Can It!

Where does a soda can come from and how does it get from ground to table? You'll explore the engineering and design behind this common item and consider its value.

GRADES 5-8

ISRI
Voice of the Recycling Industry

JASON Learning

PREPARE:

Time Required: 2 class periods (90 minutes) without extension

- Replicate student activity sheet
- Gather materials (see activity pages).
- Divide students into groups of 3-4.
- Make copies of activity pages and student data sheets.
- Collect aluminum cans of various sizes, including small juice cans and soda cans, at least two sizes per group, and at least one steel (soup or vegetable) can per group.
- Confirm students will have access to computers and internet.
- Lay an assortment of magnets, scales or balances, magnifying glasses, and rulers on each table (and any other tool you think lends itself for making observations about the different cans).

MOTIVATE:

- Provide each group of students with several clean cans (ferrous and non-ferrous) and ask them if they notice any differences between the cans. Provide them with some basic science tools like magnifying glasses, scales, rulers, and magnets.
- Challenge students to come up with some differences.
- Have students share ideas and observations. Students may discover that some of the cans are magnetic, and some are not. Some are also heavier, and have a thicker gauge (width) than others.
- Have students sort out the cans according to whether they are magnetic or not. Explain that some are made from iron & steel (called ferrous metals) and some from aluminum (called non-ferrous metals). Do not reveal which is which just yet – have students think about this as they move on to the main activity.
- Is there a trend they notice in what types of products are found in which type of can?
- Tell students that in this activity they will conduct a Web Quest to discover more about how cans are made, and in particular, those that are made from aluminum.

TEACH:

- Hand out activity pages.
- Ask students to share ideas about where aluminum comes from – where it is mined and where it is refined.
- Have students begin the Web Quest by following the directions on the student pages.

- HINT: Many of the steps in the web quest involve estimation and interpretation. Some answers will vary due to market or location. Students should develop a good understanding of the variables even if they cannot come up with a final answer that is truly accurate.

REFLECT/ASSESS

Students should be able to:

- Describe the multi-step process involved in making an aluminum can, from mining the ore to transporting the newly made can to its destination.
- Make an argument for which recycling incentive they think would be the best to encourage people to recycle responsibly, and support their choice with evidence.
- Explain which recycling incentive is the least likely to work and why.

EXTEND

Have students compare the thickness of various cans in the supermarket. Today's aluminum can is somewhat thinner than those manufactured in the past. Have students find out why! Have students investigate the coatings used inside some cans that are used to store highly acidic foods. What do students notice and why do they think this is?

JOURNAL QUESTION

Now that students have learned more about the costs and energy needed to produce a can from raw ore deposits, have them decide whether or not it is an effective way to package food. Why or why not? What other options are available? Have students evaluate these options.

WEBLINKS

ISRI Fact Sheet — Non-Ferrous Metals	https://www.isri.org/resource-center-post/resource-center-content/2021/10/14/ferrous---fact-sheet
How Aluminum Works	http://science.howstuffworks.com/aluminum.htm
How Are Beverage Cans Made?	https://industrialphysics.com/knowledgebase/articles/how-are-beverage-cans-made/

Can It!

Background

Each step in the refining process involves cost and energy. Mining is an environmentally costly process. Forming the aluminum into cans, and transporting it to the bottling plant require more energy and expense. Recycling saves both the environment and enormous amounts of energy (up to 92 percent). Collecting the used cans, crushing them into bales, and re-processing them requires only about 8 percent as much energy as using new ore. And the end result is a reliable source of aluminum without the cost of imports. That's why more than half of the aluminum we use in this country comes from recycling.

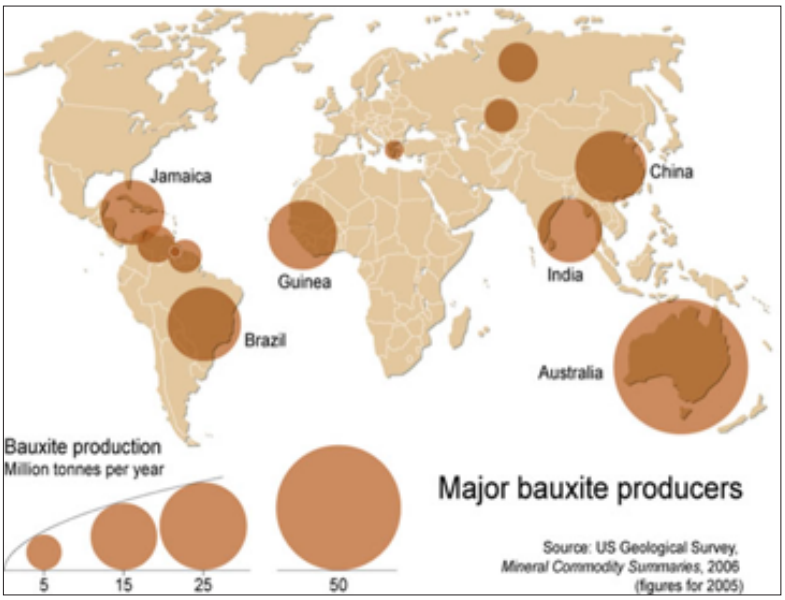

Image Credit: Princeton University

Most students will think first of soda can recycling, the topic of our lesson, but many metals that are found in far smaller quantities, like those in electronics equipment, can be equally or even more valuable.

The bauxite ore, which is used in cans, is mined in many regions around the world. Australia and Jamaica are major producers, and Turkey is increasing its capacity to export aluminum ore. The bauxite is almost always strip-mined; topsoil and lumber are removed and the next level of soil (overburden) is removed. The ore is found in the caprock layer. This forms a hard sheet that must be broken by blasting or heavy equipment. About 100 million tons of bauxite is mined each year worldwide. After mining, bauxite is processed into aluminum oxide and then converted to alumina by the process of hydrolysis

Debating How to Motivate Recycling

In almost every community there is some method of recycling. Some have curbside pickup, some provide deposit systems, and still others rely on motivated citizens to bring their recyclable non-ferrous metals to a center. Students may differ on the best way to get the maximum result. Where deposits are used, there are often complaints that the responsibility falls on the vendors. Where recycling is voluntary, many communities find that potentially valuable cans end up in landfills. Students should be encouraged to formulate a small number of good arguments for their position and back each argument up with facts.

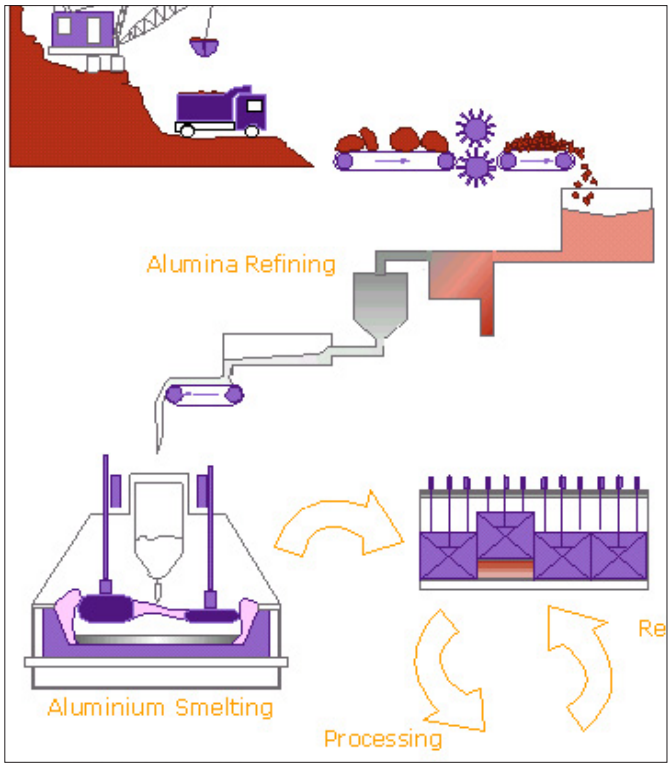

Image credit: emt-india.net

Answers to Student Questions:

Sample distances for five top sources: Australia to USA—7,500 miles; Brazil to USA—5,000 miles; India to USA— 7,500 miles; China to USA—7,000 miles; Guinea to USA—6,600 miles; and Jamaica to Washington, DC, USA—1,700 miles.

Step	What's Involved	Potential Websites for Web Quest
Mining	Exploration Stripping Drilling Breaking Mining Crushing Conveying	http://science.howstuffworks.com/aluminum2.htm
Refining Smelting	Bayer Process	http://science.howstuffworks.com/aluminum2.htm http://www.madehow.com/Volume-5/Aluminum.html
Processing	Forming Redrawing Ironing Trimming Cleaning Labeling	http://science.howstuffworks.com/aluminum3.htm
Rehabilitation	Soil Restoration Replanting	http://science.howstuffworks.com/aluminum2.htm
Transportation	Cans are lighter than glass and more efficient	https://earth911.com/living-well-being/recycled-beverage-containers/

Can It!

Non-ferrous metals like aluminum, copper, lead, nickel, tin, and zinc are especially valuable to recycle. They are among the few materials that do not degrade during the recycling process. Aluminum cans are used all over the country. More than $40 billion in non-ferrous metals are recycled each year. ISRI estimates that if all the aluminum scrap that we recycle were made into cans, they would stretch from Earth to Venus! Recycling saves enormous amounts of energy— the equivalent of 25 million barrels of gasoline a year. In this activity you will use the Internet to explore the multiple steps involved in producing a can from raw ore.

Materials:

- Computer with internet access
- Calculator
- Copy of world map

Part I: Web Quest: Investigate Aluminum

1. Using the internet and other resources, find out where aluminum comes from. What is the name of the ore?
2. Where is this ore mined? Find at least four areas of the world and label these areas on the world map.
3. Estimate the distance that the ore must be transported to reach your home state from each of the locations you have identified.
4. Find out if aluminum is magnetic or not!
5. Can you determine which of the cans you observed at the beginning of the lab was made from aluminum? What kinds of products are often stored in aluminum, and why?

Part II: Web Quest: Create a Flowchart for the "Birth" of a Soda Can!

1. There are five major steps in the process of making a soda can. From mining to transportation, describe each step listed in the flowchart on the student data sheet, defining the process. Include information about any impacts to the environment or other interesting pieces of information you feel are worth noting.
2. It would be impossible to calculate all the costs (in money, energy and to the environment) to make that can. But we can estimate. As you research the steps involved in making a soda can, find out at least one fact that can help you estimate what it takes to make it happen. What's involved? What does it cost?
3. In column 3, list your sources of information.

Reflect and Apply

Aluminum is one of the easiest and most valuable products that consumers can recycle. While it's easy to argue that recycling aluminum cans is important, people sometimes forget or get lazy! Different cities and states have different ways to motivate can recycling, ranging from education, incentives, limits on the volume of household waste and can deposits.

Imagine that your community is going to establish a new program to recycle cans. At a large meeting, four options for the system are discussed. Look at the recycling incentives below. Choose what you think is the best option. On a separate piece of paper, develop an argument and support your choice with evidence. Which option would you choose not to support? Why?

A. Each can that is sold in the community should have a deposit of a dime; that deposit is returned to the buyer when they return the can to any store that sells the same product.	B. In order to motivate people to throw less "away" and recycle, they will be required to buy authorized trash bags at $1 a bag. The more they recycle, the less they have to put in the bags.
C. Recycling bins will be collected at each home. Recycling will be the law, and there will be fines for putting cans and other recyclables into the ordinary trash collection.	D. Each resident will be required to take an educational course on the value of recycling. This educational program will also be presented in the schools at the right grade levels. People who don't recycle will take the course again.

Extension

Compare the thickness of various cans in the supermarket. Today's aluminum can is somewhat thinner than those manufactured in the past. Conduct an investigation and find out why! Investigate the coatings used inside some cans that are used to store highly acidic foods. What do you notice and why do you think this is?

JOURNAL QUESTION

Now that you have learned more about the costs and energy needed to produce a can from raw ore deposits, do you think that it is an effective way to package food? Why or why not? What other options are available? Why do you think that these options might be better or worse?

Student Name: Period:

Web Quest

1. Where does aluminum come from? What is the name of the ore?

2. Where is this ore mined? Find at least four areas of the world and label these areas on the world map provided.

3. Estimate the distance that the ore must be transported to reach your home state from each of the locations you have identified

4. Find out if aluminum is magnetic or not!

5. Can you determine which of the cans you observed at the beginning of the lab was made from aluminum? What kinds of products are often stored in aluminum, and why?

Part II: Web Quest: Create a Flowchart for the "Birth" of a Soda Can!

Complete the table below, describing each step listed in the flowchart. Include information about potential cost if possible, and any impacts to the environmental or other interesting pieces of information you feel are worth noting. Include your sources of information.

Step	Process (Describe)	Websites/Sources
Mining		
Refining Smelting		
Processing		
Rehabilitation		
Transportation		