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MODULE 1

ecosystems and biodiversity

trainer's booklet

realize the delicate balance of nature

IDEA Universal (Turkey)
DUTH (Greece)
UABSC (Ukraine)
İO-BAS (Bulgaria)

ecosySTEM PROJECT

Empowering Children for Environmental Sustainability through E-STEM

NO	Activities
1	**Module 1: Ecosystems and Biodiversity**
1.1	Nature Observation (Field Trip)
1.2	Let's Find Out Biomes!
2	**Module 2: Environment and Water**
2.1	Let's Design Water Filter
2.2	Aquaponics (Sustainable Food Production System)
2.3	Rain Harvesting
2.4	Oil Spill Solutions
2.5	Investigating Water Quality (Field Trip)
3	**Module 3: Environment and Air**
3.1	The Frightening Rise at Sea Level
3.2	Exploring Air Pollution
4	**Module 4: Environment and Soil**
4.1	Erosion
4.2	Forest Detectives (Field Trip)
5	**Module 5: Environment and Renewable Energy**
5.1	Exploring Renewable Energy
5.2	Let's Design with Eco-Friendly Energy
6	**Module 6: Environment and Waste Management**
6.1	Design by Using Waste Materials
6.2	Turning Organic Waste into Compost
6.3	Clean Up Challenge (Field Trip)

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ABOUT THE BOOKLET

The educational material includes instructions, worksheets, and theoretical background for the implementation of the activities to be carried out within the scope of the ***Empowering Children for Environmental Sustainability through E-STEM: ecosySTEM project*.**

Trainers should:

1. Examine the booklet in detail, benefit from the subject summary in the theoretical background section and be prepared for the activities.
2. Ensure that all necessary equipment and materials are ready before the activity.
3. Foster student engagement by providing guidance during the implementation process.
4. Take safety precautions and ensure that students adhere to them.
5. Conduct activities as open-ended or semi-structured, considering students' grade level, developmental level and readiness.
6. Inform students about scientific research and engineering design processes.
7. Introduce the Team Assessment Rubric for evaluation, and encourage self-assessment and peer assessment.
8. Allow students to fail in the engineering design process and learn from these experiences.

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SCIENTIFIC RESEARCH AND ENGINEERING DESIGN PROCESSES

Scientific Research Process

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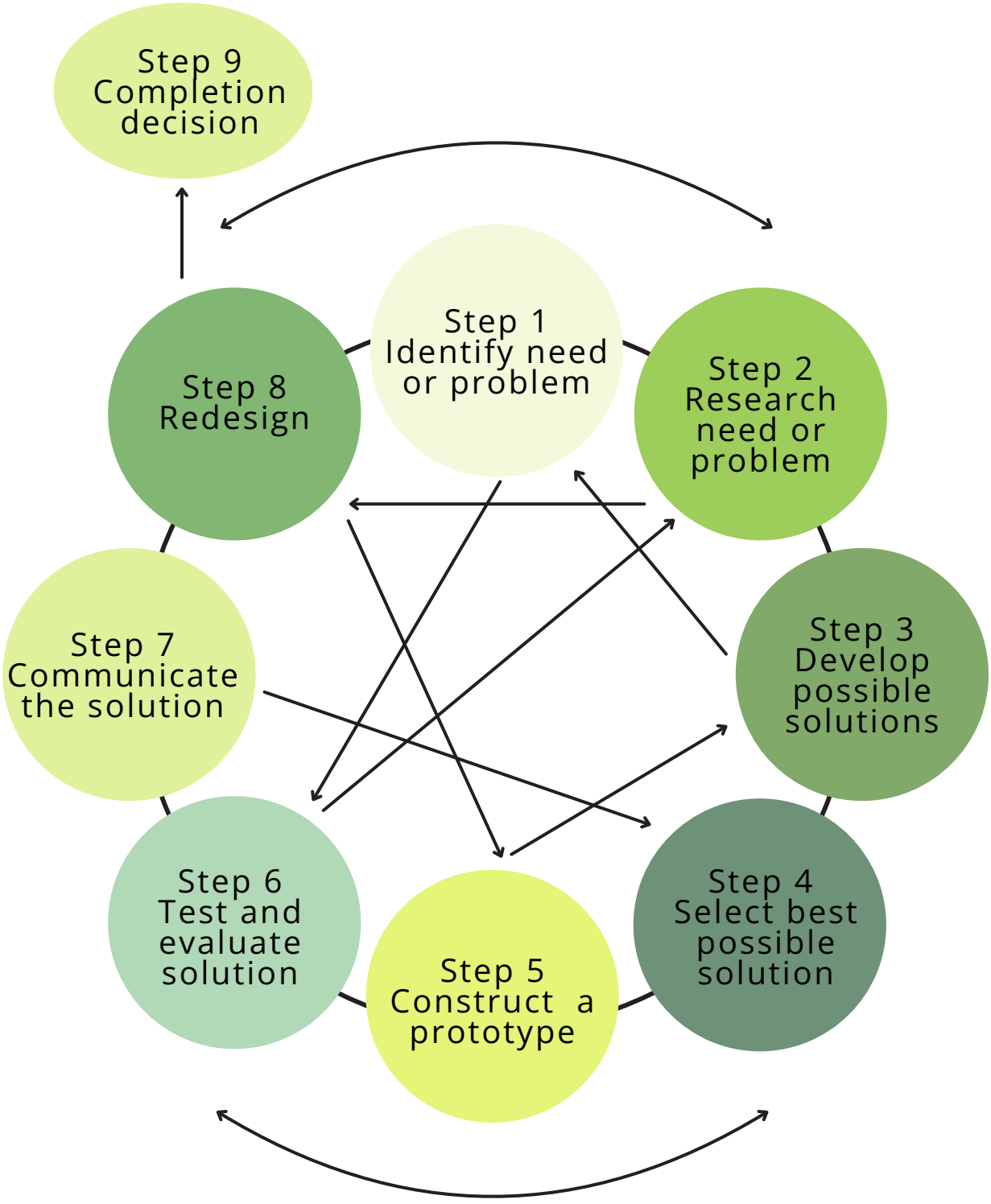

Engineering Design Process (Hynes et al., 2011 p.9)

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DESIGN EVALUATION RUBRIC

CRITERIA	(1) INADEQUATE	(2) PARTIALLY SUFFICENT	(3) ADEQUATE
Defining the Problem Is the problem clearly and precisely defined?			
Creating Possible Solutions Are there at least two possible solutions to the problem?			
Selecting a Solution Proposal Were all criteria and constraints considered when selecting the solution proposal?			
Prototyping Does the prototype meet all criteria and constraints?			
Testing and Analyzing the Prototype Has the prototype been tested? Were data collected and analyzed?			
Prototype Refinement/Development Have at least two features of the prototype been improved / proposed to be improved?			
Presentation and Discussion Was the presentation clear and effective? Were the results of the analysis shared?			
Time Management Was the design completed in the given time?			
Teamwork/Collaboration Did all team members contribute to the work?			
TOTAL POINTS			

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ECOSYSTEMS AND BIODIVERSITY

NO	ACTIVITIES	STATUS
1	Nature Observer	120 minutes
2	Let's Find Out Biomes!	80 minutes

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NATURE OBSERVER

Ages 8-15

Ecosystems and Biodiversity

120 minutes

Key Concepts

- Ecosystem
- Biodiversity
- Food chains
- Food webs
- Energy flow
- Nutrient cycles
- Ecological balance
- Environmental threats

Purpose: In this activity, it is aimed for students to explore the role of biodiversity in ecosystem dynamics, to compare species diversity across different areas in order to analyze ecological balance, to examine food chain and food web relationships to understand interactions among organisms, to collect data and conduct observations using scientific and technological methods in line with STEM-based approaches, and to develop their ability to interpret ecosystem processes by incorporating engineering and mathematics components.

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Learning Outcomes

By the end of this activity, students will be able to:

- Understand the importance of biodiversity for ecosystems and natural life.
- Explore the interactions between living and non-living components in ecosystems.
- Interpret ecological balance by observing interactions within food chains and food webs.
- Draw conclusions about the effects of biodiversity on ecosystems.
- Make predictions about the factors threatening biodiversity.
- Analyze and interpret ecosystem processes through STEM disciplines

Materials

Map, magnifying glass, binoculars, compass, sample bag, dissection kit, stereo microscope, telescope, measuring tape, markers and pencils, worksheets, mobile applications (e.g., BirdNet, Merlin Bird ID, iNaturalist, Mammal Mapper, Seek by iNaturalist, Wildlife Observer App, etc.), tablet/phone.

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EDUCATOR GUIDELINES

1- Pre-Field Trip Preparation (20 minutes)

- Divide students into teams of three to five members.
- Facilitate a brief discussion on biodiversity and ecosystem interactions.
- Explain how students can use mobile applications (e.g., iNaturalist, Seek by iNaturalist, etc.) to record their observations during the trip.
- Assign specific roles to each team member (e.g., recorder, observer, identifier).

Materials will be distributed as needed during the activity.

2- Entering the Forest and Sensory Observation (10 minutes)

- Guide students to the observation area.
- Have them close their eyes and focus on identifying natural sounds (e.g., animal calls, rustling leaves, flowing water).
- Ask students to take notes on the sounds they hear.
- Explain that they can use mobile applications like BirdNet and iNaturalist to identify unfamiliar sounds.

3- Biodiversity and Ecosystem Observation (15 minutes)

- Distribute magnifying glasses and binoculars to each team before entering the observation area.
- Ensure that the handheld telescope is used alternately among students and encourage them to observe distant details.
- Guide students to observe the interactions between biotic and abiotic components in the ecosystem.
- Encourage them to identify biodiversity patterns and record their observations.

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4- Data Collection and Sample Analysis (45 minutes)

- Ensure that teams follow the instructions on the worksheet to record their plant and animal observations.
- Guide students to properly collect the designated plant samples and place them in sample bags.
- Ensure that the collected samples are first observed with the naked eye, followed by detailed examination using a magnifying glass and a stereo microscope.

If microscope use is not feasible during the field trip, this step can be conducted at the center.

5- Sharing Results and Evaluation (30 minutes)

- Encourage teams to construct food chains and food webs based on their observations.
- Guide students to compare the number of species and individuals observed in different areas to assess ecosystem interactions.
- Support them in using scientific data collection, analysis, and mathematical modeling to make inferences about ecosystem balance.

For advanced-level students, logarithmic formulas such as the Simpson Index or Shannon-Wiener Index can be used for in-depth analysis.

- Encourage students to discuss key factors threatening biodiversity within the framework of STEM (Science, Technology, Engineering, and Mathematics) disciplines and propose solutions.

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BACKGROUND

Ecosystem and Biodiversity

Ecosystems consist of living organisms inhabiting a specific region and the non-living components they interact with. Abiotic factors such as light, temperature, water, soil, climate, and pH level directly influence the survival of organisms and the dynamic processes within an ecosystem. The biotic components of an ecosystem include producers, consumers, and decomposers:

- **Producers:** Organisms that convert inorganic substances into organic matter, producing their own food.
- **Consumers:** Organisms that obtain their food externally. They are classified into three groups: herbivores (organisms that feed only on plants), carnivores (organisms that feed exclusively on animals), and omnivores (organisms that consume both plants and animals).
- **Decomposers:** Organisms that break down organic waste and dead matter, recycling nutrients back into the ecosystem.

Biodiversity refers to the variety of species, genetic diversity, ecosystem diversity, and functional diversity within ecological processes. These four main components are essential for maintaining the balance and sustainability of ecosystems.

Species diversity represents the number and variety of species within a given ecosystem. It is estimated that there are approximately 7–10 million species on Earth. A high level of species diversity contributes to ecosystem stability and resilience against environmental changes. Genetic diversity refers to the variation in genetic material within a species or population. It allows organisms to adapt to environmental changes and ensures their survival. Ecosystem diversity refers to the variety of ecosystems found on Earth. Deserts, forests, oceans, lakes, and grasslands support various species and contribute to ecological balance. Functional diversity, finally, describes the variety of biological, chemical, and ecological processes that ensure ecosystem sustainability. Energy flow, nutrient cycles, pollination, and decomposition processes are essential for maintaining ecosystem functionality. Biodiversity not only maintains ecological balance but also provides essential resources, including food, medicine, raw materials, and energy. Additionally, it plays a crucial role in ecosystem services, such as air purification, water filtration, soil regeneration, waste decomposition, and pollination. Furthermore, biodiversity supports ecotourism, cultural heritage, and artistic activities.

Threats to Biodiversity

Biodiversity is at risk due to both natural processes and human activities. The main threats include:

- **Habitat loss:** Deforestation, agricultural expansion, and urbanization lead to the destruction of natural habitats, reducing shelter and breeding areas for species.
- **Pollution:** Water, air, and soil pollution degrade ecosystems and negatively impact the health of organisms.
- **Climate change:** Global temperature rise, extreme weather events, and seasonal changes impose stress on ecosystems, causing species migration or extinction.
- **Overexploitation:** Hunting, overfishing, and excessive agricultural production deplete natural resources, disrupt ecological balance, and threaten species populations.

Ecosystems are broadly categorized into terrestrial and aquatic types. Terrestrial ecosystems include deserts, tropical rainforests, temperate deciduous forests, coniferous forests, savannas, temperate grasslands, Mediterranean shrublands, tundras, and polar regions. Aquatic ecosystems are classified into freshwater ecosystems (lakes, rivers, wetlands) and marine ecosystems (oceans, seas, coral reefs). Conserving ecosystems requires raising awareness about biodiversity, collecting scientific data, and implementing sustainable practices.

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Food Chains and Food Webs

Organisms in ecosystems require food and energy to sustain their lives. The flow of matter and energy within ecosystems is defined as a food chain. However, feeding relationships in nature are often not limited to a single food chain; instead, multiple interconnected food chains form more complex structures known as food webs. Food webs help us understand species interactions within an ecosystem and comprehend ecological balance.

The sustainability of ecosystems depends on the balanced interactions that organisms establish with each other and their environment. Food chains and food webs, which regulate ecosystems, are fundamental mechanisms that regulate ecosystems, ensuring the continuity of energy flow and nutrient cycling.

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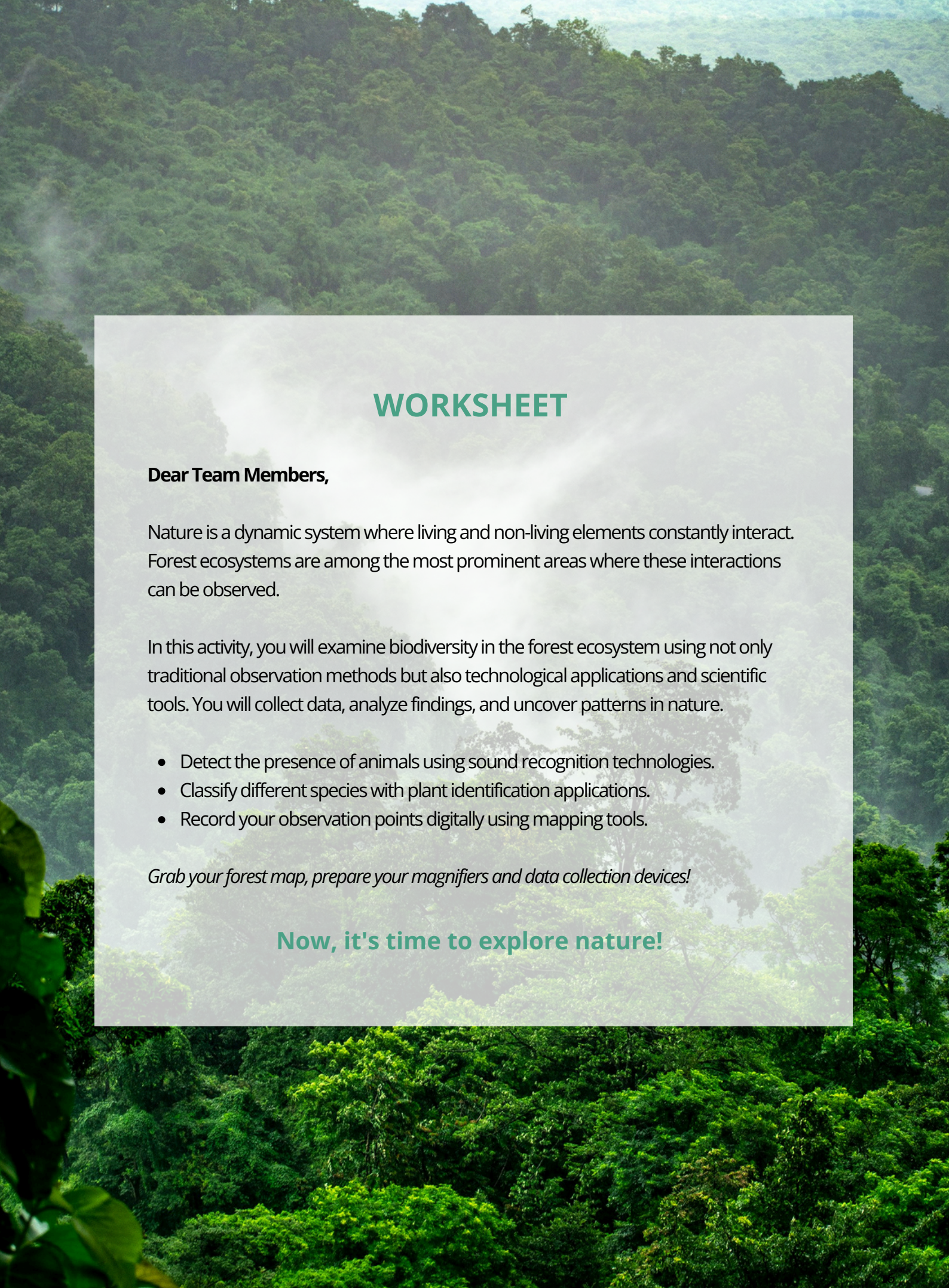

WORKSHEET

Dear Team Members,

Nature is a dynamic system where living and non-living elements constantly interact. Forest ecosystems are among the most prominent areas where these interactions can be observed.

In this activity, you will examine biodiversity in the forest ecosystem using not only traditional observation methods but also technological applications and scientific tools. You will collect data, analyze findings, and uncover patterns in nature.

- Detect the presence of animals using sound recognition technologies.
- Classify different species with plant identification applications.
- Record your observation points digitally using mapping tools.

Grab your forest map, prepare your magnifiers and data collection devices!

Now, it's time to explore nature!

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1- Forest Entry and Sensory Observation

Before you start walking in the forest, use your senses to explore your surroundings. Try to identify the living and non-living components in the ecosystem.

Close your eyes and listen to the surrounding sounds for a few minutes.
Take notes on the sounds you hear and try to guess their sources.
Notice the different scents you perceive (e.g., soil, flowers, moisture).
Compare what you sense with your eyes closed to what you observe after opening them.

Observations:

Sounds heard:

Scents perceived:

Observation after opening eyes:

First, close your eyes and listen carefully to the surrounding sounds. Try to distinguish natural sounds such as rustling leaves or flowing water, as well as different animal sounds. If you hear unfamiliar or unidentifiable sounds, you can use relevant mobile applications (e.g., BirdNet, iNaturalist, etc.).

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2- Plant Observation and Species Identification

Examine five different plant species you encounter in the forest and record your observations in the table below.

PLANT NAME (SCIENTIFIC NAME)	PHYSICAL CHARACTERISTICS	DRAWING

Detailed Analysis:

Carefully collect plant samples and place them in specimen bags.
Use the *Seek by iNaturalist* app to identify plant species.
Transport the collected samples to the laboratory for further analysis.
Use a dissection kit to take cross-sections of the plants.
Examine the prepared cross-sections first with the naked eye, then with a magnifying glass and a stereo microscope. Record your observations in the table below.

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OBSERVATION TOOL	OBSERVATIONS
NAKED EYE	
MAGNIFYING GLASS	
STEREO MİCROSCOPE	

Ensure that you do not damage the natural ecosystem while collecting plant samples.

Use the Seek by iNaturalist app to identify plant species.

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3- Animal Observation and Tracking

Observe and document the physical characteristics and habitats of five different animals in the forest.

To identify mammal species, you can use the iNaturalist or Mammal Mapper applications. For tracking animal signs (e.g., trails, droppings, fur, nests etc.), the Wildlife Observer App can be used.

ANIMAL NAME (SCIENTIFIC NAME)	PHYSICAL CHARACTERISTICS	OBSERVATION AREA

Observe animals quietly and without disturbing them.

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Tracking and Evidence Analysis:

Look for evidence of animals that you cannot directly observe (e.g., fur, footprints, nests etc.).

ANIMAL NAME (SCIENTIFIC NAME)	EVIDENCE OF PRESENCE

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4- Ecological Interactions and Feeding Relationships

What ecological interactions did you observe among the organisms in the forest? Can you provide examples of interactions other than feeding relationships?

ECOLOGICAL INTERACTIONS AMONG ORGANISMS

The food chain is a fundamental mechanism that ensures energy flow and nutrient cycling within ecosystems. Based on your observations, construct a food chain specific to the forest ecosystem. Try to include producers, primary consumers (herbivores), secondary consumers (carnivores), tertiary consumers (omnivores), and decomposers present in the ecosystem.

FOOD CHAIN

In natural ecosystems, feeding relationships are usually not limited to a single food chain. Food webs, which consist of multiple interconnected food chains, more accurately represent energy flow in an ecosystem. Based on your observations, construct a food web for the forest ecosystem that includes at least ten different species.

FOOD WEB

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5- Biodiversity in Different Areas

Before you start walking in the forest, use your senses to explore your surroundings. Try to identify the living and non-living components in the ecosystem.

Select two areas with different characteristics in the forest (e.g., wooded and open areas).

The selected areas must be of the same size (e.g., 10m × 10m).

Observe the plant and animal species in the selected areas.

Record the number of individuals for each species in the table. Note species distribution (dominant species, rare species).

You can use iNaturalist and Seek by iNaturalist applications to identify species.

AREA	NUMBER OF SPECIES (T)	NUMBER OF INDIVIDUALS (N)	OBSERVATION NOTES

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Compare the number of species and individuals in both areas to evaluate biodiversity. Discuss the impact of environmental factors (light, humidity, human impact, etc.) on species.

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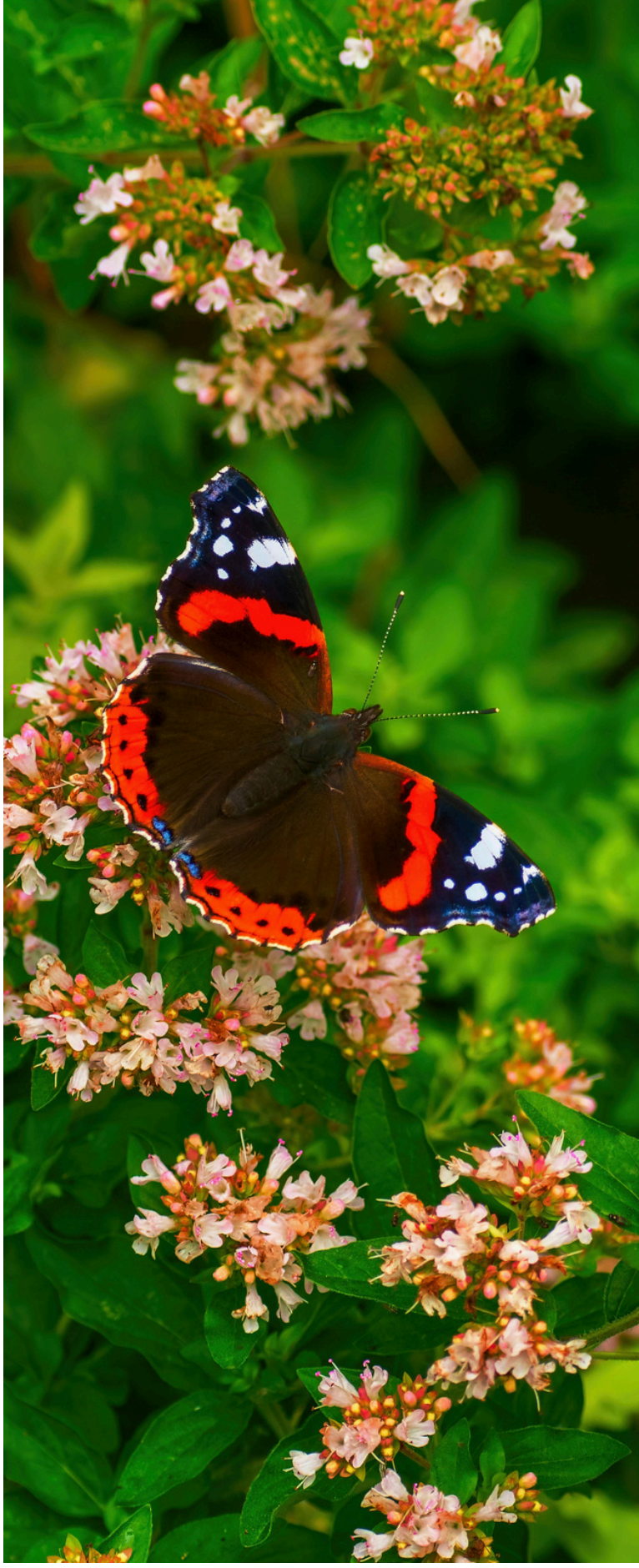
6- Ecosystem Analysis and Evaluation of Results

Which area has higher biodiversity? (*Evaluate the relationship between species number and individual count.*) What are the common characteristics of areas with high biodiversity? Discuss the positive and negative impacts of human activity on biodiversity.

Based on your time in the forest and your observations, what key conclusions can you draw about ecosystem functioning? (*Consider species interactions, the influence of environmental factors on the ecosystem, and the relationship between biodiversity and ecosystem health.*)



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Develop an innovative solution for the conservation of ecosystems and the sustainability of biodiversity using at least two STEM (Science, Technology, Engineering, and Mathematics) disciplines. (*Explain how your proposal contributes to nature and ecosystem processes.)*

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LET'S FIND OUT BIOMES!

Ages 8-15

Ecosystems and Biodiversity

80 minutes

Key Concepts

- Biomes
- Biodiversity
- Climate
- Adaptation
- Virtual reality (VR) technology

Purpose: In this activity, it is aimed for students to explore different biomes using virtual reality technology, understand the role of biodiversity in bioms, analyze the relationship between climate and bioms, and observe the interactions between living and non-living components within bioms.

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Learning Outcomes

By the end of this activity, students will be able to:

- Question the importance of biodiversity for biomes and natural life.
- Identify the key characteristics of biomes
- Explain the relationship between climate and biomes
- Explore how living organisms adapt to different biomes
- Experience virtual reality (VR) technology

Materials

Tablet, projector, TV screen, virtual reality headset, 360° VR videos, worksheets

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EDUCATOR GUIDELINES

1- Introduction (10 minutes)

- Divide students into teams of three to five members.
- Conduct a brief question-and-answer session to assess students' prior knowledge of large ecosystems.

2- Virtual Reality (VR) Experience (35 minutes)

- Guide students in exploring large ecosystems using virtual reality technology through the YouTube application.,
- Ask specific questions about each large ecosystem to help students recognize biodiversity, climate factors, and the interactions between living and non-living components.

3- Data Collection and Analysis (20 minutes)

- Ensure that students record their observations on the worksheet during the VR experience.
- Direct students to identify differences between large ecosystems and support them in analyzing their observations.
- Encourage students to reflect on biodiversity, climate, and ecosystem interactions.

4- Sharing Results and Evaluation (15 minutes)

- Allow teams to share their observations and findings from the VR experience with the class.
- Facilitate discussions on the interactions between living and non living components in large ecosystems, guiding students toward scientific conclusions.,
- Encourage students to propose scientific solutions for the conservation of large ecosystems.

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BACKGROUND

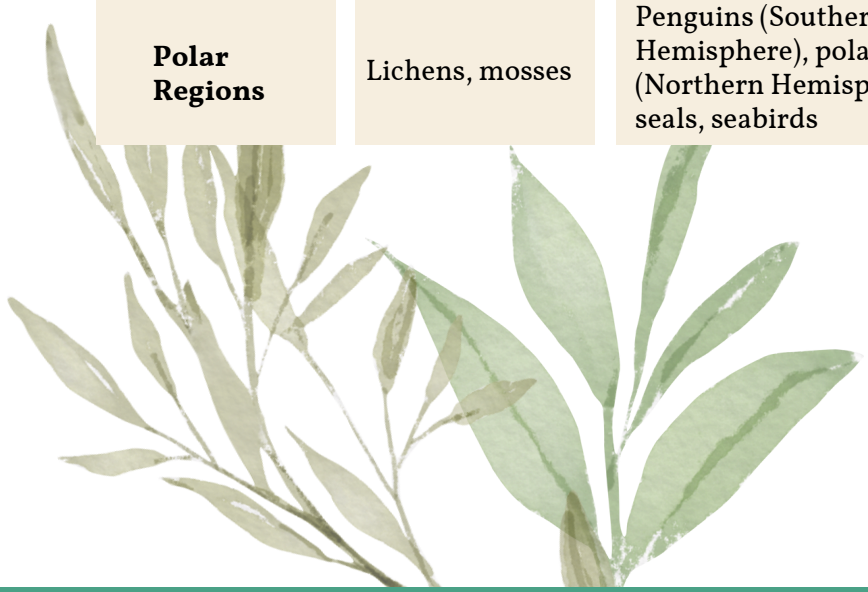
Biomes

A biome is a large-scale ecological region characterized by its climate, soil type, vegetation, and animal life. Biomes are shaped by environmental factors and support distinct ecosystems adapted to their specific conditions. Biomes are divided into two main groups: terrestrial biomes and aquatic biomes. Climatic differences play a crucial role in the formation of of both terrestrial and aquatic biomes. **Climate** refers to the long-term average weather conditions observed in a specific region over many years.

Terrestrial biomes include tropical rainforests, temperate deciduous forests, coniferous forests, deserts, savannas, temperate grasslands, Mediterranean Shrubland (Maquis), taigas, tundras, and polar regions. The fundamental characteristics of terrestrial biomes are presented in the table below.

Terrestrial Biomes and Their Characteristics

BIOMES	VEGETATION	ANIMALS	CHARACTERISTIC FEATURES
Tropical Rainforest	Evergreen broadleaf trees, lianas	Monkeys, lemurs, sloths, snakes, bats, frogs, toucans, parrots	Receives high rainfall (200 400 cm). Temperature remains between 20°C-25°C year-round. Very high biodiversity.
Temperate Deciduous Forest	Deciduous trees such as oak, walnut, beech, and maple	Squirrels, mice, badgere, lynxes, foxes deer, bears, wolves	High rainfall (75-150 cm). Temperature varies widely across season.
Desert	Cacti, drought resistant shrubs (No vegetation in extreme deserts.)	Camels, desert vipers, scorpions, lizards, hawks	Very low rainfall (less than 25 cm). Extreme daily temperature variations.
Temperate Grasslands	Grasses, herbaceous plants (No trees.)	Jackals, horses, rhinoceroses, foxes, bison, eagles	Cold winters, hot summers. Annual precipitation is 25 75 cm.
Savanna	Grasslands, scattered tree clusters	Elephants, zebras, giraffes, antelopes, cheetahs, lions	Warm temperatures year round. Annual precipitation is 30-50 cm.
Mediterranean Shrubland (Maquis)	Evergreen dwarf oaks, pine trees, shrubs	Wild goats, jackals, birds, insects, rodents	Mild, rainy winters and hot, dry summers.
Taiga (Boreal Forest)	Evergreen trees such as spruce, pine, cedar, fir	Deer, bears, weasels, rabbits, woodpeckerd, migratory birds	Long, cold winters and short, cool summers. Annual precipitation is 30 85 cm.
Tundra (Arctic)	Lichens, mosses, short herbaceous plants (No trees.)	Reindeer, musk oxen, arctic foxes, arctic hares, polar bears, snowy owls, migratory birds	Long, extremely cold winters, short, cool summers. Low precipitation (10-25 cm). Permafrost soil.
Polar Regions	Lichens, mosses	Penguins (Southern Hemisphere), polar bears (Northern Hemisphere), seals, seabirds	Temperature remains below 0°C year-round. Very low precipitation.



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Aquatic biomes are classified into two main groups: saltwater ecosystems and freshwater ecosystems. Both provide diverse habitats based on environmental factors and the physical characteristics of water.

Saltwater ecosystems are found in large water bodies like oceans and seas, where habitat conditions vary depending on depth and distance from the shore.

- **Sunlight Zone (Euphotic Zone):** This is the uppermost layer where sunlight penetrates, allowing phytoplankton and algae to photosynthesize. These organisms form the base of the oceanic food chain. The region also supports fish, marine mammals, and various invertebrates.
- **Twilight Zone (Mesopelagic Zone):** A dimly lit layer where some fish and invertebrates have adapted to low-light conditions. Many species here have large eyes and enhanced sensory abilities for navigation and hunting.
- **Midnight Zone (Bathypelagic Zone):** A completely dark layer where no sunlight reaches. Despite high pressure, cold temperatures, and constant darkness, biodiversity remains high. Many organisms in this zone have bioluminescence, producing their own light to attract prey or communicate. Anglerfish, for instance, use this ability for hunting and mating. Some species have evolved large mouths and inward-facing teeth to maximize their chances of capturing prey.
- **Abyssal Zone and Ocean Floor:** The deepest part of the ocean, where decomposer organisms play a crucial role in recycling organic matter, maintaining the balance of the ecosystem.

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Freshwater Ecosystems

Freshwater ecosystems contain water with less than 1% dissolved salts and are classified into two main types: standing water (lakes and ponds) and flowing water (rivers and streams).

- **Lakes and Ponds:** These water bodies host diverse plant and animal communities depending on depth and distance from the shore.

o Shallow areas near the shore support rooted aquatic plants.
o **Open water zones** are home to plankton and fish that rely on sunlight for survival.
o **Lake beds** contain microorganisms that decompose organic material, supporting nutrient cycles.

- **Rivers and Streams:** These dynamic ecosystems vary significantly from their source to their endpoint.

o Near the source, water is typically cold, clear, and oxygen rich, limiting phytoplankton growth but supporting oxygen dependent species.
o As the river flows downstream, the water becomes warmer, more turbid, and nutrient-rich, increasing biodiversity with fish, amphibians, birds, and aquatic insects.

- **Wetlands:** These areas are partially or fully covered by shallow water, containing fresh, brackish, or saltwater. Wetlands are classified into marshes, swamps, and bogs based on plant life.

o Ecological Importance: Wetlands play a critical role in water filtration, flood control, and biodiversity conservation by supporting various plant and animal species.

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Biomes - 360 VR

BIOMES	VEGETATION AND ANIMALS	GUIDING QUESTIONS
Tropical Rainforest **(Duration: 5,37)**	**Animals:** **Boa Constrictor:** Non-venomous. It wraps around its prey, suffocating it before swallowing it whole. **Green Vine Snake:** Camouflages with its green color. It is venomous but only effective on small animals, not lethal to humans. **Basilisk Lizard:** Uses its webbed feet to run on water (5.5 km/h) by utilizing surface tension to escape predators. **Vegetation Tall** trees, massive leaves with drip tips, and lianas.	• Can you hear the sounds? • What animals do you see around you? There are three animals nearby—can you find them? • How does the vegetation look? What shape do the leaves have? Why do you think they are like that?
Temperate Deciduous Forest **(Duration:3.03)**	**Animals:** Bird sounds can be heard. Although not visible, small mammals like mice and squirrels may be in their nests. **Vegetation:** Deciduous trees such as beech, oak, and maple; flowering plants.	• Can you hear the sounds? What animal could it be? • What do the leaves on the trees look like? • What is on the forest floor? • What season do you think it is?
Desert **(Duration:5.51)**	**Animals:** **Camel:** Adapted to survive drought, hunger, and sandstorms. Other animals are not visible as most live in burrows and are only active at night. **Vegetation:** Sparse due to drought; only drought-resistant plants survive. Leaves have a waxy coating to prevent water loss.	• What animals do you think live here? • Why can't we see them? • What can you say about the vegetation?

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BIOMES	VEGETATION AND ANIMALS	GUIDING QUESTIONS
Savanna **(Duration: 2.48)**	**Animals:** **Birds:** Bird sounds can be heard. **Herbivorous Mammals:** African wild ass, zebra, African buffalo. **Vegetation:** Grasslands with scattered acacia trees, which have thorns to protect against herbivores. Both trees and grasses have adaptations to survive drought and fires.	• What animals do you see around you? • How does the vegetation look? • Why do you think the trees are sparse and scattered?
Tundra **(Duration: 4.28)**	**Animals:** Birds are visible. Although not shown in the video, cold-resistant animals like reindeer, voles, Arctic foxes, and snowy owls inhabit this biome. **Vegetation:** Mosses, lichens, saxifrage, and fungi. Extreme cold, strong winds, and permafrost prevent tree growth.	• Does the soil change between winter and summer? • How does the vegetation look? Do you see any trees? Why or why not? • What animals do you think could live in this ecosystem?
Polar Region **(Duration: 1.55)**	**Animals:** Seals, penguins, birds. Penguins live only in the Southern Hemisphere, while polar bears are found only in the Northern Hemisphere. **Vegetation:** Lichens and mosses.	• Can you hear the wind? What do you think about the temperature? • Which hemisphere do you think we are in? • What animals do you see? • Why do you think there are no polar bears here?
Saltwater **(Duration: 2.37)**	**Marine Organisms:** **Plankton:** Phytoplankton, zooplankton. **Swimmers:** Seals (marine mammals that come ashore to breed), cod, flounder, smelt, herring, salmon, capelin. **Bottom Dwellers:** Starfish, sea urchins, oysters	• Which part of the aquatic ecosystem are we in? (Based on distance from shore: nearshore; based on depth: photic zone). • What organisms do you see around you?

WORKSHEET

Dear Team Members,

Put on your virtual reality headsets and get ready to explore the world's diverse biomes! On this unforgettable journey, you will experience biomes ranging from tropical rainforests to tundras, from deserts to polar regions.

In each biome, you will have the opportunity to observe the critical role of biodiversity in nature, the interactions between living and non-living elements, and how ecological balance is maintained. As you discover how animals survive in different biomes and how plants adapt to environmental conditions, you will gain valuable insights into the workings of nature.

This unforgettable journey begins now...

Open your eyes and start exploring!

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1- Observation Form

BIOMES	OBSERVED ANIMAL	OBSERVED VEGETATION	CHARACTERISIC FEATURES

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BIOMES	OBSERVED ANIMAL	OBSERVED VEGETATION	CHARACTERISIC FEATURES

BIOMES	OBSERVED ANIMAL	OBSERVED VEGETATION	CHARACTERISIC FEATURES

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2- Observation Questions

Answer the following questions according to each biome you explored.

The first environment you experienced belongs to which biome? Provide information about the animals and vegetation that have adapted to this biome. What adaptations of the animals you observed caught your attention? In what ways does the vegetation adapt to this biome?

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The second environment you experienced belongs to which biome? Provide information about the animals and vegetation that have adapted to this biome. What are the feeding habits of the animals you observed? What kind of food chain might exist in this biome? How have plants adapted to the challenging environmental conditions in this biome?

The third environment you experienced belongs to which biome? Provide information about the animals and vegetation that have adapted to this biome. What noticeable characteristics did you observe in the vegetation? How might these features have evolved to help the vegetation adapt to the conditions of this biome?

The fourth environment you experienced belongs to which biome? Provide information about the animals and vegetation that have adapted to this biome. How do the animals you observed survive in this biome? What behavioral and physical adaptations have they developed? What types of plants can survive in this biome? What common characteristics do these plants have?

The fifth environment you experienced belongs to which biome? Provide information about the animals and vegetation that have adapted to this biome. Compare the animals and vegetation you observed with those in other biomes. What similarities and differences do you notice?

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The sixth environment you experienced belongs to which biome? Provide information about the animals and vegetation that have adapted to this biome. What are the possible impacts of humans on this biome? What measures should be taken to protect this biome?

The last environment you experienced belongs to which biome? Provide information about the animals and vegetation that have adapted to this biome. What kind of food web might exist among the organisms you observed in this biome? What are the roles of animals in this food web?

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3- Analysis and Evaluation

Answer the following questions based on your observations.

What are the main causes of biodiversity in biomes? Explain the primary reasons for the differences between biomes. Describe how the loss of one of the biomes you observed would affect ecological balance. What can be done to protect these biomes and sustain biodiversity?

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Discuss the possible effects of climate change on the biomes you observed. Which biomes are likely to be most affected by climate change? Using at least two STEM (Science, Technology, Engineering, and Mathematics) disciplines, propose innovative solutions to mitigate these effects. Justify and explain your suggestions.

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