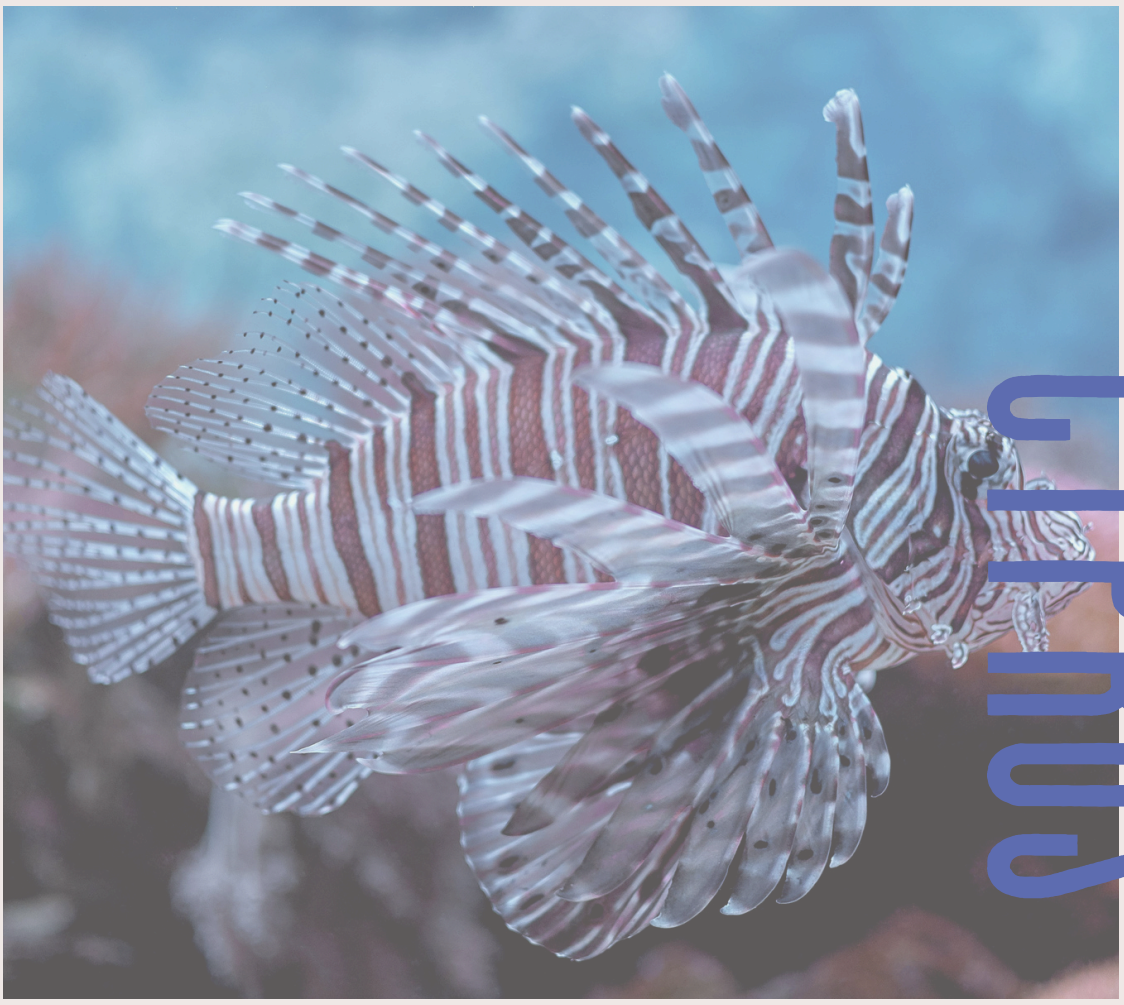
LIONFISH



CYPRUS

A Teaching and Learning Manual
for Secondary Education
on Battling the Invasion in the
Mediterranean Sea

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Project Contributions

- **FoxMedia:** Project Coordinator, developer of the concept which the project is based on - Biosphere VR, Video production and editing (see further acknowledgements in the 360VR Film on YouTube https://youtu.be/-uowNwzfLcU?feature=shared)
- **EdMedia@CYENS:** Project Partner, Teaching & Learning Manual Content development (by Eirini Christou, Andri Ioannou, Sonia Andreou, Demetra Hadjichambi, Andreas Hadjichambis), Project Evaluation

Editions: First edition: June 2024
Canva Editing: Stephanie Papalla

Cite as: Christou, E., Ioannou, A., Andreou, S., Hadjichambi, D., Hadjichambis, A. (2024). A Teaching and Learning Manual for Secondary Education on Battling the Lionfish Invasion in the Mediterranean Sea

Lionfish

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

CYENS CENTRE OF EXCELLENCE

foxmedia

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

Special thanks to the Cyprus Center for Environmental Research and Education (CYCERE), Akrotiri - Limassol

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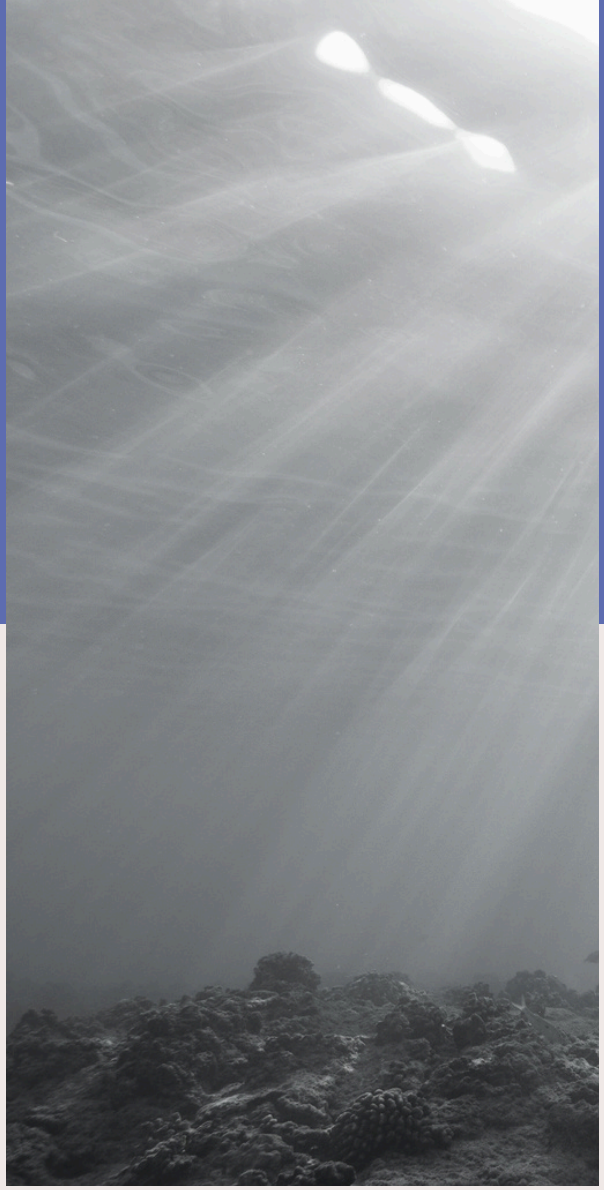


Context

This teaching & learning manual was developed as part of the KA210 European project named "Lionfish" (September 2023 - October 2024; KA210-SCH-2023-004). The consortium members were Fox Media Documentaries, a film production company based in Denmark, and CYENS – Centre of Excellence, a Research Center based in Cyprus. The teaching & learning manual was developed by the EdMedia group of CYENS and the www.cyprusinteractionlab.com, with the support of the CYCERE, a local Environmental Center. The teaching & learning manual is in line with the national curriculum of Cyprus.

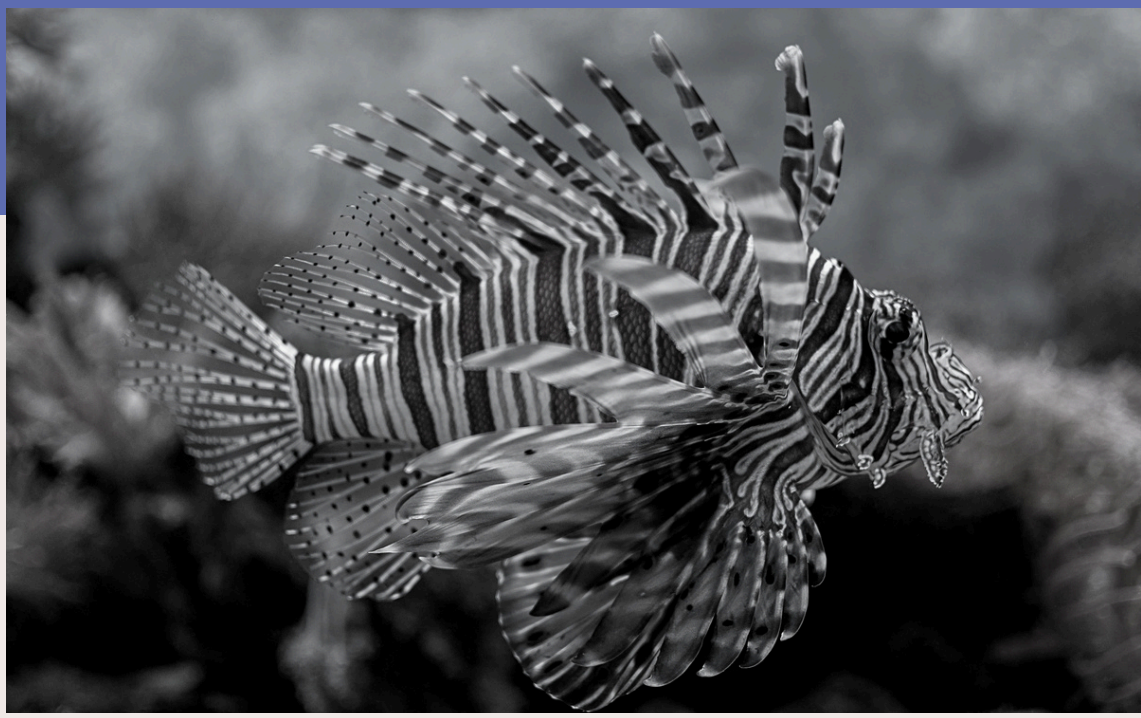
The Lionfish Project

The main purpose of the Lionfish project is to engage teachers, schools, and students into playing an active role in reacting to climate change and transitioning to climate neutral Europe by 2050. The key players of this project, students aged 12-16 years old, get immersed in a 360VR film, titled "End of Line". Then, through a series of tasks, including visual canvases and STEM/STEAM transdisciplinary learning activities, the students explore this invasive species and how it is affecting the local ecosystem and the fishermen's craftsmanship. The end goal is for students to take action by creating a solution to the problem under consideration. All in all, students are placed at the epicentre of this learning experience, while gaining new knowledge, developing skills, forming attitudes about the environment, and developing awareness about climate change.

Who is this Manual for?

This teaching & learning manual is designed for teachers and students aged 12 to 16, researchers and anyone interested in integrating this content into their teaching & learning practices as a whole or as parts. 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. Details on learning objectives, activity duration, tools & equipment, and role of teachers are provided. Also, worksheets and additional information for the enactment of each activity are included at the end of this document.

INTRODUCTION



Why this Topic?

Invasive species present unique challenges that are widely recognised these days. The lionfish, with its striking appearance and predatory nature, has become a concerning presence in various marine ecosystems. While these issues may not be as immediate as other climate challenges, they hold significance for our local environments. 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 (Cyprus)

This teaching & learning manual is linked to the national curriculum for secondary education covering the following 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"
The teaching & learning manual is aiming to engage pupils (middle to early high school, 12-16 years old).

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(1), design thinking & visual thinking techniques(2), STEM & STEAM transdisciplinary practice(3) and problem/project based learning as a general approach and philosophy to teaching and learning.

VR technologies as empathetic machines

Recent research advocates for VR technologies as an empathetic machine that can support behaviour change on social, political and environmental issues. The technology can offer fresh perspectives and thought-provoking opportunities for teaching learners of all ages how to be involved citizens.

In this project, the 360VR film "End of Line '' and the storytelling inside it, allows the students to feel the struggles presented as real, imminent, and relatable, and bring empathy into the learning experience. Immersed in the 360VR film developed by Fox Media Documentaries, the students are transported to a climate hotspot, a coast in Cyprus, where an invasive species, called Lionfish is spreading out, putting in danger the Mediterranean Sea ecosystem and the fishermen's craftsmanship. The film refers to several climate change-related issues. The primary objective is to help students understand the impact of climate change on the Mediterranean marine ecosystem and the spread of lionfish. "End of Line" is a captivating 360VR documentary that transports viewers to the picturesque waters of Limassol, Cyprus. Through the immersive power of VR, the audience joins an ageing fisherman and his son, heirs to a long lineage of fishermen, on their traditional fishing boat. As they set out into the Mediterranean Sea, viewers experience the sensation of steering through the harbour, feeling the wind and observing the intricate process of lowering four kilometres of fishing nets.

The documentary offers a unique perspective on the challenges faced by these fishermen. The son, an enthusiastic diver, explores the sea bottom, providing a closer look at the lionfish, an invasive species that has proliferated in these waters, impacting the local ecosystem and the fishermen's livelihood. Viewers accompany the fishermen on an early morning journey, witnessing firsthand the shockingly meagre catch they haul in from their extensive nets. This poignant moment underscores the stark reality of diminishing fish populations in the Mediterranean.

"End of Line" goes beyond just showcasing the struggles of a fishing family; it delves into broader environmental and cultural concerns. The documentary aims to engage students in understanding the reasons behind the dwindling fish stocks in the Mediterranean Sea. It raises critical questions about the future of fishing cultures, the impact of invasive species, and the broader ecological imbalances affecting our oceans. This 360VR film not only educates but also, emotionally connects viewers with the lives of those who have depended on the sea for generations. It's a call to reflect on the environmental changes we face and the legacy we leave for future generations. "End of Line" is meant to be a journey into the heart of a fading world, urging us to ponder, "what happens when a whole fishing culture disappears?"

1 Soudhamini. (2024). VR and empathy: a reappraisal. Media Practice and Education, 1-15.
2 Yiatros, S., Pastides, A., Karra, S., & Ioannou, A. (2022). 11. From Youth Awareness to Action: The Case of The Eit Climate-Kic Young Innovators Program in Cyprus. Engaging, 88.
3 Ioannou, A., Gravel, B.E. Trends, tensions, and futures of maker education research: a 2025 vision for STEM+ disciplinary and transdisciplinary spaces for learning through making. Education Tech Research Dev 72, 1–14 (2024). https://doi.org/10.1007/s11423-023-10334-w

DESIGN THINKING & VISUAL THINKING TECHNIQUES

Design Thinking is widely used to refer to both a method of thinking and a set of methods. It has recently been used as a pedagogical method, considering how ideas and procedures that are needed to tackle an issue from a user-centred standpoint are arranged. A variety of techniques can be used by an individual or (more often) a team to complete the various design thinking processes or phases(4). While the Design Thinking process typically consists of three to seven stages, the most popular one only has five(5):

01 EMPATHISE (with your users)

In this phase, the focus is on understanding the users' needs. Designers aim to immerse themselves in the users' environment, gather data, and develop a deep understanding of their needs, challenges, and desires. This often involves conducting interviews, surveys, and observations to gain insights into users' behaviours and motivations.

02 DEFINE (their problems, needs, and insights)

Based on the empathy phase, designers then synthesise their findings to define the core problems and needs of the users. This step involves analysing the collected data to identify patterns, pain points, and opportunities. The goal is to articulate a clear and concise problem statement that serves as a foundation for the subsequent steps.

03 IDEATE (by posing provocative questions and coming up with fresh solutions)

Ideation is the creative phase where designers generate a wide range of ideas to address the defined problems. This involves brainstorming, ideation sessions, and creative exercises to encourage out-of-the-box thinking. The goal is to explore different possibilities and potential solutions.

04 PROTOTYPE (the best solution)

In this phase, designers create tangible representations of their ideas to bring them to life. Prototypes can take various forms, from low-fidelity sketches and wireframes to more sophisticated mock-ups or physical models. The purpose is to quickly and cost-effectively test and iterate on potential solutions before investing significant resources.

05 TEST (the solution)

In this phase, designers create tangible representations of their ideas to bring them to life. Prototypes can take various forms, from low-fidelity sketches and wireframes to more sophisticated mock-ups or physical models. The purpose is to quickly and cost-effectively test and iterate on potential solutions before investing significant resources.

4 Goldschmidt, G. (2017). Design Thinking: A Method or a Gateway into Design Cognition? She Ji, 3(2), 107–112. https://doi.org/10.1016/J.SHEJI.2017.10.009
5 Stanford d.school Design Thinking Process, https://dschool.stanford.edu/resources/getting-started-with-design-thinking

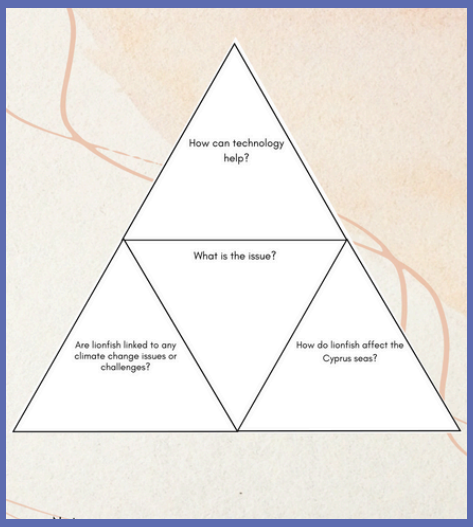
DESIGN THINKING & VISUAL THINKING TECHNIQUES

Visual thinking techniques/tools are directly linked to Design Thinking as a pedagogical model. These techniques/tools facilitate the students' understanding of complex real-world problems such as climate change, energy or food, and come up with creative solutions for them. When taking on a challenge-based learning approach with real-life challenges, the visual thinking techniques/tools help to tap into the student's creativity to innovate. This teaching & learning manual consists of visual thinking tools that can help students understand the parts and perspectives involved in a problem (e.g. climate change) and also see the potential consequences depending on the different viewpoints of the people taking part. The tools are inspired by the EU's Climate-KIC project and the respective Educational Action in Cyprus(6).

6 EU's Climate-KIC project in Cyprus, https://www.cyprusinteractionlab.com/yicy2020-climate-kic/

VISUAL CANVASES FOR THE LIONFISH PROJECT

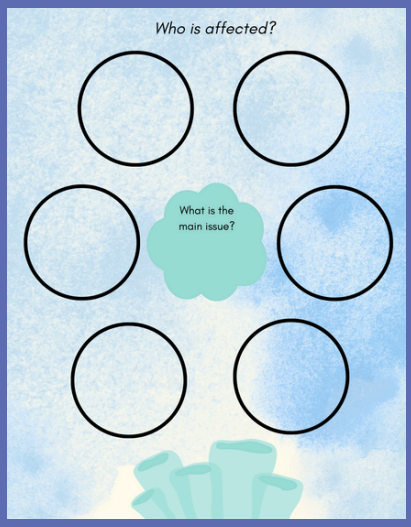
TRIANGULAR PROBLEM



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:

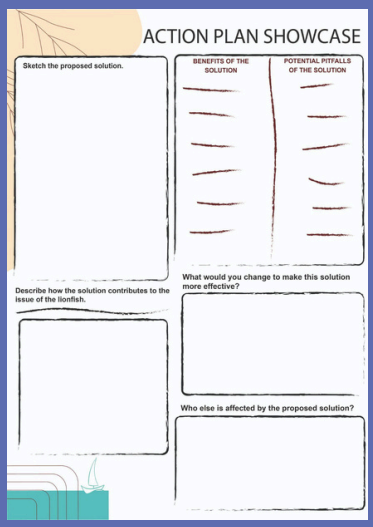
1. **What is the issue?** => Students write down the research question in the centre of the bubble. "Do lionfish affect positively or negatively the Cyprus marine ecosystem?"
2. **How do lionfish affect the Cyprus seas?** => Write down one, two, or three consequences of having the lionfish swimming in 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.

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.

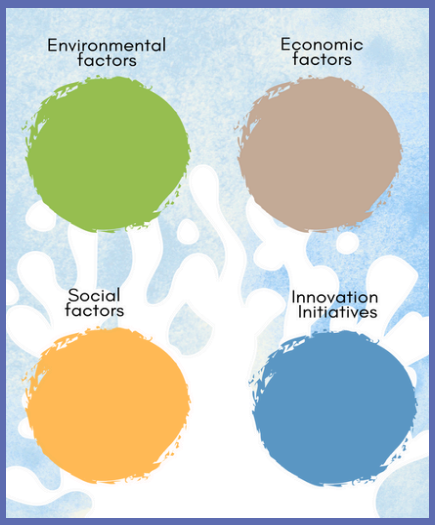
ACTION PLAN SHOWCASE



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:

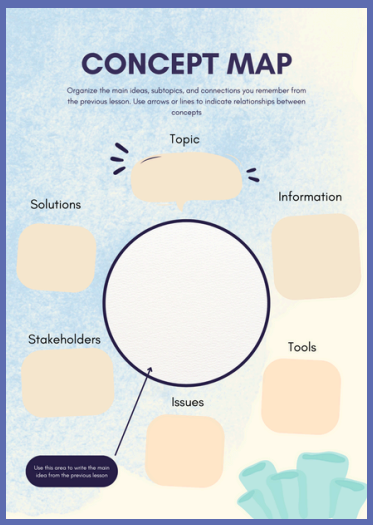
- They sketch the suggested solution
- They explain how it solves the issue (in this case the lionfish invasion)
- They note down advantages and disadvantages of the specific solution
- They suggest modifications to make the solution more effective
- They refer to the stakeholders that are affected by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

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.

CONCEPT MAP



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.

STEM, STEAM AND STEM+

STEM, STEAM, STEM+ transdisciplinary learning practices

The acronym STEM, which stands for science, technology, engineering, and maths education, has gained popularity over the past 20 years. More recent examples of work have pushed to integrate the arts (A), framing STEAM as an integrative and expanded curricular practice. Yet, in the current educational landscape, the emphasis is on STEM+ transdisciplinary learning spaces where the practices of different domains meet and coexist (7) e.g, from Biology to Mathematics, IT, and Art. Drawing on STEM, STEAM, and STEM+ ideas and practices, this project has the following learning design elements:

- Firstly, students engage in hands-on experiences using digital tools (e.g., 360VR film, multimedia, article and website browsing, creating presentations etc.).
- Secondly, they interact with different technological and engineering software and hardware such as VR headsets, 3D pens and printers, Micro:bits, LEGO EV3 mindstorms etc to explore solutions and develop prototypes.
- Thirt, the activities incorporate the use of visualisation tools, the "canvases" where students collaboratively work with to critically provide, argue and discuss possible solutions to a specific challenge.

Problem based learning & project based learning (PBL)

PBL is a general approach and philosophy to teaching and learning. The term PBL does not refer to a specific educational method, but an approach to learning. PBL was pioneered in the medical school program at McMaster University in Hamilton , Ontario, Canada in the late 1960s by Harold Barrows and his colleagues. Barrows defines the Problem-Based Learning Model as:

- Student centred learning
- Learning is done in small student groups, ideally 6-10 people
- Facilitators or Tutors guide the students rather than teach
- A problem forms the basis for the organised focus of the group, and stimulates learning
- The problem is a vehicle for the development of problem solving skills. It stimulates the cognitive process.
- New knowledge is obtained through Self-Directed Learning (SDL).

The sheer diversity of forms PBL methodology can take is paralleled only by the range of educational method designs and the skills of the teacher(8). In this project, the overall process used has been informed by previous experience of the team through the ENGINITE E+ project(9).

7 Ioannou, A., Gravel, B.E. Trends, tensions, and futures of maker education research: a 2025 vision for STEM+ disciplinary and transdisciplinary spaces for learning through making. Education Tech Research Dev 72, 1–14 (2024). https://doi.org/10.1007/s11423-023-10334-w

8 Barrows, H. S. (1986). A taxonomy of problems-based learning methods. Medical education, 20(6), 481-486.

9 The ENGINITE project https://www.cyprusinteractionlab.com/enginite/

MANUAL STRUCTURE HOW TO READ

Manual structure / How to read
The teaching & learning manual presents a learning experience that blends and combines the aforementioned pedagogical approaches, namely use of VR technologies as empathetic machines, design thinking & visual thinking techniques, STEM/STEAM transdisciplinary learning practices, and problem/project based learning.

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.

LESSONS

The learning material is divided into four lessons:

01 INTRODUCTION TO THE TOPIC (articles, videos and other multimedia for identifying the challenge)

- A pool of introductory activities that the teacher can choose from to introduce students to the ecosystem and the issue of lionfish
- Watch a 360VR film related to the lionfish.

https://www.youtube.com/watch?v=-uowNwzfLcU

- Use of the "Triangular Problem" visual canvas, to identify the challenge

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02 DEFINE THE PROBLEM/CHALLENGE (revisit the 360VR film and other multimedia, articles, and videos for defining the problem/challenge)

- What is the problem?
- Whom does the problem affect?
- Use of the "Perspective Matrix" and "Impact Map" visual canvases to better understand the perspectives of the different stakeholders surrounding a complex problem featured by smaller complex conflicts (e.g. fishermen, restaurant owners, the environment, other sea species etc.)

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03 IDEATION/ACTION PLANNING

- Use of activities to sketch proposed solutions to the challenge. Students first individually sketch solutions, vote, and then they elaborate on their most voted solutions (they can combine ideas).
- Students create an action plan using the "Action Plan Showcase Canva"

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04 PROTOTYPE & TEST

- Students prototype their best solution using different software and hardware (e.g., LEGO Mindstorm EV3, 3D pens/printers, Micro:bits), as well as recyclable material.
- Students share and test their prototypes, make refinements based on feedback and finalise their creations.

STEM+ LEARNING FOR SECONDARY EDUCATION STUDENTS

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 software and hardware such as VR headsets, 3D pens, Lego EV3 Mindstorms, Micro:bits etc. Develop basic block coding skills.
- Develop soft skills such as teamwork, communication, critical thinking and problem-solving 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.

Note: All the digital resources provided in this teaching & learning manual are available as of June 2024.

LESSON 1

Introduction to the topic

1x80minutes

Learning Goals:

By the end of this lesson, students should be able to:

- Identify the lionfish as an invasive species in the Mediterranean sea
- Explain how climate change affects the invasion of lionfish and other invasive species in the Mediterranean Sea ecosystem.

As part of the school subject "environmental education", students get introduced to the Mediterranean ecosystem. Then the focus is directed on the lionfish. Following a problem-based learning approach, students try to find answers about the questions "Are lionfish good or bad for the Cyprus seas?" and "Do lionfish affect positively or negatively the Cyprus marine ecosystem?"

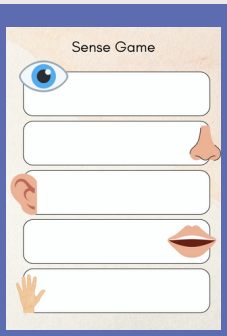
Teacher's digital resources/tools for lesson 1 can be accessed by scanning the QR code below, or by clicking on the direct links provided.

Introductory activities to the ecosystem (~15-20 mins)
[Teacher can choose between one to two of the proposed introductory activities from this section]

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.

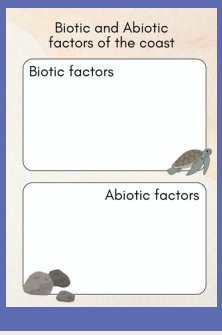
The teacher then gives instructions on how they will experience the natural world through the "Sense Game". Students become silent, sit down, and form a circle. They will use their senses one by one to listen, feel, smell, see and think around the natural environment. Then, as a group they record what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

Exploring the biotic and abiotic factors of an area	Outdoor activity	20 mins

Tools:

- Biotic and Abiotic factors worksheet (see Annex II)
- Biotic and Abiotic factors printed message (see Annex II)



Students in groups are asked to study the world of the Coast, this time through ecological recording, where they record the biotic and abiotic factors of the area.
Abiotic factors include the non-living factors that affect an ecosystem e.g. soil, water, air, temperature, pebbles, etc. Biotic Factors include all living organisms, e.g. plants, animals, etc. To record these factors, the groups are given a worksheet to locate and record the plants and animals of the beach more easily. After discussion and presentation of their findings, the teacher gives the following message to one of the students to read:
"By recording the biotic and abiotic factors that make up an ecosystem, I understand the natural richness of that ecosystem".

Exploring the fish of Cyprus via traditional resources	Students work in groups in a classroom setting	15 mins

Tools:

- Cyprus Fish Document
- Activity sheet 1 (see Annex II)
- 1 Tablet / Computer per group

In line with the "Biodiversity" chapter of the national curriculum, students are introduced to the most important fish of the Cyprus seas, according to the Cyprus Department of Fisheries and Marine Research (DFMR).

As students sit in groups of 4, the teacher presents the Cyprus Fish Document with poisonous marine organisms found in the waters of Cyprus and asks students to browse through the different species and list them in two different columns (a) fish they have heard or even eaten before in family dinners, (b) fish they have never heard before and sound or seem funny in the pictures. At this time, each student gets Activity sheet 1 and along with their groups, they browse through the document. Students then present their answers to the plenary and discuss.

Next, the teacher informs students that like in any other ecosystem, there are species that are native and other species that are so-called invasive species to the Cyprus seas. Lionfish is one such invasive species. Students are encouraged to browse through lionfish and find where they originally come from.

They note down on Activity sheet 1 the difference of a native to an invasive species.

Exploring the fish of Cyprus via matching activity	Students work in groups in a classroom setting	15 mins	Tools: • Fish Cards Matching Activity • Cyprus Fish Document • Lionfish Photo (See Annex II) • Tablets (1 per group)

Students are provided with pictures of fish in Cyprus and their names. In their groups, they try to match the photo of the fish with the names. When they finish the matching they check how other groups did the matching and compare with their answers. Then they check the answers from the Cyprus Fish Document. A picture of the Lionfish, another invasive species that entered through the Suez Canal is also provided along with more information:

Photo by Denys Razumovskyi:
https://www.pexels.com/photo/close-up-shot-of-a-lionfish-in-an-aquarium-6143803/

Exploring the fish of Cyprus using digital resources	Students work in groups in a classroom setting	15 mins	Tools: • Tablets / smartphones • Cyprus Fish Document • Kahoot Quiz • Projector • QR code (see Annex II)

The teacher launches on the projector the online Kahoot Quiz where the image of different fish of Cyprus appear on the screen, along with 4 possible names. The students have to choose the name they think belongs to each fish picture. When they finish, the teacher projects a QR code for students to scan, which leads to a document with the names and description of the fish they played in the quiz. At the same time, the teacher projects the document and emphasises on the Lionfish picture, mentioning that it is an invasive species that entered through the Suez Canal.

QR Code for fish document

1. Main lesson activities focusing on exploring the Lionfish (~40 mins) [Teacher is advised to follow the proposed activity sequence, or pick and choose between the proposed activities]

Hypothesis about the lionfish	Classroom discussion	10 mins	Tools: • Lionfish picture (see Annex II) • Role props (e.g. scientists hat or card with students name and "environmental scientist" sign)

The teacher asks the students about the species they discovered in the last lesson and shows them a Lionfish picture. A general question is raised by the teacher "Are lionfish good or bad for the Cyprus seas?"/ "Do lionfish affect positively or negatively the Cyprus marine ecosystem?" Students are encouraged to share their hypotheses and explain their thoughts in a general discussion.
The teacher then announces to the students that they now take on the role of a scientists team aiming to explore the lionfish in order to develop a plan to help reduce the ever-increasing number of lionfish in the Mediterranean Sea.

Food Relations	Outdoor activity	20 mins	Tools: • Auxiliary tabs of plants and animals • A3 size pictures Figures 1,2,3 (See Annex II)

The students are in nature around the beach or the sea. The goal in this activity is to establish the connection and interaction that exists between living organisms in nature. In short, the survival of various organisms is based on trophic relationships where one eats the other creating food chains. By expanding this relationship the food chains are intertwined creating a huge food web/food grid.

Specifically, the teacher explains to the students that initially they are going to create a large food web related to the world of the coast. That is, the organisms included in it will have as their habitat the dunes on the beach and the sea. The teacher gives some basic instructions on how the students can create a food web in a simple and illustrative way by adopting the roles of plants and animals with the use of auxiliary tabs.

According to the teacher's instructions to create the food web, when they place the tabs on them, they need the prey (the victim/the one being eaten) to point their finger at the predator (i.e. the culprit/the one eating it). When everyone follows the specific procedure, the representation of the food web can easily be created. In case the distance is longer due to the number of people, a piece of rope can be used to show the connection more clearly.

Possible dialogues:

- Educational:"Have you heard the word web before?"
- Student 1:"Is it when some things are tangled together?"
- Educational:"In a way yes. You will all be entangled with each other depending on who is eating you or who you are eating. In other words, what you will create will be various food chains where, for example, one living organism eats another but is itself also eaten by another organism."

After creating the grid:

- Educational:"Was it easy to connect? You liked it?"
- Student 2:"Yes! It was a lot of fun since we had to search to find who has the right tab. For example, I was a starfish and I had to look for the seagull to show him, since he is the culprit that eats me."
- Educational:"Indeed. Did you learn anything else useful about the starfish?'
- Student 2:"Sure! I just found out it feeds on clams so it was me to blame for the clams!"

The teacher then invites the students to participate in a small theatrical performance called "The story of a food grid". Here the teacher mentions that a new species of fish, the lionfish, has been spotted on the coast in recent years.

The Educator gives some information about the lionfish through large pictures in A3 size: "Lionfish, children, is a species that originates from the Indian Ocean. This fish originated in Indonesia and through the Indian Ocean it spread to the Persian Gulf, South Africa and the Red Sea. It entered the Mediterranean in 1991 via Suez. In 2010 it appeared in Cyprus (Figure 1: Map with movement of lionfish).

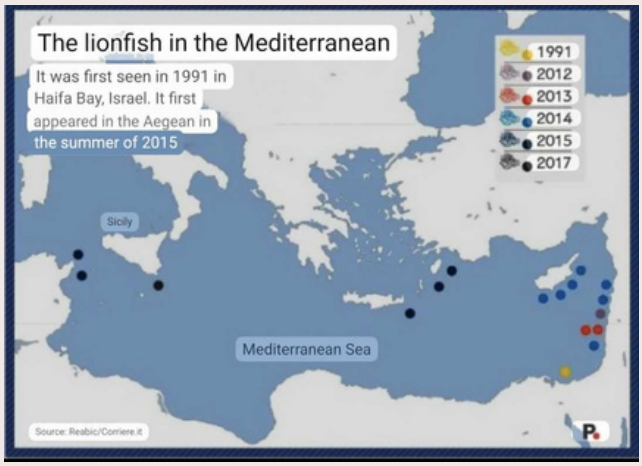


Figure 1: Map with movement of lionfish

It is a very beautiful fish with bright red, yellow, white and black colors, which reaches a length of 50 cm. Females can lay 30,000 eggs every four days with spawning lasting throughout the year. These eggs are carried by sea currents over long distances, which helps the spread of the species (Figure 2: Lionfish Morphology).

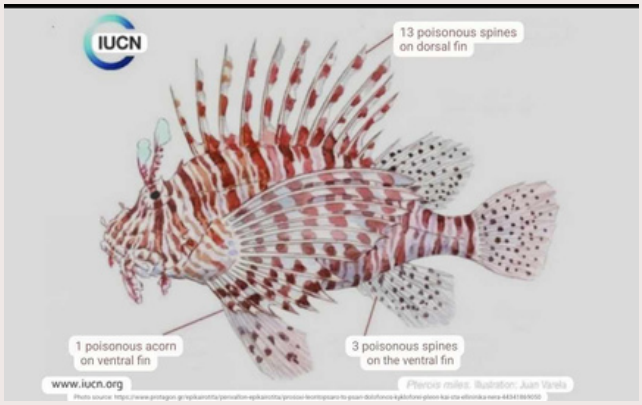


Figure 2: Lionfish Morphology

The lionfish is a carnivorous fish that eats other types of fish in large quantities and with very fast movements. Several times it scares its prey with rapid movements of its "fins", disorients it and then opens its mouth and literally "sucks" and swallows it (Figure 3: Lionfish and prey)".

Figure 3: Lionfish and prey

Lionfish feed mainly on small fish, invertebrates and molluscs and in large quantities. They can eat food about 20 times the size of their stomach (Figure 4: Lionfish and prey)".

Figure 4: Lionfish and prey

Source: https://www.boatfishing.gr/pws-epireazei-to-leontopsaro-tis-thalasses-kai-ton-kosmo-mas/

The students then try to integrate the lionfish into the food web and think about how the other aquatic organisms in the web are affected. The teacher invites a child to tab a lionfish and they try to create the new food web.

What changes are expected in the populations of individuals on which the lionfish feeds? Which organisms in the food web will be affected?

- Educational:"What can happen to the various marine organisms from the presence of the lionfish?"
- Student 1:"Since it feeds on the fish, they will decrease."
- Educational:"Correctly. Therefore, you who are fish, sit down since you no longer have life."
- Student 2:"So now I, who am a dolphin, will have no food since the fish I eat will have been consumed by the lionfish"
- Educational:"You are absolutely right!"
- Student 3:"But we who are fish will also die. So the seagulls will be without food!"
- Student 4:"The starfish will also be reduced by the presence of the lionfish, so the seagulls will not find food"
- Educational:"That's right and as you can see one affects the other and the consequences are chained, meaning I can never affect just one thing. If even a small amount of damage is done, its consequences affect all the organisms associated with those that were damaged, because of the interdependence that exists in the natural world."
- Educational:"Based on the video you watched, what environmental reason helped bring lionfish to the Mediterranean?"
- Student 5:"Global Warming and Climate Change".
- Educational:"How are local fishermen affected by the presence of lionfish?".
- Student 6:"Their catch has decreased, so they can't find fish to catch, sell and eat, so their lives are affected."
- Educational:"Despite the dangers involved, lionfish are edible and very tasty, after proper and careful cleaning so that there is no risk of poisoning. »
- Can you think of some ways to reduce the lionfish problem in the sea of Limassol?".
- Student 6:"To allow fishing, to inform other fishermen that they can fish and consume this species."

Conclusion:

"The trophic relationships that exist between coastal organisms create a complex but fragile food web."

Exploring the lionfish and its effects through a 360VR film	Students individually watch the 360VR film	10 mins	Tools: • 360VR film "End of Line" • VR standalone headsets (Oculus or cardboard) - 1 for each student • Student mobile devices • Headjack application • Wifi

The teacher tells the students that they will watch a 360VRfilm based on the real experience of a fisherman in Cyprus who refers to the Lionfish. The teacher shows a preview and explains the technicalities a 360VR experience has (moving around in different directions to experience as much as possible). The teacher can also demonstrate how to put on a VR headset.

- If you have stable WiFi, students can watch the video from YouTube using this link or by scanning the QR code with the following options:

Youtube Video QR Code

Option 1: An Oculus VR headset can be provided for every student.
or
Option 2: An affordable headset can be provided for every child (e.g., google cardboard) together with an android cell phone for each, provided by the school or owned by the student.
or
Option 3: A combination of the above i.e, prepare Oculus stations, depending on how many Oculus can be provided. The rest of the students will use cell phones in affordable headsets.

- If you don't have Stable wifi, you can follow the 3 options below:

Option 1: Download the 360VR link on the Oculus device using this link or by scanning the QR code.

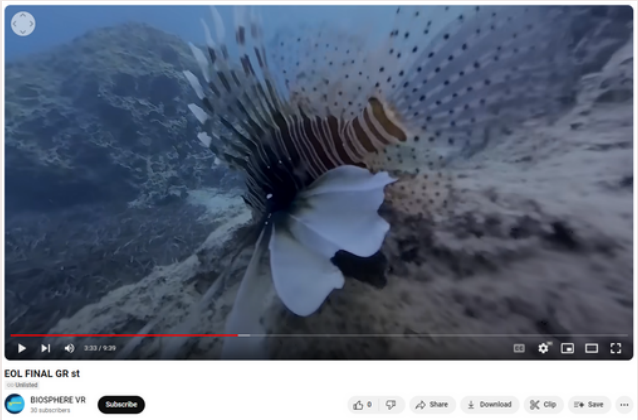
Option 2: An affordable headset can be provided for every child (e.g., google cardboard) together with an android cell phone for each, provided by the school or owned by the student.

a. Case 1: Download 'VaR's VR Video Player' and import the film (only available for android phones). This cost-free player will play the 360VR film without wifi access during the experience. The 360VR film is sized at 6.5GB and must be downloaded to import it to the VaR's VR Video Player.
b. Case 2: The 360VR film must be uploaded on Headjack https://headjack.io/ so that it can be downloaded on cell phones (Android or iPhone) before the experience when wifi is available. This way the film can be seen without wifi access during the experience. At least 2 GB of free memory is required for the download of the Headjack link on a cellphone (a code is provided). Instructions for students to download their video through headjack are available here.
c. Case 3: Download the youtube app on the cell phones and login with a youtube premium account to each phone (youtube has no limit of login to multiple devices). Download the video offline (a premium feature only). While wifi is still available, close wifi, and open youtube again in offline mode. Navigate to the profile account where you can find your offline list of videos and play it offline.Make sure to tab the cardboard icon on the video so it splits into 2 lenses.

Option 3: A combination of the above.

You also have the option for students to watch the 360VR film on a projector via Youtube, or on their personal mobile devices with no VR, but this makes the experience less immersive.

Tips to remember!
Interaction with the 360VR film needs approximately 9 minutes. Consider your time for individual students or groups interacting with the video to avoid any surprises.



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 360VR 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.

Sharing activity - Choose from the pool of sharing activities [Suggestion: Gallery exhibition]	20 mins

LESSON 2

Define the problem

1x80minutes

Learning Goals

By the end of this lesson, students should be able to:

- Describe the habits and life cycle of lionfish.
- List the negative implications to the local ecosystem and the fishermen's craftsmanship.

While students have come up with a definitive answer to the research question raised by their teacher "Do lionfish affect positively or negatively the Cyprus marine ecosystem?", they have yet to understand the nature of the lionfish, identify what the problem is and who it affects. Students take on the role of an environmental scientist aiming to develop a plan to help reduce the ever-increasing number of lionfish in the Mediterranean Sea. To achieve this, students first need to become familiar with the life cycle of the lionfish to understand small details that will help them in their venture.

Teacher's digital resources/tools for lesson 2 can be accessed by scanning the QR code below, or by clicking on the direct links provided.

Recap Activity (~10 mins)			
Choose from the pool of recap activities [Suggestion: Gallery walk]			10 mins
Main lesson activities focusing on exploring the Lionfish (~40 mins) [Teacher is advised to follow the proposed activity sequence, or pick and choose between the proposed activities]			
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?

Lionfish is a species that originates from the Indian Ocean. This fish originated in Indonesia and through the Indian Ocean it spread to the Persian Gulf, South Africa and the Red Sea. It entered the Mediterranean in 1991 via Suez. In 2010 it appeared in Cyprus. It is a very beautiful fish with bright red, yellow, white and black colours, which reaches a length of 50 cm. Females can lay 30,000 eggs every four days with spawning lasting throughout the year. These eggs are carried by sea currents over long distances, which helps the spread of the species.

The lionfish is a carnivorous fish that eats other types of fish in large quantities and with very fast movements. Several times it scares its prey with rapid movements of its "fins", disorients it and then opens its mouth and literally "sucks" and swallows it. Lionfish feed mainly on small fish, invertebrates and molluscs and in large quantities. They can eat food about 20 times the size of their stomach.

QR Code to scan for access to sources

Pool of digital sources for students to explore:

Videos

- Video 1 - Divers Fight the Invasive Lionfish | National Geographic: Divers Fight the Invasive Lionfish | National Geographic
- Video 2 – Why hunt and eat lionfish Why hunt and eat lionfish video
- Video 3 – Lionfish – Secure capture with pole and spear. How to create it and clean it. Λεοντόψαρα(Lionfish)🦁🐟 Ασφαλής σύλληψη με Pole και Ψαροντούφεκο! Εξήγηση κατασκευής και καθάρισμα! (forward to 3:11 minute) - (Resource only available in Greek).
- Video 4: The Invasive, Venomous Lionfish Is Killing Atlantic Reefs The Invasive, Venomous Lionfish Is Killing Atlantic Reefs (HBO)
- Video 5: Short YouTube video from the Cyprus Department of Fisheries and Marine Research (DFMR), explaining how artificial reefs are an important spot for fish to shelter, find food and reproduce.

Presentations

- Lionfish presentation 1
- Lionfish Presentation 2

Articles:

- Article 1 - Lionfish Hunting: 7 tips to find your prey: Lionfish Hunting: 7 Tips to Find Your Prey - OceanWide Explorers
- Article 2 - Lionfish From Sea to Table National Marine Sanctuaries - How to Catch and Cook Lionfish.
- Article 3 and video about lionfish (English): Red Lionfish | National Geographic
- Article 4: Invasive lionfish becoming permanent feature of Mediterranean Sea Invasive lionfish becoming permanent feature of Mediterranean Sea - Oceanographic
- Article 5: What's the Big Deal with Lionfish Being Invasive?
- Article 6: How to catch lionfish with nets
- Article 7: AN INVASIVE SPECIES: THE LIONFISH

Impact Map for System Analysis	Students work in groups in a classroom setting	15 mins	Tools: • Impact Map (see Annex I)

Students will use the "Impact Map" visual canva in their groups to analyse environmental, economical and social factors related to the invasion of the lionfish, as well as refer to innovation initiatives. The "Impact Map" for system analysis emphasises 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.

Some possible inputs for the impact map include:

Environmental Factors:

- Disruption of native ecosystems: Lionfish disrupt native marine ecosystems by preying on native fish species and altering food webs.
- Decreased biodiversity: The invasion of lionfish can lead to a decrease in biodiversity as they outcompete native species for resources and space.
- Coral reef degradation: Lionfish populations can negatively impact coral reef health by consuming juvenile fish that play a crucial role in maintaining reef resilience.
- Spread of diseases: Lionfish may introduce new diseases or parasites to native marine species, further destabilising the ecosystem.

Social Factors:

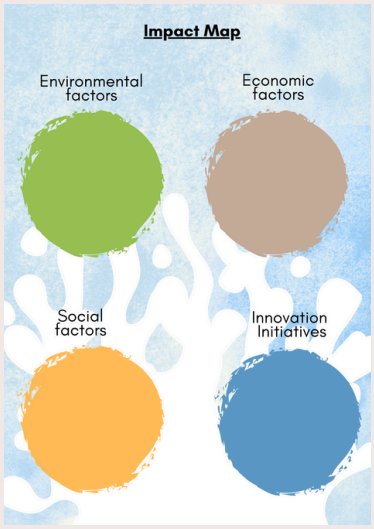
- Impact on Fisheries: The invasion of lionfish can affect traditional fishing practices and livelihoods of local fishermen due to competition for resources and potential damage to commercial fish populations.
- Recreational activities: Lionfish presence may impact recreational activities such as snorkelling and diving as they may pose a threat to humans due to their venomous spines.
- Cultural significance: In some communities, lionfish may have cultural significance, and their invasion may disrupt traditional beliefs or practices related to marine life.

Economic Factors:

- Impact on Tourism: The presence of lionfish in marine ecosystems can deter tourists who may be concerned about safety and the health of coral reefs, leading to a decline in tourism revenue.
- Management costs: Controlling lionfish populations and mitigating their impact on the environment require financial resources for research, monitoring, and management efforts.
- Loss of ecosystem services: The invasion of lionfish may lead to a decline in ecosystem services such as fisheries production and coastal protection, resulting in economic losses for local communities.

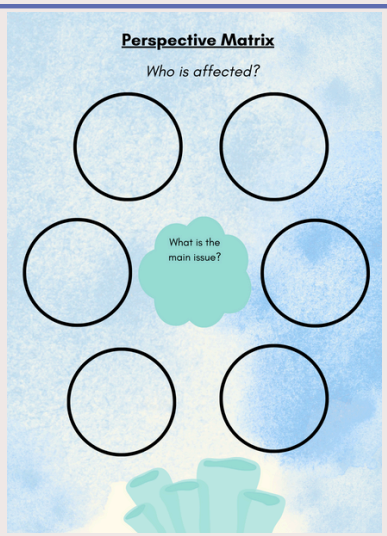
Innovation Initiatives:

- Development of lionfish harvesting technologies such as lionfish traps or specialised fishing gear to reduce their population.
- Implementation of educational programs and campaigns to raise awareness about the impact of lionfish on marine ecosystems and promote responsible consumption.
- Exploration of biocontrol methods such as introducing natural predators or parasites to regulate lionfish populations.
- Implementation of artificial intelligence (AI) technologies for monitoring lionfish populations and predicting their spread to optimise management strategies.
- Promotion of lionfish consumption as a sustainable seafood option to create demand and reduce their population.
- Establishment of citizen science programs to engage local communities in lionfish monitoring and removal efforts.



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 - Choose from the pool of sharing activities for the students to share their work	20 mins

LESSON 3

Ideation / Action Development Plan

1x80minutes

Learning Goals

By the end of this lesson, students should be able to:

- Use sketching techniques to demonstrate their ideas
- Work collaboratively in brainstorming solutions and take decisions
- Develop solutions to the lionfish invasion problem and present them to their classmates.

Students take on the role of an environmental scientist aiming to develop a plan to help reduce the ever-increasing number of lionfish in the Mediterranean Sea.

Teacher's digital resources/tools for lesson 3 can be accessed by scanning the QR code below, or by clicking on the direct links provided.

Recap Activity (~10 mins)		
Choose from the pool of recap activities [Suggestion: Concept mapping]		**10 mins**

Main lesson activities focusing on exploring the Lionfish (~30 mins) [Teacher is advised to follow the proposed activity sequence, or pick and choose between the proposed activities]			
Introduction to technology and it's potentials	Plenary discussion and work in groups in a classroom setting	10 mins	Tools: • Guiding presentation

The teacher opens a discussion for the students to think of possible solutions to the lionfish challenges/issues based on the following statement: "How might we manage lionfish populations in the Mediterranean? ". As scientists, students now have to think of solutions. The teacher, using the technology guiding presentation, introduces the students to various technologies. The teacher ask the students if they identify, have ever used and know how the presented technologies function (3D pens/Printers, arduino, micro:bit, LEGO) and how they can be used to provide solutions to the lionfish challenge (e.g. they can be used to develop prototypes, ideas, detect and collect lionfish etc.).

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

Shore Leader	Outdoor Activity	20 mins	Tools: • Mirror (optional) • Printed message for humans (See Annex II)

Students are in the field, ideally at the coast, and must understand that a decisive factor in the survival of the coastal ecosystem is also the action of humans, for whom the beach is a place of rest and recreation, especially during the summer months.

The students' objective is to identify (and optionally record) the various evidences of human presence on the coast and the effect these evidences have on this natural area. The human elements they will detect revolve around various axes, such as residential development, garbage, human impact on the sea, etc.

After an extensive discussion about the impact of humans on the coast, the teacher gives a mirror to the students and asks them who they do see in the mirror. Then, the teacher or a student reads a message that says: **"Humans have in their hands the power to either destroy the beautiful natural ecosystem of the coast, or to protect it."**

The teacher explains to the students that since they have discovered the problem that threatens the coasts now solutions must be found for it. However, it is emphasised that the solutions must be based on the healthy relationship between man and nature and be intertwined with the preservation of the natural environment and the Sustainability of the Earth. When we say Earth Sustainability we explain that it is the preservation of the planet for future generations.

Sharing activities **[Teacher chooses 1 of the proposed activities for the students to present their posters] - Choose from the pool of sharing activities**	**15 mins**

LESSON 4

Prototype and Testing

2x80minutes

Learning Goals

By the end of this lesson, students should be able to:

- Use digital and technological tools to create an artefact
- Demonstrate proficiency in constructing prototypes using material such as LEGO EV3 Mindstorm, 3D pens, BBC Micro:bits, based on provided instructions and video demonstrations.
- Develop basic block coding skills to control their prototypes
- Refine their code through iterative testing, applying principles of trial and error to optimise the functionality of their robotic grip or spear.

Students in lesson 4 will develop a solution to the emerging problem of lionfish for the Cyprus seas and the Mediterranean Sea in general. Students will work again in groups of 4 to create a functioning prototype that can be tested in the end by different users. In this lesson, students will prototype their solutions and test them. The prototype development process can be done using various prototyping tools, among them LEGO EV3 Mindstorm, BBC micro:bit, Arduino, 3D pens, recycling material etc. Students will share their prototypes with their peers, test them, make refinements and finalise their prototypes. An alternative is also provided in case of limited time.

Teacher's digital resources/tools for lesson 4 can be accessed by scanning the QR code below, or by clicking on the direct links provided.

Recap Activity (~10 mins)
Choose from the pool of recap activities

Pool of prototyping activities (~50 mins)

[Teacher chooses 1-2 of the proposed prototype activities or provides students the option to choose between different tools for prototyping. The students can use any combination of the proposed prototype material to develop their prototype, based on what is available in their school to develop a prototype]

Students work in groups in a classroom setting in all activities

Poster development	Tools: • Canva or google slides [if the activity takes place online] • A3 paper and markers [if the activity takes place traditionally]	30 mins

Students in their groups create a digital poster to raise awareness and to inform the public about the lionfish, based on the information they explored.

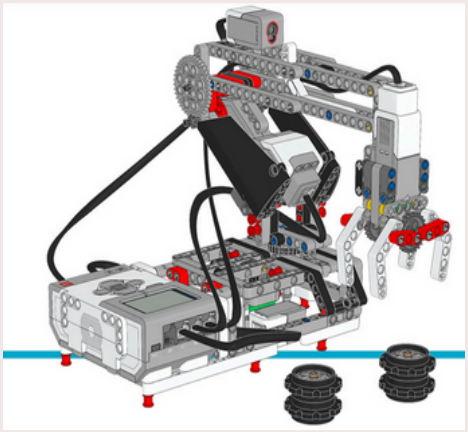
The poster should include information about:
- What the lionfish is
- How it looks like (image/sketch)
- How other species are affected
- It's taste and nutritive elements

Useful Sources:
- Article - Lionfish From Sea to Table

National Marine Sanctuaries - How to Catch and Cook Lionfish.
- Video - How is the DFMR promoting the consumption of the lionfish?

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.

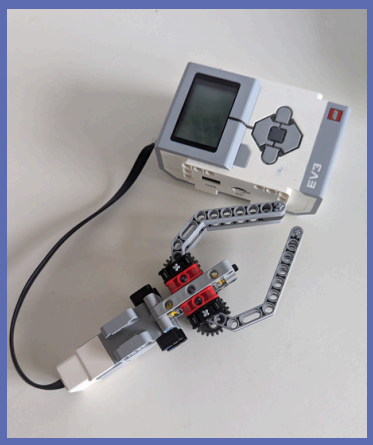


After the design of their refined, robotic grip, students will work on the programming of their artefact on computers in their groups. After going through the trial provided by the EV3 desktop application, through trial and error, students will succeed in finding the best code for their product. The 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 accordingly with "If...then" statements. Students exchange roles within their groups so that all can work on the programming application.

Sources and videos can also be used for inspiration:

- EV3 Simple gripper: Lego Mindstorms EV3 Simple Gripper Using Medium Servo Motor - Building Instruction
- Gripper arm: Lego Mindstorm Ev3 Simple Gripper Claw Arm With Medium Servo Motor | Building Instructions
- Grab & Lift: Lego Mindstorms EV3 Tutorial - Basic Grab & Lift building instructions
- Grabber: Simple Grabber Mechanism - Using Lego mindstorms ev3 - Pick & Crab in 5 Mins; ev3 Grabber ; Ev3 Claw

IDEA 1: Robotic grip LEGO EV3 Mindstorm: Create a refined, robotic grip or spear to help lionfish hunters in catching them.

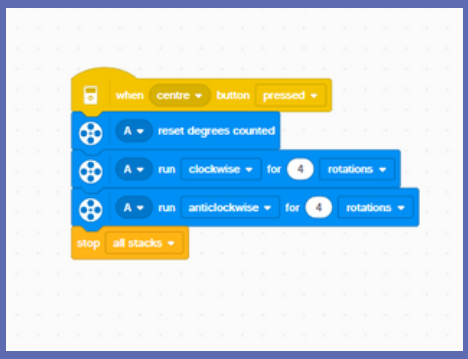


The robotic handle is activated when students press the action button on the LEGO mindstorm device. The idea is that when the button is pressed, the handle opens and then closes to collect the lionfish.

Created following video instructions here

Created using LEGO Mindstorms EV3 Education core set 45544 and 45560

Sensors: Motor



Code created using the EV3 classroom desktop app

IDEA 2: Robotic species that attack or collects lionfish using LEGO EV3 Mindstorm:
Source for inspiration: Youtube Video (instructions for minute 1.20)

The robotic species automatically detects the lionfish using a motion detector, without the need for a user. It shall be placed in areas where lionfish are likely to congregate.

Created following video instructions here (instructions for minute 1.20)

Created using LEGO Mindstorms EV3 Education core set 45544 and 45560

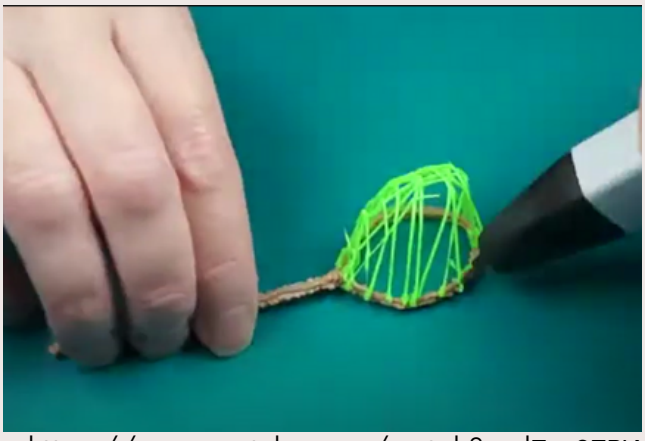
Sensors: Motion sensor

Code created using the EV3 classroom desktop app

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.



Fishing Net with 3D pen, https://www.youtube.com/watch?v=jl7rp27BWRQ

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

Create a smart system with BBC Micro:bits that tracks lionfish behaviour, identifies a pattern and makes predictions	Tools: • 2 BBC Micro:bits per group • MakeCode software	30 mins

Main idea: Researchers consider the identification of the lionfish patterns very significant, since we can understand a lot from their repeated behaviour, such as where they live, where they have their eggs, what they eat, what they prefer and what they avoid. This information is very crucial for strategy development.

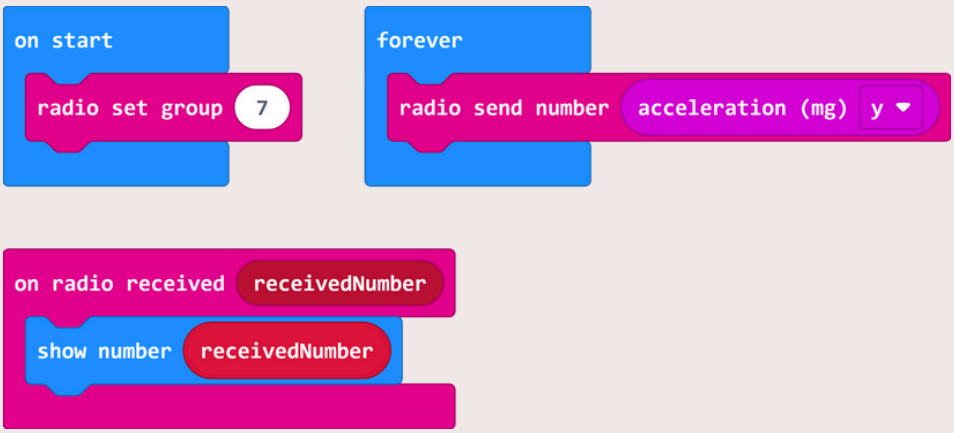
Source for inspiration:
The EU-funded RELIONMED-LIFE project suggested the development of an early detection system for lionfish and proceeded to develop an online dedicated portal and a phone application. (Preventing lionfish invasion in Cyprus through early response and targeted removal)

Solution: Create a GPS tracker for lionfish that gives specific information about the behaviour of the lionfish. The system should send signals to the researchers' monitor, identify a pattern from their repeated behaviour and make calculated decisions on their preferences which can inform other areas in the Mediterranean Sea that may be affected in the near future.

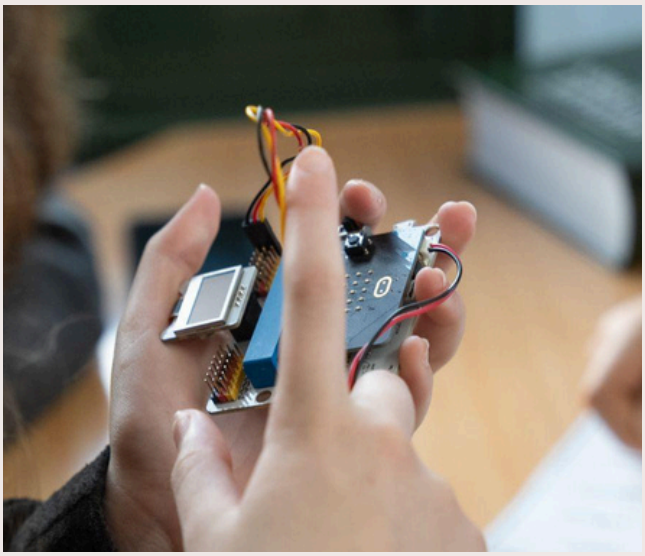
Steps:

1. Each team will need at least two micro:bits for this project.
   - One will be attached to the animal, and the other will be used as a receiver.
2. Open the MakeCode editor.
3. Create a new project.
4. Add the necessary radio extension blocks to your project.
5. Find the block that sets the radio group and set it to 7. This ensures that both micro:bits are using the same group.
6. If you're working in pairs, each pair should choose a unique radio group number from 0 to 255.
7. Use the accelerometer blocks to read the movements of the animal.

Indicative Code:



Source: https://microbit.org/projects/make-it-code-it/animal-tracker/ / https://www.cyprusinteractionlab.com/wp-content/uploads/2024/06/Lesson-4-Animal-tracker_-micro_bit.pdf

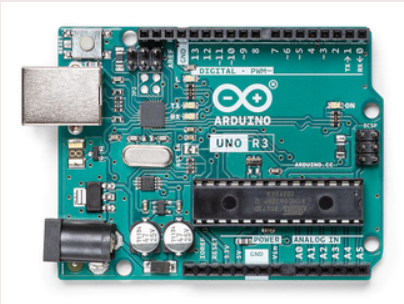


Source: Animal tracker | micro:bit

Create an automatic gate to trap the lionfish using Arduino	Tools (per group): • Arduino UNO • HC SR04 ultrasonic sensor • Servo motor • Jumper wires and a breadboard • USB cable for uploading the code • Arduino IDE software • Recyclable material	30 mins

Create an automatic gate programmed with Arduino that opens and closes when lionfish are detected aiming to trap them (e.g. for bringing them back to their origin or sell them).
Steps:

1. Connect the VCC pin of the ultrasonic sensor with the 5V pin of the Arduino and the GND pin of the ultrasonic sensor with the GND pin of the Arduino.



1. Then join the TRIG pin of the sensor with the digital-10 pin of the Arduino. Attach the ECHO pin with the digital-11 pin of the Arduino.
2. Take a servo motor and connect its positive supply wire with the 5 volts pin of the Arduino. Join the negative supply wire of the servo motor with the GND pin of the Arduino.
3. At last, connect the signal wire of the servo motor with the digital-9 pin of the Arduino.
4. Then power your Arduino UNO so that the components start working.
5. Write your code in Arduino IDE and upload it to Arduino Uno using the USB cable.
6. Use recyclable material to decorate your prototype and create the gate

Indicative code:

```
#include <Servo.h>
Servo servoMain; // Define our Servo
int trigpin = 10;
int echopin = 11;
int distance;
float duration;
float cm;

void setup()
{
servoMain.attach(9); // servo on digital pin 10
    pinMode(trigpin, OUTPUT);
    pinMode(echopin, INPUT);
}

void loop()
{
  digitalWrite(trigpin, LOW);
  delay(2);
  digitalWrite(trigpin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigpin, LOW);
  duration = pulseIn(echopin, HIGH);
  cm = (duration/58.82);
  distance = cm;

  if(distance<60)
  {
    servoMain.write(180); // Turn Servo back to centre position (90 degrees)
   delay(3000);
  }
   else{
     servoMain.write(0);
     delay(50);
   }

}
```

Functionality:

- The ultrasonic sensor is used for sensing the incoming lionfish.
- Once the lionfish passes through the sensor, it will detect the motion and send corresponding signals to the Arduino.
- It will calculate the distance between lionfish and sensor.
- Then the gate will open and after a gap of a few seconds, it will close automatically.
- The motor will move 180 degrees and come back to its initial position once again

Source: Automatic Gate Open Using Arduino and HC SR04 - Techatronic / https://www.cyprusinteractionlab.com/wp-content/uploads/2024/06/Lesson-4-Automatic-Gate-Open-Using-Arduino-and-HC-SR04-Techatronic.pdf

First Round of sharing and testing (~20 mins)

The teacher chooses 1 of the proposed activities for the students to share their prototypes and test them with their peers to provide feedback using the peer-evaluation form.

Prototype refinement | 30 mins

The students return to their teams and make refinements of their prototypes based on the feedback received by their peers. The teacher goes around the groups to facilitate the process.

Second Round of sharing and testing (~20 mins)

The students share their refined prototypes with their peers. The teacher congratulates everyone for their efforts!

Voting for the best prototype (~5 mins)

The students can vote for their favourite prototype and the winning team gets the "Lionfish Innovative Solution Award" (See Annex II).

No time to prototype?

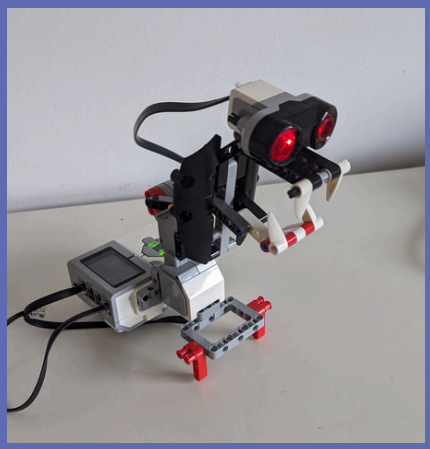
No time to prototype? Alternative: Technology potential demonstration	Tools: • 2 Ready made Lego EV3 robots • Action Plan Showcase Canva A3 (1 per group - See Annex I)	25 mins

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).

Robotic Handle

The robotic gripper is activated when students press the LEGO mindstorm device's action button. The idea is that when the button is pressed, the handle opens and then closes to collect the lionfish.

Aggressive robotic species



The robotic species automatically locates the lionfish using a motion detector, without the need for a user. It is placed in places where lionfish are shown to congregate.

The teacher gives each team one of the two robotic solutions to explore. Students in their teams are asked to interact with the robotic prototypes, to investigate whether they are good solutions or not. This will be done by using the action plan showcase canvas, which in the middle has the photo of the robotic idea from which various aspects of the robotic solution will be studied and derived. The canvas is presented and explained to the students. They are expected to fill in the canvas with the pros and cons of the solutions, how they solve the problem (or not), who else should act, what changes they would make to the existing solutions.

The teacher has the role of coordinator. She/he moves between the groups to listen to the students' thoughts, challenge them and guide them if necessary.

Possible questions

Teacher:
-What do you think about robotic solutions?
-Are they functioning perfectly?
-What are their advantages/disadvantages?

Students:
-The robotic grip is better as the lionfish can be harvested and used for consumption
-What if the robotic species accidentally attacks other species besides the lionfish?
Etc.

Teacher:
-Do you have other ideas for using robots to fight lionfish?
-How could existing robots be modified to act better?

Students:
-We can combine both in a way that the robotic fish kills the lionfish and it is collected by the robotic gripper to be sold to restaurants for consumption
-Robotic fish could have a large stomach where lionfish are trapped after being swallowed but not killed and then harvested by restaurateurs, fishermen, etc.
-They suggest other ideas

Teacher:
-Is the use of robots enough to solve the lionfish problem?
-What else should we do?
-Who else should be involved?

Students:
They refer to fishermen who because of lionfish do not catch as many fish, restaurant owners to convince them to buy and serve lionfish, to the public who need to be convinced of the nutritional values and taste of lionfish to convince them to consume them, advertising companies for the promotion of lionfish with recipes, etc.

If there is time, each team can suggest and make changes to the robots' programming to better serve their purpose.

Presentation and Conclusion:
Each group then presents the canvas they have created by listing the most important elements. The discussion highlights the importance of interdisciplinary collaboration and innovative thinking to address complex environmental challenges such as the lionfish invasion. Students are encouraged to contribute to ongoing efforts to protect marine ecosystems.

RECAP ACTIVITIES

5-15 mins

In the beginning of each lesson, the teacher chooses 1 of the proposed activities to connect the previous lesson with the current lesson.

A pool of recap activities that are applicable to all lessons are presented here. In the beginning of each lesson, the teacher can choose one of the proposed activities. This allows students to revisit and reinforce their understanding of the previous lesson's material, fostering a seamless connection with the current lesson.

Gallery walk	• This activity requires that students in the previous lesson have created a gallery (e.g. hang their creations in the classroom, place them on large tables etc).

While the students' creations or canvases are hung in the classroom, the teacher asks the students to walk around to take a look and refer to what they learnt in the last lesson. They then discuss and clarify any points.

Concept Mapping	Tools: • A3 Concept Map per group (see Annex I) • Markers

Students are given A3 papers in their groups to 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.

Interactive Quiz	Tools: • Kahoot Quiz (example)

Create a quiz or trivia game using platforms like Kahoot!, but instead of straightforward questions, incorporate elements from the previous lesson into puzzles, riddles, or challenges. For instance, if the previous lesson was about physics principles, integrate questions that require application of those principles to solve problems.

Discussion and peer-teaching	Tools: • N/A

The teacher guides a conversation for a review of what has been learnt in the previous lessons. Some prompts for the discussion include:

- Explain what you remember from the past few lessons
- Take turns explaining a key concept from the previous lesson to a partner or small group.
- Discuss with your peers one key takeaway from the previous lesson that stood out to you. How did you arrive at this conclusion, and what questions or insights do you have based on it?
- Let's imagine you're faced with a problem similar to what we discussed in the previous lesson. How would you apply the strategies or concepts we learned to solve it?
- How do you think the concepts we learned in the previous lesson apply to real-life situations? Can you give an example of how you might encounter these ideas outside the classroom?

Discussion and peer-teaching	Tools: • N/A

The teacher guides a conversation for a review of what has been learnt in the previous lessons. Some prompts for the discussion include:

- Explain what you remember from the past few lessons
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- How do you think the concepts we learned in the previous lesson apply to real-life situations? Can you give an example of how you might encounter these ideas outside the classroom?

SHARING ACTIVITIES

15-20 mins

A pool of sharing activities that are applicable to all lessons are presented here. At the end of each lesson or after a specific activity, the teacher can choose one of the proposed activities for the students to present and discuss with their peers their ideas, creations or findings.

Learning Goals:

With the use of sharing activities, the students are expected to:

- Present their ideas and answers with the rest of the class
- Explain and discuss the rationale behind their answers / creations
- Reflect on their answers and ideas
- Exchange ideas with other groups

Sharing activities [At the end of each lesson or after a specific activity, the teacher chooses 1 of the proposed activities for the students to present their ideas, answers, creations or findings]	15-20 mins

Group presentation and discussion	Tools: Optional: • Collaborative writing document • Projector

One or two representatives of each group showcase the group's findings, canvases, ideas, prototypes or thoughts and explain the rationale behind them. The teacher facilitates the discussion and encourages students to share their thoughts and observations. Other groups ask questions and discuss pros and cons of each idea presented. Each time the groups switch, a new representative steps forward, ensuring that every member has the opportunity to share their expertise and insights with their classmates.

Optional: The teacher projects a document where she keeps notes for each group based on the discussion. Alternatively, a shared writing document template is given to students where they collaboratively share feedback.

Gallery exhibition	Tools: • Tape

Every group proudly displays their canvases/activity sheets on the classroom wall. In a dynamic and interactive session, group members engage in a collaborative exchange of ideas by rotating among the displayed projects. Each group warmly welcomes their peers, sharing insightful explanations about their discoveries and the underlying thought processes that led to their innovative solutions. Each time the groups switch, a new representative steps forward, ensuring that every member has the opportunity to share their expertise and insights with their classmates. The teacher also goes through all groups to check on their ideas, initiate discussion about the film, its significance, and the challenges faced by the ecosystem.

Online gallery exhibition	Tools: • Online space for sharing results (school's website, FB group, class online community)

Every group captures a snapshot (or screenshot in case the previous activity took place online) of their findings, canvases, ideas, prototypes or thoughts and contributes it to a dedicated online community, carefully curated by the teacher. Accompanying their visual representation is a brief description provided by each group, providing context to their innovative solution/idea. Peers are warmly invited to explore these digital galleries, actively engaging in a collaborative exchange by commenting on their classmates' ideas. The teacher facilitates an online discussion and encourages students to share their thoughts and observations.

Digital presentation	Tools: • Digital presentation tool: • Sway • PowerPoint • Google Slides • Prezi • Other • 1-2 PCs per group

Students work in their groups to prepare a presentation of their final product/ideas/findings, using a digital presentation tool. The teacher shares a table of contents with the main information required when pitching their product/ideas to an audience (how did they make their product, what are the thoughts behind it etc.). Each group presents and demonstrates their artefact to the others. Discussion is made around their product/findings/ideas. Additionally, students will be asked to take photos and/or videos of their product/findings in action, or they can choose to live demonstrate it in front of the audience.

ANNEX 1 - CANVASES

ACTION PLAN SHOWCASE

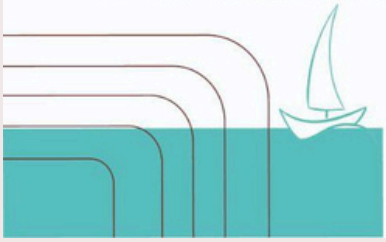
Sketch the proposed solution.

BENEFITS OF THE SOLUTION	POTENTIAL PITFALLS OF THE SOLUTION

Describe how the solution contributes to the issue of the lionfish.

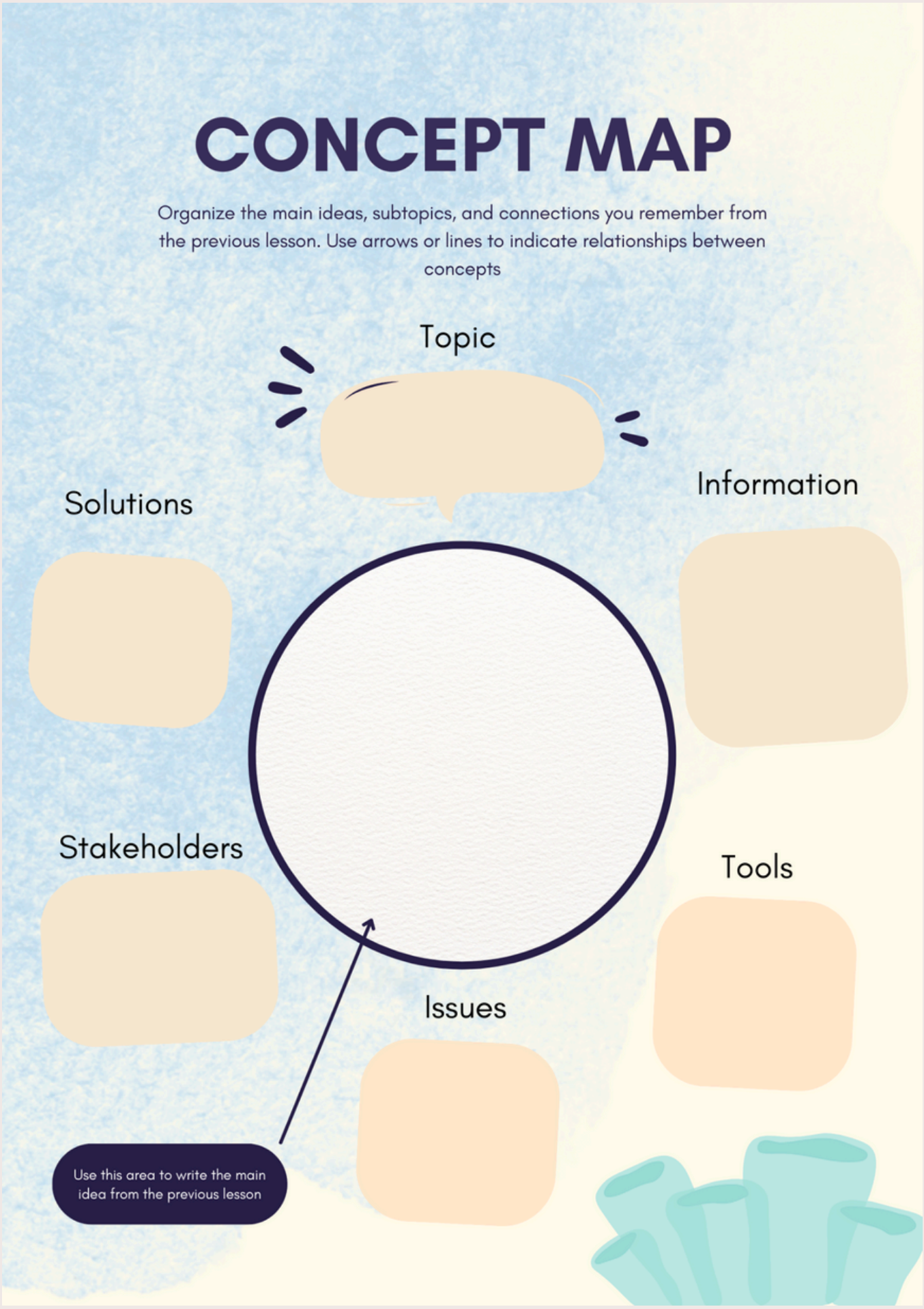
What would you change to make this solution more effective?

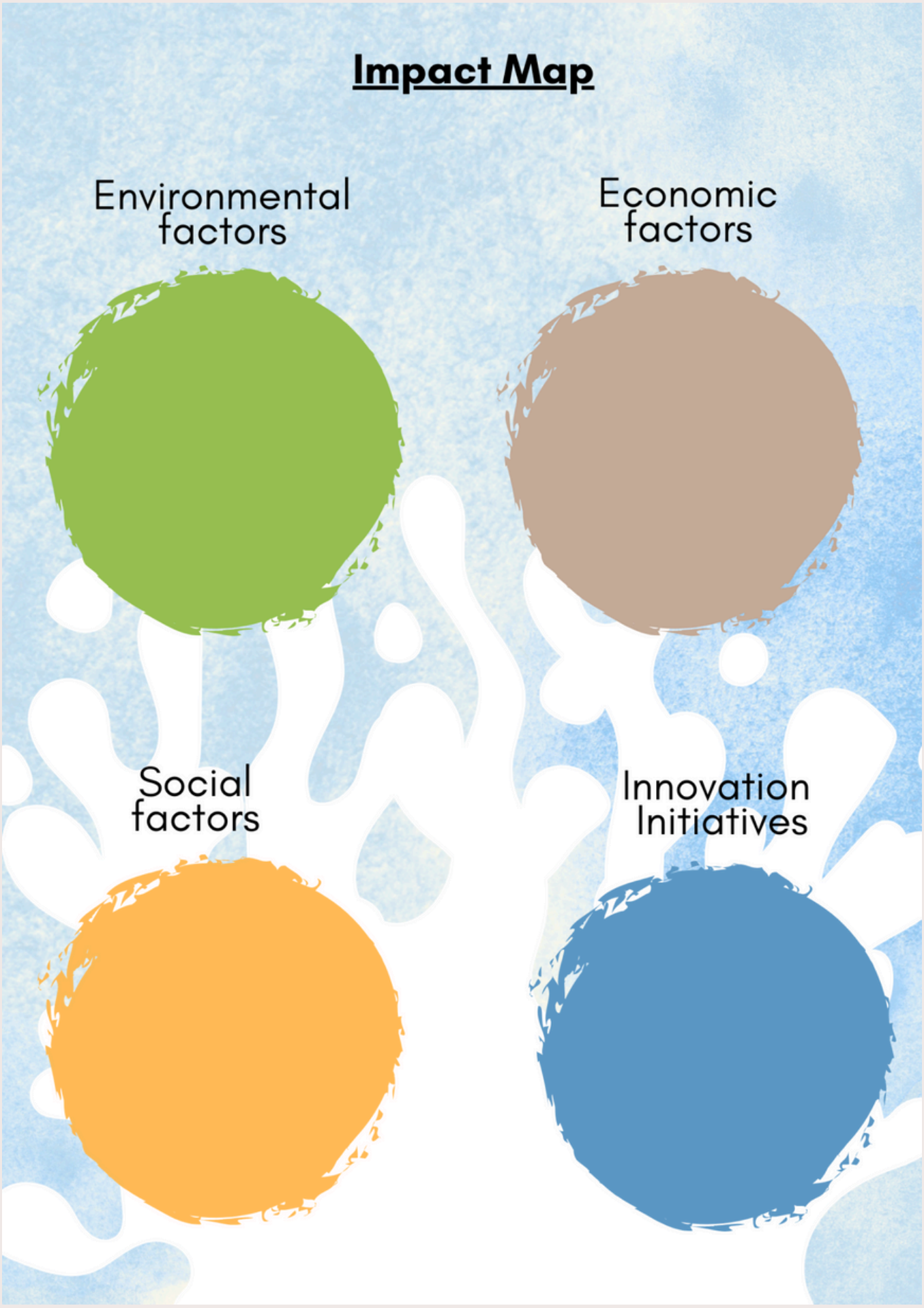
Who else is affected by the proposed solution?



CONCEPT MAP

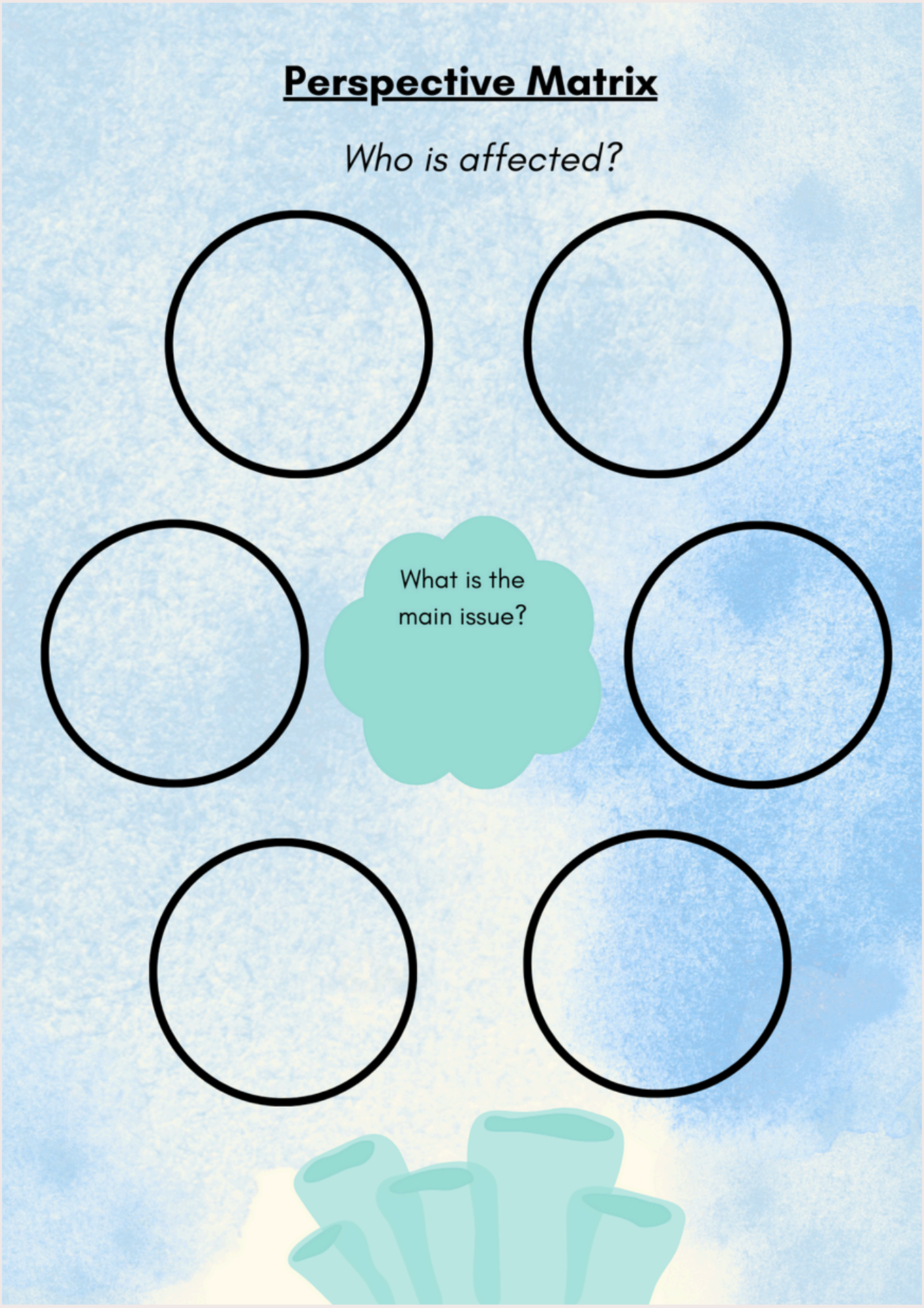
Organize the main ideas, subtopics, and connections you remember from the previous lesson. Use arrows or lines to indicate relationships between concepts




Impact Map
Environmental factors
Economic factors
Social factors
Innovation Initiatives

Perspective Matrix

Who is affected?



Triangular Problem

How can technology help?

What is the issue?

Are lionfish linked to any climate change issues or challenges?

How do lionfish affect the Cyprus seas?

Notes:

ANNEX 2 - ACTIVITY SHEETS AND OTHER LESSON VISUAL MATERIAL

CYPRUS POISONOUS FISH

Fish I heard of before

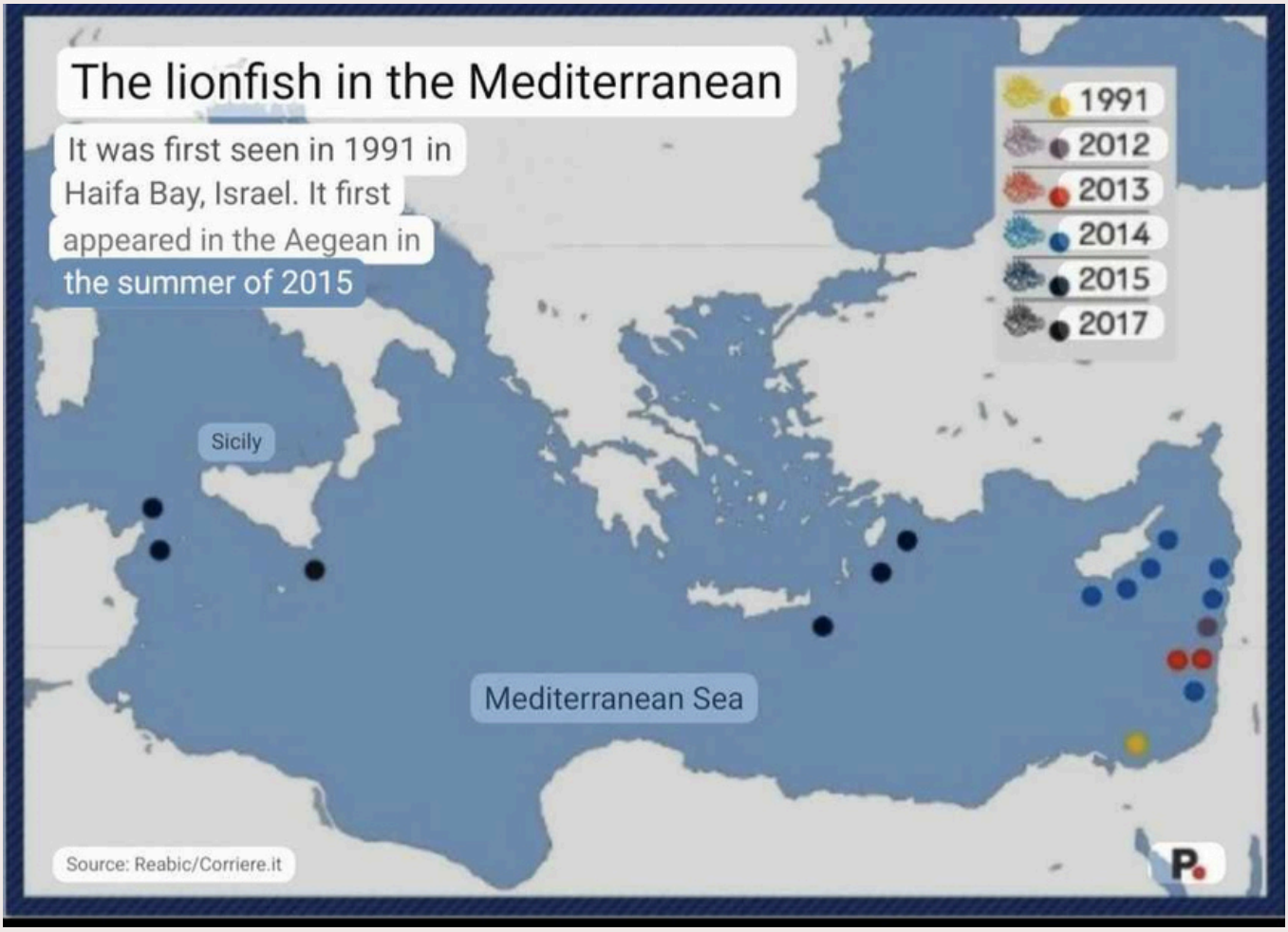
Fish I haven't heard of before

Fish I ate before

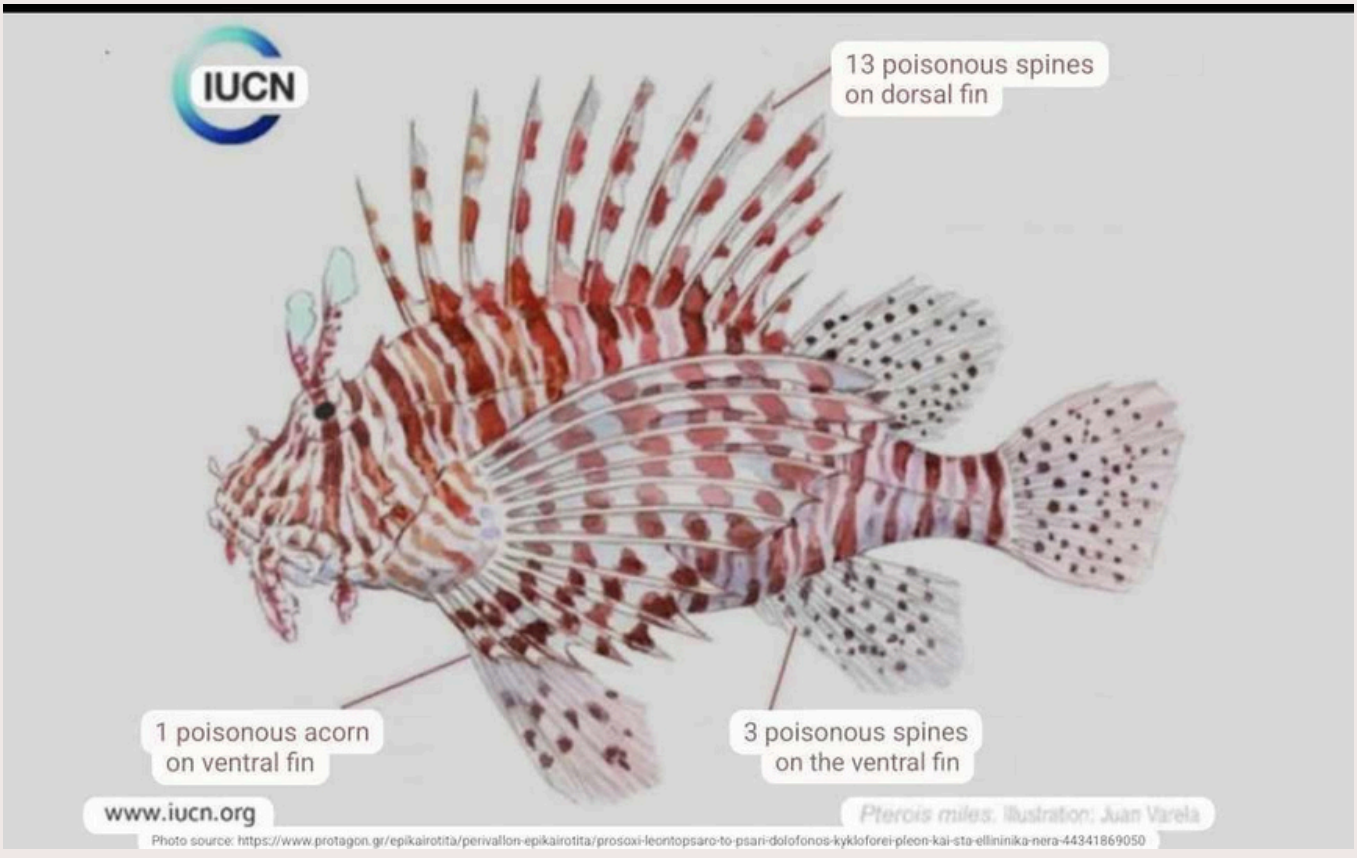
Sources

Poisonous marine organisms in the waters of Cyprus. Link.

Lesson 1. Activity Sheet 1



Lesson 1 Figure 1: Map with movement of lionfish



Lesson 1 Figure 2. Lionfish Morphology

Lesson 1 Figure 3.

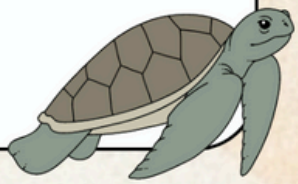
Lesson 1 Figure 4.

Lesson 1 - QR Code to access fish document

Lesson 1. Lionfish photo Photo by Denys Razumovskyi: Lesson 1 - QR Code to access fish document

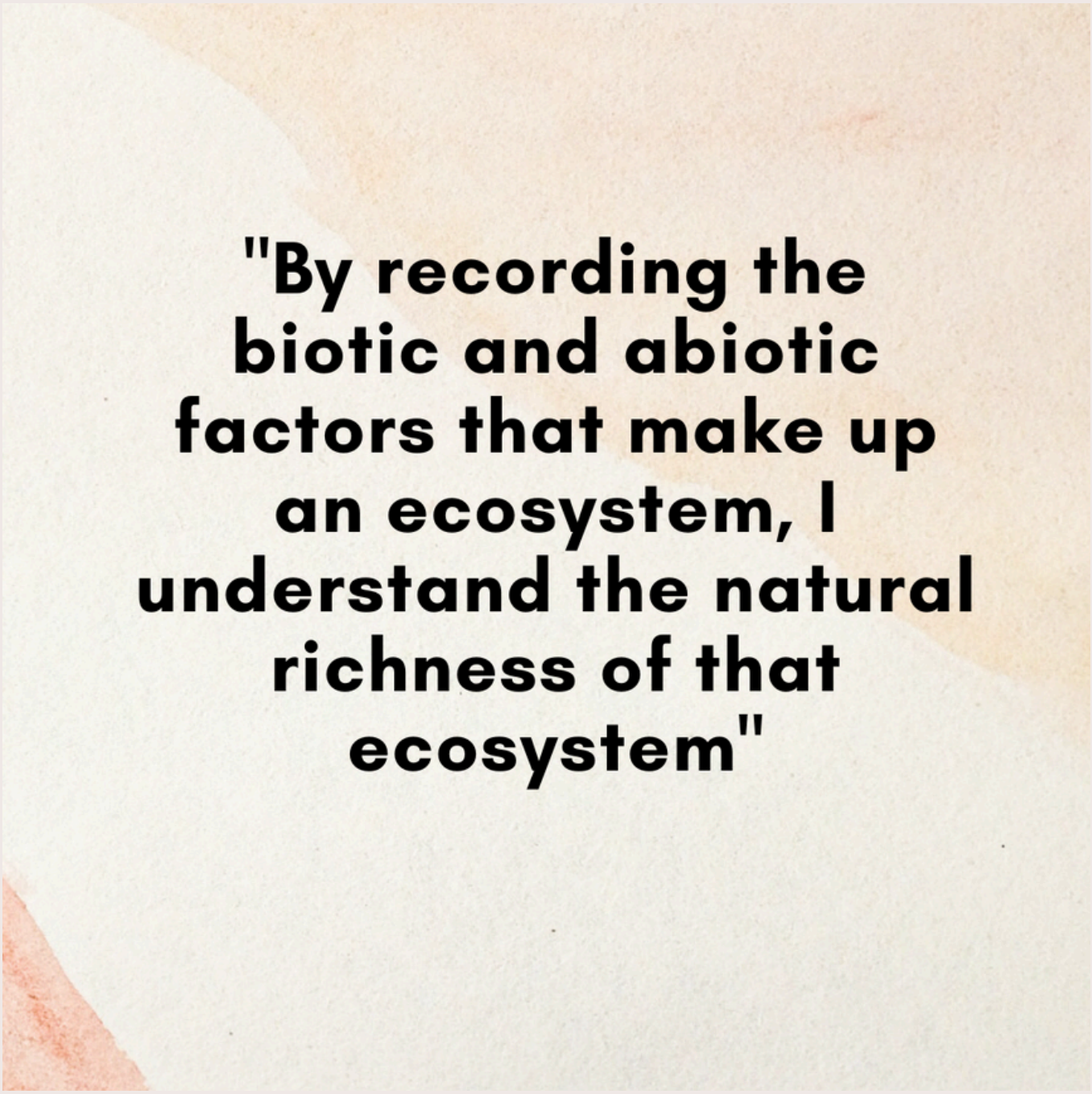
Biotic and Abiotic factors of the coast

Biotic factors



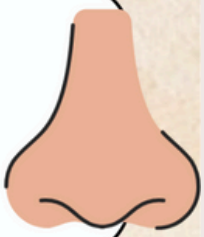
Abiotic factors

Lesson 1. Biotic and Abiotic factors worksheet

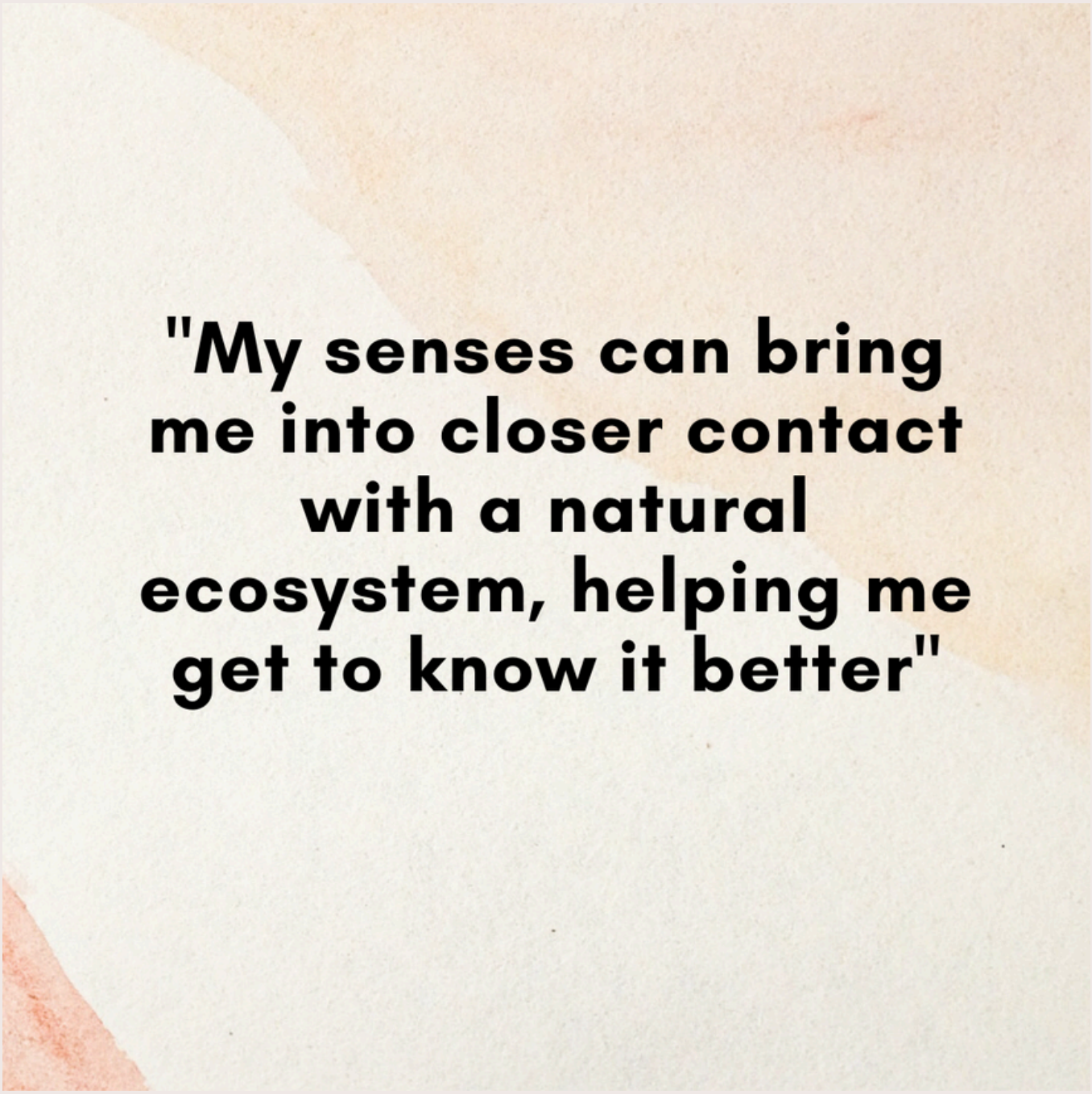


Lesson 1. Biotic and Abiotic factors message

Sense Game



Lesson 1 Sense Game worksheet



Lesson 1: Printed senses message

Lesson 2 - Activity 1. QR Code to scan for access to sources

Exploring the

Lionfish

APPEARANCE

ARRIVAL IN CYPRUS

ORIGIN

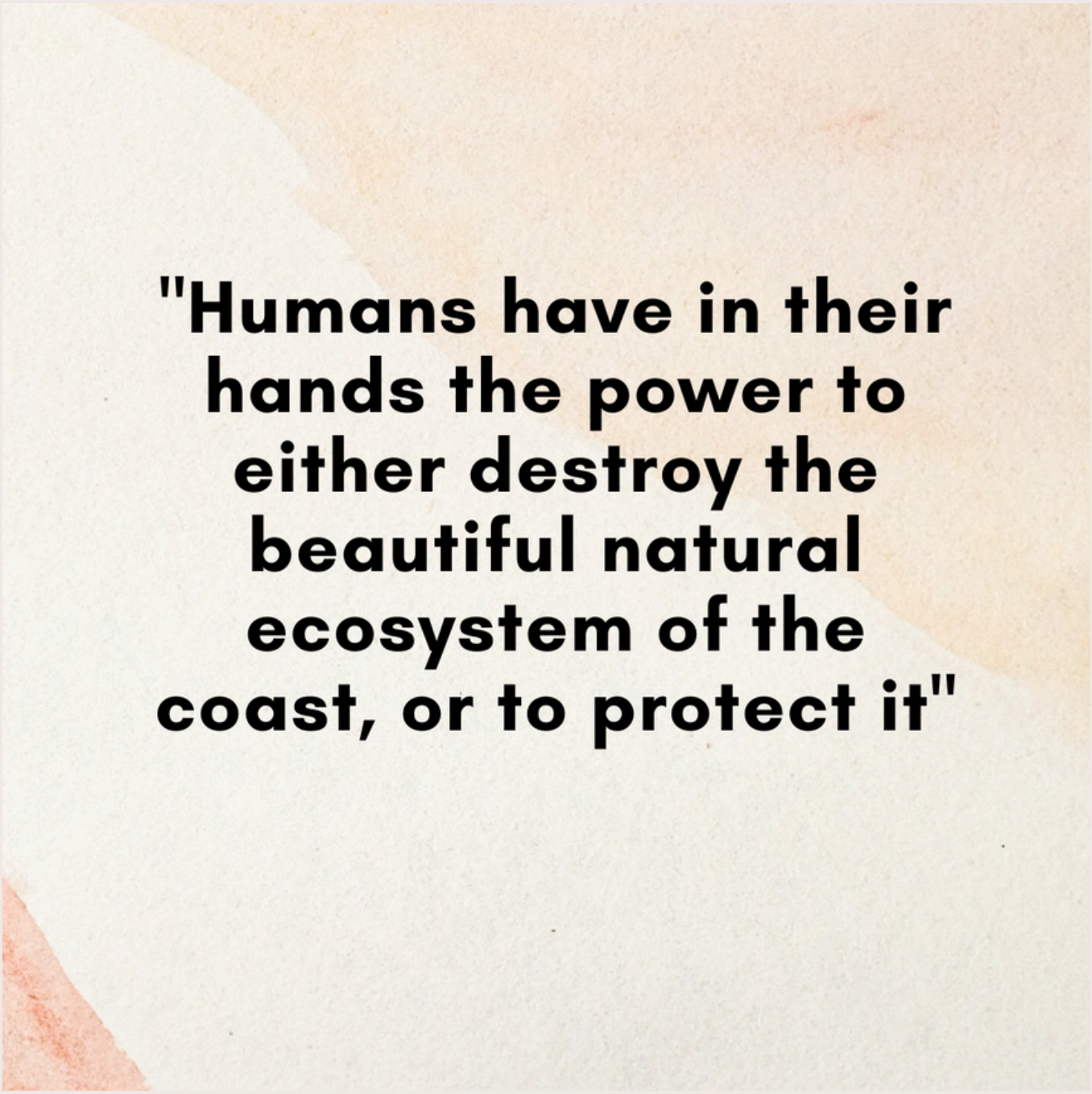
ATTRACTED TO

ATTRACTED FROM

ALIMENTATION PREFERENCES

OTHER

How many eggs do they lay?
How long do they live?
How can we catch them?
Can we eat them?
Are they dangerous for the Mediterranean?



Lesson 4. Printed Message for humans

Lesson 4. Lionfish Innovative Solution Award

ACKNOWLEDGEMENTS

Lionfish

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

CYENS CENTRE OF EXCELLENCE

Foxmedia

Special thanks to the Cyprus Center for Environmental Research and Education (CYCERE), Akrotiri - Limassol