Grade 6
Electricity & Electrical Devices
Mini-Unit on Batteries

Overview

This mini unit was developed to be a part of your Grade 6 science unit on the **Electricity and Electrical Devices**. It was envisioned as a continuous flow of lessons. However you may feel free to pick and choose or rearrange the lessons in any order to suit the needs of your classroom. Every effort was made to cite any external sources referenced. If I have missed any please let me know and I will make every effort to rectify the problem.

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Lesson #1 - A Life Without Electricity

Ontario Curriculum connections:

Science:

Electricity and Electrical Devices:

The Big Ideas

3. Electrical energy plays a significant role in society, and its production has an impact on the environment.

Specific Expectations

3.8 - **Describe** ways in which the use of electricity by society, including the amount of electrical energy used, has changed over time.

Language:

Writing:

1.1 - **Identify** the topic, purpose, and audience for a variety of writing forms
1.2 - **Generate** ideas about a potential topic and **identify** those most appropriate for the purpose.
2.5 - **Identify** their point of view and other possible points of view; **determine**, when appropriate, if their own view is balanced and supported by the evidence; and **adjust** their thinking and expression if appropriate.

Activation:

- Break the class into groups of 4-6 students and give each group a piece of chart paper and some markers.
- Ask each group to list as many things as they can think of that they use in their lives that require electricity to work.
- Give the groups about 10 minutes to compile their lists.
- Discuss how pervasive the the use of electricity is in our world and culture.
- What if we didn't have electricity? What would life be like?

Activity:

- The students will write a diary or journal entry about a day in their lives if there was no electricity.
- Discuss with the class how would their morning routine might differ from now? Their method of getting to school? How would their school day be different? What would they do after school for entertainment? How would they communicate with friends?
- Jot some of their ideas on the board or chart paper to give the students some ideas for their writing.
- Appendix 1.1 Journal Page. marking Rubric Appendix 1.2

Consolidation:

- You could have some students volunteer to read their journal entries.
- Another approach could be to ask the students what they think their grandparents did after school. How did they talk to friends? What did they do for fun? You can have them fill out an

interview form (Appendix 1.3) to report back to class how their grandparents dealt with less electronic technology in their lives. This can be taken up and discussed at a later date when time permits.

Lesson #2- How Batteries Work

Ontario Curriculum connections:

Science:

Electricity and Electrical Devices:

The Big Ideas

1. Electrical energy can be transformed into other forms of energy.
3. Electrical energy plays a significant role in society, and its production has an impact on the environment.

Specific Expectations

2.1 - **Follow** established safety procedures for working with electricity.
2.5 - **Use** technological problem-solving skills to **design**, **build**, and **test** a device that transforms electrical energy into another form of energy in order to perform a function.
2.6 - **Use** appropriate science and technology vocabulary, including current, battery, circuit, transform, static, electrostatic, and energy, in oral and written communication.
3.6 - **Explain** the functions of the components of a simple electrical circuit.

Supplies

Box of pencils, D Cell batteries, flashlight bulbs or LEDs, electrical wire, tape

Activation:

- Read or have the students read the first 2 paragraphs on Appendix 1.4.
- As a whole group make a circle in the classroom. Have all of the students place their right hand over their neighbour's left hand.
- You will represent the battery and will begin by taking a pencil and with your right hand, swing your arm to the right so that your right hand comes to rest on your neighbours left hand. They in turn will, with their right hand, grab the pencil from you and swing it over to their partner's left hand. The left hands will not grab the pencil but just act as a target for their neighbours right hand.
- NO-ONE may hold more than 1 pencil at a time.
- The students are to continue passing the pencil(s) around the circle (circuit) in this manner until the pencils return to you, the battery.
- At some point create a break in the circle and ask the students why the pencils have stopped moving
- As the battery, continue to add new pencils until they get back to you around the circle.
- Explain to the students that the pencils are electrons that are coming out of the battery and flowing along a wire, the students, in a circuit, the circle they have formed. The electrons go all the way around and return to the positive terminal of the battery.
- Make sure to discuss the following terms in relation to the circuit activity above so that the students can answer the questions on the worksheet. (Appendix 1.4)
    - **Electricity** is a form of energy caused by charged particles (electrons)
    - **Electric Current** is the flow of the electrons
    - An **Electric Circuit** is a path that electrons flow along.

Activity:

- See Appendix 1.4 Part II

Consolidation:

- Ask some students to share their diagram of how they lit their bulb and to explain it using the terms learned today, **Electricity**, **Current**, and **Circuit**.

Lesson #3- Vinegar Battery (or Lemon)

Ontario Curriculum connections:

Science:

Electricity and Electrical Devices:

The Big Ideas

1. Electrical energy can be transformed into other forms of energy.

Specific Expectations

2.1 - **Follow** established safety procedures for working with electricity.
2.2 - **Design** and **build** series and parallel circuits, **draw** labelled diagrams identifying the components used in each, and **describe** the role of each component in the circuit.
2.5 - **Use** technological problem-solving skills to design, **build**, and **test** a device that transforms electrical energy into another form of energy in order to perform a function.
2.6 - **Use** appropriate science and technology vocabulary, including current, battery, circuit, transform, static, electrostatic, and energy, in oral and written communication.
2.7 - **Use** a variety of forms (e.g., oral, written, graphic, multimedia) to **communicate** with different audiences and for a variety of purposes.
3.5 - **Identify** ways in which electrical energy is transformed into other forms of energy.
3.6 - **Explain** the functions of the components of a simple electrical circuit.

The reason I've chosen a vinegar battery over lemons is twofold. One it provides more voltage to light up an LED. Second, vinegar is pretty darn cheap, and if you plan on using this lesson year over year, you can reuse all of the equipment. As a bonus it should be less messy as well.

Supplies:

1. At the Dollar Store I found several **containers** for holding the **vinegar**.

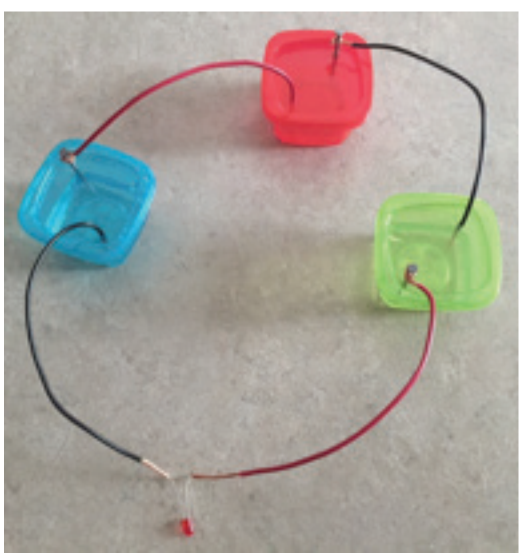

I found that the pack of 6 Food Containers for $1.50 worked the best since the lids seal in the vinegar, cutting down on messes, compared to the little red Shot Glasses, and they were also much less costly to get a class set than the Spice Jars.

2. The most expensive items were the **LEDs**, which can be had for $1.99 each at Radioshack. If your school has old flashlight bulbs those can work as well, but their voltage specifications vary widely and if you get one with too high a voltage rating the vinegar or lemon batteries simply will not light them up.


3. **Wires and Galvanized nails**. Most schools have copper wire around in the science supply area. Or ask around with staff. Someone is bound to have some left over from a remodel or from an old surround sound set up. I found that while 12 gauge solid copper wire (on the left in the picture) worked fine it was a bit stiff for kids to manipulate and could cause spilt vinegar as students adjusted the wires to hook up the parts of the battery. Instead I much preferred the 14 gauge stranded copper wire (speaker wire, on the right). It was much more malleable for the kids to work with and to wrap around the galvanized nails.

<u>Preparation</u>:

- Poke 2 holes into the lid of the plastic containers at opposing corners.
- Strip about 3-4 cm of the plastic casing off the ends of the wires.
- Fill each container with enough vinegar so that the nails and the wire can both be sitting in it when the students insert them through the lid.
- Each group will need **3 containers, 3 nails, 4 wires, and 1 LED**.
- The finished battery will look something like this.



<u>Activation</u>:

- Have students explain what they learned in the previous lesson regarding the flow of electrons. Encourage them to draw a picture on the board.
- When the class has been reminded about the the concepts of **electricity**, **current**, and a **circuit**, explain that a battery uses the same principles to provide power to all of their favourite devices. Add a lightbulb to their circuit drawing and label it the **load**. Explain that anything that you want to power with electricity is called the **load**.
- Draw a picture of a battery on the board/chart paper. Label the top with a **positive sign**, the bottom with a **negative sign**, and the middle of the battery with the word **electrolyte**.

<u>Activity</u>:

- Divide the class into small groups and hand out the 3 containers, 3 galvanized nails, 4 wires, and the LED to each group.
- Explain to the students that they now have all the part they need to make a battery that will light up the LED. A **positive terminal**, a **negative terminal**, an **electrolyte**, and the **load** (LED)
- Their challenge is to connect the parts to create an **electrical circuit** to deliver the **electrical current** to the **load** or LED.
- Allow them to experiment and even discuss any challenges with other groups if need be.

<u>Consolidation</u>:

- Each group will draw the completed working battery and circuit that they created to light the LED, and explain how the LED is being lit up from the battery using the provided worksheet (Appendix 1.5)
- If needed have a group explain their battery circuit and how it works to the class to help any groups who are struggling to explain what is happening in their circuit.

<u>Possible Extension</u>

- If you chose to go deeper into the working of a battery you can pull the class back together and discuss how the electrons gather at the negative terminal (galvanized nail), but since there are so many they are over crowded. As with most things in nature they want to be balanced. Some of the electrons want to go to the positive terminal (copper wire), as there are far fewer electrons there. There is a problem however. The electrons can't get back through the electrolyte. By creating your circuit with the wires you are giving the electrons a path back to the positive terminal. Your LED is in the middle of that path so as the electrons pass through it they light it up. This is how we use electricity, the flow of electrons, to power just about anything that we want.

Lesson #4 - History of the Battery

Ontario Curriculum connections:

Science:

Electricity and Electrical Devices:

The Big Ideas
2. Other forms of energy can be transformed into electrical energy.

Specific Expectations
3.8 - **Describe** ways in which the use of electricity by society, including the amount of electrical energy used, has changed over time.

Language:

Reading:

1.1 - **Read** a wide variety of texts from diverse cultures, including literary texts, graphic texts, and informational texts.
1.3 - **Identify** a variety of reading comprehension strategies and **use** them appropriately before, during, and after reading to understand increasingly complex texts.
1.4 - **Demonstrate** understanding of increasingly complex texts by summarizing and explaining important ideas and citing relevant supporting details.
1.8 - **Make** judgements and draw conclusions about ideas in texts and **cite** stated or implied evidence from the text to support their views.

Writing:

1.3 - **Gather** information to support ideas for writing, **using** a variety of strategies and a range of print and electronic resources.
2.5 - **Identify** their point of view and other possible points of view; **determine**, when appropriate, if their own view is balanced and supported by the evidence; and **adjust** their thinking and expression if appropriate.

Activation:

- Remind the class what they have learned and accomplished so far in this unit.
- Ask them how long ago they think batteries might have been invented. Take some guesses and put them on the board. Show them this link to a battery from about 2000 years ago.
  http://batteryuniversity.com/learn/article/when_was_the_battery_invented
- Discuss the parts and connect it to their vinegar battery and its parts.

Activity:

- Tell the class that while we have discovered possible batteries from that far back we don't really know much about how they were used or what they were used for. Instead they will be looking at the more modern and documented history of the battery.
- Instruct the students to summarize the contributions of each scientist on the provided website on their worksheet (Appendix 1.6). Once completed they are to decide which one of the scientists, in their opinion, had the most important contribution to the development of the modern battery.

- You can allow the students to view this webpage on the internet in the lab, on netbooks, or iPads depending on your schools available technology. You could also cut and past each scientists writeup onto a single document file. I will leave the last option up to you just to avoid any copyright issues for this unit.
  http://www.batteryfacts.co.uk/BatteryHistory/index.html

Consolidation:

- Have some students share which scientist they felt made the most important contribution to the development of the modern battery.
- Allow them to debate and defend their and their classmates choices.

Lesson #5 - Regular vs. Rechargeable Batteries

Ontario Curriculum connections:

Science:

Electricity and Electrical Devices:

The Big Ideas

3. Electrical energy plays a significant role in society, and its production has an impact on the environment.
4. Society must find ways to minimize the impact of energy production on the environment.

Specific Expectations

1.2 - Assess opportunities for reducing electricity consumption at home or at school that could affect the use of non-renewable resources in a positive way or reduce the impact of electricity generation on the environment.

Math:

Number Sense and Numeration:

Overall Expectations

Solve problems involving the multiplication and division of whole numbers, and the addition and subtraction of decimal numbers to thousandths, using a variety of strategies.

Specific Expectations

- Solve problems involving the multiplication and division of whole numbers, using a variety of tools (e.g., concrete materials, drawings, calculators) and strategies.
- Use estimation when solving problems involving the addition and subtraction of whole numbers and decimals, to help judge the reasonableness of a solution.
- Represent relationships using unit rates.

Activation:

- Show the students an old incandescent bulb, or a picture if you can't find one, and a new CFL bulb.
- Ask the class which ones they have (more of) in their houses. Why?
- If the students do not come up with the ideas of cost or life of the bulb, try to lead them toward those answers.
- Explain that while the CFLs do cost more they last so much longer that the upfront cost is offset over the life of the bulb by not having to buy as many replacement bulbs.

Activity:

- Tell the students that there is much debate over whether rechargeable batteries are actually a good way to save money over non-rechargeable ones. While the idea of needing to use fewer resources to keep making replacement batteries and instead being able to recharge batteries is a great one we need to check the numbers. While saving the Earth's natural resources may be enough of a reason to convince some people that rechargeables are the way to go, some people only worry about how much it will cost them. If we want to convince those people that rechargeable batteries are the way to go, we will need to convince them that it is actually cheaper to pay more at the start when they buy the rechargeable batteries.

- Split the class into groups of 2 and give each pair a copy of the question data (Appendix 1.7), a piece of chart paper, and some markers.
- Depending on your class and their ability you can choose to include the table (Appendix 1.8) that has the numbers organized for the students or you could choose to leave that out and let them organize the data themselves

<u>Consolidation</u>:

- Here you could have the students explain their methods of understanding and solving the problem with a math congress or bansho.
- You might also want to discuss t he expensive initial cost of going the rechargeable route and what barriers that may put up in stopping low income families from actually saving money by using rechargeable batteries.

Appendix 1.1

My Journal

Date: ______________

Ontario Schools
BATTERY
RECYCLING
CHALLENGE

Appendix 1.2

No Electricity Journal Rubric

CATEGORY	4	3	2	1
Format	Complies with all the requirements for a Journal entry.	Complies with almost all the requirements for a Journal entry.	Complies with several of the requirements for a Journal entry.	Complies with less than 75% of the requirements for a Journal entry.
Ideas	Ideas were expressed in a clear and organized fashion. It was easy to figure out what the entry was about.	Ideas were expressed in a pretty clear manner, but the organization could have been better.	Ideas were somewhat organized, but were not very clear. It took more than one reading to figure out what the entry was about.	The entry seemed to be a collection of unrelated sentences. It was very difficult to figure out what the entry was about.
Sentences & Paragraphs	Sentences and paragraphs are complete, well-constructed and of varied structure.	All sentences are complete and well-constructed (no fragments, no run-ons). Paragraphing is generally done well.	Most sentences are complete and well-constructed. Paragraphing needs some work.	Many sentence fragments or run-on sentences OR paragraphing needs lots of work.
Grammar & spelling (conventions)	Writer makes no errors in grammar or spelling.	Writer makes 1-2 errors in grammar and/or spelling.	Writer makes 3-4 errors in grammar and/or spelling	Writer makes more than 4 errors in grammar and/or spelling.
Capitalization and Punctuation	Writer makes no errors in capitalization and punctuation.	Writer makes 1-2 errors in capitalization and punctuation.	Writer makes 3-4 errors in capitalization and punctuation.	Writer makes more than 4 errors in capitalization and punctuation.

Appendix 1.3

Grandparent Interview

How did you keep in touch with friends without cell phones, email, Twitter, Facebook, etc.?

What did you do for fun with your friends after school or on the weekends?

How did you study for tests and complete assignments?

Electric Circuits

Name:___________________________

Electricity -- we depend on it every minute of every day. And yet to many of us, electricity seems a mysterious and even magical force. Before Ben Franklin did his famous and very dangerous kite flying experiment, electricity was thought to be a type of fire. In 1847, the year Thomas Edison was born, most people considered electricity to be some sort of dangerous fad. By the time Edison died in 1931, entire cities were powered by electricity.

Although it has been used as an energy source for over 100 years, many people don't understand the basic principles of electricity. In this lesson, we will begin to develop an understanding of electrical current. First we will act out an electric circuit:) Then we will use our critical thinking skills and deductive reasoning to create our own electric circuits using a few simple materials!

1. What is electricity?

2. What is electrical current?

3. What is an electric circuit?

Part I : Act it Out Draw what we did:)

GRADE 6 ELECTRIC CIRCUIT

Teacher- battery
Students - wire conductor
Circle = Circuit
Pencils - Electrons inside wire conductor (students)

I was playing the part of a battery in this circuit and all batteries have a positive end, represented by our left hands, and a negative end, represented by our right hands. We passed the “electron” to the person on our right. The student receiving the “electron” in turn passed the one he or she was holding to the right. We continued passing the electrons to the person on our right. Because electrons share the same negative charge, they repel one another, which keeps them moving along in the same direction. The flow of electrons through a conductor is called electrical current.

As long as the circle remains intact and the electrons continue to flow, our circuit is closed. To illustrate what happens when a circuit breaks or opens, we would create a gap in our circle that is too wide to pass electrons. The current would stop as a result.

Part II - Light a Bulb

You are now going to apply what you have learned about circuits to a light bulb. You will receive 2 lengths of wire (with the ends stripped), a flashlight bulb, a D-cell battery, and some tape. Use your CRITICAL THINKING SKILLS and TRIAL AND ERROR to get your bulb to light. Draw a diagram of your circuit making sure you include ALL of its parts.
SAFETY NOTICE Exploring electricity is safe as long as it is done with low-voltage batteries (such as D-cell) and under adult supervision. Never experiment with electricity from a wall outlet. Doing so can be fatal.

Did you get the bulb to light?

In what order did you connect the parts?

How did you know that electricity flowed?

What happened if the circuit was broken, that is, if there was a gap in the circuit?

APPENDIX 1.5

Creating a Battery

1. Draw and label the completed battery and circuit that you and your group built.

2. Explain how your battery works. Be sure to include the electrical terms that we have learned, including **electrons**, **current**, **circuit**, and **load**.

Appendix 1.6

The History of the Battery

Summarize the contributions of each scientist to the creation of the modern battery.

Luigi Galvani: ______________________________

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Alessandro Volta: ______________________________

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William Sturgeon: ______________________________

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John Daniell: ______________________________

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Gaston Planté: ______________________________

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Georges Leclanché:

Carl Gassner:

Waldmar Jungner:

Thomas Alva Edison:

Samuel Ruben:

Lew Urry:

In your opinion which of the above mentioned scientists made the most important contribution to the development of the modern battery. Provide evidence for your reasoning as to why your choice is better than the other scientists.

Ontario Schools BATTERY RECYCLING CHALLENGE™

Rechargeable vs. Non-Rechargeable Batteries

The average family in North America uses about 90 batteries per year. These can mainly be found in Remotes, clocks, toys, phones, wireless mice and keyboards, wii remotes, baby monitors, toothbrushes, cameras, and battery-powered decorations for Hallowe'en and Christmas.

Lets say we need about 30 batteries at any one time, some needing to be replaced more often (Wii remotes) than others.

When shopping I don't want to pick the cheapest things because they will probably not last as long requiring me to replace them even more often. I will therefore buy brand name batteries.

On amazon.ca I found a pack of 24 Duracell AA batteries for $17.87. If we go by the average of 90 batteries per year we will need to buy 4 of these packages to get us through the year.

On the rechargeable side I will need a good charger that will turn itself off and not shorten the life of the rechargeable batteries. The best value that I found came with an auto shut-off to prevent overcharging and also comes with 4 Duracell batteries and costs $24.97.

I found Rechargeable Energizer batteries at a price of $14.25 for a pack of 4. Since we need 30, but I'd like to have an extra set of 2, so I don't have to wait for some to recharge when others wear out, we'll get 7 packs plus the 4 in the charger to make it 32 batteries in total.

OH YES!! I almost forgot. Electricity for recharging the batteries also costs money. Using the average cost of electricity in Ontario the cost of charging the batteries over a 1 year period will be about $0.24.

<u>Think!!!   What costs are recurring and what costs are not</u>

Your job is to determine at what point in time the rechargeable batteries become cheaper to use than non-rechargeable batteries.

Appendix 1.8

Items	Cost
4 packs of 24 non-rechargeable batteries	$17.87 per pack
1 Charger and 4 rechargeable batteries	$24.97
7 Packs of 4 rechargeable batteries	$14.25 per pack
Cost of electricity to charge the batteries over 1 year.	$0.24

Items	Cost

Appendix 1.9

Quiz

1. Pick a side, pro or con, where rechargeable batteries are concerned. Use information learned in class and your own ideas to present evidence and argue for your chosen point of view.

2. Draw and label a diagram of a vinegar battery powering a light or other load device.

3. Describe how life has changed since the widespread availability of electricity and portable batteries. Use examples learned in class and from your own life.