ACTIVITY INTRODUCTION

**Location:** Inside due to PowerPoint  
**Materials:** PowerPoint, Worksheets

Break students up into pairs or groups and distribute worksheets. Each student will get their own worksheet but will work together to answer the questions. They will work on the sheets after the PowerPoint presentation.

Students will be asked to think about world trade, specifically maritime trade, how it has changed, its extent, and its environmental impacts.

This teacher's guide provides some potential answers to the worksheet questions.

**TEACHER’S GUIDE - Page 1**

**Slide 1: Title**

**Slide 2:**

Sound is incredibly important to marine wildlife because light does not penetrate more than 200 meters. Visibility is limited. In addition, sound travels 5 times faster in water than in air. Most animals use sound to forage for food, to communicate, and to navigate. (Slide taken from a NOAA PowerPoint on flashdrive.)

**Slide 3: World Map of Shipping Lanes**

Today, 90% of the world's trade is dependent on ocean transport. The lines on the world map below are shipping paths. The red lines are the places where there is the most shipping traffic. The dark blue lines represent less shipping traffic. The white areas are places where there is very little or no shipping traffic. Areas with high shipping traffic have increased in activity by 300% since 1992.

- What does this map represent? *Shipping or Marine Traffic*
- What are the blue lines? *Light Shipping Traffic*
- What percentage of the ocean has very little marine traffic? *White parts ~10-13%*
- Why do you think there is little to no traffic in the white areas? *Sea ice*

**Slide 4: Map of Sea Ice**

Sea ice makes it difficult and dangerous for many ships to travel near the poles, even though this is a shorter route. Because of climate change, sea ice is being coming less of an issue.

- What do you think this means for maritime shipping lanes? *Ships will begin to go the shorter routes into areas once protected by sea ice. Ships will bring noise and pollution.*

**OBJECTIVES**

To think critically about the advancement of transportation technology and its impacts.

To think critically about the manufacture and global transport of consumer goods and its environmental impact.

Gain an understanding of how noise generated from human activities, such as shipping and gas exploration, negatively impacts marine mammals.

To raise student's awareness about the role they play in world trade and empower them to become a part of the solution.

**NEXT GENERATION SCIENCE STANDARDS**

Grade 4  
4-LS1-1, 4-LS2-2, 4-PS3-2, 4-ESS2-2, 4-ESS3-1  
Grade 5  
5-ESS3-1  
Middle School  
MS-ESS3-3, MS-ESS3-4
**Slide 5:**
The sound link on the top left of the PowerPoint slide is shipping noise. Play the shipping noise and have students guess what it is.

The sound link on the bottom right is the sound of a North Atlantic Right Whale. Play this sound and have students guess what it is. The next slide you will give them the answer.

**Slide 6:**
Explain that the sounds were a commercial shipping vessel and a Right Whale call.

Explain (or reiterate) that dB is decibel, which is the intensity, or loudness, of the sound. Frequency is the pitch.

- Who is louder? *It varies. The ship can be louder or softer than the whale.*
- Do the whale and vessel have similar frequencies? *Yes—they overlap*
- Why might this be a problem? *Similar frequencies means it can be difficult for whales to detect each other’s calls, because sound waves of the same wavelength can interfere with each other or hide the sound (masking).*

**Slide 7:**
This is a time lapse of a 9 hour period in Stellwagen Bank National Marine Sanctuary. The outline is the sanctuary. Review the color scale on the right side with students before you play the clip.

The little dots are Right Whales. The large turquoise, yellow, and red dots are ships passing through. The color indicates decibel level per the scale.

- What do you notice about the size of the whale sounds vs. the sound of the ships? *The dots are bigger and the colors of higher decibels.*
- Why are the shipping dots so much bigger? *The ship produces a lot more noise of higher decibels, traveling farther in the water.*
- Think about how long it takes for each ship to cross the sanctuary. Remember this is a 9 hour time frame. Imagine hearing that shipping noise for 9 hours.

Be sure to point out that the darker blue color is not totally quiet, but about 100 decibels. The darkest blue is land.

**Slide 8:**
Explain that there are other human activities that generate a great deal of ocean noise. Can you think of any?

Play sound. Have students guess the sound.
Slide 9:
Point out how high the decibels are. It's even higher than the shipping traffic decibels. Decibels work on a logarithmic scale, so an increase of 10 dB causes a doubling of perceived loudness and represents a ten-fold increase in sound level. In other words, if the sound of one vacuum cleaner measures 70 dB, 80 dB would be the equivalent of 10 vacuum cleaners (from NPs website http://www.nature.nps.gov/sound/science.cfm).

Explain the role of the air gun: the explosion of the air gun generates massive pressure and sound, which penetrates hundreds of kilometers into the sea floor and are reflected back to the hydrophones, which record the reflected sound waves. Much like how dolphins and other marine mammals use echolocation, the reflected sound waves indicate what is underneath the sea floor.

This technique is used to find pockets of natural gas.

Play sound again.

Usually, several air guns are fired more than once and can severely harm marine animals in the area.

The sounds can be detected from 4,000 km away from the source. (Niekirk et al. 2012)

Slide 10:
View video of underwater sounds from the Right Whale Listening Network. You will need Quicktime to play the clip or if you have Internet access, visit http://www.listenforwhales.org/page.aspx?pid=443

What do you think of the sounds of marine mammals compared to human sounds?

Slide 11:
(Slide taken from NOAA power point on flashdrive).

Ask students:

- How does the speed of sound in water help marine mammals communicate?
- How do you think noise pollution is affected by the speed of sound under water?

Slide 12:
Have the students look over the worksheet to start the activity/lesson. You will find a teacher guide for the worksheet following this page.

You can put the map of the world with the shipping traffic on the screen and have students trace their shirts' paths.
1. Have your partner check the tag in the back of your shirt.
   a. Where does it say your shirt was made?
   b. Mark this location with an X on the map.
   c. How do you think your shirt got from the factory to the store?
   d. Make a list and draw the modes of transportation you think it took. Include at least 3 steps.

If the tag is difficult to find or looking for it makes a student uncomfortable, have a few objects on hand that give the location of manufacturing, such as the objects in the Sound Choices kit.

Example of steps:
Tag says Made in Indonesia

Step 1: Truck from factory to nearest port.
Step 2: Clothing is loaded onto a ship and travels to California (California is the closest US coast, but it could also travel around Africa to the east coast).
Step 3: Shirt is loaded onto another truck which brings the clothes to the warehouse.
Step 4: Another truck drives some of the clothes to Providence Place Mall (or the store where it was from).

Make sure the students understand the map is a representation of the round earth, and that travel can go off one side of the page onto the other.

2. If your shirt had to cross an ocean, it most likely traveled aboard a ship like this (right). This ship is called a container ship, because it is stacked with large rectangular containers that contain goods from all over the world.

Before the invention of the engine, cargo ships were powered by wind. Below is an example of a ship that was used in the 17th century and some of the early trade routes.

**TAKING IT FURTHER**
Ask the students to think about where their shirts really came from. In another words, what is it made of? Cotton would come from a field. Polyesters are a chemical reaction and can be made from coal, air, water, and petroleum. Have students research where different materials come from, how they are processed, and then the trip the material takes to become the shirt on their back.
Today, 90% of the world's trade is dependent on ocean transport. The lines on the world map below are shipping paths. The red lines are the places where there is the most shipping traffic. The dark blue lines represent less shipping traffic. The white areas are places where there is very little or no shipping traffic. Remind students that sea ice is the reason ships avoid the white areas. Students will be directed to use the map and mark the shipping route they think their shirt took.

3. How is trade different now from trade in the 17th century?
- Faster
- To more parts of the world
- Ships can carry more
- There are more ships now than there were before
- Safer
- Ships are not limited by wind

4. In what ways do you think trade has improved since the 17th century?
- Safer
- Faster
- Can get products (including food) from all over the world
- Less expensive because it is less difficult and less dangerous

5. Do you think there are any negative environmental impacts?
- Noisy
- Uses fossil fuels
- Collisions with marine mammals
- Oil spills
- Air pollution

6. You have already learned some things about the way marine mammals use sound to communicate, navigate, and find food. How do you think the sound of shipping impacts the ability of these marine mammals to hear?
- Underwater noise makes it difficult for marine mammals to communicate with each other, find mates, navigate, and find food.
7. Climate change is causing the polar ice cap to melt. How will this change shipping traffic in the ocean?

8. What will this mean for the animals that live in those areas?

9. How can you, your community, and school make a difference?

With your partner, brainstorm some ways ocean noise can be reduced.

   a. What are the sources of noise pollution?
   b. Are there lifestyle changes you can make to reduce noise?
   c. What could you do to decrease the need for shipping and for gas and oil exploration?
   d. Is there a way to make these activities quieter?
   e. Think about highways and other land based noise sources, how can you make choices to decrease these sources?

   - Buy local or within North America (still impacts terrestrial wildlife with rail, vehicle, air traffic).
   - Make a list of local sources of goods and hand out for people to use.
   - Raise awareness within community.
   - Buy less or buy second-hand.
   - Use alternative means of underwater gas and oil exploration.

"When we as a citizen look at what we're buying in a store, and it's coming from far away, we're participating in these patterns in the ocean," Tournadre from http://www.livescience.com/48788-ocean-shipping-big-increase-satellites.html
1. Have your partner check the tag in the back of your shirt.

Where does it say your shirt was made?

Mark this location with an X on the map.

How do you think your shirt got from the factory to the store?

Make a list or draw the modes of transportation you think it took. Include at least 3 steps.

2. If your shirt had to cross an ocean, it most likely traveled aboard a ship like this. This ship is called a container ship, because it is stacked with large rectangular containers that contain goods from all over the world.

Before the invention of the engine, cargo ships were powered by wind. Below is an example of a ship that was used in the 17th century and some of the early trade routes.
Today, 90% of the world’s trade is dependent on ocean transport. The lines on the world map below are shipping paths. The red lines are the places where there is the most shipping traffic. The dark blue lines represent less shipping traffic. The white areas are places where there is very little or no shipping traffic.

On the map below, mark the shipping route you think your shirt took.

3. How is trade different now from trade in the 17th century?

4. In what ways do you think trade has improved since the 17th century?

5. Do you think there are any negative environmental impacts?
6. You have already learned about the way marine mammals use sound to communicate, navigate, and find food. How do you think the sound of shipping impacts the ability of these marine mammals to hear?

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