One Step topics are centered around real-world problems and solutions!

In this video and lesson plan, students learn about how people in Douala, Cameroon are taking plastic bottle pollution and turning them into boats, solving two problems at once: **pollution and a shortage of fishing boats.**

ONE STEP™

A 2-FOR-1 POLLUTION SOLUTION

LESSON PLAN | GRADES 6-8

#stompoutcarbon for a better tomorrow!

The city of Douala, Cameroon has a major issue. It is a city that thrives mainly on fishing, but the water in the rivers are so polluted with plastic bottles that it is difficult for fish to survive, *and* for fishermen to catch enough fish to support themselves. Decreased fish yields mean less profit for fishermen, which exacerbates the problem of fishermen investing in expensive wooden boats.

C1E1 (7 mins)

Ecoboats: The Solution that Floats

Learn how one person solved two different problems at the same time! Could you solve a pollution crisis and a food shortage at the same time? That's what Ismael Essome is doing in Cameroon, Africa!

Thanks to the resourceful people at Madiba & Nature, this problem has a very unique solution: use the plastic bottles to make boats! These inventions, known as Ecoboats, clean the pollution and provide the local inhabitants with affordable boats for fishing. In this lesson and video, students will see how one young entrepreneur solves two problems with one solution, all while diverting tons of plastic waste. Ingenuity, creativity, and innovation are at the heart of this man's passion for the environment and the people of his city.

High-quality, engaging videos get students interested in and excited about learning.

Spanish subtitles and English captions are available for videos.

Visuals and animations in the videos help define and explain concepts.

OBJECTIVES

Break lessons up over multiple days and/or class periods based on time.

Lesson Time: 2 hr 55 mins+

Lesson Description: In this lesson, students will learn about the problem of plastic pollution, especially plastic bottle pollution, and how this problem is being managed in different parts of the world. Working primarily in small groups, students will collect and analyze data to understand the scope of the plastic waste problem in their own school community, then use the engineering process to design and create an invention that solves a local community problem and upcycles plastic materials from their school. Finally, students will design an elevator pitch to explain and "sell" their product to people.

Easy-to-follow objectives and lesson overview.

Students will:

- Students will learn about the value of engineers and the engineering process in solving problem.
- Students will discuss and analyze the scope of plastic waste problems in their school community.
- Students will use the engineering process to create a design that solves multiple community problems.
- Students will analyze the success of their design and reflect on ways to improve their design.
- Students will create a concise and compelling "pitch" to explain the value of their invention to a larger audience.

Prior Knowledge:

- It is helpful (but not necessary) for students to have some familiarity and experience with the engineering process.

TO PREPARE

This lesson requires students to engineer a project by upcycling waste materials, and will require collection time before completing the lesson. Students will first collect data about plastic waste in their school community, then use the data to inform the materials they use for their engineering project. Collect these materials yourself, set up a bin in the teacher's lounge requesting supplies from faculty, or send home a letter requesting supplies from families.

- **common plastic waste materials:** straws, bottles, bottle caps, bags, plastic-lined milk cartons, ziploc bags, plastic packaging materials, etc.
- **other helpful engineering materials to collect:** paper towel/toilet paper rolls, cardboard, egg cartons, aluminum foil, etc.
- **common classroom materials:** scissors, glue/tape/other binding materials

Resources and materials needed are included with every lesson plan.

Vocabulary Words

Vocabulary slides provide student-friendly definitions with visuals to scaffold understanding.

Use the Vocabulary Slides to review these words and concepts as needed.

biodiversity: the variety of life in the world or in a particular ecosystem

economy: the way in which goods and services are made, sold, and used in a country or area

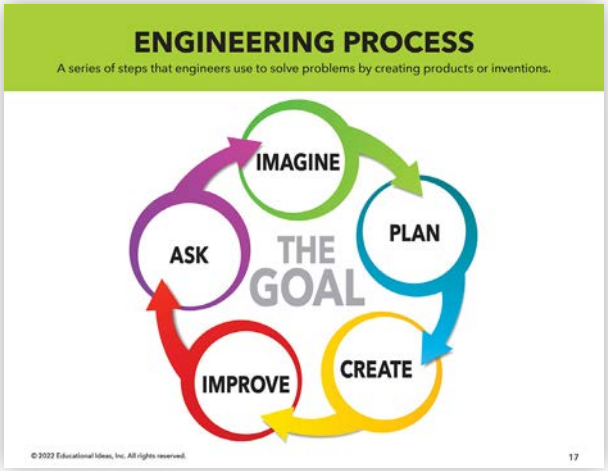
ecotourism: tourism directed toward natural environments intended to support conservation efforts

engineer: a scientist that solves problems by creating products or inventions

engineering process: a series of steps that engineers use to solve problems by creating products or inventions

innovation: a new idea, device, or method

upcycle: the reuse of an object or material that creates a product of higher quality or value than the original



Visuals and animations help define and explain important standards-aligned concepts.

Cross Curricular Lesson Suggestions

Math: Share the statistic that the average American produces 7 pounds of waste each day. Ask students to estimate the amount of each type of waste they produce, including paper, plastic, food waste, etc. (If time permits, ask students to complete a waste journal for 1–7 days to create a more accurate picture of their waste.) Ask students to convert estimations or data into proportions by creating a pie chart. Lead a discussion around how changing habits would change proportions in their pie chart.

Social Studies: Mark locations around the globe showing areas where fishing is the most important industry (Douala, Cameroon; La Higuera, Chile; Dutch Harbor, Alaska, United States; Vladivostok, Russia, etc.). Lead a discussion about what these locations have in common, and ask them to predict the most important industry before revealing it. Discuss the connection between geography and natural resources, and repeat the process with a different natural resource if desired.

ELA: Read about the Plastiki catamaran, created by environmentalist David de Rothschild. Discuss similarities and differences between Ecoboats and Plastiki, including the goal of each project.

Art: Organize a trash cleanup in your community for students. Encourage students to carefully collect trash (always wearing gloves) and design their own work of art with the materials to encourage others to reduce waste.

Music/ELA: Distribute copies of the lyrics to "Plastic Beach" by the Gorillaz. Lead a discussion about the meaning of the lyrics and what they're referring to. Students can also research the inspiration behind the album, as well as album art, to better inform them about the work.

All of One Step's videos and lessons are designed to support learning across the curriculum. From climate science to ELA, geography, government, history, and more, One Step is flexible and easy to incorporate throughout the school day.

ENGAGE

30–60+ minutes* (depending on data collection method chosen)

Lessons utilize short learning activities to assess prior knowledge, stimulate curiosity, and guide students towards desired learning outcomes, while also uncovering misconceptions resulting in engaged students who produce thoughtful responses to the questions presented.

Ancillary Materials: Engineering Notebook

Supplies: disposable gloves (if needed), notebook

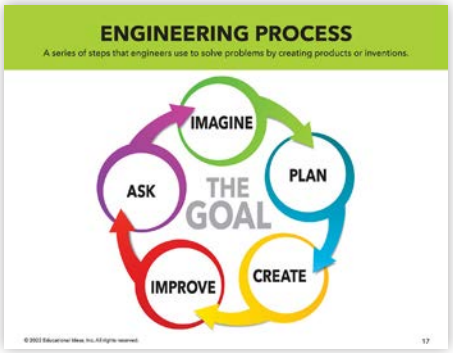
Engage students in a whole group discussion with the following prompts:

- What do you already know about engineering?
- What do engineers do?

Group and partner discussion prompts promote rich classroom discussion and inspire inquiry-based learning.

Watch NASA Kids' Intro to Engineering video. Engage students in a whole group discussion with the following prompts:

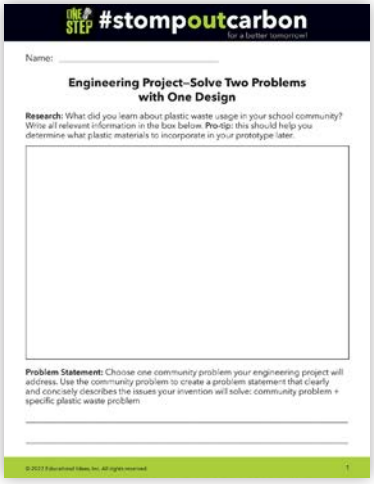
- What did you learn about the engineering process?
- What do engineers do, and why are they important?
- *(Discuss in partnerships, then share with the whole group.)* Waste, especially plastic waste, is a big problem worldwide. How could engineers help solve this problem?



Note: *Based on your students familiarity with engineers and the engineering process, you may choose to skip this video.*

Explain to students that they will act as engineers to design and create a product that addresses plastic waste in their community. Before they create the product, they will collect data about plastic waste in order to better understand the problem and record data in their Engineering Notebook (if applicable). Choose one of the following suggested procedures for students (or more, depending on timing and the needs of your students):

- **School data collection "field trip":** Distribute gloves to students and conduct a brief (15–20 minutes) field trip around the school campus. Discuss important types of data to collect before beginning the field trip (plastic litter around campus, number of recycling bins and how much they are used, amount of recyclable plastic waste found in trash bins, etc.). Encourage students to explore different parts of campus and share data afterwards so students identify trends in plastic usage.



Hands-on activities keep students physically and mentally stimulated.

ENGAGE *con't*

30–60+ minutes* (depending on data collection method chosen)

- **Design a plastic waste survey:** Divide students into groups and ask them to determine a specific audience and objective for their survey (determining what types of disposable materials are used most, what percentage of recyclable materials are actually recycled, etc.). Ask students to create a survey draft on a free website like Google Forms, then share with another group for feedback. After surveys are finalized and distributed, groups should analyze data and share trends with the whole group. *(**Note:** If you choose to use Google Forms, it will automatically organize data by question for easy analysis.)*
- **Plastic journal:** Ask students to track their plastic usage at school for 1–5 days. Students should share their results and compare data in order to identify trends in plastic usage.

Activities allow students to relate what they're learning to solution-oriented ways they can implement in their own lives.

EXPLORE

Lessons offer opportunities for students to investigate and explore the topic through research challenges, experiments, and shared observations, enabling them to construct explanations and develop a strong foundational understanding.

45 mins

Ancillary Materials: Global Plastic Bottle Statistics, Engineering Notebook

Display Global Plastic Bottle Statistics and engage students in a whole group discussion with the following prompts:

- How many plastic bottles are used around the globe every day? *(**Note:** It may be helpful to write out 1.3 billion to help students grasp the enormity of the number.)*
- What surprises you most about this data?
- Where do you think these plastic bottles go?

Tell students that before you reveal the details of their engineering project, they will watch a video about another engineer for inspiration. Watch the video "Ecoboats" and engage students in a whole group discussion with the following prompts:

- How might plastic pollution affect plants and animals in the environment?
- How does reducing pollution affect biodiversity? Why does that matter?

- How might a decrease in biodiversity affect ecosystems? *(**Note:** A decrease in biodiversity will always impact an ecosystem in some way; for example, a decrease in insects means there is less food for animals that eat insects. A decrease in predators could mean an increase in prey animals, like mice, and a decrease in the populations of their food source. Push students to answer with specificity by giving them specific prompts, if needed. The Climate Talk lesson "Animals" will address ecosystems in detail.)*
- What are the two problems that Ecoboats help solve?
- How could you use this story as inspiration to solve multiple problems in your community?

Explain to students that they will go through the engineering process in order to design and build a prototype that solves a community problem and incorporates common plastic waste materials in the school community, like the engineers at Madiba & Nature did with Ecoboats. Preselect 2–3 community problems and display for groups to choose; suggested community problems include:

- Drought/flooding problems
- Decrease in a specific plant/animal population
- Insufficient shade shelters

Instructional notes are embedded throughout each lesson plan and include potential student responses, misconceptions, and guidance.

***Note:** The list above is meant to be used as a guide only. The engineering project will be more meaningful if you choose a problem in the students' local community/school community.*

Guide groups through the creation of a problem statement, which should clearly and concisely describe the issues their invention will solve (community problem + specific plastic waste problem in school community). If needed, you can model how to create a problem statement or workshop groups' problem statement drafts with the whole group.

Encourage students to be as creative as possible during the brainstorming process. The most creative ideas can create the most innovative solutions! Go over brainstorming guidelines with students as needed:

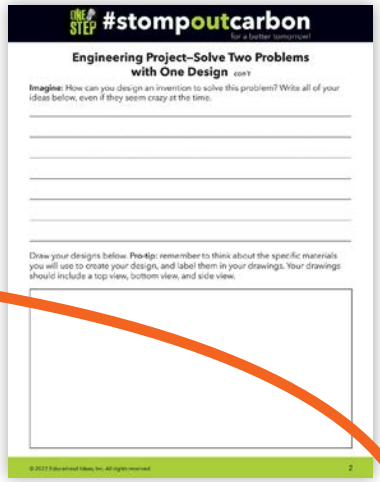
- Use your imagination when brainstorming.
- No negativity or disrespectful comments.
- Write down all ideas, even if they seem crazy at the time.

EXPLORE *con't*

45 mins

- Consider the materials you have to build with as you brainstorm – what's the function of each material? How could you use that material to help solve the community problem?
- Think about ways to build on each other's ideas, or combine ideas to come.

Ask students to independently brainstorm and record ideas in their Engineering Notebook, then share their ideas with their small group. Circulate and support groups as needed. *(**Note:** Based on timing and your students' familiarity with Internet research, you may choose to let students research their selected community problem before brainstorming solutions. Regardless, students should be given at least 15 minutes of uninterrupted brainstorming time.)*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Engineering Project–Solve Two Problems with One Design con't

Imagine: How can you design an invention to solve this problem? Write all of your ideas below, even if they seem crazy at the time.

Draw your designs below. **Pro-tip:** remember to think about the specific materials you will use to create your design, and label them in your drawings. Your drawings should include a top view, bottom view, and side view.

 2

After students finish brainstorming, they should consider each member's design and choose a final design. Remind students that the final design choice can be one student's design or a combination of several student designs. Ask students to complete the materials list in their Engineering Notebook.

Continual teacher prompts and worksheets make it easy for teachers to stay on track and be prepared with student activities.

EXPLAIN

Lesson activities encourage students to explain their findings and observations, while allowing teachers to introduce scientific concepts, address misconceptions, and guide students in understanding related concepts.

30 mins

Ancillary Materials: Engineering Notebook

Supplies: common plastic waste materials (to be determined by student data collection; common materials include straws, bottles, bottle caps, bags, plastic-lined milk cartons, ziploc bags, plastic packaging materials, etc.); other engineering materials (paper towel/toilet paper rolls, cardboard, egg cartons, aluminum foil, etc.), scissors, glue/tape/other binding materials


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Engineering Project–Solve Two Problems with One Design con't

Create: After your team decides on one design, write your materials list in the box below.

Create: Work as a team to create your design with recycled materials. **Pro-tip:** It's okay to change your original plans if your design isn't working the way you expected.

Improve: Discuss the following questions with your team and record your responses below.

1. What are you most proud of about your engineering project?

 3

EXPLAIN *con't*

30 mins

Remind students that their goal is to create an invention that solves a community problem and contributes to the school community's plastic waste problem. Go over the relevant parts of the rubric and answer any student questions before beginning. Distribute requested materials to each group along with tape, scissors, and glue. After students complete their model, ask them to complete the reflection found in their Engineering Notebook.

Note: *Depending on timing and the needs of your students, it may be beneficial to allow students to briefly present their ideas to the group and gather feedback from their peers. This can be accomplished verbally or through a gallery walk format with written student feedback cards. Students can then use their reflection and peer feedback to improve their prototype.*

Challenge students to extend learning goals by applying what they've learned in a new situation or context.

Approximate time evaluation is included with each portion of an activity to ensure timely classroom management.

ELABORATE

30–40 mins

Supplies: notebooks

Engage students in a brief whole group discussion with the following prompt:

- How do you think engineers/inventors move from the prototype stage, which we're in, to actually creating something usable for people?

Supplement the discussion as needed. By the end of the conversation, students should recognize that engineers/inventors have to "pitch" their design or explain its usefulness, in order to get funding support from investors or the government.

Explain to students that they will create their own 1-minute "elevator pitch" of their prototype to help "sell" their idea to anyone. Students should record ideas for their pitch in their notebooks. Display and discuss the pitch requirements; suggest requirements include:

- The pitch must clearly explain the who, what, when, where, why, and how of the issues and solution.
- The pitch must be designed in a way that would convince anyone (investor, government official, potential customer) that your product solves two problems with one solution.

ELABORATE *con't*

30–40 mins

- The pitch should include one slide (poster paper or digital) that enhances the message of the pitch.
- The pitch should include a brief demonstration with the prototype so that people understand how it works.
- The entire pitch shouldn't last longer than 1 minute.

Optional project prompts included in lessons, allowing teachers to take learning one step further.

Based on timing and the needs of your students, you may choose to ask groups to present their pitches to the whole class or to create a video of their pitch for you to view later.

Optional Extension Project: Challenge students to turn their pitch into a social media campaign for their invention and run their campaign on a school social media account, if possible.

Lessons include ways to evaluate students' progress towards their learning goals. Tasks in these sections might include a poster presentation, a classroom debate, or a written explanation of a concept or model. One Step provides suggested rubrics to support teachers in evaluating learning.

EVALUATION

Ancillary Materials: Ecoboats Rubric

Evaluate students' efforts throughout the lesson by using the provided rubric.

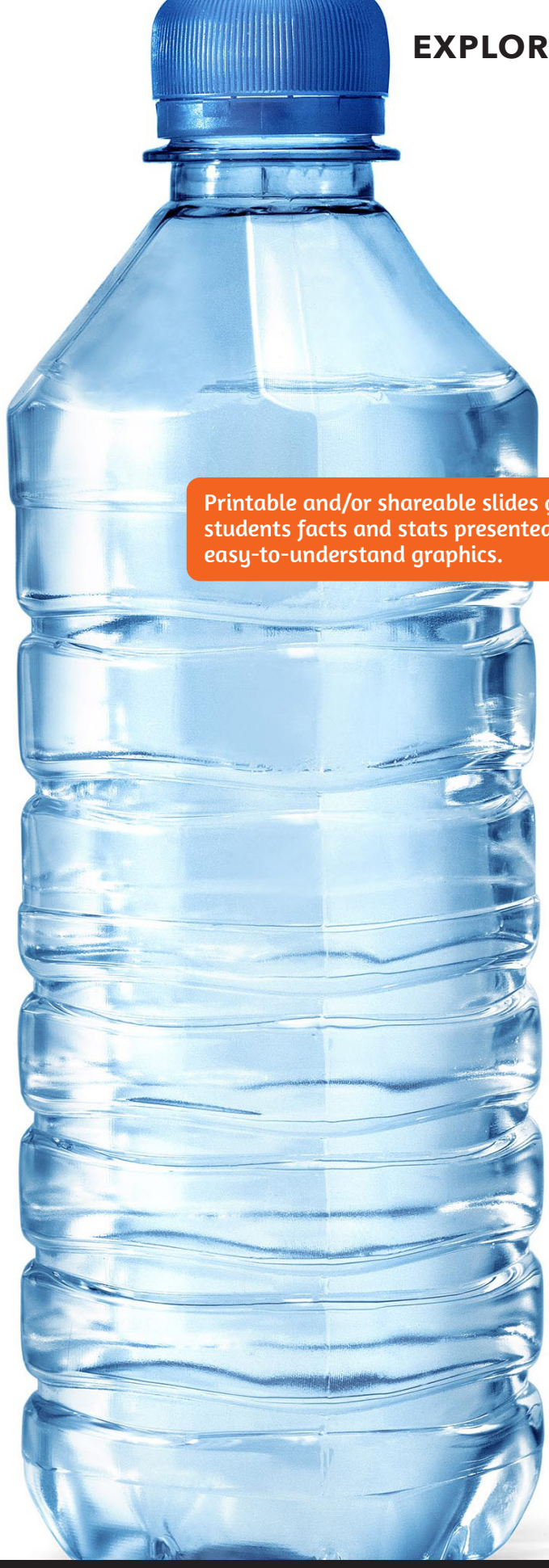
Note: *The goal of this rubric is to provide a holistic grade of students' efforts throughout the engineering project, including teamwork within small groups, creating design prototype and product pitch. The rubric also includes a section for whole group discussions throughout the lesson. Please feel free to alter the categories and/or points values based on the needs of your students.*


Rubric for Ecoboats Engineering Project

Sections	Requirements	5 = Excellent	3 = Good	1 = Needs Improvement
Engineering Project Brainstorming/ Planning	Student brainstorms numerous solutions, and records ideas in notebook. Student considers both the cost-saving problem and uses waste materials for prototype. Student works with group to explore different ideas while giving and receiving feedback. Student evaluates the team's many ideas to determine which design best meets project criteria and constraints.	All of the required elements are present.	Many of the required elements are present.	Few of the required elements are present.
Engineering Project Execution/ Reflection	Student works with group to create a prototype and revises in the moment as needed to best meet project constraints. Student accurately self-assesses strengths and weaknesses of prototype, and records tangible ideas for improvement in notebook.	All of the required elements are present.	Many of the required elements are present.	Few of the required elements are present.
Engineering Project Pitch	Student plays an active role in the creation and/or delivery of group pitch. Group pitch addresses all requirements; explains all elements of the issues and solution; is designed to persuade the audience that the product definitively addresses the identified issues; includes one slide that enhances the message of the pitch; includes a demonstration of prototype; doesn't exceed 1 minute in length.	All of the required elements are present.	Many of the required elements are present.	Few of the required elements are present.
Project Teamwork	Throughout the project, student remains engaged, on topic, and respectful. Student generates ideas, and respectfully gives feedback on other group members' ideas. Looks for solutions to interpersonal problems, and compromises when disagreements occur.	All of the required elements are present.	Many of the required elements are present.	Few of the required elements are present.
Whole Group Discussions	Throughout the lesson, student is engaged in whole group discussions. Student contributes to the discussion in a positive way. Student uses insights gleaned during discussions to inform engineering project.	All of the required elements are present.	Many of the required elements are present.	Few of the required elements are present.

Ready-made grading rubrics make it easy for teachers to assess student content and concept knowledge.

EXPLORE: GLOBAL PLASTIC BOTTLE STATISTICS



Printable and/or shareable slides give students facts and stats presented in easy-to-understand graphics.

worldwide plastic bottle consumption

481.6
billion bottles in a year

40
billion bottles in a month

1.3
billion bottles in a day

54.9
million bottles in an hour

almost **1**
million bottles a minute

Drowning in Plastic: https://graphics.reuters.com/ENVIRONMENT-PLASTIC/0100B275155/index.html
Euromonitor International; Science Advances; Geyer et al (2017), Our World in Data; Reuters

That's like 5,500 bottles in the blink of an eye!

Definitions and visuals help define and explain concepts; especially helpful for English learners.

Vocabulary

BIODIVERSITY

The variety of life in the world or in a particular ecosystem.

ECONOMY

The way in which goods and services are made, sold, and used in a country or area.

ECOTOURISM

Tourism directed toward natural environments intended to support conservation efforts.

ENGINEER

A scientist that solves problems by creating products or inventions.

ENGINEERING PROCESS

A series of steps that engineers use to solve problems by creating products or inventions.

INNOVATION

A new idea, device, or method.

UPCYCLE

The reuse of an object or material that creates a product of higher quality or value than the original.

Rubric for Ecoboats Engineering Project

Sections	Requirements	5 = Excellent	3 = Good	1 = Needs Improvement
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One Step lessons, projects, and experiments employ all 5Es and help teachers address NGSS performance expectations.

MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Constructing Explanations and Designing Solutions Asking Questions and Defining Problems	**LS2.C:** Ecosystem Dynamics, Functioning, and Resilience **LS4.D:** Biodiversity and Humans **ETS1.A:** Defining and Delimiting Engineering Problems **ETS1.B:** Developing Possible Solutions **ESS3.C:** Human Impacts on Earth Systems	Stability and Change Cause and Effect **Connections to Engineering, Technology, and Applications of Science** Influence of Science, Engineering, and Technology on Society and the Natural World **Connections to Nature of Science** Science Addresses Questions About the Natural and Material World

One Step Focus Skills Embedded Within NGSS Performance Expectations

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All lesson plans come with ready-made student worksheets, saving teachers the time and energy spent creating their own.

Students can also access the worksheets as Google files on the One Step app.

Student Materials

Name: _____

Engineering Project—Solve Two Problems with One Design

Research: What did you learn about plastic waste usage in your school community? Write all relevant information in the box below. **Pro-tip:** this should help you determine what plastic materials to incorporate in your prototype later.

Problem Statement: Choose one community problem your engineering project will address. Use the community problem to create a problem statement that clearly and concisely describes the issues your invention will solve: community problem + specific plastic waste problem

_____

_____

Engineering Project—Solve Two Problems with One Design *con't*

Imagine: How can you design an invention to solve this problem? Write all of your ideas below, even if they seem crazy at the time.

Draw your designs below. **Pro-tip:** remember to think about the specific materials you will use to create your design, and label them in your drawings. Your drawings should include a top view, bottom view, and side view.

Engineering Project—Solve Two Problems with One Design *con't*

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Improve: Discuss the following questions with your team and record your responses below.

1. What are you most proud of about your engineering project?

Engineering Project—Solve Two Problems with One Design *con't*

2. What was the most difficult part about the engineering project?

3. If you had more time, what would you change?

4. How has your thinking about engineers and the engineering process changed?