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General Fisheries
Commission for
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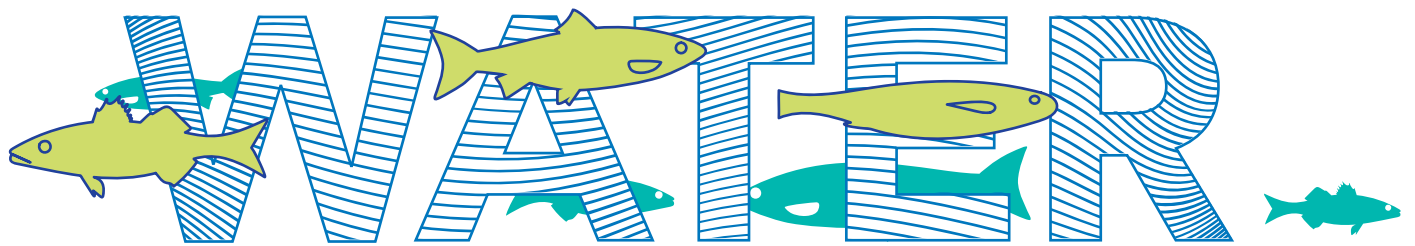
Education toolkit for the
Blue Transformation of aquaculture in
the Mediterranean and the Black Sea



Funded by the
European Union



FARMERS OF THE



Education toolkit for the Blue Transformation of aquaculture in the Mediterranean and the Black Sea

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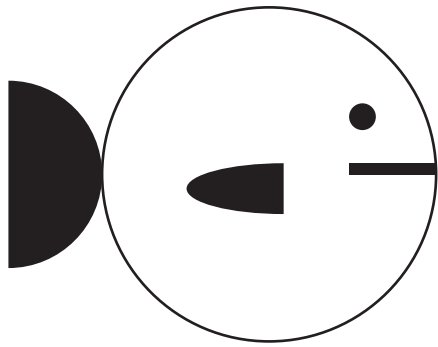
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Preparation of this document

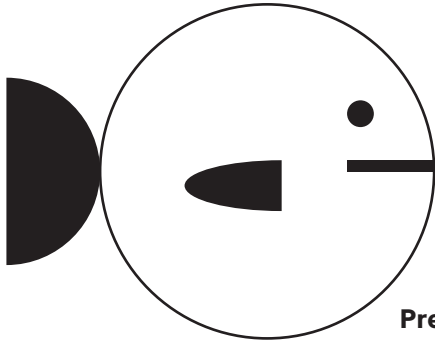
This publication presents an education journey on Blue Transformation in aquaculture for students of the Mediterranean and Black Sea region. It was prepared by the General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO) with inputs from students and teachers across the region who tested the activities and provided their feedback.

This educational toolkit was developed as part of a wider GFCM initiative, within the framework of the Scientific Advisory Committee on Aquaculture (CAQ), to stimulate learning and promote the social acceptability of the aquaculture sector. It is complemented by other tools, such as the *Guidelines in support of social acceptability for sustainable aquaculture development*, the guide *Farmed aquatic food for all tastes: the journey of twelve Mediterranean and Black Sea species from farms to your plates*, and initiatives, such as the empowerment programme for young women in aquaculture.

Divided into three units for teachers, students ages 5–18 and students ages 13–18, this toolkit highlights the environmental, social and economic benefits of farmed aquatic food systems with activities centered around enjoyable learning, teamwork and critical thinking. It is designed as a user-friendly tool to stimulate interaction and its format with black and white pages allows for easy photocopying and printing, thus providing another chance for students to express their creativity.

The materials were prepared by Eleni Svoronou. Technical coordination was ensured by Houssam Hamza (Aquaculture Officer), with the support of GFCM experts, namely Georgios Paximadis (Specialist on Aquaculture), Linda Fourdain (Marine Aquaculture Expert), Maissa Gharbi (Aquaculture Consultant) and Sindi Simeonova (Aquaculture Information Management Specialist).

The publication was managed by Alexandria Schutte (Publications Specialist), in coordination with Ysé Bendjeddou (Publications Coordinator) and under the supervision of Dominique Bourdenet (Knowledge Management Officer). Graphic elements were created by Xara Marantidou and Fani Peroni-Chalkia of MULO creative lab, while the graphic design, cover and layout were handled by Yamrote Alemu.



Contents

Preparation of this document	iii
Foreword	vii
Acknowledgements	viii
Introduction	1

UNIT 1	The adult's guide to sustainable aquaculture	9
	Overview of the aquaculture sector	10
	Sustainability	13
	Socioeconomic dimension	16

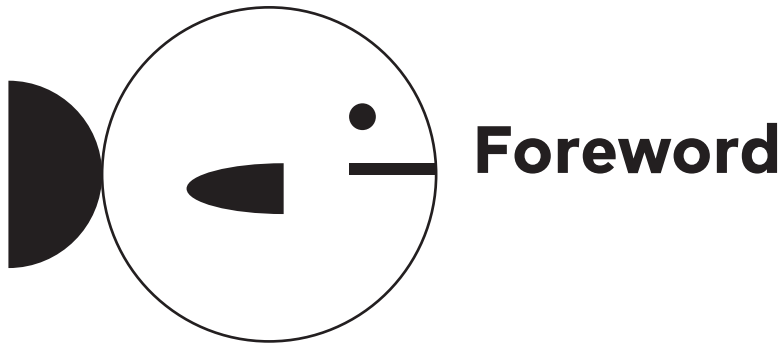
UNIT 2	The fingerling's foray into sustainable aquaculture	17
	Activity 1. A fish called "yam yam"	18
	» Activity sheet 1.1	20
	» Activity sheet 1.2	21
	Activity 2. A day at the fish market	24
	» Activity sheet 2.1	26
	» Activity sheet 2.2	29
	Activity 3. Where does it come from?	32
	» Activity sheet 3.1	34
	» Activity sheet 3.2	35
	Activity 4. What's on their mind?	36
	» Activity sheet 4.1	38
	Activity 5. Roll the dice	40
	» Activity sheet 5.1	42
	Activity 6. How did it start? Where will it go?	44
	» Activity sheet 6.1	45
	» Activity sheet 6.2	51
	Activity 7. Aqua games	54
	» Activity sheet 7.1	56
	» Activity sheet 7.2	59

Activity 8. A trip to the Kuriat Islands	60
»● Activity sheet 8.1	62
»● Activity sheet 8.2	63
»● Activity sheet 8.3	64
Activity 9. A zero-waste farm	66
»● Activity sheet 9.1	68
Activity 10. Discussion room	70
»● Activity sheet 10.1	72
Activity 11. Campaigners for sustainable development	74
Activity 12. Geography matters	76
»● Activity sheet 12.1	78
Activity 13. Aquaculture at school	80

UNIT 3

The juvenile's journey into sustainable aquaculture 81

Activity 1. Your group, your power	82
»● Activity sheet 1.1	83
Activity 2. Empathize: understanding the target audience	84
»● Activity sheet 2.1	86
»● Activity sheet 2.2	88
Activity 3. Define: setting the goal of the campaign	90
»● Activity sheet 3.1	91
Activity 4. Ideate: reaching for the sky	94
»● Activity sheet 4.1	95
Activity 5. Prototype: trying the idea at the small scale	96
»● Activity sheet 5.1	97
Activity 6. Implement: launching the campaign	100
»● Activity sheet 6.1	101
»● Activity sheet 6.2	102
References	104
Glossary	108
Appendix 1	110
Appendix 2	112
Appendix 3	114



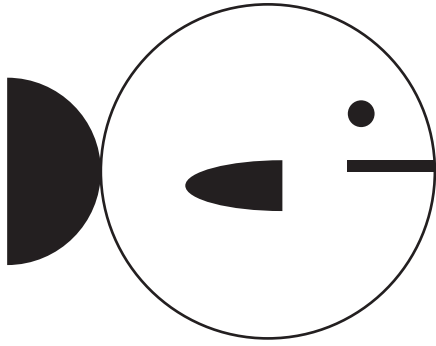
Farmers of the water: education toolkit for the Blue Transformation of aquaculture in the Mediterranean and the Black Sea is a one-of-a-kind guide designed to take teachers and students on a journey to discover the aquaculture sector throughout the Mediterranean and the Black Sea.

Created for students and teachers, this toolkit stands out due to the collaborative approach used during its preparation; the activities contained within were tested during a pilot phase that involved a number of schools across the region. Its aim is to provide a progressive and enjoyable learning experience on a topic whose benefits are not always well known. By working through the activities in the toolkit, students will uncover the critical role of aquatic food production in ensuring food security, creating jobs, fostering economic development, and supporting the wellbeing of people and communities. They will also become equipped with the necessary tools to consume responsibly, while gaining an appreciation for the considerable efforts made by aquaculture farmers in producing sustainable, healthy and affordable aquatic foods.

Within its 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea, the GFCM has highlighted the importance of improving the perception of aquaculture to ensure the competitiveness, resilience and social acceptability of the sector as well as to support the provision of healthy and affordable proteins to consumers. Central to the long-term social acceptability of sustainable aquaculture are the consumers of tomorrow.

This publication aligns with FAO's Blue Transformation vision, its Strategic Framework and its commitment to achieve better production, better nutrition, a better environment and a better life, leaving no one behind. More broadly, it supports efforts towards attaining the United Nations Sustainable Development Goals and harnesses the potential of youth to transform agrifood systems in alignment with these objectives.

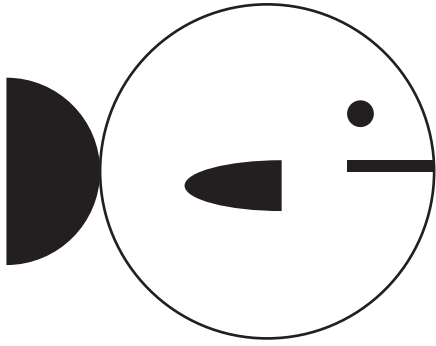
The GFCM encourages students and teachers in the Mediterranean and Black Sea region to embark on this educational journey and discover their important role in shaping a sustainable future.



Acknowledgements

The pilot-testing phase for this publication was crucial in shaping the effectiveness and relevance of the activities contained within and many thanks are due to the teachers and students that were involved in this process. Namely those from Groupe Scolaire El-Bassatine, Farabi School, École Primaire Menzel Khyr, École Hôtelière de Monastir, Association Générale des Insuffisants Moteurs Medenine, Lycée Fatouma Bourguiba and Lycée Pilote Monastir, all located in Tunisia, as well as Golden Modern School in Egypt and Al Berdawni-Zahle Public School in Lebanon. Together, they contributed to creating a publication that responds to modern educational needs and classroom experiences, and reflects the issues that are important to communities in the region.

Warm thanks are extended to Lahsen Ababouch (Senior Consultant), Ibrahim Al Hawi (Chairperson of the Scientific Advisory Committee on Aquaculture) and Mohamed Elaraby (Vice-Chairperson of the Scientific Advisory Committee on Aquaculture) for their valuable inputs and review of the material. Their guidance helped to strengthen the technical components of the toolkit, ensuring that it provides a comprehensive picture of the aquaculture sector in the region. Special appreciation goes to Notre Grand Bleu association for its contributions, for sharing its experiences with aquaculture educational programmes for youth, and for providing the videos used in Appendixes 2 and 3, thus enhancing the contents of this publication.



Introduction

In the Mediterranean and Black Sea region, the farming of aquatic organisms, such as fish, molluscs, crustaceans and other invertebrates, also known as aquaculture, has considerable environmental, social and economic significance (FAO, 2022). This sector provides jobs, economic stimulus and food while helping to ensure that wild stocks are fished within their maximum sustainable yield.

However, these benefits are not always well known and misconceptions persist (Bacher, 2015). In this regard, stakeholders in the region are working towards a Blue Transformation of the sector to expand the positive contributions of aquatic foods systems. In parallel to this transformation, the General Fisheries Commission for the Mediterranean (GFCM), a regional fisheries management organization with a mandate on fisheries and aquaculture, is working to improve knowledge of the benefits of the sector and its overall social acceptability, as highlighted in its 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea. Guiding these efforts is FAO's Strategic Framework which strives for better production, better nutrition, a better environment, and a better life, leaving no one behind.

As part of this work, the GFCM presents the environmental education toolkit *Farmers of the Water: Education toolkit for the Blue Transformation of aquaculture in the Mediterranean and the Black Sea*, designed to take students ages 5–18 of the Mediterranean and the Black Sea (and indirectly their families) on a journey to discover the benefits of the aquaculture sector in the region, the importance of a Blue Transformation, and the role that aquaculture plays in the achievement of the United Nations Sustainable Development Goals (SDGs).

At first glance, this may seem to be a technical subject more appropriate for vocational training; however, aquaculture can be a relevant, attractive and fun area of investigation for all ages:

- Children can explore and develop enthusiasm for science and sustainable development.
- Adolescents can discover potential career paths in the aquaculture sector.
- Teachers can effectively present the complex notion of food security, sustainable development, and Blue Transformation in an accessible way using sustainable aquaculture as a case study.

By providing opportunities to engage with aquaculture, this publication empowers students to become critical thinkers, responsible citizens and informed consumers – all while having fun and expressing their creativity.

Box 1. Aquaculture: a growing sector in the Mediterranean and the Black Sea

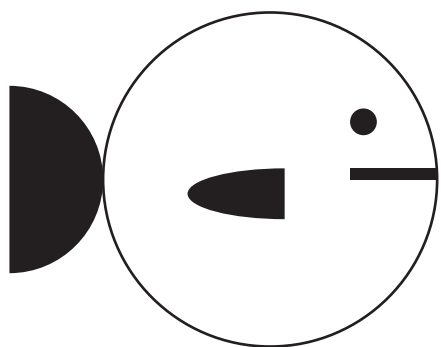
Aquaculture is an active and growing sector in the Mediterranean and the Black Sea. It is playing an increasingly important role in food security, employment and economic development, while also providing a way to increase aquatic food production without exceeding the natural productivity of wild stocks. In 2021, Mediterranean and Black Sea farms produced almost 3.3 million tonnes of aquatic foods; and marine and brackish water farms alone generated USD 4.9 billion and directly employed over 97 000 people (FAO, 2023).

From a blue economy perspective, aquaculture holds strategic importance and is a key target for future development in coastal communities across the region. If managed and governed effectively, it could provide multiple socioeconomic benefits.

Numerous stakeholders in the region, including the General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO), are working towards the Blue Transformation of Mediterranean and Black Sea aquaculture in order to create a fair and sustainable sector that is productive, profitable and globally competitive.

Source: FAO. 2023. *The State of Mediterranean and Black Sea Fisheries 2023 – Special edition*. General Fisheries Commission for the Mediterranean. Rome. <https://doi.org/10.4060/cc8888en>





The education journey

This learning journey is designed with respect to students' needs and is divided into three units:

- Unit 1. The adult's guide to sustainable aquaculture, intended for teachers;
- Unit 2. the fingerling's foray into sustainable aquaculture, intended for students ages 5–18; and
- Unit 3. the juvenile's journey into sustainable aquaculture, intended for students ages 13–18.

Unit 1 provides teachers with relevant, background knowledge on the aquaculture sector in the Mediterranean and the Black Sea, including its sustainability and socioeconomic dimensions. Unit 2 emphasizes learning about aquaculture through play, while Unit 3 is a continuation of the learning journey for older students and highlights teamwork and campaigning for a social cause. Together, Units 2 and 3 will take students from a point of limited knowledge about aquaculture to a solid understanding of the sector where they feel comfortable taking action to share their knowledge with their peers.

Unit 1. The adult's guide to sustainable aquaculture

This unit is addressed to teachers and presents a well-rounded picture of aquaculture in the Mediterranean and the Black Sea region, highlighting its various dimensions. The objective is to provide teachers with a thorough comprehension of the sector to help them effectively guide students on an educational journey. In particular, this unit dives into the historical dimensions of aquaculture in the region, common farming practices, the sustainability of the sector and relevant socioeconomic aspects.

Additional resources are provided within the instructions for each activity to offer teachers more thorough insight into relevant topics.

Unit 1 at a glance

1. Overview of the aquaculture sector

Introduction to the history, practices and public perception of aquaculture

2. Sustainability

Exploration of the sustainability of aquaculture and the ongoing Blue Transformation

3. Socioeconomic dimension

Description of the economic impacts of aquaculture and its potential to support livelihoods

Unit 2. the fingerling's foray into sustainable aquaculture

This unit is aimed at students ages 5–18 and their teachers. It highlights the ongoing Blue Transformation of aquaculture by establishing a basic understanding of the concept and showcasing the multiple dimensions of sustainable aquaculture. The objective of this stage of the education journey is to help students develop critical thinking, skills to make informed consumer choices and positive attitudes towards the sector.

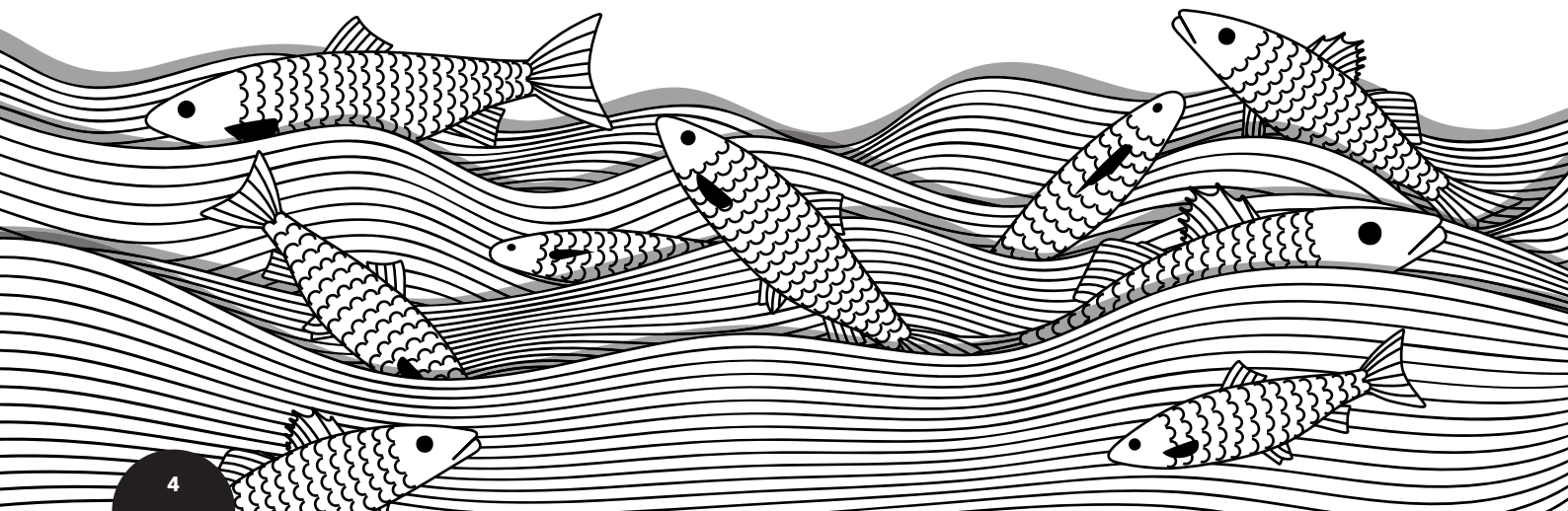
The emphasis is on the three dimensions of sustainability: environment, society and economy. Technology and innovation are also highlighted within the activities. It consists of 13 activities aimed at increasing students' knowledge, awareness, and critical and systemic thinking about the aquaculture sector. Each activity consists of a one- or two-page description for the teacher and one or more activity sheets for students.

Teachers should read all of the activities in advance and tailor the education journey as necessary, either by performing all activities or selecting those that best suit their students' needs. The activities do not need to be performed in a specific order.

While most activities are best suited to students ages 8 and older, they can all be adapted for younger students (see Appendix 1 for suggested adaptations).

The duration of a given activity can be shortened or expanded depending on the length of discussions, students' interest and time constraints.

Connections to existing curriculum are not mentioned here because of the wide variety of curricula around Mediterranean and the Black Sea countries. However, it is possible to connect the activities to one or more subjects including languages, history, mathematics, physics, art and technology.



Unit 2 at a glance

1. A fish called “yam yam”

Duration: 45 minutes

Introduction to aquaculture and the idea that fish can be tasty, healthy and sustainable.

2. A day at the fish market

Duration: 3 hours

Exploration of aquaculture and its importance, complemented by a visit to a local fish market.

3. Where does it come from?

Duration: 45 minutes

Evaluation of the links between aquaculture, the environment and society, as well as the rights of consumers to information.

4. What’s on their mind?

Duration: 45 minutes

Discovery of public attitudes towards aquaculture through interviews.

5. Roll the dice

Duration: 2 hours

Analysis of interview results from Activity 4 and overview of the connection between the SDGs and aquaculture.

6. How did it start? Where will it go?

Duration: 2 hours

Discovery of the origins of aquaculture and the sector’s possible future.

7. Aqua games

Duration: 45 minutes to 2 hours

Investigation of plant and non-fish aquatic organism aquaculture and the role of aquaculture as a nature-based solution.

8. A trip to the Kuriat Islands

Duration: 2 to 3 hours

Exploration of the link between aquaculture and biodiversity conservation through a case study.

9. A zero-waste farm

Duration: 45 minutes

Review of key species for sustainable aquaculture and introduction to zero-waste farming. .

10. Discussion room

Duration: 45 minutes

Assessment of the potential benefits and downsides of aquaculture through a debate.

11. Campaigners for *sustainable development

Duration: 45 minutes

Opportunity to apply knowledge and raise awareness about the benefits of aquaculture.

12. Geography matters

Duration: 30 minutes

Investigation of the connections within the Mediterranean and Black Sea region.

13. Create your own farm

Duration: varies based on size and complexity of farm

Application of knowledge about aquaculture practices through the construction of an aquaculture farm.

Unit 3. The juvenile’s journey into sustainable aquaculture

This unit is not addressed to the teacher. Instead, it is addressed to students ages 13 and older, with the possibility to present it to younger students, depending on the degree of experience they have with teamwork. During this stage of the journey, students will use the knowledge that they gained in Unit 2 and will act as campaigners to promote sustainable aquaculture to their peers and the school community.

Students can work as a team or the entire class can participate in subteams of five to six students, and they should organize themselves following the instructions in each activity. Meanwhile, the teacher’s role is to set the tone, monitor their progress and provide support when needed. As students become acquainted with the activities, the teacher should gradually step back.

Students can work through all activities or the teacher can select a smaller number that best suits time constraints to give students an idea of what is at stake in aquaculture and motivate them to become campaigners. In this case, the most appropriate activities are Activity 4 and Activity 5.

While designing their campaign, students will have an opportunity to employ a methodology that can be very useful for their post-secondary school life (Figure 1). Known as design thinking, this methodology has become popular in both the private and public sectors. It is a methodology that allows innovative ideas to emerge and be tested. They will also practice their leadership, teamwork and communication skills as well as learn how to design a campaign, target consumers’ behaviors, measure success and adapt strategies based on results.

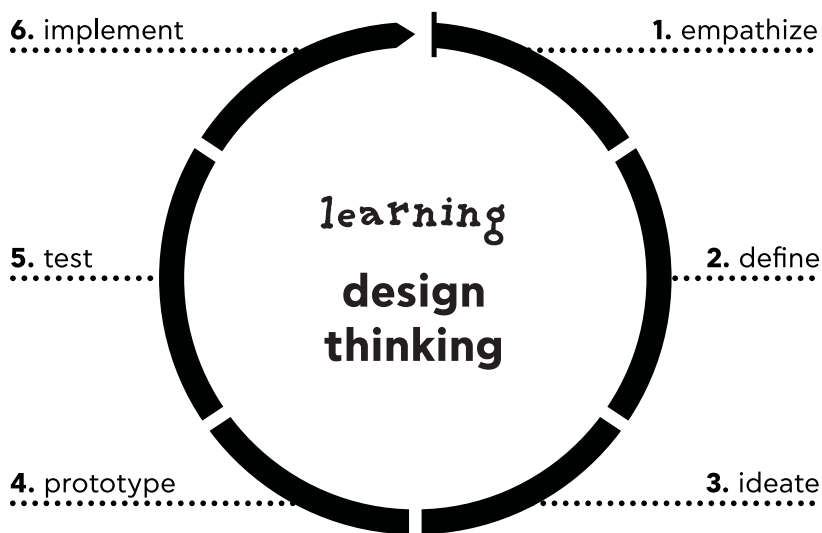
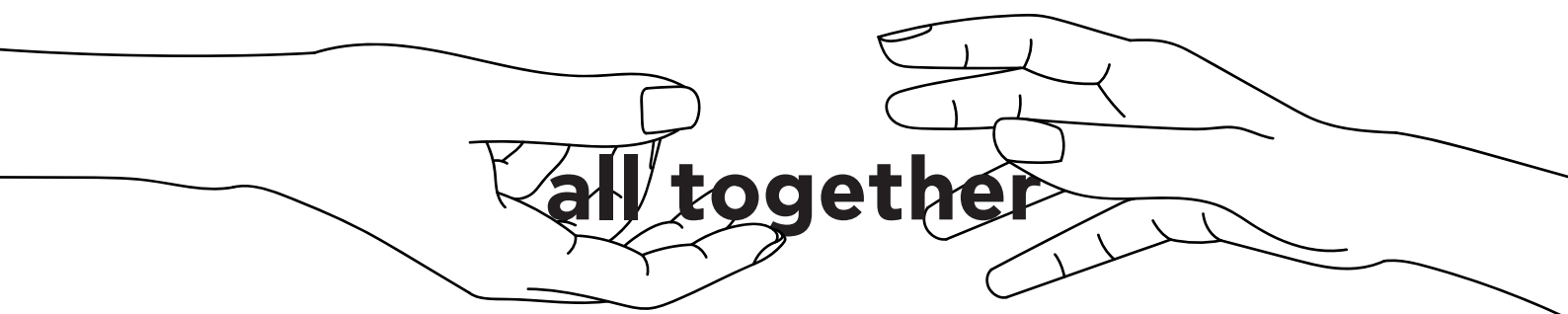


Figure 1. Design thinking methodology

Source: Adapted from Interaction Design Foundation. 2016. What is Design Thinking? In: Interaction Design. [Cited 9 October 2024]. <https://www.interaction-design.org/literature/topics/design-thinking>

If the teacher plans to run the project to more than one grade, or even for the whole school, there will be many more possibilities. The activities from Unit 2 can be combined with the methodology from Unit 3 to create tailored learning and active citizenship journeys according to the needs of each grade. It is also possible to create a puzzle out of this material, the pieces of which can be distributed to classes and teams. A whole school approach is always the recommended recipe for achieving better results in environmental education. Appendix 2 highlights examples of aquaculture education initiatives that have been implemented in the Mediterranean and the Black Sea to complement the teachings in this toolkit.



Unit 3 at a glance

1. Your group, your power

Duration: 30 minutes

Introduction to the design thinking methodology.

2. Empathize: understanding the target audience

Duration: 90 minutes

Discovery of the target audience's point of view through interviews.

3. Define: setting the goal of the campaign

Duration: 60 minutes

Determination of the goal of the campaign.

4. Ideate: reaching for the sky

Duration: 60 minutes

Investigation of possible answers to the "how might we" question.

5. Prototype: trying the idea at the small scale

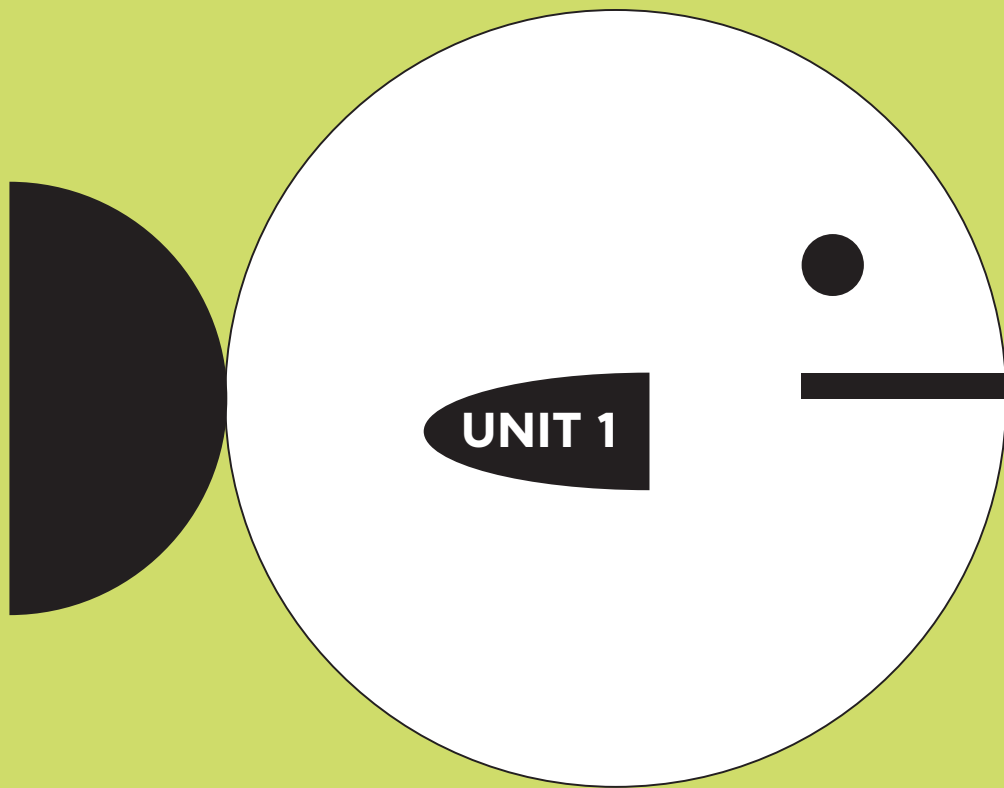
Duration: 60 minutes

Construction of three-dimensional models of the chosen solution and storyboards.

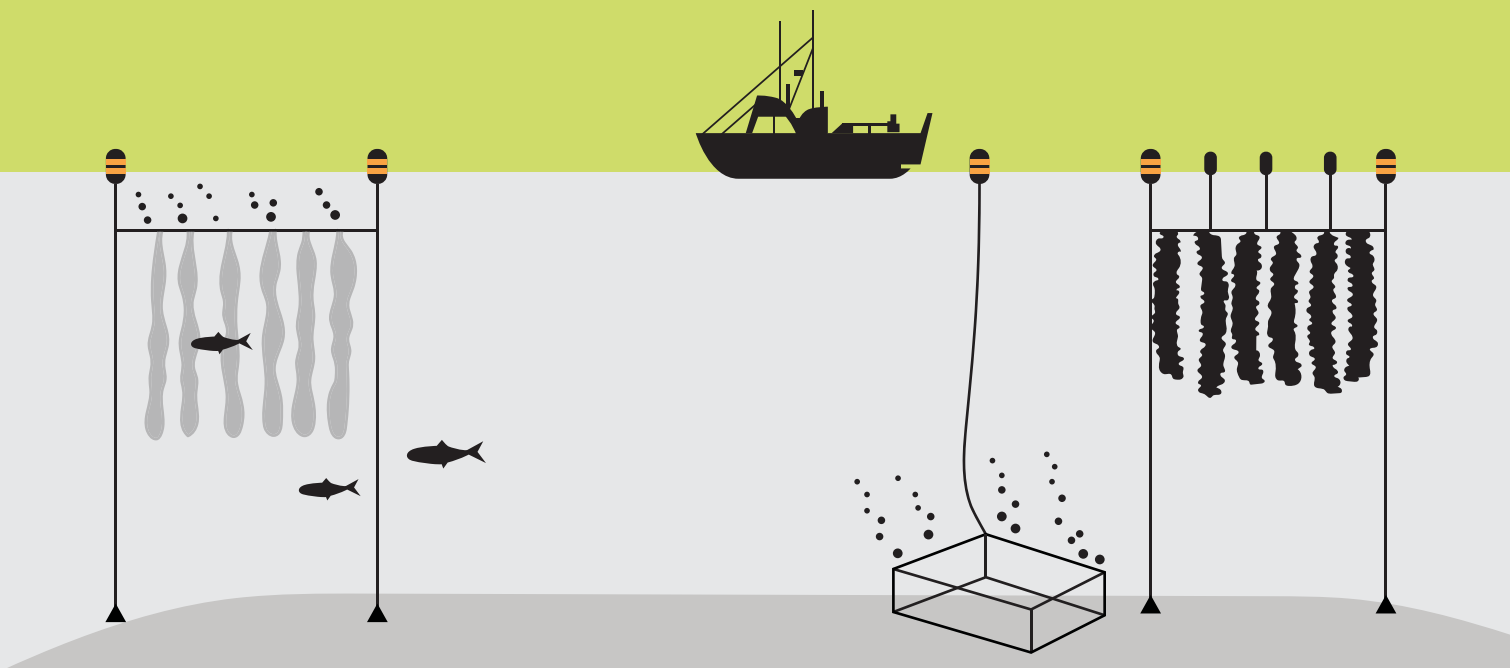
6. Implement: launching the campaign

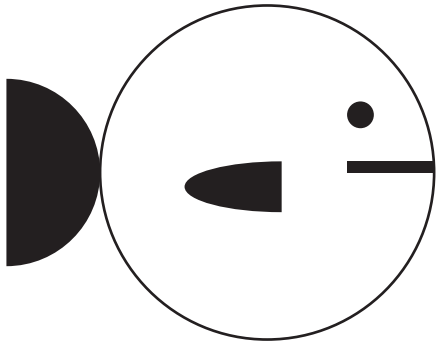
Duration: 60 minutes

Preparation of a plan and launch of the campaign.



The adult's guide to sustainable aquaculture





Overview of the aquaculture sector

This unit contains information about the aquaculture sector and aims to provide background knowledge about the subject. More specific information and links are provided within Unit 2 and Unit 3 activities.

Background

Aquaculture – the farming of aquatic organisms (Box 2) – involves the breeding, rearing and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes and oceans. Farming also implies some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, or protection from predators, as well as individual or corporate ownership of the stock being cultivated (FAO, 2022). The organisms are largely destined for direct human consumption, but a portion of them is used in a range of pharmaceutical, cosmetic and biotechnological applications (FAO, 2024). Aquaculture can also be used to maintain or increase aquatic food production without increasing pressure on the wild stocks that are being fished beyond sustainable levels.

Box 2. Most commonly farmed species in the Mediterranean and the Black Sea

Nile tilapia (<i>Oreochromis niloticus</i>)	Meagre (<i>Argyrosomus regis</i>)
Mediterranean mussel (<i>Mytilus galloprovincialis</i>)	European seabass (<i>Dicentrarchus labrax</i>)
Gilthead seabream (<i>Sparus aurata</i>)	Atlantic bluefin tuna (<i>Thunnus thynnus</i>)

Source: FAO. 2023. *The State of Mediterranean and Black Sea Fisheries 2023 – Special edition*. General Fisheries Commission for the Mediterranean. Rome. <https://doi.org/10.4060/cc8888en>



History

The exact origins of aquaculture in the Mediterranean and Black Sea region remain unclear. However, it can be said that Egyptians were among the pioneers of fish farming in the region – and worldwide – as tomb friezes suggest that they were cultivating tilapia in artificial ponds as far back as 2500 BCE (Bardach *et al.*, 1972).

By the sixth century BCE, aquaculture practices had spread into modern-day Italy where the Etruscans operated marine fish farms and later where the ancient Romans raised European seabass (*Dicentrarchus labrax*), gilthead seabream (*Sparus aurata*), mullets and oysters (Barazi-Yeroulanos, 2010).

Moving into the Middle Ages, monks in monasteries and members of the aristocracy began to develop carp culture in freshwater ponds (Jhingran, V.G., 1987; Alimentarium, 2023). By the end of the thirteenth century, farmers had also begun to grow mussels using novel techniques that would remain the standard for hundreds of years (Alimentarium, 2023).

The 1700s and 1800s were accompanied by a new set of challenges to the development of aquaculture, thanks to the industrial revolution. In Europe, pollution, hydroelectric dams and irrigation canals led to a decline in some fish populations (Jhingran, V.G., 1987; Alimentarium, 2023). To help combat this decline, farmers turned their attentions to artificial breeding, in which they intervene in the reproduction process, in particular for trout.

Since then, advancements in technology and substantial developments in research have greatly impacted aquaculture in the Mediterranean and Black Sea region, allowing farmers to enhance their operations and produce in a more sustainable way, and leading it to become the active and growing sector that it is today.

Farming methods

Aquaculture is usually conducted in three main types of environments – freshwater, brackish water and marine water – using ponds, tanks, cages, raceways or ropes.

Pond culture has roots dating back thousands of years and involves breeding or growing fish in natural or artificial basins (Figure 2; Baluyut, 1989).

Cage culture is a more recent development and involves breeding or growing fish in fixed or floating net enclosures (Figure 3).

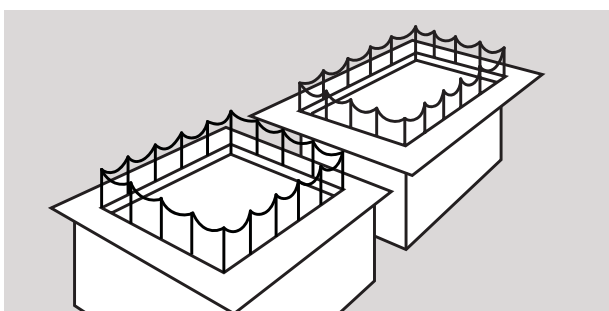


Figure 2. Aquaculture ponds

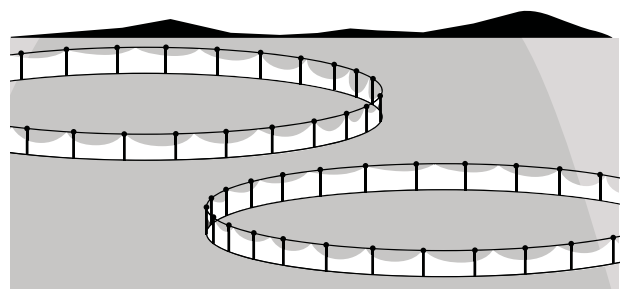


Figure 3. Aquaculture cages

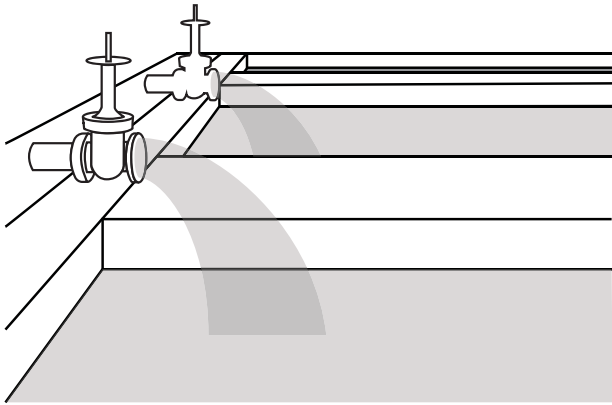


Figure 4. Raceways

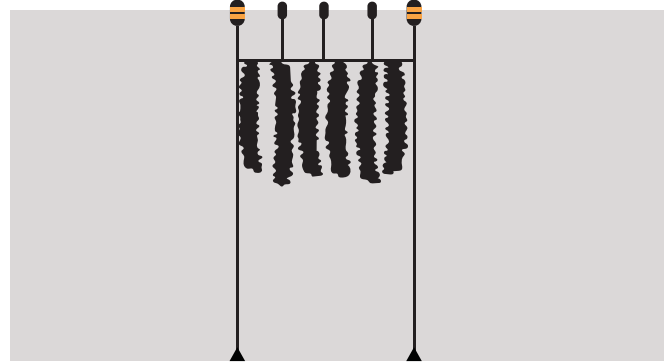


Figure 5. Ropes suspended from a longline

Raceways, or flow-through systems, supply continuous water flow in a long artificial channel and can permit producers to farm at a higher density (Figure 4).

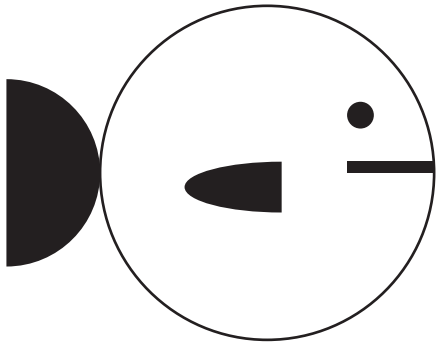
Ropes suspended from a longline (Figure 5), fixed table, floating platform or wrapped around a fixed pole can be used to farm molluscs.

Facts and figures

In the Mediterranean and the Black Sea, production reached almost 3.3 million tonnes in 2021. Of the total production, 70 percent was farmed in freshwater, 24 percent was farmed in marine water and 6 percent was farmed in brackish water (FAO, 2023a).

Public perception

The aquaculture sector contributes to food security, providing a rich source of nutritious proteins while holding substantial economic and cultural value in the region. However, the benefits of the sector are not always obvious and misinformation can be widespread. As such, fostering a better understanding of aquaculture, for example through educational initiatives such as this one, can help to improve public perceptions and support the success of the sector in the region.



Sustainability

The Blue Transformation roadmap, defined by FAO for the transformation of aquatic food systems, sets the objective of sustainably increasing global aquaculture production by 35 percent by 2030 (FAO, 2024). This increase will help to support food security in the region by providing an enhanced source of safe and healthy protein. However, considering that aquatic food systems can have a considerable impact on ecosystem health, it is essential to implement robust strategies and sustainable management guidelines. These measures will help ensure that this growth does not come at the expense of the environment or society (Box 3).

Box 3. Blue Transformation and aquaculture sustainability

Intensifying and expanding aquaculture production to satisfy global demand for aquatic food and distribute benefits equally is one of the three core objectives of the Blue Transformation vision of the Food and Agriculture Organization of the United Nations (FAO). Within this objective, FAO highlights the importance of not only enhancing aquaculture production, but also of doing so sustainably.

In particular, a Blue Transformation envisions a sector where aquaculture operations minimize environmental impacts and use resources efficiently, and in which the ecological impacts of aquaculture development are regularly monitored and reported.

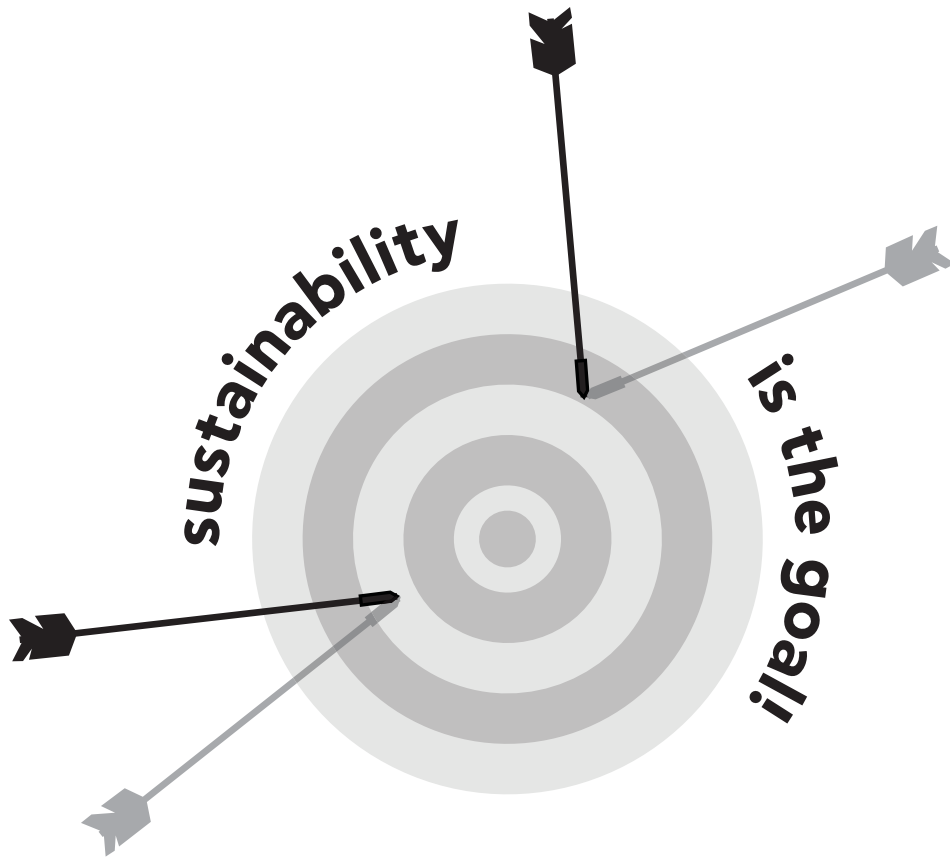
Priority actions to enhance the sustainability of the aquaculture sector include:

- Facilitating the implementation of sustainable aquaculture practices that support biodiversity, facilitate ecosystem restoration and the delivery of ecosystem services, strengthen climate change mitigation and adaptation and build resilience to stressors.

- Supporting the development of climate and disaster-resilient aquaculture infrastructure.
- Facilitating the efficient, diverse and nature-positive use of inputs and resources (e.g. water and feed).
- Increasing capacity on biosecurity, disease control and aquatic health management at local, national and global levels.
- Supporting climate-smart monitoring and reporting of aquaculture interactions with ecosystems, particularly in vulnerable habitats.
- Developing and promoting indicators of aquaculture sustainability.

Source: FAO. 2022. *Blue Transformation Roadmap 2022–2030: A vision for FAO's work on aquatic food systems*. Rome. <https://doi.org/10.4060/cc0459en>





Sustainable aquaculture ranges from minimizing the ecological footprint to generating a net profit for the environment and local communities. In general, the goal is to sustainably intensify and expand aquaculture production to satisfy global demand for aquatic foods and distribute benefits equitably.

Several such benefits come in the form of ecosystem services, including the restoration of habitats for wild fish, and stock enhancement and restocking (FAO, 2023b).

Recently, focus has shifted to restorative aquaculture (Box 4). This practice, which can be associated with activities such as seaweed farming, shellfish farming and sea urchin roe enhancement, aims to restore the health of ecosystems including through the improvement of water quality, provision of habitats, sequestration of carbon and restocking of wild populations.

The production of non-fed species, including marine bivalves and seaweeds can benefit the environment as these species assimilate waste materials, including waste from fed species, thereby lowering the nutrient load in the water and improving water quality. Similarly, the production of filter feeders, such as sea cucumbers and oysters, can benefit the environment as these species eat or filter organisms and dissolved matter, including in areas where an increased concentration appears as a direct or indirect result of human activities.

To enhance the sustainability of the sector, researchers are exploring alternative feeds and production methods, such as using fish byproducts to produce fish feed instead of wild caught species (Garrido Gamarro, E. *et al.*, 2013).

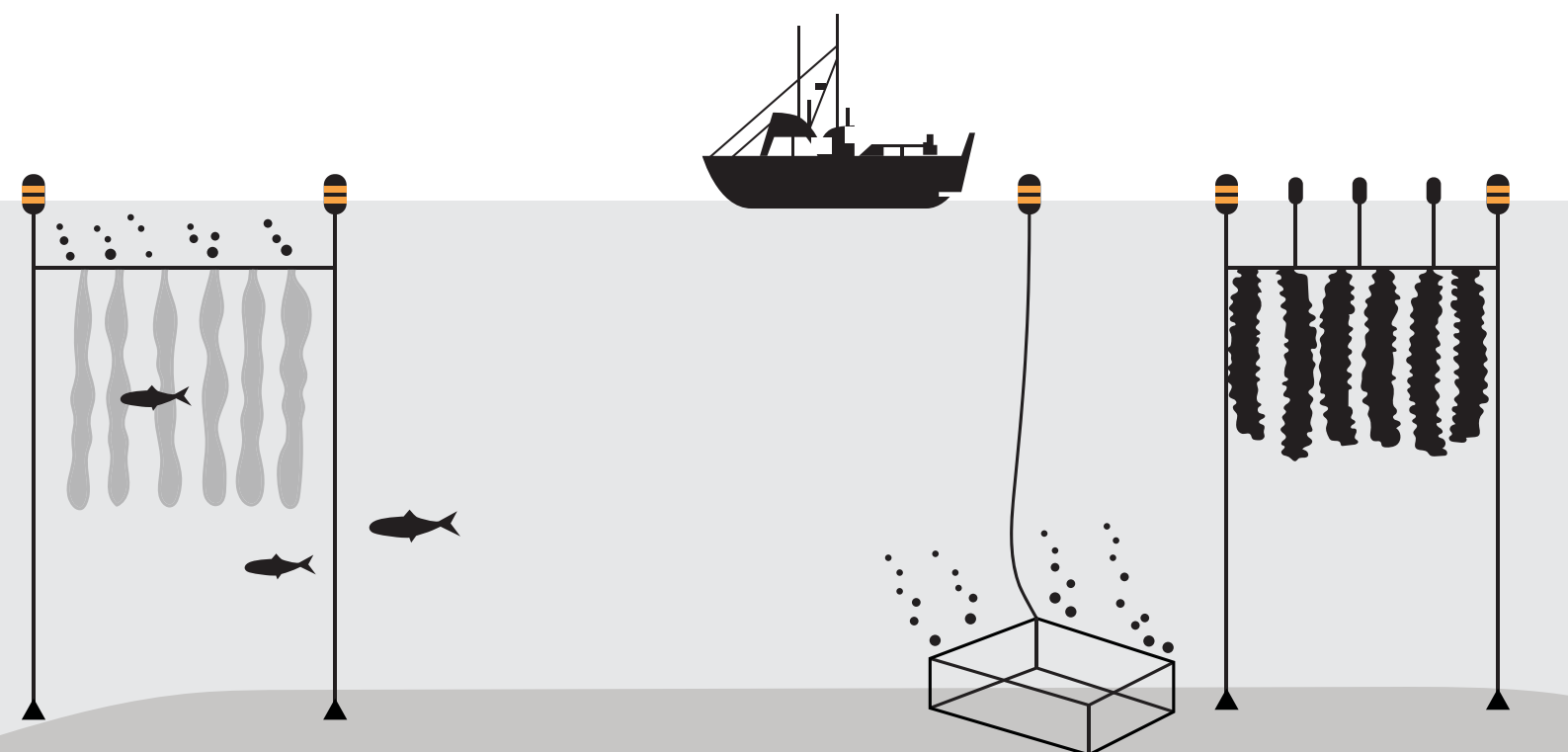
Producers are also turning to aquaponics, a type of sustainable aquaculture that involves the symbiotic cultivation of plants and aquatic animals in a recirculating environment. The effluent water from aquaculture fish tanks provides nutrients to the plants, which in turn purify the water to create the appropriate conditions for the farmed species (Somerville *et al.*, 2014).

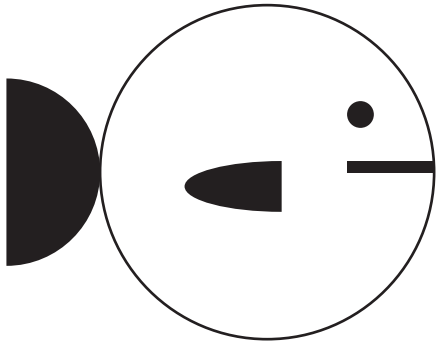
Box 4. Potential benefits of restorative aquaculture

A single hectare of restorative aquaculture farms:

- removes more than half a tonne of nitrogen (which would cost USD 50 000 to remove through wastewater treatment);
- filters up to 95 million litres of water per day (about 40 Olympic-sized swimming pools);
- increases the abundance of wild fish by up to 5 tonnes per year; and
- captures carbon dioxide in coastal waterways and prevents ocean acidification.

Source: The Nature Conservancy. 2021. *Global Principles of Restorative Aquaculture*. Arlington, USA.





Socioeconomic dimension

In addition to the environmental benefits that the aquaculture sector can provide, it can also have great socioeconomic influence, in particular in coastal areas which are home to a significant portion of the global population and are particularly vulnerable to the effects of climate change and loss of biodiversity. In 2021, marine and brackish water aquaculture in the Mediterranean and Black Sea region directly generated over 97 000 jobs and USD 4.9 billion in revenue (FAO, 2023a).

Aquaculture also provides supplementary forms of employment and livelihood opportunities for fishers (Box 5), generates greater foreign exchange earnings, contributes to the safeguarding of indigenous knowledge and traditions, and is a major component of the present and future nutritional food supply.

Box 5. Example employment opportunities in the aquaculture sector

There are many types of jobs that exist in the aquaculture sector, including:

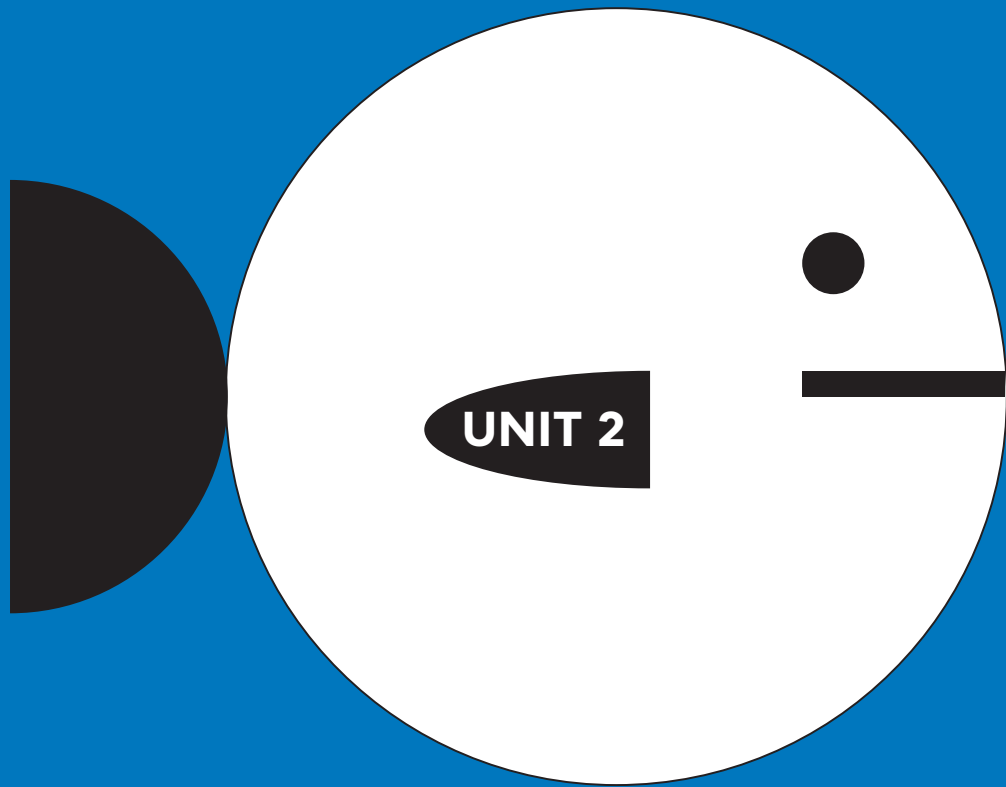
- Farm manager
- Hatchery manager
- Feed technician
- Hatchery technician
- Labourer
- Diver
- Biologist
- Research and development specialist
- Veterinarian
- Engineer

Source: Canadian Aquaculture Industry Alliance. 2024. Careers in aquaculture. In: *Canadian Aquaculture Industry Alliance*. [Cited 10 September 2024]. <https://aquaculture.ca/careers-in-aquaculture-index>

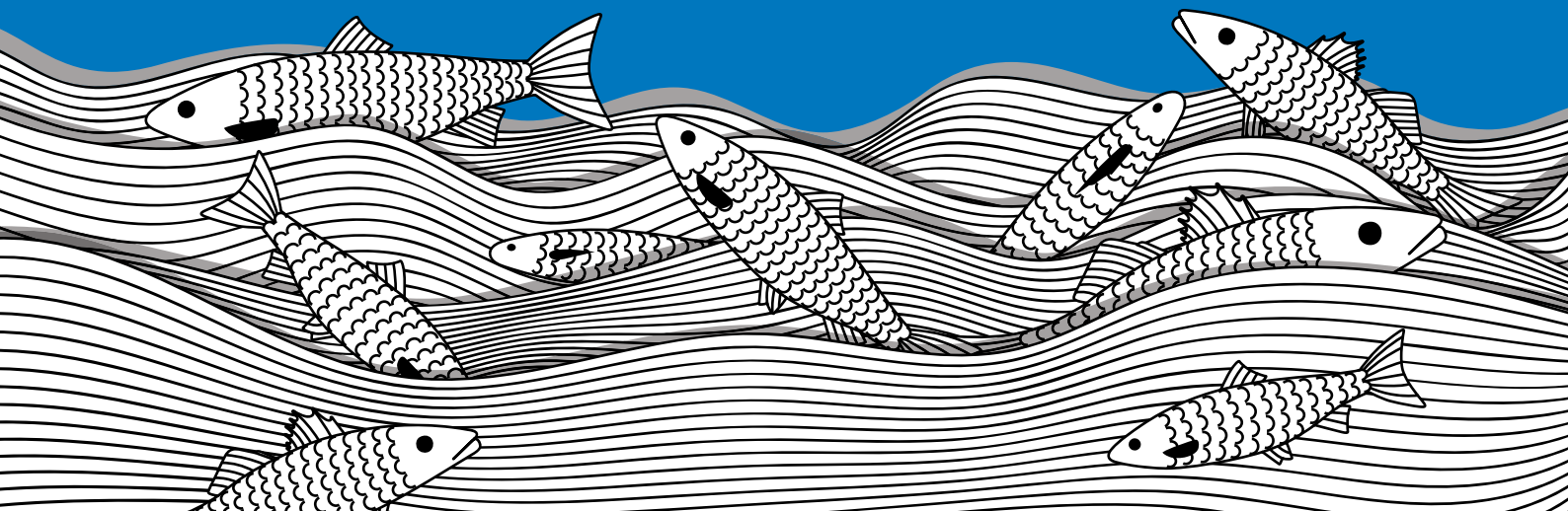
Suggestions for the remainder of the education journey

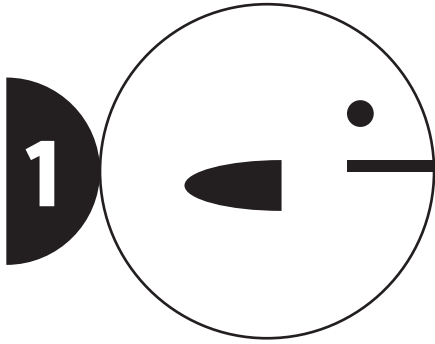
Now that you have gained essential background knowledge on aquaculture in the Mediterranean and Black Sea region, you are ready to continue to the next phase of the education journey and to guide your students in discovering this dynamic sector.

The combination of the upcoming activities was designed to provide a comprehensive overview of aquaculture in the region. However, the journey can be adapted to suit your needs and the needs of your students, in order to help you best prepare the active citizens, informed consumers, scientists and innovators of tomorrow.



The fingerling's foray into sustainable aquaculture





A fish called “yam yam”

Duration

45 minutes

Objective

Introduce aquaculture and the idea that fish can be tasty, healthy and sustainable

Skills practised

Discussing, presenting

Key messages

Fish is a tasty, healthy and environmentally friendly food.

Aquaculture is the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants.

Materials

- Activity sheets 1.1, 1.2
- Scissors for children
- Coloured pencils or pens

Organization

Individual, whole class

Resources

Document 1.1



Document 1.2

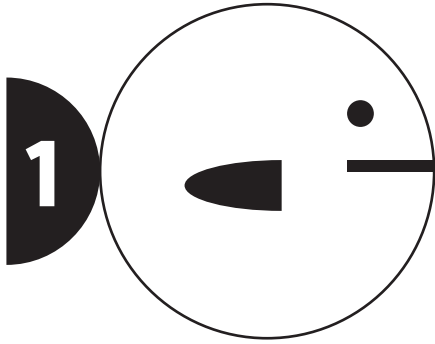


Instructions

Aquatic foods: tasty, good for our health and good for the planet

1. Distribute Activity sheet 1.1 to students and instruct them to draw their favourite fish and answer the questions on the sheet. Discuss the results as a class.
2. Distribute Activity sheet 1.2 to students and introduce the concept of a food pyramid (Figure 6). Instruct students to answer the questions on the sheet and then discuss the results as a class. Highlight that aquatic foods are a source of high-quality protein, vitamins, minerals and omega-3 fatty acids, which are good for heart health (FAO, 2024). For more information, see Document 1.1 using the QR code (Mozaffarian and Elvevoll, 2010). For healthy Mediterranean-inspired recipes with aquatic foods to prepare as a class or for students to prepare at home, see Document 1.2 (FAO, 2023c), accessible through the QR code, and Appendix 3.
3. Explain that there are two ways to get aquatic species from the water onto our plates: capture fishing (harvesting wild organisms from marine and freshwater environments) and aquaculture (farming fish, shellfish and aquatic plants). Highlight that these aquatic food systems have, on average, a lower carbon footprint and fewer impacts on the environment than other animal food systems (FAO, 2024).
4. Lead students in summarizing the merits of aquatic food for our health and the planet.

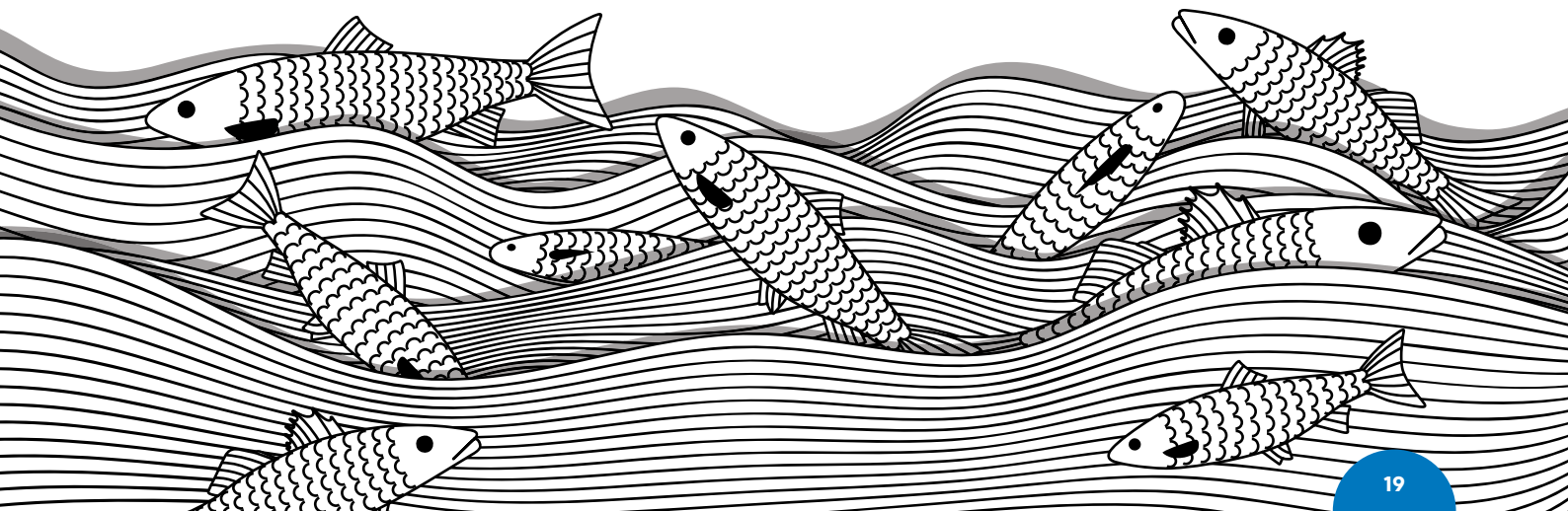


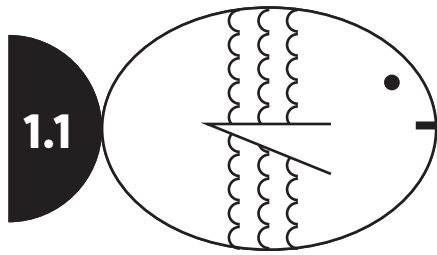


A fish called "yam yam"

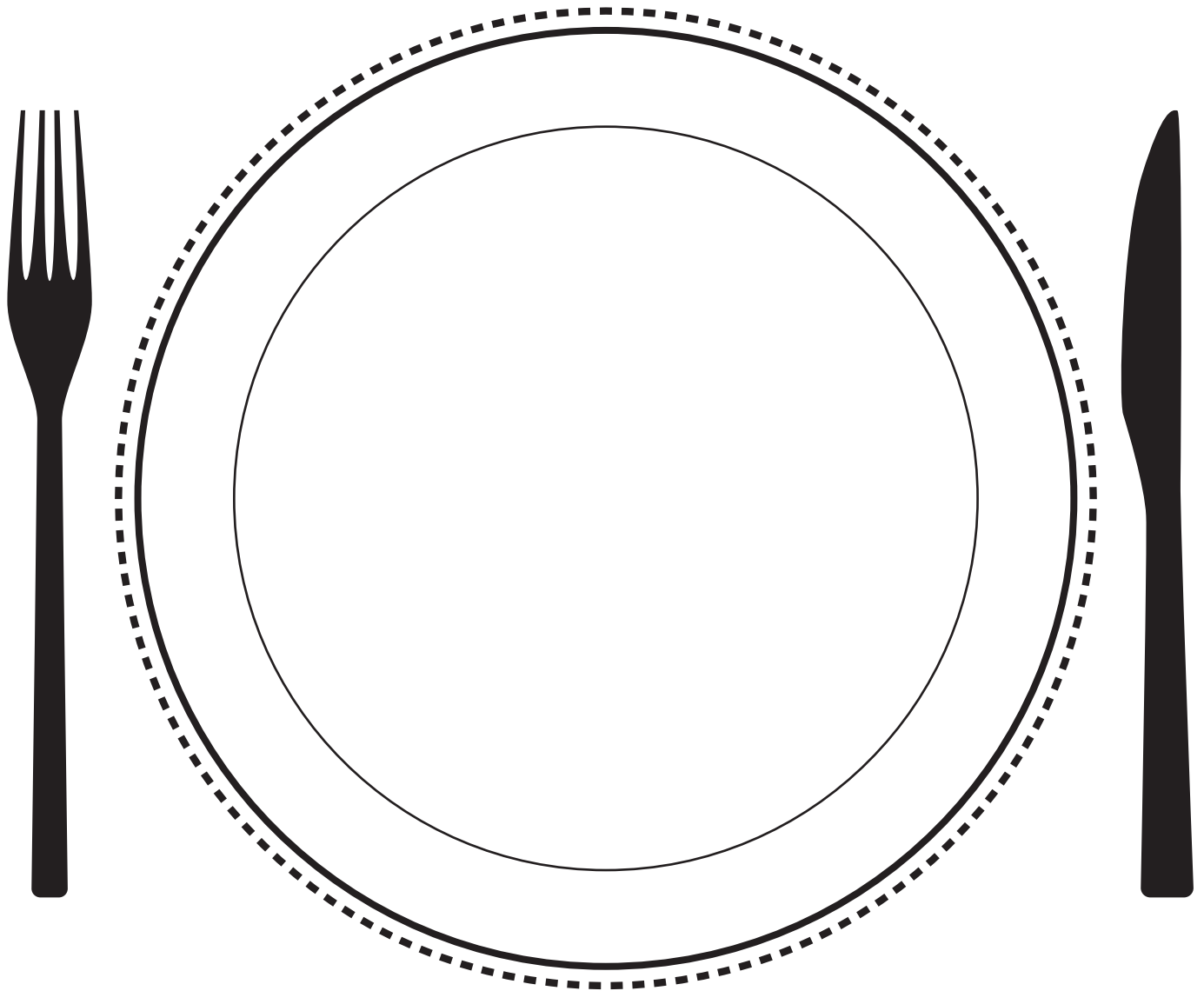
Our star system!

5. To conclude this activity, ask students to each stand up with their drawings from Activity sheet 1.1 and explain their drawing to the class. Once everyone has presented, instruct them to use what they have learned during this activity to rate their lunch on a scale of one to five, in terms of taste, health and impact on the environment.





A fish called "yam yam"



Draw your favourite fish on the plate

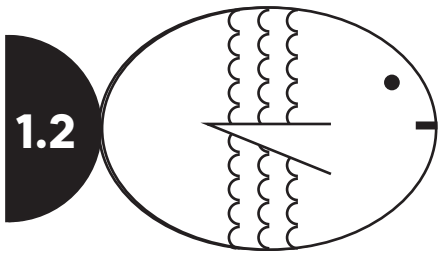
What fish is it? _____

Where does it come from? _____

How do you like it cooked? _____

How often do you eat it? _____

Cut out your drawing and get ready to invite your classmates to lunch!



A fish called "yam yam"

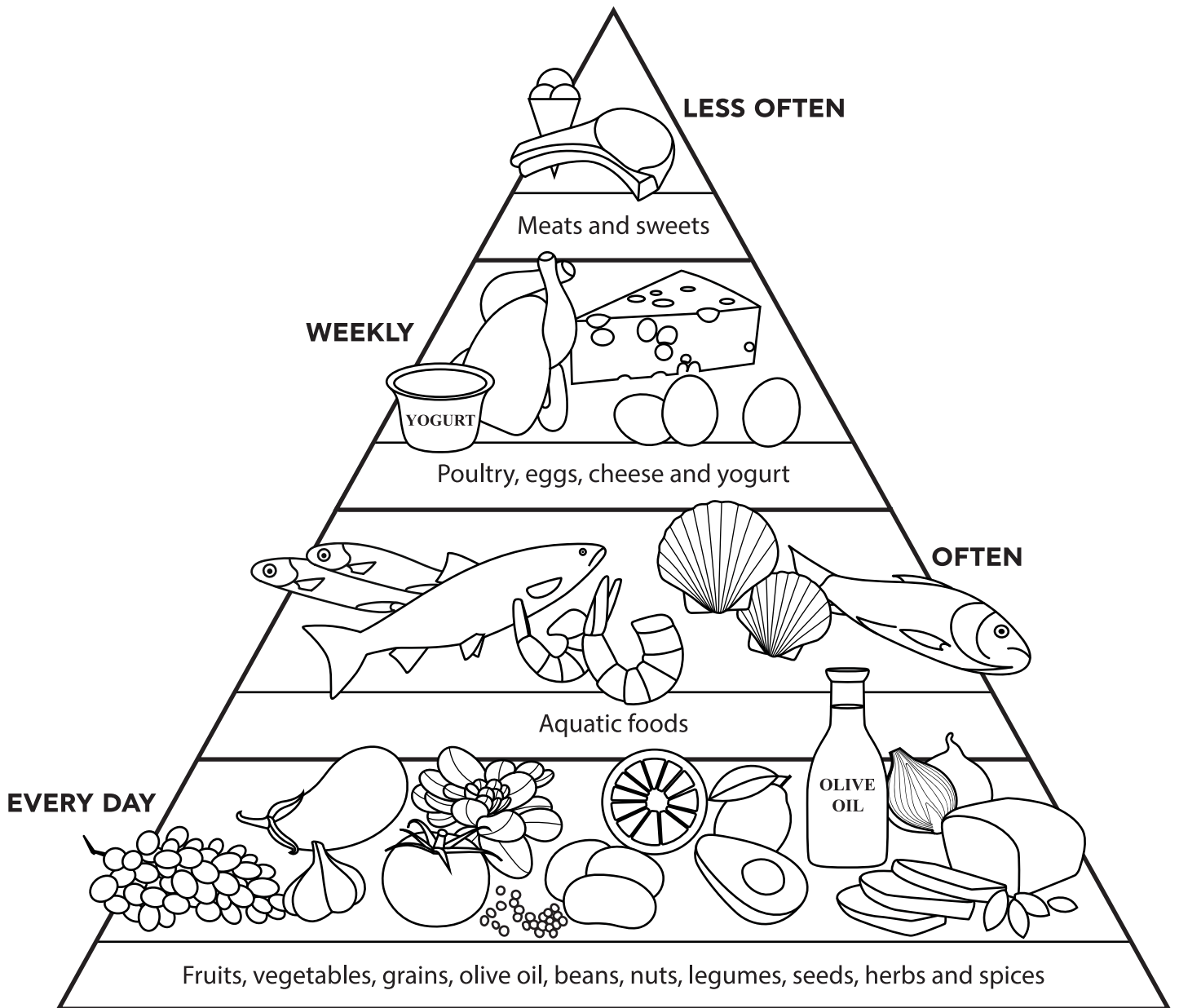
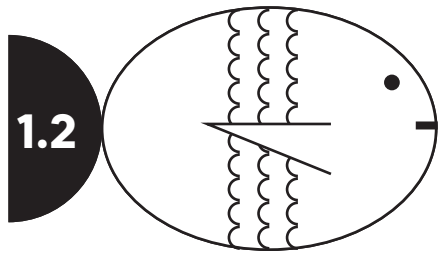


Figure 6. Mediterranean diet food pyramid





A fish called "yam yam"

Use the food pyramid to answer the following questions:

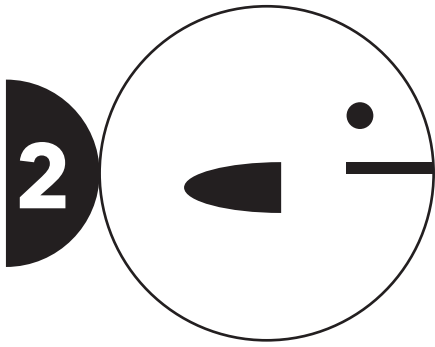
How often are aquatic foods eaten in the Mediterranean diet?

How often are fruits and vegetables eaten in the Mediterranean diet?

How often are meats eaten in the Mediterranean diet?

Is your diet similar to the Mediterranean diet? If not, how could you adapt the pyramid to reflect your local foods and traditions?





A day at the fish market

Duration

3 hours

Objectives

Provide insight into aquaculture, its importance and the most commonly farmed species.

Offer students a deeper exploration of the sector through a field visit to a fish market.

Skills practised

Communicating, interviewing, teamwork

Key messages

About half of the aquatic food we consume comes from aquaculture.

Aquaculture is a dynamic part of the economy.

Consumers have the right to know what they buy.

Materials

- Activity sheets 2.1 and 2.2
- Notepads and pens

Organization

Individual, groups, whole class

Resources

Document 2.1



Document 2.2



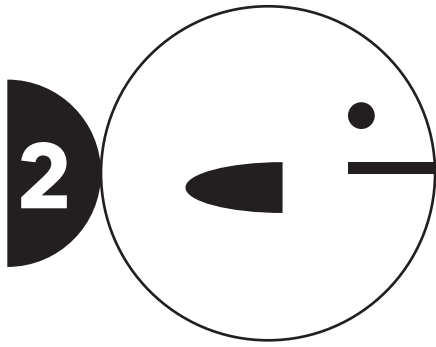
Instructions

Preparing for field work

1. Discuss the difference between capture fishing and aquaculture with the class. In particular, explain the following:
 - Aquaculture is the rearing of aquatic organisms.
 - Unlike traditional farms, aquaculture farms are found in the sea, in ponds, on the coast and in tanks. Aquaculture is dominated by finfish, molluscs (mainly bivalves), crustaceans and marine invertebrates.
 - Roughly half of the aquatic food we consume comes from aquaculture. In 2022, the contribution of aquaculture to global aquatic food production was 51 percent (FAO, 2024).

For information about aquaculture and its importance, see Document 2.1, accessible through the QR code (FAO, 2024).
2. Distribute Activity sheet 2.1 to students and instruct them to complete the exercises and answer the questions on the sheet. Discuss the following answers as a class:
 - Fish
 - 1. Seabass; 2. Seabream; 3. Turbot; 4. Meagre
 - The term “finfish” distinguishes fish that possess fins from other organisms, such as shellfish, jellyfish and starfish.
 - Crustaceans
 - 1. Crawfish; 2. Crab; 3. Shrimp
 - Crustacean derives from the Latin word *crusta*, meaning shell.
 - Molluscs
 - 1. Oyster, 2. Scallops, 3. Mussels, 4. Clams
 - Bivalve derives from the Latin words *bis* and *valvae*, which mean two and the leaves of a door, respectively, referring to the two halves of a hinged shell.

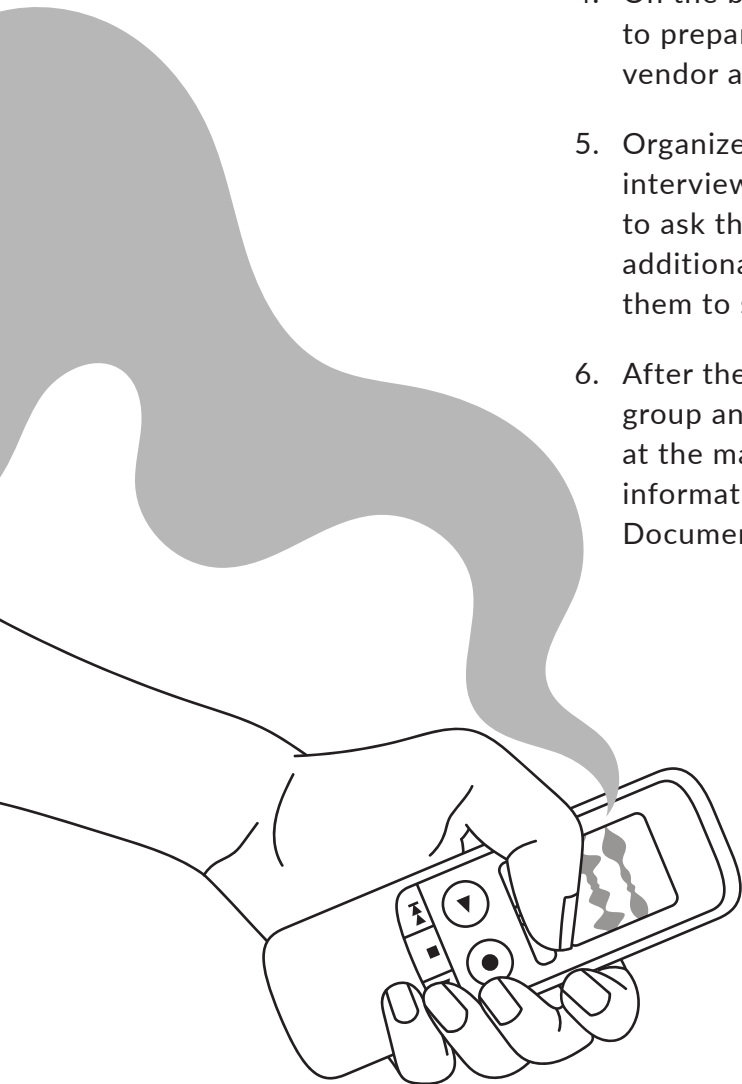




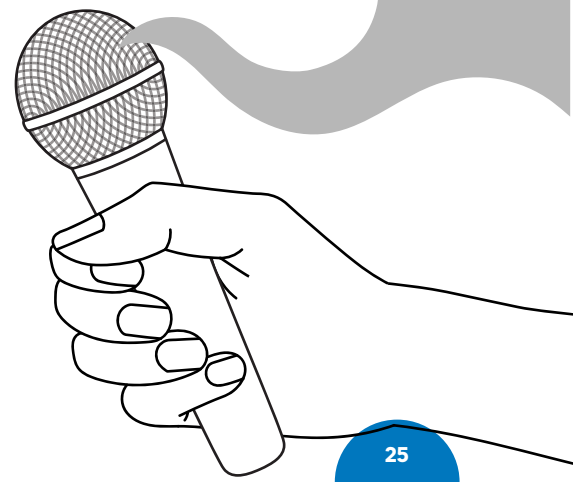
A day at the fish market

Searching for information that matters

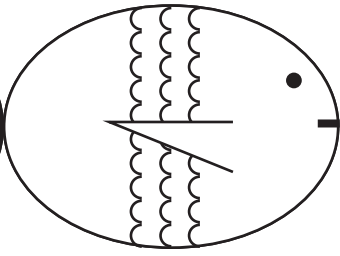
3. Distribute Activity sheet 2.2 to students and divide them into small groups. Ask the groups to brainstorm what information they would like to know about aquaculture and the aquatic foods they eat.
4. On the basis of their brainstorming, instruct each group to prepare a list of questions they would like to ask a fish vendor and complete the activity sheet.
5. Organize a visit to a local fish market where students interview a fish vendor. During the visit, instruct students to ask their questions and record the answers and any additional observations using phones or notepads. Remind them to save their notes as they will be used in Activity 3.
6. After the interviews, distribute Activity sheet 2.3 to each group and instruct them to explore one or more stands at the market and complete the exercises. For more information on choosing a high-quality fish, see Document 2.2, accessible through the QR code (Huss, 1995).



**Ask questions
Find answers**



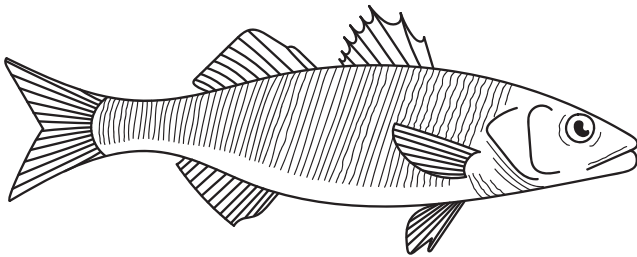
2.1



A day at the fish market

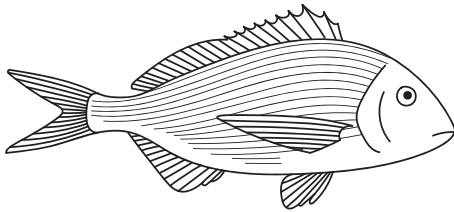
Connect the fish with their names

1



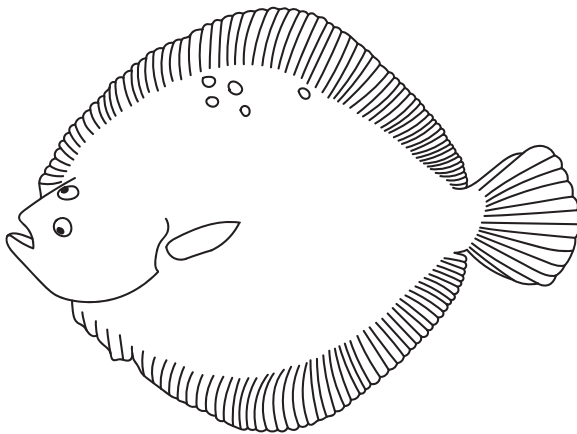
meagre

2



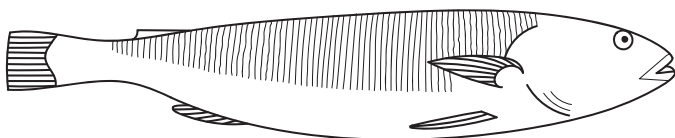
turbot

3



seabass

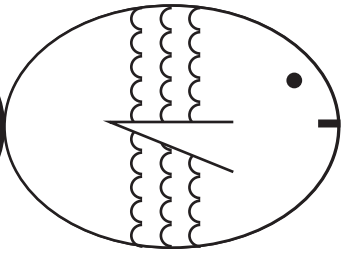
4



seabream

These fish are also known as finfish. Why do you think that is?

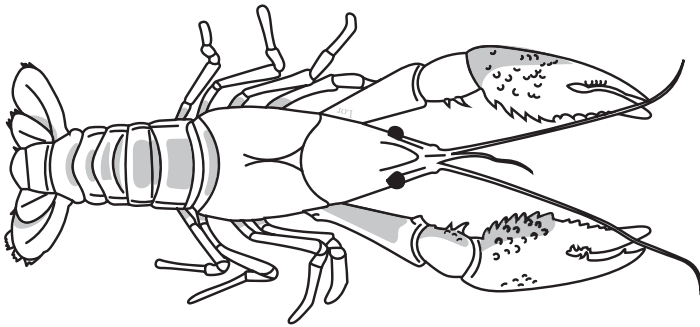
2.1



A day at the fish market

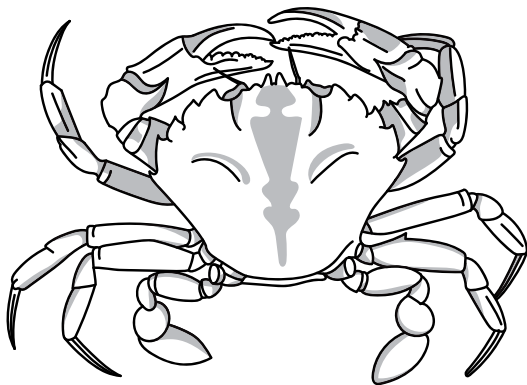
Connect the crustaceans with their names

1



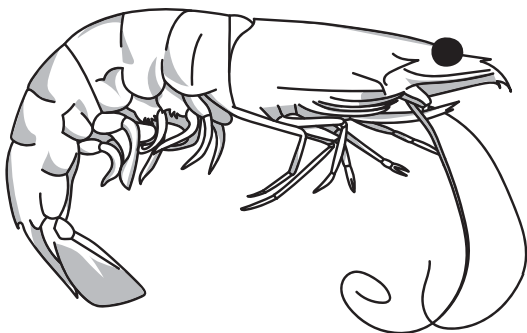
Crab

2



Crawfish

3

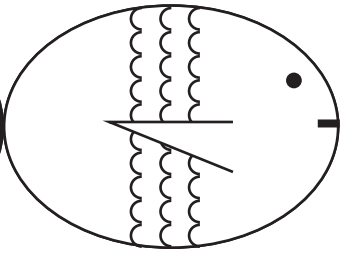


Shrimp

What do they have in common ?

What do you think the name "crustacean" means?

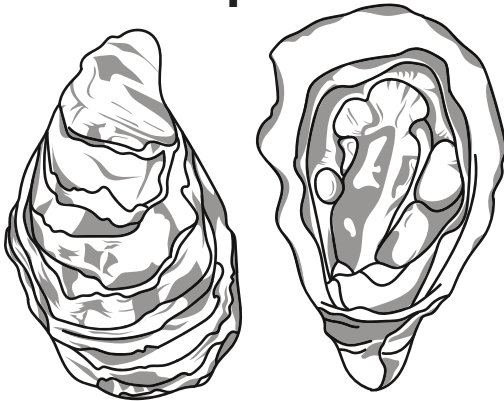
2.1



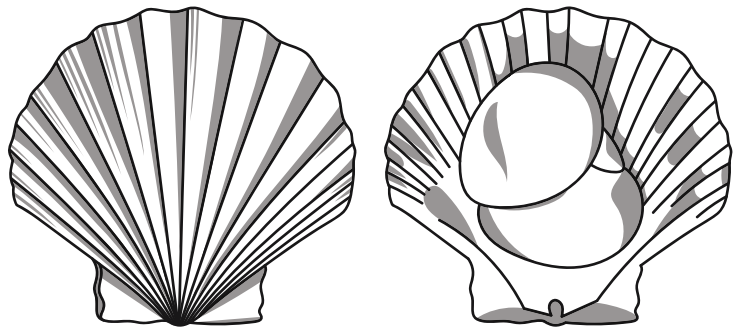
A day at the fish market

Connect the molluscs with their names

1



2



Oysters

Scallops

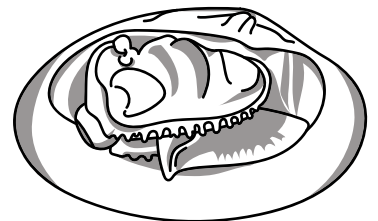
Mussels

Clams

3

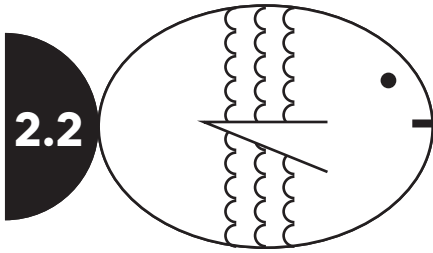


4



What do they have in common ?

They are also called "bivalves". Why?



A day at the fish market

Your teacher has organized a visit to a fish market! At the market, you will have the opportunity to interview a vendor and discover different species.

Before the visit, work together with your group to brainstorm the following:

- What would you like to know about the aquatic foods you buy and eat?
- What would you like to know about aquaculture in your country, in the region and in the world?

Write your ideas below or in your notebook.

Based on your answers above, work together to prepare a list of questions to ask the vendor. For example:

1. Where do the aquatic foods we see here come from?
2. Are there any farmed aquatic products here? If yes, can you tell us more about them?
3. Do we import or export any farmed aquatic foods?
4. What are the most commonly farmed species in our country and in our region?
5. Are farmed aquatic foods equally good for our health as wild-caught aquatic foods?

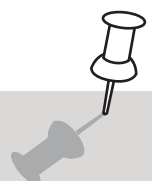
Write your questions below or in your notebook.

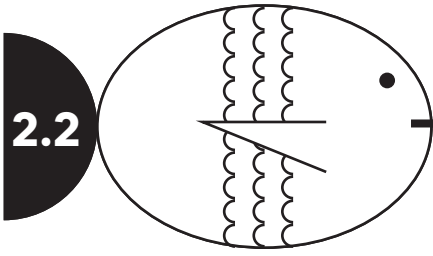


Tips

for your interview

- Decide who will ask the questions.
- Decide who will takes notes.
- Begin by introducing yourselves and the purpose of your visit.
- Listen carefully and try not to repeat questions that the other teams have already asked.





A day at the fish market

Making observations

After the interview, explore the market and observe the aquatic foods that are for sale. Read the labels and talk to the vendors.

Based on what you discover, fill in the table below.

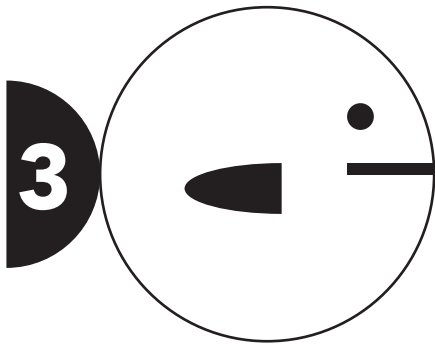
Name (fish, molluscs, crustaceans)	Country of origin	Wild caught or farmed?

Choose one of the fish that you included in the table and answer these questions to understand if it is of good quality.

- 1. How does the skin look?
 - a) Bright
 - b) Dull
- 2. How does the fish feel?
 - a) Stiff
 - b) Soft
- 3. How do the eyes look?
 - a) Clear
 - b) Cloudy
- 4. What colour are the gills?
 - a) Red
 - b) Faded or discoloured
- 5. How does the smell?
 - a) Fresh
 - b) Sour, stale, rancid

If you answered “a” to all questions, the fish is fresh and high quality!





Where does it come from?

Duration

45 minutes

Objectives

Evaluate the links between aquaculture, the environment and society, as well as the rights of consumers to information.

Skills practised

Analysing, communicating, presenting, summarizing, teamwork

Key message

It is important to enhance the sustainability of the aquaculture sector.

Materials

- Activity sheet 3.1
- Screen to display the video

Organization

Individual, groups, whole class

Resource

Video 3.1



Instructions

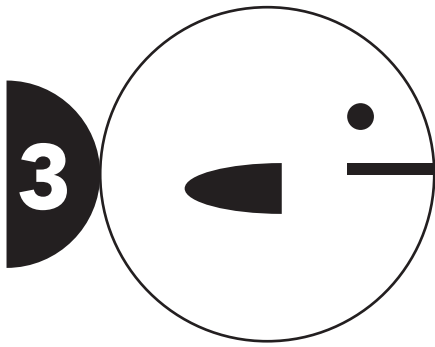
Preparing for field work

1. Divide students into the same groups used in Activity 2. Instruct them to evaluate the information they collected at the fish market using Activity sheet 2.2. Instruct the groups to briefly present their results to the class.
2. Ask students what else they would like to know about aquaculture and aquatic foods and prepare a list.

Designing a fish certification card

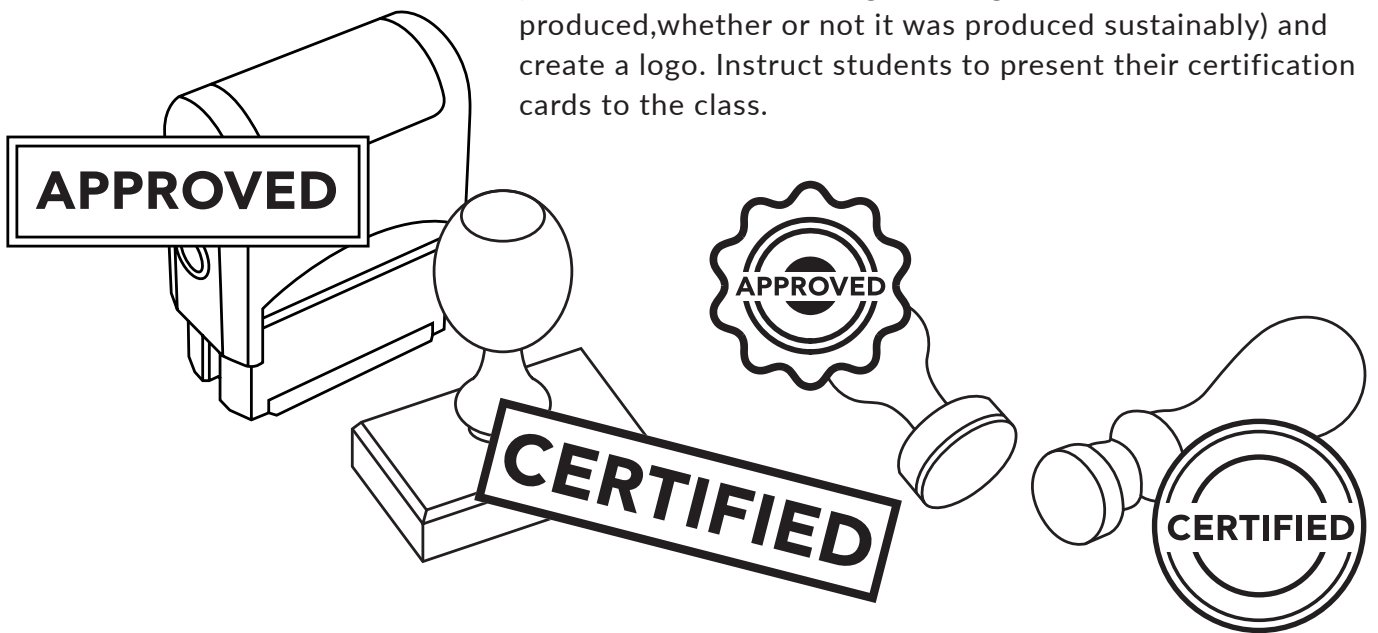
3. Ask students if they think it is important to know how the farmed aquatic foods they eat are produced, for example, what happens on the farm, the degree of sustainability, how the species are treated.
4. Help students brainstorm the needs of a fish (the fish needs to be fed, stay healthy, reproduce, have clean water with enough oxygen, etc.) and the needs of the environment around the farm (the area where the farm is situated needs to stay clean, healthy and accessible to the local community). Ask students if they think consumers should know if these needs are being met.

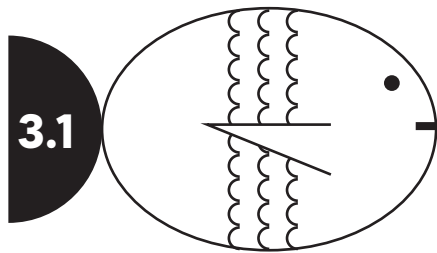




Where does it come from?

5. Show students Video 3.1, accessible through the QR code and instruct them to complete the quiz in Activity sheet 3.1 (FAO, 2023d). All answers are correct except for point 7. Review the answers as a class.
6. Ask students if they think it is important for consumers to have more information about how their food is produced, in particular whether it is produced sustainably. Explain that for wild capture fisheries, FAO has divided waters worldwide into 27 major fishing areas, which help scientists, fishers and stakeholders to compare data and keep track of where fish originate. Ask students if they think this could also be a useful practice for aquaculture.
7. Distribute Activity sheet 3.2 to students. Instruct them to create a fish certification card to provide consumers with more information about their food. They should choose a name for their certification, decide what information it will provide the consumer (e.g. the origin of the fish, how it was produced, whether or not it was produced sustainably) and create a logo. Instruct students to present their certification cards to the class.





- Where does it come from?

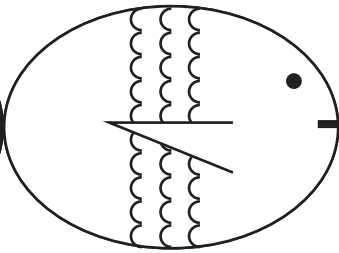
Based on the video you watched, what is FAO's vision for sustainable aquaculture?

(Tick the right answers)

- The expanding human population is well-fed
- Livelihoods are supported
- Biosecurity and diseases are controlled
- Antimicrobial use is regulated
- Technology is used to reduce impacts on the environment
- Research and technology are used to improve genetics
- Children work under good conditions
- Research and technology are used to generate new and sustainable feeds
- Natural resources are used efficiently
- Biodiversity and animal welfare are safeguarded



3.2



Where does it come from?

This is your chance to design a fish certification card! Your certification will give consumers more information about the food they buy.

Choose a name for your certification, list the information it will provide the consumer and design an eye-catching logo.

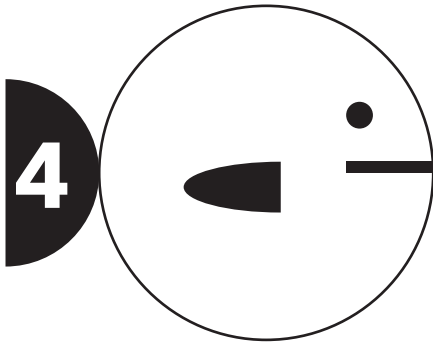
Name: _____

Origin: _____

Logo:

Compare logos with your classmates and vote to choose the one that would be most attractive to consumers.





What's on their mind?

Duration

45 minutes for preparation and 2–4 days to conduct interviews

Objectives

Discover public attitudes towards aquaculture and raise awareness about the sector through interviews.

Skills practised

Communicating, interviewing, listening

Key messages

Consumers may not be well informed about aquaculture.

Misconceptions and a lack of information can be the basis for taking action and measuring results.

Material

Activity sheet 4.1

Organization

Pairs, whole class

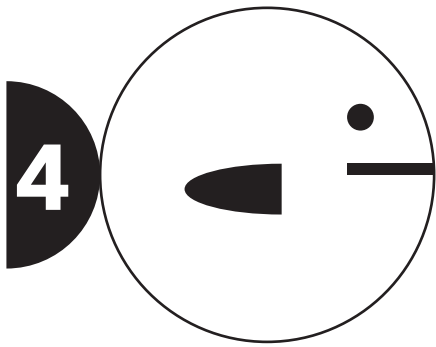
Instructions

Ask the right questions

1. Guide students in discussing the following questions:

- What might their peers, teachers and families think of the aquatic foods they eat?
- Do they ever wonder where the fish they eat comes from?
- What do they know and think about aquaculture?
- Do they understand the sector's importance in the global economy?
- Do they understand the sector's importance for food security?
- How do they compare wild-caught aquatic foods to farmed aquatic foods?
- Do they have any fears, thoughts or prejudices against farmed aquatic foods?

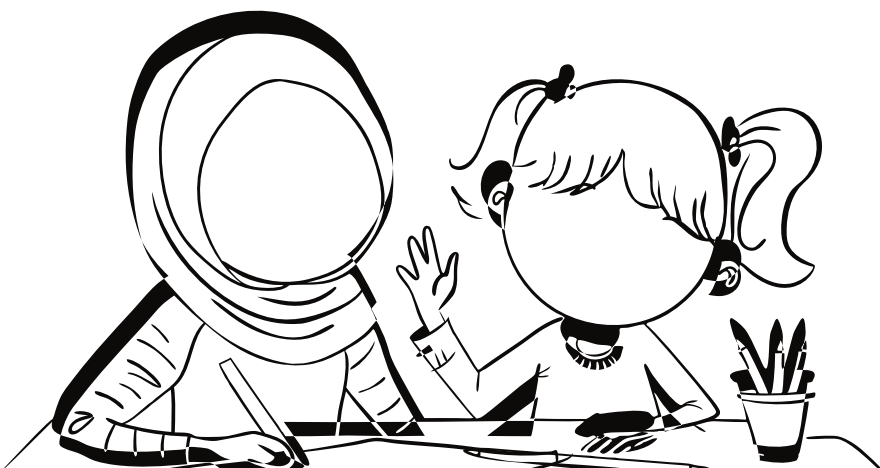




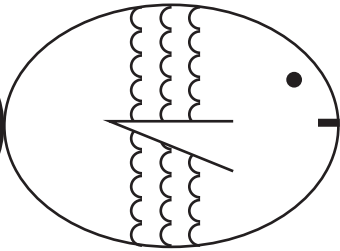
What's on their mind?

The aquatic pulse of our school community

2. Distribute Activity sheet 4.1 to students and divide them into pairs. Instruct them to brainstorm a series of yes or no, and open-ended questions to ask their peers, teachers and families about aquaculture, using the activity sheet as a guide.
3. Ask each pair to share their suggestions with the class. Help the class to agree on five to seven common questions, with a maximum of two open ended questions (younger students can opt for more yes or no and multiple choice questions).
4. Instruct each student to record the questions in their notebook and to use them to interview a peer, teacher or family member, before an agreed-upon deadline. Older students can use online survey tools, if they desire.



4.1



What's on their mind?

Mission

Your mission is to gain an understanding of what your peers, families and teachers think about aquaculture.

With your partner, think of a series of questions you want to ask them. Use the examples below for inspiration.

- How often do you eat aquatic foods?
 - a) Less than once a week
 - b) Once a week
 - c) Twice a week
 - d) More than twice a week

- Do you check where your aquatic foods come from?
 - a) Always
 - b) Sometimes
 - c) Never

- Do you know what aquaculture is?
 - a) Yes, very well
 - b) A little bit
 - c) I have no idea

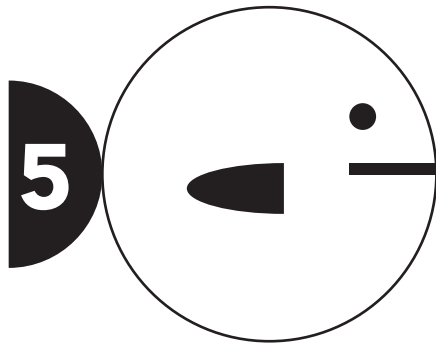
- What do you prefer:
 - a) Wild-caught aquatic foods
 - b) Farmed aquatic foods
 - c) I do not care

- Do you trust farmed aquatic foods? Rate your trust from 1 to 5. (1 = Not at all, 5 = Totally)
- 1 2 3 4 5

- Approximately what percentage of aquatic foods do you think comes from aquaculture?
 - a) 80 percent
 - b) 50 percent
 - c) 10 percent

- What would you like to know about aquaculture?





Roll the dice

Duration

2 hours

Objectives

Analyse the results of the interviews from Activity 4 and discover the benefits of aquaculture.

Skills practised

Convergent thinking, simple statistics or mathematics, systemic thinking

Key messages

The value and potential of aquaculture need to be better understood.

Aquaculture can contribute to the United Nations Sustainable Development Goals (SDGs), especially to end hunger and poverty, protect life under water and support climate action.

Material

Activity sheet 5.1

Organization

Individual, groups, whole class

Resource

Website 5.1

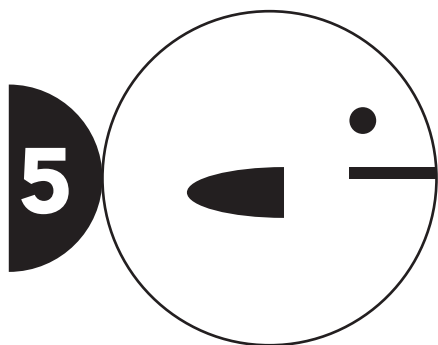


Instructions

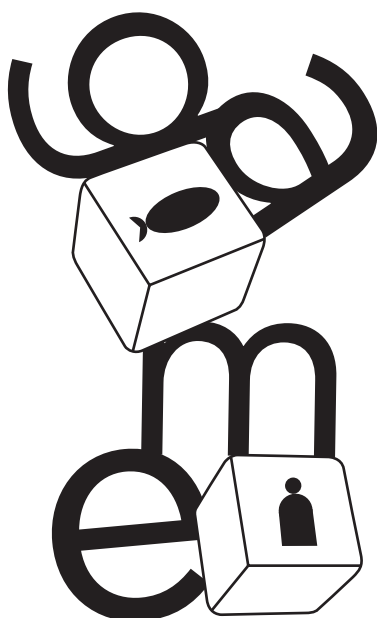
Analysing results

1. Guide students in drawing graphs based on the results of the interviews they conducted in Activity 4 (this can be done using digital tools or by hand on paper). Students can also interpret the results using percentages.
2. Based on the graphs, discuss the following questions as a class:
 - a) How does the public perceive aquaculture?
 - b) How much do they know about aquaculture?
 - c) What can we do to improve the perception and understanding of the value of aquaculture by society?
3. Explain that we can help to improve the perception of aquaculture by illustrating its potential to contribute to the achievement of many SDGs. If this is the first time students hear about the SDGs, give a brief introduction. For more information, see Website 5.1, accessible through the QR code (UNDESA, 2023).





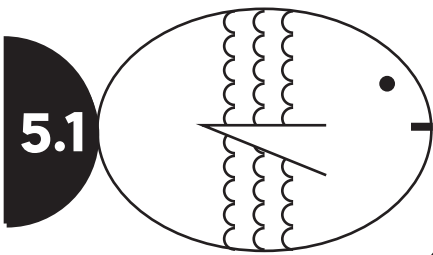
Roll the dice



Finding connections

4. Divide students into groups of up to five, one of whom will be the timekeeper, and distribute Activity sheet 5.1 to each group. Instruct each group to cut out and assemble the key SDGs and facts dice (FAO, 2024; UNDESA, 2023).
5. Explain the rules, as follows:
 - In each group, the student sitting to the left of the timekeeper starts the game. They roll the dice to reveal one SDG and one fact.
 - The student tries to create a short story that connects the SDG and the fact.
 - If they succeed, they gain one point and can roll the dice a second time. If they cannot think of a story within two minutes, the student to their left gets the chance to try.
 - The game continues in a clockwise manner for as long as you decide. At the end of the game, the student with the most points out of their group is the winner.
6. After the game, discuss some of the stories shared to ensure that students understand the vital role that aquaculture plays in sustainable development by providing nutritious food, job opportunities for women and economic growth opportunities for local communities.





1 NO POVERTY

8 DECENT WORK AND ECONOMIC GROWTH

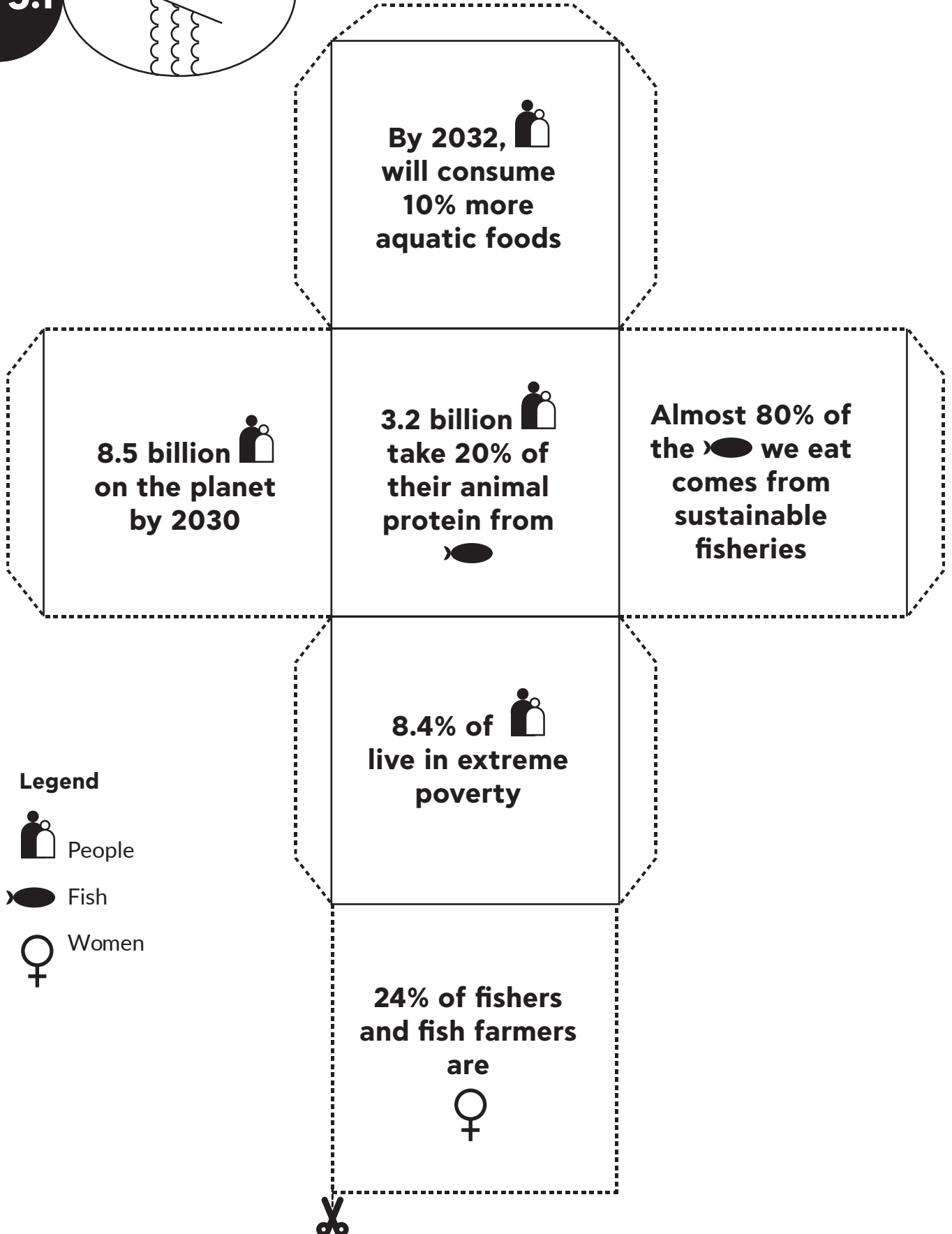
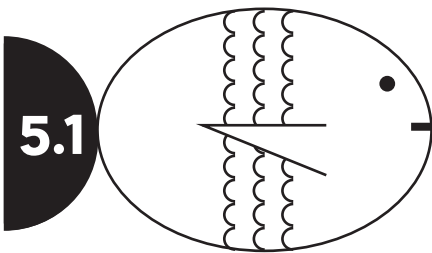
14 LIFE BELOW WATER

2 ZERO HUNGER

5 GENDER EQUALITY

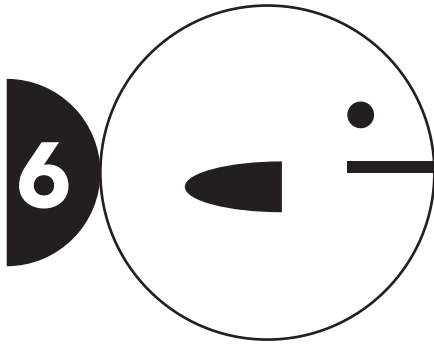
13 CLIMATE ACTION





Legend

-  People
-  Fish
-  Women



How did it start? Where will it go?

Duration

2 hours

Objectives

Discover the origins of aquaculture and look into its future.

Skills practised

Divergent thinking, storytelling

Key messages

Aquaculture has a long history in the Mediterranean and the Black Sea and remains an important element of the region's culture.

Materials

Activity sheets 6.1 and 6.2

Organization

Individual, whole class

Resources

Document 6.1



Website 6.1



Website 6.2



Instructions

A story from the past

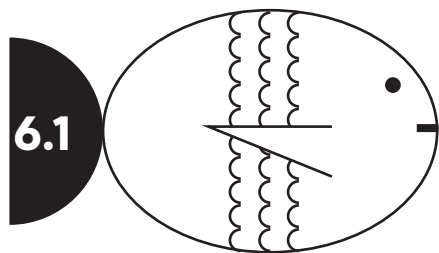
1. Distribute Activity sheet 6.1 to students. Instruct them to place the sections of the timeline side-by-side and tape them together to create one long timeline showcasing aquaculture's past, present and future.
2. Instruct them to use their artistic skills to illustrate the timeline.
3. Ask the students to present their timelines to the class. Discuss what interesting discoveries they made.
4. For more information about the history of aquaculture, see Document 6.1 and Website 6.1, accessible through the QR codes (Rabanal, 1988; Alimentarium, 2023). For more information about the history of aquaculture in the Mediterranean region, see Website 6.2, accessible through using the QR code (Barazi-Yeroulanos, 2010).

The present

5. Distribute Activity sheet 6.2 to students. Instruct them to use the sheet as a guide to describe what happens on an aquaculture farm.

Looking to the future

6. Discuss the potential future of aquaculture with the class. In particular, explain the following:
 - Global per capita consumption of aquatic animal foods is projected to reach 21.3 kg in 2032 – 0.1 kg more than in 2022. Approximately 60 percent of the aquatic foods that are available for human consumption are expected to come from aquaculture (FAO, 2024).
 - To meet this increasing demand, the GFCM envisages a sector should be that is competitive, sustainable, productive, profitable and equitable.
 - This requires innovative thinking. Technological innovation, for example, combined with local knowledge and traditional techniques can take aquaculture to the next level of productivity and, environmental sustainability.

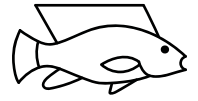


Let's be serious about history!

Use your artistic skills to illustrate the story of aquaculture through the ages!

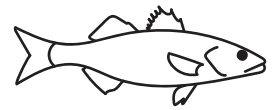
Place the sections side-by-side and tape them together to create one long timeline showcasing aquaculture's past, present and future.

2500 BCE



Egyptians were pioneers of fish farming in the Mediterranean and Black Sea region (and around the world). Decorations inside ancient tombs suggest that they were farming tilapia as far back as 2500 BCE (Bardach *et al.*, 1972).

600 BCE



By the sixth century BCE, aquaculture had spread into what is now known as Italy. There, the Etruscans operated marine fish farms and later the ancient Romans raised European seabass, gilthead seabream, mullets and oysters (Barazi-Yeroulanos, 2010).

Middle ages



In the Middle ages, monks in monasteries and members of the aristocracy began to farm carp in freshwater ponds (Jhingran, V.G., 1987; Alimentarium, 2023). By the end of the thirteenth century, farmers started to grow mussels using techniques that would remain the same for hundreds of years (Alimentarium, 2023).

1700s–1800s

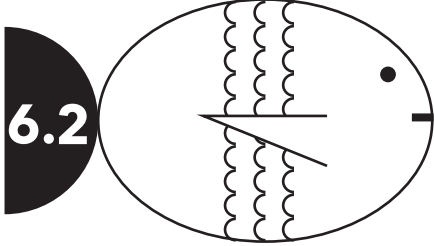


As a result of the industrial revolution, aquaculture faced a new set of new challenges with pollution, hydroelectric dams and irrigation canals causing a decline in some fish populations in Europe (Jhingran, V.G., 1987; Alimentarium, 2023). To help combat this decline, some farmers turned their attentions from natural breeding to artificial breeding, in which they intervene in the reproduction process, in particular for trout.

Present



Since the industrial revolution, aquaculture in the Mediterranean and Black Sea region has greatly improved. New technology and cutting-edge research now help farmers enhance their facilities and produce in a more sustainable way. What will happen to the aquaculture sector next? As the consumers, scientists, farmers and engineers of the future, it is up to you!

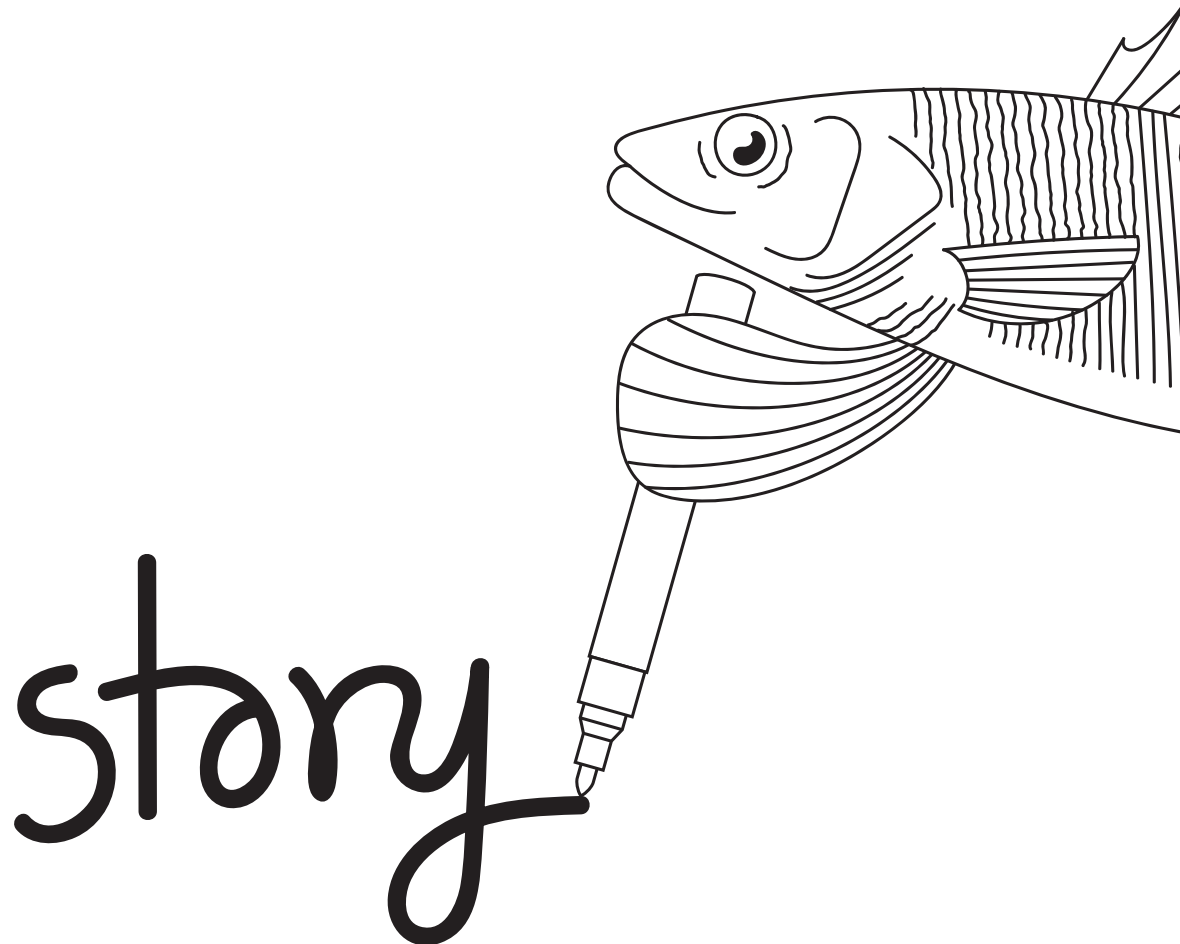


How did it start? Where will it go?

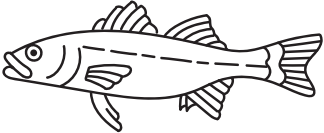
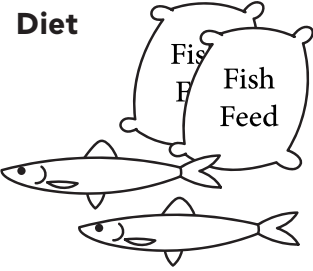
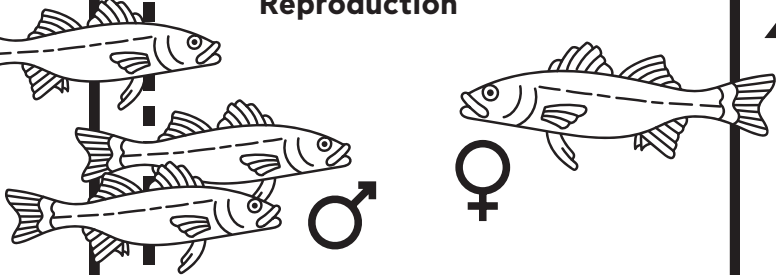
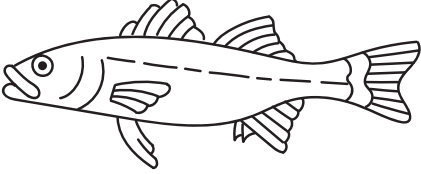
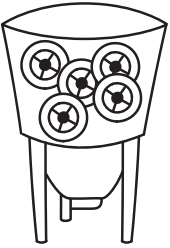
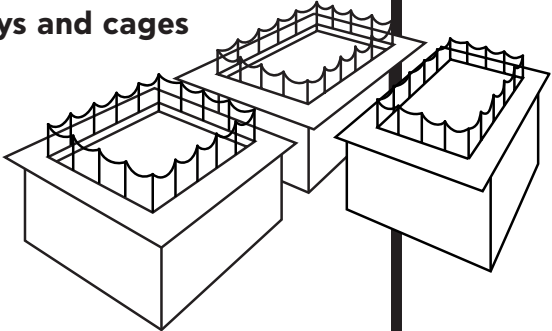

Hello!

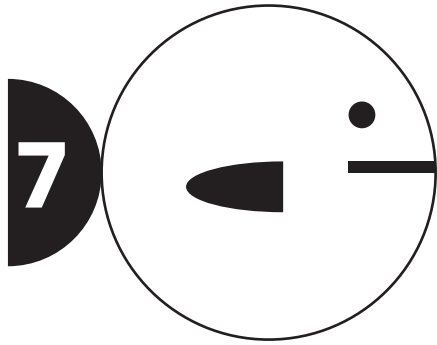
I am a European seabass farmer from the Mediterranean and Black Sea region.

Using the illustration as a guide, can you help me write the story of my farm?



The story of a European seabass farm

<p>Broodstock 2-3 years</p>  <p>----- ----- -----</p>	<p>Diet</p>  <p>----- ----- ----- ----- -----</p>
<p>Reproduction</p>  <p>----- ----- -----</p>	<p>18 months - 400 g</p>  <p>----- ----- -----</p>
<p>----- ----- ----- ----- ----- -----</p> <p>Eggs 300 000/m²</p> 	<p>Raceways and cages</p>  <p>----- -----</p>
<p>Yolk sac fry Larva Juvenile</p>  <p>----- ----- -----</p>	



Aqua games

Duration

45 minutes to 2 hours

Objective

Investigate plant and non-fish aquatic organism aquaculture and the role of aquaculture as a nature-based solution.

Skills practised

Communicating, teamwork

Key message

Aquaculture can be a nature-based solution.

Materials

Activity sheets 7.1 and 7.2

Organization

Groups, whole class

Resource

Document 7.1

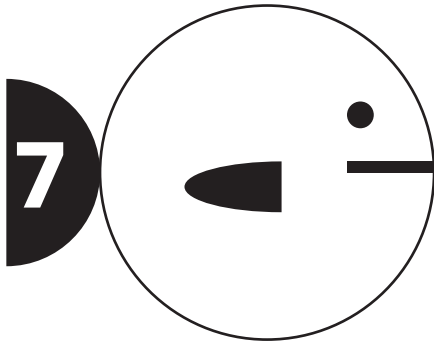


Instructions

Time to play

1. Print and cut out four copies of the fish, mollusc, crustacean and plant cards (36 total) and two copies of the special cards (eight total) that are included in Activity sheet 7.1. These cards make up one deck. You will need one deck of cards per group mentioned in step 2.
2. Divide students into groups of up to five and distribute Activity sheet 7.1 and one deck of cards to each group.
3. Instruct students to review the aquatic organisms on the cards. Explain that they are all good choices for aquaculture depending on the circumstances (local conditions, climate, biodiversity, economy, etc.).
4. Introduce the concept of nature-based solutions: actions that support ecosystems towards addressing social, economic and environmental challenges and benefitting people and nature (FAO, 2022).
5. Explain the positive role of mussels, oysters, seaweed, sea urchins and sea cucumbers in keeping marine ecosystems healthy and farms clean, and highlight the ecological importance of filter feeders. For more information see Document 7.1 (Cai *et al.*, 2021) and Websites 7.1, 7.2 and 7.3, accessible through the QR codes (GFCM, 2022; Responsible Seafood Advocate, 2022; Perez, 2022).
6. Comment on the negative effects of the excessive use of antiparasitic treatments and antibiotics.
7. Instruct students to select and play one or more of the games listed on the activity sheet.





Aqua games

Resources

Website 7.1
about sea urchins



Website 7.2
about sea cucumbers



Website 7.3
about filter feeders



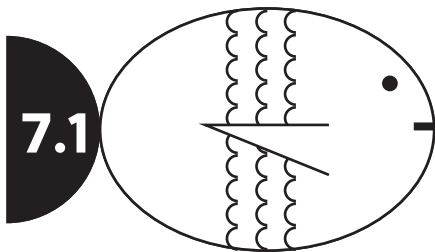
Time to play true or false

8. Distribute Activity sheet 7.2 to students and explain the following:
 - Sea cucumbers live on the bottom of the sea and like earthworms, they rework the seabed and clean up organic waste (DGMARE, 2021).
 - These strange-looking creatures are nutritious and considered to be a tasty delicacy in some parts of the world – earning an expensive price tag as a result.
 - They are also known for their use in traditional medicine (Kampouris, N., 2022).
 - The growing demand for sea cucumber puts pressure on its wild populations. Turning to aquaculture can be of great nutritional, economic and conservation value, as it can help protect biodiversity (DGMARE, 2021).
9. Instruct students to use this information to complete the true or false exercise. Note that the answers are: 1. false, 2. true, 3. true, 4. false, 5. true, 6. false, 7. true, 8. true.

Time to reflect

10. Discuss the special ecological value of bivalves as filter feeders, of sea urchins and sea cucumbers.





Aqua games

Time to play

Your teacher will divide the class into groups and provide you with a deck of cards.

Listen to your teacher explain the importance of each card.

With your group, play one (or more!) of the games listed below. Have fun!

1. UNO

How to play

Distribute seven cards to each student in your group and place the remaining cards face down in a pile on the table. Turn the top card in the pile face up and set it on the table to create the discard pile.

Decide which student goes first. If this student has a card in their hand that matches either the aquatic organism or the species family (fish, mollusc, crustacean or plant) shown on the top card of the discard pile, they get rid of their card by adding it to the discard pile.

If they do not have a matching card, they must draw a new card. They continue taking cards until they find a match.

Play continues in a clockwise direction. The first player to successfully discard all their cards wins the game!

Some cards have special rules:

- Excessive antiparasitic treatments and antibiotics card: if a student discards this card, the next student must draw three cards.

- No involvement of the local community card: if a student discards this card, the next student must draw two cards.
- Sea urchin card: if a student draws this card, they can discard it regardless of what card is face up on the discard pile.
- Sea cucumber card: if a player discards this card, they can automatically discard one more card with it.

2. Memory

How to play

Shuffle the cards and lay them face down on the table.

Choose which student goes first. This student turns over two random cards. If the cards match, they set the cards aside and gain one point. If the cards do not match, they turn the cards over again.

Play continues until all cards have been matched. The student with the highest number of points wins.

3. Guess who I am

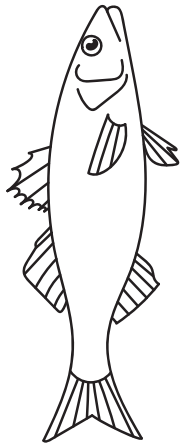
How to play

Shuffle the cards. Each student chooses a card at random and sticks it to their forehead.

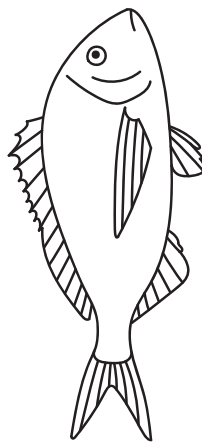
Each student asks yes or no questions to try to determine their identity.

The student who guesses their identity using the fewest number of questions wins!





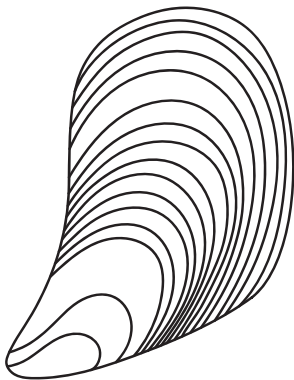
Seabass
Fish



Seabream
Fish



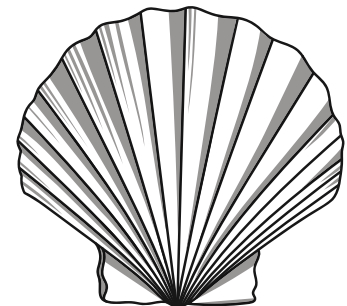
Meagre
Fish



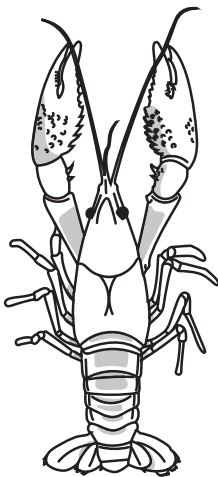
Mussel
Mollusc



Oyster
Mollusc



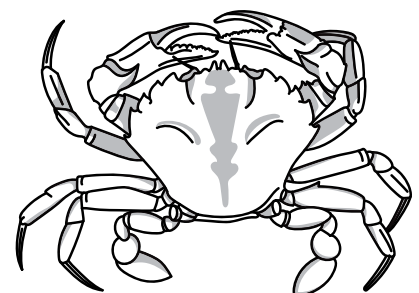
Scallop
Mollusc



Crayfish
Crustacean



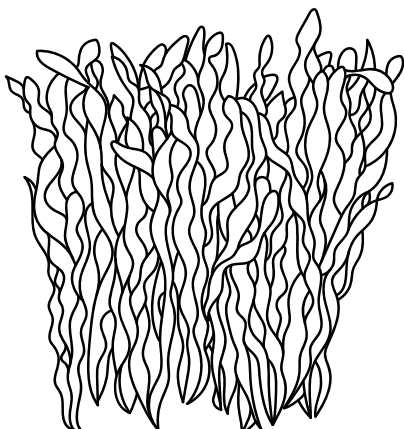
Shrimp
Crustacean



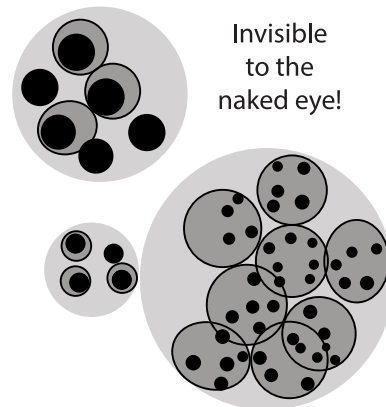
Crab
Crustacean



Spirulina
Plant

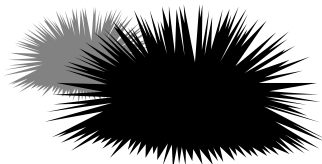


Seaweed
Plant

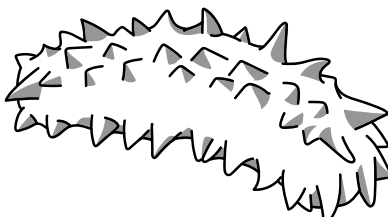


Invisible
to the
naked eye!

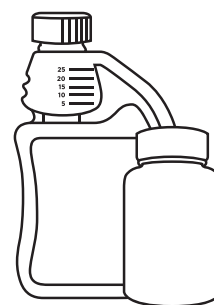
Microalgae
Plant



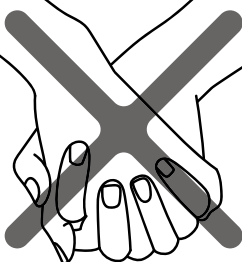
Sea urchin
Special card



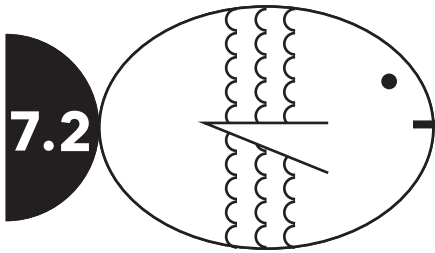
Sea cucumber
Special card



**Excessive use
of anti-parasitic
treatments
and antibiotics**
Special card



**No involvement
of local community**
Special card

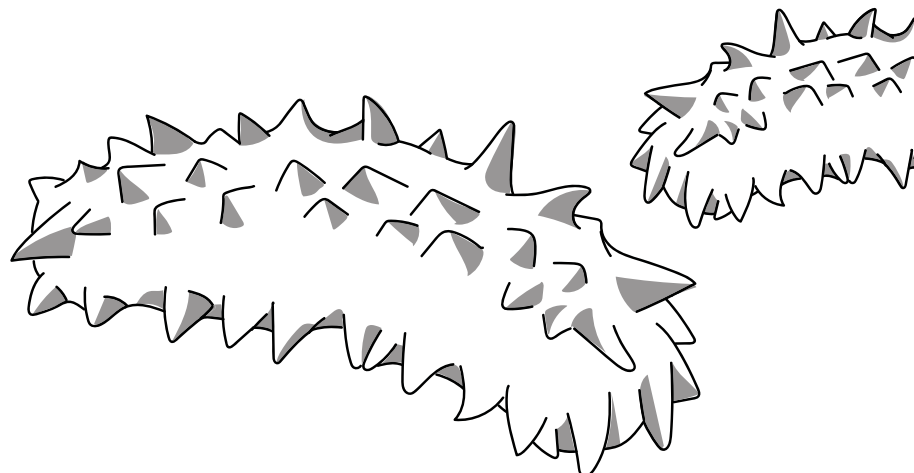


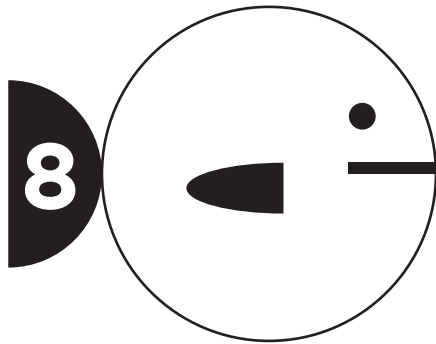
Aqua games

Time to play true or false?

indicate your answer with a tick in the TRUE or FALSE box.

	T	F
1. Sea cucumbers are plants, they are the cucumbers of the sea, as their name suggests.	<input type="checkbox"/>	<input type="checkbox"/>
2. Sea cucumbers clean marine ecosystems.	<input type="checkbox"/>	<input type="checkbox"/>
3. Farming sea cucumbers may contribute to the preservation of this species.	<input type="checkbox"/>	<input type="checkbox"/>
4. Sea cucumber aquaculture has no economic value.	<input type="checkbox"/>	<input type="checkbox"/>
5. Sea cucumbers are appreciated for their taste and are also used for pharmaceutical purposes.	<input type="checkbox"/>	<input type="checkbox"/>
6. Sea cucumbers and oysters should never be farmed together.	<input type="checkbox"/>	<input type="checkbox"/>
7. Healthy and sustainable food means food that is good for human health and for the planet.	<input type="checkbox"/>	<input type="checkbox"/>
8. Sea cucumber aquaculture can be considered a nature-based solution.	<input type="checkbox"/>	<input type="checkbox"/>





A trip to the Kuriat Islands

Duration

3 hours

Objectives

Explore the link between aquaculture and biodiversity conservation, gain better insight into sustainable aquaculture and discover responsible entrepreneurship, through a case study.

Skills practised

Active listening, calculating

Key message

Sustainable aquaculture can be compatible with conservation efforts, including marine protected areas.

Materials

- Notebooks and pencils
- Screen to display the video
- Cylindrical container (e.g. bottle or can)
- Ruler or measuring tape
- Calculator
- Activity sheets 8.1, 8.2 and 8.3

Organization

Groups, whole class

Resources

Document 8.1



Instructions

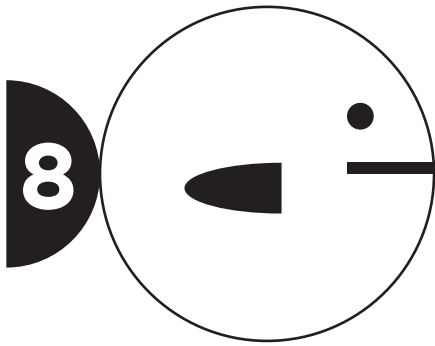
Welcome to the Kuriat Islands

1. Introduce students to the Kuriat Islands in Monastir Bay, Tunisia. In particular, explain the following:
 - The Kuriat Islands are composed of two islands located in Monastir Bay in Tunisia.
 - They have extraordinary biodiversity, numerous marine habitats and host several species of conservation interest including the loggerhead turtle (*Caretta caretta*), the bottlenose dolphin (*Tursiops truncatus*), the noble pen shell (*Pinna nobilis*) and various species of seahorses (*Hippocampus spp.*) (IUCN, 2021).
 - They are important for aquaculture activities, fishing and tourism.

Additional information is available in Document 8.1, accessible through the QR code (IUCN, 2021).

2. Explain that the Kuriat Islands are the site of a marine protected area. Ask students what they think this means and if they would expect to find aquaculture cages in a marine protected area.
3. Explain to students that the class will go on a virtual expedition to the Kuriat Islands by watching a video. Instruct them to write down as many species as they see in the video and to count the number of aquaculture culture cages they notice.
4. Play Video 8.1, accessible through the QR code, which provides a look into the biodiversity of the Kuriat Islands (HDM Productions, 2022).
5. Ask students to share the names of the species they noticed with the class. Write a list of the species, adding to it based on students' inputs until all the species have been named
6. Ask students how many aquaculture cages they counted? Ask if they think this activity is harmful, beneficial or neutral to the local biodiversity?





A trip to the Kuriat Islands

Resources

Video 8.1



Video 8.2



Green entrepreneurs

7. Distribute Activity sheet 8.1 to students and divide them in small groups of up to six. Explain that each group is going to set up their own farm and enterprise. Instruct them to complete the exercise in the sheet to decide their roles on the farm.

Making calculations

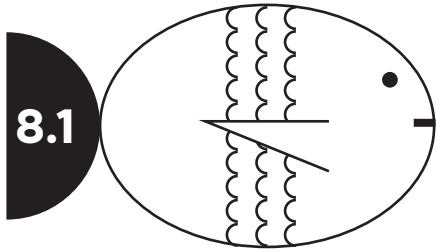
8. Distribute Activity sheet 8.2 and a small cylindrical container to each group. Explain that they will practice calculating volume and surface area and will discover why these measurements are important to enhance sustainability on aquaculture farms.
9. Guide students through calculating the volume and the surface area of the top of the containers.
10. Discuss why volume is an important measurement for aquaculture farmers. In particular, explain that farmed fish need adequate space to move around so that they can be healthy and grow properly with low stress (Segner *et al.*, 2019).
11. Discuss why surface area is an important measurement for aquaculture farmers. Highlight that it can be used to help farmers calculate how much protective netting they need to cover the top of each cage.

Seeds of hope

12. Distribute Activity sheet 8.3 to students.
13. Play Video 8.2, accessible through the QR code, to give students insight into sustainable seaweed farming (Notre Grand Bleu, 2024a).
14. Instruct students to complete the exercise in the sheet.

Note to teachers: there are many examples of aquaculture facilities near islands or areas of significant biodiversity in the Mediterranean and the Black Sea. While this activity is centered around the Kuriat Islands, you can choose to adapt it to highlight a local biodiversity-rich area that interests you.





A trip to the Kuriat Islands

Green entrepreneurs

Who works on an aquaculture farm?

Farmer

Role _____

Scientific advisor

Role _____

Financial manager

Role _____

Sales manager

Role _____

Marketing officer

Role _____

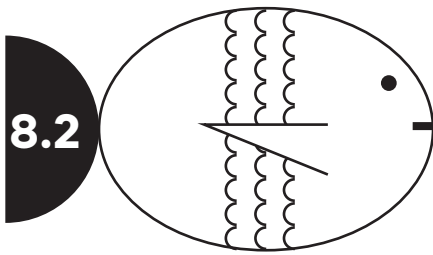
Environmental and social responsibility expert

Role _____



Your group's mission is to manage a sustainable aquaculture farm in the Kuriat Islands.

Decide your roles on the farm and describe what you will do.



A trip to the Kuriat Islands

Green entrepreneurs

Making calculations

The site of your farm is ready, but before you can start farming fish, you need to set up the aquaculture cages.

The cylindrical container given to you by your teacher is a scaled-down model for the aquaculture cage you plan to build at your farm and you must calculate its volume and surface area.

Step 1. Calculate the volume of the container

Measure the radius (the distance from the centre of the base of the container to the edge) and the height of the container. Write these numbers down.

Calculate the volume using the following formula:

$$V = \pi r^2 h$$

Where:

V = volume

π = pi

r = radius

h = height

Step 2. Calculate the surface area of the container

Recall the radius that you measured in step 1 and calculate the surface area of the base of your container using the following formula:

$$A = \pi r^2$$

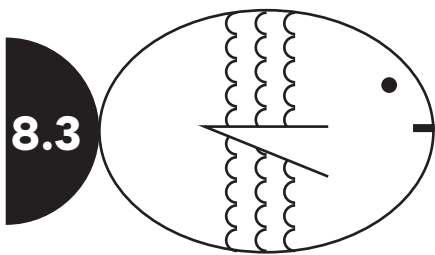
Where:

A = area

π = pi

r = radius





A trip to the Kuriat Islands

Seeds of hope

Two years later

Congratulations! Your farm is so successful that you decide to start a new enterprise called “Seeds of hope”, a pioneering restorative aquaculture seaweed farm. Your team cultivates seaweed on ropes which are attached to longlines and set in water. Once the seaweed grows to an appropriate size, it is harvested, sorted, washed and dried naturally on nets. The seaweed that you produce is used to make seaweed hand cream and cosmetic products.

Observe Figure 7 and try to explain what a restorative aquaculture farm is. Using the illustration as a guide, discuss how your farm has a positive impact on the environment.

A single hectare of restorative farms...

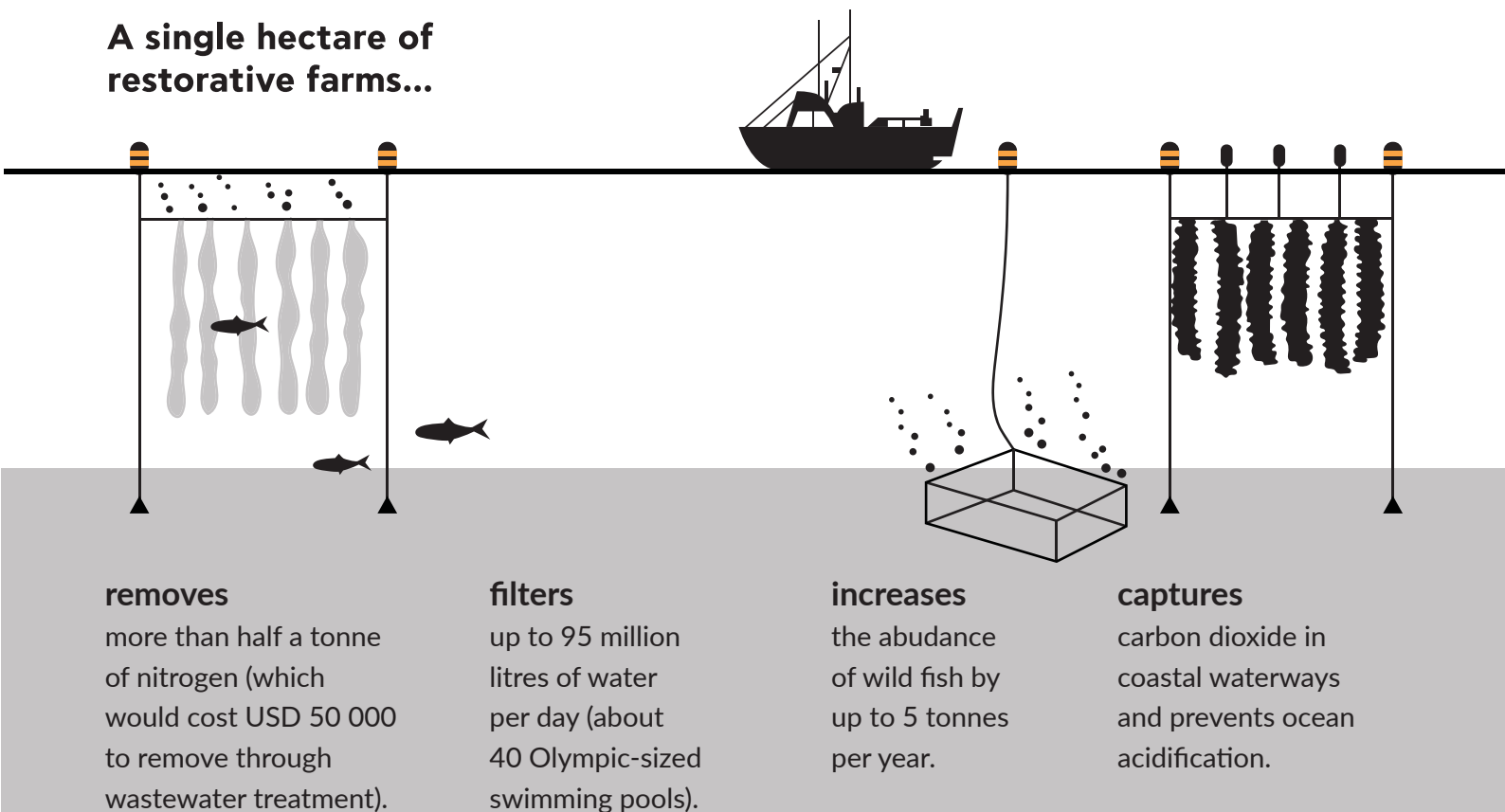
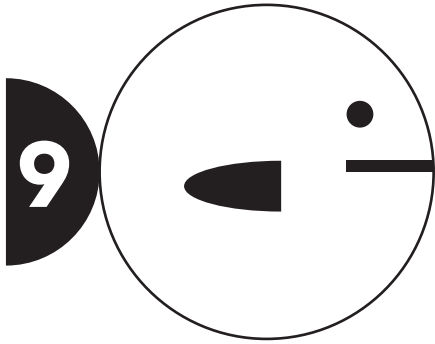


Figure 7. Impacts of a restorative aquaculture farm

Source: Adapted from The Nature Conservancy. 2021. *Global Principles of Restorative Aquaculture*. Arlington, USA.



A zero-waste farm

Duration

45 minutes

Objectives

Review key species for sustainable aquaculture and introduce the concept of a zero-waste farm.

Skills practised

Communicating, teamwork

Key message

It is possible for an aquaculture farm to produce zero waste.

Material

Activity sheet 9.1

Organization

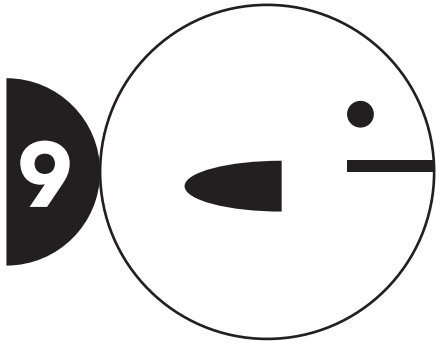
Pairs, whole class

Instructions

And the winner is...

1. Ask students to organize their chairs in a circle and to take a seat. Stand in the middle and assign each student, and yourself, a name from the following list:
 - sea urchin
 - sea cucumber
 - seaweed
 - bivalve
2. Call one of the names. The students assigned to that name stand up and find an empty chair to sit in. You should also participate in this round. The student left standing moves to the middle of the circle and calls out one, or more, of the names.
3. Continue the game for as long as you deem appropriate.





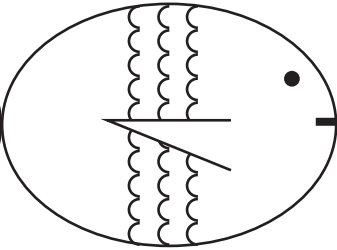
A zero-waste farm

Integrated multi-trophic aquaculture: a concept to explore

4. Explain that fish farms produce waste that can include solid debris from human activities (e.g. plastic items); organic matter, including uneaten feed and detritus; inorganic matter, including nutrients from the fish and other organisms; chemicals that are used to keep the equipment clean; and antibiotics and other medicines for the fish (e.g. for parasites).
5. Ask students if they think it is possible to have a zero-waste farm.
6. Distribute Activity sheet 9.1 to students and divide them into pairs. Instruct them to complete the exercise on the sheet.
7. Discuss their findings as a class, in particular explain that mussels, oysters, clams and sea urchins feed on organic waste, such as the uneaten food of the fish and feces, and macroalgae extract nutrient waste. Together, these organisms can help to create a zero-waste farm. This is a concept known as integrated multitrophic aquaculture.



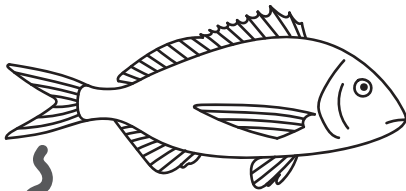
9.1



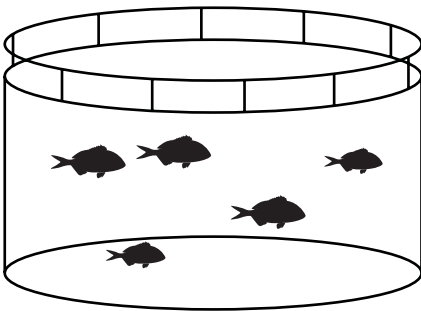
A zero-waste farm

In this farm, the waste generated during production is considered a valuable resource. Can you guess why? Discuss your ideas with your partner.

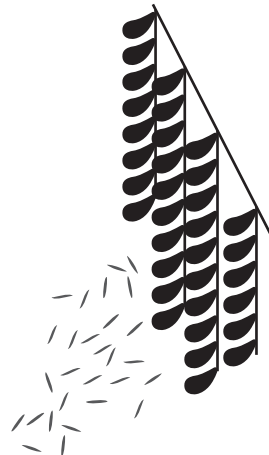
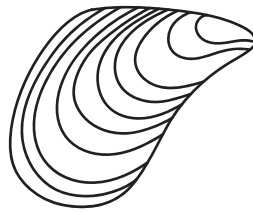
Finfish



organic matter

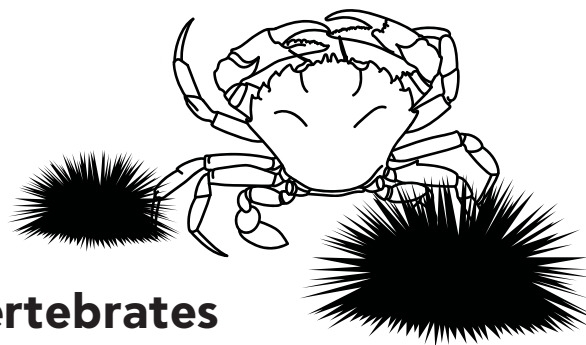
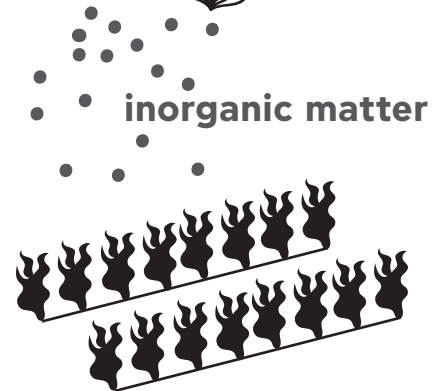


Shellfish



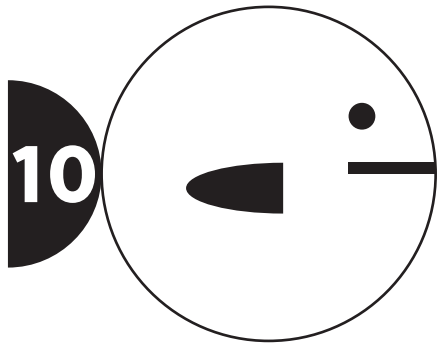
faeces and pseudofaeces

Seaweeds



Invertebrates





Discussion room

Duration

45 minutes

Objective

Assess the potential benefits and downsides of aquaculture through a debate.

Skills practised

Debating, imagining

Key message

Aquaculture can contribute to sustainable development if all requirements (environmental, social, economic) are met at the planning and implementation stage.

Material

Activity sheet 10.1

Organization

Groups, whole class

Instructions

Guided imagery

1. Create a relaxing atmosphere by playing some background water music (available on the internet). Ask students to close their eyes and prepare for a trip into the past, back through the aquaculture education journey. Read the following passage to take students on a guided tour.

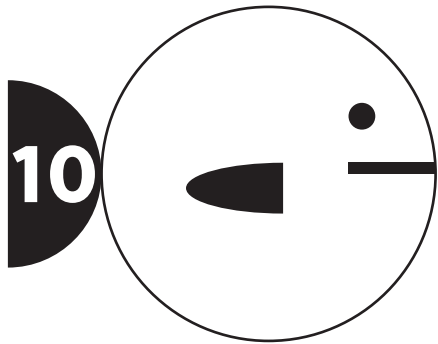
“Together, we are on a journey to discover the aquaculture sector. Along the way, we have learned a lot of information about aquaculture in our region. We realized we should ask for more information about the fish we eat, discovered farmed aquatic foods at a fish market, surveyed our school community, explored the ways in which aquaculture can help us achieve the SDGs and enhance food security, took a trip to the Kuriat Islands, and had the chance to appreciate the ugly – but beneficial – sea cucumber and all the potential cleaners of a farm.

Now, we have arrived at the point in our journey when it is time for you to showcase the knowledge you have gained.

There is a plan to build a new aquaculture site at the nearest coast to our school. The community is divided with some against the plan and some excited about that plan.

What do you think?”



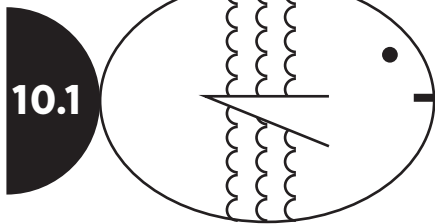


10 Discussion room

Debate

2. Divide students into two groups. One group will advocate for the aquaculture farm and the other will argue against it.
3. Distribute Activity sheet 10.1 to students, instruct them to think of their arguments and begin the debate.
4. Following the debate, discuss the outcomes as a class. Ask students if the farm should be built and explain that the answer is “yes, provided that...”.
5. List all the requirements that aquaculture farms should meet to minimize potential risks and maximize potential benefits. Remind students of the diagram on the integrated multitrophic aquaculture farm in Activity sheet 9.1.





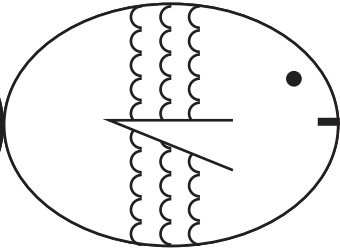
Discussion room

Potential benefits of aquaculture

- ▶ **Food security enhancement**
Aquaculture can produce large amounts of nutritious aquatic foods.
- ▶ **Water quality improvement and nutrient removal**
Aquaculture can improve water quality as there are many organisms (e.g. mussels) that filter the water and remove nutrients and harmful microorganisms from the ecosystem.
- ▶ **Habitat provision and reduced pressure on wild fish**
Some commercial species are fished at unsustainable levels. Aquaculture can help to ease unsustainable pressure on these stocks.
- ▶ **Carbon sequestration**
Many farmed species such as algae and shellfish absorb CO₂ and help mitigate climate change effects.
- ▶ **Ocean acidification regulation**
Organisms such as sea cucumber regulate the acidity of the water which is increasing due to climate change.
- ▶ **Restocking and wild stock enhancement**
Juveniles can be released to seas, lakes and rivers to enrich wild fish stocks. Essentially, farms can function like a genetic reservoir for wildlife.
- ▶ **Livelihoods**
Aquaculture offers a source of employment, both directly and indirectly, and supports the livelihoods of thousands in the Mediterranean and Black Sea region.









10.1

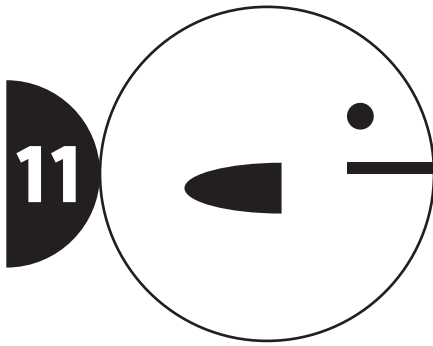


Discussion room

Potential negative impacts of aquaculture

- 
Environmental impacts
 Waste is produced from the organisms living in the farm and from human activity, including chemicals, antibiotics and solid waste. Local biodiversity can be affected when non-indigenous species are farmed (e.g. if a fish escapes from the farm).
- 
Human health impacts
 Some are concerned that human health could be affected depending on the conditions of farm, quality of food and medical treatments.
- 
Traceability
 It can be difficult to trace the exact processes used in aquaculture to determine to what degree they are sustainable and to inform consumers so that they can make responsible decisions.
- 
Impacts on the local community
 Local communities may miss out on benefits.
- 
Conflicts with other users
 Tourism entrepreneurs may lose income following the construction of an aquaculture facility – it may reduce accessibility to the area or have unfavourable visual impacts.
- 
Deprivation of land, water and natural resources
 Land, water and natural resources used for aquaculture may have been deprived from local communities.





Campaigners for sustainable development

Duration

45 minutes

Objective

Apply knowledge and raise awareness about the benefits of aquaculture.

Skills practised

Artistic expression, campaigning, collecting data and monitoring results, interviewing

Key message

It is important to transform knowledge into action.

Material

Activity sheet 4.1

Organization

Groups, whole class

Resources

Video 11.1



Video 11.2



Video 11.3

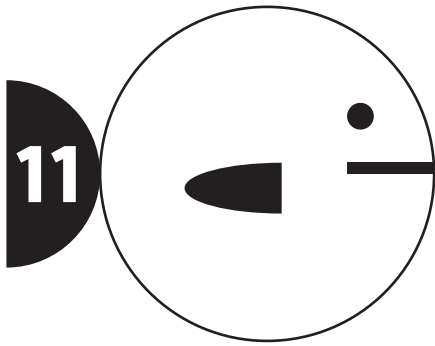


Instructions

Communicate, share, be a game changer

1. Encourage students by emphasizing that they now recognize the significance of aquaculture towards achieving key SDGs and they possess a clear understanding of public perceptions surrounding the sector. It is now time for them to share their insights and knowledge with others.
2. Help students to brainstorm communication tools and means to raise awareness on social and environmental causes.
3. Ask students what factors they think contribute to changes in attitudes, values and consumption patterns. Inquire if they believe that influencers play a significant role in this process and if they are aware of any individuals who could help bring about these changes.
4. Divide students into small groups. Instruct each group to develop a creative campaign to raise awareness about the benefits of sustainable aquaculture to their peers, teachers and families. For example, a group may design a poster, release a short video, create a street theatre scene, perform pantomime, or create a dance. For more information and examples, see Videos 11.1, 11.2 and 11.3, accessible through the QR codes (Karpos, 2014; Urge2 Splurge, 2018; Marwadi College, 2016).

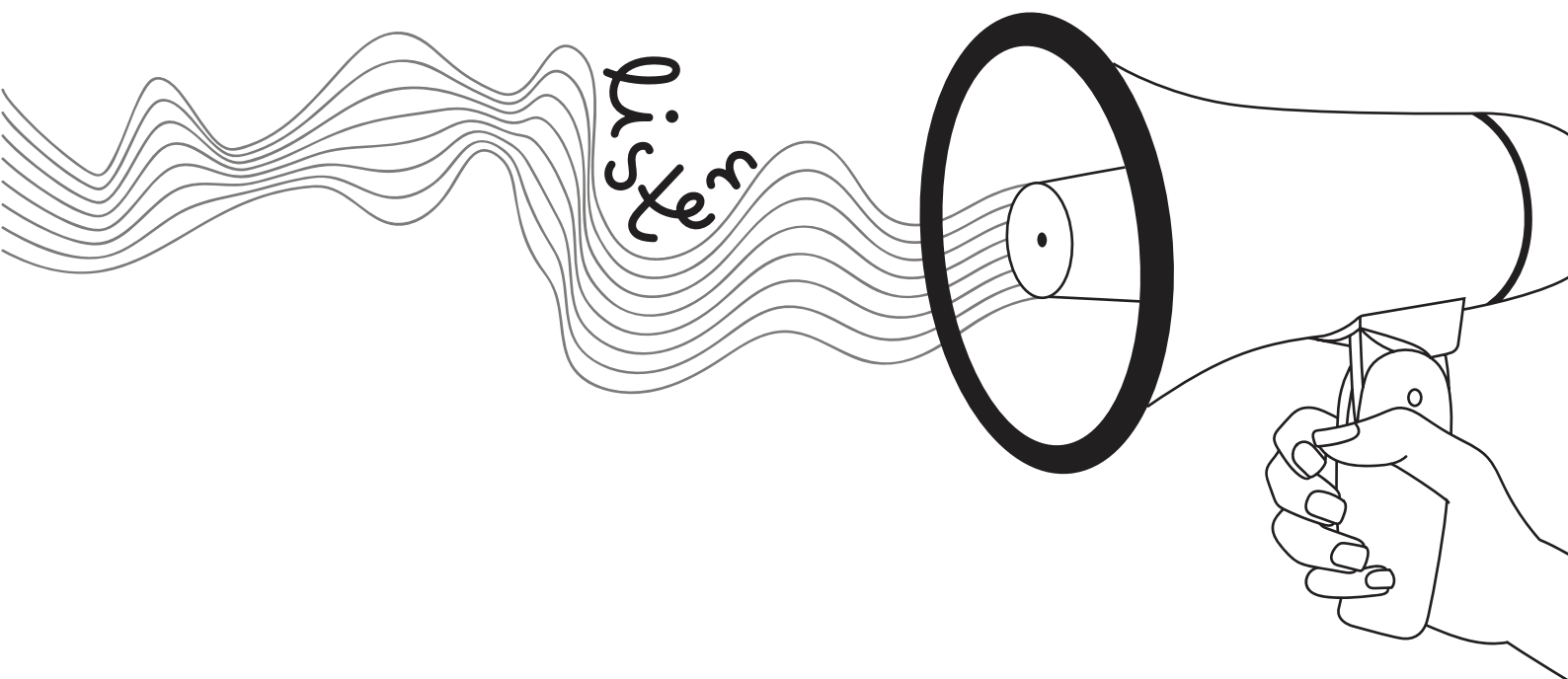


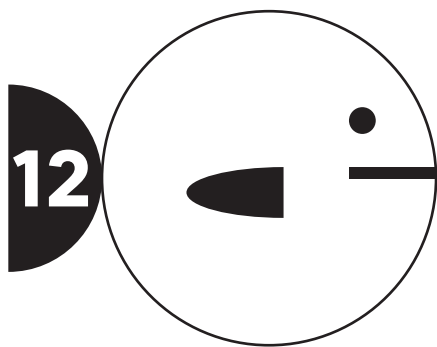


Campaigners for sustainable development

Measure your impact

5. Run the campaigns for a predetermined time period, for example two weeks.
6. Distribute Activity sheet 4.1 to students. Instruct them to complete the exercise on the sheet to determine the results of the awareness-raising campaign.
7. If the results do not show a positive change in attitudes towards aquaculture, instruct students to adapt their campaigns as needed and repeat.





Geography matters

Duration
30 minutes

Objective
Investigate the connections within the Mediterranean and Black Sea region.

Skills practised
Global and local thinking, orientation, reading maps

Key message
Environmental and sustainable development solutions require cross border communication.

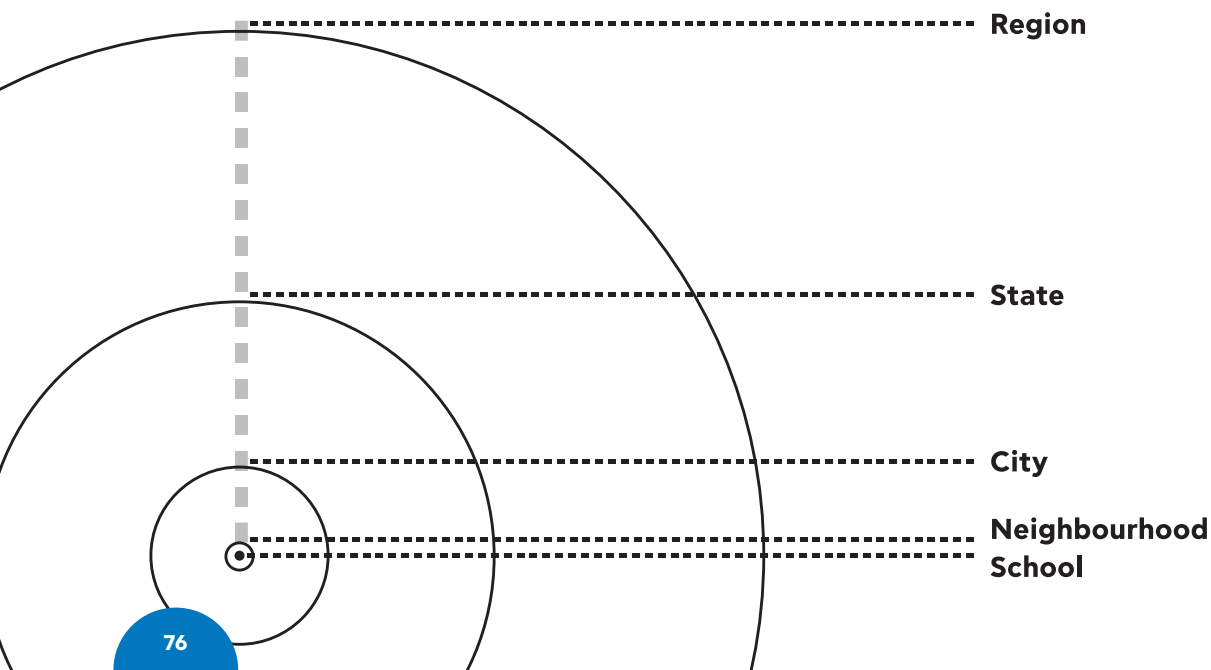
Material
Activity sheet 12.1

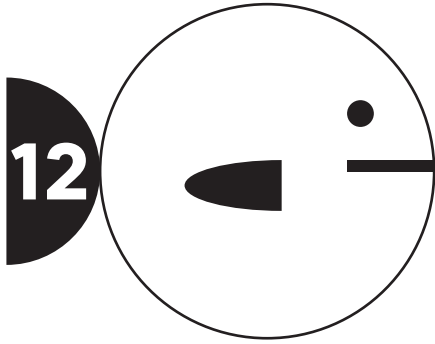
Organization
Individual, whole class

Instructions

Geography matters

1. Instruct students to draw a dot, representing the school, in the middle of a piece of paper and to draw circles around the dot identifying their neighborhood, city, state and region. Discuss how the school is part of a wider community.
2. Comment on the Mediterranean and Black Sea map (Figure 8). Discuss the characteristics of this region and how a semi-enclosed sea basin, such as the Mediterranean Sea, might shape the environment, economy and society of the countries bordering it.
3. Discuss the common challenges for the conservation of the marine environment in the Mediterranean and Black Sea region, and for the aquaculture sector.

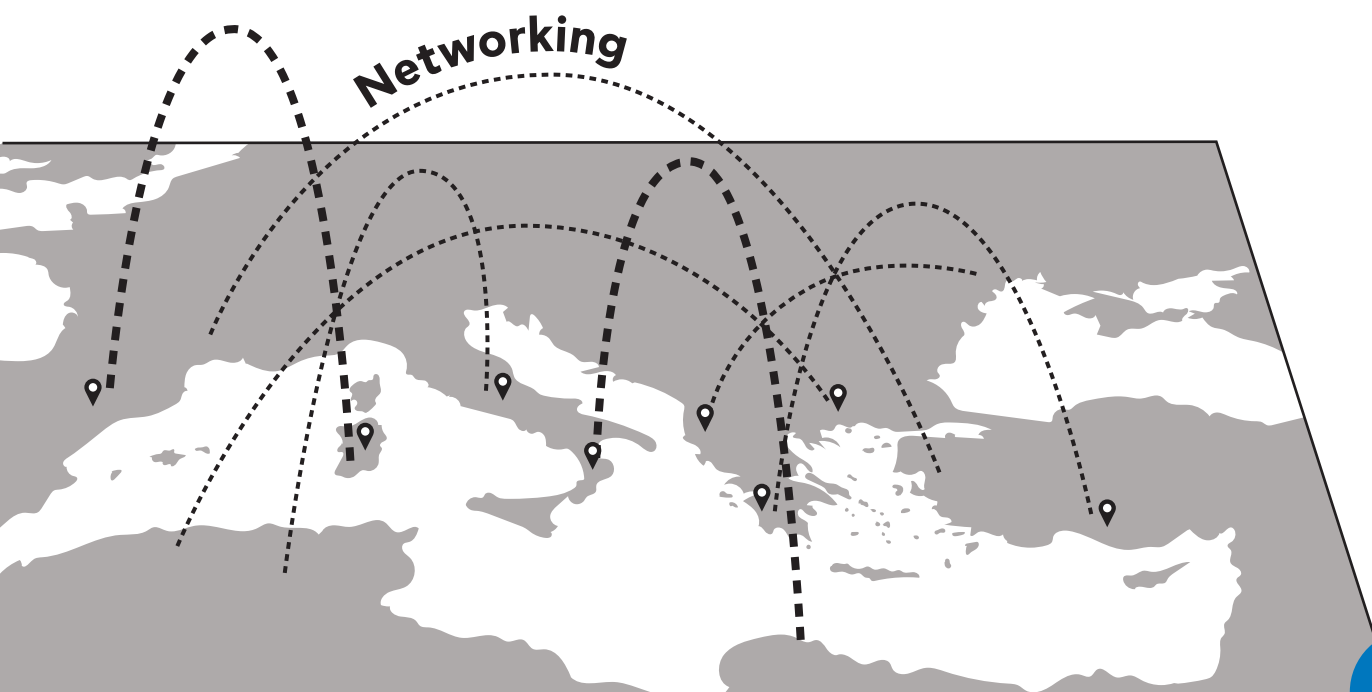


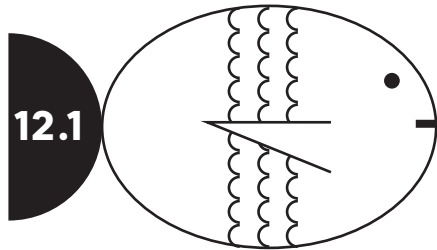


Geography matters

Our region, our aqua-network

4. Introduce the General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO), its mandate and its action. In particular, explain that it is a regional fisheries management organization with 22 member countries and the European Union and that its main objective is to ensure the conservation and sustainable use of living marine resources as well as the sustainable development of aquaculture in the Mediterranean and the Black Sea.
5. Distribute Activity sheet 12.1 to students. Instruct them to complete the exercise.
6. Ask students to present their aqua-network to the class.



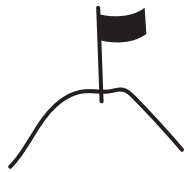


Geography matters

Our region, our aqua-network

Draw your country on the map in Figure 8 and draw its flag.

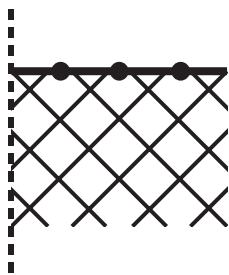
With your class, brainstorm ways in which you can create a network of schools working together in the region on aquaculture – an aqua-network!



The most common aquaculture practices in the Mediterranean and the Black Sea are the use of net pens (cages) for fish and the use of ropes for shellfish farming.



Look for pictures of these practices on the internet. Use these practices as inspiration to draw an aqua-network on the map. For example, you could draw a net spread across the region, or shellfish-farming ropes below the water.

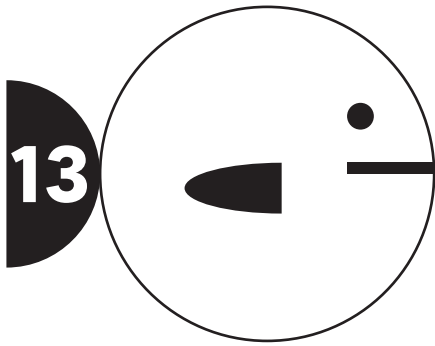


Be creative!





Figure 8. The Mediterranean and the Black Sea



Aquaculture at school

Duration

Variable

Objective

Apply knowledge about aquaculture practices through the construction of an aquaculture farm.

Skills practised

Listening, teamwork

Key message

Sustainable aquaculture is a promising route forward to support food security.

Material

Noted in Document 13.1

Organization

Whole class

Resources

Document 13.1



Website 13.1



Instructions

Create your own farm

1. Guide the students in creating an aquaculture farm at school. Instructions are available in Document 13.1, accessible through the QR code (FAO, 2015), and more information is available at Website 13.1, accessible through the QR code (Brainard, 2015).

Discuss aquaponics

2. Introduce the concept of aquaponics (Figure 9). Ask students if they think it is possible to combine agriculture and aquaculture and show them the illustration below. To set up and experiment with a simple aquaponics system at school, you may use Document 13.1 and contact the GFCM Secretariat at gfc-secretariat@fao.org.

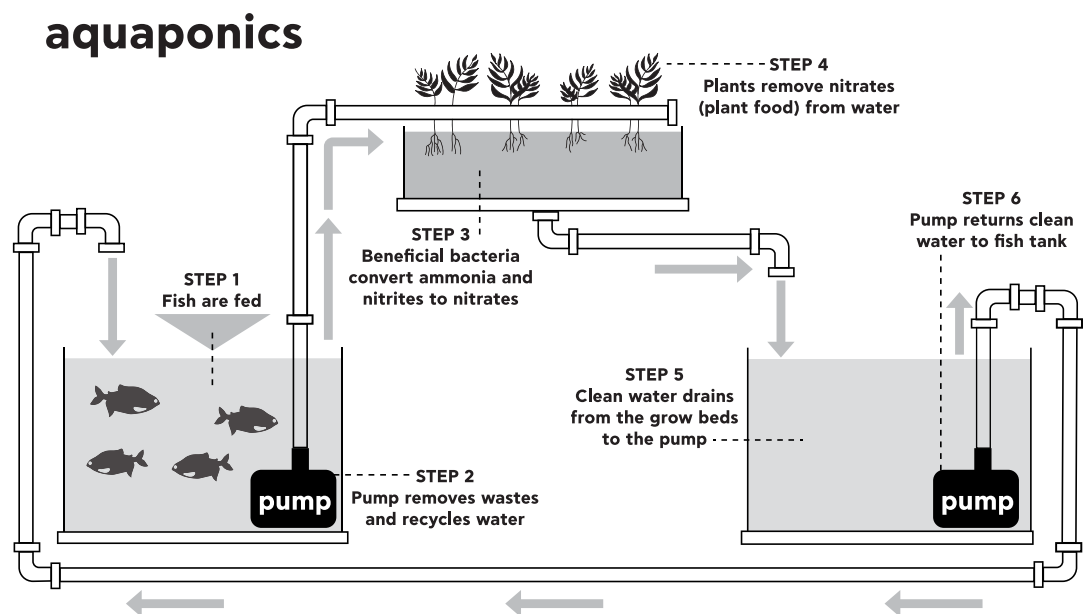
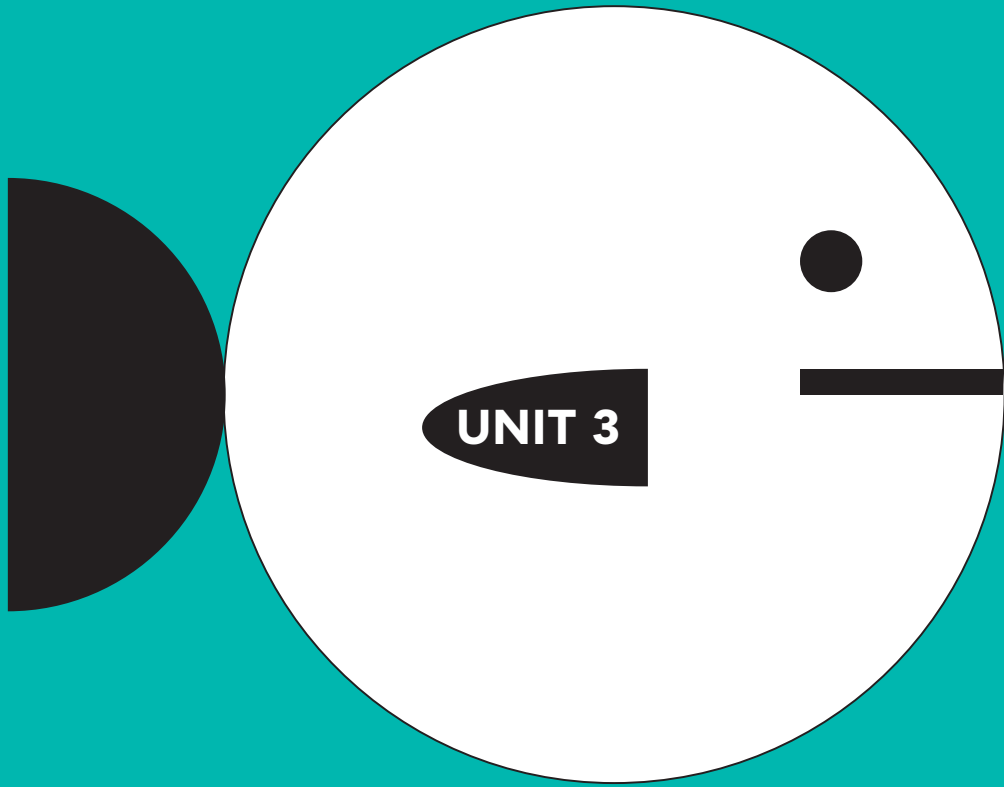


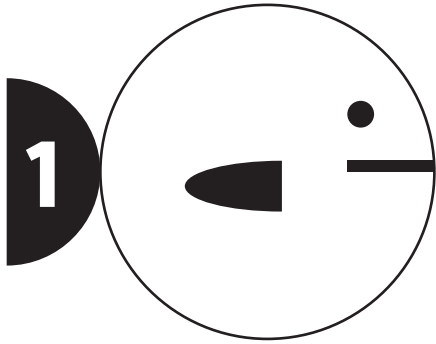
Figure 9. Aquaponics system

Source: Adapted from Targeted Aquaponic Growth. 2024. Aquaponics 101. In: *Targeted Aquaponic Growth*. Las Colinas, USA.[Cited 16 July 2024]. <https://tag2grow.org/aquaponics101/>



The juvenile's journey into sustainable aquaculture





Your group, your power

Duration

30 minutes

Objective

Introduce the design thinking methodology

Skills practised

Team building

Materials

- Meeting space
- Activity sheet 1.1
- Pencils

Organization

Groups

Instructions

Team players make good campaigners

1. You have learned a lot about aquaculture and you are ready to take action! You are now a member of a group dedicated to communicating the benefits of sustainable aquaculture.

Combating hunger and poverty, reducing pressure on overexploited wild fish stocks, mitigating the impacts of climate change, providing a source of sustainable livelihoods to local communities and contributing to gender equality – lofty goals, but you know sustainable aquaculture can help.

However, not many consumers know as much about aquaculture as you do.

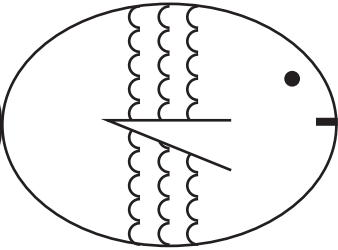
In this second stage of your aquaculture education journey, your group's mission is to share your knowledge about aquaculture to contribute to a positive attitude towards the sector.

You can do this in six steps, starting with an exercise to get to know your group members.

2. Complete the exercise on Activity sheet 1.1 and discuss the experience with your group.



1.1



Your group, your power

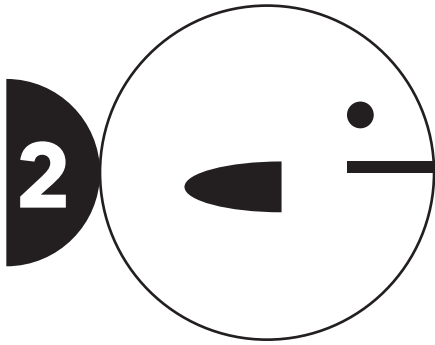
Bingo!

Following the signal to start, try to fill in all nine squares with answers from nine different group members. The first student to complete the card shouts "Bingo" and the game is over. If all the answers are correct, this student wins. If not, the student who filled in the greatest number of squares is the winner.

Find somebody who....

<p>...loves fish. Favorite fish: _____ Name of student: _____</p>	<p>...loves shellfish. Favorite shellfish: _____ Name of student: _____</p>
<p>...can name one filter feeder. Filter feeder: _____ Name of student: _____</p>	<p>...has been an activist for some cause. The action: _____ Name of student: _____</p>
<p>...has done volunteer work at least once. Volunteer work: _____ Name of student: _____</p>	<p>...knows what a campaigner does. A campaigner: _____ Name of student: _____</p>
<p>...can name one farmed aquatic species. Fish name: _____ Name of student: _____</p>	<p>...can name one quality of a good team player. Quality: _____ Name of student: _____</p>
<p>...can name one quality of a good team leader. Quality: _____ Name of student: _____</p>	





Empathize: understanding the target audience

Duration

90 minutes

Objective

Discover the target audience's point of view through interviews

Skills practised

Designing interviews, listening

Materials

- Meeting space
- Screen to display the video
- Activity sheet 2.1

Organization

Pairs

Resource

Video 2.1



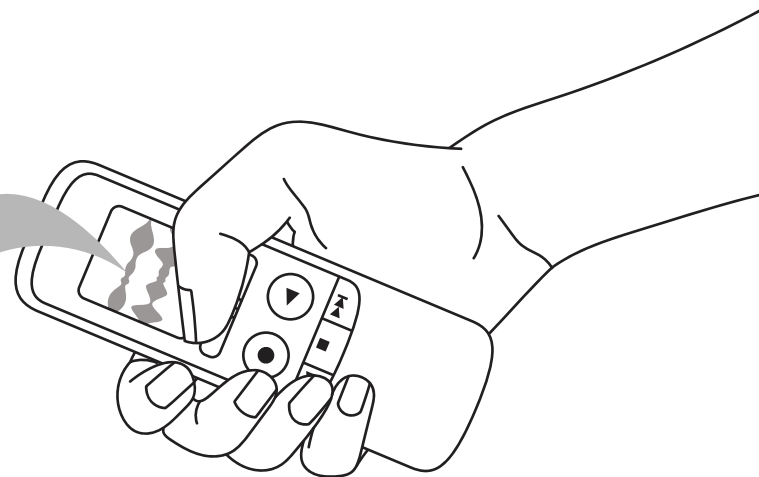
Instructions

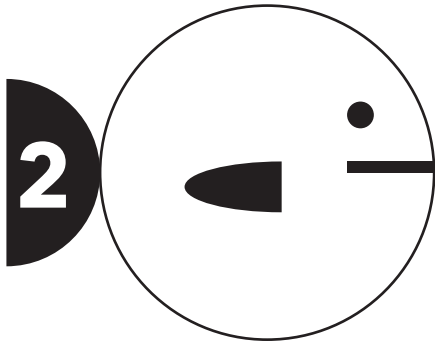
The innovative campaigner's method

1. This will not be just another environmental awareness campaign. Awareness campaigns are good, but they do just what they say: they raise awareness for something. How about going one step further? Let's change attitudes and, even better, change consumer behaviour patterns!

One thing we know for sure is that telling someone to do something is not enough. We need to consider the needs of the target audience, their profile, lifestyle and psychology. The proposed methodology is called design thinking. It is about designing innovative solutions to problems which may not even have been conceived as problems.

2. Watch Video 2.1, accessible through the QR code, to learn more about design thinking, (Sprouts, 2017).





Empathize: understanding the target audience

Connect with your audience

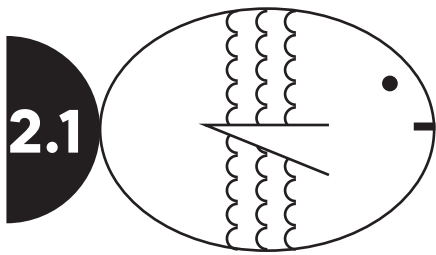
3. Your campaign to promote sustainable aquaculture should aim to change the perception of the target audience about aquaculture.

The first step in effectively influencing your audience is to empathize. One way to do so is to listen closely to what they have to say – in this case through interviews.

For this activity, you should set aside your own point of view and listen closely to your interviewee to understand their fears, inner motivations, needs, lifestyle, values and so on. Try to gain an understanding of the factors they consider when making a choice. Your final campaign will have to take into consideration these inner motivations.

4. Working in pairs and using Activity sheet 2.1, design a survey for your peers, teachers and family members. Use the survey to interview one peer, one teacher and one family member.
5. Using the answers and Activity sheet 2.2, create a profile for each interviewee.





Empathize: understanding the target audience

Connect with your audience

It is time to discover what your target audience thinks about farmed aquatic foods! When conducting your interviews, remember the following:

- Introduce yourself and explain the purpose of the interview.
- Immerse yourself in what the interviewee experiences.
- Observe the interviewee's body language.
- Engage with the interviewee.
- Listen closely to the answers.

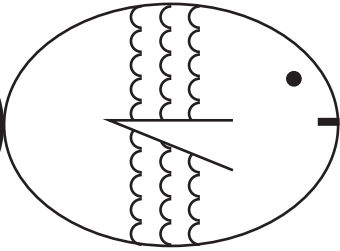
Try to opt for open-ended questions, for example:

- How often do you eat aquatic foods?
- What do you like or dislike about aquatic foods?
- Tell me about a time you really enjoyed eating an aquatic food.
- Do you ever choose to eat aquatic foods or is it always your family's choice?
- If an aquatic food was widely available in a quick snack format, would you buy it? Imagine this food and describe it.
- What information would you like to have about this delicious aquatic food snack/
- Have you ever connected your food with the state of the world, for example, hunger, poverty and climate change.
- Was there ever a time when you made a different food choice as a result of the information on the packaging.

Record the answers and complete the exercise on the activity sheet after the interview.



2.1



Empathize: understanding the target audience

Answers

of interviewee _____

1. _____

2. _____

3. _____

4. _____

5. _____

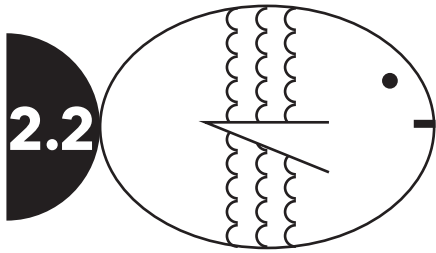
6. _____

7. _____

8. _____

9. _____

10. _____



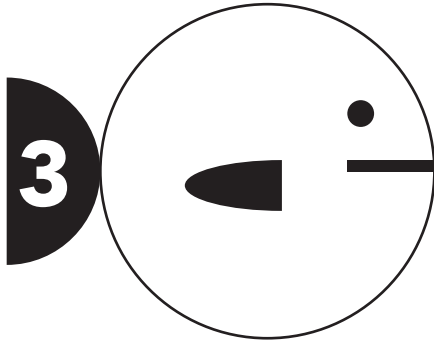
Empathize: understanding the target audience

What does your interviewee say, think, do and feel?

Summarize. Identify the key takeaways about the interviewee's values, food consumption patterns, lifestyle, priorities and needs.

Name of interviewee: _____

<p>say</p>	<p>think</p>
<p>do</p>	<p>feel</p>



Define: setting the goal of the campaign

Duration

60 minutes

Objective

Determine the goal of the campaign

Skills practised

Defining, summarizing, thinking

Materials

- Meeting space
- Paper and pencil
- Activity sheets 2.1 and 3.1

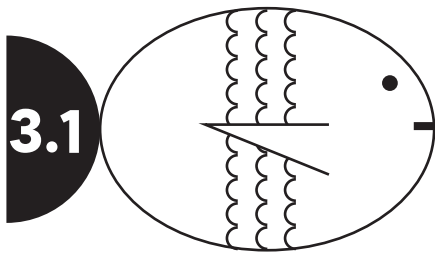
Organization

Pairs and groups

Instructions**Campaign challenge**

1. Now is the time to define the goal of your campaign from your target audience's point of view. Working in pairs, use Activity sheet 2.2 and Activity sheet 3.1 to phrase the goal as a "how might we" question.
2. Share each pair's "how might we" questions with the group and together decide which one will guide your campaign.





Define: setting the goal of the campaign

Your “how might we” question

It is important to phrase the goal of your campaign as a “how might we” question because these questions leave room for innovation and facilitate brainstorming. It is also important to consider the needs of the target audience.

“How might we” questions have a standard format.

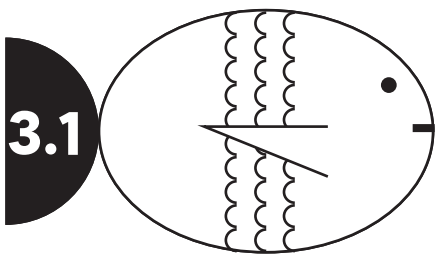
Use it to structure yours. Shape the question around the profile of your target audience.

The criteria of a good question:

- Based on an insight gained from your interviews.
- Tracks a desired outcome, in this case, the positive attitude towards aquaculture.
- Written in a way that motivates you to think of creative solutions.
- Broad enough to ensure many creative ideas.
- Does not suggest a solution.

HOW MIGHT WE





Define: setting the goal of the campaign

Try to prepare several different questions and choose the best one as a group.

How might we help _____ (target audience)
 who _____ (key insight from interviews)
 to _____ (desired result)?

How might we help _____ (target audience)
 who _____ (key insight from interviews)
 to _____ (desired result)?

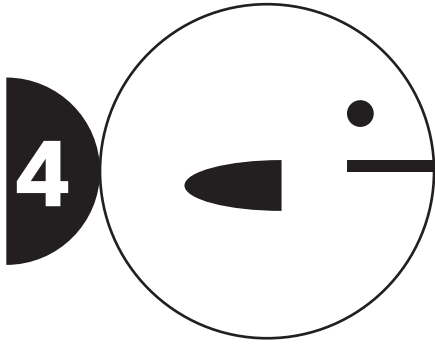
How might we help _____ (target audience)
 who _____ (key insight from interviews)
 to _____ (desired result)?

How might we help _____ (target audience)
 who _____ (key insight from interviews)
 to _____ (desired result)?

Examples

How might we help the teenagers of our school (target audience)
 who associate aquatic foods with boring family gatherings (key insight from interviews)
 to consider farmed aquatic foods in their dietary choices (desired result)?

How might we help the teenagers of our school (target audience)
 who enjoy eating small fried fish but will never opt for it if they have other choices (key insight from interviews)
 to consider farmed aquatic foods in their dietary choices (desired result)?



Ideate: reaching for the sky

Duration

60 minutes

Objective

Investigate possible answers to the “how might we” question

Skills practised:

Brainstorming, defining, summarizing

Materials

- Meeting space
- Your “how might we” question
- Activity sheet 4.1
- Coloured sticky notes and coloured pens

Organization

Groups

Resource

Video 4.1



Instructions

Warm up!

1. You have now reached a consensus on your “how might we” question that will guide the rest of your work so it is now time to brainstorm for solutions.

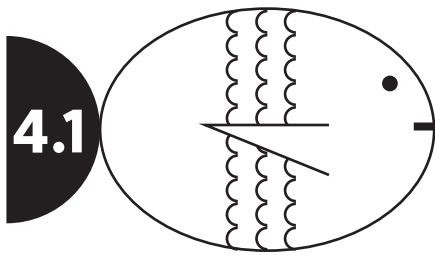
Write out and hang your question on the wall of your meeting room so that it is visible for all group members to remind you of the focus of your campaign.

2. To get your group ready to brainstorm, perform one warm up exercise. For example, in one minute, each group member should try to think of the possible uses for a paper clip. Whoever has the biggest list reads it aloud and the rest of your group suggests new uses to add to the list – the group is always more clever than the individual. For more information on where and how new ideas originate, see Video 4.1, accessible through the QR code (RiverheadBooks, 2010).

Brainstorm

3. There are two phases to brainstorming. In the first phase, try to think of as many ideas as you can. In the second phase, prioritize your ideas based on two criteria: impact and feasibility. Using Activity sheet 4.1, brainstorm solutions to your “how might we” question.





Ideate: reaching for the sky

Brainstorm

Phase 1. Aim for quantity

Put on some up-beat music, if it helps, and spend 1-2 minutes individually brainstorming answers to your “how might we” question.

Write each idea on a sticky note using coloured pens – do not worry about adding details and do not judge your ideas. Try to think outside the box.

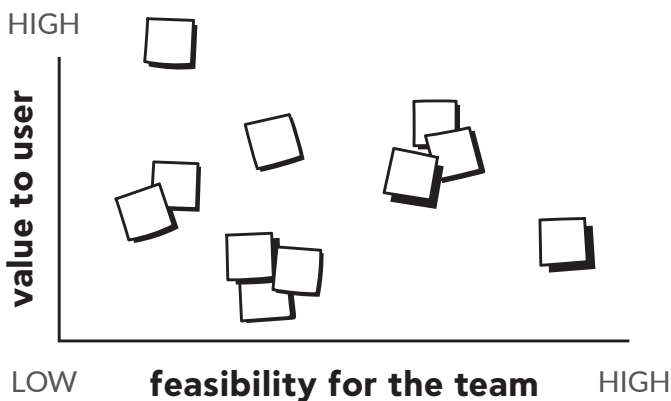
As a group, discuss your ideas.

Organize your ideas into clusters by combining those that are alike. As you are doing this, expand your ideas and add additional sticky notes as necessary. After you have clustered your group’s ideas, give each cluster a title.

For example, the idea to create posters with the most common aquaculture species can be clustered together with the idea to create placemats with key aquaculture species and recipes, under the heading “species inventories and teasers”. The idea to host a fish cooking day at school can be grouped together with the idea to invite a chef under the heading “cooking”.

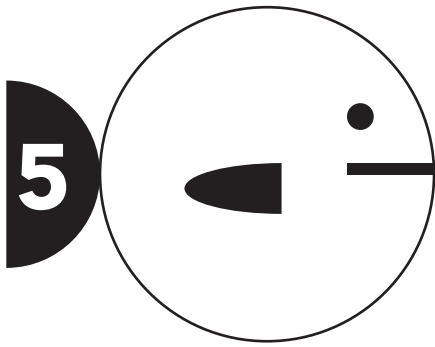
Phase 2. Aim for rational, effective and realistic choices

Sort your idea clusters based on a scale of feasibility and impact. Be creative, flexible, discuss alternatives and listen to each other. It should look something like this:



Choose the idea that rates high on both axes





Prototype: trying the idea at the small scale

Duration

60 minutes

Objective

Construct three-dimensional models of the chosen solution and storyboards

Skills practised

Building a model, creating a storyboard

Materials

- Meeting space
- Screen to display the video
- Papers, magazines for colored illustrations, glue, scissors, pencils, recyclable packages, empty boxes, whatever can be used to create a three-dimensional model
- Activity sheet 5.1

Organization

Groups

Resource

Video 5.1

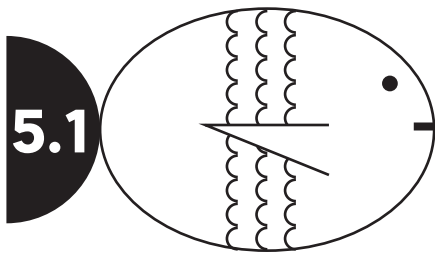


Instructions

Make it tangible

1. In Activity 4, you defined your group's best idea in terms of feasibility and impact. Before moving forward, conduct a final check: does your idea answer the "how might we" question? If not, refine it. Feel free to modify your "how might we" question, if necessary, as long as it is based on the needs of your target audience. If you feel that you need to go back to your interviewees (or to new ones) for one more round of empathy discussion, do it! Design thinking is a non-linear methodology. You always go back to check, monitor and improve your idea.
2. Now it is time to put your idea into practice. Using Activity sheet 5.1, prepare a three-dimensional model of your idea, called a "prototype", as well as a storyboard to show the target audience's journey and the experience you will offer them. If your idea is a two-dimensional object, such as a poster, you can make a model of your poster and define the location it will be placed. For more information, see Video 5.1, accessible through the QR code (CreativeCharlie, 2016).
3. Show your prototype and storyboard to members of your target audience and get their feedback.





Prototype: trying the idea at the small scale

Make it tangible

Follow the instructions below to prepare your prototype and storyboard. Use them to get feedback from your target audience about your idea.

Do not try to sell your idea or fall in love with it. Your prototype and storyboard are means to test your idea. Listen carefully to feedback and be ready to change, improve or even delete and recreate your idea. Trial and error will get you there!

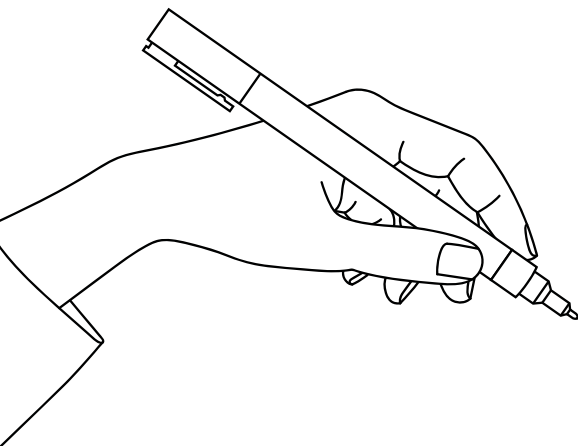


Phase 1. Build a model

Prototypes are meant to help you define the details of your idea, improve it and test it. Using inexpensive materials, prepare your tangible, three-dimensional prototype.

Phase 2. Draw a storyboard

Illustrate the journey of a member of your target audience to your solution. Prepare a scene from before your solution, when the target audience member first experiences it, how they react and the end result.



Narrative

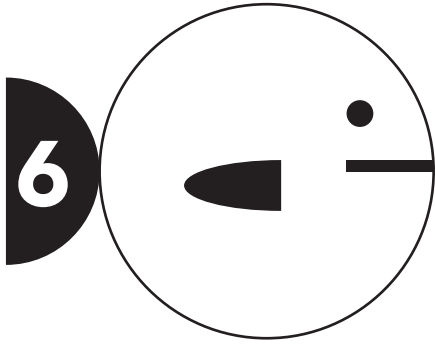
Scene 1. The consumer rejects a dish with farmed aquatic foods

Scene 2. The consumer sees your solution

Scene 3. The consumer is motivated and asks for more information

Scene 4. The consumer considers eating farmed aquatic foods

A large rectangular frame divided into four quadrants by a horizontal line and a diagonal line. The quadrants are labeled 1, 2, 3, and 4 in their respective corners.



Implement: launching the campaign

Duration
30 minutes

Objective
Prepare a plan and launch the campaign

Skills practised:
Scheduling, defining indicators of success

Materials

- Meeting space
- Activity sheet 6.1

Organization
Groups

Instructions

Ready for action!

1. You have shown your prototype and storyboard to your target audience and you listened carefully to their feedback. Did your idea resonate with them? Were the messages and style of message appropriate for the problem? Based on their reactions, it may be necessary to improve your idea. Once you feel confident with your idea, it is time to implement your campaign.
2. Using Activity sheet 6.1, create a schedule for your campaign and define your indicators of success.
3. Decide on a name for your campaign and design a logo.
4. Launch your campaign based on the schedule you defined and discuss the results with your group.
5. Congratulations for planning this campaign based on design thinking! Sustainable aquaculture has great potential for creating a better world, and you are now a key player in this area.

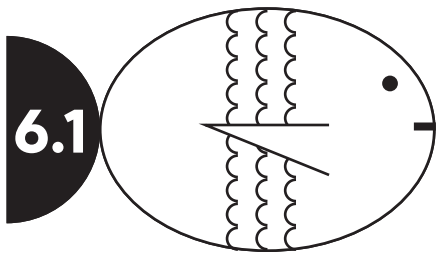
Getting inspired

6. Using Activity sheet 6.2, read the stories of two young women who pursued a career in aquaculture and consider following the path you have just opened by acting as a campaigner. You could become an aquaculture professional of the future!

				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

LAST THINGS TO DO





Implement: launching the campaign

Implement Your campaign

- Name of your campaign: _____
- Logo: _____
- Timetable (4-6 weeks is a good time span)
Start date and end date: _____

Success indicators:

1. _____

Measurement method: _____

2. _____

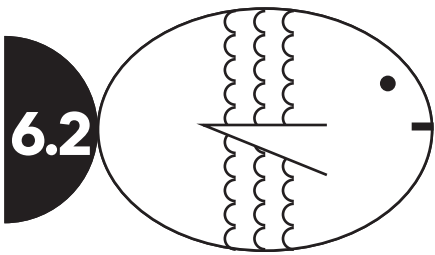
Measurement method: _____

For example:

Twenty-five percent of school mates who attended our theatre play changed their perception about aquaculture.

Measurement method: Randomized survey after the theatre show.





Implement: launching the campaign

Getting inspired

Amina Kechuindi

My name is Amina Kechuindi and I am an agricultural engineer from Tunisia specialized in fisheries and the environment. I am currently working as a consultant in sustainable development and as a writer focusing on environmental issues in Tunisia.

People always ask me how I can handle the pressure of two jobs in marine research, but my answer is always the same: I am passionate about what I do!

Growing up in a small coastal village, I spent a large portion of my time around water and became eager to learn more about its secrets. At the time, we did not have internet, so I read books and watched documentaries of a famous naval officer and explorer named Jacques-Yves Cousteau. He became my superhero. I wanted to be just like him: dive deep and explore the sea and support marine biodiversity and aquatic ecosystems. I wanted to have his courage and be able to show the world the beauty of the seas. Watching his adventures made me more and more interested in the diversity of marine life and the importance of the ocean for the health of the planet. The more I learned, the more I grew to love oceans and seas, until I decided to make protecting them my career.

I went on to study fisheries and the marine environment and obtained my engineering degree. In the meantime, I remained active in civil society and tried my best to promote the environmental cause wherever I went. I also earned my diving certificate and became a professional diver after two years of training, reaching depths of 38 m in the Mediterranean Sea. With each of these steps, I got closer and closer to my dream: to make a change and be part of saving the seas!

I believed, and still believe, that aquaculture can contribute to that change. Sustainable aquaculture could be the key to feeding our growing population while reducing pressures on overexploited wild stocks.

Maintaining ocean health is a major concern for me, but I believe that aquaculture has the potential to address many of my worries. For this reason I am eager to learn more about the sector and to explore the possibility of starting an entrepreneurial adventure in this field!

“We must plant the sea and herd its animals, using the sea as farmers instead of hunters. That is what civilization is all about – farming replacing hunting”

Jacques-Yves Cousteau



Garazi Rodríguez

My name is Garazi Rodríguez and I am an aquaculture professional from Spain. I am currently working for the Spanish Association of Aquaculture Producer's (APROMAR) that represents the companies farming finfish in Spain with the goal of making them more competitive and of enhancing the sustainability of the aquaculture sector in Europe.

My journey into the world of aquaculture began with a snorkeling adventure in 2017, when I came across a few beautiful shells. I fell in love at first sight! Each return to the beach fueled my curiosity as I searched for these treasures. I soon discovered that these shells belonged to abalone (*Haliotis tuberculata*), a species sought after for jewelry making and a gourmet product in Japan and other Asian countries, fetching prices of up to EUR 80/kg! This led me to a company that was growing them in Galicia, Spain.

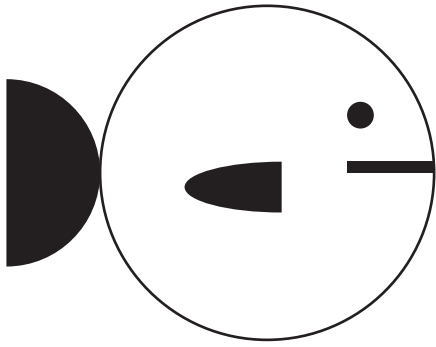
At the time, I was looking for a job and inspired by my new-found fascination with abalone, I began to research more about the aquaculture sector. Recognizing its potential to produce affordable, nutritious and high-quality protein, I decided to pursue a master's degree in aquaculture with the goal of becoming of the experts in the fast-growing sector within ten years.

Before graduating, I applied for a job, but had not received a response by the time I secured an internship in the Kingdom of the Netherlands.. Just before I left for my internship, I received a call for an interview in response to my job application. Fast forwards five years and I am still thriving at APROMAR, where my passion has transformed into a fulfilling career.

Abalone opened my eyes to the wonders of aquaculture. It led me down a path where I feel that I belong – one that allows me to achieve my goals and help enhance food security. My job has connected me with dedicated professionals and has granted me the opportunity to travel the world and learn new things every day.

**A career in aquaculture is one for the present and the future.
The sector is innovative, diverse and growing each day.
I encourage you to explore this field.
It will unlock a world of opportunities for your future.**





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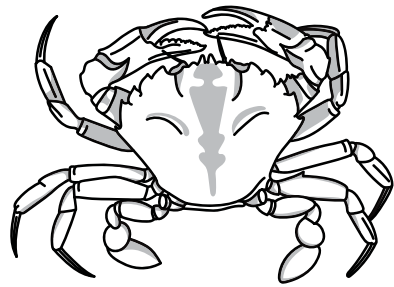
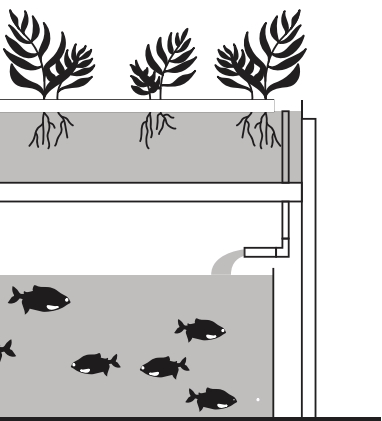
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Glossary



Terms and definitions are provided, when possible, as in the FAO Term portal (FAO, 2022). Additional terms and definitions are in line with references provided or as per GFCM practice.

Algae: A simple, nonflowering and typically aquatic plant of a large group that includes seaweed and many single-celled forms. Algae contain chlorophyll but lack true stems, roots, leaves, and vascular tissue.

Aquaponics: Bio-integrated system that links recirculating aquaculture with hydroponic vegetable, flower and/or herb production.

Aquatic foods: Food for human consumption grown in or harvested from water.

Bivalve: An aquatic mollusc that has a compressed body enclosed within a hinged shell, such as oysters, mussels, and scallops.

Carbon footprint: Total amount of greenhouse gases associated with a product or activity.

Carbon sequestration: The process of increasing the carbon content of a reservoir other than the atmosphere.

Crustacean: An aquatic animal belonging to the phylum Arthropoda, a major group of invertebrate organisms characterized by their chitinous exoskeleton and jointed appendages, occurring in marine and freshwater and on land, such as crabs, lobsters, crayfish, shrimps and prawns. Microcrustaceans include cladocerans and copepods.

Ecosystem restoration: The process of reversing the degradation of ecosystems, such as landscapes, lakes and oceans to regain their ecological functionality; in other words, to improve the productivity and capacity of ecosystems to meet the needs of society.

Filter feeder: Aquatic animal that feeds by extracts small pieces of food and particles from the surrounding water (Perez, 2022).

Integrated multi-trophic aquaculture (IMTA): The practice which combines, in appropriate proportions, the cultivation of fed aquaculture species (e.g. finfish, shrimps) with aquaculture species that extract their inorganic (e.g. seaweeds) and organic food (e.g. suspension feeders such as bivalves and deposit feeders such as sea cucumbers) from the surroundings. Such arrangement creates a balanced ecosystem management approach to aquaculture for environmental sustainability (biomitigation), economic stability (product diversification and risk reduction) and social acceptability (better management practices).

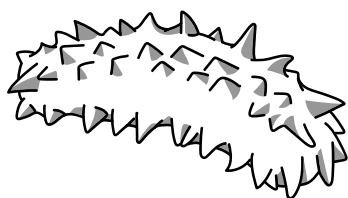


Livelihood: A means of securing the necessities of life.

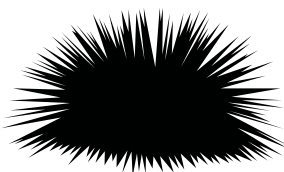
Mollusc: A class of aquatic animals with soft bodies (and often hard shells), such as oysters, mussels, cuttlefish, snails and slugs.

Nature-based solution: Actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits.

Non-fed aquaculture: Farming of aquatic organisms that do not need supplemental feeding, including fish, molluscs, crustaceans and aquatic plants.



Restocking: The release of cultured or wild-caught aquatic species (usually juveniles) into the wild to restore the spawning biomass of severely overfished stocks to levels at which they can once again provide sustainable yields. This may also involve re-establishing a commercial species where it is locally extinct due to overfishing or releasing juveniles reared in conservation hatcheries to help restore endangered or threatened species.



Restorative aquaculture: The practice of restoring the health of ecosystems including through the improvement of water quality, provision of habitats, sequestration of carbon and restocking of wild populations.

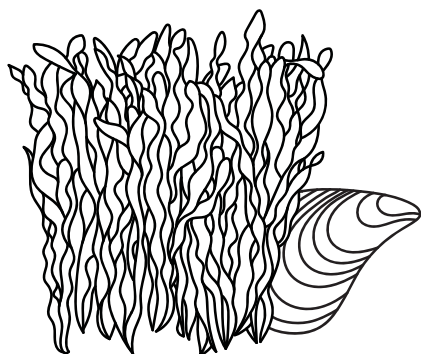
Sea cucumbers/holothurians: Marine animals belonging to the phylum Echinodermata, class Holothuroidea. Certain species are fished for human consumption, traditionally in small artisanal fisheries (FAO, 2004).

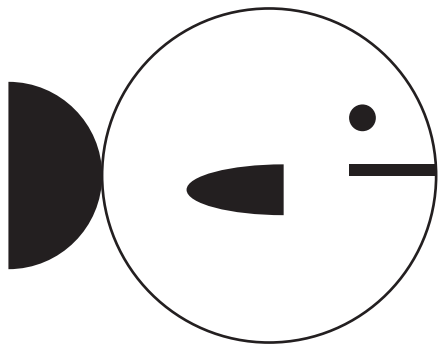
Sea urchin: Marine species of the phylum Echinodermata, class Echinoidea. They usually live in areas with algal food available and are commercially important for human consumption (McBride, 2005).

Seaweed: Large marine alga, occurring both naturally and under cultivation, but specifically excluding phytoplanktonic algae and microalgae.

Shellfish: Aquatic invertebrates possessing a shell or exoskeleton, usually molluscs and/or crustaceans.

Traditional knowledge: Knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity.





Appendix 1

Adaptations of the activities for students ages 5–7

How much scientific information is too much for our students? As mentioned previously, one of the intentions of this education journey is to respect the needs of children and adolescents, especially their need to play, socialize and interact. This is why a wide range of games and participatory methods have been used to teach the complex aspects of aquaculture and its potential to fulfill many SDGs. Games, role play, field visits, interviews, simulation games and hands-on projects such as setting up a fish farm at school are proposed. However, students ages 5–7 might have difficulty understanding some concepts. Below is a list of simplifications, adaptations and ideas to help younger students learn and play at a level that is appropriate for their age.

1. A fish called “yam yam”

The definition of aquaculture can be simplified to an age-appropriate level and teachers can discuss students’ experiences of keeping fish in a fishbowl. Teachers can describe the carbon footprint of food as the cost to the environment during the journey from farm to fork.

2. A day in the fish market

The interview questions can be simplified to an age-appropriate level and students can observe and record common fish and ask vendors if they were wild-caught or farmed. Following the interview, teachers can stimulate discussion about farmed aquatic foods.

3. Where does it come from?

The analysis of results from Activity 2 can be simplified to an age-appropriate level. Students can take pictures of aquatic food packages they have at home and discuss what information is provided on the packages and what other information they would like to know. Based on this discussion, students can draw their own labels. Teachers can introduce the main features of sustainable aquaculture, such as keeping the farm and the surrounding area clean.

4. What’s on their mind?

The interview can be limited to two to three common questions for the entire class.

5. Roll the dice

The analysis of results from Activity 4 can be simplified to an age-appropriate level. Teachers can cover the most complex aspects of the dice and make these blank sides of the dice “chose-your-own” options. If climate change has not been introduced to students before, teachers can introduce it now, emphasizing the role of CO₂ emissions in climate change.

6. How did it start? Where will it go?

The timeline descriptions can be simplified to an age-appropriate level.

7. Aqua games

Students can use the cards in many ways and in many versions of games.

8. A trip to the Kuriat Islands

Students can watch Video 8.1 and discuss. Teachers can build on this stimulus lead discussions about the compatibility of sustainable aquaculture, conservation efforts and marine protected areas.

If time and resources allow, teachers can complement Activity sheet 8.3 with a hands-on activity to create seaweed hand cream, a seaweed face mask or other seaweed-based product. A sample recipe using agar (derived from red algae) is available below with ingredients measured as percentages to scale the final amount of product based on needs (SELT Marine Group, 2024).

Yellow clay face mask

Ingredients

- Yellow clay powder (47.76 percent)
- Cold water (21.61 percent)
- Glycerin (17.57 percent)
- Agar powder (1–1.5 percent)
- Rosewater (4.78 percent)
- Vitamin E oil (0.29 percent)
- Sweet almond oil (7.07 percent)

Directions

- Mix the water and agar powder in a small saucepot and bring to a boil.
- Remove from heat and stir in the glycerin and rosewater.
- Gradually add the clay and stir to combine.
- Stir in the vitamin E and sweet almond oils, and add any essential oils of your choice.

9. A zero-waste farm

Teachers can simplify Activity sheet 9.1 to an age-appropriate level, such as by asking students to work as a class and draw arrows between “who eats whom” in an integrated multitrophic aquaculture farm. Teachers can comment on the importance of this closed system for the quality of water.

10. Discussion room

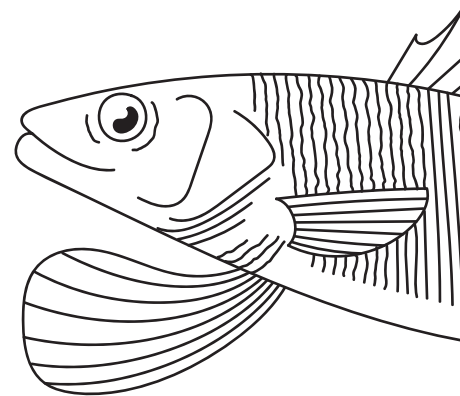
Teachers can simplify the pros and cons arguments to “we will feed more people” and “water can be polluted”, respectively, and can lead the discussion to the “yes, under certain conditions” answer.

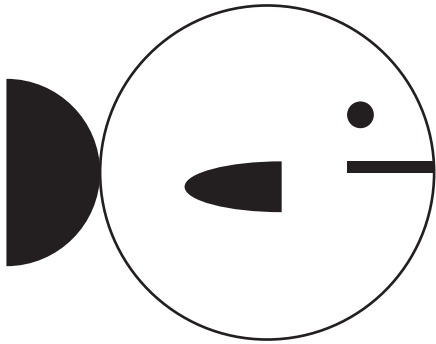
11. Campaigners for sustainable development

Students can explain to their families one reason why it would be beneficial to buy farmed aquatic foods.

12. Geography matters

Using a world map on the wall or on the screen, teachers can lead students in naming the countries around the Mediterranean and the Black Sea and what these countries have in common. Teachers can highlight the importance of working together to support overexploited fish stocks and alleviate hunger, poverty and climate change.





Appendix 2

Advancing aquaculture education for sustainable development

In collaboration with Notre Grand Bleu, a Tunisia-based non-governmental organization, the GFCM is continuing to advance aquaculture education towards empowering communities to embrace sustainable practices for a better future. Here are some examples of the initiatives that have been developed.

Aquaculture education cabin

This hub for knowledge on sustainable aquaculture, aquaponics, ecosystem services, climate change and microplastics was built to be a 360° educational experience for students. The cabin features informative posters on aquaculture practices, artwork, screens to showcase videos of various aquaculture activities and to connect virtually with students in other countries, and audio systems for voiceovers in three languages (Video 1; Notre Grand Bleu, 2025a).

Video 1



Aquaponics units

Three aquaponics units combining aquaculture and hydroponics were installed in schools in Monastir, Tunisia. These units are being used to educate students about the sustainability and benefits of aquaponics systems and their connection to the Blue Transformation vision, and to facilitate practical learning experiences (Video 2; Notre Grand Bleu, 2025b) (Video 3; Notre Grand Bleu, 2025c).

Video 2



Video 3



Training for rural women and young chefs

Several trainings on responsible aquaculture practices, nutrition, product valorization and culinary skill development were organized for rural women and young chefs. Practical demonstrations and theoretical sessions equipped participants with knowledge on freshwater fish and novel techniques for preparing farmed aquatic foods, and aimed to empower attendees to make informed decisions and contribute to sustainable food systems (Video 4; Notre Grand Bleu, 2025d) (Video 5; Notre Grand Bleu, 2025e).

Video 4



Video 5



International Day of Education and World Tourism Day

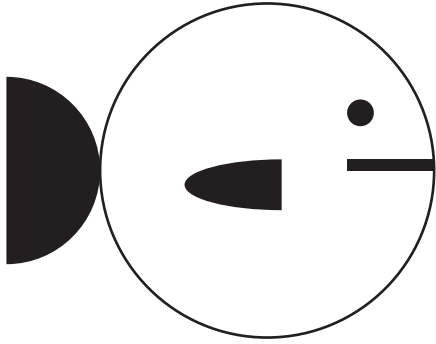
Open days were organized on the occasion of the International Day of Education and World Tourism Day and aimed to showcase aquaculture practices and aquaponics solutions, emphasizing their relevance for sustainable tourism and environmental conservation. Culinary sessions promoted the valorization of farmed aquatic foods while workshops encouraged youth engagement and aquaculture educational endeavours, collaborative action planning on aquaponics, *Posidonia* conservation and composting initiatives (Video 6; GFCM, 2024) (Video 7; Notre Grand Bleu, 2025f).

Video 6



Video 7





Appendix 3

Mediterranean-inspired aquatic food recipes

To complement the discussions of the health benefits of aquatic foods and the Mediterranean diet, find Mediterranean-inspired recipes at the QR codes below.



Baked seabream fillets
(Video 1; Notre Grand Bleu, 2024b)



Seabream carpaccio
(Video 2; Notre Grand Bleu, 2024c)



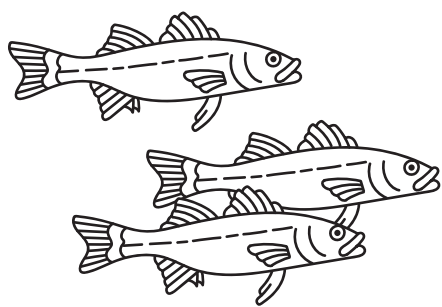
Seabream kefta
(Video 3; Notre Grand Bleu, 2024d)



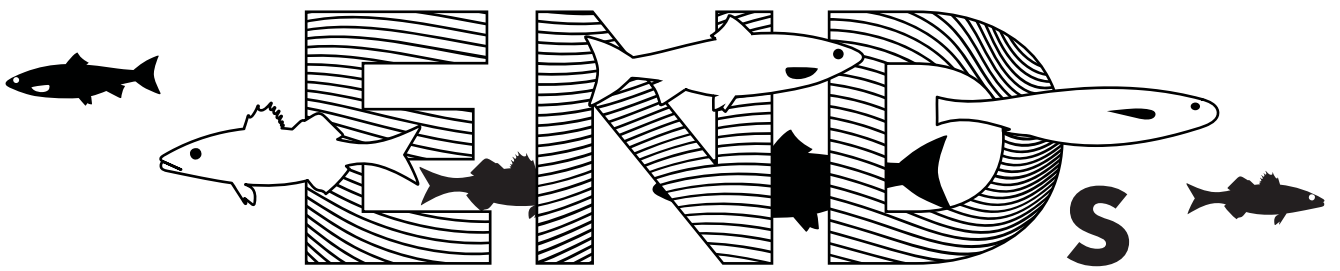
Breaded seabream
(Video 4; Notre Grand Bleu, 2024e)



Seabass en croute
(Video 5; Notre Grand Bleu, 2024f)



The story of aquaculture starts and...



with you.

Farmers of the water: Education toolkit for the Blue Transformation of aquaculture in the Mediterranean and the Black Sea

This publication presents an educational toolkit designed to take teachers and students throughout the Mediterranean and the Black Sea on a journey to discover the aquaculture sector in their region. Divided into three units for teachers, students ages 5–18 and students ages 13–18, this educational journey highlights the environmental, social and economic benefits of farmed aquatic food systems with activities centered around fun, teamwork and critical thinking. By working through the activities in the toolkit, students will join in the Blue Transformation of aquaculture and discover their power to contribute to sustainable and resilient farmed aquatic food systems.

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