math

science

Recycling...Sorting It All Out

Objective

To help students test and better understand the properties of different recyclable materials.

Activity Description

Students rotate to different stations to evaluate recyclable items and learn how to sort them into different categories.

Materials Needed

- Recyclable items listed below
- Magnets
- An aquarium tank or other large container filled with water
- Rocks or other items that vary in density
- Balance scale
- Scissors
- Tablespoon of sand
- Copies of the *Sorting Statistics Worksheet*
- Calculators (optional)

Key Vocabulary Words

Sorting
Recyclables
Magnetism
Density
Mass
Matter

Duration

1 hour

Skills Used

Communication
Research
Computation
Observation/classification

Activity

Step 1: A day or two before the lesson, ask students to bring in different recyclable items from home or collect items left over from lunch. See the box at right for the list of materials to request. Be sure to clean these items before the lesson and remove any sharp edges. Store these items in a utility closet or some other storage room at the school until you are ready to conduct the lesson.

Step 2: To begin the lesson, discuss how waste is reduced by recycling. Explain how after recyclables are collected from businesses and homes, they are sent to a facility where they are sorted into different categories of materials. Explain that it is important for recyclers to tell the difference between materials because they end up being recycled into different products. (Refer to the Teacher Fact Sheet titled *Recycling* on page 73 for more information on this process).

Recyclable Items

Steel food cans
Aluminum soda cans
Plastic detergent bottles
Plastic milk jugs
Newspapers
Magazines
Notebook paper
Cardboard boxes

Journal Activity

Ask students if they can think of an innovative way to sort recyclables? Ask them to describe or draw their invention.

Step 3: Organize three different stations throughout the classroom.

Station One should include the steel and aluminum cans, a magnet, and an information sheet about magnetism. This sheet should explain that magnets are pieces of iron or steel that can attract other metals.

Station Two should include the plastic items and a large container (e.g., an aquarium) filled with water, along with scissors and a few heavy and light objects. You should prepare an information sheet explaining that density refers to how compact an object is. As an example, note that a bowling ball is much more dense than a foam rubber ball of the same size because the bowling ball is more compact and made of heavier material.

Station Three should include the paper items and a scale. An information sheet should explain that mass refers to the amount of matter in an object. You can weigh an object on a scale to determine its mass.

Step 4: Once the stations are set up, hand out worksheets, break the students up into groups of three, and explain that students should rotate from station to station in their groups and fill out their worksheet as they go. Students can discuss answers within their groups.

Step 5: At Station One, have students experiment with the magnet and the different cans to discover that some of the cans are attracted to the magnet while others are not. At Station Two, students should compare the density of various plastic items. Students can compare the density of other items with plastic, and can cut up plastic into pieces to see how density is affected. At Station Three, students can place various paper items on the scale and record the different weights.

Step 6: Discuss the questions from the worksheet. Students should understand that recycling sorting facilities use magnets to separate the steel cans from the rest of the collected recyclables. They should also understand that density is important because it can be used to identify and separate different items. Recycling sorting facilities use sinking/floating exercises to sort plastics from other materials, such as crushed glass, since plastic containers float. Students should also understand that sorting facilities use scales to weigh the recyclable materials they receive so they know how much material is being recycled.

Assessment

1. Ask students to explain magnetism. Ask them why only some objects are attracted to magnets. Which ones?
2. Ask students to explain density and how to test for it.
3. Ask students what mass means. Have them explain how to test something to determine its mass.
4. Have students list some of the techniques that sorting facilities use to separate different recyclables.

Enrichment

1. Visit a local recycling materials recovery facility to see firsthand how the different recyclables are sorted.
2. Ask students to draw their own recycling sorting facility. Ask them to start with a pile of recyclables at one end and show how the different recyclables would be separated (e.g., magnets, conveyor belts) as they move through the facility. Ask them to decide whether their diagram will only involve machinery or whether it will involve people to sort some of the items. Ask them to label each of the different stations in the facility and describe how each station works.

Sorting Statistics

Name:

_____

Station One

1. How many steel cans are at Station One? Use the magnet to find out. Now, multiply that number by the number of students in your classroom. If you recycled 56 percent of these cans, approximately how many would that be? As a nation, we recycled 56 percent of our steel cans in 1998.

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2. How would magnets help workers at a recycling sorting facility?

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3. Suppose you have 10 aluminum cans—5 containing recycled aluminum and 5 with no recycled content (made from bauxite, the primary ore). Next, suppose it takes 5 watts of energy to make a can with recycled aluminum and 100 watts to make a can from bauxite. How much energy does it take to make the 5 recycled-content cans? How about the 5 nonrecycled cans? Note that it takes 95 percent less energy to make an aluminum can from recycled aluminum versus making one from scratch.

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4. Calculate the aluminum can recycling rate for Anywhereville, USA, given the following information:

- 1,938 pounds of aluminum cans were recycled
- 3,370 pounds of aluminum cans were produced
- There are an average of 33.04 cans per pound

Number of cans recycled:

_____

Number of cans produced:

_____

Recycling rate:

_____

Station Two

1. Does the size and shape of an object affect its density? Test a few different types of plastic objects in the water and record your results. You can cut up some plastic and try some other objects for comparison—record all results.

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2. How is testing for density helpful to a recycling sorting facility?

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3. Note that the following formula is used to determine the density of an item: density = mass (grams)/volume (centimeters^3). Now, assume a piece of garbage—a popcorn bag—has a mass of 12 grams and a volume of 5 centimeters^3. What is its density?

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4. Note that water has a density of 1.0 g/cm^3. Items that have a density of less than 1 float in water, while those that are more than 1 sink. Do plastic bottles have a density greater or less than 1?

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Station Three

1. Describe the characteristics of the different types of paper. How are they similar? How are they different? Consider color, texture, glossiness, thickness, etc.

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2. Assuming you recycle 7 newspapers a week, 365 days a year, how many newspapers do you recycle per year?

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3. Using the scale at Station Three, weigh a newspaper to determine its mass. Using your answer from question 2, what is the total mass (in pounds) of the newspapers you recycle each year? In tons? (There are 2,205 pounds in a ton.)

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4. Assuming that each ton of paper recycled saves 17 trees, how many trees have you saved by recycling your newspaper each year?

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