

Battery Basics (Lesson 1)

Grade level: Elementary

Subject: Science

Introduction

In these two combined lessons, students discuss how batteries work as a power source. They examine various types of batteries, both primary (non-rechargeable) and secondary (rechargeable), and identify common characteristics of both.

In the second lesson, students calculate the number of battery-operated devices they encounter each day. They discuss why the disposal of batteries is potentially harmful to the environment, and explore ways to ensure batteries are properly recycled.

Objectives

At the end of this lesson, students will:

- Identify types of batteries as primary or secondary
- Chart the use and number of batteries in their daily lives
- Summarize why batteries are potentially harmful to the environment
- Suggest possible ways to ensure batteries are recycled properly

Materials

- Flashlight
- Transistor radio
- Watch
- Cellphone
- TV controller
- Any item that is battery-operated
- Four different [rechargeable] cellphone batteries, watch battery, etc. (Be sure to have examples of both primary and secondary.)

Resources

- Worksheet 1a—*Battery Background Information*
- Worksheet 1b—*Battery Station*
- Worksheet 1c—*Household Survey*

Procedure

1. The teacher presents a number of different objects to the class: a flashlight, radio, digital camera, watch, cellphone, etc.

Students are asked to identify what all of the items have in common.

Hint: What makes each of them work?

2. The teacher introduces the topic of batteries – a power source that converts chemical energy into electrical energy. The batteries are removed from each item for the students to see. The teacher provides a brief overview of how batteries work, and characteristics of each. (See *Battery Background Information*.)



BATTERY BASICS

3. Students are placed into small groups to visit four or five separate battery stations. At each station, students are asked to examine a different type of battery, sketch it, label characteristics, and identify what type of battery they are examining. (*Worksheet 1a Battery Stations*) Each student will need a copy of the worksheet for each station.
4. Students discuss findings as a class.
5. Students are told that in the next lesson they will be discussing batteries that are primary (non-rechargeable) and secondary (rechargeable). In preparation, they are asked to complete the *Household Survey* (*Worksheet 1b*), which asks them to keep track of what types of items in their household require batteries and the number of batteries each item requires.

Please request that students do not fill in the totals at the bottom of the sheet.



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Battery Basics (Lesson 2)

Introduction

In this lesson students calculate the number of batteries used in their households and consider the benefits of using secondary batteries as opposed to primary batteries. Students then discuss the environmental hazards of batteries and how they can be recycled when they are no longer in use. Extended activities provide students with the opportunity to promote the recycling of batteries.

Procedure

1. Students are asked to share their completed Household Surveys. What were some examples of items they found? (After sharing examples, students may choose to add additional items to their surveys.)
 - Students are then asked to add up the total number of batteries listed. What was their total number? How many of the batteries they listed were primary and secondary?
 - Students are asked to share their numbers with others. What is the total number of batteries from each household in the class? What is the total number of primary and secondary batteries in the class? Is it possible to estimate how many primary and secondary batteries might be in each household in the school?
2. As a supplementary math activity, students might create a bar graph or a pie chart depicting the number of primary and secondary batteries found in their households, or found in the entire class.
3. The purpose of these estimates is to get students thinking about the number of batteries used in each household and what happens to them when they are discarded. In what ways might using secondary batteries help limit the number of batteries thrown away?
 - Is it better to have families use primary or secondary batteries? Why or why not? (Students might create a list of reasons for and against.)
 - How do we safely dispose of batteries?
4. Share with students Canadian statistics of battery disposal and the dangers of throwing batteries into the garbage and/or landfill.
 - Some types of batteries may employ toxic materials, such as lead, mercury and cadmium.
 - When each battery no longer works it must be disposed of properly to prevent environmental damage.
 - Batteries are a form of electronic waste (e-waste).
 - According to a 2007 report by Environmental Canada, by 2010, Canadians will have thrown away over 495 million batteries, all which could have been recycled.
 - Inside landfills these batteries may leak hazardous materials into the soil, which can eventually make their way into water systems. This could pose a health risk to local citizens.



- According to the report, only 2 per cent of batteries are recycled. Recycling facilities can separate these metals, and use the material to create new batteries or other metal products.

Extended activities

How can recycling or using secondary batteries help? How can students make a difference?

Students are divided into groups to explore the following:

a. What does your school have in place?

Does your school have a battery recycling program? If so, who has organized the program? How does it work? What happens to the batteries once they are recycled? Create an advertising campaign for the program. Consider posters, advertisements, video or digital productions.

b. How can we start a battery recycling program?

If there is no program in place, start your own! Find out who to contact and how it works. How will you advertise it around the school? Consider posters, advertisements, video or digital productions.

c. Create a Battery Summary Guide for families on battery use

What are some tricks to make batteries last longer? Should families use primary or secondary batteries? Why or why not? How should families dispose of their batteries? Prepare your guide to be distributed to families throughout the school.

d. Create your very own Community Battery Recycling Guide

Where can we take batteries for recycling in our community? Research locations and create a Guide that can be distributed to families in your classroom.

e. Primary/Secondary Battery Life Expectancy

As a further classroom extension activity, once students are working on their projects, they can conduct an experiment to compare the overall life expectancy and cost of non-rechargeable versus rechargeable batteries.

- The teacher will need two same-volt, non-rechargeable and rechargeable batteries, and two identical items, such as flashlights.
- Be sure to write down the cost of each battery, so costs can be compared.
- Turn the flashlights on and record the amount of time they remain on. (You may wish to turn them off at the end of class or end of the day.)
- The experiment will need to be conducted a number of times to determine the average life span for a non-rechargeable and rechargeable battery.



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Worksheet 1a: Battery Background Information

1. A battery gives power to items that need electricity to work

- A battery is an electrochemical device, containing two or more power cells connected electrically, so that the chemical energy is converted into electricity.
- Batteries are useful. They allow us to transport electricity and use electronic items in locations where there are no electrical outlets, such as parks, beaches, etc.



2. Terminals

- In a battery, each cell that stores the electrical energy in a chemical state has two electrodes that react with the chemical and each other to release energy.
- The battery's two metal ends are called terminals.
- Usually one terminal is flat (negative end or -) and the other is button-shaped (positive end or +).

3. Primary and secondary

- Although there are many different kinds, shapes and sizes of batteries, they can be put into two large categories:

- Primary batteries*
- Secondary batteries*

A. *Primary batteries* (non-rechargeable or disposable). They are used and then discarded. Common examples are alkaline batteries used for flashlights.

B. *Secondary batteries* (rechargeable) can be discharged and recharged multiple times. Examples include the lead-acid batteries used in cars and lithium ion batteries used for portable electronics, such as iPods.

4. Casing

- All rechargeable batteries have a connection from the positive electrode to the positive terminal. The negative terminal is usually the case that contains the chemicals. The case is important because it keeps the chemicals from leaking out.



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5. Main parts

Each battery consists of four main parts:

- A. Positive electrode
- B. Negative electrode
- C. Electrolyte – a paste-like substance or solution that contains charged particles that can move or conduct an electric current.
- D. Separator – material that provides separation and insulation.

6. Circuits and currents

- Electricity created by a battery consists of a stream of tiny invisible particles, called electrons, flowing from one metal end of the battery to the other metal end – just like a liquid.
- The path it follows is called a *circuit*. When electricity flows in a circuit, it is called a *current*.
- Electricity only flows when it can go from one terminal to another. The positive and negative electrodes must have a pathway or circuit to follow.
- When the circuit is complete, electricity flows from an area of high electrical potential to one of low potential. The difference in electrical potential makes the electricity move.

7. Conductors and insulators

- Electricity can flow through some things, but not through others. Materials that allow electricity to flow through it are called *conductors*.
- Metals usually make good conductors. If electricity cannot flow through the material, it is called an *insulator*.

8. Volts

- All batteries have a number followed by the letter “V”. The “V” stands for volts.
- A volt is an electrical unit that measures the potential difference between two points in an electrical circuit.
- The *voltage* number is the number of volts in a battery. It explains how hard electrons are being pushed through the circuit from an area of high electrical potential to one of low potential.
- Batteries with higher numbers have a higher strength. You can make voltage stronger by using several batteries.



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Worksheet 1b: Battery Station

Name _____

Station _____

Battery _____

Primary or secondary _____

Draw your battery and label the following:

+ terminal

- terminal

number of volts

size/kind or make

Summary:



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Worksheet 1c: Household Survey

What items in your home operate on batteries? How many batteries are in each item? Are the batteries rechargeable? Complete the following survey

Household item	How many batteries?	Rechargeable? (Yes or No)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
	Total number of batteries:	Rechargeable = Non-rechargeable =



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