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**COURSE FOR ENVIRONMENTAL EDUCATION**

*e-Modules: Teaching Learning activities and their technology enhanced material set to develop*

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| **MODULE 4** | **THE IMPACTS OF THE ENVIRONMENTAL PROBLEMS AND CLIMATE CHANGE (PART 1 – ECOSYSTEMS)** |
| **PART 2** | **Aquatic / marine ecosystems**  |
| **Lesson 1-2** | **What are the changes in (marine )ecosystems and the risks marine ecosystems face?** |

SUMMARY

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### COURSE TIME, TARGET AND TOPIC

##### Age of target students: 15+

* + **Teaching time:** 1 hour
	+ **Disciplines:** Biology
	+ **Title:** Marine ecosystems

### COURSE OBJECTIVES

#### Competences promoted in this lesson:

* + Communication in foreign languages competency
	+ Digital competency
	+ Learning to learn competency
	+ Social and citizenship-related competencies

#### Lesson objectives:

* Students discuss marine ecosystems
* Students observe the changes in marine ecosystems and assess the risks marine ecosystems face.
* Students organise an action to take public attention on marine ecosystems

### LEARNING – TEACHING PROCESSES

There are 4 activities in this lesson:

1. **ENGAGE:** Initial representation and recall
2. **EXPLORE: The Earth, a set of ecosystems** (watch a video, if there is time, make Internet research and a short presentation)
3. **EXPLAIN: Ecosystems, communities of interacting living beings** (work in group to complete a table)
4. **EXTEND: You’re an exobiologist** (create an imaginary ecosystem)

### EVALUATION

The evaluation is described in the last part of document.

### DOCUMENTS

# ENGAGE

## Initial representation and recall ecosystems

Students repeated what an ecosystem is. „What is ecosystem?”

An ecosystem is a community of living organisms in conjunction with the nonliving components of their

environment, interacting as a system. This includes plants, animals, and microorganisms, as well as the physical and chemical factors such as air, water, soil, and sunlight. Ecosystems can be as large as a forest or as small as a pond. The interactions between the living and nonliving components allow ecosystems to maintain a balance and sustain life.

Ecosystems are typically categorized based on their predominant characteristics, which can include factors like climate, vegetation, and geographical location. Here are some common types of ecosystems:

1. Terrestrial Ecosystems
2. Aquatic Ecosystems
3. Man-made Ecosystems
4. Specialized Ecosystems
5. Transitional Ecosystems

These categories are not exhaustive, and there can be overlaps and variations within ecosystems based on local conditions and human influences.

Students repeated what an ecosystem is. «So what is marine ecosystem?”

A marine ecosystem refers to the interactions between living organisms and their environment in the saltwater habitats of the world. These ecosystems can include oceans, coral reefs, estuaries, and coastal areas. Marine

ecosystems are incredibly diverse and play a crucial role in maintaining the balance of life on Earth. They support a wide variety of plant and animal species, ranging from microscopic phytoplankton to large whales. Marine

ecosystems also provide essential services such as oxygen production, carbon sequestration, food, and recreational opportunities for humans.

# EXPLORE

## The Earth, a set of ecosystems

There are countless ecosystems around the world, each characterized by its unique combination of living

organisms and their physical environment. Ecosystems can range from vast forests to tiny ponds, from deserts to coral reefs. It's impossible to provide an exact number of ecosystems because they vary in size, complexity, and classification criteria. Additionally, ecosystems are not isolated entities; they often interact and overlap with one another, forming a complex web of life on Earth.

Exploring marine ecosystems can be a fascinating endeavor due to the immense diversity of life and

environments found in the world's oceans. Here are some key aspects and components of marine ecosystems you might encounter during exploration:

1. **Physical Environment**: Marine ecosystems encompass a wide range of habitats, including coastal areas, coral reefs, open oceans, deep sea trenches, and more. Each of these habitats has unique physical characteristics such as temperature, salinity, pressure, and light availability, which greatly influence the organisms that can thrive there.
2. **Biodiversity**: Marine ecosystems host a staggering array of life forms, from microscopic phytoplankton to massive whales. This biodiversity supports complex food webs and ecological interactions. Exploring marine biodiversity can involve studying various organisms such as fish, marine mammals, invertebrates, algae, and bacteria.
3. **Coral Reefs**: Coral reefs are among the most biodiverse marine ecosystems, providing habitat for a vast array of marine species. They are built by colonies of tiny coral polyps and are home to numerous fish, invertebrates, and other organisms. Coral reef exploration involves studying the reef structure, the species that inhabit it, and the ecological processes that sustain these ecosystems.
4. **Deep Sea**: The deep sea is one of the least explored environments on Earth, with vast expanses of seafloor and extreme conditions such as high pressure, low temperatures, and darkness. Deep-sea exploration involves using specialized equipment such as remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs) to study deep-sea life, geological features, and hydrothermal vents.
5. **Marine Conservation:** Exploring marine ecosystems also involves studying the impacts of human activities such as overfishing, pollution, climate change, and habitat destruction. Marine conservation efforts aim to protect and preserve these ecosystems for future generations by implementing measures such as marine protected areas, sustainable fisheries management, and pollution control.

Overall, exploration of marine ecosystems requires interdisciplinary approaches involving biology, ecology,

oceanography, geology, and technology to gain a comprehensive understanding of these complex and dynamic environments.

# EXPLAIN

## Ecosystems, communities of interacting living beings

Ecosystems are indeed communities of interacting living beings, along with their physical environment. They encompass all the organisms in a particular area and the non-living factors with which they interact. These

interactions can include relationships such as competition, predation, mutualism, and symbiosis, among others. Ecosystems can vary greatly in size and complexity, from small microecosystems like a puddle or a rotting log to vast biomes like tropical rainforests or oceans. Regardless of their size, ecosystems are characterized by the flow of energy and cycling of nutrients among their components.

At the heart of every ecosystem are the relationships between organisms and their environment. These

interactions shape the structure and function of the ecosystem, influencing factors such as species diversity, population dynamics, and ecosystem resilience. Understanding ecosystems and the interactions within them is crucial for conservation efforts, as it allows scientists and policymakers to assess the health of ecosystems,

identify threats, and develop strategies for their protection and management.

Ecosystems are often described as communities of interacting living beings because they represent dynamic networks of organisms and their physical environment, where various components interact and influence each other in complex ways. Here's why ecosystems are considered communities of interacting living beings:

1. Interdependence: Within an ecosystem, organisms are interdependent, meaning they rely on each other for various resources such as food, shelter, and reproduction. For instance, plants rely on sunlight, water, and

nutrients from the soil, while animals may depend on plants for food and habitat. These interdependencies form intricate food webs and networks of relationships.

1. Energy Flow: Ecosystems operate on the principle of energy flow, where energy is transferred from one organism to another through feeding relationships. Primary producers, like plants, harness energy from the sun through photosynthesis and convert it into organic matter. This energy then flows through the ecosystem as herbivores consume plants, carnivores consume herbivores, and so on, forming trophic levels within the food chain.
2. Nutrient Cycling: Nutrients essential for life, such as carbon, nitrogen, and phosphorus, cycle through

ecosystems in biogeochemical processes. Decomposers break down dead organic matter, returning nutrients to the soil or water, where they can be taken up by plants and reused by other organisms. This cycling of nutrients is crucial for sustaining life within the ecosystem.

1. Competition and Cooperation: Organisms within ecosystems often compete with each other for limited resources such as food, water, and space. This competition helps regulate population sizes and shapes

community structure. Additionally, organisms may also engage in cooperative interactions, such as mutualism and symbiosis, where both parties benefit from their relationship.

1. Feedback Loops: Ecosystems exhibit feedback loops, where changes in one component can have cascading

effects throughout the system. For example, if a predator population declines due to habitat loss or overhunting, it can lead to an increase in prey populations, which may then impact plant populations through herbivory, ultimately altering the structure and function of the entire ecosystem.

Understanding ecosystems as communities of interacting living beings highlights the interconnectedness and complexity of life on Earth. It emphasizes the importance of considering the relationships between organisms and their environment when studying, managing, and conserving ecosystems.

# EXTEND

## Student project

Student create an imaginary marine ecosystem called "Aqua Reef":

**Location:** Aqua Reef is located in the tropical waters of the fictional Archipelago, nestled between the islands.

##### Physical Environment:

* Aqua Reef consists of a sprawling coral reef system stretching across an area of approximately 100 square

kilometers. The reef is built upon a submerged plateau with depths ranging from shallow waters near the surface to deeper sections reaching 30 meters.

* The water surrounding Aqua Reef is crystal clear, with visibility extending up to 30 meters. It maintains a warm temperature year-round, averaging around 25-28°C, ideal for supporting diverse marine life.
* The reef is bathed in sunlight, providing ample energy for photosynthesis to support coral growth and sustain the vibrant ecosystem.

##### Biodiversity:

* **Coral Gardens**: AquaReef boasts an extensive array of coral formations, including branching corals, massive corals, and delicate coral gardens. These corals provide habitat and refuge for a multitude of marine species.
* **Marine Fauna:** The reef teems with life, from colorful reef fish like clownfish, parrotfish, and angelfish to larger predators such as reef sharks, barracudas, and moray eels. Sea turtles gracefully navigate through the waters, while octopuses and cuttlefish display their camouflaging abilities among the coral crevices.
* **Invertebrates**: The reef supports a diverse community of invertebrates, including sea stars, sea urchins, and colorful nudibranchs. Crustaceans like hermit crabs scuttle along the sandy seabed, while vibrant anemones sway gently in the currents.
* **Pelagic Visitors**: Beyond the reef, pelagic species like dolphins, whales, and manta rays occasionally visit Aqua Reef, drawn by the abundance of food and favorable conditions.

##### Ecological Interactions:

* **Mutualistic Relationships:** Symbiotic partnerships thrive within Aqua Reef, such as the mutualistic relationship between clownfish and sea anemones. The clownfish find shelter and protection among the anemone's

tentacles, while the anemone benefits from the nutrients provided by the clownfish.

* **Predation and Prey:** The reef ecosystem is governed by predation and prey relationships, with predators hunting smaller fish and invertebrates for sustenance. However, these interactions help maintain a balance within the ecosystem, preventing any one species from dominating.
* **Nutrient Cycling:** Decomposers like bacteria and fungi play a vital role in nutrient cycling within Aqua Reef,

breaking down organic matter and recycling nutrients back into the ecosystem to support primary producers like corals and algae.

# EVALUATE

Evaluation of the lesson on marine ecology can be conducted based on various criteria such as student engagement, comprehension of the material, participation in discussions, and ability to apply acquired knowledge to problem-solving. Here are several criteria and methods for assessment:

##### Student Engagement:

* + - Assessing participation in class discussions, responses to teacher questions.
		- Observing group work during interactive tasks.

##### Understanding of the Material:

* + - Administering a brief test or quiz on the key concepts of marine ecology presented in the lesson.
		- Reviewing and assessing homework assignments related to the lesson, such as reflections or analyses of specific marine ecosystem issues.

##### Engagement and Quality of Participation:

* + - Evaluating the quality of students' responses and argumentation during discussions.
		- Considering the ability to express their own opinions and ask questions.

##### Application of Knowledge:

* + - Assessing the outcomes of group activities, such as presentations or simulations, where students were required to apply acquired knowledge to solve specific situations.
		- Analyzing homework assignments where students may have proposed practical solutions to marine ecosystem problems.

Additionally, feedback from students can be used, such as through anonymous surveys or classroom discussions, to find out what they liked most about the lesson and what could be improved. This can also be a valuable tool for assessing the effectiveness of the lesson and planning future sessions.

Marine Ecosystem

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| **Across**1. Where freshwater and salt water meet (coastal area)
2. Interaction of all living things in an area
3. very simple plants that live in water; the size ranks from microscopic plankton to meters-long kelp
4. an island consisting of a circular coral reef surrounding a bay
5. an animal that eats another animal for food

**13.** rotate between submergence and non submergence because of the tidal waves1. the top of the kelp forest where blades rest on the surface of the water
2. poison produced by a living organism
3. Under layer; something to hold on to or attach to
4. total amount of dissolved salts in a water sample
5. special blades on the bottom of the kelp above the hold fast that produce spores.
 | **Down**1. rise and fall of Earth's water on its coastline
2. Forms an symbiotic relationship with corals
3. Plants that are adapted to grow, it is either floating on the surface or submerged in mud
4. a long coral reef near the shore (parallel to it)
5. a animal that eats plants
6. algae and animals that float in water which are carried by waves and the currents
7. an alteration of adjustment by a species improves the relationship in the environment

**14.** a large stream of (waves) moving water the flows through the oceans**17.** Known as nature soup, decomposed marsh grass |

1. **Estuary:** The area where freshwater and saltwater meet, typically occurring in coastal regions where rivers or streams flow into the ocean.
2. **Ecosystem:** The interaction of all living things in an area, including plants, animals, and microorganisms, as well as their physical environment.
3. **Tides**: The rise and fall of Earth's water on its coastline, caused by the gravitational pull of the moon and the sun.
4. **Zooxanthellae**: Microscopic algae that form a symbiotic relationship with corals, residing within their tissues and providing them with nutrients through photosynthesis.
5. **Plants:** These are very simple plants that live in water, ranging in size from microscopic plankton to meters-long kelp. They play important roles in aquatic ecosystems by producing oxygen, providing habitat and food for aquatic organisms, and contributing to nutrient cycling.
6. **Atoll:** An island consisting of a circular coral reef surrounding a central lagoon or bay, often formed on the rim of an ancient submerged volcano.
7. **Predators:** An animal that eats another animal for food, obtaining nutrients and energy by consuming the flesh or body parts of other organisms.
8. **Hydrophytes**: Plants that are adapted to grow in water, either floating on the surface or submerged in mud. They may include species like water lilies, duckweed, and various types of algae.
9. **Barrier Reef**: A long coral reef located near the shore and running parallel to it, forming a barrier between the open ocean and the coastline.
10. **Herbivore**: An animal that eats plants as its primary food source, obtaining nutrients and energy from vegetation.
11. **Plankton**: Algae and animals that float in water and are carried by waves and currents. Plankton include both phytoplankton (algae) and zooplankton (tiny animals).
12. **Adaptation**: An alteration or adjustment by a species that improves its relationship with the environment, enhancing its chances of survival and reproduction.
13. **Intertidal Zone:** The area of the shoreline that is alternately submerged and exposed by the rise and fall of the tides.
14. Ocean **Current**: A large stream of moving water that flows through the oceans, driven by factors such as temperature, salinity, wind, and the Earth's rotation.
15. **Canopy:** The top layer of a kelp forest where the blades of kelp plants rest on the surface of the water, forming a dense canopy-like structure.
16. **Venom:** Poison produced by a living organism, typically injected into prey or enemies through specialized structures such as fangs or stingers.
17. **Detritus:** Known as "nature soup," detritus refers to decomposed organic matter, such as decomposed marsh grass, that forms a nutrient-rich mixture in aquatic ecosystems, supporting various organisms at the base of the food

chain.

1. **Substrate:** The underlying layer of material in an ecosystem, providing a surface for organisms to attach to or hold on to.
2. **Salinity:** The total amount of dissolved salts in a water sample, typically measured in parts per thousand (ppt) or as a percentage.
3. **Sporophylls:** Specialized blades on the bottom of kelp plants, located above the holdfast, that produce spores for reproduction.

# All links to sources

##### [Marine Ecosystems - National Geographic Society](https://www.google.com/url?sa=t&rct=j&q&esrc=s&source=web&cd&cad=rja&uact=8&ved=2ahUKEwjezObnyMmEAxWW8QIHHTxIB2cQFnoECBAQAw&url=https%3A%2F%2Fwww.nationalgeographic.org%2Ftopics%2Fresource-library-marine-ecosystems%2F%23%3A~%3Atext%3DMarine%2520ecosystems%2520are%2520aquatic%2520environments%2Cdifferent%2520physical%2520and%2520biological%2520characteristics.&usg=AOvVaw1hq8qekk6XyvkrWLX_nITA&opi=89978449)

**https://education.nationalgeographic.org/resource/resource-library-marine-ecosystems/** [**Marine Ecosystem Crossword**](https://wordmint.com/public_puzzles/596377)

##### https://wordmint.com/public\_puzzles/596377 [Ecosystem](https://education.nationalgeographic.org/resource/ecosystem/)

**https://education.nationalgeographic.org/resource/ecosystem/**

##### [Evaluation of the effect and investment benefit of Marine ecosystem protection and restoration](https://www.frontiersin.org/articles/10.3389/fevo.2022.991198/full)

**https://**[**www.frontiersin.org/articles/10.3389/fevo.2022.991198/full**](http://www.frontiersin.org/articles/10.3389/fevo.2022.991198/full)