STEM Stories: Stanley at Sea

Lesson Plan

STEM Career Connections: Health Sciences and Mechanical

Engineering **STEM Disciplines:** Science, Technology and Engineering

Mathematics **Non-STEM Disciplines:** English Language Arts

Design Challenge Problem/Scenario:

You are on a vacation at your friend's lake house. You and your friend's family decide take Max, the family dog, and go out on the lake for a boat trip. While out on the boat, the water becomes rough, and Max falls overboard into the water. Since Max is still a puppy, he does not know how to swim yet.

Engineering Design Challenge:

Your team's challenge is to use supplies that are on the boat to create a flotation device that will keep Max afloat. Max has already fallen overboard, so the flotation device must be able to be put on and taken off Max quickly and easily.

Essential Question Students Investigate:

How can my team design a flotation device to help a dog that has fallen into a lake? How can we use different types of materials to design a lifesaving flotation device that can save a dog from drowning in a lake?

Enduring Understandings:

- Using the engineering design process when approaching problems results in unique solutions.
- Collaboration and following the engineering design process lead to more creative and effective solutions to problems.
- The properties of a material (in particular its density) determine its ability to float or sink in water.

English Language Arts Standards:

- RL.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- RL.3.3 Describe characters in a story (e.g., their traits, motivations, or feelings) and explain how their actions contribute to the sequence of events.

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- RL.3.6 Describe the difference between points of view in texts, particularly first- and third-person narration.
- RL.3.7 Explain how specific aspects of a text's illustrations contribute to what is conveyed by the words in a story (e.g., emphasize aspects of a character or setting).
- W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons.
- W.3.3 Write narratives to develop real or imagined experiences or events using effective technique, descriptive details and clear event sequences.
- SL.3.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.
- SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.
- SL.3.6 Speak in complete sentences when appropriate to task and situation in order to provide requested detail or clarification.

Science Standards:

Science Inquiry and Applications, Technological and Engineering Design
During the years of PreK to grade 4, all students must develop the ability to:

- Plan and conduct simple investigations
- Employ simple equipment and tools to gather data and extend the senses
- Communicate about observations, investigations and explanations
- Review and ask questions about the observations and explanations of others
- Identify problems and potential technological/engineering solutions
- Understand the design process, role of troubleshooting

Grade 1: PHYSICAL SCIENCE: Motion and Materials

- Properties of objects and materials can change.

Grade 3: PHYSICAL SCIENCE: Matter and Forms of Energy

- All objects and substances in the natural world are composed of matter.

Mathematics Standards:

- Represent and interpret data. CCSS.MATH.CONTENT.3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units--whole numbers, halves, or quarters.
- Use place value understanding and properties of operations to perform multi-digit arithmetic. CCSS.MATH.CONTENT.3.NBT.A.2 Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- Use place value understanding and properties of operations to perform multi-digit arithmetic. CCSS.MATH.CONTENT.3.NBT.A.2 Multiply one-digit whole numbers by

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multiplies of 10 in the range 10-90 (e.g., 9 x 80, 5 x 60) using strategies based on place value and properties of operations.

- Represent and solve problems involving multiplication and division. CCSS.MATH.CONTENT.3.OA.A.1 Interpret products of whole numbers, e.g., interpret 5 x 7 as the total number of objects in 5 groups of 7 objects each.
- Represent and solve problems involving multiplication and division. CCSS.MATH.CONTENT.3.OA.A.1 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.
- Multiply and divide within 100. CCSS.MATH.CONTENT.3.OA.C.7 Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that 8 x 5 = 40, one knows 40 ÷ 5 = 8) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers.

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Materials List:

Material	Quantity per Team	✓	Quantity per Kit	✓
Stanley at Sea by Linda Bailey	~		1	
Tomato Soup Cans	~		3 (testing)	
Bucket	~		1	
Balloons	1		8	
Foam Pieces	1		8	
Paper Cups	1		8	
Rubber Bands	3		24	
Paper Clips	4		32	
String	1 foot		8 feet	
Elmer's Glue	1 bottle		8 bottles	
Ziploc Snack Bags	2		16	
Paper	5 sheets		40 sheets	
Pencils	5		40	

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Activity 1

Introduction: 15 minutes

- Sit in a chair and gather the students on the floor around you so they can all see the book.
- Describe the full scope of the Engineering Challenge (Activity 1, Activity 2, Activity 3, etc.).
- Introduce *Stanley at Sea* by Linda Bailey by reading the title and author and examining the cover illustration.

Pre-Reading: 10 minutes

Lead a pre-reading discussion by showing the students the Book Box to help make predictions about the story.

- Show the students each item and lead a discussion about what clues they might give the students about the characters, the setting, and the plot.
- Pass out the Book Box handout, which can be pasted into the STEM journals, asking the students to record a one sentence prediction for each item from the Book Box.

Read Aloud: 20 minutes

Read the book aloud to the class, making sure to share the illustrations on each page. Stop periodically to ask the students to share how their predictions from the Book Box are being realized in the story.

Throughout the read-aloud, you can use the following strategies to monitor the students' comprehension of the story:

- Ask students a question about the story, then ask them to "turn and talk" to their neighbor to answer the question. Be sure to set a signal for when students should stop their conversation and come back to the large group (hand clapping, snapping, etc.). Questions you might ask include:
  - What is the setting of the story?
  - Who are the main characters?
  - What are some ways you might have helped Stanley and his friends? (this question is a preview to the Engineering Design Challenge).

Post Reading: 15 minutes

Give the students an introduction to point of view by offering the following description, "The narrator is a very important part of the story. When we read a story, we have to decide if one of the characters is telling the story, or if the narrator is someone not in the story. This helps us know what kind of information we can get about the characters."

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Show the students the anchor chart for point of view.
Point out the words that show that the story is being told from Stanley's point of view.

Next, tell the students they will be working with a partner to tell stories from different points of view. First, model this for the students by telling them a three sentence story about something exciting that happened to you. For example, "This weekend, **my** family and **I** went on a camping trip. **We** went on a long hike, and while **we** were hiking, it started raining. **We** were soaked from head to toe, but **we** still had a lot of fun!" Now, tell the story again from a different point of view. "This weekend, **Mrs. Smith** and **her** family went on a camping trip. **She** and **her** family went on a long hike, and while **they** were hiking, it started raining. **They** were soaked from head to toe, but **they** still had a lot of fun!"

Now, ask the students to work with a partner. Each person should tell his or her partner a three-sentence story about something exciting that happened to them. Then, tell the story from a different point of view. They do not need to write the stories down.

If there is time, bring the students back together and debrief this exercise. What was challenging about changing the point of view? Which story did you like better?

Wrap Up: 5 minutes

Review what was learned during today's session.

- Invite a retelling of the book by asking students to share what happened first, second, third, and so on in the story.
- Review what is meant by "point of view".
- Remind the students of the Engineering Design Challenge.
- Distribute parent letter.

Activity 2

Introduction: 10 minutes

- Remind the students that during the previous session they read and discussed the book *Stanley at Sea* by Linda Bailey. Today they will be presented with a Design Challenge Problem and Engineering Design Challenge. Do a "picture walk" through the book to remind students of the main idea. Also remind students about point of view (display anchor chart from previous activity).

Quick Write: 15 minutes

Distribute the STEM journals to the students (composition notebooks). Ask them to write the date at the top of the page, and *Entry #X: Point of View*.

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- Now, the students should write their stories down. They can add more sentences to the story if appropriate (differentiation). You can also use the **sentence stems** to differentiate this activity for struggling writers.
- They should write the story twice, first from a first-person point of view, then from a narrator's point of view.

Set a timer for 10 minutes (www.online-stopwatch.com/) **and ask the students to write for the full ten minutes. Tell them to keep their pen moving the whole time, even if they are illustrating their response.**

When the ten minutes are up, invite the students to the large group and ask students to share their responses if they wish (and as time allows).

Application: 20 minutes

- Display slide 1 of the PowerPoint: Ask the students to share some ideas about what engineers do for their jobs.
- Slides 2 & 3: Continue the discussion about what engineers do for their jobs.
- Slide 4: Play one of the YouTube videos for the king-ii emergency flotation device or something similar. A good recommendation is the NY Times site: https://well.blogs.nytimes.com/2015/08/18/technology-to-keep-swimmers-safe/
- Slide 5: Present the Design Challenge Problem.
    - Design Challenge Problem: You are on a vacation at your friend's lake house. You and your friend's family decide take Max, the family dog, and go out on the lake for a boat trip. While out on the boat, the water becomes rough and Max falls overboard into the water. Since Max is still a puppy, he does not know how to swim yet.
- Slide 6: Present the Engineering Design Challenge.
    - Engineering Design Challenge: Your team's challenge is to use supplies that are on the boat to create a flotation device that will keep Max afloat. Max has already fallen overboard, so the flotation device must be able to be put on and taken off Max quickly and easily.

The goal for the students to design and test a flotation device to keep a soup can from sinking. The device must be in one attached piece and able to be affixed to the soup can within one minute (so students cannot just attach foam or balloons to the soup can -- but they could assemble their flotation device and then put their soup can in it, or wrap it around the soup can). Some portion of the soup can must touch the water and get wet. The soup can should not be placed in a boat, for example, where it would remain dry.

- Slide 7: Explain or share the Design Goals.
    - Device must be in one attached piece
    - Able to be affixed to the can within a one minute period of time
    - Some portion of the can must touch the water and get wet. (Some portion of the can must also be above water)
    - You cannot just create a boat!

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    - Have fun!!
- Slide 8: Introduce the resources/materials available.
- Slide 9: Explain the design testing procedures.
    - During testing, the flotation device must be attached to a soup can in less than one minute. After attaching the device to the soup can it will be placed into the bucket of water (as indicated in the setup). The design passes if the soup can floats for more than one minute.
- Slide 10: Explain the Engineering Design Process.
    - Give students the Engineering Design Process Graphic Organizer STEM Challenge handout and the Stanley at Sea: Engineering Design student handout.
- Have the students complete the "Ask" step of the Engineering Design Process.
    - Ask the students to notice that the word Ask is in one of the circles of the Engineering Design Process both on the PowerPoint and Stanley at Sea: Engineering Design student handout.
    - Students should Ask themselves what materials they would like to use to build their flotation device for Max.
    - Students should write these materials on their STEM Challenge handout.
    - Walk around as the students complete the Ask step of the Engineering Design Process.
- Slide 11: Explain to the students that the next time they meet, they will spend time on the Imagine step in the Engineering Design Process. In fact, you can ask students to start imagining what their product will look like when they are at home, and they can share their ideas with their families.

Wrap Up: 10 minutes

Review what was learned during today's session.

- Invite a retelling of the book by asking students to share what happened first, second, third, and so on in the story.
- Review what is meant by "point of view".
- Remind the students of the Engineering Design Challenge.
- Preview the next session by explaining to students that they will continue the Engineering Design Process so that they can imagine and plan to build their floatation devices for Max.
- Distribute the parent letter to each student.

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Activity 3

Set-Up:

- Designate space for displaying and gathering available materials.
- Designate space for each team to collaborate and build their design ideas.
- Designate space for design testing. Make sure there is room for all students to observe.
- Set up a bucket of water for testing the flotation devices for the soup cans.

Introduction: 5 minutes

- Remind the students that during the previous session they read and discussed the book *Stanley at Sea* by Linda Bailey and were presented with a Design Challenge Problem and Engineering Design Challenge. Generate a discussion about the Design Challenge Problem and Engineering Design Challenge. Do a "picture walk" through the book to remind students of the main idea.

Engineering Design Process, Imagine: 15 minutes

- Display slide 11 of the PowerPoint:
    - Ask the students to notice that the word Imagine is in one of the circles of the Engineering Design Process both on the PowerPoint and Stanley at Sea: Engineering Design student handout.
    - Students should Imagine what their floatation device for Max will look like.
    - Students should draw a picture or write a description of their floatation device for Max on their STEM Challenge handout.
    - Walk around as the students complete the Imagine step of the Engineering Design Process.
    - Ask the students to share their ideas with their team.
    - Walk around as the students share their ideas with their teammates. Make sure that each student is given ample time to share his or her ideas. Students get excited about wanting to build a floatation device for Max and often rush through the sharing process. Remind students that the sharing process is extremely important as engineers often alter their designs based on ideas shared during the brainstorming process.

Engineering Design Process, Plan: 15 minutes

- Display slide 11 of the PowerPoint:
    - Ask the students to notice that the word Plan is in one of the circles of the Engineering Design Process both on the PowerPoint and Stanley at Sea: Engineering Design student handout.
    - Students should Plan as a team what their flotation device for Max will look like.
    - Students can use teammates' ideas or a combination of the teams' ideas, but remind them that they must create one flotation device for Max together as a team!

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- Students should draw a picture or write a description of their floatation device for Max on their STEM Challenge handout.
- Walk around as the students complete the Plan step of the Engineering Design Process.
- Make sure all students are contributing to the planning process. Often the dominant students expect the other students to use his or her ideas. Remind students that coming to a team consensus is important as engineers are often expected to plan with a group of people.
- Ask the students probing questions about their floatation device for Max:
  - How did you combine your individual design ideas?
  - Why did you choose that design?
  - How did you create the idea for this design?
  - What are your reasons for selecting the material for your floatation device for Max?
- Before allowing teams to build their floatation device for Max, require them to gain approval of their sketch of the team's prototype design idea. You can write "Approved" beside the sketch on a student's paper or hand them a note card with "Approved" written on it. A colored note card works nicely as you can easily see if a team has the note card on their desk or table before they begin to work with the materials.

Buying Time!: 15 minutes

- Students work as a team to decide what materials they want to purchase to create a floatation device for Max. The materials are on the Stanley at Sea: Buying Time! handout. Students should use the table in the handout to record the number of each item they want to purchase, the cost associated with each item, and the total cost of all items.
- Walk around the room as the students discuss the materials they would like to purchase.
- Once a team is ready to purchase their materials, have them tell you the cost of the materials they would like to purchase and the change they should receive.

Engineering Design Process, Create: 30 minutes

- Slide 11: Teams create their floatation device for Max.
  - Ask the students to notice that the word Create is in one of the circles of the Engineering Design Process both on the PowerPoint and Stanley at Sea: Engineering Design student handout.
  - As the students are creating their floatation device for Max, walk around the room and ask them probing questions about their design. For example:
    - Why did you choose those materials for the design?
    - Will the design be strong enough to make Max float?
    - How challenging is it to create a floatation device that can be easily put on and taken off?

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Wrap Up: 10 minutes

- Ask students to place their handouts and materials in a safe location and to clean up their area.
- Distribute a parent letter to each student.

Activity 4

Introduction: 10 minutes

- Show the students the book, *Stanley at Sea*, and ask them to raise their hands and offer a one-sentence summary of the book. Invite as many one-sentence summaries as time allows. Alternatively, ask the students to turn to a partner and tell a one-sentence summary of the book.
- Help teams of students locate their handouts and materials.
- Remind the students that during the previous session they created a flotation device for Max.
- Today, students are going to test their flotation device for Max.

Floatation Device Testing: 30 minutes

- Each team tests their prototype floatation devices while other teams observe.
    - During testing, the floatation device must be attached to a soup can in less than one minute. After attaching the device to the soup can it will be placed into the bucket of water (as indicated in the setup). The design passes if the soup can floats for more than one minute.
    - Celebrate each team's design by having the class applaud for that team after that team shares their design.
    - Students should complete the Stanley at Sea: Test and Improve Your Device handout.

Reflection: 10 minutes

- Slide 12: Ask students to discuss with their team:
    - What do you like best about your floatation device?
    - What would change about your floatation device?
    - What aspects of other team designs stood out to you?
    - Did other designs give you any ideas for ways to improve your design?
    - What modifications will you make to redesign your floatation device?
    - How did the materials affect the ability of your floatation device to prevent the soup can from sinking?
- If time permits, ask some students to share their ideas with the entire class.
- Ask the students if they have any ideas as to what type of engineer might design and build floatation devices.

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Wrap Up: 5 minutes

- Ask students to place their handouts and materials in a safe location and clean up their area.
- Distribute the parent letter to each student

Activity 5

Introduction: 5 minutes

- Last time we tested our flotation device for Max.
- Today we are going to create an improved device for Max.

Floatation Device Redesign and Construction: 30 minutes

- Slide 12:
    - Students use what they have learned testing their designs to modify their floatation devices to make them better.
    - As the students are working on their new designs, walk around the room and ask them probing questions about their redesign. For example:
        - How well did your first design work?
        - Why are you making that change?

Redesigned Floatation Device Testing: 20 minutes

- Each team tests their redesigned floatation devices while other teams observe.
    - During testing, the floatation device must be attached to a soup can in less than one minute. After attaching the device to the soup can it will be placed into the bucket of water (as indicated in the setup). The design passes if the soup can floats for more than one minute.
    - Celebrate each team's design by having the class applaud for that team after that team shares their design.

Wrap Up: 20 minutes

- Ask students to place their handouts and materials in a safe location and clean up their area.
- Discuss text-to-self, text-to-text and text-to-world connections with the students. Put the Text Connections handout on the overhead or Elmo machine so all students can see it and explain each type of connection.
- If time allows, read the story, *Stanley at Sea,* again. As you read, ask the students to make text-to-self, text-to-text or text-to-world connections between what they hear in the story and the STEM challenge. Ask them to keep track of their connections using tally marks for each connection on a blank copy of the handout, which can be pasted into the STEM journal as an additional entry.
- Stop periodically throughout the story to share your own connections as a model, then invite students to share their connections. Remind them of the importance of using "textual evidence" to make their connections. Ask, "What sentence or picture in

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the story helped you make that connection?".
- (Optional Writing Activity) Ask the students to write a one paragraph summary of their connections to the book and the STEM challenge in their STEM notebooks.
- Slide 13: Conclude by discussing the following questions as post-activity surveys are distributed.
    - What ideas do you have for engineering a better world?
    - How can you turn ideas into reality?
- Allow time for students to complete their post-activity survey.
- Distribute the parent letter to each student.

Activity 6

Introduction: 5 minutes
- Ask students what happen immediately after the dogs were rescued.

Investigation!: 15 minutes
- Give each student a Stanley at Sea: Investigation! handout.
- After the dogs were rescued, the people brought them steak and sausage three different times. Each time the dogs were fed, they were given two platters of food with seven steaks and 14 sausages on each platter. How many steaks and sausages were they given altogether?
- Stanley's owners first noticed that Stanley was gone at 12:30pm. The owner was reunited with Stanley at 6:45pm. How long was Stanley gone?
- The gentleman who rescued the dogs traveled 55 feet down to the dog's boat. It took the gentleman three minutes to travel down, two minutes to safely secure the dog, four minutes to travel back up to the top of the ship, and one minute to safely place the dog on the deck of the ship. How long did it take him to rescue all four dogs? How many feet did the gentleman travel to rescue all four dogs?

Sharing Time: 15 minutes
- Allow students to share how they answered the Investigation questions. Encourage students who do not correctly answer the questions to share their responses as discussing incorrect processes can be extremely beneficial to support learning.

Create a Story Problem: 10 minutes
- Allow students time to create their own story problem from a situation in Stanley at Sea.

Sharing Story Problem Time: 10 minutes
- Allow students time to share their story problems.

Wrap Up: 5 minutes
- Ask students to place their handouts in a safe location.

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