MM7: SDG15 SPACE4SDGS TERRAFORMING BIODIVERSITY

SDG 15: Terraforming for Biodiversity

- Design a satellite, drone, or robotic system that actively supports and monitors the development of ecosystems on a terraformed planet, ensuring balance and sustainability as life is introduced to new environments.

Challenge
In this challenge, you are tasked with designing a satellite, drone, or robotic system that supports and monitors the development of ecosystems on a terraformed planet. This project aligns with SDG 15: Life on Land, which emphasises protecting and promoting biodiversity. Try to envision how technology can help establish and sustain balanced, thriving ecosystems in new environments. The goal is to explore innovative solutions that actively contribute to biodiversity, ensuring these habitats are sustainable, resilient, and capable of supporting diverse forms of life.

Considerations
- You should consider how a terraformed environment—such as a recreated forest, grassland, or wetland—would need careful monitoring to ensure species diversity, balanced growth, and protection against environmental changes.
- Your designs should prioritise sustainability, recognizing that life in newly created ecosystems may face unique challenges.
- The systems should be autonomous or semi-autonomous, collecting data on species health, soil and air quality, and ecosystem changes, providing the feedback needed to maintain balance and sustainability.

Background
The idea of terraforming, or transforming a lifeless planet into a habitable environment, is both exciting and complex. On Earth, natural ecosystems are formed over millions of years, resulting in complex networks of interdependent species. Attempting to replicate this on another planet, however, requires careful planning and technological support. If we introduce life to a terraformed environment, it must be continuously monitored and supported to ensure species survive, grow, and evolve without disrupting ecosystem balance.

Technology, especially space-based and robotic systems, can play a critical role in these efforts. Satellites can capture large-scale data from space, observing how entire regions develop over time. Drones can gather detailed information from specific locations, observing plant growth, water sources, and animal populations. Robotic systems on the ground can monitor soil, air, and water quality to keep conditions stable. Together, these technologies could form a comprehensive system for sustaining life on a terraformed planet, providing real-time feedback to make necessary adjustments.

Your Mission

Your mission is to explore designs for an innovative, space-based system that can monitor and protect the ocean. Think creatively about how to use technologies like satellites, drones, or remote sensors. How can these tools collect and relay data to benefit scientists, governments, and communities in real-time? Consider the types of data most needed to protect ocean health, such as temperature, pollution levels, or biodiversity. Your solution should be feasible, impactful, and support SDG15 by helping maintain a terraformed planet

Project Objectives

- Design a creative solution that uses satellite, drone, or robotic systems to support ecosystem development on a terraformed planet.
- Understand key elements of biodiversity and ecosystem balance to create a sustainable habitat.
- Communicate how the proposed solution will help monitor and protect life in newly developed ecosystems.

Deliverables

- Concept Sketches: Visual representations of your proposed design, including labelled parts and a summary of how each part functions.
- System Description: A written overview explaining how your system will work to support and monitor ecosystems, the data it will gather, and the benefits it will provide.
- Presentation: A presentation that explains the importance of biodiversity, the basics of ecosystem balance, and how your system could support these on a terraformed planet.

Questions to Consider

- What specific factors need to be monitored to maintain balance in a terraformed ecosystem (e.g., soil nutrients, water cycle, species interactions)?
- How will your system collect and relay data, and how could this data be used to make decisions that support ecosystem health?
- Who would benefit from this technology, and how could it help ensure a stable and sustainable environment?
- What makes your solution unique compared to other environmental monitoring systems?

Design Process Overview

Step 1: Introduction: What is available?

- Explore how space technology can help build ecosystems on terraformed planets.

Step 2: Empathy - Who are your users?

- Create user profiles for planetary engineers, biologists, and future settlers.

Step 3: Defining the Problem

- Define challenges like introducing species, maintaining climate, and ensuring ecosystem balance.

Step 4: Ideate

- Brainstorm satellite, drone, or robotic solutions to manage ecosystem development on a terraformed world.

Step 5: Ideate 2 – Good Idea / Bad Idea

- Refine ideas to improve scalability and adaptability to planetary environments.

Lesson 6: Prototype

- Build a prototype of a system that tracks or supports ecosystem growth (e.g., drones that plant seeds).

Step 7: Test

- Test the system in simulations or extreme environments, gathering feedback and iterating

Each step will take one or more lessons, your teacher will guide you with lessons and resources from 'Space Design Challenge Problem to Pitch' Module and the Future of Space

VISIT

The United Nations Office for Outer Space Affairs (UNOOSA) works to promote international cooperation in the peaceful use and exploration of space, and in the utilisation of space science and technology for sustainable economic and social development.

https://www.unoosa.org/oosa/en/ourwork/space4sdgs/index.html

Step 1: Introduction: Explore what it takes to create a balanced ecosystem.

Research key aspects of biodiversity, such as species interdependence, nutrient cycles, and habitat needs. Visit https://www.unoosa.org/oosa/en/ourwork/space4sdgs/sdg15.html to find out more on how space innovation is engaging with ecosystems. Explore the planets using the NASA link in the supporting links section.

Support: Use the resources in MM2,4 and 5 and the Problem to Pitch Space Design Challenge, Lesson 1,

Step 2: Empathy: Understand the needs and experiences of the potential users

- Talk to environmental science teachers, watch documentaries, or explore online resources to understand why and how biodiversity is essential for ecosystem health.
- Imagine the experience of life on a new planet and the challenges it might face without balanced ecological support. See additional support p7 for developing your user profiles

Identifying Potential Users

- Consider who would benefit from access to a system that monitors and supports biodiversity in a terraformed environment.
- Are you designing for specific users, such as ecologists studying newly introduced species, conservation groups working to maintain balanced ecosystems, or policy advisors needing reliable data to make environmental decisions?
- Think about how these users could interact with a satellite, drone, or robotic monitoring tool to protect and support developing ecosystems on a terraformed planet.

Daily Challenges and Pain Points

Describe the challenges this individual or group might face when working to support biodiversity in a terraformed setting. For example, what barriers might they encounter in accessing or interpreting environmental data related to ecosystem health? Consider the difficulties in predicting and balancing species populations, monitoring resource availability, or adapting to unknown environmental conditions. How could your design address these challenges, helping users understand and respond to changes effectively?

Impact on Goals and Daily Life

- Identify what this user needs to simplify their work, make data-driven decisions, or contribute

effectively to biodiversity conservation in a terraformed environment.

- Describe how the proposed solution would help users achieve their goals and overcome the unique challenges they face.
- For example, your design could provide ecologists with real-time data on species health or alert conservationists to resource imbalances, enabling timely interventions.
- What positive impact could this tool have, such as delivering reliable ecosystem information that supports strategic actions for biodiversity conservation?

Global Benefits and Impacts

- How will your tool help connect users to a larger understanding of biodiversity needs in newly created ecosystems?
- Consider how it might enable communities to understand broader ecological impacts or encourage actions for sustainable ecosystem management.
- Think about ways your tool could support community or educational initiatives, inspiring global action for biodiversity and environmental stewardship on a terraformed planet.

Creating User Profiles for Your Proposed Solution

After reviewing the SDG 15 challenge, your task is to create a user profile for someone who would benefit from a biodiversity monitoring dashboard, satellite, or robotic system on a terraformed planet. This tool will present critical ecosystem data in a user-friendly way, empowering users to make informed, data-driven decisions that support balanced and sustainable habitats.

Consider how different users might interact with this tool: it could be an ecologist analysing the growth of newly introduced species, a planetary conservationist monitoring ecosystem balance, or a policymaker ensuring sustainable development. These profiles will guide your understanding of the key features and data your tool should provide to support biodiversity in a transformed environment.

Step 3: Define - Identify a specific challenge within the larger goal of supporting biodiversity in a terraformed ecosystem.

- For example, consider issues like monitoring soil and water quality, preventing overpopulation of certain species, or tracking plant health.
- Clearly define the problem your system will address, and narrow down your focus to a manageable but meaningful component of ecosystem monitoring.

Support: Use the resources in MM7: Problem to Pitch Space Design Challenge, Lesson 3, Refine,

Step 4: Ideate Generate a wide range of ideas, thinking creatively about potential solutions

- Consider different types of technology, such as satellite imaging, drone flyovers, or ground-based robots, and how each might collect data or support the environment.
- Sketch out ideas, combine different concepts, and brainstorm unique features that could improve monitoring, support biodiversity, and help maintain ecosystem balance.

Step 5: Choose your most promising ideas and start refining them.

- Think about how you will power your system, make it resilient to environmental changes, and ensure it can collect accurate data.

Support: Use the resources in MM7: Problem to Pitch Space Design Challenge, Lesson 4 and 5, Ideate

Step 6: Prototype Create a prototype or model that shows your solution would work

- This could be a 3D-printed model, a digital simulation, or a diagram with annotations.
- Test your concept by sharing it with others and gathering feedback on how well it addresses the challenges of ecosystem monitoring.
- Refine your design based on their feedback, focusing on areas that could improve functionality and usability.
- Consider user feedback and prioritise features that make the system user-friendly, sustainable, and resilient against data misinterpretation or technical issues.

Support: Use the resources in MM7: Problem to Pitch Space Design Challenge, Lesson 6 Prototype

Prototypes can be 3D or 2D if using wireframes for software / apps. You can read this article to help you https://www.figma.com/resource-library/what-is-wireframing/

Mock-ups can help you imagine how a user might interact with your satellite data -based app or system. The following links in Canva to create prototypes for any platform

- https://www.canva.com/prototypes/templates/
- https://www.canva.com/prototypes/
- https://www.canva.com/prototypes/templates/desktop/

Explore Canva's Mock-up app to show a range of prototypes for different aspects of your programme

Creating a Mobile Interface Mock-up for SDG 15: Space-Based Solution to Monitor and Protect Biodiversity on a Terraformed Planet

These steps guide the creation of an accessible and functional mobile interface to support the SDG 15 mission of monitoring and protecting biodiversity on a terraformed planet.

Open a New Project

- Begin by creating a new project in Canva (or a similar design tool) with dimensions set to 1080x1920 pixels. This size is optimised for a mobile screen, supporting accessibility, readability, and ease of use on mobile devices.

Set Up a Mobile Background

- Search in the Elements tab for a "mobile screen" frame and place it in the centre of the canvas.
- Choose a calming background colour, like soft green or earthy grey, to create a visual connection to nature and ensure good contrast for text and icons. This will help keep users focused on the critical biodiversity information displayed.

Design the App's Home Screen

- Within the mobile frame, add a rectangular navigation bar at the bottom of the screen. This bar should provide easy access to primary sections like "Biodiversity Tracker," "Ecosystem Health Insights," and "Actions," where users can monitor ecosystem data, view biodiversity trends, and learn about conservation efforts.
- At the top, include a circular or square area for the app's logo, creating a welcoming first impression. Add a title like "Ecosphere Guardian" to give the app a sense of purpose.

Add Buttons or Icons for Core Features

- Place large, clear buttons or icons for key features, such as "Explore" for educational resources, "Monitor" for real-time ecosystem data visualizations, and "Connect" for community forums or expert interactions.

- Label each button with clear, easy-to-read text. Consider adding alt-text descriptions or audio labels to support users with visual impairments. Space the icons and buttons for easy tapping, preventing accidental selections.

Insert a Data Preview Section

- In the centre of the screen, add a rectangular area as a “Data Preview” section where users can see dynamic updates, like “Species Population Trends,” “Soil and Air Quality,” or “Habitat Health Alerts.” Use a legible font size for displaying data, and consider options for text enlargement or voice narration to enhance accessibility for all users.

Use Colors and Borders for Clarity

- Add borders around each button and icon to create a polished, organised look. Select colours that fit an ecological theme, like greens, browns, and neutrals, to evoke a sense of environmental awareness. Ensure that colours have sufficient contrast to support readability for users with colour blindness, enhancing accessibility for all users.

Review, Download, and Save

- Review the mock-up to ensure all elements are well-aligned, easy to read, and user-friendly. Check that icons, labels, and the layout are intuitive, making navigation straightforward for users. Once the design is final, download and save the mock-up, ready for feedback and further refinement.

Step 7: Test

- Share your prototype with classmates, teachers, or potential users to gather feedback.
- Ask if the system is user-friendly and intuitive to use, observe how they interact with the tool and what they find challenging or helpful.
- Use their insights to refine the design, making adjustments to improve ease of use, readability, and relevance.
- Test the concept by explaining it to others or through a small trial (if feasible) to see if it addresses the problem effectively.

Support: Use the resources in MM7: Problem to Pitch Space Design Challenge, Lesson 7 Test

- Awe me (2021) How To Terraform a Planet - EPIC HOW TO https://www.youtube.com/watch?v=5Ye7FeOa7dg
- Kurzgesagt – In a Nutshell (2021) How To Terraform Venus (Quickly) https://www.youtube.com/watch?v=G-WO-z-QuWI
  NASA (2024) About the planets https://science.nasa.gov/solar-system/planets/
- United Nations (2024) SDG14 Targets and Indicator https://sdgs.un.org/goals/goal15#targets_and_indicators
- United Nations (2024) Desrtification, Land Degradation and Drought https://sdgs.un.org/topics/desertification-land-degradation-and-drought
- United Nations (2024) Biodiversity and Ecosystems https://sdgs.un.org/topics/biodiversity-and-ecosystems
- UNOOSA (2024) Decent Work and Economic Growth https://www.unoosa.org/oosa/en/ourwork/space4sdgs/sdg14.html

Prompts for User Profiles: SDG 15 Challenge on Terraforming for Biodiversity

As you begin to design your solutions, you should consider the types of people who would benefit from or be directly engaged with the project. Here are some prompts to help you think about user-profiles and the needs of individuals who could use their solution:

Young Ecologists and Aspiring Scientists

- Inspiration and Understanding: What would inspire a young person who's passionate about biodiversity to contribute to this project?
- Think about what aspects of terraforming and ecosystem monitoring excite them, such as supporting new habitats or protecting vulnerable species.
- How could space-based technologies, like drones or satellites, play a role in this vision?

Clarity and Accessibility:

- What foundational knowledge would help tech-savvy teenagers and young scientists understand how drones, satellites, or robotic systems can monitor biodiversity?
- Would simplified explanations of space tech, such as sensors or tracking systems, or case studies on current ecological monitoring help them engage more deeply?

Interactivity and Learning:

- Could hands-on experiences—like analysing simulated ecosystem data, designing a simple sensor, or building a drone mock-up—help aspiring scientists feel more connected to their project?
- How might this challenge give them the sense that they're making a meaningful impact on global biodiversity conservation?

Planetary Habitat Managers and Ecological Planners

- Community Impact and Relevance: How would this solution support individuals responsible for the health and balance of habitats on a terraformed planet?
- For instance, what real-time data would be most useful, such as soil quality indicators, species population metrics, or early warning signs of ecological imbalance?

Ease of Use and Accessibility:

- What platforms or tools would make it easy for these users to access the biodiversity data they need?
- Could data be delivered through an app, a web portal, or even alert notifications when conditions require immediate action?

Supporting Local Goals and Activities:

- How could this data assist in daily decision-making to maintain biodiversity and support sustainable development? For example, could the solution help planners decide on optimal planting locations for new species, monitor water resources, or track changes in species interactions over time?

Researchers and Environmental Scientists

- Specific Data Needs: What types of data would ecologists, environmental scientists, or planetary biologists require to understand the success of introduced ecosystems? Would metrics on species survival rates, ecosystem diversity, or environmental stability over time help them assess the impact of terraforming efforts?

Research and Public Awareness:

- How might these scientists use the data to inform their research and share findings with the public? For instance, could they use this information to identify ecological risks, communicate the importance of ecosystem balance, or propose measures to protect biodiversity on a larger scale?

Planetary Policy Makers and Governance Officials

- Policy Development and Environmental Management: What kind of data would help policymakers make informed decisions about sustaining a newly created ecosystem?
- Consider what information could guide them on issues like habitat zoning, conservation initiatives, or balancing species populations.

- Climate Resilience and Biodiversity Protection: How would these officials use biodiversity and ecosystem health data to create policies that promote resilience in the face of environmental changes? For example, would real-time updates on ecosystem health inform conservation policies, set limits for resource usage, or support emergency interventions?

Climate-Conscious Citizens and Biodiversity Advocates

- Accessible Knowledge for Advocacy: What information would a climate-conscious citizen need to understand the importance of biodiversity in a terraformed environment? How could access to ecosystem health data empower them to advocate for environmental protection and engage in community conservation activities?
- Community Awareness and Involvement: How could this tool connect citizens to a larger understanding of environmental needs? For instance, could updates on habitat health or population changes encourage them to raise awareness, support sustainability measures, or volunteer in community conservation projects?