

“Extending the CTE-STEM Pipeline into Middle Schools”

Green Engineering

Saving Nomilu’u (Part 1)

Solutionary Phase	Solutions
Lesson # and title	Lesson 10: Saving Nomilu’u (Part 1)
Duration	45 minutes

Lesson Overview

Students will use what they learned in the fundamentals and problem cycles in order to solve the problems caused by sea level rise on an imaginary island called Nomilu’u. During Part 1 of the solution sequence, students will be learning about the island, choosing a user, defining the problem facing that user, and brainstorming some solutions.

Learning Objectives

After this activity, students should be able to:

- Explain the stages/steps of the engineering design process.
- Define the problems facing the island.
- Understand project criteria and constraints.
- Apply what they learned in earlier lessons to come up with possible solutions.

Content Standard(s)

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. (Grades 6 - 8)

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (Grades 6 - 8)

CTE.EA.B.6.1. Understand the steps in the design process.

CTE.EA.B.6.5. Demonstrate the process of developing multiple details, within design constraints, into a single solution.

CTE.EA.C.3.2. Produce proportional two- and three-dimensional sketches and designs.

CTE.EA.C.2.1. Employ engineering design equipment using the appropriate methods and techniques.

College and Career Connection(s)

Students will learn about structural engineers, coastal engineers, and environmental engineers. They will then practice the engineering design process through the lens of one of these engineering disciplines.

Equipment, Instructional Resources, and Materials

Building Materials (not used until part 2) - these can be gathered in advance

- **Required Materials**

- [Clear plastic tubs](#) (approximately shoe-box sized or larger)
- Clay
- Sand
- Water
- Miscellaneous Maker Materials
 - Some ideas can be found on the [Team budget spreadsheet](#)

- **Recommended Materials**

- [Monopoly houses/hotels](#) or something similar to represent the houses/hotel
- Cork pieces or something similar to represent boats in the bay
- Moss or fake/model plants

Student Materials

- Printed or digital copies of [Save Nomilu'u Engineering Design Challenge](#)
- Printed or digital copies of [Saving Nomilu'u: Student Instruction Sheet](#)
- Optional: [Team budget spreadsheet](#) - please copy and edit this document to reflect the materials available.
 - Possible extension: have students research the environmental impact of the different building materials.

Technology Tools:

- 1:1 Computers (optional)
- Access to projector and Google Apps for Education
- Book Creator App: (optional) for Engineering Notebook and for student Reflection (Google Slides can also be used as a Engineering Design Notebook)

Suggested Student Grouping

- Whole group: Review Engineering Design Process and Introduce Engineering Design Challenge
- Small groups (~3 students)

Vocabulary

- Gross Domestic Product
- Cyclone
- Cabana
- Cassava
- Tarro
- Terrace
- Contaminate
- Sea Wall
- Wages
- Coastal Engineering
- Environmental Engineering
- Field research
- Coastal resilience

- Economy
- Renovation
- Preservation
- Navigation channels
- Seismic
- Sediment
- Adverse
- Remediation action plan
- Environmental audits
- Environmental policies and regulation
- Water quality assessments for potable and industrial waste
- Longshore transport
- Barrier islands
- Mitigation

The Lesson

Preparation

Prior to Class

- Gather and prepare all materials in advance.
 - Slide deck and projector
 - Printed or digital copies of [Save Nomilu'u Engineering Design Challenge](#)
 - Printed or digital copies of [Saving Nomilu'u: Student Instruction Sheet](#)
 - Have experiment materials ready so students can preview what they can use to prototype
- Optional: Create google form or something similar to collect student user selections for formation of groups.

Lesson Procedure

[Link to Lesson Slide Deck:](#)

Activity/Task	Description	Time (min)

Slides 1-2: Introduce the Challenge and Review the Parts, People, and Interactions Protocol	<ul style="list-style-type: none"> • Tell students that they will be acting as engineers to solve the sea level rise problems affecting an imaginary island called the The Republic of Nomilu'u. While the island may be imaginary, the problems facing the island are based on real problems facing many different places in the world. • Go through the Parts, People, and Interactions protocol with students. Tell them that they will be using it to learn more about the problems facing the island. 	2 mins
Slide 4: Students Explore the Challenge	<ul style="list-style-type: none"> • Pass out paper copies or have students access digital copies of the Save Nomilu'u Engineering Design Challenge • Have students independently read the information about the challenges facing the island and the people who live there using the Parts, People, and Interactions protocol. Students should annotate the document as they read. • Have students discuss as a class what they learned about the island. 	8 mins
Slides 5-7: Coastal Engineering	<ul style="list-style-type: none"> • Ask students what types of engineers work with these types of issues. Students can popcorn out some ideas based on the engineering disciplines they learned about in previous lessons. • Tell the students that they are going to watch some short videos about 2 types of engineering who might help solve the problems on Nomilu'u. • Have the students watch each video and discuss what they learned about those types of engineers. <ul style="list-style-type: none"> ◦ Some of the language in this video can be higher level - recommend pausing the video to discuss terms 	10 mins
Slides 8-11 :Review Engineering Design and Set-up Engineering Firms	<ul style="list-style-type: none"> • Remind students what the main challenges facing Nomilu'u are. • Ask students if they recall the steps of the engineering design process. Have students popcorn out the steps. <ul style="list-style-type: none"> ◦ Remind students that they practiced these steps with a simple problem in the 3 little pigs challenge. Today they will start using these steps to solve the more complicated problems on Nomilu'u. • Remind students that in order to help define a problem, engineers focus on a user (a person with a need or problem). Tell the students that they will be selecting one of the people on Nomilu'u to be their user. • Group the students based on the user they chose into groups of about 3-4 students. <ul style="list-style-type: none"> ◦ Recommended: have students fill out a google form or something similar to select their user. Alternatively, students can be grouped in advance and allowed time to discuss who they would like to define for. • Tell the students that they will be forming an engineering firm with multiple 	5 mins

	<p>different types of engineers.</p> <ul style="list-style-type: none"> ○ Each member of the team will have a different engineering focus. Have students decide who will be a(n): Coastal Engineer, Environmental Engineer, or Structural Engineer. ○ Pass out or have students open a digital copy of the student worksheet. ○ Have students decide on the name for their engineering firm. Have students record their firm name on their worksheet. ○ Have students read and circle the description of the engineer they will be for this project. 	
Slides 12-13: Define/Identify	<ul style="list-style-type: none"> ● Have students discuss and answer the “define” questions with their small group. <ul style="list-style-type: none"> ○ Have them think back to the solutions they saw implemented in the problem cycles. ○ Remind students of the problem statements they wrote for the little pigs challenge. Example: The pigs need a stable house to hide in because the wolf wants to eat them and can blow down unstable houses. ● Have students discuss/answer the criteria and constraints with their small group. <ul style="list-style-type: none"> ○ Students can use the example budget as part of the constraints. This should be edited to match the materials, time, etc. for the class. ○ Optional extension: have students research the environmental impact of different building materials and add them to the budget. 	10 mins
Slide 14: Brainstorm/Select	<ul style="list-style-type: none"> ● Have students spend about 3-5 minutes independently writing/sketching ideas before discussing with the group. ● Once students have determined their selected design, all group members should draw the plan to check that they understand how they will be building it tomorrow (the labeled diagrams should match) 	10 mins

Assessment/Extension		
Sides 16 (optional)	<p>Slide 16 Bonus/Extension - This can be assigned as a reflection (in-class or homework) or introduced at the beginning of the lesson for students to take notes in during the lesson. Students can be given the choice in how they would like to capture their notes/reflections such as pencil/paper, Google slides, or Book Creator.</p> <p>Sample Book creator link:(optional) - Suggestion: Have students choose which reflection questions they would like to answer.</p>	10-20 mins

Grade Student Instruction Sheet (optional)	Student instruction sheets (Part 1) can be collected and reviewed as an optional formative assessment. An Engineering Design Rubric can be helpful in assessing students.	N/A
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