GREAT LAKES LEARNING

LESSONS & ACTIVITIES BASED ON THE MONTHLY GREAT LAKES NOW PROGRAM

EPISODE 2305 | FREIGHTER MADNESS

RECYCLING FREIGHTERS

OVERVIEW

This lesson will explore the phenomenon of shipbreaking, including how the technique of breaking down freighters allows us to recycle the materials and parts of the ship for other uses. Students will model shipbreaking in order to better understand the process.

LESSON OBJECTIVES

- **Know** how shipbreaking takes place
- **Understand** the recycling numbers on plastic containers
- **Be able to** harvest bricks and parts from one LEGO build to create another altogether different build

WHAT YOU'LL NEED

- Computer or mobile device with Internet access to view video and online resources
- Notebooks and pencils
- Chart paper
- Sticky notes
- Markers
- Lab supplies (see individual activities for a full list)
- Copies of the Student Handouts

INTRODUCTION

Many people have a recycling bin in their home, office, or school. But there are some recyclables that just won't fit into a tidy plastic container—freighters! That's right. When freighters reach the end of their usable life, they are recycled for parts, artifacts, and materials that can be salvaged in a process known as shipbreaking. Great Lakes Now explores shipbreaking, focusing on a shipyard that recycles large freighter ships from the Great Lakes, including several famous ships. The ships are brought to the yard either by towing or by their own power. The shipbreaking process involves breaking down the ships while prioritizing safety. The shipbreakers carefully collect items such as portholes, lights, and steel, sorting through materials to sell, recycle, or discard.

This lesson includes multiple activities, including lab activities, that can span the course of several sessions or be adapted to fit the needs of your group's meeting format.

Some prior knowledge* with which students should be familiar includes:

- states of matter
- properties of matter
- boiling point and melting point
- physical change

Follow this QR Code or hyperlink to the Episode Landing Page!

Check out our full collection of lessons for more activities related to topics like these.

****The sequence of these activities is flexible, and can be rearranged to fit your teaching needs.***

NGSS CONNECTIONS

Phenomenon: Recycling Materials

- MS-PS1-3
- MS-ESS3-3
- MS-ETS1-1
- MS-ETS1-2
- MS-ESS3-4
- SEP 2
- SEP 3
- SEP 4
- SEP 6
- SEP 7

During the course of the lesson, students will progress through the following sequence** of activities:

- Class discussion to elicit and activate prior knowledge about **recycling**
- Virtual field trip to a paper recycling plant
- Teacher notes on shipbreaking
- Watch segments from *Great Lakes Now*
- Class discussions to debrief the videos
- Model shipbreaking with LEGO bricks
- Read about **recycling efforts in Michigan**
- Learn about the recycling number system
- Conduct an experiment to turn plastic bottles into a new product

The lesson progresses through three major sections: **launch, activities, and closure.** After the launch of the lesson, you are ready to begin the lesson activities. Once finished with the activities, students will synthesize their learning in the closure. You can select the activities that are best suited for your learners and teaching goals, and then sequence them in a way that makes sense within your learning progression and the scaffolds of the lesson.

If you use this lesson or any of its activities with your learners, we'd love to hear about it!

Contact us with any feedback or questions at:
GreatLakesNow@DPTV.org

TEACHER BACKGROUND INFORMATION

by Gary G. Abud, Jr., Great Lakes Now Contributor

**This information can be presented by the teacher as notes to students at the teacher's discretion.*

When most people think of recycling giant cargo ships don't come to mind. But shipbreaking is a form of recycling and has many parallels with traditional household recycling. Though freighters are large structures comprised largely of metals, and everyday recycling focuses on reclaiming plastic waste, both practices involve processes of managing waste, recovering salvageable materials, and safeguarding the environment.

Plastic Recycling Numbers

The recycling numbers on containers are a part of a coding system developed by the Society of the Plastics Industry (SPI) in 1988 to help identify and sort different types of plastic. These numbers are usually found on the bottom of plastic containers, and they are often surrounded by a triangle made up of three arrows. It is important to note that not all plastics are accepted for recycling in all cities. Some recycling programs only accept certain types of plastic, while others may not accept any plastics at all. Some plastics are more difficult to recycle than others, which can make it more expensive or less environmentally friendly to recycle them.

Two common types of plastics are HDPE (high-density polyethylene) and LDPE (low-density polyethylene). These two plastics are commonly used to make various types of containers. For example, HDPE is often used to make milk jugs, juice bottles, and sports drink bottles. It is also used to make shampoo and conditioner bottles, as well as some plastic bags. LDPE is used to make squeezable bottles, such as those used for ketchup and mustard. It is also used to make flexible plastic bags, including those used for produce and frozen foods. Additionally, LDPE is used to make some types of plastic wrap and food storage containers.

Shipbreaking

When large ships, such as freighters, reach the end of their useful life, they can be recycled for their metal and other materials. The process of recycling a ship is known as **shipbreaking**, and it involves dismantling the entire ship. This includes removing engines, machinery, equipment, and other items that can be saved, as well as separating and disposing of hazardous materials such as asbestos or oil. The remaining materials, including the steel hull and other metals, are typically cut up and sold for **scrap metal**. Scrap metal is valuable because it can be melted down and eventually incorporated into new metal parts, thus recycling the metal.

Shipbreaking is a big job. It can be dangerous with the size of the ships, the heavy machinery, and the types of materials that are being recovered, but just like with traditional recycling, there are regulations, systems, and safety guidelines to make sure that recycling a ship is done properly without harm to people or the environment. These come from the the International Maritime Organization and ensure ships are recycled responsibly.

Depending on the size of the ship, large machinery such as cranes and bulldozers may be used to break down and haul away parts of the freighter, but smaller manual tools are also part of the job, including cutting torches, saws, and grinders. That means that skilled tradesmen are often involved in the process, such as welders to cut larger pieces of metal into smaller ones using cutting torches.

Once the materials are removed from the freighter, they are sorted and the pieces that can be recycled are stocked up to take to their final destination, usually a recycling plant for scrap metal for example and a landfill for unusable debris.

LESSON LAUNCH

A. Warm Up

The warm up is intended to be structured as teacher-facilitated, whole-group student discussion activities. It helps students to begin thinking about the topic at the center of the lesson.

1. Ask students to list out on a piece of paper five things that come to mind when thinking of **recycling**.
2. Have students pair up with a partner to share their five ideas with each other. If any ideas appear on both lists, have students circle those.
3. Then, engage students in a whole-group discussion to ask them to share any ideas that were circled.
4. Generate a list of the circled ideas.
5. Ask for volunteers to share any ideas that were not circled that they think are really important to include in this topic.
6. Generate a separate list of those ideas.
7. At the end of making the two lists, have students copy down one single list of all the circled ideas and important ideas in their notebooks or on their paper.
8. Ask students individually to rank the ideas in the list from most to least relevant.
9. Ask for some students to share which term should be most relevant and why they think that is. Engage the whole group in discussion to arrive at consensus about the most relevant idea related to **recycling** that they already know about or that came to mind during this exercise.

B. Bridge to Learning

Activate prior knowledge and get students thinking about the sorting of recyclables by doing the following demonstration:

1. Gather various recyclable waste items, including plastic bottles, aluminum cans, paper, cardboard, and glass bottles. Add a few non-recyclable items like egg shells or banana peels.
2. Label large bins with recycling symbols for plastic, metal, paper, glass, compost, and landfill.
3. Select volunteers and distribute gloves.
4. Have each volunteer choose an item; ask the class to suggest the appropriate bin.
5. Volunteers should confirm group decision after each item.
6. Sort waste into labeled bins, discussing reasons for specific placements.
7. Guide sorting process and stress the importance of properly sorting recycling.
8. Conclude by discussing recycling's impact on conserving resources and reducing landfill waste.

C. Close Reading a Video

Ask students to consider the question: what makes something recyclable? Invite a few student responses before watching this video showing **a visit to a plant that does paper recycling from PBS LearningMedia**. Have students complete the **Notice and Wonder** student handout for the video before discussing their responses in small groups. Invite groups to share some key noticings and wonderings. Summarize the whole group findings and wrap up with a discussion that revisits the initial question: what makes something recyclable?

D. Background Information Notes

Explain that we are about to learn more about recycling metal—specifically, metal that comes from out-of-use freighters—through a special process called shipbreaking. Then pr freighters. Then provide ovide **Teacher Background Information**.

ACTIVITY 1: WATCH A GREAT LAKES NOW SEGMENT

This activity is a video discussion of a *Great Lakes Now* episode segment.

First, inform students that they will be watching a *Great Lakes Now* segment discussing how Great Lakes freighters get broken down and the parts recycled, a process called shipbreaking. During the video they need to jot down four things they took away from the video using the **4 Notes Summary Protocol**.

Then, if students are not already familiar, introduce them to the 4 Notes Summary Protocol, which they will use after they finish watching the video, where they write down one of each of the following notes:

- **Oooh!** (something that was interesting)
- **Aaah!** (something that was an ah-ha moment)
- **Hmmm…** (something that left them wanting to know more)
- **Huh?** (a question they have afterward)

Next, have students watch the segment from episode 2305 of *Great Lakes Now* called **Shipbreaking**.

Last, have students complete their individual 4 Notes Summary and then discuss those in groups of 3-4 students.

Teaching Tip: Use the Student Handouts to help students organize their thinking in writing around each of the lesson protocols.

Post-Video Discussion

After the groups have had time to go over their 4 Notes Summaries, invite a handful of students to share out some of their notes, eliciting at least 1-2 of each of the 4 Notes and listing those somewhere for the whole group to see.

Ask students to turn back and talk with their groups to make connections between the *Great Lakes Now* video and what they remember from the warm-up activities.

How is what we saw in the video related to what we discussed earlier during the lesson launch activities?

After giving the groups some time to talk, bring the whole group back together for a shareout and discussion of ideas.

In this culminating discussion, the goal is to help students make connections between the video segment and what they discussed during the launch activities earlier in the lesson about what they knew about **recycling.**

Once the discussion finishes, have each student write a "**Sum It Up**" statement in their notebooks. This is a single sentence that captures the big idea of what was just learned.

Have 2-3 students share out their **Sum It Up** statements before concluding this activity.

ACTIVITY 2: READ ABOUT RECYCLING EFFORTS IN MICHIGAN

In this activity, students will read about the recycling efforts one state has made that has helped it to significantly increase its recycling rate by over one third. The state of Michigan has gone from a statewide rate of recycling of about 14% to a rate of 19% in a matter of a few years. And there are lessons to be learned.

In this activity, students will use a **Think Pair Square Protocol** for discussing what they will read about this very topic.

First, have students partner up and distribute the article **Michigan Increases Recycling** by The Associated Press from *Great Lakes Now*. Allow time for students to individually read the article, and have them jot down three things they took away from the article using the **Rose Thorn Bud Protocol**—in their notebook or using the handout.

Then, give students time after reading to discuss the article that they read with their partner. Have students share their rose, thorn, and bud with each other, including how those points connect to each other. The pair should come up with a statement to summarize all of their article takeaways.

Next, have two student pairs join up, standing near each other to form the four corners of a square, to discuss the article and what they talked about in their pairs. Encourage them to come to a consensus about which point they found most important or interesting in the article.

Last, have each group craft a summary statement of the most important point from their discussion and ask for a volunteer in each group to share that key point with the whole group. As student groups share their most important point, record their ideas on the board and have students copy the list of student ideas down into their notebooks. Once the shareout is complete, ask students to return to their groups and discuss one last question based on the article:

How does your community's recycling efforts compare to what you read in the article that Michigan is doing?

You can keep this as a class discussion based on the article itself, or this can be extended into a writing assignment, presentation project, or further research on the topic to allow students to engage more deeply with the issue.

Teaching Tip:
If the reading level of the article is going to be tough for some students to read individually, have partners or small groups read the article together aloud while each follows along.

ACTIVITY 3: INVESTIGATING RECYCLING NUMBERS

The purpose of this experiment is to investigate the densities of different plastics in order to learn about the recycling numbers system for plastic containers, which was developed by the Society of the Plastics Industry (SPI).

Materials:

- Plastic containers of varying types according to recycling numbers 1-7, e.g., several containers of each type
- Pairs of strong scissors
- Graduated cylinders (100mL)
- Electronic mass balances
- water
- Rulers with millimeter tick marks

First, inform students that they will be working with a partner to investigate the different types of materials used in plastic containers, as categorized by the recycling numbers, by comparing their densities. You may wish to review the calculation of volume of a rectangular prism (V=lhw) as well as density (d = m/v).

Next, have students obtain a sample of each type of container, number 1-7, by cutting credit card-sized pieces of each. Have students cut square-shaped pieces of each plastic small enough to fit into the graduated cylinder. Make the pieces the same size if possible. Measure the mass, length, and width of the pieces.

Since the plastic is too thin to precisely measure its thickness (e.g., the height of the rectangular prism) have students use the method of water displacement to measure the volume of each plastic. They should fill the graduated cylinder and measure the volume of water. Then, put a small square of one type of plastic in the graduated cylinder and measure the new water volume. The difference between water volumes represents the volume of the plastic. This should be repeated for each type of plastic.

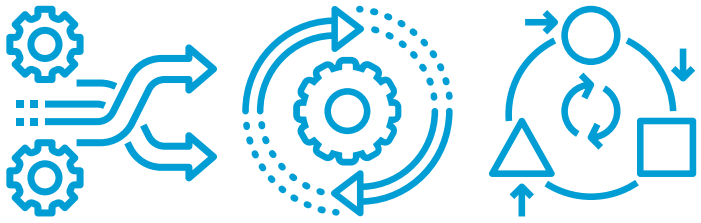
Once the volume of the plastic is determined, along with its mass, the density can be calculated in g/mL or g/cm^3 (*note: 1mL = cubic centimeter*).

Similarly, using the measured volume and the measured dimensions of length and width of the plastic piece, its thickness can be calculated using the rectangular prism volume equation.

Last, summarize the calculations and measurements of each plastic type using **the student handout data table**. This should allow the group to compare each plastic type in terms of its dimensions, mass, volume, and density.

What conclusions can be drawn about the different types of plastic from this experiment? How do the densities compare? Are the plastics all the same thickness? How do the rankings compare from most to least in terms of density and thickness? Have groups compare their data with each other's to summarize class findings.

ACTIVITY 4: TRANSFORMING PLASTIC INTO PRODUCTS



The purpose of this experiment is to teach students about recycling and how plastic can be transformed into a different product.

Materials:

- HDPE (high-density polyethylene) or LDPE (low-density polyethylene) plastic bottles (e.g., milk jugs, juice bottles, squeezable ketchup bottles, or sports drink bottles)
- Scissors
- Glass beaker
- Hot mitt or beaker tongs
- Hot plate
- Wooden craft sticks
- Silicone mold of any shape (can be purchased online or at a craft store)

First, inform students that they will be working with a group to model the plastic recycling process by taking plastic containers, melting them down, and using the plastic melt to produce a new plastic product. Have students form their groups and distribute the plastic containers to each group. Have them remove any labels, stickers, lids, rings, or paper that remains on the containers.

Teaching Tip:

Practice this process on your own before trying out with your student group, so that you can see what pointers you'll need to give them when they perform the experiment.

Procedure:

Next, groups should follow these steps:

1. Cut the plastic into small pieces using scissors. Make sure that the pieces are roughly the same size.
2. Preheat the beaker on the hot plate for a few minutes on a level 5/10.
3. Place the plastic pieces into the beaker and heat them until they melt completely. Stir the plastic with a wooden stick to ensure that it melts evenly.
4. Once the plastic has melted, carefully, using hot mitts or beaker tongs pour the plastic into the silicone mold. Fill the mold to the top and smooth the surface with the wooden stick.
5. Let the plastic cool and solidify in the mold for about 10-15 minutes. To accelerate the cooling and solidification, you can place the mold on an ice pack (optional)
6. Once the plastic has hardened, carefully remove the newly formed plastic pencil from the mold.

Then, after students have transformed a plastic bottle into a new product, have them display their new products for everyone to see. Give students time to go around and see the different products and to make some observations about them.

Last, engage the whole class in a discussion about how the different products turned out and whether there were differences based on the types of plastic used in the process.

ACTIVITY 5: MODELING SHIPBREAKING WITH LEGO BRICKS

The purpose of this activity is to teach students about recycling and the importance of reusing materials by modeling shipbreaking by taking pre-built LEGO structures, break them down into individual component pieces, and then build new structures with the very same pieces.

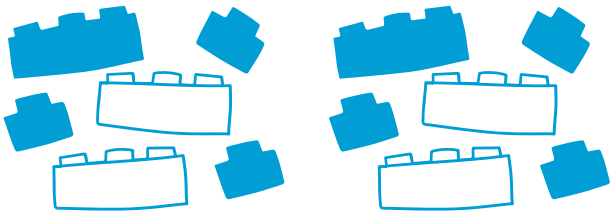
Teaching Tip: Consider using LEGO Creator 3in1 sets, which offer three different builds using the same pieces. Alternatively, you can provide an assortment of LEGO bricks or encourage students to donate their unused LEGO parts/sets from home for this activity.

Materials:

- Pre-built LEGO structures (one per student or small group)
- LEGO bricks of various shapes and sizes
- Work surface for building
- Paper and pencil for sketching designs
- Optional: bin or container for collecting LEGO pieces

First ask students about their past experiences with LEGO building. Introduce the concept of recycling and reusing materials to create something new, and draw a parallel between LEGO building and repurposing reusable parts from structures like freighters.

Next, inform students that they will be taking a pre-made LEGO build, breaking it down into individual parts, and creating an entirely different build from the pieces. Give each student or group a pre-built LEGO structure to examine and observe. Give them time to take the structure apart and to organize the individual pieces out on the table. Encourage them to work carefully and patiently, as some pieces may be difficult to separate. You can have tools on hand for this, if necessary. Have students keep tally of how many of each type of brick they have from the build on their paper. As you monitor their progress, remind them to start thinking about their challenge: to build an entirely new structure that will reuse as many of the bricks from the original build as possible, but they may add in additional non-reused bricks from a common bin of extra bricks.



Then, give them some time to plan and sketch out what they're going to build. Have them account for the number of each type of brick that will go into their build. Instruct them that they may use additional, non-recycled, bricks in their build from the common brick bin. Keep track of how many of each type of non-reused brick were incorporated into the new build.

Have them count how many of each type of brick they have left after the final build. Subtract the total that were left from the total started with (only with the recycled bricks) and that will be how many recycled bricks were used in this build. Divide the number of recycled bricks used by the total number of bricks started with from the prior build to get the **conservation rate** (expressed as a percent) for their recycling build, e.g., the percentage of your starting build they were able to reuse. If any additional bricks were used in the new build, account for those to calculate a **percent reused materials** for the new build. Take the number of recycled bricks divided by the total number (non-reused and recycled combined) of bricks in the new build. This figure will report what percent recycled materials the new build is made of.

Last, have all the students show off their new builds and present their calculations. Discuss with different groups how they arrived at their builds and achieved their conservation rates as well as percent recycled materials. Help students to see the connections to the materials industry where common household products often display a percentage of recycled materials that the product contains. Ask students about their experience breaking down the pre-built structures and building new structures, and what they learned from the process about shipbreaking, recycling, and reusing materials.

LESSON CLOSURE

After the conclusion of all the activities, help students to make connections* between everything they did in the lesson and what they learned overall.

A. Free Recall

Group students in pairs or triads (e.g., in groups of 2-3 partners) and distribute the **Free Recall Protocol handout**, Alternatively, you can have students do this in their notebooks. Set a 3-min timer and have students generate a list of everything they can remember learning about in this lesson related to the central topic of the lesson. This doesn't have to be in depth, just whatever each group can call to mind. Have them draw lines between any terms that relate to one another. After the timer finishes, give groups a chance to volunteer to share aloud 2-3 things from their free recall lists and any of the connections that they made with those. Jot down any ideas that come up multiple times during the shareout for the whole group to see.

B. Lesson Synthesis

Give students individual thinking and writing time in their notebooks to synthesize their learning, by jotting down their own reflections using the **Word, Phrase, Sentence Protocol.**

In the Word-Phrase-Sentence Protocol, students write:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

C. Cool Down

After the individual synthesis is complete, students should share their synthesis with a partner.

After sharing their syntheses, have students complete a **3, 2, 1 Review** for the lesson with their partner, recording in their notebooks or, optionally, on exit ticket slips to submit, each of the following:

- **3 things** that they liked or learned
- **2 ideas** that make more sense now
- **1 question** that they were left with

Invite several students to share aloud what they wrote in either the synthesis or 3, 2, 1 Review.

Lastly, ask one student volunteer to summarize what has been heard from the students as a final summary of student learning.

**Optionally here, the teacher can revisit the learning objectives and make connections more explicit for students.*

Teaching Tip: Use the Student Handouts to help students organize their thinking in writing around each of the lesson protocols.

NAME: _____

A Word, Phrase, Sentence Protocol

What is a **word** that you thought was most important from this lesson?

What is a **phrase** that you would like to remember from this lesson?

What is a **sentence** that sums up what you learned in this lesson?

3, 2, 1 Review Protocol

What are **3 things that you liked or learned** from this lesson's activities?

-
-
-

What are **2 ideas that make more sense** now to you?

-
-

What is **1 question that you were left with** after this lesson?

-

NAME: _____

Free Recall Protocol

With 1-2 partners, generate a list of everything you can remember learning about in this lesson related to the central topic of the lesson. Draw lines between any terms that relate to one another.

NAME: _____

Notice & Wonder Protocol

NOTICE	WONDER
Things that you noticed about the topic	*Things that you wondered about the topic*

NAME: _____

4 Notes Summary Protocol

OOOH!

Something that was interesting to you

AAAH!

Something that became clearer; an "ah-ha" moment

HMMM...

Something that left you wanting to learn more

HUH?

Something you questioned or wondered

Sum It Up Statement:

Summarize your group discussion about your 4 Notes Summaries below:

NAME: _____

Think Pair Square Protocol

THINK

Write down your own individual ideas

PAIR

Summarize what you and your partner discussed

SQUARE

Summarize what your group discussed

NAME: _____

Rose, Thorn, Bud Protocol

ROSE

Something that "blossomed" for you in your learning

THORN

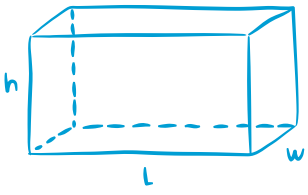
Something that challenged your thinking or was difficult to understand

BUD

Something that's new and growing in your mind — a "budding" idea

NAME: _____

Investigating Types of Plastics by Recycling Number



$V = lwh$

$d = \frac{m}{V}$

Plastic #	Mass (g)	Volume (mL)	Volume (cm^3)	Length (cm)	Width (cm)	Height/ Thickness (cm)	Density (g/mL)	Density (g/cm^3)
1								
2								
3								
4								
5								
6								
7								

How do the densities of the plastics compare?

How do the thicknesses of the plastics compare?