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| Series and parallel resistances | | |
| Content | The lesson presents the equivalent resistance of series and parallel resistor circuits, and provides practice in calculating total resistance. Students construct circuits of bulbs wired in series and in parallel, observe bulb brightness, and relate bulb brightness to current flow. | |
| Learning objectives | The student will be able to:  1. calculate the equivalent resistance of resistor circuits connected in both series and parallel combinations;  construct series and parallel circuits of lamps (resistors); andobserve and explain relative bulb brightness in series and parallel circuits. | |
| Materials/technology resources | 1. Slide presentation: “SeriesAndParallelResistances.ppt” 2. Interactive calculators: “Series resistances calculator” and   “Parallel resistances calculator”   1. Investigation: Modular Circuits Kit: bulbs, wires, batteries, switch,   jumpers   1. Student work: “SeriesAndParallelResistancesAssignment.pdf” | |
| Lesson plan segments | * Slide presentation: The presentation defines equivalent resistance and presents the equations for calculating the equivalent resistance of series and parallel resistor combinations. Interactive calculators are used to model the use of the equations for *Req* and tie this new content to the students’ developing understanding of Ohm’s law. * Investigation: Students construct circuits of lamps wired in series and in parallel. They observe bulb brightness, and relate lamp brightness to resistance and current flow. | Macintosh HD:Users:tomhsu:Desktop:Icon_Tiffs:Auditory.tif Macintosh HD:Users:tomhsu:Desktop:Icon_Tiffs:Visual.tif Macintosh HD:Users:tomhsu:Desktop:Icon_Tiffs:Kinesthetic.tifMacintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Interpersonal.tif |
|  | * Student work: *Series and parallel resistances* assignment   The student assignment provides a place for students to record the results of their investigation, and includes additional practice problems. Encourage students to complete these problems independently and then discuss their answers with a partner. Students may benefit from having access to the e-book calculators to complete their work. | Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:linguistic.tif Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Logical.tif  Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Intrapersonal.tif |
|  | * Reading: from the *Essential Physics* textbook, pages 487 - 491 | Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:linguistic.tif |

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| Assessment evidence | **Objective 1**: Two resistors with resistances of 10 ohms and 30 ohms are connected in series with a 20-volt battery. What is the equivalent resistance of the circuit?  (*in slide presentation*)answer: 40 ohms  **Objective 1**: Two resistors with resistances of 10 ohms and 30 ohms are connected in parallel with a 20-volt battery. What is the equivalent resistance of the circuit? (*in slide presentation*)answer: 7.5 ohms  **Objective 2 and 3**: Construct and observe resistor (bulb) circuits connected in series and in parallel. How bright are the parallel bulbs compared to the series bulbs? Compared to the single bulb? Why? (*in student investigation*)  answer: The parallel bulbs are brighter than the series bulbs. They have the SAME brightness as the single bulb. The total resistance of this circuit is less than the series circuit, so more current flows through each bulb. Also, each of these bulbs is connected to the full 3V of the two batteries, so they will get the same current flow as the single bulb. | | | | | | | | | |
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| Prior knowledge | Students are familiar with the concepts of current and voltage and the use of Ohm’s law to analyze circuits with a single resistor. They have previously used the multimeter, power supply, breadboard and lamps. | | | | | | | | | |
| Equations | Series resistance:   Parallel resistance: | | | | | | | | | |
| Vocabulary | series circuit parallel circuit equivalent resistance | | | | | | | | | |
| Standards | The student is expected to:   * design and implement investigative procedures, including making observations, asking well-defined questions, and formulating testable hypotheses. * construct and calculate the current, voltage and resistance of resistor circuits connected in both series and parallel combinations. | | | | | | | | | |
| Crosscutting concepts | Patterns | Cause  and  Effect | | Systems  and  Models | Energy  and  Matter | | Structure  and  Function | Stability  and  Change | | Scale, Proportion, Quantity |
| * The arrangement of resistors in a circuit has a major effect on current flow. * Resistor circuits can be modeled as systems of water-filled pipes and pumps. | | | | | | | | | |
| Key to differentiated instruction: | | | visual Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Visual.tif | | | linguistic Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:linguistic.tif | | | auditory Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Auditory.tif | |
| interpersonal Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Interpersonal.tif | | | intrapersonal Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Intrapersonal.tif | | | kinesthetic Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Kinesthetic.tif | | | logical Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Logical.tif | |