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Climate change and its impact on biodiversity

BIOS4YOU
AR 2.0

BIO-INSPIRED STEM TOPICS FOR ENGAGING YOUNG GENERATIONS
THANKS TO THE USE OF AUGMENTED REALITY

Project Number: 2023-1-DE03-KA220-SCH-000126516

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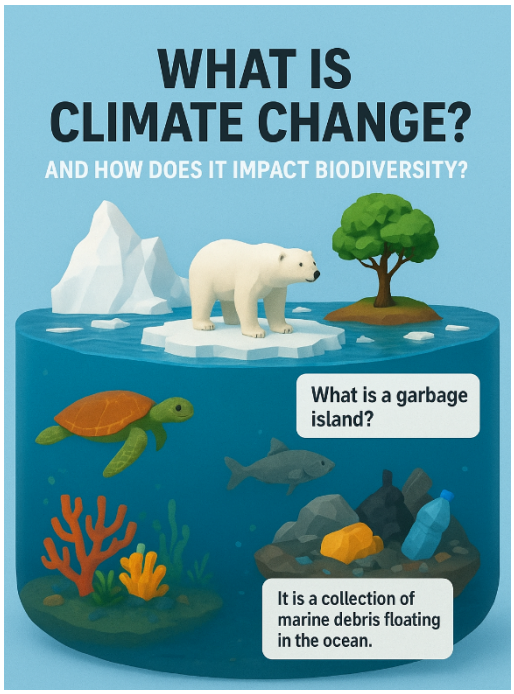

General topic of the learning path	Climate Change and Its Impact on Biodiversity
Specific name of the learning unit	Ecosystems on the Edge
Age of the target users	15-17 years
Requirements for the learner	• Basic knowledge of: environmental science, climate change, biodiversity, Agenda 2030, Thermodynamics, basic knowledge of physics and chemistry concepts; at last familiarity with smartphone/tablet use. • Access to a computer or tablet with internet connectivity. • No prior coding or AR development experience required.
Description of the learning unit	This interdisciplinary unit uses Augmented Reality (AR) technology to explore the effects of climate change on biodiversity over time, promoting critical thinking and awareness of sustainability aligned with the UN 2030 Agenda. Students engage with immersive scenarios from the medieval era to future ecosystems through interactive quizzes and gamified choices.
Subject: Parties involved	Physics, Chemistry, Thermodynamics, Biology, Science, Civic Education.
Keywords	Agenda 2030, AR, Australian's Coral Reef, Bleaching, Garbage patch, immersive experience, Artic, climate change, time comparison, Seychelles, extinction of the species, ice loss, sea level rising
Key qualifications, skills and knowledge that can be acquired	• Awareness of climate change impacts, • Critical thinking, • Ethical reasoning, • Sustainable decision-making,

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	• Teamwork, • Digital literacy through AR. • Proactive and innovative thinking towards environmental challenges. • Appreciation for nature's role in sustainable solutions. • Motivation to participate in climate action. • Scientific Inquiry • Communication
Resources and didactic aids used	• Mobile devices or tablets with AR capabilities, • Printed or digital AR markers, • videos, • 3D models, • Interactive quizzes integrated into the AR experience • Textbooks/Scientific articles • Case studies • Internet resources • Free AR platforms (Delightex)
Assessment criteria and evaluation	• Performance and engagement based on correct quiz answers, • Overall scoring in the gamified activity, • Activity Completion: Execution of practical AR exercise • Participation in group discussions for reflection and comparison of choices.

Introduction:

This learning unit introduces students to the complex topic of climate change and its impact on biodiversity using AR to turn abstract science concepts into interactive, immersive experiences. Through virtual scenarios ranging from historical to future ecosystems, students are encouraged to understand cause-effect relationships, engage emotionally, and reflect on sustainability aligned with the UN 2030 goals.

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1. Section 1: Explore

With this unit lesson students will learn the fundamental concepts surrounding climate change and its impact on biodiversity. Using immersive Augmented Reality content, learners navigate through a series of historically and ecologically diverse environments such as medieval manors, coral reefs, the Seychelles islands, and the Arctic.

This approach allows students to visualize how ecosystems have evolved over time and the critical threats they face today, including coral bleaching, rising sea levels, and the decline of key species. The information is delivered through engaging videos, 3D models, and clear narration, helping to establish a strong foundational understanding. This aims to spark curiosity and provide context so that students are well-prepared for deeper inquiry and decision-making in the following stages.

The topic is connected with other subjects like Physics or Thermodynamics and Chemistry, and relate directly to real-world phenomena students encounter in environmental science; by some questions that require a focus on and that are also important for a critical thinking mind set.

In particular, it is good to prepare the students in this, by explaining them the relation between the temperature and the molecular volumes or the dispersion of particles in fluids; the relation between the pH of the sea and the Temperature. It is also important to focus on Agenda 2030 Goals, Biodiversity and extinction risks in the Artic, from tiny crustaceans like Krill to Polar Bears or Sea Turtles and so on; greenhouse gases effects on earth, Earth's Albedo.

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2. Section 2: Execute

The "Execute" section offers practical activities to help students understand the importance of biodiversity in the context of climate change, aligning with the 2030 Agenda goals. Students can use augmented reality (AR) to visualize the effects of melting glaciers on sea levels and simulate the loss of critical habitats like rainforests or coral reefs.

Through interactive models, they can compare past scenarios (rich, stable ecosystems before industrialization), the present (the accelerated decline of many species and areas at risk), and a hypothetical future where conservation strategies are either applied or ignored.

For instance, an AR simulation shows how the reduction of biodiversity makes ecosystems more vulnerable to extreme events, while the protection of "key areas" strengthens natural resilience. Quizzes prompt reflection on causes and solutions: Why does the melting of polar ice accelerate sea-level rise and threaten coastal cities and marine biodiversity? Group activities involve drafting adaptation strategies inspired by the 2030 Agenda targets (such as Goal 15: Life on Land) to restore habitats and prevent the extinction of symbolic species.

In this way, through engaging and interactive digital experiences, students are challenged to critically evaluate the impact of human activities on the environment, promoting a conscious and responsible vision for the present and future of the planet.

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3. Section 3: Enhance

AR tools enhance learning by making STEM topics more accessible and engaging. The combination of 3D models, videos, and interactive choices in questions deepens understanding of climate processes and biodiversity dynamics. Suggested AR apps and digital resources (that are specified in the Training Units Exercise Template) can be integrated into classroom activities to support inquiry-based learning and collaborative problem-solving, fostering a mindset of sustainability.

AR facilitates comprehension of intricate scientific concepts such as climate dynamics and ecosystem interactions by turning them into concrete, interactive visuals and highlights the added value of Augmented Reality in enriching the learning experience. This multisensory engagement stimulates curiosity and boosts retention, helps visualize abstract concepts or hypothetical future scenarios. Features like 3D models, clickable hotspots, supplementary videos, and gamified quizzes deepen understanding while making learning enjoyable by a gamification process.

An example of AR tool is: Delightex (CoSpaces Edu), it allows users to create interactive 3D virtual worlds and then experience them in augmented reality or virtual reality. It features a drag-and-drop interface and a visual block-based coding language (CoBlocks), making it highly accessible for students and teachers with no prior coding experience. It

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offers a free version with core functionalities. Students can design and build their own virtual ecosystems, simulate environmental changes, and visualize restoration efforts. Its creative freedom empowers students to become content creators, not just consumers.

The gamification elements — such as points and collaborative challenges — not only sustain motivation but also develop soft skills like teamwork and communication if students work in small groups. Introducing AR tools in this way increases student connection to the subject matter, promotes active learning, creativity and supports the development of critical environmental literacy and problem-solving capabilities for real-world matters.

Conclusion:

This unit enables students to approach the complex topics of climate change and biodiversity by transforming abstract scientific concepts into immersive experiences through augmented reality. Through virtual scenarios ranging from past to future, students visualized the evolution of ecosystems and current threats such as coral bleaching or the loss of key species, reflecting on the causes and the importance of sustainability-focused choices.

Practical activities inspired by bio-inspiration fostered understanding and the search for concrete solutions, demonstrating how learning from nature can guide innovative and effective strategies for real-world challenges, in alignment with the goals of the 2030 Agenda.

The use of AR tools facilitated active and collaborative learning: 3D models, interactive quizzes, immediate feedback, and group activities stimulated curiosity, enhanced critical thinking, and strengthened both environmental knowledge and transversal skills like communication and teamwork.

In conclusion, this experience made the connection between theory and reality more direct and engaging, encouraging students to keep exploring, analyzing, and imagining responsible solutions for the planet's future.

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Phase	Description
Explore	- Research and Discovery: students investigate the impact of climate change on biodiversity by virtually exploring a range of environments (e.g., medieval manors, coral reefs, Seychelles, Arctic)
	- Content Development: Present and connect fundamental concepts from environmental science, chemistry, physics and thermodynamics, focusing on real-world phenomena (e.g., links between sea pH and temperature, greenhouse gases, albedo, extinction risks).
	- Needs Analysis: to identify students' prior knowledge and misconceptions, laying a strong foundation with 3D models, videos, clear narration and interactive visuals.
Execute	- Curriculum Implementation: Practical activities harnessing AR to simulate the effects of melting glaciers, sea-level rise, habitat loss and biodiversity decline over time help with the critical thinking and soft skills, but also with innovative ideas about the making-decision process.
	- Interactive Exercises: Students use interactive models and overlays to compare past, present and future scenarios, critically reflect on causes and consequences, and complete quizzes that assess understanding.
	- Feedback Collection: Share AR projects, reflect on outcomes, and get feedback from peers/teachers.
Enhance	- AR Integration: Use AR app Delightex with Ecosystems on the edge to visualize habitats and climate changes hypothetical impacts
	- Interactive Learning: Explore ecosystems into the AR App making ecological concepts tangible with immersive scenarios, contextual videos, imaginary futuristic scenarios.

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	Gamified Content: - **Points and Badges**: dynamic scoring system where they earn "points" or none at all by answering the questions - **Quests and Levels**: The questions difficulty level increase with the time, each scenario is different and at first is very basic because they first engage with the habitats and the videos showed and then they go through the real challenge - **Rewards for Exploration**: The earning points system encourage them to apply their knowledge to gain more point in each phase and, at the end, they can do a ranking list with the points earned. - **Collaborative Gamified Tasks**: They can work on a different subtopic with AR and make a project with the same scheme, like introducing videos, images, 3D models, they can also test the coding system by making Questions&Answers or a scoring system.
	AR-Based Assessments: Replace traditional tests with AR-based evaluations, such as students exploring their AR urban ecosystem models or completing biodiversity "quests" in real environments.

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