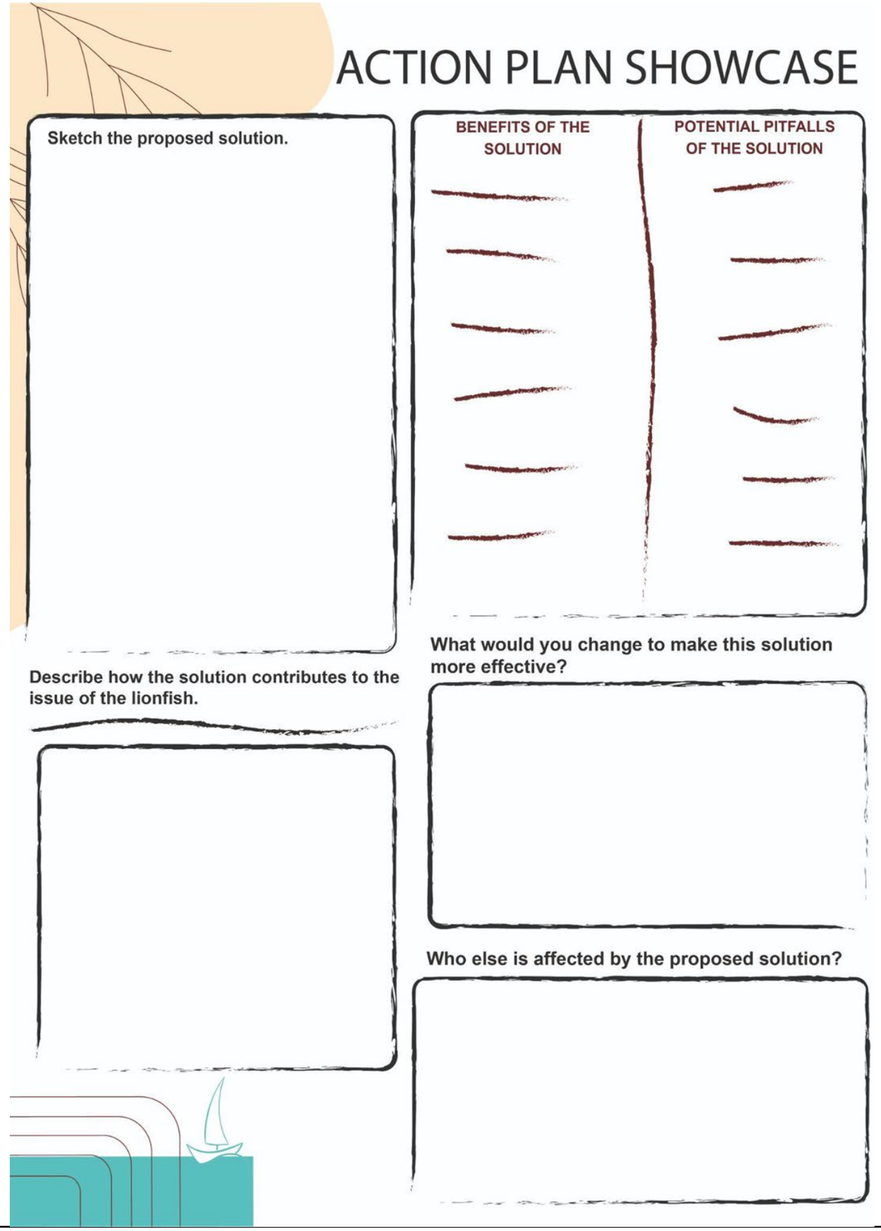
The “Perspective Matrix” visual canvas inspired by the “Actor Tree” designed in the EU’s Climate-KIC project, enable students to gain a deeper understanding of the various points of view held by the various parties involved in a complex issue. The visual canvas helps the students become accustomed to recognising the requirements of particular actors who contribute to or inform a situation, helping to understand complex situations and all actors involved.

Impact Map



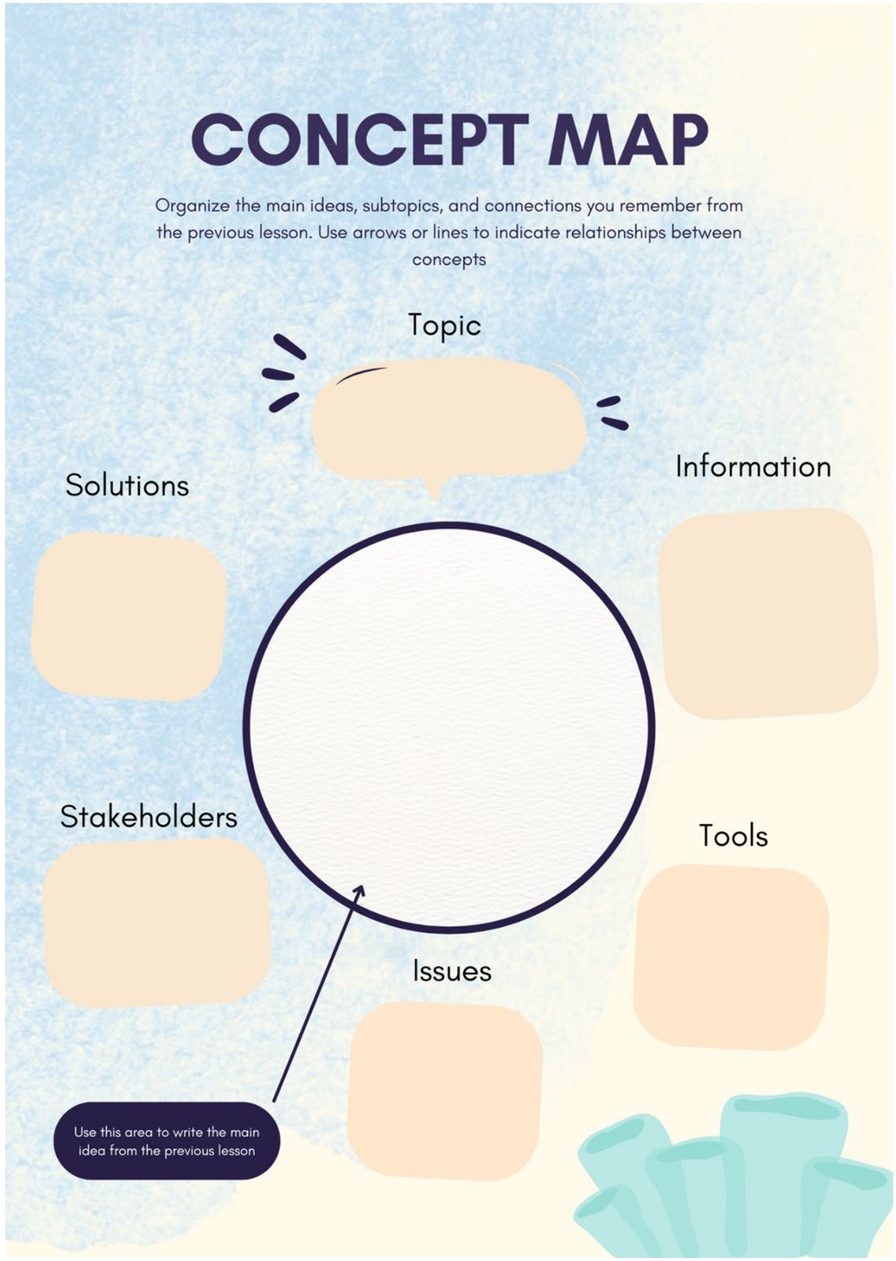
The “Impact Map” visual canvas inspired by the “Context Map” designed in the EU’s Climate-KIC project, emphasises a system analysis including trends as possible catalysts for change. In order for students to start formulating potential solutions, it is helpful to frame the problem and clarify how the actions of the stakeholders are impacting and/or changing it. This visual canvas can be used to analyse environmental, economical and social factors related to the invasion of the lionfish, as well as refer to innovation initiatives.

Action plan showcase



In the “Action Plan Showcase” visual canvas, inspired by the “Cover Story” designed in the EU’s Climate-KIC project, students are asked to suggest and evaluate a solution as follows:

- They sketch the suggested solution
- They explain how it solves the issue (in this case the lionfish invasion)
- They note down advantages and disadvantages of the specific solution
- They suggest modifications to make the solution more effective
- They refer to the stakeholders that are affected by this solution and how they are affected.



The “Concept Map” can be used in the beginning of a lesson so that students reflect and recall on what was covered in the last lesson. Students organise the main ideas, subtopics, and connections they remember from the previous lesson. The teacher encourages them to use arrows or lines to show relationships between concepts.

Pedagogical approaches

STEM/STEAM (ή αλλιώς STEM+)

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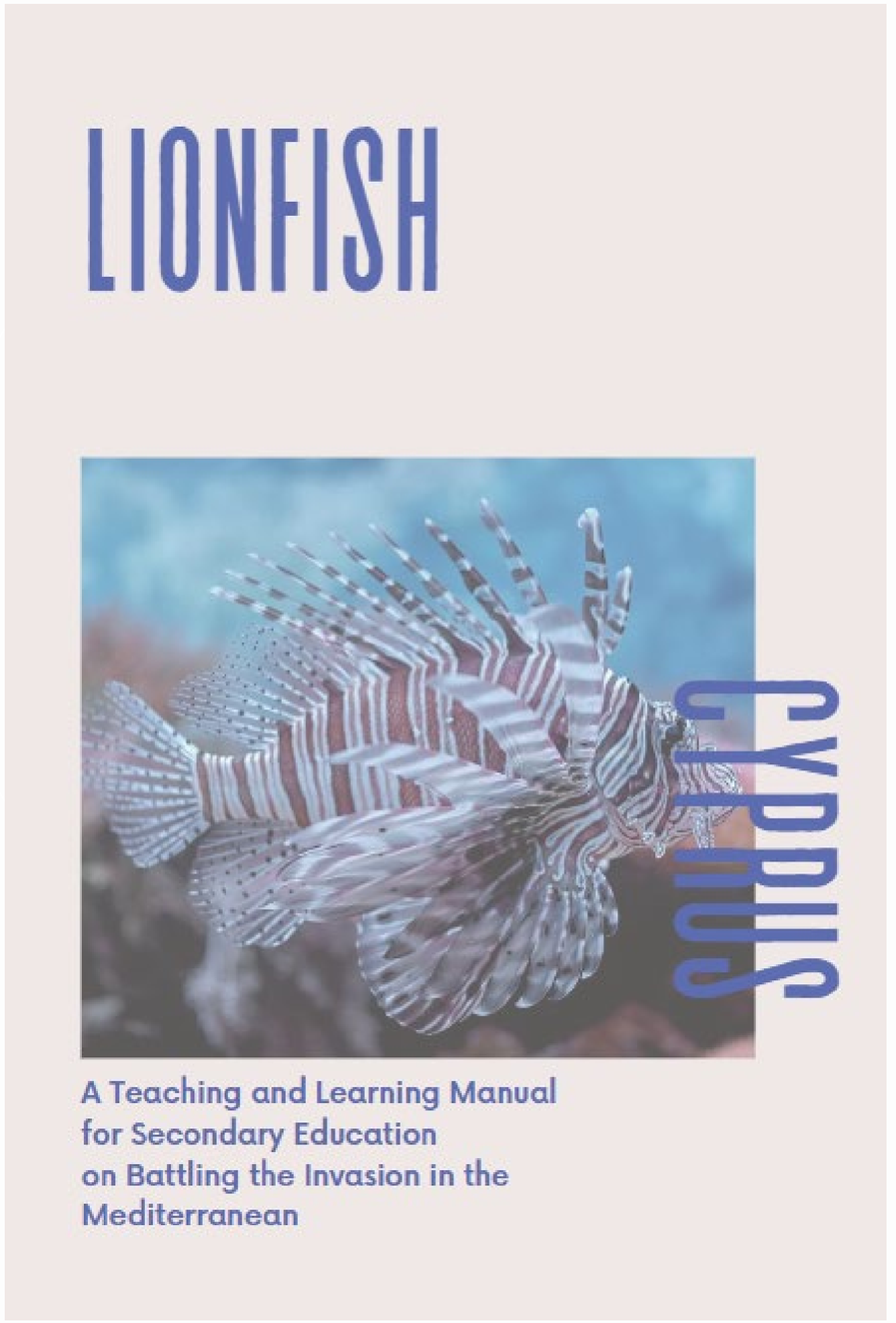
How to read?

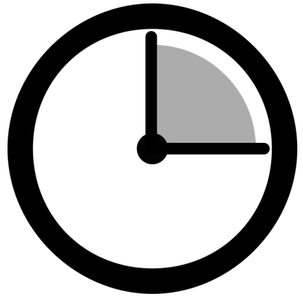
- There are both out of the classroom and in-classroom activities.
- The teacher can pick and choose between the activities provided, ensuring that the learning objectives of each lesson are met.
- At the start of the lesson, the teacher can select from a range of recap activities to bridge the new material with the previous lesson.
- Similarly, at the conclusion of each lesson or after specific activities, the teacher can choose from various activities for students to showcase their work.
- From the main activities of each lesson, the teacher can either follow the set of activities provided for each lesson or select the ones that best suit their lesson to meet specific learning objectives.



Learning objectives

After completing the unit, students are expected to:

- Gain knowledge about the ecological impact of the lionfish invasion and the importance of implementing effective strategies for controlling invasive species.
- Learn how climate change affects the invasion of lionfish and other invasive species in the Mediterranean Sea ecosystem.
- Become familiar with STEAM equipment such as VR headsets, 3D pens, Lego EV3 Mindstorms, Arduino, Micro:bits
- Develop soft skills such as teamwork, communication, critical thinking and problem-solving skills
- Develop basic block coding skills
- Work collaboratively in small groups to brainstorm, design, decide, build, and program their developed prototypes.



Classroom Orchestration

There are both out of the classroom and in-classroom activities. In the classroom, students usually work in groups of four (4), an ideal number for better understanding the problem collectively, discuss along the way and share their thoughts.

Duration

If followed thoroughly, the learning experience will take approximately 5x80 minute lessons. However, the teacher can choose to select the parts they wish to focus on and decrease the expected activity duration. Some situations suggest following a set order of activities, while they always allow teachers to pick activities from a varied list to customise their approach.

Learning Manual

The Teaching & Learning manual is organized in four sections/lessons

01 Introduction to the topic (articles, videos and other multimedia for identifying the challenge)

02 Define the problem/challenge (revisit the 360VR film and other multimedia, articles, and videos for defining the problem/challenge)

03 Ideation/Action planning

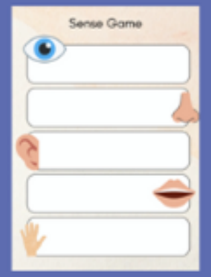
04 Prototype & Test

Lesson 1 - Introduction to the topic

Exploring the natural environment using your senses	Outdoor activity	20 mins

Tools:

- Printed senses message (See Annex II)
- Sense Game worksheet (see Annex II)



The activity takes place at a local beach. The teacher welcomes the students to the shore area and gives them some information about the area. The teacher makes an introduction about how important it is to have contact with the natural environment, as well as experiencing various experiences in it. Next, she/he explains to the students that if we use all our senses we can experience the natural world much better. In other words, using all the senses opens up new worlds for us since we can see the environment from other angles.

The teacher then gives instructions on how they will experience the natural world through the "Sense Game". Students become silent, sit down, and form a circle. They will use their senses one by one to listen, feel, smell, see and think around the natural environment. Then, as a group they record what they experienced in their worksheet.

The teacher then reads or gives a student the following message to read: **"My senses can bring me into closer contact with a natural ecosystem, helping me get to know it better."**

Identifying the issues of Lionfish	Students work in groups in a classroom setting	20 mins	**Tools:** • Triangular problem template (see Annex I)

Note for teachers: The resources of this activity can be given either traditionally with printed material or online using digital material and mobile devices (below we assume the later).

After viewing the 360 VR film students in their groups are given a visualisation tool, named "Triangular Problem" canvas, and are asked to fill it in based on what they have heard in the video.

Using the "Triangular Problem" canvas, students in their groups answer the following questions to conclude to a final response:

1. What is the problem? => Students write down the research question in the centre of the bubble. "Do lionfish affect positively or negatively the Cyprus marine ecosystem?"
2. How do lionfish affect the Cyprus seas? => Write down one, two, or three consequences of having the lionfish swimming in the Cyprus seas.
3. Are lionfish linked to any climate change issues or challenges? => Write down one or two environmental problems related to lionfish.
4. How can technology help with this issue? => Write down one or two technological solutions to this problem.

Lesson 2 - Define the Problem

Exploring the lionfish life-cycle through traditional and digital resources	**Students work in groups in a classroom setting**	**20 mins**	**Tools:** • **Activity sheet 2 in A3 for each group (see Annex II)** • **Digital resources (QR Code: Optional – see Annex II)**

Note for teachers: The resources of this activity can be given either traditionally with printed material or online using digital material and mobile devices (below we assume the later). Another idea is for students to scan a QR code to access the sources.

Each student/group receives a folder which includes labelled documents to browse through. Students use their tablets or mobile devices to study material related to the lionfish (web articles, announcements, videos, blogs, newspaper articles) by scanning the QR codes provided. During this activity, students/groups are encouraged to work at their own pace, since they need to browse through various web articles, recipes, announcements, videos, blogs, newspaper articles. Each group has to go through at least 2 videos, 2 presentations and 2 articles from the given resources.

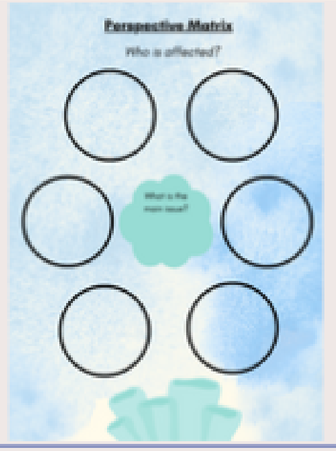
While exploring the digital resources, each group is given Activity sheet 2 and has to note down the required information on their worksheet,based on what they have explored through the digital resources, but also through the video. Using Activity sheet 2, students will learn more about lionfish (where they sleep, where they eat, how they kill them, their natural predators, etc.) and discover their life cycle. Every new piece of information about lionfish that can be useful will go directly on Activity sheet 2.

Students after reading the resources, should be equipped with the following information:

- Where do they originate from?
- What do they look like?
- When did they appear in Cyprus?
- How many eggs do they lay?
- What do they eat?
- How long do they live?
- What attracts them?
- How can we catch them?
- Can we eat them?
- Are they dangerous for the Mediterranean?

Identifying the relevant stakeholders	**Plenary discussion and work in groups in a classroom setting**	**15 mins**	**Tools:** • **Perspective Matrix (see Annex I)**

After students understand the life cycle of the lionfish and its impact, they will discuss in the plenary about what and who is affected by the lionfish (fishermen, restaurant owners, authorities, other species etc.). Then in their groups they write the relevant stakeholders using the "Perspective Matrix" visual canvas. Indicative topics to be included in the canva: The main issue is the lionfish invasion in the mediterranean sea that eliminates the rest of the fish. Among the relevant stakeholders, fishermen, divers, restaurant owners, government, tourists, local people etc. can be included.



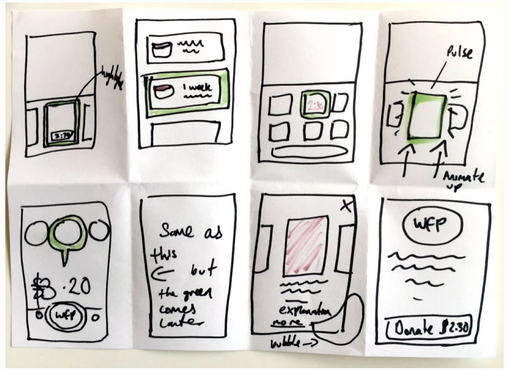
Sharing activity - for the students to share their work	**20 mins**

Lesson 3 - Ideation / Action Planning

Crazy 4s	Students work in groups in a classroom setting	10 mins	Tools: • A4 paper (1 per student) • Markers/Pens (1 per student) • Sticky Notes • Dot voting stickers

Having in mind the technologies presented previously, each student is given an A4 paper and folds it twice in the middle so that they get 4 rectangles. They then get 4 sticky notes to stick in each rectangle. The students have 4 minutes to sketch an idea of a possible solution in each sticky note (1 minute per idea).

The teacher highlights that students don't have to create a perfect drawing, and go for quantity instead of quality drawing depicting innovative ideas for solutions. Students in their groups then present their ideas to each other (1 minute per student). Then they get three dot voting stickers to vote on the ideas they liked the most. The mostly voted ideas can then be discussed in the entire classroom.



Action Plan development	Students work in groups in a classroom setting	15 mins	Tools: • A3 paper (1 per student) • Markers/Pens (1 per student) • Action Plan Showcase Canva (see Annex I)

According to the information above, lionfish tend to be attracted to artificial reefs, like shipwrecks, which makes their containment a challenging activity. The divers, the so-called lionfish hunters, will face difficulties reaching the lionfish due to the difficult terrain they live in. Furthermore, as it was noted in the above sources, spearing and clear vinyl collecting nets can be used for capturing lionfish, since you cannot rely on catching a lionfish with the traditional methods, such as on a hook and a line. However, spearing is a difficult hobby, therefore, to reduce the growing lionfish population, we need to equip more people with a tool that helps them in their pursuit. The teacher tells the students that now they have to discuss in their scientific team about what solution they will follow and how they plan to make it work, having to take in mind the following:

- They have to control the lionfish from spreading in the mediterranean sea
- They have to find a way to convince people that lionfish is eatable and tasty (by advertisements, providing them information, articles, posters etc.)
- They have to negotiate with restaurant owners who would like to sell the lionfish
- They have to collaborate with the fishermen and other authorities

Students in their groups make a short draft of their plan and how it will work by filling in the Action Plan Showcase Canva. They can also use their sticky notes from the previous activity.

Below are some sources students can inspire from for developing their own plans:

- Article: Scientists develop a plan to manage lionfish populations in the Mediterranean Scientists develop a plan to manage lionfish populations in the Mediterranean - University of Plymouth
- Report on the lionfish challenge: To encourage and reward recreational and commercial divers to remove lionfish from Florida waters. Lionfish Challenge 2023 | FWC
- Lionfish university - Trap for lionfish (article) Trap Research - Lionfish University. / Designs for Two New Traps for Capturing Lionfish in Deep Water
- How to catch lionfish with nets

Note: All resources available as of 14/04/2024

Lesson 4 - Prototype & Test

Prototype development using LEGO EV3 Mindstorms	Tools: • LEGO EV3 Mindstorms 45544 (for each team) • LEGO ready-to-use building instructions for creating a robotic arm (for each team)	30 mins

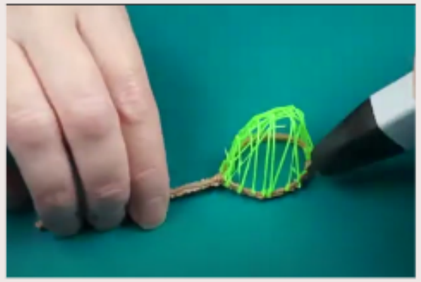
A practical example in this sense can be the design of a robotic hand, using the LEGO EV3 Mindstorms. LEGO has ready-to-use building instructions for creating a robotic arm. Students are expected to create the base and make modifications to create a one-of-a-kind robotic grip or spear that will not look like anyone else's in the class.

After the design of their refined, robotic grip, students will work on the programming of their artefact on computers in their groups. After going through the trial provided by the EV3 desktop application, through trial and error, students will succeed in finding the best code for their product. The students will use the necessary software program that will be downloaded on their computer. Based on the sensors they will use, the teacher will help the teams

Prototype development using recycling material and technology 3D pens	Tools: • 3D pens or 3D printer (1-2 per group) • Recyclable material • Scissors • Tape	30 mins

Students, in their groups, prototype their solution using 3D pens or 3D printers. They can also use recyclable material if they wish to. Students, in their groups, prototype their solution using a combination of recyclable material that can be enhanced with the use of 3D pens or 3D printers and micro:bits for more interactivity by adding sensors.
Ideas:
-Propose fishing mechanisms for lionfish (e.g. special fishing nets, spears, etc.).
-Create a smart manual grip, spear or net to help lionfish hunters in catching them.

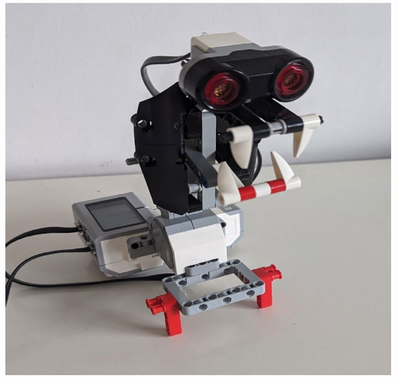
Sources for inspiration:
- How to catch lionfish with nets
- Canoe and fishing net: MYNT3D Canoe and Fishing Net 3D pen Project tutorial
- Video: Hand Catching A Poisonous Baby Lionfish with Net
- Video: Microbit Fishing

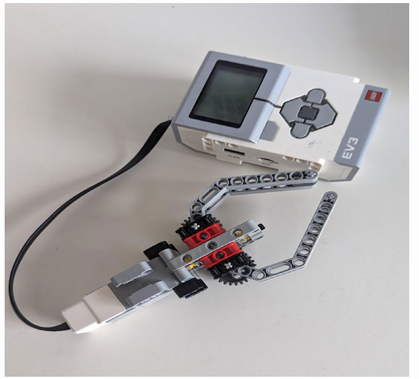


Innovative solution award

No time to prototype?

- In case of time limitations, the teacher develops beforehand and presents a ready-made prototype (e.g. a robotic gripper developed using LEGO EV3 mindstorm or/and a new robotic species that eats lionfish), as possible solutions to combat the species.
- The teacher does not explain to them how these solutions work, but asks the students to guess by showcasing the hardware/software with the commands.
- Basic principles of robotics are also explained (e.g. that there are sensors, that it is programmed by humans and that it can work autonomously).





Resources

The teaching & learning manual includes all the resources teachers need, presented as links, QR codes, or printable materials available in the appendix.

Link to the teaching & learning manual

THANK YOU!

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