Unit 4: You’ve Got To Move It

Objectives:
- Research using a database.
- Create a presentation.
- Identify and evaluate strategies to solve a problem.
- Employ latitude and longitude to solve a problem.
- Interpret ocean currents map.
- Use evidence to develop an explanation.
- Design a scale drawing.
- Define a solution to a problem based on materials and time.
- Develop a plan for scaling up production of a product.
- Evaluate trade-offs of product development.

Background Information
There are approximately 17 million to 20 million shipping containers in existence worldwide. Roughly 5 – 6 million are currently in transit via ships, trucks, planes, and trains, and in total make about 200 million trips a year according to billiebox.co.uk (as of 2/3/16). Each container in transit typically costs $2,000 to $3,000 and has a standard size of either 20 or 40 feet in length. Shipping in this manner is considered the most economical form of delivering goods, as over 90% of goods from around the world are transported in this fashion. To further exemplify this, out of every 100 shipping containers that enter the United States ports, 50 leave our ports after completely unloading their imported goods, 45 are stored in a shipping container storage facility, and the other five are reserved.

Vessels encounter forces from wave action as they travel. Surging and rolling relate to forward and backward motions as the bow rises and falls. Swaying and pitching involve side to side, or starboard to port movements. Heaving and yawing involve upward and downward motions. These motions cause various stresses on the boat and cargo.

With such large quantities of cargo crossing aquatic routes, container spills occur. When a container falls off a ship, it may sink to the bottom and break open- completely releasing its contents- or become a safety hazard for other vessels using that shipping route. Estimates place up to 10,000 containers lost at sea each year, with spilled objects travelling about 10 miles per day due to the ocean’s currents. These spilled objects can be classified into two distinct categories: flotsam and jetsam. Flotsam is debris that accidentally falls from ships, whereas jetsam is cargo that is intentionally dropped overboard. An array of flotsam has occurred, including the infamous spills of Doritos, Hershey’s Kisses, Legos, Nike shoes, ice hockey equipment, and rubber ducks.

Just as cars have unique VIN numbers, shipping containers also have unique seven digit identifying numbers. Other numerical identifies may change due to the country flag that is flown on the vessel. Multiple vessel tracking systems exist.
Logistics of the shipping industry are complex and offer a variety of STEM related career opportunities around the world.

**Inquiry Overview**
Students will be engaged in various facets of the cargo shipping process. They begin by conducting an investigation of real-time vessel data from around the world, followed by the modeling and testing of shipping containers. Next students use ocean current maps to learn about the issues associated with flotsam. Repurposing of a shipping container is the culminating activity for this unit.

**Activities**

**Activity 1 – Where in the World**

**Objectives:**
- Research using a database.
- Create a presentation.

**Standards:**
- **NGSS Science and Engineering Practices:** SEP2, SEP3, SEP5, SEP6, SEP8
- **Common Core Mathematical Practices:** MP5
- **Common Core ELA:** W.4.2, SL.6.1, SL.6.4, RST.6-8.3

**Estimated Time:**
- 10 minutes – Introductory Discussion
- 30 minutes – Exploration & Discussion of Website(s)
- 40 minutes – Trading Card
- 10 minutes - Debrief

**Advance Preparation:**
- You may wish to have a world map available for student use with the activity.
- Decide ahead of time if you will make a generic account for each of the websites, create an account for each student, or have each student register for their own account.

**Suggested Inquiry Approach:**
Host a class discussion to get students thinking about imports, exports, and the way in which these items are transported. Use the following questions if needed to prompt participation:
- What are some items that we purchase and use in our everyday lives?
- What are some of the countries that we rely on for these products?
- How do they get to us?
- What types of items does the United States sell to other countries?
- What do we call products that come into the country?
- What do we call products that we sell and send to other countries?
- How could we keep track of all of the boats used to transport goods?
Share with students that they will be working with a partner to investigate real-time data about vessels in the oceans.

Begin by having students select a partner with which to work. Have students log onto http://www.myshiptracking.com/ and/or http://www.marinetraffic.com/. Introduce the website(s) to the students. Allow plenty of time for students to investigate the features of the website(s). Assist as needed.

Introduce the idea of a trading card, such as a baseball trading card. Should students need prompting, use questions such as:

- What is a sports trading card?
- What kind of information is found on one of these cards?
- Why are they made?

Distribute student pages. Explain to students that they now have the opportunity to select a favorite cargo and create a Vessel Trading Card for the Fusion Fleet. Have students answer the discussion questions. Host a discussion of their ideas and have them share their Vessel Trading Card.

**Debrief Activity 1:**
As a whole class, have students discuss the following questions:

- What surprised you the most?
- What concerns do you think exist in the shipping industry?

**Activity 2 – Stack the Deck**

**Advanced Preparation:** Determine which materials will be used, as well as where and how materials will be set up for use with the loading of the containers.

**Objectives:**
- Identify and evaluate strategies to solve a problem

**Standards:**
NGSS: 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3, MS-ETS1-1
NGSS Science and Engineering Practices: SEP1, SEP2, SEP4, SEP5, SEP6, SEP 7, SEP8
Common Core Mathematical Practices: MP5
Common Core ELA: W.6.1, SL.6.1, RST.6-8.3

**Estimated Time:**
- 15 min – Introduction & Boat Labeling
- 60 min – Activity
- 15 min – Debrief

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**Stack the Deck**

**Materials:**
- for each student:
  - Student pages
- for each team of 4:
  - 8 – container templates
  - Scissors
  - Tape
  - Ruler
  - Quart bag
  - Ship platform
  - Materials for packing shipping containers

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This year’s shipping materials include:
- Light
- Heavy
- Irregularly shaped
- Roll
- In the kit
- In the classroom

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What materials are in the kit and your classroom?

Consider shipping items that are:
Suggested Inquiry Approach:

To begin this activity, have students summarize the discussion from the previous activity.

Distribute a ship platform to each group. Have the groups label the following on their platform:

- **Bow or Forward**
- **Stern or Back**
- **Starboard or Right Side (facing forward)**
- **Port or Left Side (facing forward)**

Ask students to think about what forces/motions might affect a cargo ship as it travels across the ocean. Have students share their ideas in groups of four. Then have each group share the groups’ ideas. Continue with the discussion eliciting thoughts about how the forces might affect the ship and its cargo. Accept all ideas.

Share with the students that they have the opportunity to model the effects of the ocean motion on the cargo of a ship. Distribute the student pages. Read through steps 1-3. Share the container template, explaining how to cut and assemble it.

**Note:** Encourage groups to not use excessive amounts of tape as they will need to reopen the containers and load them for the next part of the activity.

When student groups are prepared, have the groups test their loading ideas by placing the containers on the ship platform following the group’s loading plan. Explain to students how the testing will occur. Assist groups as needed with the testing. Encourage detailed descriptions of results as they record their efforts.

After groups have developed their plans for loading the filled containers, assist as needed while groups fill the containers with the appropriate cargo. Encourage groups as they complete the remainder of the steps in the procedure. Allow plenty of time for groups to complete the discussion questions.

**Debrief Activity 2:**

As a whole class, have students discuss the following questions:

- **What else should be considered as containers are filled? Loaded onto ships?**
- **What would happen if a ship cannot withstand the forces that the water, wind, and weather apply on it?**
Activity 3 – Sink or Swim

Advance Preparation:
- It may be helpful to have a world map available for students to use.
- Warm and cold water are needed for Part 1 of the activity. Determine how that will be obtained, distributed, and discarded.

Objectives:
- Employ latitude and longitude to solve a problem.
- Interpret ocean currents map.
- Use evidence to develop an explanation.

Standards:
NGSS: 4-PS3-2
NGSS Science and Engineering Practices: SEP2, SEP3, SEP5, SEP6, SEP7, SEP8
Common Core Mathematical Practices: MP2, MP4, MP5, MP6, MP7

Estimated Time:
- 20 min – Reading Book & Discussion
- 60 min – Activity
- 10 min - Debrief

Suggested Inquiry Approach:

Read the book, *10 Little Rubber Ducks* by Eric Carle to the students. Ask students to share with one another what happens to containers that fall overboard. Continue the discussion by inquiring how the book you read and containers overboard might be related. Have them consider and then share in their groups of 4 what would affect ocean currents and how the currents would be related to cargo spill. Poll the groups as to their ideas. Share with the class that the book you read was inspired by a cargo spill.

Distribute the student pages. Read the section on marine debris together. Allow time for students to share their thoughts. Read through the procedure for Part 1. Answer any student questions regarding the steps. Explain how the groups will obtain the cold and warm water.

Carry out Part 1, assisting groups as needed.

Once the materials are cleaned up from Part 1, have a class discussion about questions 1-3. Have students record their answers based on the discussion.
Distribute the world map to each of the students. Focus student attention on the Event Data Table. Ask students questions such as:
- What is the topic of the table?
- What is interesting to you?
- What are the numbers for the spill location?
- How would items get from one location to another?

**Note:** Review latitude and longitude as needed.

Students should now complete step 1 from Part 2 of the procedure. Distribute the ocean current map for students to refer to while completing the possible explanations for the movement of the flotsam.

Have each group of 4 select a spill and their ideas of how the items got from one location to where they were washed ashore.

**Debrief Activity 3:**
As a whole class, have students discuss the following questions:
- Cargo that is spilled due to accidents is called flotsam. How does studying flotsam help us learn about ocean currents?
- How would understanding ocean currents help with shipping across the oceans?
- Sometimes cargo is thrown overboard on purpose. This is called jetsam. When and why would a crew do this?

**Extension:**
You may wish to show footage of a ship crash, loss of cargo, or rescuing a container ship. Once such video is about the Baltic Ace.
[https://www.youtube.com/watch?v=ZpOug8xsa0](https://www.youtube.com/watch?v=ZpOug8xsa0)

**Activity 4 – What’s Old is New**

**Objectives:**
- Design a scale drawing.
- Define a solution to a problem based on materials and time.
- Develop a plan for scaling up production of a product.
- Evaluate trade-offs of product development.

**What’s Old is New**

**Materials:**

**for each student:**
- Drawing paper
- Drawing supplies — crayons, colored pencils, a pencil
- Graph paper
- Ruler
- Scrap paper

**for the teacher:**
- Computer
- Projector
- What’s Old is New powerpoint
Dive In: Oceanographic Engineering

Standards:
NGSS: 3-5-ETS1-1
NGSS Science and Engineering Practices: SEP2, SEP6, SEP8

Common Core ELA: SL.6.4, RST.6-8.7

Estimated Time:
- 5 min – Power point Introduction
- 40 min – Idea Development
- 10 min – Sharing of Ideas
- 5 min - Debrief

Suggested Inquiry Approach:

Introduce this activity by sharing the powerpoint. Elicit student thoughts and comments as the powerpoint proceeds. Present the challenge of repurposing a container to the students.

Questions such as the following may be helpful:

- What is a scale drawing?
- How is a scale drawing made?
- Why would a key be helpful in a scale drawing?
- What types of details would someone need/want to see in drawings about your idea(s)?

You may wish to have groups brainstorm possible ideas. Using scrap paper, students should sketch and plan their ideas. Once students have done their initial sketches, distribute the drawing and the graph paper so students may draw their final designs. Allow time for the students to share their finished products.

Debrief Activity 4:

As a whole class, have students discuss the following questions:
- How feasible do you think your idea is?
- What do you think should be done with containers that are no longer needed?
- What do you think should happen to containers that fall overboard?
- Who should have the responsibilities of cleaning up and paying for the debris?

Resources:
http://uh.edu/engines/epi2879.htm
http://web.vims.edu/nmea/docs/NIKE-CURRENT_new.pdf
http://www.mnn.com/your-home/remodeling-design/photos/8-eye-catching-shipping-container-homes/a-new-kind-of-living
http://people.hofstra.edu/geotrans/eng/ch3en/conc3en/globalcontainerflows.html
Dive In: Oceanographic Engineering

Notes

http://www.mnn.com/your-home/remodeling-design/photos/8-eye-catching-shipping-container-homes/a-new-kind-of-living
http://www.nauticadynamics.com/
https://www.windows2universe.org/teacher_resources/ocean_education/DuckDuckData.pdf pg 14, 15, 17
http://www.rmrco.com/docs/m1207_ship_movements_at_sea.pdf
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