STEAM Education & Leadership Workshops:

Lesson Plan: Climate Change Mitigation: Upcycling Plastics into Functional Materials

Developed by Sunday Akinlade – Teach For Nigeria Alumnus

Age range

12- 16 years old

Learning Objectives

By the end of this lesson, learners should be able to:

- ☑ Explain how plastic production contributes to global greenhouse gas emissions
- ☑ Analyze the lifecycle of petroleum-based plastics and quantify their contribution to greenhouse gas emissions during production and incineration.
- ☑ Formulate a personal climate action plan based on the "Refuse, Reduce, Reuse" hierarchy
- ☑ Design and construct a functional prototype using non-biodegradable waste, applying the Engineering Design Process (EDP).

Structure of the lesson

- Starter: The teacher leads a brief discussion on climate change using relatable, real-world examples.
- Exploration: Students conduct a "waste audit" to identify common plastic items found within the school environment.
- Concept Introduction: The teacher explains the interconnectedness of climate change, pollution, and the importance of the "Reuse" principle.
- Scientific Background: The Plastic-Climate Connection
- Hands-On Project: Students transform plastic bottles into functional items, such as pen cases and flower vases.
- Presentation: Groups present their designs, explaining their creative process and the utility of their products.
- Reflection: Students commit to one personal action they will take to reduce plastic waste in their daily lives.

Duration

1 hour: 30 Minutes

Materials:

- **Substrate:** Cleaned and dried post-consumer plastic bottles (PET #1 is recommended for ease of cutting)
- **Engineering Tools:** Sharp scissors, rulers, markers, and adhesives (craft glue or supervised hot glue guns).
- **Measuring & Marking:** Markers, rulers, and pencils
- **Aesthetics: Acrylic paint, cardstock, ribbons, or beads.**

- **Safety Gear:** Waste collection bins and a first-aid kit for minor cuts.

Note to Educators

- Connect Local Actions to Global Impact
- Encourage students to look for the "Resin Identification Code" (numbers 1-7 in a triangle) to understand material properties.
- **Safety First:** A safety Officer is recommended to closely supervise the use of sharp tools and high-heat adhesives. This is to mitigate liability and ensure student safety.
- **Functional Creativity:** Ensure the end product is not just "decorated trash" but serves a genuine utility, extending its life cycle and keeping it out of the landfill longer.

Resources

Slides: Climate Change Mitigation: Upcycling Plastics into Functional Materials

Timing	Facilitator's actions	Students outcomes	Technical notes
0-5 mins	**The Hook:** Present the "Invisible Oil" statistic: Ask, "How much oil is in this bottle?" When discussing the "Hook," ensure students understand that plastics are made from fossil fuels. This is the "missing link" in many students' minds between a bottle and a warming planet.	**Awareness and Connectedness** **Focus:** Social awareness, Perspective taking, Global consciousness, environmental literacy and foundational knowledge. Students will analyze the lifecycle of a plastic bottle to understand how plastics are derived from fossil fuels. Students will evaluate the direct connection between physical waste and global fossil fuel consumption.	Use clear, age-appropriate definitions and relatable imagery.

5- 15mins	**Exploration:** Lead a "Waste Audit." Guide students to identify and categorize plastic types found in the local environment. Create a simple table students can use during the 10–20 minute exploration phase to categorize their findings (e.g., Type of Plastic, Resin Code, Current State). Guide Students to share how the waste impacts the environment . *Please note: educators can conduct a "Desktop Audit" using items already in their backpacks/bins.*	**Awareness, and Mastery** **Focus:** Identification, Social awareness and local environmental observation. Students gain Mastery of local environmental literacy and identification of waste sources. Students categorise plastics into different types common in their school or home environment. Learners define climate change and recognize its impact through real-life examples.	Use clear, age-appropriate definitions and relatable imagery. Supplement with pictures or a short video of local waste sites.
15 -25 mins	**Concept Introduction:** Explain the "Reuse" principle. Contrast the energy cost of melting plastic (recycling) vs. repurposing it (upcycling). Provide a simple definition: "**Recycling** breaks a product down into its raw materials to make something new, while **Upcycling** takes a product as it is and gives it a higher value or a new function".	**Mastery, Connectedness and Agency** **Focus:** Collaboration, Critical thinking and systems mapping. Students describe how reusing plastic reduces carbon emissions and pollution. They give examples of plastics that have been repurposed in their environment. Students understand their role in co-creating solutions to reduce the impact of climate change.	Keep the explanation interactive using Q&A.
25-30 mins	**Scientific Background** Most students view plastic as a "litter" problem (choking oceans), but it is also a "climate" problem. Guide Students to understand that: • 99% of plastic comes from fossil fuels (oil and gas). The extraction of these fuels releases methane (CH_4) and Carbon dioxide (CO_2). • Refining plastic is one of the most carbon-intensive manufacturing processes	**Awareness and Agency** Focus: Foundational Literacy, Problem Solving and Critical Thinking. Students will understand that the "cost" of a plastic bottle isn't just the price paid, but the release of Greenhouse Gases Students will transition from seeing plastic solely as a "solid waste" problem (visual pollution/choking wildlife) to a "gaseous waste" problem	Clarify that upcycling is not a permanent solution.

	in the world.	(atmospheric warming).	
30 -70 mins	**Hands-On Project:** Demonstrate how to upcycle bottles. Assign students to groups of 4-5, depending on the class size and encourage each student in a group to participate actively. **The Challenge:** Create a pen case, cutlery holder, or flower vase by transforming waste into valuable resources. Ensure all safety protocols are strictly followed.	**Mastery, Agency and Connectedness** Critical thinking, Creative problem-solving, and fine motor skills, and collaboration Students apply creative problem-solving and fine motor skills. Students successfully create a pen case, cutlery holder, or flower vase.	**Safety First:** Closely supervise the use of sharp tools and high-heat adhesives. Ensure to **sand down or tape sharp plastic edges** to prevent injury.
70-85mins	**Group presentations** Facilitate a "Gallery Walk." Groups explain their design process and the utility of their product. Evaluation Rubrics: • Durability, • Utility, • Creativity and material efficiency	**Wellbeing, Awareness, and Mastery** **Focus:** Gratitude, self-confidence, accountability. Students build confidence in scientific communication and accountability Learners showcase work and commit to one personal action to reduce waste.	Encourage confidence and concise explanations.
85-90 mins	**Reflection session.** Guide students to share one key insight from the session. Encourage each Student to appreciate one person who was helpful during the project.	**Wellbeing, Mastery and Agency** Focus: Gratitude, Empathy, Collaboration and global mindedness. Students transition from classroom theory to real-world application by selecting one measurable, personal action to mitigate plastic waste Students recognise the collaborative nature of STEAM projects by identifying and verbalizing the specific contributions of a peer.	To avoid repetitive answers (like "I learned recycling is good"), provide students with "Sentence Starters." *Example:* "I used to think plastic was just litter, but now I realize it is..."