



Education 432: Secondary Principles & Practices  
Lesson Plan Template

**Science 9: Electricity Lesson 5 & 6 (& a little bit of 7)**

**Teachers' Name: Mr. Andrew Kroon**

**Grade: 9**

**Subject: Science 9**

**Topic: Electricity (Series and Parallel Circuits)**

**A. Learning Goals & Success Criteria**

Learning goals: In this lesson we hope to...

- Develop our understanding of simple circuits to adapt it to more complicated types of circuits
- Learn how to accurately draw different types of circuits
- Build on our knowledge of simple circuit building in order to build more complex circuit types
- Build on the math skills used in previous classes to calculate values from more complex questions and circuits.

Success Criteria: Success will be demonstrated by the students' ability to...

- Describe how current and potential difference act differently in series and parallel circuits
- Draw series and parallel circuits based on descriptions
- Correctly attach an ammeter or voltmeter to a circuit to measure a specific load or branch's current or potential difference.
- Calculate unknown current, voltage, and resistance values from given values from other loads and/or branches within the same circuit

**B. Lesson Outcomes**

GCOs/Competencies:

- Skills, Knowledge, and STSE

SCOs:

- Describe series and parallel circuits involving varying resistance, voltage, and current (308-17)
- Rephrase questions in a testable form and clearly define practical problems (208-1)
- Use instruments effectively and accurately for collecting data (209-3)
- Identify, and suggest explanations for, discrepancies in data (210-7)
- Identify potential sources of error and determine the amount of error in a measurement (210-10)
- Explain the importance of using precise language in science and technology (109-14)



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C. Lesson Phases	
Intro Time: 15 minutes	<b>Introduction:</b> <ul style="list-style-type: none"><li>- I would hand out the exit slips from the previous class (but I would hand each one to a different student)</li><li>- Review the questions on the slips as a class so that the students can correct their classmates' work.</li><li>- Students could then pass each other back their exit slips so they can have them to study off of or use for future assignments or quizzes/tests</li></ul>
Body Time: 35 minutes	<ul style="list-style-type: none"><li>- After running through the worksheets I would give the students a challenge<ul style="list-style-type: none"><li>• I would draw a simple circuit on the board (1 resistor, 1 battery, an ammeter, a voltmeter)</li><li>• I would give the energy the resistor uses, the amount of charge that passes through the resistor in 1 minute</li><li>• I would then ask them to find the resistance</li><li>• They could use charge and time to get current, charge and energy to get potential difference, and from there they can get resistance</li></ul></li></ul> <p style="text-align: center;">OR</p> <p>They could substitute the current and voltage equations into the resistance equation to get resistance first then the rest</p> <b>Body:</b> <ul style="list-style-type: none"><li>- Students can pair up with those around them and I would instruct them to open their chrome books and go to the following website: <a href="https://phet.colorado.edu/sims/html/circuit-construction-kit-ac-virtual-lab/latest/circuit-construction-kit-ac-virtual-lab_all.html">https://phet.colorado.edu/sims/html/circuit-construction-kit-ac-virtual-lab/latest/circuit-construction-kit-ac-virtual-lab_all.html</a></li><li>- Series circuits<ul style="list-style-type: none"><li>• Series circuits are circuits where all loads in the circuit are in one continuous loop.</li><li>• I would have them test the current in a circuit with 1 load 1<sup>st</sup>. I would then ask them if they believe the current would change if more loads were added to the circuit.</li><li>• I would then draw a series circuit with 3 loads on the board. I would ask the class if they think the current will be greater between loads 1&amp;2 or between loads 2&amp;3. I would then allow them a few minutes to build the circuit drawn on the board in the virtual lab and have them test the current at each point so they can see for themselves (it's a trick, the current will be the same across the whole circuit)</li></ul></li></ul>



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- Adding multiple loads to the same series circuit will decrease the current (because there are now more sources of resistance), however, the current will remain constant over the entire circuit as it is all one continuous path with no alternative routes.
- I would then ask, if all the loads have the same resistance, which load will have the highest potential difference. Using the same circuit they had just built I would get the students measure the potential difference across each load to test and see (also a trick, if they all have the same resistance and the same current, then they all have the same potential difference)
- If the loads have the same resistance, then they will also have the same potential difference, however, if they have differing resistances, then their potential differences will not be the same. However, the sum of each loads individual potential difference will be equal to the potential difference of the power source (if a 9V battery is used, the 9V is distributed between the loads, and the sum of each loads potential difference will be 9V)

- Parallel circuits

- Parallel circuits are circuits where loads are dispersed over 2 or more branches. So rather than one continuous loop, there are multiple loops connected to the same source.
- I would then draw a parallel circuit with 2 branches, one branch with 1 load and the other branch with 2 loads. I would ask which branch would have the greater current assuming each load has the same resistance. Then I would allow the students a few minutes to deconstruct the last circuit and build the new one and test the current of each branch. Demonstrating where to connect the ammeter to ensure they are measuring the current in the right place (the branch with only one load would have a higher current)
- Because of the different paths, the current will not be constant across the entire circuit. The current before the first fork in the road will be equal to the current when the branches all come back together.
- The sum of the current of each branch will be equal to the current before/after the branches. The way the current divides will be based on the resistance of each branch. The resistance of each branch is the sum of the resistance of the loads on the branch. I would then ask them to measure the current flowing back to the battery after the branches rejoin to test that it is in fact the sum of the branch currents.
- I would then ask the students which branch would have the greatest potential difference. I would have them connect the voltmeter and test the potential difference at each branch and I would give a demonstration



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Closing Time:  
10 minutes  
(remaining questions  
will be done as a  
start up for the next  
class)

to ensure they attach the voltmeter correctly to measure the entire branch (it's a trick both branches would have the same potential difference). The full potential difference from the battery is felt by each branch regardless of the resistance.

- I would then ask which bulb will have the greatest potential difference. I would then ask the students to measure the voltage across each bulb (it's the lone bulb with no others on the branch). This is because even though each branch is supplied with the same potential difference regardless of the resistance, the 2 bulbs on the same branch are technically in series with each other, so while these bulbs experience the same current on the branch, the potential difference is divided between the 2 bulbs, just like how the potential difference is divided between each load on a series circuit.

- Equivalent resistance

- Equivalent resistance is the overall resistance of a group of resistors and can be calculated no matter if the resistors are in series or parallel.
- Equivalent resistance for resistors in series is simply the sum of each loads individual resistances.
- Equivalent resistance for resistors in parallel is equal to the sum of the inverse of each loads individual resistances. The equivalent resistance is always smaller than the smallest individual resistance because the resistance is shared over multiple branches instead of 1 single loop.
- I like to think of each branch on a parallel circuit as a separate series circuit. Each branch has a constant voltage divided between the loads, and the current is constant from the start of the branch to the end of the branch and it is dependent on the resistance of the loads on the branch.
- In order to simplify a series circuit I often like to think of it as a simple, 1-load circuit, because the collective resistance of each load is what affects the current, and the voltage across the whole thing is the sum of the voltage across each load.

**Closing:**

- Time for example questions!
  - Draw a series circuit consisting of a 9V battery, a 2  $\Omega$  resistor, a 1  $\Omega$  resistor, a 3<sup>rd</sup> resistor of unknown resistance and an ammeter. The ammeter reads a current of 1.5A. What is the potential difference across each load? What is the value of the unknown resistance?
  - Once the circuit is drawn, to get the voltage across each load you would use  $R=V/I$ , then to get the V across the unknown resistor, you simply



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	<p>subtract the V of the known ones from the 9V of the battery. Then you would use this V to calculate the unknown resistance</p> <ul style="list-style-type: none"><li>• Draw a parallel circuit consisting of 3 branches. The first branch has a <math>2\ \Omega</math> resistor, the second has a <math>2\ \Omega</math> resistor, and the 3<sup>rd</sup> has a <math>4\ \Omega</math> resistor, an unknown resistor, and an ammeter. There is also an ammeter right before the positive terminal of the battery after all the branches reconverge. The ammeter leading back to the battery reads 4A of current. The ammeter on branch 3 reads 2A. What current is flowing through each of the other branches? What potential difference does each branch get? What is the unknown resistance?</li><li>• Once the circuit is drawn, the first thing I would do is find the current flowing through branches 1 and 2. Both branches have the same resistance, we know the total current is 4A and that the 3<sup>rd</sup> branch gets 2A, that leaves 2A to be split evenly between branches 1 and 2 since they have the same resistance. Each of the other branches gets 1A current.</li><li>• In a parallel circuit, each branch gets the same amount of potential difference regardless of resistance. Using branch 1 and the formul <math>R=V/I</math>, we can find the potential difference for that branch (and thus the potential difference of each other branch).</li><li>• Using the known resistance and the current for branch 3, you can calculate the potential difference across the known resistor. Subtracting this from the potential difference across the whole branch gives you the potential difference across the unknown resistor. Then you can use <math>R=V/I</math> to get the unknown resistance.</li></ul> <p>- Using the example circuits that we had just worked through I would then ask the students to calculate the equivalent resistance of each one and time permitting I would do a couple more equivalent resistance problems</p>
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**D. Assessment Tasks**

Introduction Phase Assessment(s):

- Peer marking lets the students have a chance to check their own knowledge while correcting their classmates'
- Seeing their classmates' answers may help them see the topics through a different lens aand expand their own knowledge by seeing their peers' thinking

Body of Lesson Phase Assessment(s):

- Asking students what they think will happen before telling them what will happen and why gives them the chance to think more deeply about the content and helps them to form scientific hypotheses based on prior knowledge.



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- Watching the students build the circuits together allows the teacher to see how well they work together and how much they had been paying attention in the previous class/how well they remember it. It also lets the teacher observe how their students benefit from visual/kinesthetic exercises as opposed to primarily auditory learning.

Closing of Lesson Phase Assessment(s):

- Running through examples with the students helps them to understand the step by step process of solving complex problems.
- Allowing students the chance to walk you through a question step by step gives them a chance to think critically about the material and form their own thought process on how to solve complex problems.

**E. Resources**

- Projector/Smart Board
- White Board
- Printer (for worksheets)
- Worksheets
- Textbook (McGraw-Hill & Ryerson SCIENCEPOWER 9)
- Calculator (potentially)
- Chromebooks

**F. Inclusive Practices**

- Drawings and projector provide visuals for students who learn better visually
- Virtual Lab on the chromebooks allows students not only to visualize but to physically ut together the circuits we are talking about in class giving them a chance to physically engage with the content in a virtual setting and allows them a chance to virtually practice what we may eventually do in person in the lab (if lab equipment works and if there is enough for everybody)