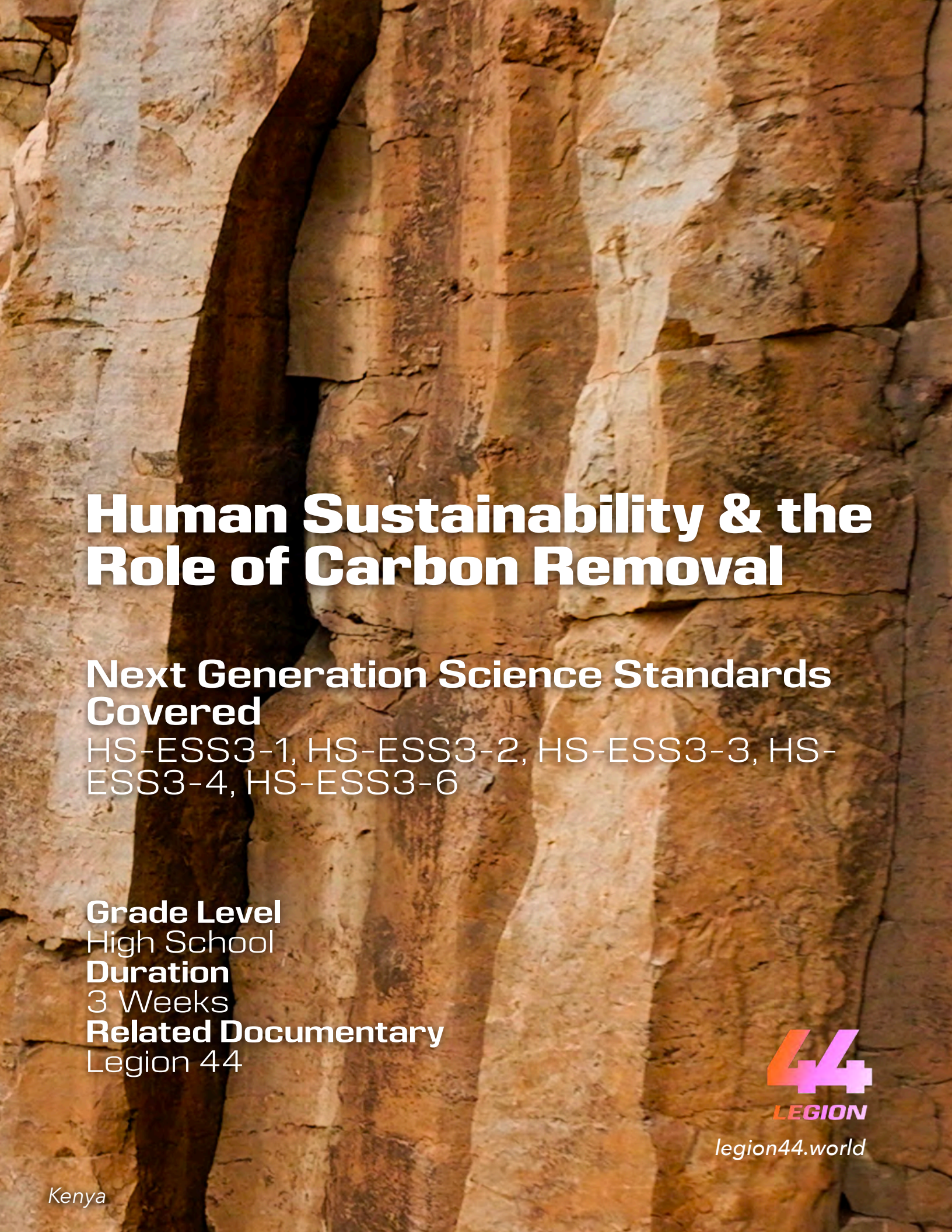


Human Sustainability & the Role of Carbon Removal

Next Generation Science Standards Covered

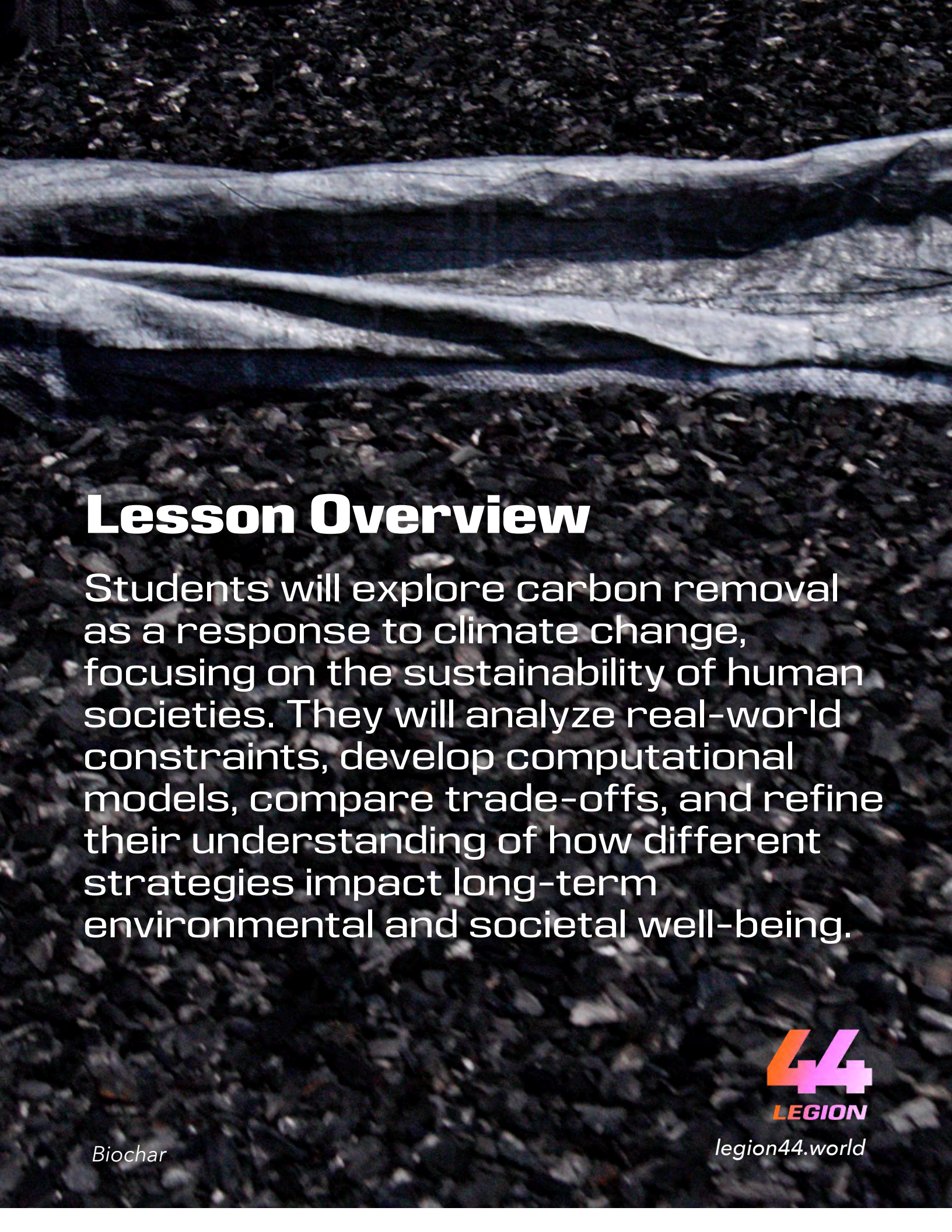
HS-ESS3-1, HS-ESS3-2, HS-ESS3-3, HS-ESS3-4, HS-ESS3-6

Grade Level
High School
Duration
3 Weeks
Related Documentary
Legion 44

LEGION

legion44.world

Kenya



Lesson Overview

Students will explore carbon removal as a response to climate change, focusing on the sustainability of human societies. They will analyze real-world constraints, develop computational models, compare trade-offs, and refine their understanding of how different strategies impact long-term environmental and societal well-being.

Week 1: Understanding Resource Availability & Climate Impacts

Objectives

1. Explain how the availability of natural resources affects societal and environmental sustainability.
2. Use computational models to analyze relationships among Earth systems and human activity.

Activities

Introduction & Documentary Segment (60 min)

1. Show a 15-20 min segment of Legion 44 on resource dependency and climate impacts.
    a. 00:00 –18:24: Premise for the need of carbon removal and how current resource dependency is impacting communities around the globe
    b. 33:27 – 36:55: How can carbon removal help with atmospheric CO_2 emissions and therefore, climate change mitigation.
2. Class discussion using guiding questions:
    a. How have resource availability and extraction influenced human society?
    b. How do we balance meeting today's energy needs with long-term sustainability?
    c. What role do carbon removal and emissions reduction play in these systems?

PhET Greenhouse Gas Simulation & En-ROADS Climate Simulator
(Take-Home or In-Class)

1. Students complete a guided worksheet exploring:
    a. How greenhouse gases trap heat in Earth's atmosphere.
    b. How different climate policies (e.g., renewables, efficiency, carbon removal) affect global temperature projections.
    c. How reliance on current resources influences future energy sustainability.

Class Discussion: Energy & Material Dependencies (60 min)

1. Emphasize how today's infrastructure (fossil fuels, mining) enables future renewables (solar, wind, batteries).
2. Debate: Should society prioritize phasing out fossil fuels quickly or invest more in cleaner extraction techniques?

Week 2: Evaluating and Managing Sustainable Resource Use

Objectives

1. Compare competing strategies for managing energy and mineral resources in a sustainable way.
2. Use computational models to evaluate trade-offs and long-term impacts.

Activities

Group Project Launch: Sustainability Trade-Offs (60 min)

1. Students (in teams) select a challenge related to sustainable resource management. Example projects:
    a. Grid Resilience Analysis: Compare different energy portfolios against variable demand curves.
    b. Battery vs. Hydrogen Storage: Evaluate trade-offs in cost, efficiency, and long-term viability.
    c. Carbon Capture vs. Natural Climate Solutions: Compare direct air capture with reforestation.
2. Provide a structured project outline:
    a. Define the problem & constraints.
    b. Describe two or more competing sustainability strategies.
    c. Use computational modeling to compare trade-offs.

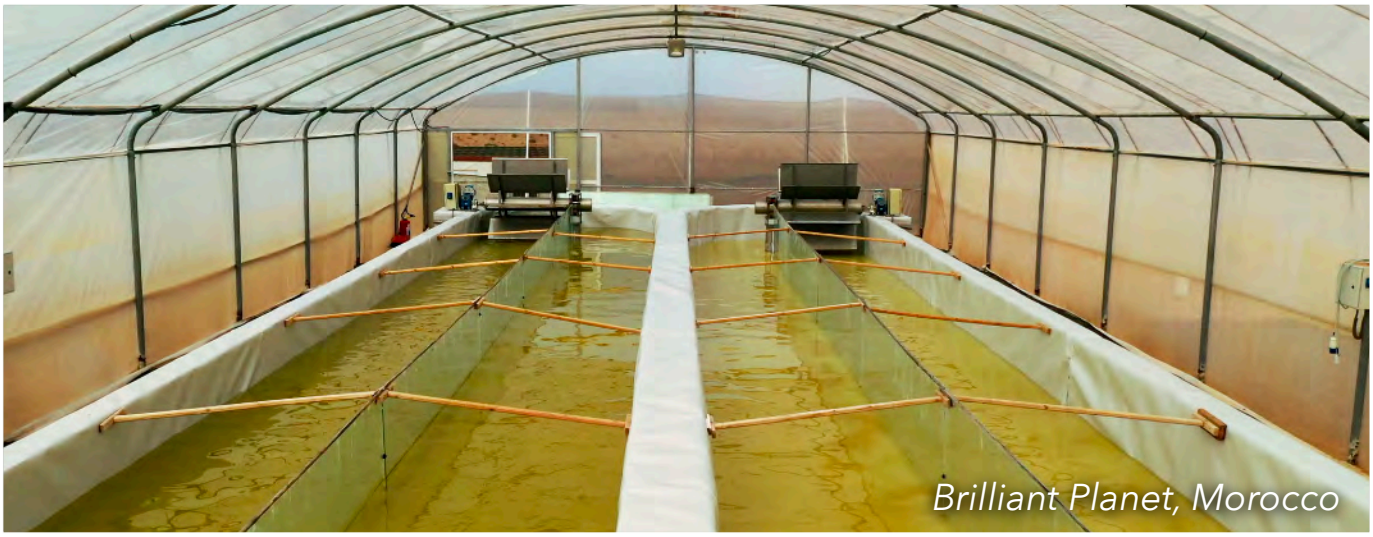
Computational Modeling & Trade-Off Analysis (120 min)

1. Students use simulation tools to analyze their selected challenge:
   a. En-ROADS for energy transitions & policy impacts.
   b. Custom Excel models for evaluating costs, efficiency, and emissions.
2. Teacher circulates to assist with defining assumptions, setting parameters, and interpreting results.

Week 3: Peer Review, Refinement & Final Evaluation

Objectives

1. Critically evaluate how solutions support long-term environmental sustainability.
2. Provide constructive feedback and refine strategies based on peer input.



Activities

Project Presentations & Peer Review (10-15 min per presentation)

1. Teams present their findings, including:
   a. Key trade-offs of their solutions.
   b. Model predictions & real-world feasibility.
   c. What factors limit effectiveness?
2. Peer evaluation using a rubric:
   a. Clarity of problem definition & constraints.
   b. Strength of proposed solutions & supporting evidence.
   c. Consideration of economic, environmental, and social trade-offs.

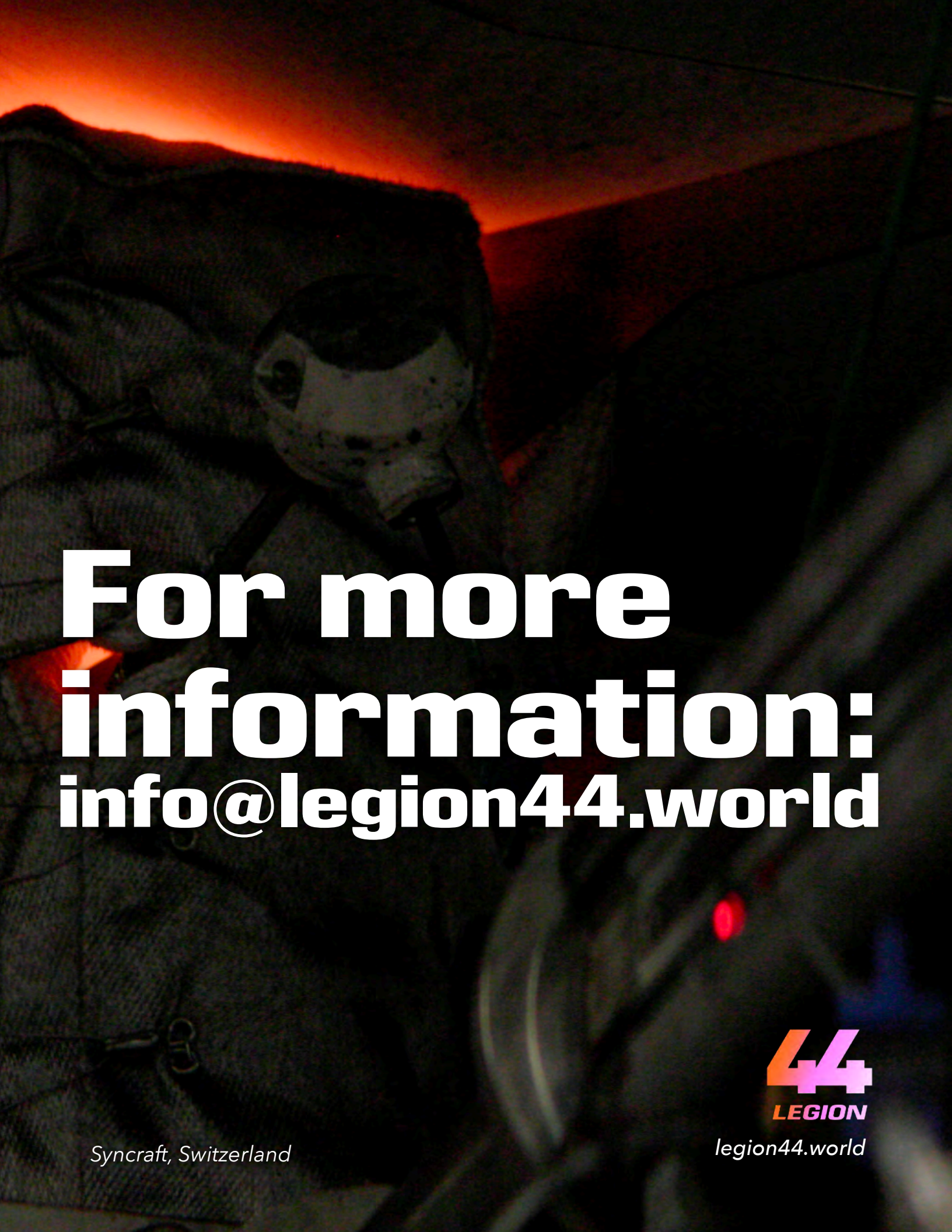
Refinement & Final Reflection (15-30 min)

1. Students revise their sustainability strategies based on feedback.
2. Exit Ticket: What was the most important trade-off your team considered? What would improve your solution?


Sargassum from Seafields, St. Vincent & the Grenadines

Assessment and Grading

- **Participation in Discussions (15%)** – Engagement in class discussions and research activities.
- **Project Proposal (20%)** – Clear problem definition, realistic constraints, and well-defined criteria.
- **Final Project & Model (40%)** – Depth of analysis, use of simulations, and creativity of the solution.
- **Peer Review & Reflection (25%)** – Thoughtfulness in evaluating peers and applying feedback.



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