Program	**Manufacturing Technology: The Aluminum Can**
Four	Teacher's Guide

Cans are such a part of our everyday life we almost fail to notice them. If we do notice a can, it is probably not because of the engineering as much as it is for the graphics or shape. Seldom, if ever, do we look at a can and marvel at the important contribution it has made to society.

Thanks to the can, sailors began to travel the world with safe fresh food. It has allowed us to safely keep foods on our shelves for long periods of time without spoilage. Fruits and vegetables have been made available to us throughout the year because of the innovation of the can. What started as a contest over 200 years ago, became an innovation that has changed the world.

Today, many of the cans we use are made from aluminum, a material that was unknown when the first cans were made. This innovation has had a meaningful effect on the environment. According to the Can Manufacturers Institute, the weight of the aluminum cans recycled in 2001 was equal to the weight of 14 aircraft carriers. That adds up to a significant impact on the environment! Once refined, aluminum can be recycled using a very small amount of energy, resulting in huge savings, energy savings we can use to light our homes and power our factories.

Program Objectives

Students will learn that:

- Science and scientists are at work in northwest Ohio solving the problems posed by human activities and their effects on the environment.
- Businesses and governments routinely apply the process of scientific investigation to improve products while accessing risk and cost to the community and environment.
- Science skills learned in high school are needed in the workplace.

Ohio Science Standards

Physical Science

Benchmark F

Explain how energy may change form or be redistributed but the total quantity of energy is conserved.

Indicator 15, Grade 9

Trace the energy transformations of energy within a system (e.g., chemical to electrical to mechanical) and recognize that energy is conserved. Show that these transformations involve the release of some thermal energy.

Science and Technology

Benchmark A

Explain the ways in which the processes of technological design respond to the needs of society.

Indicator 3, Grade 9

Explain why a design should be continually assessed and the ideas of the design should be tested, adapted and refined.

Earth Science

Benchmark D

Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources.

Indicator 5, Grade 10

Explain how the acquisition and use of resources, urban growth and waste disposal can accelerate natural change and impact the quality of life.

Scientific Inquiry

Benchmark A

Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.

Indicator 4, Grade 9

Decide what degree of precision based on the data is adequate and round off the results of calculator operations to the proper number of significant figures to reasonably reflect those of the inputs.

Materials

- Computer with access to the Internet
- Paper and pen
- Handouts

Pre-Viewing Activity – Prepare to Learn

The first part of this lesson is to have students look critically at a can and observe some of its features. Bring a variety of cans to class, including both

two-piece and three-piece aluminum and steel cans. Discuss some of the obvious features such as the lightness of the aluminum, the rigidity of the steel and the overall design. With the design, what features might be aesthetic rather than functional? Are there any key design differences between aluminum and steel?

The general purpose of a can is a good discussion to have -- where would our lives be without them? During the course of a day, how much of what we eat and drink comes from a can, and more importantly, why? Over the years the can has evolved from a glass bottle with a cork stopper, to a soldered tin box, to the lightweight aluminum unit we use today. The modern can is a perfect example of a design that has been re-accessed and refined to meet the needs of society. It is very easy to take cans for granted, but think about their importance in a world without refrigeration.

The refinement of the aluminum can has saved the economy millions of dollars in shipping and material costs. In 1972, a pound of aluminum produced 21.75 cans; today that same pound of aluminum produces 32 cans, a savings of over 47 percent. The annual production of cans runs in the billions, so a savings of a fraction of a percent can be worth millions of dollars!

The final discussion might revolve around the conservation of energy and how easy aluminum is to recycle. During the interview, Jed Osborne explains how the amount of energy stored in a single aluminum can is equivalent to that needed to run a television for three hours. Recycling aluminum cans saves 95 percent of the energy used to make aluminum cans from virgin ore. With the cost of energy increasing every year, along with our demand for aluminum, some day the aluminum buried in landfills might be worth recovering.

Vocabulary

- Nutra-ceutical
- Head space
- Closures
- Hydraulics
- Vacuum
- Atmospheric pressure
- Bauxite

Related Discussion Items

- How much energy is stored in an aluminum can?
- How can fractions of a number effect the can business? Give an example of this using decimals or fractions. Saving one penny per can on thirteen billion cans is equivalent to how many dollars? $130,000,000 dollars!

- Amount of metal saved in aluminum cans; for example, in 1972 a pound of aluminum produced 21.75 cans; today that same pound produces 32 cans, a savings of over 47 percent.
- Future can technology will include self-heating and cooling cans; what are some other possible innovations?
- What are some of the energy transformations that take place when recycling aluminum?
- What are the advantages of recycling aluminum?

Activity

Create a concept map as a follow-up to the guided discussion. Have your students describe the positive environmental impact of a human activity such as the recycling of aluminum cans.

Quiz

1. Much like the tires on a car, the aluminum beverage can is engineered to be a pressure vessel. It is this pressure that gives the can its strength.

   True or False

2. One of the advantages of the aluminum can is that it is very easily recycled.

   True or False

3. Because the steel can must hold a vacuum it needs to be rigid in order to resist atmospheric pressure.

   True or False

4. The production of aluminum from bauxite requires electricity. The production of electricity often results in the production of greenhouse CO2, a greenhouse gas. Since recycling uses less electricity, it can reduce the production of greenhouse gases.

   True or False

5. The degree of precision with numbers is important at Ball Metal. The need to round off results to a proper number of significant figures is very important to Ball's manufacturing costs.

   True or False

Related Lesson Plans

Garbage: How Can My Community Reduce Waste?
(ORC# 5704)

In this content resource students learn about waste management, how waste is handled now, and how some communities are doing it better. The resource includes online activities that challenge students' knowledge about solid waste.

Educational Resources

Additional Resources Using: D3A2

Search String = recycling
aluminum
food manufacturing
food preservation

The **D3A2** helps educators analyze data, and then points them to resources such as lesson plans, assessments and activities designed specifically to address the academic need identified by the data. In addition to linking content to data analysis, educators will have general search capabilities to locate education content resources aligned to the Ohio's Academic Content Standards. Examples of the state resources queried are:

INFOhio
http://www.infohio.org/

Ohio Resource Center
http://ohiorc.org/

Other Resources

Terrific Science: The Crandon Mine Controversy
http://www.terrificscience.org/freeresources/lessonpdfs/Crandon_Mine.pdf

Ohio Department of Education: Monitoring Urban Development
http://ims.ode.state.oh.us/ode/ims/lessons/content/CTE_LP_S02_BB_L10_I01_01.doc

Ohio Department of Education: Scientific Evidence: Reliable or Not?
http://ims.ode.state.oh.us/ode/ims/lessons/content/CTE_LP_S02_BB_L10_I01_01.doc

PBS: Science of Sports – Spring Man
http://www.pbs.org/safarchive/4_class/45_pguides/pguide_405/4545_sm.html

NIST Physics Laboratory: A Walk Through Time
http://physics.nist.gov/GenInt/Time/time.html