Key: Yellow highlight = required component

Sea Turtle Eggs: Washed to Sea?

Subject Area(s) Life science, problem solving

Associated Unit none

Associated Lesson none

Activity Title **Sea Turtle Eggs: Washed to Sea?**

Header

Image file: sea_turtle_nest.jpg

ADA Description: A sea turtle nest on the beach is protected by four wooden stakes and wire.

Source/Rights: © By Ianaré Sévi [CC BY-SA 3.0 (https://creativecommons.org/licenses/by-sa/3.0)], from Wikimedia Commons

Grade Level 3 (3-5)

Activity Dependency

Time Required 12 sessions of 60 minutes each

Group Size

Expendable Cost per Group US $5

Summary

In this lesson, students will employ the full engineering process to research and design prototypes that could possibly solve the massive loss of sea turtle life during a hurricane event. Students will think about multiple factors surrounding this issue, and will work to develop solutions.

Engineering Connection

In this lesson's activities, students work as engineers to design and build prototypes. Like engineers, the students must consider the impacts of every design, including cost and practical limitations, as well as potential environmental consequences.

Engineering Category =
Engineering design process

Keywords
Hurricane, sea turtle, 3D printing, nesting, environment

Educational Standards (List 2-4)
Source, year, standard number(s)/letter(s), grade band and text (its unique ID# is optional)
State STEM Standards (required)

SC.3.N.1.1: Raise questions about the natural world, investigate them individually and in teams through free exploration and systematic investigations, and generate appropriate explanations based on those explorations.

ITEEA Standards (required)

Standard 8, C: The design process is a purposeful method of planning practical solutions to problems.

Standard 8, D: Requirements for a design include such factors as the desired elements and features of product or system or the limits that are placed on the design.

NGSS Standards (strongly recommended)

3-LS4-4: Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

3-ESS3-1: Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

CCSS Standards (strongly recommended)

Pre-Requisite Knowledge
If using a 3D printer, students should have knowledge of TinkerCad software or another simple software program that can be used to design 3D objects. If using a 3D pen, students should have knowledge of how to use the pen effectively.

Learning Objectives
After this activity, students should be able to:
- Explain environmental impacts of hurricanes.
- Plan a structure to address the issue of sea turtle nests being lost to storm surge

Materials List

Teacher will need:

- Chart paper
- One Tiny Turtle by Nicola Davies
- Sea Turtle Scientist by Steve Swinburne
- Follow the Moon Home by Phillipe Cousteau

Each group needs:

- Recyclable materials such as cardboard, paper, toilet paper tubes
- Plastic pan or tray in which to test the structures
- Sand
- Small ping pong balls

To share with the entire class:

- 3D printer or 3D printing pen
- Filament

Introduction / Motivation

Vocabulary / Definitions

Word	Definition
Additive manufacturing	3D printing; manufacturing that combines
Clutch	A sea turtle's nest of eggs
Doomed eggs	Eggs which are destroyed by natural causes, such as weather events
Egg chamber	The large hole in the ground into which eggs are deposited by the nesting sea turtle
Emergence	Refers to both when the female sea turtle leaves the water to come onto the beach, and when the eggs hatch into baby turtles
Hatching success	The amount of eggs in a clutch that hatch into baby turtles, compared to the total amount of eggs
Oviposition	Egg laying
Prototype	A first model or sample to show how a product or device will work
Relocation	When humans move a sea turtle nest from one place to another to protect it

Source: http://seaturtleexploration.com/wp-content/uploads/2014/08/Sea-Turtle-Vocabulary-final1.pdf

Lesson Background & Concepts for Teachers

Hurricanes are a common occurrence in parts of the world, including Florida and the Caribbean region. 2017 was a particularly active hurricane season. Due to the extreme weather, there were many environmental effects of the hurricanes that made landfall during the season. For example, sea turtle nests were disturbed, and a large proportion of eggs were lost. In Puerto Rico, there were many societal effects of the hurricanes, including loss of life, loss of resources, and damage and devastation to homes and buildings.

Sea turtles are a threatened species. Nesting sea turtles lay about 115 eggs each time they come ashore in a nesting season, and they nest between 2 and 8 times in a season. Of every 1000 sea

turtle eggs, only one will survive to adulthood. Since survival rates are so low, the mass loss of eggs due to hurricane storm surge can have a large environmental impact.

Relocation of turtle nests from the beach is not ideal, because sea turtles are conditioned to select the best location for their eggs. Sea turtle eggs are very sensitive to temperature, and it is believed that nesting sea turtles lay their eggs in a particular way to maximize egg survival.

The Alabama Sea Turtle Manual may be of interest for students, as it explains how the sea turtle volunteers take data on sea turtle nests, how they know that a nest is present, how they can "read" sea turtle flipper marks to determine movement, and guidelines for moving or relocating sea turtle nests.
http://www.alabamaseaturtles.com/wp-content/uploads/2014/11/ASTConservationManual.pdf
http://www.seeturtles.org/baby-turtles/

Additive manufacturing (3D printing) is a way to create custom solutions to problems. In contrast to traditional (subtractive) manufacturing, 3D printing offers greater customization and less waste of resources. While the technology is still being developed, it offers many opportunities for novel designs and problem-solving.

Procedure

Before the Activity

Print copies of the engineering design process. Collect recyclable materials for the students' prototypes.

Day 1: Effect of Hurricanes on Sea Turtle Nests

Before the Activity

- Print articles for students to read; collect other resources about sea turtles and hurricanes, if desired.
- Get the book One Tiny Turtle by Nicola Davies, if available, or a different book that describes sea turtle nesting and hatching behaviors.

With the Students

- Read One Tiny Turtle by Nicola Davies out loud to the students.
- Have a class discussion about the sea turtle nesting behaviors that the students heard described in the book.
- Record important behaviors and facts on a piece of chart paper.
- Tell the students that good scientists and engineers carefully research their topics.
- Hand out the sea turtle and hurricane article to the students and instruct them to read it and take notes.
- Students can discuss what they've read in their groups.
- Ask for some students to share their initial impressions.
- Pass out a copy of the engineering design process.
- Explain to the students that they will be working together to solve a problem related to sea turtles and hurricanes.

Day 2: Research about Sea Turtle Nesting

Before the Activity

- Gather books and articles about sea turtles.
- Prepare students for Internet research by displaying the chart paper from the day before.
- This chart paper will give them ideas of keywords to search for when doing Internet research.

With the Students

- Tell the students that they will be conducting background research to better prepare themselves for engineering a solution to a problem.
- Like good scientists and engineers, students will need to fully understand multiple components of the problem before they are able to solve it.
- The students will research sea turtle nesting.
- Students should use books and internet sources to better understand how sea turtles nest.
- Specifically, students should be able to describe how often sea turtles nest, how many eggs are in each nest, what a nest looks like and how it is formed, and potential problems that can arise during the nesting process, especially related to human interference.
- Review effective research tips for the students prior to beginning the activity.
- Hand out a graphic organizer (if desired) to help students keep track of their information.

Day 3: Research about Environmental Effects of Hurricanes

Before the Activity

- Gather books and articles about hurricanes.
- Get a sheet of chart paper on which to display some potential keywords.

With the Students

- Review information learned about sea turtles from the previous day.
- Remind students of the article that they read which described the effect of Hurricane Irma on sea turtle nests.
- Tell the students that like good scientists and engineers, they will continue to research background information on the problem that they will solve.
- Tell the students that they will research the environmental impacts of hurricanes.
- Students may be familiar with impacts of hurricanes on buildings and homes, but they may be unaware that hurricanes can also negatively impact ecosystems.
- One topic of interest for students may be the Puerto Rican parrot, which was nearly wiped out after Hurricane Hugo in 1989, or the Cozumel Thrasher, which was also nearly extinct after Hurricane Gilbert in 1989. http://www.hurricanescience.org/society/impacts/environmentalimpacts/

Day 4: Brainstorming Solutions

Before the Activity

- Prepare a sheet of chart paper for each group of students, or have the students record their ideas on a sheet of paper.

With the Students

- Review brainstorming procedures with the students.
- Remind them to listen to each other's ideas and to encourage each other to come up with more ideas.
- Students will begin brainstorming solutions in their groups of 3-4.
- Ask the students to come up with as many possible solutions as they can think of.
- Ask students to write possible solutions on sticky notes.
- Collect all the sticky notes on a piece of chart paper that will remain displayed throughout the unit.
- Students can refer to the chart paper throughout the remainder of the design process.
- Then, ask each student to write down his or her favorite possible solution on a piece of paper or in their lab notebooks.

Day 5: Evaluating and Selecting Design

Before the Activity

- Print rubrics, if desired, for students to use.
- Make sure that students have access to their favorite design solution for reference during this part of the activity.

With the Students

- In their groups, students will analyze each model.
- They will decide on a final design.
- They can either create a new design based on desired parts from all of their designs, or may elect to use one group member's design in its entirety.
- In order to best evaluate the designs, students should be given a rubric so that they can more objectively examine all of their options.
- If rubrics are not used, students should have structured discussion questions or topics to use to evaluate each other's designs.
- By the end of the session, students should have finished evaluating all designs.

Day 6: Sketching and Finalizing Design

Before the Activity

- Give students access to their final design selections from day 5.

With the Students

- If students are selecting an existing design, they will now sketch the design from different angles (top, left, right, bottom).
- Students who are using components of each group member's individual designs from day 4 will need to produce their final sketches.
- Students also need to think about how they will test their designs.
- Students will be given one pan with sand each to use to test their designs; mini ping pong balls will serve as the sea turtle eggs.
- Students should carefully consider how sea turtles produce their nests when determining how to set up their test models.

Day 7: Discussing Importance of Prototypes

Before the Activity

- Give students access to their final designs.
- Collect videos, books, or pictures that depict prototypes in preparation for today's discussion.

With the Students

- Tell the students that before making a final product to sell or to use, engineers create prototypes, which are models of the actual product.
- Ask students why they think that it's important for engineers to make prototypes before they make the actual product.
- Explain that prototypes are often made of different materials than the actual product.
- Show students examples of clay car prototypes to prompt discussion.
- In their groups, students will create a model of their chosen design using cardboard and other recyclable materials.

Day 8: Evaluation and Redesign

Before the Activity

- Students should be completely finished with their initial design/prototype.
- Students should be ready to present their initial designs to the class.
- If students are not finished, provide additional time.

With the Students

- Students present their initial designs to the class.
- Other groups can ask questions and offer suggestions for improvement.
- Students can discuss possible limitations of their designs with each other, and develop plans for improvement or re-design.

Day 9: Producing Final Prototypes

Before the Activity

- Review use of 3D printing software, if students will be using it in the next step.
- Prepare troubleshooting tips and alternative activities in case of "technical difficulties."

With the Students

- If students will be using a 3D printer or 3D printing pens to produce their final prototype, they need to be trained on how to use the software and how to use the devices prior to beginning the activity.
- Make sure that there are enough computers or tablets for each student.
- You may want to consider taking students to the computer lab to work.
- This step may take more than one day, depending on the experience level of the students.
- Students not working with 3D software or design can continue to work on improving the structures that they have made.

Day 10: Testing Final Structures

Before the Activity

- Make sure that students have been trained on using 3D printers or 3D pens.
- If using a 3D printer, this step may take several days.

- If using a 3D pen, be sure to review safety procedures and monitor students closely as they use the pens.
- Students not using 3D printing should go directly to test their structures.

With the Students

- Students print their structure using the 3D printer or using the 3D pen.
- Students test the structure using the sand, plastic tray, and ping pong ball model set up in step 6.
- Students may wish to test their structure several times.
- After students have tested, be sure to have a class discussion about successes and failures during the activity.

Day 11: Creating Proposals for Stakeholders

Before the Activity

- Give students access to their final designs.
- Have the book Follow the Moon Home by Phillippe Cousteau ready to read aloud to the class.

With the Students

- Read Follow the Moon Home by Phillippe Cousteau.
- Ask students how the "concerned citizens" described in the book helped solve a problem.
- Discuss citizen activism and how it applies to their project.
- Let the students know that they will be producing a proposal to present to stakeholders.
- Stakeholders could include sea turtle professionals, city officials, or other "concerned citizens" (who could be other students, teachers, or school administrators).
- Proposals should include a description of the problem, how the students solved the problem, why their solution was beneficial, and a description of the costs associated with their solution.
- Students will use Microsoft PowerPoint or Google Slides to present their proposal.
- Presentation development and production may take several days, depending on the experience level of the students.

Day 12: Presenting Proposals to Stakeholders

Before the Activity

- Students should be completely finished with their proposal presentations.
- Consider inviting community members such as parents, government officials, environmental activists or groups, etc. Other teachers, students, and administrators could also benefit from listening to the students' proposals.

With the Students

- Students will present their proposals in groups to stakeholders.
- Stakeholders can ask questions, express concerns, or give suggestions.

Image Insert Image # or Figure # here (use Figure # if referenced in text)

https://commons.wikimedia.org/wiki/File:Opel_50_Jahre_Design_(14541643013).jpg

Figure 1

Image file: ___?

ADA Description: ___? *(Write as if describing the image to a blind person; do not repeat caption content.)*

Source/Rights: © ___?

Caption: Figure 1. A clay prototype allows automotive engineers to see details and potential issues prior to manufacturing.

Attachments

Safety Issues

-

Troubleshooting Tips

Investigating Questions

Assessment

Pre-Activity Assessment

Class Discussion - Science vs. Engineering

Activity Embedded Assessment

Sea Turtle Structure Rubric

Post-Activity Assessment

Stakeholder Proposal Rubric

Activity Extensions

Activity Scaling

- For lower grades, students can draw their structure without modeling it.

- For higher grades, students can design, test, and print multiple structures. Students can make larger-scale models, test their structure in a more authentic environment (beach or larger area of sand), or study actual sea turtle nests, if possible.

Additional Multimedia Support

References

Department of Interior - U.S. Fish and Wildlife Service. Alabama Sea Turtle Conservation Manual. Revised March 2008. http://www.alabamaseaturtles.com/wp-content/uploads/2014/11/ASTConservationManual.pdf

University of Rhode Island. Hurricanes: Science and Society. Accessed June 28, 2018. http://www.hurricanescience.org/society/impacts/environmentalimpacts/

Other

Redirect URL

Contributors

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Acknowledgements

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Classroom Testing Information

Name: _____

Sea Turtle Structure Design Rubric

Initial Brainstorming Session

Describe your team's design.

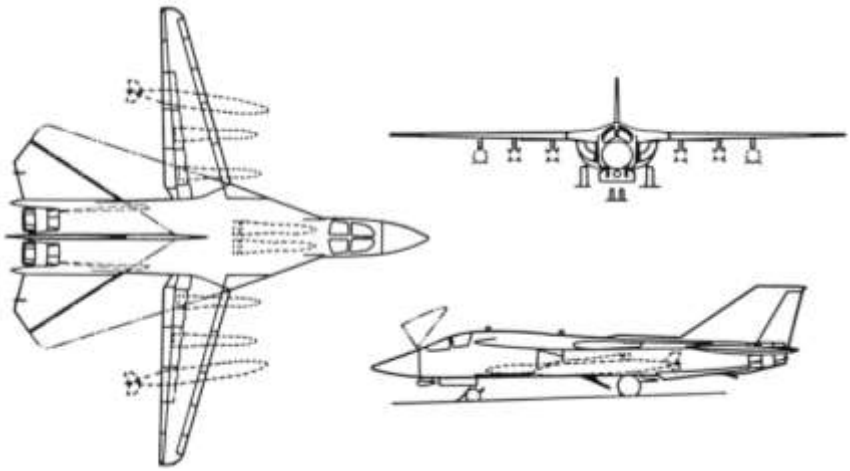
Why did you select this design instead of some of the other design ideas?

Does the design meet these requirements? Write YES or NO: _____

Requirements
Your team brainstormed at least 4 different ideas.
The design helps protect sea turtle's eggs in the case of a hurricane, tropical storm, or other major weather event.
The design does not prevent baby sea turtles from crawling to the sea when they've hatched.

Design in Different Views

In this packet, you will draw the design's top, side, and front views. This will help you think about what your design will look like, and will also help you when you begin building your design.



This picture shows the top, front, and side views of the airplane. This way, you know what the airplane looks like from every angle.

https://commons.wikimedia.org/wiki/File:Gerneral_Dynamics_F-111B_3-view_drawing.png

Top View:

Side View:

Front View:

Design Evaluation

As you look at each team member's design, write some notes to help evaluate their design. Make sure to think about the problem.

Design name: _____

1. **How easy is it to set up this design?**

   Very easy Kind of easy Not very easy Very hard

2. **How much does this design protect the eggs?**

   Very protective Kind of protective

   Not very protective Not protective at all

3. **Could this design prevent eggs from hatching?**

   Yes No

   If you wrote yes, explain how it could prevent the eggs from hatching:

4. **Could this design prevent baby sea turtles from getting to the sea?**

   Yes No

If you wrote yes, explain how it could prevent baby sea turtles from getting to the sea:

5. **Are there any problems with the design that we could fix?**

6. **What do you think is good about this design?**

Sea Turtle Read-Aloud

Suggested Discussion Questions

One Tiny Turtle by Nicola Davies

1. What did we learn about baby turtles? Is it easy for them to survive?
2. How long does it take for turtles to fully mature?
3. How old are turtles when they lay their first nest? What does this tell you about sea turtles?
4. Why is coming on shore difficult for sea turtles?
5. How do sea turtles make their nests?
6. Based on information in the story, how many sea turtle nests are there? Many or few?
7. How is the baby sea turtle's journey to the sea difficult?

Sea Turtle Scientist by Stephen Swinburne

1. What steps did Dr. Stewart take to help save the sea turtles on St. Kitts?
2. Why does Dr. Stewart look at nests after they hatched?
3. What kinds of things does Dr. Stewart do at the sea turtle rescue hospital?
4. What kind of scientific research does Dr. Stewart do in her lab?
5. What kinds of tasks do the sea turtle patrol volunteers do?
6. Why is Dr. Stewart's research so important?

Follow the Moon Home by Phillippe Cousteau

1. Based on the information in the story, why is it important for beach-goers to fill in holes and knock down sandcastles after they're finished playing on the beach?
2. Why are lights on the beach bad for baby sea turtles?
3. What did the students do first to start solving the problem? What did they do next? (It may help to write out the steps on chart paper.)
4. Why was it important for all the students to have different jobs?

Sea Turtle Proposal

Create a proposal describing how you want to solve the sea turtle and hurricane issue. Your proposal will be presented to some important citizens, so make sure that it is clear and makes sense. You will use PowerPoint or Google Slides to make your presentation.

Remember:

Your proposal should make the audience want to help you solve the problem. After listening, everyone should want your solution to be set into place.

Make sure to read the rubric before and after making your presentation to make sure you have all the required information.

In your presentation:

1. Explain the sea turtle problem. Make sure to describe why sea turtles are important, and how hurricanes can negatively affect them.
2. Explain how your group thinks the sea turtle problem should be solved.
3. Explain why your solution is great and helps solve the problem in the best way.

You can also include information about:

- Sea turtle nesting
- Sea turtle survival rates
- Effects of hurricanes on the environment
- Sea turtle scientist research
- Sea turtle beach patrol groups
- Pictures of your solution
- Description of how you brainstormed your solution
- How you used the engineering design process

Proposal Rubric

Content

3 points	2 points	1 points	0 points
The sea turtle facts presented in the proposal are all accurate.	There are one or two mistakes in the sea turtle information presented.	There are three or four mistakes in the sea turtle information presented.	There are five or more mistakes in the sea turtle information presented.
The proposed solution makes sense and is easy for anyone to understand.	The proposed solution is a little confusing, but makes sense after the group has answered some questions.	The proposed solution is very confusing, but the group members are able to somewhat explain their solution after answering questions.	The proposed solution cannot be understood by any audience member, even after questions have been asked.
The proposed solution meets all requirements, including ease of use, practicality, and avoiding harm to the animals.	The proposed solution does not meet one of the requirements.	The proposed solution does not meet two of the requirements.	The proposed solution does not meet three or more of the requirements.

Design

3 points	2 points	1 points	0 points
The text is easy to read.	The text is a little hard to read.	The text is very difficult to read.	The text cannot be read at all.
Every slide contains one picture.	Most slides contain a picture.	Some slides contain a picture.	There are no pictures in the presentation.
The pictures are relevant and make sense.	There are one or two pictures that do not relate to the slide's information.	There are three or four pictures that do not relate to the slide's information.	Five or more of the pictures do not relate to the slide's information.
Each slide has a title and some information.	One or two slides are missing a title or information.	Three or four slides are missing a title or information.	Five or more slides are missing a title or information.

Presentation

3 points	2 points	1 points	0 points
All members of the group participated.	Most members of the group participated.	Only one member of the group participated.	The group did not present.
The speaker was loud enough to be heard during the entire presentation.*	The speaker was a little difficult to hear or understand.	The speaker was difficult to hear or understand.	The speaker could not be heard or understood during the entire presentation.
The speaker spoke fluidly without reading off of notes or off of the PowerPoint.*	The speaker read one or two times during the presentation.	The speaker read three or four times during the presentation.	The speaker read five or more times during the presentation.

**indicates an individual student score.*