LESSON TITLE: ELECTRICITY (PART 1)

TOTAL TIME: TWO 60-MINUTE PERIODS

BRIEF DESCRIPTION

In the first class, students will watch *The House That STEM Built: Electricity* video. This video introduces Ohm's law and how to solve for current, voltage, and resistance. The lesson plan provides specific points for the students to stop and practice using the Ohm's law equation. The first lesson is followed by an exit slip that the teacher can use as a formative assessment tool. In the second class, students will complete Kinulations (Kinesthetic Simulations) to demonstrate circuits.

CURRICULUM OUTCOMES

Taken from the pre-2020 New Brunswick Grade 9 Science curriculum. This lesson also applies to the Electric Circuits section of the Physics 12 course.

GENERAL CURRICULUM OUTCOMES

Understanding the flow of electricity through different circuits.

SPECIFIC CURRICULUM OUTCOMES

308-16: Describe the flow of charge in an electrical circuit.

308-17: Describe series and parallel circuits involving varying resistance, voltage, and current.

308-18: Relate electrical energy to domestic power consumption costs.

NEW BRUNSWICK GLOBAL COMPETENCIES ACHIEVED[1]

- Critical Thinking and Problem-Solving
    - Learners engage in an inquiry process to solve problems, as well as acquire, process, interpret, synthesize, and critically analyze information to make informed decisions.
    - Learners see patterns, make connections, and transfer their learning from one situation to another, including real-world applications.
    - Learners solve complex problems by taking concrete steps to design and manage solutions.

LEARNING OBJECTIVES

The learner will be able to

- use Ohm's law to solve for current, voltage, and resistance.

MATERIALS

- Loose leaf.
- Pencil or pen.
- Calculator.
- Whiteboard markers.
- "Electricity Exit Slip" handout.

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1 https://www2.gnb.ca/content/dam/gnb/Departments/ed/pdf/K12/curric/competencies/NBCompetencies.pdf?fbclid=IwAR1ldrZs1gFgiNm8rC4oz7Fmx6mSn-6t_QJkenev0eD33rZ-foYYn6bmdmc *also available at* https://tinyurl.com/nb-competencies

BEFORE CLASS

Print one copy of the "Electricity Exit Slip" handout for each student.

WARM-UP: 10 MINUTES

To get students thinking about electricity, write the following two questions on the board.

→ When do you use electricity?

→ What things use electricity in our homes?

Give students approximately **5 minutes** to write a response to each question. After the desired amount of time is given, ask for students to volunteer to share their answers to each question. Possible answers to the question, "when do you use electricity?" could include

→ watching TV,

→ charging my phone, and

→ making food.

Possible answers to the question, "what things use electricity in our homes?" could include

→ oven,

→ fridge,

→ lights/lamps, and

→ doorbell.

Alternative: If students are able to use technology in the classroom, a Jamboard could be used for students to post their answers for the class to see. The Jamboard can then be saved for future use.

ACTIVITY: 45 MINUTES

Start watching *The House That STEM Built: Electricity* video. Feel free to pause the video and ask some or all of the following open-ended

questions to prompt discussions.

- 1:55 – Have students copy the definition of **electricity** in their notes.
- 2:22 – Have students write out a definition for **dynamic electricity**. This activity should last approximately **5 minutes**.
    - Since there is no direct definition of dynamic electricity written in the video, ask students to come up with their own definition based on the information verbally shared in the video.
    - After a few minutes, ask students to share what they wrote down.
    - After a few students have shared their own definitions, work together as a class to create a final definition.
    - Take this final definition and copy it on the whiteboard so that students who are struggling to write their own can have something to copy.
    - A good definition that the teacher can use is, “dynamic electricity occurs when electric charges circulate inside a conducting pathway.”
- 2:36 – Have students copy the definitions of **conductor** and **conductivity** in their notes.
- 2:47 – Have students write out a definition of **resistors** in their notes. This activity should last approximately **5 minutes**.
    - Since there is no direct definition of resistors written in the video that students can copy from, ask students to come up with their own definition based on the information verbally shared in the video.
    - After a few minutes, ask students to share what they wrote down
    - After a few students have shared their own definition, work together as a class to create a final definition
    - Take this final definition and copy it on the whiteboard so

that students who are struggling to write their own can have something to copy.

- A good definition that the teacher can use is, “a resistor is an object that reduces or limits the flow of electricity through the circuit.”

- 4:02 – pause the video and ask the class two check-in questions.
  - How many types of electrical circuits are there and what are they called? Answer: two—series and parallel.
  - Why are resistors shown as jagged lines? Answer: to show that this is a more difficult pathway for electricity to flow.
  - Having the check-in point helps to see if the students are following along with the video and activities.
- 4:08 – Have students copy the diagram for a parallel circuit in their notes.
- 4:41 – Have students copy the equation for Ohm’s law in their notes.
- 6:00 – Have students draw the diagram with the values in their notes. After students have the diagram drawn, they should solve for the current.
  - The equation for Ohm’s law will need to be rearranged. After a few minutes of students trying to solve for the current, write the proper rearranged equation on the board for students who may be struggling to solve the problem.

$$I = V/R$$

- 6:42 – Have students copy in their notes the equation when two resistors are present and connected in parallel.
- 10:05 – Solve the question, “how many lightbulbs would be needed to exceed 15 A?” This activity should last approximately **7 minutes**.
  - After a few minutes, write the rearranged formula that needs to be used on the board for students who may be

struggling.

$$R = V / I$$

- 11:50 – Have students continue solving for how many light bulbs are needed to reach the 15 A maximum.
  - During the previous step, students determined that $R = 8\ \Omega$.
  - However, students need to use that value and the $1/R$ equation shown in the video to solve for the number of light bulbs needed to create 8 Ω of total resistance.
- 12:27 – Have a class discussion on ways that you can save power. This activity should last approximately **7 minutes**.
  - Ask for students to raise their hands to volunteer an answer.
  - As students are sharing their answers, write them on the whiteboard.
  - Alternative: If students are able to use technology in the classroom, a Jamboard could be used for students to post their answers for the class to see. The Jamboard can then be saved for future use.
  - Once you start playing the video again, the video will provide examples. Have the student make their lists visible so students can see if any of the examples mentioned in the video were the same examples mentioned in class.
- 13:21 – Have students solve the cost of electricity for the homeowners in their notes.
  - After a few minutes, write the formula on the board for students who may be struggling to get started.

$$\textit{Monthly cost} = \textit{rate} \times \textit{electricity used}$$

- 13:38 – Have students convert the cents to dollars.

CONCLUSION: 5 MINUTES

Hand out the "Electricity Exit Slip" handout to each student. Students will write one paragraph for the final question in the video, "what do you think the world would look like without electricity?"

Students will hand in this slip to the teacher at the end of the class. The teacher can use this exit slip as a formative assessment tool

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DIFFERENTIATION

CONTENT

Use *The House That STEM Built: Electricity* video to also introduce series circuits. The video uses parallel circuits, but series circuits could also be used to teach the equation of Ohm's law.

PRACTICE

While students are solving math questions involving Ohm's law throughout the video, they can work in pairs/groups.

PRODUCT

The exit slip can be adjusted depending on students. Some students may only be able to write a few sentences while others could potentially write a minimum of two paragraphs. The final length of the exit slip can be decided by the teacher.

EXTENSION

After students have written a response for the exit slip. The teacher can take time to discuss some of the responses.

ELECTRICITY EXIT SLIP

Name: _____ Class: _____ Date: _____

DIRECTIONS

Write a 1 paragraph response to the following question.

→ What do you think the world would look like without electricity?

LESSON TITLE: ELECTRICITY (PART 2)

TOTAL TIME: TWO 60-MINUTE PERIODS

BRIEF DESCRIPTION

In this second class, students will complete a Kinulation demonstrating the movement of electricity in a parallel and series circuit. A Kinulation is a kinesthetic simulation. Students will be moving their bodies in order to demonstrate the concept of electricity moving in circuits.

CURRICULUM OUTCOMES

Taken from the pre-2020 New Brunswick Grade 9 Science curriculum. This lesson also applies to the Electric Circuits section of the Physics 12 course.

GENERAL CURRICULUM OUTCOMES

Understanding the flow of electricity through different circuits.

SPECIFIC CURRICULUM OUTCOMES

308-16: Describe the flow of charge in an electrical circuit.

308-17: Describe series and parallel circuits involving varying resistance, voltage, and current.

308-18: Relate electrical energy to domestic power consumption costs.

NEW BRUNSWICK GLOBAL COMPETENCIES ACHIEVED[2]

- Critical Thinking and Problem-Solving
  - Learners engage in an inquiry process to solve problems, as well as acquire, process, interpret, synthesize, and critically analyze information to make informed decisions.
  - Learners see patterns, make connections, and transfer their learning from one situation to another, including real-world applications.
  - Learners solve complex problems by taking concrete steps to design and manage solutions.
  - Learners formulate and express questions to further their understanding, thinking, and problem-solving.
- Innovation, Creativity, and Entrepreneurship
  - Learners formulate and express insightful questions and opinions to generate novel ideas.
  - Learners take risks in their thinking and creating; they discover through inquiry research, hypothesizing, and experimenting with new strategies or techniques.
  - Learners seek and make use of feedback to clarify their understanding, ideas, and products.
  - Learners enhance concepts, ideas, or products through a creative process.
- Collaboration
  - Learners learn from and contribute to the learning of others by coconstructing knowledge, meaning, and content.

2 https://www2.gnb.ca/content/dam/gnb/Departments/ed/pdf/K12/curric/competencies/NBCompetencies.pdf?fbclid=IwAR1ldrZs1gFgiNm8rC4oz7Fmx6mSn-6t_QJkenev0eD33rZ-foYYn6bmdmc *also available at* https://tinyurl.com/nb-competencies

LEARNING OBJECTIVES

The learner will be able to

→ demonstrate the flow of electricity in a parallel and series circuit.

MATERIALS

→ Pencil or pen.

→ Loose leaf.

BEFORE CLASS

The teacher should gather all the materials needed for the Kinulation. The materials needed are listed in the attached lesson plan titled Series and Parallel Circuits.

WARM-UP: 15 MINUTES

Show students the full *The House That STEM Built: Electricity* video. This will be the second time they have viewed the video. Ask students if there are any questions about electricity, the equation used, and circuits.

ACTIVITY: 40 MINUTES

Students will complete a Kinulation to demonstrate the movement of electricity in a circuit.

The lesson plan outlining the Kinulation directions is attached to this document, titled Series and Parallel Circuits.

CONCLUSION: 5 MINUTES

Generate a class discussion using the final questions listed in the lesson plan for the Kinulation.

DIFFERENTIATION

CONTENT

The House That STEM Built: Electricity video focuses on parallel circuits. While doing the Kinulation, the teacher can also take the time to introduce series circuits.

PRACTICE

Depending on class size, two different groups can perform the Kinulation. One group can organize themselves as a parallel circuit and the other group can organize themselves as a series circuit.

PRODUCT

Ensure that each student has participated in each type of circuit.

EXTENSION

While students are completing the Kinulation, the teacher can provide values such as amps, volts, and ohms. The students can take these values and solve for a missing value.

The teacher can extend the electricity lesson for a third day and complete one of the other two Kinulations about electric circuits that can be found here https://www.kinulations.com/.

LESSON TITLE: SERIES AND PARALLEL CIRCUITS **CLASS SIZE: 24**

CLASS: GRADE 9 SCIENCE **TIME: 60 MINUTES**

CURRICULUM OUTCOMES

308-16: describe the flow of charge in an electrical circuit.

308-17: describe series and parallel circuits involving varying resistance, voltage, and current.

LEARNING OBJECTIVES

- To familiarize students with the workings of series and parallel circuits, and to help them understand the functions of all elements involved, especially in regards to circuits, including the use of resistors (light bulbs) and switches.
- To deepen the students' understanding of ampere/current, voltage, and resistance.

MATERIALS

- See-through cups (one per student).
- Marbles/balls to represent electrons.
- Flashlights to represent resistors.
- Signs that indicate who serves as a battery and who serves as a switch.

SUGGESTIONS

Make sure that you have sufficient room to conduct this activity and provide students with real-life examples (e.g., Christmas tree lights, flashlight). During the activity, randomly take away students' cups and ask them how this interruption would affect the electrical current.

INTRODUCTION

Discuss features of electric circuits that students can recall from memory. Some possibilities include

- metal wires with electrons that flow through them (positive and negative attraction and repulsion),
- series vs. parallel circuits, and
- electron flow creates potential for work; if you have a circuit with no resistors, short-circuits.

Explain what a kinulation is (broken up into kinesthetic and simulation). Tell them that these are used to help students learn difficult concepts that are otherwise difficult to picture. It allows students to become part of the demonstration, and therefore easier to remember and learn. Ask students if they would like to try one.

ACTIVITY

1. Ask students to form a circle and hand out a cup to each student.
2. Once the students have provided some of the answers, hand out the according signs that read "BATTERY" and "SWITCH" to students, and explain that they serve as conductors.
3. Now that the students have created a series circuit, and roles have been assigned, start giving out balls to the student that represents the battery and ask for the balls to be transferred from one cup to another, following the electrical current. The teacher could also let the students figure out where the current would start, keeping in mind that the electrons are negatively

charged and are thus repelled by the negative side of the battery.

4. Explain the concept of an ampere to students and ask them what would happen if another lamp (resistor) was added to the series circuit.

    → Resistance would double and amps would decrease by half.

5. Ask students to form a parallel circuit and go over the same scenario as in #4.

    → Resistance would stay the same and all resistors would be provided with the same voltage.

CONCLUSION

Possible wrap-up questions:

- → What benefits do you see in becoming part of the demonstration of the concept?
- → Is anything clearer to you because of being involved?
- → What type of system (parallel or series) would seem most beneficial for power grids? Can you see any downfalls?

    → Costs associated with parallel are greater, but if everyone was on series, one house blowing a fuse could knock out an entire neighbourhood.