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| Resistance and Ohm’s law | | |
| Content | This lesson introduces the concept of electrical resistance and the application of Ohm’s law. The interactive calculator is used to explore the proportional relationships between *I, V,* and *R*. In the investigation, students measure the current through a set of known resistors for a fixed voltage and graph the inverse relationship between current and resistance. They then apply Ohm’s law to experimentally determine the resistance of a lamp. | |
| Learning objectives | The student will be able to:  1. characterize materials as conductors or insulators based on their electrical properties; 2. state and apply Ohm’s law to calculate current, voltage or resistance in an electric circuit involving a single resistor; and 3. demonstrate the use of current and voltage sensors, power supplies and resistors. | |
| Materials/technology resources | 1. Slide presentation: “ResistanceAndOhmsLaw.ppt” 2. Interactive calculator: “Ohm’s law calculator” 3. Investigation: Modular Circuit Kit: battery, three resistors, bulb,   switch, current sensor, voltage sensor, wires, jumpers   1. SPARKvue file “17C\_ResistanceAndOhmsLaw.spklab” 2. Student work: “ResistanceAndOhmsLawAssignment.pdf” | |
| Lesson plan segments | * Slide presentation: Define conductors and insulators, introduce and apply Ohm’s law to calculate voltage, current, or resistance. Model the use of the interactive calculator in exploring the proportional relationships in Ohm’s law. * Investigation: Students apply a fixed voltage to each resistor and measure the resulting current. They generate graphs of current as a function of both *R* and 1/*R*, and measure the slope of the second graph, which is equal to voltage. In part 2 of the investigation, students experimentally determine the resistance of a lamp by applying Ohm’s law to measured values of current and voltage. | Macintosh HD:Users:tomhsu:Desktop:Icon_Tiffs:Visual.tif Macintosh HD:Users:tomhsu:Desktop:Icon_Tiffs:Auditory.tif  Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Interpersonal.tifMacintosh HD:Users:tomhsu:Desktop:Icon_Tiffs:Kinesthetic.tif |
|  | * Student work: *Resistance and Ohm’s law* assignment   The student assignment provides a place to record the results of the investigation. A follow-on section provides additional student practice in applying Ohm’s law. Encourage students to work independently to complete the assignment before checking their answers with a peer or by using the interactive calculator. | Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:linguistic.tif Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Intrapersonal.tif  Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:Logical.tif |
|  | * Reading: from the *Essential Physics* textbook, pages 480 - 485 | Macintosh HD:Users:tomhsu:Desktop:  TeacherMaterials:Icon_Tiffs:linguistic.tif |

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| Assessment evidence | **Objective 1**: Which materials listed below are conductors? (*in slide presentation*)  a) aluminum b) rubber c) copper d) gold e) diamond  **Objective 2**: What is the voltage drop across a 50 Ω resistor when a current of  0.10 A flows through it? (*in slide presentation*)  answer: 5 V  **Objective 3**: Demonstrate the use of current and voltage sensors, power supplies, and resistors. (*in student investigation*) | | | | | | | | | |
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| Prior knowledge | Students should be familiar with the concepts of current and voltage, and have prior exposure to the use of the multimeter and power supply. | | | | | | | | | |
| Equations | Ohm’s law:  *V* = *IR* | | | | | | | | | |
| Vocabulary | resistance electrical insulator  resistor electrical conductor  ohm ( ) | | | | | | | | | |
| Standards | The student is expected to:   * demonstrate the use of course apparatus and equipment, including sensors or multimeters, power supplies, and resistors. * characterize materials as conductors or insulators based on their electrical properties. * design, construct, and calculate in terms of current through, potential difference across, and resistance of electric circuit elements. | | | | | | | | | |
| Crosscutting concepts | Patterns | Cause  and  Effect | | Systems  and  Models | Energy  and  Matter | | Structure  and  Function | Stability  and  Change | | Scale, Proportion, Quantity |
| * Ohm’s law is an equation model for predicting current flow in electrical systems. * The molecular structure of a material determines its function as a conductor or insulator. Metals contain conduction electrons that are free to flow in a current. | | | | | | | | | |
| 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 | |