

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|-----------------------------------|--|--|--------------------|---|---------------------|------------------------------------|
| 1HCS1.1.a Nature and Application of Science and Technology | History and Context of Science | Science is an international activity in which significant inventions and innovations have come from around the world... | Investigate various scientific concepts, inventions, and technological innovations that have been developed by different world cultures such as astronomy in Asia, or metallurgy in Africa... | 41 | Galileo and Newton conducted experiments with balls on ramps | 75 | the discovery of atom's nucleus |
| | | | | 52 | Dr. Harold Edgerton and strobe photography | | |
| | | | | 52 | Dr. Harold Edgerton and strobe photography | | |
| | | | | 78 | Newton's laws of motion | | |
| | | | | 81 | Newton's discovery of the connection between force and mass and acceleration | | |
| | | | | 91 | biomechanics application | | |
| | | | | 92 | applications of biomechanics | | |
| | | | | 112 | impact of technology | | |
| | | | | 152 | Sir Isaac Newton and law of universal gravitation | | |
| | | | | 155 | first artificial human- made Earth satellite was Sputnik | | |
| | | | | 178 | Great Pyramid of Giza and simple machines | | |
| | | | | 257 | Pierre and Jacques Curie and the piezoelectric effect | | |
| | | | | 269 | wave motion and equilibrium | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 290 | technological breakthrough of sound recording | | |
| | | | | 310 | past theories of light | | |
| | | | | 325 | history of printing | | |
| | | | | 348 | the usefulness of recorded images | | |
| | | | | 349 | Galileo and telescopes | | |
| | | | | 349 | the telescope | | |
| | | | | 350 | Newtonian reflecting telescope | | |
| | | | | 361 | Young's double-slit experiment | | |
| | | | | 368 | Einstein's thinking revolutionized physics | | |
| | | | | 382 | Ben Franklin and current | | |
| | | | | 420 | Charles-Augustin de Coulomb | | |
| | | | | 447 | discovering and using magnetism | | |
| | | | | 499 | development of atomic theory | | |
| | | | | 501 | search for elements and alchemy | | |
| | | | | 561 | the Alvin research submarine | | |
| | | | | 575 | discovery of helium | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|---|--------------------------------|---|--|--------------------|--|---------------------|--------|
| | | | | 580 | Newton and classical physics | | |
| | | | | 625 | turning lead into gold | | |
| 1HCS1.1.b Nature and Application of Science and Technology | History and Context of Science | Science is an international activity in which significant inventions and innovations have come from around the world... | Select a contemporary or technological challenge such as HIV, cancer research, space exploration, or ozone depletion. Explore the dimensions of the issue and the kinds of collaborative efforts that are in place to deal with it ... | 234 | gyroscopes and the space shuttle | | |
| | | | | 236 | rocket engines | | |
| | | | | 259 | measuring mass in space | | |
| | | | | 392 | environmental impact of auto pollution | | |
| | | | | 621 | human technology contributes to radiation in environment | | |
| | | | | 628 | nuclear waste | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|--|-----------------------------------|--|--|--------------------|--|---------------------|---------------------------------|
| 1HCS1.2.a Nature and Application of Science and Technology | History and Context of Science | Science is divided into many disciplines such as astrophysics, biochemistry, and geophysics. Each discipline is a field of endeavor in itself and requires specialized training... | Investigate the development of new scientific disciplines both historical, such as Lavoisier's work in forming the foundation of modern chemistry, and contemporary such as molecular biology... | 41 | Galileo and Newton conducted experiments with balls on ramps | 75 | the discovery of atom's nucleus |
| | | | | 52 | Dr. Harold Edgerton and strobe photography | | |
| | | | | 78 | Newton's laws of motion | | |
| | | | | 81 | Newton's discovery of the connection between force and mass and acceleration | | |
| | | | | 91 | biomechanics application | | |
| | | | | 92 | applications of biomechanics | | |
| | | | | 152 | Sir Isaac Newton and law of universal gravitation | | |
| | | | | 349 | Galileo and telescopes | | |
| | | | | 350 | Newtonian reflecting telescope | | |
| | | | | 382 | Ben Franklin and current | | |
| | | | | 420 | Charles-Augustin de Coulomb | | |
| | | | | 440 | magnetism | | |
| | | | | 447 | history of magnetism | | |
| | | | | 499 | development of atomic theory | | |
| | | | | 501 | ancient Greeks' ideas of elements | | |
| | | | | 580 | Newton and classical physics | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|-------------------------|-------|------------------|-------------------------|--------------------|------------------------------|---------------------|--------|
| | | | | 614 | Marie Curie | | |
| | | | | 615 | Henri Bequerel and beta rays | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|-----------------------------------|--|---|--------------------|--|---------------------|--------|
| 1HCS1.2.b Nature and Application of Science and Technology | History and Context of Science | Science is divided into many disciplines such as astrophysics, biochemistry, and geophysics. Each discipline is a field of endeavor in itself and requires specialized training... | Select a major scientific discovery (e.g., DNA, transistor, x-rays, antibiotics) and discuss the influence of this discovery on the thoughts and work that followed in a variety of scientific disciplines. | 13 | medical and health professions use physics | | |
| | | | | 16 | the relation between physics and other fields of science | | |
| | | | | 52 | Dr. Harold Edgerton and strobe photography | | |
| | | | | 52 | Dr. Harold Edgerton and strobe photography | | |
| | | | | 91 | biomechanics application | | |
| | | | | 91 | biomechanics application | | |
| | | | | 92 | applications of biomechanics | | |
| | | | | 112 | impact of technology | | |
| | | | | 155 | first artificial human-made Earth satellite was Sputnik | | |
| | | | | 178 | Great Pyramid of Giza and simple machines | | |
| | | | | 257 | Pierre and Jacques Curie and the piezoelectric effect | | |
| | | | | 269 | wave motion and equilibrium | | |
| | | | | 290 | technological breakthrough of sound recording | | |
| | | | | 310 | past theories of light | | |
| | | | | 325 | history of printing | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 348 | the usefulness of recorded images | | |
| | | | | 349 | the telescope | | |
| | | | | 361 | Young's double-slit experiment | | |
| | | | | 368 | Einstein's thinking revolutionized physics | | |
| | | | | 447 | discovering and using magnetism | | |
| | | | | 449 | Earth's magnetism | | |
| | | | | 501 | search for elements and alchemy | | |
| | | | | 561 | the Alvin research submarine | | |
| | | | | 575 | discovery of helium | | |
| | | | | 592 | connections between biology and chemistry and physics | | |
| | | | | 625 | turning lead into gold | | |
| | | | | 641 | research on future of the universe | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|--|-----------------------------------|---|---|--------------------|---|---------------------|------------------------------------|
| 1HCS1.3.a Nature and Application of Science and Technology | History and Context of Science | Scientific theories are based on the body of knowledge that exists at any particular time... | Trace the evolution and progression of a theory surrounding an important area of scientific development such as structure of the atom, origin and evolution of the universe, or formation of Earth's geological features ... | 41 | Galileo and Newton conducted experiments with balls on ramps | 75 | the discovery of atom's nucleus |
| | | | | 78 | Newton's laws of motion | | |
| | | | | 81 | Newton's discovery of the connection between force and mass and acceleration | | |
| | | | | 152 | Sir Isaac Newton and law of universal gravitation | | |
| | | | | 349 | Galileo and telescopes | | |
| | | | | 350 | Newtonian reflecting telescope | | |
| | | | | 382 | Ben Franklin and current | | |
| | | | | 420 | Charles-Augustin de Coulomb | | |
| | | | | 499 | development of atomic theory | | |
| | | | | 580 | Newton and classical physics | | |
| | | | | 614 | Marie Curie | | |
| | | | | 615 | Henri Bequerel and beta rays | | |
| | | | | 641 | research on future of the universe | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|-----------------------------------|---|---|----------------------------|---------------|-----------------------------|---------------|
| 1HCS1.3.b Nature and Application of Science and Technology | History and Context of Science | Scientific theories are based on the body of knowledge that exists at any particular time... | Review selected scientific articles from popular magazines and newspapers such as New York Times, Science Times over an extended period of time. Identify a scientific theory that is currently being modified... | | | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|--------------------|---|--|--------------------|---|--|--|
| 1INQ1.1.a Nature and Application of Science and Technology | Science as Inquiry | The identification and formulation of appropriate questions guide the design and breadth of a scientific investigation. | Formulate scientific investigations from relevant questions and issues. Formulate questions to indicate conceptual insights and a depth of understanding around these questions and issues. | 3 8 9 432 | inquiry starts with questions formulating a hypothesis testing ideas against scientific evidence making a simple capacitor | 11 21 33 48 65 79 82 82 89 201 201 | formulate a testable hypothesis plan the experiment formulate a testable hypothesis formulate a hypothesis form a hypothesis write a hypothesis plan three experiments to determine which variable affects the period of a pendulum design an experiment what is it that moves in the case of a wave? determine the equipment you will need design a procedure to separate a mixture |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|--|--------------------|---|---|--------------------|--|--|---|
| 1INQ1.2.a Nature and Application of Science and Technology | Science as Inquiry | Scientific investigations in many cases follow no fixed set of steps. However, there are certain features of a valid scientific investigation that are essential and result in evidence that can be used to construct explanations. | Design and conduct a scientific investigation either as an individual or group activity. The investigation should be sufficiently complex to require the use of various experimental techniques and strategies... | 9 432 | testing ideas against scientific evidence making a simple capacitor | 21 28 67 82 82 85 85 129 201 201 202 | conduct the experiment set up the ultimate pulley set up the straight track plan three experiments to determine which variable affects the period of a pendulum design an experiment select appropriate technology to make measurements design and test a way to increase natural frequency choose circuit parts to light a bulb determine the equipment you will need design a procedure to separate a mixture conduct your experiment |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|--|--------------------|--|---|--------------------|---|---------------------|--------------------------------------|
| 1INQ1.3.a Nature and Application of Science and Technology | Science as Inquiry | Tools and technologies extend human capabilities to perform investigations in more detail and with greater accuracy and improved precision. Expand the capacity to use a variety of tools and techniques in order to solve a wide range of practical problems. | Following instructions in manuals or taking instructions from an experienced person to learn the proper use of new instruments. | 18 | measuring distance | 1 | estimating length |
| | | | | 23 | reading a digital timer | 4 | using a timer |
| | | | | 25 | accuracy and precision of measurements | 5 | using photogates |
| | | | | 25 | accuracy and precision of measurements | 6 | accuracy and resolution and printing |
| | | | | 383 | using a multimeter to measure voltage | 9 | using timer and photogates |
| | | | | 385 | measuring current with an ammeter or multimeter | 11 | using timer and photogates |
| | | | | 387 | using a multimeter to measure resistance | 14 | using a timer and photogates |
| | | | | 504 | Celsius and Fahrenheit thermometers | 17 | using a timer and photogates |
| | | | | 505 | how thermometers work | 18 | use a timer and photogates |
| | | | | | | 21 | conduct the experiment |
| | | | | | | 21 | use a timer and photogates |
| | | | | | | 23 | use a timer and photogates |
| | | | | | | 26 | use a timer and photogates |
| | | | | | | 28 | set up the ultimate pulley |
| | | | | | | 42 | use a timer and photogates |
| | | | | | | 43 | measure and record the distance |
| | | | | | | 47 | use a timer and photogate |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|-------------------------|-------|------------------|----------------------|--------------------|--------|---------------------|---|
| | | | | | | 50 | use a timer and photogate |
| | | | | | | 58 | use a timer and photogate |
| | | | | | | 60 | measure input and output forces |
| | | | | | | 65 | use a timer and photogate |
| | | | | | | 67 | measure vertical distance |
| | | | | | | 67 | set up the straight track |
| | | | | | | 67 | use a timer and photogate |
| | | | | | | 75 | use a timer and photogates |
| | | | | | | 82 | measure the length of the string |
| | | | | | | 82 | use a timer and photogate |
| | | | | | | 85 | select appropriate technology to make measurements |
| | | | | | | 85 | design and test a way to increase natural frequency |
| | | | | | | 87 | use photogate and timer to measure the period |
| | | | | | | 90 | use a timer and photogates |
| | | | | | | 129 | choose circuit parts to light a bulb |
| | | | | | | 131 | use a multimeter to measure current |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|-------------------------|-------|------------------|----------------------|--------------------|--------|---------------------|---|
| | | | | | | 132 | use a multimeter to measure voltage |
| | | | | | | 135 | use a multimeter to measure current and voltage |
| | | | | | | 139 | use a multimeter |
| | | | | | | 140 | use the multimeter |
| | | | | | | 163 | use a multimeter |
| | | | | | | 164 | use a multimeter to measure voltage |
| | | | | | | 165 | use a multimeter |
| | | | | | | 166 | use a photogate and timer |
| | | | | | | 169 | use a multimeter |
| | | | | | | 171 | use a multimeter |
| | | | | | | 176 | use a thermometer |
| | | | | | | 178 | measure the temperature |
| | | | | | | 180 | measure the temperature |
| | | | | | | 202 | conduct your experiment |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|--|--------------------|--|--|----------------------------|--|-----------------------------|---------------|
| 1INQ1.3.b Nature and Application of Science and Technology | Science as Inquiry | Tools and technologies extend human capabilities to perform investigations in more detail and with greater accuracy and improved precision. Expand the capacity to use a variety of tools and techniques in order to solve a wide range of practical problems. | Using computers to produce tables and graphs and to make spreadsheet calculations. | | data tables and graphs can be created on computer or graphing calculator | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|--|---------------------------------------|--|--|--------------------|--|---------------------|---|
| 1INQ1.4.a Nature and Application of Science and Technology | Science as Inquiry | The close examination of evidence is necessary to construct logical scientific explanations and present arguments which defend proposed explanations. Such critical analyses of supporting evidence are not only important to scientific investigations... | In an investigation, use various strategies to construct and develop logical explanations that decide what evidence from an investigation is useful. | 2 | understanding natural laws | 12 | was this experiment better or worse than the first? |
| | | | | 3 | connecting cause and effect through observation | 12 | cause and effect relationships |
| | | | | 7 | revising explanations through observation | 13 | is there a trend in measurements? |
| | | | | 8 | refining theories based on observations | 13 | create a graph |
| | | | | 9 | connecting cause and effect through analysis | 13 | compare prediction to measurement |
| | | | | 10 | the usefulness of phlogiston theory despite being incorrect | 16 | create a graph |
| | | | | 16 | what do the results tell you? | | |
| | | | | 11 | acceptance of the Copernican model of the solar system on the basis of scientific evidence | 16 | describe the graph |
| | | | | 18 | are the accelerations different? | | |
| | | | | 11 | Ptolemy model vs. Copernicus model of the solar system | 19 | does the ball accelerate? |
| | | | | 22 | create graphs | | |
| | | | | 40 | making a good model | 22 | compare calculation with graph estimate |
| | | | | 43 | constructing a graph | 22 | how do you measured positions compare to model? |
| | | | | 43 | graphs are a way of representing data | 29 | does experiment agree with prediction? |
| | | | | 44 | graphical models | 37 | make a graph |
| 44 | checking a graphical model's accuracy | 38 | make a graph | | | | |
| | | 43 | sketch four graphs | | | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--|
| | | | | 44 | using a graphical model to make a prediction and checking the model's accuracy | 43 | what would happen if...? |
| | | | | 45 | recognizing patterns and cause and effect relationships | 43 | how does the measurement compare to your prediction? |
| | | | | 45 | recognizing patterns using graphs | 56 | create a graph |
| | | | | 54 | understanding patterns in relationships between variables | 58 | explain why the angular acceleration is different |
| | | | | 54 | constructing a graph | 63 | as mechanical advantage increases what happens to length of pulled string? |
| | | | | 55 | create a graph from a data table | 66 | what does the graph tell you? |
| | | | | 56 | indicate relationships between variables in graphs | 66 | create a graph of speed vs. position |
| | | | | 71 | parachutes and air resistance | 76 | compare predicted mass to actual mass |
| | | | | 103 | evaluating perpetual motion claims | 80 | explain your observations |
| | | | | 246 | understanding graphs of harmonic motion | 82 | make three different graphs |
| | | | | 290 | the process of digital sound reproduction | 82 | analyze data |
| | | | | 297 | frequency spectrum | 87 | sketch a graph |
| | | | | 304 | comparison of wave forms from guitar sounds | 87 | explain how force applied causes the response |
| | | | | | | 90 | what effect does changing the tension have? |
| | | | | | | 90 | explain why higher tension makes waves move faster |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--|
| | | | | 306 | explain why hearing can be damaged by loud sounds | 92 | explain how wind might cause big waves in water |
| | | | | 307 | decibel level vs. frequency graph for human hearing | 97 | did the method give an accurate result? |
| | | | | 411 | the waveform of AC electricity | 97 | reliability of a double-blind test |
| | | | | 427 | diagramming electric fields using field lines | 109 | explain how the colored filters work |
| | | | | 443 | diagramming magnetic fields using magnetic field lines | 114 | are there differences between your prediction and measurement? |
| | | | | 479 | current vs.voltage graph for a transistor | 132 | what conclusions can you draw? |
| | | | | | | 133 | did battery voltage change? |
| | | | | | | 133 | analyze data and explain a rule |
| | | | | | | 135 | graph voltage vs. current |
| | | | | | | 136 | graph voltage vs. current |
| | | | | | | 151 | make a graph of voltage vs. time |
| | | | | | | 160 | create a graph |
| | | | | | | 167 | make a graph of voltage vs. number of magnets |
| | | | | | | 169 | make a current vs. voltage graph for the diode |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|---------------------------------|--------------|-------------------------|---------------------------------|----------------------------|---------------|-----------------------------|---|
| | | | | | | 204 | build models of Na and Cl and use them to explain bonding |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|--|--------------------|--|---|--------------------|--|---------------------|--|
| 1INQ1.4.b Nature and Application of Science and Technology | Science as Inquiry | The close examination of evidence is necessary to construct logical scientific explanations and present arguments which defend proposed explanations. Such critical analyses of supporting evidence are not only important to scientific investigations... | In an investigation, use various strategies to construct and develop logical explanations that use tables, charts, and graphs when making arguments and claims in oral and written presentations. | 24 | making graphs of experimental results over time | 13 | create a graph |
| | | | | 42 | writing procedures in a lab notebook helps make sure your results are repeatable | 15 | record data in a table |
| | | | | 43 | constructing a graph | 16 | create a graph |
| | | | | 43 | constructing a graph | 16 | describe the graph |
| | | | | 44 | graphical models | 17 | use a data table |
| | | | | 54 | constructing a graph | 18 | record data |
| | | | | 55 | create a graph from a data table | 21 | record results in table |
| | | | | 142 | finding x and y components of velocity for model rocket | 22 | create graphs |
| | | | | 290 | the process of digital sound reproduction | 27 | record position and time data |
| | | | | 411 | the waveform of AC electricity | 29 | record mass and force |
| | | | | | | 37 | make a graph |
| | | | | | | 38 | make a graph |
| | | | | | | 43 | create four graphs |
| | | | | | | 43 | sketch four graphs |
| | | | | | | 56 | create a graph |
| | | | | | | 66 | record data in table |
| | | | | | | 66 | create a graph of speed vs. position |
| | | | | | | 70 | record data in table |
| | | | | | | 82 | create data table for self-designed experiment |
| | | | | | | 82 | record your data in table |
| | | | | | | 82 | make three different graphs |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--------|--|--------|
| | | | | | | 87 sketch a graph | |
| | | | | | | 122 communicate your findings | |
| | | | | | | 122 present your findings | |
| | | | | | | 135 graph voltage vs. current | |
| | | | | | | 136 graph voltage vs. current | |
| | | | | | | 151 make a graph of voltage vs. time | |
| | | | | | | 160 create a graph | |
| | | | | | | 167 make a graph of voltage vs. number of magnets | |
| | | | | | | 169 make a current vs. voltage graph for the diode | |
| | | | | | | 175 display information you found for your element | |
| | | | | | | 202 keep detailed notes as you work | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|---|--------------------|--|--|--------------------|--|---------------------|---|
| 1INQ1.4.c Nature and Application of Science and Technology | Science as Inquiry | The close examination of evidence is necessary to construct logical scientific explanations and present arguments which defend proposed explanations. Such critical analyses of supporting evidence are not only important to scientific investigations... | In an investigation, use various strategies to construct and develop logical explanations that make and interpret scale drawings. | 24 119 499 | time scales in physics drawing displacement vector using a scale scale and Brownian motion | 28 85 92 | interpret setup diagram draw a sketch of your system sketch the wave fronts |
| 1INQ1.4.d Nature and Application of Science and Technology | Science as Inquiry | The close examination of evidence is necessary to construct logical scientific explanations and present arguments which defend proposed explanations. Such critical analyses of supporting evidence are not only important to scientific investigations... | In an investigation, use various strategies to construct and develop logical explanations that form logical arguments about cause and effect relationships in an investigation | 2 3 9 45 | understanding natural laws connecting cause and effect through observation connecting cause and effect through analysis recognizing patterns and cause and effect relationships | 12 90 | cause and effect relationships what effect does changing the tension have? |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|--|--------------------|--|---|--------------------|---|---|--|
| 1INQ1.4.e Nature and Application of Science and Technology | Science as Inquiry | The close examination of evidence is necessary to construct logical scientific explanations and present arguments which defend proposed explanations. Such critical analyses of supporting evidence are not only important to scientific investigations... | In an investigation, use various strategies to construct and develop logical explanations that: choose summary statistics to describe group differences, and indicate the spread of the data, as well as the data's central tendency. | 412 | average voltage and current of AC power | 13 25 58 63 66 67 71 82 133 | is there a trend in measurements? find the average time find average of three trials as mechanical advantage increases what happens to length of pulled string? what does the graph tell you? calculate average of three times calculate average work and power analyze data did battery voltage change? |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|---|--------------------|--|--|--------------------------|--|---------------------|--|
| 11NQ1.4.f Nature and Application of Science and Technology | Science as Inquiry | The close examination of evidence is necessary to construct logical scientific explanations and present arguments which defend proposed explanations. Such critical analyses of supporting evidence are not only important to scientific investigations... | In an investigation, use various strategies to construct and develop logical explanations that: participate in group discussions on scientific topics by restating or summarizing accurately what others have said, asking for clarification or elaboration... | 42 | writing procedures in a lab notebook helps make sure your results are repeatable | 122 122 | present your findings communicate your findings |
| 11NQ1.4.g Nature and Application of Science and Technology | Science as Inquiry | The close examination of evidence is necessary to construct logical scientific explanations and present arguments which defend proposed explanations. Such critical analyses of supporting evidence are not only important to scientific investigations... | In an investigation, use various strategies to construct and develop logical explanations that: retrieve pertinent information from reference books, newspapers, magazines, compact discs, and computer data bases. | 456 472 499 499 | Hans Christian Oersted Dr. D. Bruce Montgomery Albert Einstein Democritus | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|--|--------------------|--|---|--------------------|--|---------------------|---|
| 1INQ1.4.h Nature and Application of Science and Technology | Science as Inquiry | The close examination of evidence is necessary to construct logical scientific explanations and present arguments which defend proposed explanations. Such critical analyses of supporting evidence are not only important to scientific investigations... | In an investigation, use various strategies to construct and develop logical explanations that: construct models in order to visualize the relationship of various elements of a product, process, or system. | 7 | developing models to explain observations | 13 | create a graph |
| | | | | 11 | Ptolemy model vs. Copernicus model of the solar system | 13 | compare prediction to measurement |
| | | | | 40 | making a good model | 16 | create a graph |
| | | | | 40 | creating useful models | 16 | describe the graph |
| | | | | 43 | constructing a graph | 22 | how do you measured positions compare to model? |
| | | | | 44 | graphical models | 22 | create graphs |
| | | | | 44 | using a graphical model to make a prediction and checking the model's accuracy | 22 | compare calculation with graph estimate |
| | | | | 54 | constructing a graph | 22 | uniform acceleration model |
| | | | | 55 | create a graph from a data table | 22 | model for uniform accelerated motion |
| | | | | 60 | creating the acceleration formula from experiments | 24 | create an algebraic model |
| | | | | 66 | developing the formulas for a model of motion with constant acceleration | 28 | solve second law equation for string tension |
| | | | | 101 | a model for friction | 28 | system of Atwood's machine |
| | | | | 102 | a model for static friction | 29 | does experiment agree with prediction? |
| | | | | 202 | processes | 32 | develop a model that predicts acceleration |
| | | | | 204 | natural systems and efficiency | 37 | make a graph |
| | | | | 206 | reversible and irreversible processes | 38 | make a graph |
| | | | | | | 43 | create algebraic model |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--|
| | | | | 212 | energy flow in systems | 43 | how does the measurement compare to your prediction? |
| | | | | 214 | natural systems work in cycles | 43 | sketch four graphs |
| | | | | 215 | food webs and ecosystems | 49 | write a formula |
| | | | | 282 | write a formula relating velocity of wave to period and wavelength | 56 | create a graph |
| | | | | | | 66 | create a graph of speed vs. position |
| | | | | 290 | the process of digital sound reproduction | 76 | compare predicted mass to actual mass |
| | | | | 297 | frequency spectrum | 82 | make three different graphs |
| | | | | 312 | light intensity follows an inverse square law | 87 | sketch a graph |
| | | | | 330 | optics and optical instruments | 94 | give an equation that describes your observations |
| | | | | 411 | the waveform of AC electricity | 114 | are there differences between your prediction and measurement? |
| | | | | 449 | shifting and reversal of Earth's magnetic poles | 135 | graph voltage vs. current |
| | | | | 492 | the binary number system and its use in computers | 136 | graph voltage vs. current |
| | | | | | | 151 | make a graph of voltage vs. time |
| | | | | | | 160 | create a graph |
| | | | | | | 167 | make a graph of voltage vs. number of magnets |
| | | | | | | 169 | make a current vs. voltage graph for the diode |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|--------------------|--|--|--|---|---------------------|---|
| | | | | | | 189 | Bernoulli's equation |
| 1INQ1.4.i Nature and Application of Science and Technology | Science as Inquiry | The close examination of evidence is necessary to construct logical scientific explanations and present arguments which defend proposed explanations. Such critical analyses of supporting evidence are not only important to scientific investigations... | Develop the practice of analyzing data, and considering claims by: noticing and criticizing arguments based on the faulty, incomplete, or misleading use of numbers... | 25 42 62 188 292 372 576 | why accuracy and precision are important controlling variables in experiments acceleration of cars perpetual motion machines sound in space holograms and science fiction special effects transporter beams | 43 45 202 | discuss sources of error discuss sources of errors identify two sources of experimental error |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|--------------------|--|--|--|---|--|--|
| 1INQ1.4.j Nature and Application of Science and Technology | Science as Inquiry | The close examination of evidence is necessary to construct logical scientific explanations and present arguments which defend proposed explanations. Such critical analyses of supporting evidence are not only important to scientific investigations... | Develop the practice of analyzing data, and considering claims by: checking graphs to see that they do not misrepresent results by using inappropriate scales or by failing to specify the axes clearly. | 25 42 43 44 54 55 290 411 | why accuracy and precision are important controlling variables in experiments constructing a graph graphical models constructing a graph create a graph from a data table the process of digital sound reproduction the waveform of AC electricity | 13 16 16 22 37 38 43 43 45 56 66 82 87 135 136 151 160 167 169 | create a graph create a graph describe the graph create graphs make a graph make a graph discuss sources of error sketch four graphs discuss sources of errors create a graph create a graph of speed vs. position make three different graphs sketch a graph graph voltage vs. current graph voltage vs. current make a graph of voltage vs. time create a graph make a graph of voltage vs. number of magnets make a current vs. voltage graph for the diode |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---------------------------------|--------------|-------------------------|---------------------------------|----------------------------|---------------|-----------------------------|--|
| | | | | | | 202 | identify two sources of experimental error |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|--|--|---|--------------------|---|---------------------|--------|
| 1STS1.1.a Nature and Application of Science and Technology | Science, Technology, and Society | The practice of science and technology is not a linear process. In many cases, the desire of scientists to find what is real in nature creates opportunities for technology development. | Investigate a range of modern technological products and systems from the world. Identify those examples in which a scientific advance led to new technological opportunities such as discovery of DNA/biotechnology; splitting of the atom/nuclear energy... | 12 | engineers design practical devices for solving problems | | |
| | | | | 12 | all technology is based on fundamental laws of physics | | |
| | | | | 31 | use of nanotechnology | | |
| | | | | 31 | use of nanotechnology | | |
| | | | | 51 | analyzing motion with video and strobe photography | | |
| | | | | 72 | antilock brakes application | | |
| | | | | 72 | antilock brakes application | | |
| | | | | 112 | relationship between science and engineering and technology | | |
| | | | | 112 | designing a bridge | | |
| | | | | 138 | use of robots | | |
| | | | | 155 | geostationary satellites | | |
| | | | | 172 | bicycle physics application | | |
| | | | | 196 | hydroelectric power application | | |
| | | | | 196 | hydroelectric power application | | |
| 209 | range of power for common devices | | | | | | |
| 216 | energy from ocean tides | | | | | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 217 | research into tidal power | | |
| | | | | 228 | seat belts and air bags | | |
| | | | | 235 | jet engines application | | |
| | | | | 235 | jet engines application | | |
| | | | | 243 | oscillators are used in communications and music and clocks | | |
| | | | | 257 | quartz crystals application | | |
| | | | | 257 | quartz crystals application | | |
| | | | | 263 | waves can carry information | | |
| | | | | 280 | microwave ovens application | | |
| | | | | 280 | microwave ovens application | | |
| | | | | 293 | uses of Doppler radar | | |
| | | | | 311 | invention of electric light | | |
| | | | | 325 | the printing press | | |
| | | | | 325 | the printing press | | |
| | | | | 349 | the telescope | | |
| | | | | 369 | technological advances have allowed discovery of the expanding universe | | |
| | | | | 372 | holography application | | |
| | | | | 378 | importance of electricity | | |
| | | | | 392 | hybrid gas/electric cars application | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 392 | hybrid gas/electric cars application | | |
| | | | | 413 | wiring application | | |
| | | | | 413 | wiring application | | |
| | | | | 429 | electron beam accelerators | | |
| | | | | 434 | how television works application | | |
| | | | | 434 | how television works application | | |
| | | | | 451 | MRI application | | |
| | | | | 451 | MRI application | | |
| | | | | 472 | maglev train application | | |
| | | | | 473 | how magplanes levitate | | |
| | | | | 490 | why computers are useful | | |
| | | | | 492 | computers and electronic addition of numbers application | | |
| | | | | 516 | refrigerator application | | |
| | | | | 534 | energy-efficient building application | | |
| | | | | 534 | energy-efficient building application | | |
| | | | | 560 | deep water submarine Alvin application | | |
| | | | | 570 | use of radioactive isotopes in medicine | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|-------------------------|--------------------|---------------------------|---------------------|--------|
| | | | | 585 | laser application | | |
| | | | | 615 | smoke detectors | | |
| | | | | 622 | x-ray machines | | |
| | | | | 623 | creation of CAT scans | | |
| | | | | 623 | CAT scans | | |
| | | | | 623 | creation of CAT scans | | |
| | | | | 631 | nuclear power application | | |
| | | | | 631 | nuclear power application | | |
| | | | | 632 | nuclear energy | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|--|--|---|--------------------|--|---------------------|--------|
| 1STS1.2.a Nature and Application of Science and Technology | Science, Technology, and Society | The social, economic, and political forces of a society have a significant influence on what science and technology programs are pursued, invested in, and used. | Use case studies of actual societal challenges such as sea level change, spread of HIV, and deforestation, and identify and discuss the scientific, technologic, and policy aspects of the various challenges... | 219 | using energy efficient products | | |
| | | | | 392 | hybrid cars combine advantages of gasoline fuel and electric power | | |
| | | | | 392 | environmental impact of auto pollution | | |
| | | | | 534 | energy-efficient building application | | |
| | | | | 604 | balancing chemical equation of acid rain | | |
| | | | | 607 | impact of combustion reaction of gasoline | | |
| | | | | 621 | sources of radiation in the environment | | |
| | | | | 621 | human technology contributes to radiation in environment | | |
| | | | | 628 | nuclear waste | | |
| | | | | 632 | nuclear waste | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|--|---|--|--------------------------------|--|---------------------|---|
| 1STS1.2.b Nature and Application of Science and Technology | Science, Technology, and Society | The social, economic, and political forces of a society have a significant influence on what science and technology programs are pursued, invested in, and used. | Investigate how government policy and the circumstances and values of a society determine which science and technology projects are funded and which ones are not, such as Superconducting Supercollider... | | | | |
| 2MS2.1.a Materials and Their Properties | Mixtures and Solutions | Mixtures have variable compositions and are either homogenous or heterogeneous. A homogeneous mixture (solution) has the same properties throughout whereas a heterogeneous mixture consists of two or more phases that differ in properties... | Mixtures have variable compositions and are either homogenous or heterogeneous. A homogeneous mixture (solution) has the same properties throughout whereas a heterogeneous mixture consists of two or more phases that differ in properties... | 29 500 501 503 592 | describing elements and molecules and mixtures matter is mostly molecules and mixtures elements compounds and elements and mixtures substances and mixtures | 175 201 | describe one mixture that contains the element separate the mixture and find percent composition |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|---------------------------|---|---|---------------------------------|--|---------------------|---|
| 2MS2.2.a Materials and Their Properties | Mixtures and Solutions | A variety of methods are used to prepare mixtures and to separate mixtures into their component parts. These methods such as blending, grinding, use of surfactants, distillation, floatation, and filtration are used throughout the scientific and industrial | Discuss and demonstrate water purification methods which separate dissolved and suspended materials in water. | | | 175 201 | describe one mixture that contains the element separate the mixture and find percent composition |
| 2MS2.3.a Materials and Their Properties | Mixtures and Solutions | The properties of solutions depend upon the concentration, properties, and interactions of the solute and solvents. | Discuss various factors (e.g., type and concentration of solute, type of solvent, and temperature) which affect the rate and extent of solubility and the specific properties of a solution such as acidity, viscosity, B Pt. elevation and F. Pt. depression.. | 594 594 594 594 600 | definition of a solution powders dissolve quickly solubility and temperature water as the universal solvent the pH scale | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|---------------------------|---|--|---------------------------------|--|------------------------|--|
| 2MS2.3.b Materials and Their Properties | Mixtures and Solutions | The properties of solutions depend upon the concentration, properties, and interactions of the solute and solvents. | Identify the effects of human exposure to various materials at low concentrations in air, water, or soil. Report the results using various concentration units and/or data presentations (threshold limits for detecting salt in water, second hand smoke... | 570 604 622 623 632 | use of radioactive isotopes in medicine balancing chemical equation of acid rain x-ray machines CAT scans nuclear energy | | |
| 2MT2.1.a Materials and Their Properties | Material Technology | The properties of materials determine how they are used by society. New material discoveries are being used to improve the quality of life, however, their development often raises social, economic, and environmental issues. | Design an object which requires a variety of materials and defend how the selection depends on the properties and interactions of the chosen materials. | 113 534 546 | build and test a prototype structure out of toothpicks R-values of common building materials types of solid materials and their properties | 83 85 163 191 | design and construct a pendulum create a system that oscillates design and test different electric motors build an air-speed tester |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|---------------------|---|--|----------------------------|--|-----------------------------|---------------|
| 2MT2.1.b Materials and Their Properties | Material Technology | The properties of materials determine how they are used by society. New material discoveries are being used to improve the quality of life, however, their development often raises social, economic, and environmental issues. | Investigate how plastics are tailored to very specific uses and how these uses lead to technological challenges regarding the recycling of plastics. Speculate what determines the price at which a plastic is sold. | 546 607 | physical properties of plastics impact of combustion reaction of gasoline | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---------------------------------------|---|--|--------------------|--|---------------------|---|
| 2PSM2.1.a Materials and Their Properties | Properties and Structure of Matter | All matter is composed of minute particles called atoms. Atoms are electrically neutral and consist of a nucleus of neutrons and positively charged protons surrounded by negatively charged electrons ... | Present the various theories and models developed to describe the structure and behavior of the atom. Describe the particles that make up the atom: their size, composition, location, and movement... | 420 | electric charge is a property of the particles that make up the atom | 75 | the discovery of atom's nucleus |
| | | | | 420 | electric charge is a property of the particles that make up the atom | 175 | record atomic number |
| | | | | 422 | movement of electrons in current | 194 | basic properties of subatomic particles |
| | | | | 437 | draw a model of an atom | 194 | subatomic particles |
| | | | | 444 | magnetism is a property of particles that make up the atom | 197 | quantum physics |
| | | | | 444 | electrons and magnetism | 197 | quantum theory and electrons |
| | | | | 459 | atomic currents | 200 | explore how a vibrating string has similar properties to a quantum system |
| | | | | 480 | electrons in a semiconductor | 203 | electrons and energy levels |
| | | | | 499 | development of atomic theory | 203 | review subatomic particles |
| | | | | 500 | smallest piece of matter is the atom | | |
| | | | | 566 | three particles make up the atom | | |
| | | | | 566 | charge and mass of electrons and protons and neutrons | | |
| | | | | 567 | structure of the atom | | |
| | | | | 567 | mass and the nucleus | | |
| | | | | 569 | elements and atoms and atomic number | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 570 | chemical properties of isotopes due to atomic structure | | |
| | | | | 572 | stability of nucleus and balance of protons and neutrons | | |
| | | | | 574 | Neils Bohr's theory | | |
| | | | | 576 | Neils Bohr | | |
| | | | | 576 | quantum states | | |
| | | | | 577 | energy levels and quantum states | | |
| | | | | 577 | energy levels explain spectral lines | | |
| | | | | 578 | quantum state holds one electron | | |
| | | | | 579 | quantum states are called orbitals in chemistry | | |
| | | | | 580 | comparing classical and quantum physics | | |
| | | | | 581 | classical vs. quantum theory of light | | |
| | | | | 582 | quantum theory | | |
| | | | | 582 | classical vs. quantum concept of electron | | |
| | | | | 583 | how the uncertainty principle differs from classical theory | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 583 | how the uncertainty principle differs from classical theory | | |
| | | | | 583 | the uncertainty principle | | |
| | | | | 584 | quantum theory and probability | | |
| | | | | 588 | properties of subatomic particles | | |
| | | | | 588 | quantum states and energy levels | | |
| | | | | 589 | electrons in classical vs. quantum physics | | |
| | | | | 629 | conservation of particles in nuclear reactions | | |
| | | | | 630 | antimatter and neutrinos and other particles | | |
| | | | | 646 | standard model of particle physics | | |
| | | | | 647 | matter and antimatter | | |
| | | | | 648 | standard model of particles | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|--|---|--|--------------------|---|---------------------|---|
| 2PSM2.2.a Materials and Their Properties | Properties and Structure of Matter | Elements are pure substances that are composed of identical atoms. Chemists and physicists have identified the elements, isolated them from their natural sources, synthesized them from other elements, and determined their properties... | Discuss the features of the periodic table of the elements. Select any element and discuss the utility of the information presented (symbol, atomic number and mass, electron configuration). Locate the various families and groups ... | 502 | how the periodic table is organized | 175 | record atomic number |
| | | | | 502 | the periodic table | 175 | identify symbol and atomic number and average atomic mass |
| | | | | 569 | elements and atoms and atomic number | 194 | the periodic table |
| | | | | 569 | periodic table is arranged by atomic number | 194 | identify symbol and atomic number and mass number |
| | | | | 570 | chemical properties of isotopes due to atomic structure | 204 | build model of Na and Cl atoms and explain why they bond to form a molecule |
| | | | | 578 | periodic table and quantum states | | |
| | | | | 596 | chemically similar elements and periodic table | | |
| | | | | 596 | alkali metals | | |
| | | | | 598 | groups in periodic table related to valence | | |
| | | | | 598 | arrangement of the periodic table | | |
| 599 | alkali metals tend to form ionic bonds | | | | | | |
| 612 | identifying groups on periodic table | | | | | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---------------------------------------|------------------|--|--|--|--------------------------|--|
| 2PSM2.3.a Materials and Their Properties | Properties and Structure of Matter | (blank) | Substances are formed by atoms interacting with one another and transferring or sharing electrons. These interactions generally involve the electrons farthest from the nucleus, and result in the formation of chemical bonds | 573 593 595 596 597 597 598 599 599 604 610 612 | chemical reactions chemical reactions involve rearrangement of atoms electrons from chemical bonds valence and chemical bonds Lewis dot diagrams why chemical bonds form use of noble gases to prevent chemical bonds in MIG welding ionic vs. covalent ionic and covalent bonds balancing chemical equations in terms of atoms and molecules Lewis dot diagrams ionic vs. covalent bonds | 203 204 204 204 | how many electrons are in the outermost level? determining oxidation numbers what are valence electrons? modeling a chemical bond |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---------------------------------------|---|---|--------------------|--|---------------------|--------|
| 2PSM2.4.a Materials and Their Properties | Properties and Structure of Matter | The properties of compounds depend on the properties and interactions of their molecules. These molecular properties and interactions depend on the kinds of atoms in the molecule, molecular shape and motion, and the electrical forces that exist... | Select a variety of available elements (e.g., iron, magnesium, copper, zinc, carbon, sulfur) and a variety of compounds that contain these elements (e.g., ferric chloride, magnesium sulfate, cupric sulfate, sugar,). Describe the physical nature ... | 503 592 595 | difference between elements and compounds elements and compounds properties of substances are properties of molecules not elements | | |
| 2PSM2.4.b Materials and Their Properties | Properties and Structure of Matter | The properties of compounds depend on the properties and interactions of their molecules. These molecular properties and interactions depend on the kinds of atoms in the molecule, molecular shape and motion, and the electrical forces that exist... | Describe water according to its physical properties (e.g., clarity, odor, density, freezing point, boiling point, surface tension). Develop a molecular model of water that can be used to support this description. Discuss the characteristics of oxygen... | 594 | water as the universal solvent | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|--|---|---|--------------------|--|---------------------|----------------------------------|
| 2PSM2.5.a Materials and Their Properties | Properties and Structure of Matter | Elements and compounds exist as solids, liquids, and gases. In solids, the atomic and molecular structure are orderly and nearly rigid and the vibration of atoms and molecules is constrained to a fixed site... | Develop models that describe the structure and behavior of solids, liquids, and gases at the atomic and molecular level. Use these models to discuss the processes of diffusion, boiling, melting, freezing, evaporation, and condensation,... | 29 | all matter is made of atoms | 174 | matter is composed of atoms |
| | | | | 30 | physical differences between solids and liquids and gases | 177 | observe a common phase change |
| | | | | 30 | relationship between states of matter and arrangement and motion of atoms and molecules | | |
| | | | | 33 | describe movement of atoms in solids and gases | | |
| | | | | 499 | idea that matter is made of atoms proved through Brownian motion | | |
| | | | | 501 | atoms and elements | | |
| | | | | 508 | characteristics of matter related to its phase | | |
| | | | | 508 | phases of matter and arrangement of molecules | | |
| | | | | 509 | melting | | |
| | | | | 510 | boiling | | |
| 511 | evaporation and condensation | | | | | | |
| 519 | phases of matter | | | | | | |
| 595 | chemical bonds determine properties of materials | | | | | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---------------------------------------|--|---|---|---|--------------------------|--|
| 2PSM2.6.a Materials and Their Properties | Properties and Structure of Matter | Isotopes of a given element differ in the number of neutrons in the nucleus, although their chemical properties remain essentially the same. Radioactive isotopes spontaneously decay, releasing energy, and/or emitting particles ... | Construct a table that organizes critical information (symbol, name, atomic number, number of neutrons, mass number, number of electrons) for a series of elements and their isotopes (carbon, hydrogen, fluorine, lead). | 502 570 571 571 572 588 589 | the periodic table isotopes explained atomic mass atomic mass of stable isotopes chart of stable isotopes carbon isotopes calculate atomic mass and average atomic mass | 175 194 194 213 | identify symbol and atomic number and average atomic mass identify symbol and atomic number and mass number isotopes explore radioactive isotopes |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---------------------------------------|--|---|--|---|---------------------|---|
| 2PSM2.6.b Materials and Their Properties | Properties and Structure of Matter | Isotopes of a given element differ in the number of neutrons in the nucleus, although their chemical properties remain essentially the same. Radioactive isotopes spontaneously decay, releasing energy, and/or emitting particles ... | Participate in an activity that models and demonstrates the exponential decay curve of radioactive samples. A suggested activity can be found in ChemCom, Chemistry in the Community, 2nd Edition, (ACS). | 502 570 614 614 615 616 617 618 618 620 634 636 | elements past #92 are radioactive and decay radioactive isotopes three kinds of radioactivity radioactive decay alpha and beta and gamma radiation energy and radioactivity half-life half-life calculation carbon dating danger of gamma rays and alpha particles three kinds of radioactive decay half-life of nitrogen-13 | 209 210 211 | radioactive decay and half life simulate radioactive decay types of radiation |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---|---|---|--------------------------|--|---------------------|--------|
| 2TCM2.1.a Materials and Their Properties | Transformation and Conservation of Matter | Chemical reactions which take place between the atoms and molecules of elements and compounds occur all around us, for example, combustion, rusting of iron, growing of plants, and cooking of foods. Complex chemical reactions take place constantly... | Identify examples of chemical reactions that take place around us (e.g., cooking, greening of grass, air pollution, combustion of fuel, rusting of metal). Discuss the conditions which must be met in order for these reactions to take place... | 579 593 602 607 | structure of water molecule chemical change example of burning formation of rust is a chemical reaction reactions of burning gasoline | | |
| 2TCM2.2.a Materials and Their Properties | Transformation and Conservation of Matter | Virtually all chemical reactions release or absorb energy. During chemical reactions, energy in the form of heat, light, or electricity is absorbed in the breaking of bonds or released when new bonds are formed... | Investigate how the rate of a chemical reaction such as hydrogen peroxide decomposition or fermentation of sugar can be changed by altering such conditions as temperature and pressure, the concentration of reactants, or addition of a catalyst... | | | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---|--|---|--------------------|--|---------------------|---|
| 2TCM2.2.b Materials and Their Properties | Transformation and Conservation of Matter | Virtually all chemical reactions release or absorb energy. During chemical reactions, energy in the form of heat, light, or electricity is absorbed in the breaking of bonds or released when new bonds are formed... | Prepare reaction pathway diagrams which illustrate the energy relationship of reactants and products and the energy barrier which must be overcome in order for reaction to proceed. Use these diagrams or a set of parameters to balance equations ... | 596 | noble gases and alkali metals | 206 | is this reaction endothermic or exothermic? |
| | | | | 597 | the energy of chemical bonds is described | | |
| | | | | 603 | endothermic vs. exothermic reactions | | |
| | | | | 603 | chemical reactions and energy | | |
| | | | | 610 | energy in reaction of dynamite | | |
| | | | | 625 | energy changes in nuclear reactions | | |
| | | | | 626 | source of energy in nuclear reactions | | |
| | | | | 627 | energy of fusion reactions | | |
| | | | | 628 | energy of fission reactions | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---|---|---|--|--|--------------------------|--|
| 2TCM2.3.a Materials and Their Properties | Transformation and Conservation of Matter | A large number of reactions, usually in solution, that are important in non-living and living systems, involve the transfer of either electrons (oxidation/reduction) or hydrogen ions (acid/base reactions). | Explore and report on the use of electron transfer and acid base reactions in some common natural or industrial processes such as photosynthesis, manufacture of NH ₄ NO ₃ fertilizer, and manufacture of TiO ₂ pigment. | 595 596 597 598 599 599 602 612 | electrons from chemical bonds valence and chemical bonds why chemical bonds form use of noble gases to prevent chemical bonds in MIG welding ionic vs. covalent ionic and covalent bonds chemical reaction of making water ionic vs. covalent bonds | 203 204 204 204 | how many electrons are in the outermost level? determining oxidation numbers what are valence electrons? modeling a chemical bond |
| 2TCM2.4.a Materials and Their Properties | Transformation and Conservation of Matter | Regardless of how atoms and molecules in a closed system interact with one another, or how they combine or break apart, the total weight of the system remains the same. (Benchmark for Scientific Literacy, 1993.) | Regardless of how atoms and molecules in a closed system interact with one another, or how they combine or break apart, the total weight of the system remains the same. (Benchmark for Scientific Literacy, 1993.) | 605 605 612 | calculating mass of products and reactions mass conservation in chemical reactions law of mass conservation | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---|---|--|----------------------------|---------------|-----------------------------|---------------|
| 2TCM2.5.a Materials and Their Properties | Transformation and Conservation of Matter | Certain small molecules (monomers) react with one another in repetitive fashion (polymerization) to form long chain macromolecules (polymers). The properties of the macromolecules depend on the properties of the molecules used in their formation... | Collect various plastic containers designed to package or hold materials used in daily activities (e.g., soft drinks, milk, cooking oil, sandwiches, yogurt, hot drinks, catsup). Demonstrate the feasibility of a recycle process that would separate ... | | | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---------------------------------------|------------------|--|--|--------------------|---|---------------------|---|
| 3FM3.1.a Energy and Its Effects | Force and Motion | A force acting on an object and moving it through a distance does work on that object and changes its kinetic energy (energy of motion), potential energy (energy of position), or both. The ratio of output work to input energy is the efficiency... | Analyze and describe qualitatively the changes in potential and kinetic energy of a person participating in an individual sport (e.g., ski-jumping, diving, hitting a ball, and racing). | 190 | conversions of energy | 66 | law of conservation of energy |
| | | | | 191 | the formula for potential energy | 68 | calculate potential and kinetic energy |
| | | | | 191 | calculate the potential energy of a cart | 68 | find the total energy at each position |
| | | | | 192 | calculating kinetic energy depends on speed and mass | 72 | potential to kinetic energy conversion in a pendulum |
| | | | | 192 | the formula for kinetic energy | 72 | draw an energy flow diagram |
| | | | | 193 | deriving the formula for kinetic energy | 74 | investigating collisions and conservation of energy |
| | | | | 193 | calculate the kinetic energy of a moving car | 88 | potential to kinetic energy conversions of a pendulum |
| | | | | 194 | energy transformations | | |
| | | | | 194 | energy transformations | | |
| | | | | 195 | applying conservation of energy for a marble rolling on a hilly track | | |
| | | | | 196 | energy transformation hydroelectric plant | | |
| | | | | 196 | energy transformation hydroelectric plant | | |
| | | | | 197 | conservation of energy for Hoover Dam | | |
| | | | | 197 | calculating energy supplied by Hoover Dam | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 199 | kinetic and potential energy conversions while bouncing in a trampoline | | |
| | | | | 202 | efficiency and energy conversions | | |
| | | | | 205 | efficiency in biological systems | | |
| | | | | 207 | power is the rate of doing work or using energy | | |
| | | | | 208 | units of power | | |
| | | | | 209 | calculating power for common devices | | |
| | | | | 211 | estimate average input power of a person | | |
| | | | | 212 | energy flow in a pendulum | | |
| | | | | 212 | energy conversion | | |
| | | | | 213 | the conversion process of energy flow | | |
| | | | | 216 | estimating the energy in tides | | |
| | | | | 219 | energy flow of a model solar car | | |
| | | | | 220 | calculate energy and power for humans | | |
| | | | | 245 | kinetic to potential energy changes in motion of an oscillator | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 253 | harmonic motion involves both potential and kinetic energy | | |
| | | | | 253 | oscillators exchange energy back and forth between potential and kinetic | | |
| | | | | 256 | resonant systems accumulate energy | | |
| | | | | 277 | waves propagate by exchanging energy between two forms | | |
| | | | | 320 | photosynthesis converts light energy to chemical energy | | |
| | | | | 324 | light from chemical reactions | | |
| | | | | 356 | electromagnetic waves exchange energy between electricity and magnetic parts | | |
| | | | | 393 | conversion of energy in regenerative braking | | |
| | | | | 400 | energy conversions in a series circuit | | |
| | | | | 451 | MRI--energy exchange by a nucleus in a magnetic field | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|-------------------------|--------------------|--|---------------------|--------|
| | | | | 464 | electric motor uses electromagnets to convert electrical energy to mechanical energy | | |
| | | | | 467 | electric generators transform mechanical energy into electric energy | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---------------------------------------|------------------|--|---|--------------------|--|---------------------|--|
| 3FM3.1.b Energy and Its Effects | Force and Motion | A force acting on an object and moving it through a distance does work on that object and changes its kinetic energy (energy of motion), potential energy (energy of position), or both. The ratio of output work to input energy is the efficiency... | Use a simple machine such as a 10 speed bicycle to investigate the relationship among work, power, and efficiency. Calculate the mechanical advantage and discuss its importance in the use of the machine. | 105 | friction is the force that keeps nails and screws in place | 59 | investigate block and tackle machine |
| | | | | 134 | forces on an inclined plane | 60 | operate and study a block and tackle machine |
| | | | | 173 | changing gears in a bicycle | 61 | find the mechanical advantage |
| | | | | 178 | input and output for simple machines | 62 | investigate block and tackle machine |
| | | | | 178 | how simple machines manipulate forces | 69 | calculate efficiency for each ball |
| | | | | 179 | types of simple machines | 70 | calculate work |
| | | | | 179 | how to calculate mechanical advantage | 70 | calculate person's power |
| | | | | 180 | the mechanical advantage of a lever | 71 | calculate work done |
| | | | | 181 | how a lever works | 71 | calculate power output for each climber |
| | | | | 181 | how a lever works | | |
| | | | | 182 | mechanical advantage of ropes and pulleys | | |
| | | | | 183 | how wheels and gears work | | |
| | | | | 184 | ramps and screws | | |
| | | | | 185 | how to calculate work | | |
| | | | | 187 | calculating work done against gravity | | |
| | | | | 191 | calculate the potential energy of a cart | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 192 | calculating kinetic energy depends on speed and mass | | |
| | | | | 193 | calculate the kinetic energy of a moving car | | |
| | | | | 197 | calculating energy supplied by Hoover Dam | | |
| | | | | 200 | calculate fulcrum point of a lever | | |
| | | | | 202 | definition of efficiency | | |
| | | | | 203 | efficiency explained | | |
| | | | | 207 | power is the rate of doing work or using energy | | |
| | | | | 207 | calculate power in climbing stairs | | |
| | | | | 208 | units of power | | |
| | | | | 208 | power formulas | | |
| | | | | 209 | calculating power for common devices | | |
| | | | | 210 | estimating the power in wind | | |
| | | | | 211 | power in biological systems | | |
| | | | | 211 | estimate average input power of a person | | |
| | | | | 213 | efficiency of an energy flow process | | |
| | | | | 216 | estimating the energy in tides | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 219 | ideal vs. real machine | | |
| | | | | 220 | calculate energy and power for humans | | |
| | | | | 220 | calculate power rating | | |
| | | | | 220 | calculate efficiency of model solar car | | |
| | | | | 236 | fuel efficiency of turbofan engines | | |
| | | | | 311 | efficiency of electric vs. fluorescent light bulbs | | |
| | | | | 393 | efficiency of hybrid cars | | |
| | | | | 409 | power and efficiency of electric cars | | |
| | | | | 440 | the difference between magnetic poles and electric charge | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---------------------------------------|------------------|---|--|--------------------|---|---------------------|---|
| 3FM3.2.a Energy and Its Effects | Force and Motion | Displacement, velocity, acceleration, and time are used to describe the motion or changes in the motion of an object. | Use available data to display graphically the effect of weight, speed, and driver response time on the stopping distance of cars and trucks. Discuss the importance of each variable in determining the overall stopping distance... | 13 | physics and bicycles | 13 | graph speed versus position |
| | | | | 48 | graphs showing changes in speed | 17 | find the acceleration |
| | | | | 50 | graphs for motion of increasing speed and decreasing speed | 25 | derive acceleration equation |
| | | | | 61 | constant speed and constant acceleration | 27 | were any forces acting on the ball? |
| | | | | 63 | calculating acceleration from a speed vs. time graph | 29 | calculate the acceleration |
| | | | | 64 | calculate speed in accelerated motion | 73 | calculating momentum |
| | | | | 67 | calculate time and distance from acceleration | 75 | investigate collisions and conservation of momentum |
| | | | | 74 | sketching speed vs. time graphs for different changes of motion | 77 | the momentum form of Newton's second law |
| | | | | 76 | analyzing graph for changes in motion | | |
| | | | | 78 | force is an action that can change motion | | |
| | | | | 80 | Newton's laws and cup holders | | |
| | | | | 81 | force is related to acceleration | | |
| | | | | 100 | friction is a force that resists motion | | |
| | | | | 148 | centripetal force causes circular motion | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 155 | satellite motion application | | |
| | | | | 172 | force and torque transformations in bicycles | | |
| | | | | 173 | force and torque transformations in bicycles | | |
| | | | | 223 | momentum formula and calculating momentum | | |
| | | | | 226 | solving elastic and inelastic collision problems | | |
| | | | | 228 | car crash safety | | |
| | | | | 229 | force on a rocket from change in momentum | | |
| | | | | 230 | calculate change in momentum for elastic vs. inelastic collisions | | |
| | | | | 236 | momentum conservation of turbofan engine | | |
| | | | | 238 | momentum in billiards | | |
| | | | | 239 | calculate momentum | | |
| | | | | 240 | forces in a car stopping | | |
| | | | | 254 | definition of periodic force | | |
| | | | | 276 | natural frequency and harmonics | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---------------------------------------|------------------|---|--|--------------------|---|---------------------|--|
| 3FM3.3.a Energy and Its Effects | Force and Motion | Objects can have linear motion, rotational motion, or both. Newton's Laws can be used to predict changes in linear motion and/or rotational motion. Momentum allows objects to remain in motion after the applied force is removed... | Use Newton's Laws of Motion to investigate the effect of force on velocity, acceleration, and equilibrium of an object. Describe the relationship between the kinetic and potential energy of the object using narrative and/or quantitative descriptions. | 13 | physics applies to the internal working of the body | 17 | find the acceleration |
| | | | | 13 | biomechanics | 25 | derive acceleration equation |
| | | | | 13 | physics and bicycles | 26 | study Newton's first law |
| | | | | 61 | any acceleration must come from a force | 27 | explain how Newton's first law applies |
| | | | | 64 | calculate speed in accelerated motion | 27 | were any forces acting on the ball? |
| | | | | 67 | calculate time and distance from acceleration | 27 | collect data on Newton's first law |
| | | | | 78 | changes in motion only occur through force | 28 | investigate Newton's second law |
| | | | | 78 | force is an action that can change motion | 29 | calculate the acceleration |
| | | | | 79 | what systems in a car overcome the law of inertia | 30 | Newton's third law and free body diagrams |
| | | | | 79 | all objects tend to resist changes in motion | 30 | investigate Newton's third law |
| | | | | 79 | all objects tend to resist changes in motion | 31 | draw free body diagrams and identify action-reaction pairs |
| | | | | 80 | seat belts and air bags and Newton's first law | 31 | draw free body diagrams and identify action-reaction pairs |
| | | | | 80 | Newton's laws and cup holders | 45 | balancing a specified force |
| | | | | 80 | Newton's laws and cup holders | 49 | consider forces acting on the ball |
| | | | | 81 | force is related to acceleration | 49 | consider forces acting on the ball |
| | | | | 81 | force is related to acceleration | 60 | operate and study a block and tackle machine |
| | | | | 81 | Newton's second law of motion | 60 | operate and study a block and tackle machine |
| | | | | 81 | Newton's second law of motion | 72 | potential to kinetic energy conversion in a pendulum |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--|
| | | | | 83 | calculation using Newton's second law | 77 | relationship between force and motion and the second law |
| | | | | 83 | finding the net force | | |
| | | | | 84 | calculating net force | 88 | potential to kinetic energy conversions of a pendulum |
| | | | | 84 | Newton's second law and dynamics problems | | |
| | | | | 85 | if there is acceleration there must be force | | |
| | | | | 85 | finding force from acceleration | | |
| | | | | 85 | force problems | | |
| | | | | 86 | zero acceleration means net zero force | | |
| | | | | 87 | explaining Newton's third law in terms of an astronaut moving through space | | |
| | | | | 87 | forces always occur in action-reaction pairs | | |
| | | | | 88 | Newton's third law operates on pairs of objects | | |
| | | | | 88 | explaining Newton's third law in terms of moving a skateboard | | |
| | | | | 89 | solving problems with action-reaction forces | | |
| | | | | 89 | identifying which force is acting on which object | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 90 | the natural jet engine in a squid | | |
| | | | | 90 | examples of Newton's third law | | |
| | | | | 91 | force platform used to analyze forces from running and walking | | |
| | | | | 92 | force from a vertical jump | | |
| | | | | 93 | problems using Newton's first law and second law | | |
| | | | | 94 | seat belt problem | | |
| | | | | 98 | effects of g forces and zero gravity on the human body | | |
| | | | | 99 | balanced force problems | | |
| | | | | 100 | friction is a force that resists motion | | |
| | | | | 102 | the normal force as the reaction in an action-reaction pair | | |
| | | | | 103 | net force includes the force of friction | | |
| | | | | 106 | net force must be zero in equilibrium | | |
| | | | | 106 | Newton's second law and net force | | |
| | | | | 107 | net force of zero and free-body diagram | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 107 | forces on a free-body diagram | | |
| | | | | 108 | use equilibrium to find an unknown force | | |
| | | | | 108 | equilibrium and Newton's second law | | |
| | | | | 111 | understanding reaction forces in terms of springs and deformation | | |
| | | | | 112 | analysis of forces on a bridge | | |
| | | | | 116 | calculate the acceleration of a toy | | |
| | | | | 133 | balancing forces in two dimensions | | |
| | | | | 135 | normal force of an inclined plane | | |
| | | | | 136 | calculating acceleration on a ramp | | |
| | | | | 137 | the vector form of Newton's second law | | |
| | | | | 137 | predicting motion in three dimensions and controlling force and acceleration in space missions | | |
| | | | | 137 | calculating acceleration from 3-D forces | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 139 | determining position by triangulation and inertial navigation | | |
| | | | | 141 | calculate the net force | | |
| | | | | 148 | direction of force determines linear or rotational motion | | |
| | | | | 148 | centripetal force causes circular motion | | |
| | | | | 149 | calculating centripetal force | | |
| | | | | 150 | formula for centripetal acceleration | | |
| | | | | 150 | using centripetal acceleration to create the feeling of gravity by rotating the space station | | |
| | | | | 151 | banked turns | | |
| | | | | 155 | satellite motion application | | |
| | | | | 156 | satellites in orbit | | |
| | | | | 168 | Newton's first law and rotational inertia | | |
| | | | | 169 | Newton's second law applies to rotational motion | | |
| | | | | 171 | Newton's second law for rotational motion variables | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 172 | force and torque transformations in bicycles | | |
| | | | | 173 | force and torque transformations in bicycles | | |
| | | | | 178 | how simple machines manipulate forces | | |
| | | | | 179 | how to calculate mechanical advantage | | |
| | | | | 180 | the mechanical advantage of a lever | | |
| | | | | 180 | mechanical advantage of human arm | | |
| | | | | 181 | how a lever works | | |
| | | | | 182 | mechanical advantage of ropes and pulleys | | |
| | | | | 183 | how wheels and gears work | | |
| | | | | 184 | ramps and screws | | |
| | | | | 194 | energy transformations | | |
| | | | | 196 | energy transformation hydroelectric plant | | |
| | | | | 199 | kinetic and potential energy conversions while bouncing in a trampoline | | |
| | | | | 212 | energy flow in a pendulum | | |
| | | | | 222 | Newton's first law and momentum | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 224 | momentum and Newton's third law | | |
| | | | | 228 | seat belts and air bags | | |
| | | | | 228 | Newton's second law relating force and momentum | | |
| | | | | 228 | car crash safety | | |
| | | | | 229 | momentum form of Newton's second law | | |
| | | | | 234 | gyroscopes and the space shuttle | | |
| | | | | 238 | cars that crumple in a collision | | |
| | | | | 240 | forces in a car stopping | | |
| | | | | 245 | kinetic to potential energy changes in motion of an oscillator | | |
| | | | | 252 | Newton's second law and natural frequency | | |
| | | | | 253 | oscillators exchange energy back and forth between potential and kinetic | | |
| | | | | 254 | definition of periodic force | | |
| | | | | 425 | electric forces always occur in pairs according to Newton's third law | | |
| | | | | 440 | the difference between magnetic poles and electric charge | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|-------------------------|--------------------|--|---------------------|--------|
| | | | | 448 | biological compasses of animals | | |
| | | | | 548 | Newton's third law and pressure in a fluid | | |
| | | | | 550 | pressure and the third law | | |
| | | | | 557 | pressure of gases | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---------------------------------------|------------------|---|---|--------------------|--|---------------------|---|
| 3FM3.3.b Energy and Its Effects | Force and Motion | Objects can have linear motion, rotational motion, or both. Newton's Laws can be used to predict changes in linear motion and/or rotational motion. Momentum allows objects to remain in motion after the applied force is removed... | Describe different ways in which the effects of twisting forces (torque) are used in everyday situations (e.g., tightening a bolt, using a screwdriver, or opening a combination lock). Demonstrate how the magnitudes of these torques can be altered. | 160 | center of rotation | 53 | relationship between force and torque |
| | | | | 160 | how torque and force differ | 53 | calculating torque |
| | | | | 161 | line of action and the torque created by a force | 54 | explore rotational equilibrium and net torque |
| | | | | 161 | calculating torque using torque equation | 80 | torque changes the direction of angular momentum vector |
| | | | | 162 | combining torques to find the net torque | | |
| | | | | 162 | calculating torque | | |
| | | | | 163 | solve a rotational equilibrium problem | | |
| | | | | 163 | in rotational equilibrium the net torque is zero | | |
| | | | | 164 | calculate a torque from an angled force | | |
| | | | | 164 | when force and lever arm are not perpendicular | | |
| | | | | 174 | calculating torque | | |
| | | | | 174 | compare force and torque | | |
| | | | | 181 | torque and mechanical advantage of a lever | | |
| | | | | 183 | mechanical advantage of gears | | |
| | | | | 234 | torque resists change in angular momentum | | |
| | | | | 442 | torque between two magnets | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---------------------------------------|------------------|---|--|--------------------|---|---------------------|--|
| 3FM3.3.c Energy and Its Effects | Force and Motion | Objects can have linear motion, rotational motion, or both. Newton's Laws can be used to predict changes in linear motion and/or rotational motion. Momentum allows objects to remain in motion after the applied force is removed... | Use the law of Conservation of Momentum to describe and discuss the results of a collision between two or more objects (e.g., players in various sports, moving vehicles). | 222 | comparison of kinetic energy and momentum | 73 | momentum is a vector |
| | | | | 223 | momentum is a vector | 73 | calculating momentum |
| | | | | 223 | momentum formula and calculating momentum | 75 | investigate collisions and conservation of momentum |
| | | | | 224 | law of conservation of momentum | 77 | the momentum form of Newton's second law |
| | | | | 225 | conservation of momentum in collisions | 78 | which ball had a greater change in momentum? |
| | | | | 226 | solving elastic and inelastic collision problems | 79 | investigate angular momentum |
| | | | | 226 | applying conservation of momentum | 80 | explain life application of conservation of momentum |
| | | | | 227 | momentum conservation for collisions in two and three dimensions | 80 | angular momentum behaves like a vector |
| | | | | 229 | force on a rocket from change in momentum | | |
| | | | | 230 | calculate change in momentum for elastic vs. inelastic collisions | | |
| | | | | 230 | impulse formula | | |
| | | | | 231 | conservation of angular momentum examples | | |
| | | | | 231 | what is angular momentum | | |
| | | | | 232 | angular momentum depends on speed and mass and shape | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 232 | conservation of angular momentum | | |
| | | | | 233 | formula for angular momentum | | |
| | | | | 235 | jet engines work because of conservation of momentum | | |
| | | | | 236 | momentum conservation of turbofan engine | | |
| | | | | 237 | why is momentum a vector | | |
| | | | | 238 | momentum in billiards | | |
| | | | | 238 | difference between impact and impulse | | |
| | | | | 239 | calculate momentum | | |
| | | | | 276 | natural frequency and harmonics | | |
| | | | | 370 | Einstein's thinking about momentum of particles moving near the speed of light | | |
| | | | | 629 | conservation of momentum in nuclear reactions | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|----------------------------|---|--|--------------------|--|---------------------|---|
| 3FSE3.1.a Energy and Its Effects | Forms/Sources of Energy | Electromagnetic radiation is a form of energy which can exhibit both wave and particle characteristics and does not require a material medium for its transmission. The energy of the radiation depends on both the intensity (brightness) and frequency. | Conduct experiments to demonstrate wave characteristics such as propagation, frequency, wavelength, amplitude, and interference for both mechanical and electromagnetic waves. Discuss how these characteristics are used in modern devices (e.g. sonar, radar). | 242 | what is a cycle? | 81 | investigate the motion of a pendulum |
| | | | | 244 | concepts of period and frequency explained | 88 | if frequency is increased what happens to total energy? |
| | | | | 245 | concept of amplitude explained | | |
| | | | | 249 | analyze the motion of the cycle of a pendulum | 89 | making wave pulses on a string |
| | | | | 251 | systems tends to have a preferred frequency | 89 | study characteristics of a wave pulse on a string |
| | | | | 258 | identify period and frequency and cycle and amplitude | 89 | study wave pulses on elastic cord |
| | | | | 260 | calculate speed of an oscillator | 90 | study the speed of the wave pulse |
| | | | | 262 | waves are all around us | 90 | measure speed of a wave pulse |
| | | | | 264 | frequency and amplitude and wavelength in waves | 91 | make different types of waves in a ripple tank |
| | | | | 264 | basic properties of frequency and wavelength and amplitude | 91 | making circular waves in a ripple tank |
| | | | | 265 | wave pulse | 91 | is your water wave transverse or longitudinal? |
| | | | | 265 | concept of speed of a wave | 91 | making plane waves in a ripple tank |
| | | | | 266 | formula for speed of a wave | 93 | investigate frequency and wavelength |
| | | | | 266 | speed of a wave is the speed at which a cycle moves | 94 | investigate harmonic wave patterns |
| | | | | | | 94 | investigate the wavelength of standing waves |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--|
| | | | | 267 | transverse and longitudinal waves | 94 | investigate the frequency of standing waves |
| | | | | 267 | water waves are transverse and Slinky is longitudinal | 96 | investigate human perception of sound |
| | | | | 268 | creating plane waves and circular waves | 101 | investigate interference with sound waves |
| | | | | 268 | one- and two- and three-dimensional waves | 125 | study the polarization of a transverse spring wave |
| | | | | 273 | constructive and destructive interference | | |
| | | | | 273 | sound and light waves and interference | | |
| | | | | 275 | standing waves on a string | | |
| | | | | 276 | concept of harmonics | | |
| | | | | 277 | standing waves are used to store energy | | |
| | | | | 277 | energy of a wave is proportional to frequency and amplitude | | |
| | | | | 277 | standing waves on a string | | |
| | | | | 278 | nodes and antinodes | | |
| | | | | 278 | modes of a wave | | |
| | | | | 278 | wavelength of a standing wave | | |
| | | | | 279 | vibration of a drum | | |
| | | | | 279 | modes of vibration | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 281 | microwaves | | |
| | | | | 281 | use of microwaves in microwave ovens | | |
| | | | | 282 | describe relationship between wave characteristics | | |
| | | | | 283 | type of wave represented by a spring | | |
| | | | | 286 | properties of sound waves | | |
| | | | | 286 | sound waves require matter to traverse | | |
| | | | | 289 | acoustics | | |
| | | | | 292 | sound is a longitudinal wave | | |
| | | | | 292 | importance of wavelength of sound waves | | |
| | | | | 295 | designing a musical instrument | | |
| | | | | 295 | standing wave patterns of sound | | |
| | | | | 296 | design of a good concert hall | | |
| | | | | 296 | interference of sound waves | | |
| | | | | 298 | sonograms | | |
| | | | | 301 | echolocation and beats | | |
| | | | | 301 | consonance and dissonance and beats | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 302 | harmonics and frequency and the color of sound | | |
| | | | | 302 | musical instruments | | |
| | | | | 303 | design of a guitar | | |
| | | | | 303 | sound from a guitar | | |
| | | | | 306 | beats in a musical sound | | |
| | | | | 308 | wave amplitude and harmonics of tuning fork and musical instrument | | |
| | | | | 359 | descriptions of radio waves and microwaves and infrared rays | | |
| | | | | 359 | waves of the electromagnetic spectrum | | |
| | | | | 360 | x-rays and gamma rays | | |
| | | | | 452 | MRI uses radio waves | | |
| | | | | 452 | MRI--each nucleus is a resonant oscillator | | |
| | | | | 530 | electromagnetic radiation | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|----------------------------|---|--|--------------------|---|---------------------|---|
| 3FSE3.2.a Energy and Its Effects | Forms/Sources of Energy | Electricity results from the movement of electric charges through a complete circuit under the influence of an applied voltage. The electric current flowing in any circuit or part of a circuit depends on the voltage and resistance and can be calculated ... | Construct parallel and series circuits and apply Ohm's law when evaluating the circuits. | 386 | relationship between current and resistance | 134 | Ohm's law |
| | | | | 388 | Ohm's law | 135 | derive Ohm's law from experiment |
| | | | | 396 | calculation of voltage from resistance and current | 136 | use Ohm's law to calculate the resistance |
| | | | | 398 | parallel circuit defined | 137 | parallel circuit and Ohm's law |
| | | | | 398 | series circuit defined | 137 | investigate series circuits |
| | | | | 399 | current and resistance in a series circuit | 138 | build a parallel circuit |
| | | | | 399 | calculating current in a series circuit using Ohm's law | 138 | apply Ohm's law to series circuits |
| | | | | 400 | voltage in a series circuit | 139 | compare series and parallel circuits |
| | | | | 401 | parallel circuits | 139 | analyze parallel circuits |
| | | | | 402 | advantages of parallel circuits over series circuits | 140 | build and analyze network circuits |
| | | | | 402 | voltage and current in a parallel circuit | 171 | use Ohm's law to calculate the resistance of the transistor |
| | | | | 403 | using Ohm's law in parallel circuits | | |
| | | | | 403 | resistance in parallel circuits | | |
| | | | | 404 | using Ohm's law for circuit analysis | | |
| | | | | 405 | voltage dividers | | |
| | | | | 406 | comparing series and parallel circuits | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 407 | solving network circuits | | |
| | | | | 407 | solving network circuits | | |
| | | | | 407 | calculate currents and voltages in a network circuit | | |
| | | | | 414 | why series circuits are not used in homes and buildings | | |
| | | | | 414 | why parallel circuits are used in homes and buildings | | |
| | | | | 415 | compare current in a series and parallel circuit | | |
| | | | | 416 | using Ohm's law to calculate current | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|----------------------------|--|--|--|---|---------------------|--------|
| 3FSE3.2.b Energy and Its Effects | Forms/Sources of Energy | Electricity results from the movement of electric charges through a complete circuit under the influence of an applied voltage. The electric current flowing in any circuit or part of a circuit depends on the voltage and resistance and can be calculated ... | Outline the differences between AC and DC current, and discuss the reasons for their use in specific applications. | 411 411 412 466 470 471 478 478 484 484 | definition of AC current definition of DC current calculating power for AC circuits using a power factor AC motors generators are source of alternating current transformers only work with AC current diodes and AC to DC adapters diodes and AC to DC adapters rectifier circuit converts AC electricity to DC rectifier circuit converts AC electricity to DC | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|----------------------------|--|---|--------------------|--|---------------------|--|
| 3FSE3.3.a Energy and Its Effects | Forms/Sources of Energy | Electric forces between charged objects are attractive or repulsive. The electric forces between electrons and protons are attractive, determine the structure of atoms, and are involved in all chemical reactions ... | Discuss the role that attractive electric forces between electrons and protons have in determining the structure of the atom. | 418 | electric charge is a fundamental property of matter | 146 | build a simple electroscope |
| | | | | 419 | electric forces are created between electric charges | 147 | investigate the concept of electric charge |
| | | | | 420 | electric charge is a property of the particles that make up the atom | 149 | investigate charged balloons |
| | | | | 420 | explanation of coulomb | 194 | basic properties of subatomic particles |
| | | | | 421 | current is the flow of charge | | |
| | | | | 422 | negative charge of electrons and current flow | | |
| | | | | 422 | movement of electrons in current | | |
| | | | | 423 | static electricity and charge polarization and induction | | |
| | | | | 424 | relationship of electric force and charge | | |
| | | | | 425 | the force between charges | | |
| | | | | 426 | charge creates an electric field | | |
| | | | | 428 | source charges and test charges | | |
| | | | | 430 | a capacitor stores charge | | |
| | | | | 433 | ability of a capacitor to store charge is capacitance | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 444 | magnetism is a property of particles that make up the atom | | |
| | | | | 459 | atomic currents | | |
| | | | | 480 | electrons in a semiconductor | | |
| | | | | 500 | smallest piece of matter is the atom | | |
| | | | | 566 | charge and mass of electrons and protons and neutrons | | |
| | | | | 567 | mass and the nucleus | | |
| | | | | 568 | forces in the atom | | |
| | | | | 588 | properties of subatomic particles | | |
| | | | | 626 | strong force and electromagnetic force in the nucleus | | |
| | | | | 649 | four forces in nature | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|----------------------------|---|--|--------------------|--|---------------------|---|
| 3FSE3.4.a Energy and Its Effects | Forms/Sources of Energy | Magnetic forces and electric forces are thought of as different aspects of a single electromagnetic force. Moving electric charges produce magnetic fields which exert magnetic force on other objects and produce electric forces... | Construct an electromagnet and demonstrate how it can be used. Investigate the relationship between the magnetic force and the electric current. Discuss the advantages and disadvantages of permanent magnets vs. electromagnets. | 435 | steering the electron beam on television screen | 159 | build an electromagnet |
| | | | | 456 | magnetic field of a wire | 160 | study the right-hand rule |
| | | | | 457 | right-hand rule | 160 | find out what happens to strength of electromagnet when current is increased |
| | | | | 457 | force on a current in a magnetic field | 160 | what happens to the strength of an electromagnet when you increase the current? |
| | | | | 458 | coils and solenoids | | |
| | | | | 459 | the magnetic field of coils and permanent magnets | | |
| | | | | 461 | calculate magnetic field at the center of a coil | 165 | investigate electromagnetic induction |
| | | | | 462 | coils used in electromagnets | | |
| | | | | 462 | finding the poles of an electromagnet using right-hand rule | | |
| | | | | 462 | electromagnets | | |
| | | | | 463 | adding turns increases an electromagnet's strength | | |
| | | | | 463 | building an electromagnet | | |
| | | | | 464 | electric motor uses electromagnets to convert electrical energy to mechanical energy | | |
| | | | | 465 | how electromagnets are used in electric motors | | |
| | | | | 467 | concept of electromagnetic induction | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------------------|-------------------------|---|--|--------------------|--|---------------------|--|
| | | | | 471 | transformers operate on electromagnetic induction | | |
| | | | | 472 | electromagnet-based maglev | | |
| | | | | 475 | using right-hand rule | | |
| | | | | 475 | diagram of electromagnet | | |
| 3FSE3.4.b Energy and Its Effects | Forms/Sources of Energy | Magnetic forces and electric forces are thought of as different aspects of a single electromagnetic force. Moving electric charges produce magnetic fields which exert magnetic force on other objects and produce electric forces... | Devise an experiment to generate an electric current using a wire and a magnet. Measure the magnetic field resulting from the flow of the current. | 458 | coils and solenoids | 165 | investigate electromagnetic induction |
| | | | | 459 | the magnetic field of coils and permanent magnets | 165 | investigate Faraday's law of induction |
| | | | | 461 | calculate magnetic field at the center of a coil | | |
| | | | | 462 | coils used in electromagnets | | |
| | | | | 463 | adding turns increases an electromagnet's strength | | |
| | | | | 467 | concept of electromagnetic induction | | |
| | | | | 468 | magnetic flux | | |
| | | | | 469 | Faraday's law of induction | | |
| | | | | 471 | transformers operate on electromagnetic induction | | |
| | | | | 473 | Eddy currents | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|----------------------------|---|---|--------------------|--|---------------------|---|
| 3FSE3.5.a Energy and Its Effects | Forms/Sources of Energy | Chemical energy is derived from the gain or loss of electrons between atoms during the making and breaking of chemical bonds. The energy released or absorbed in a chemical reaction can be predicted and measured... | Measure heat evolved or absorbed in a chemical reaction. Discuss how energy and matter are conserved in the reaction. | 194 | the law of conservation of energy | 206 | is this reaction endothermic or exothermic? |
| | | | | 194 | conservation of energy explained | | |
| | | | | 195 | conservation of energy in a closed system | | |
| | | | | 203 | efficiency and conservation of energy | | |
| | | | | 206 | connection between efficiency and time | | |
| | | | | 215 | energy flows in biological systems | | |
| | | | | 227 | kinetic energy conservation for elastic collisions | | |
| | | | | 370 | relationship and conservation of mass and energy | | |
| | | | | 469 | energy conservation and Faraday's law | | |
| | | | | 515 | thermodynamics and conservation of energy | | |
| | | | | 552 | conservation of energy in fluids | | |
| | | | | 553 | energy conservation and Bernoulli's equation | | |
| | | | | 596 | noble gases and alkali metals | | |
| | | | | 597 | the energy of chemical bonds is described | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 603 | chemical reactions and energy | | |
| | | | | 603 | endothermic vs. exothermic reactions | | |
| | | | | 610 | energy in reaction of dynamite | | |
| | | | | 625 | energy changes in nuclear reactions | | |
| | | | | 626 | source of energy in nuclear reactions | | |
| | | | | 627 | energy of fusion reactions | | |
| | | | | 628 | energy of fission reactions | | |
| | | | | 629 | conservation of energy in nuclear reactions | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|----------------------------|--|---|--------------------|--|---------------------|---|
| 3FSE3.6.a Energy and Its Effects | Forms/Sources of Energy | Nuclear energy is related as heat, light, or radiation when a portion of the mass of the nucleus is converted to energy. The nuclear forces which hold the nucleus of an atom together are much stronger than the repulsive electric forces between protons... | Compare the matter and energy relationships in nuclear fission, and nuclear transmutations with those in fossil fuels. Discuss the advantages and disadvantages of each for power generation. | 196 | environmental impacts of hydroelectric power | 143 | the cost of using electrical appliances |
| | | | | 196 | hydroelectric power system | | |
| | | | | 197 | efficiency of the Hoover Dam | | |
| | | | | 217 | extracting tidal power | | |
| | | | | 217 | advantages of tidal energy | | |
| | | | | 470 | energy for generators | | |
| | | | | 570 | use of radioactive isotopes in medicine | | |
| | | | | 597 | the energy of chemical bonds is described | | |
| | | | | 602 | hydrogen as a fuel | | |
| | | | | 608 | alternate fuels to gasoline | | |
| | | | | 618 | power released by radioactive decay | | |
| | | | | 621 | sources of radiation in the environment | | |
| | | | | 622 | x-ray machines | | |
| | | | | 623 | CAT scans | | |
| | | | | 625 | energy changes in nuclear reactions | | |
| | | | | 626 | source of energy in nuclear reactions | | |
| | | | | 627 | energy of fusion reactions | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|-------------------------|--------------------|----------------------------------|---------------------|--------|
| | | | | 628 | energy of fission reactions | | |
| | | | | 631 | nuclear power application | | |
| | | | | 631 | nuclear power application | | |
| | | | | 632 | nuclear energy | | |
| | | | | 632 | nuclear waste | | |
| | | | | 632 | nuclear energy | | |
| | | | | 634 | comparison of fission and fusion | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|--|--|--|--------------------|---|---------------------|--|
| 3IEM3.1.a Energy and Its Effects | Interactions of Energy and Materials | Energy waves may interact with materials leading to the formation of heat or other forms of energy. These interactions, which depend upon the nature of the wavelength of the radiation, can be used to create practical devices such as electric heaters,... | Investigate the reflection, refraction, transmission, or absorption of light waves by various materials. | 310 | how we see | 106 | study refraction in a prism |
| | | | | 315 | light bends as it moves into a material | 106 | use a mirror to study how light behaves |
| | | | | 315 | mirrors | 106 | study reflection in a prism |
| | | | | 315 | light rays bounce off a surface | 113 | study how refraction works |
| | | | | 317 | how the human eye sees color | 114 | study the critical angle of refraction in a prism |
| | | | | 318 | how we perceive color | 114 | study index of refraction |
| | | | | 319 | we see mostly reflected light | 123 | study light interference |
| | | | | 324 | the process of how light is reflected | 123 | study light diffraction patterns |
| | | | | 324 | the process of how light is reflected | | |
| | | | | 331 | lenses bend light | | |
| | | | | 331 | mirrors reflect light | | |
| | | | | 332 | specular and diffuse reflection | | |
| | | | | 332 | the image in a mirror | | |
| | | | | 333 | finding the normal line for reflection | | |
| | | | | 334 | the index of refraction | | |
| | | | | 334 | refraction is the bending of light rays | | |
| | | | | 335 | refraction depends on index of refraction in both materials | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 336 | total internal reflection and the critical angle | | |
| | | | | 336 | how fiber optics work | | |
| | | | | 338 | how the human eye sees images | | |
| | | | | 339 | the image formed in a mirror | | |
| | | | | 340 | design of a lens | | |
| | | | | 345 | diffraction spot size image defect | | |
| | | | | 353 | explain fiber optic cables | | |
| | | | | 353 | explain index of refraction | | |
| | | | | 358 | index of refraction is ratio of speed of light in material to speed of light in vacuum | | |
| | | | | 361 | interference of light waves and Young's double-slit experiment | | |
| | | | | 362 | diffraction grating | | |
| | | | | 364 | transmission of light through two polarizers | | |
| | | | | 372 | three-dimensional images and the human eye | | |
| | | | | 373 | holograms and the interference of light | | |
| | | | | 376 | fiber optic cable calculation | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------------------|--------------------------------------|---|---|--------------------|---|---------------------|--------|
| | | | | 530 | absorption of thermal radiation | | |
| | | | | 531 | blackbody and perfect absorption of light | | |
| | | | | 574 | absorption of light | | |
| | | | | 586 | emission and absorption of photons in laser light | | |
| 3IEM3.1.b Energy and Its Effects | Interactions of Energy and Materials | Energy waves may interact with materials leading to the formation of heat or other forms of energy. These interactions, which depend upon the nature of the wavelength of the radiation, can be used to create practical devices such as electric heaters,... | Identify the different ways in which electrical conductors, insulators, and semiconductors respond to an electric potential. Discuss the differences in terms of the particulate model of matter. | 390 | classifying materials as conductor or insulator or semiconductor | | |
| | | | | 395 | classify conductivity of materials | | |
| | | | | 421 | negative charges move in a conductor | | |
| | | | | 422 | atomic structures of conductors and insulators and semiconductors | | |
| | | | | 429 | using a conductor as shielding from electric fields | | |
| | | | | 480 | conductivity and semiconductors | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|--|--|--|----------------------------|------------------------------|-----------------------------|---------------|
| 3IEM3.2.a Energy and Its Effects | Interactions of Energy and Materials | When radiation energy is absorbed or emitted by individual atoms or molecules, the changes in energy involve the jump of an electron from one distinct energy level to another, These energy changes, which are characteristic of the atom or molecule,... | Use flame tests to identify the various elements in a mixture. Discuss how scientists use this technique to analyze unknown materials or celestial bodies. | 575 | spectral analysis of the sun | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|--|--|--|--|--------------------|--|---------------------|---|
| 3IEM3.2.b Energy and Its Effects | Interactions of Energy and Materials | When radiation energy is absorbed or emitted by individual atoms or molecules, the changes in energy involve the jump of an electron from one distinct energy level to another, These energy changes, which are characteristic of the atom or molecule,... | Describe things which are luminous such as fireflies, marine organisms, and the Sun vs. things which are illuminated such as the Moon, street signs, or bike reflectors. | 310 | how we see | 110 | all light is produced by atoms |
| | | | | 317 | how the human eye sees color | 124 | use a spectrometer to measure wavelength of different colors of light |
| | | | | 318 | how we perceive color | | |
| | | | | 319 | we see mostly reflected light | 197 | absorption and emission of light by atomic electrons |
| | | | | 324 | the process of how light is reflected | | |
| | | | | 357 | relationship between frequency and energy and color of light | | |
| | | | | 362 | diffraction patterns and the spectrometer | | |
| | | | | 375 | relate color to frequency for visible light | | |
| | | | | 574 | emission/absorption spectrum | | |
| | | | | 575 | spectrum of hydrogen | | |
| | | | | 575 | spectral analysis of the sun | | |
| | | | | 638 | spectral-line patterns and red shift | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---|--|--|--------------------|---|---------------------|--|
| 3PCAE3.1.a Energy and Its Effects | Production /Consumption/ Application of Energy | Demand for energy by society leads to continuous exploration in order to expand supplies of fossil fuels (e.g., drilling deeper oil and gas wells, drilling offshore). In addition, technology has been developed to create alternate energy sources... | Compare the advantages and disadvantage (including cost) of different finite and renewable energy sources and identify their applications. | 196 | environmental impacts of hydroelectric power | 143 | the cost of using electrical appliances |
| | | | | 196 | hydroelectric power system | | |
| | | | | 217 | advantages of tidal energy | | |
| | | | | 217 | extracting tidal power | | |
| | | | | 470 | energy for generators | | |
| | | | | 602 | hydrogen as a fuel | | |
| | | | | 608 | alternate fuels to gasoline | | |
| | | | | 618 | power released by radioactive decay | | |
| | | | | 631 | nuclear power application | | |
| | | | | 632 | nuclear energy | | |
| | | | | 632 | nuclear energy | | |
| | | | | 634 | comparison of fission and fusion | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---|--|--|---------------------------------|--|-----------------------------|---------------|
| 3PCAE3.1.b Energy and Its Effects | Production /Consumption/ Application of Energy | Demand for energy by society leads to continuous exploration in order to expand supplies of fossil fuels (e.g., drilling deeper oil and gas wells, drilling offshore). In addition, technology has been developed to create alternate energy sources... | Investigate the extent to which energy efficiency programs involving a major societal use of energy (e.g., transportation, farming, manufacturing, producing electricity) lead to reduction in the amount of a natural resource consumed. | 197 219 392 534 631 | efficiency of the Hoover Dam using energy efficient products hybrid cars combine advantages of gasoline fuel and electric power energy-efficient building application nuclear power application | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---|--|---|--------------------|---|---------------------|---|
| 3PCAE3.2.a Energy and Its Effects | Production /Consumption/ Application of Energy | Advances in the scientific understanding of synthetic materials have provided new devices (e.g., transistors, light emitting diodes, optical switches, superconducting ceramics) used in electronic equipment. This has revolutionized many aspects of life... | Analyze the function of a modern electronic device (e.g., remote control unit, CD player) and compare its use with the device which was previously used for the same function. Describe the advantages offered by the replacement ... | 470 | generating electricity by induction | 166 | build a generator |
| | | | | 471 | transformers | 168 | explore the properties of diodes |
| | | | | 478 | diodes and the bias voltage | 170 | understand the uses of transistors in circuits |
| | | | | 479 | transistors | 170 | measure voltage and current characteristics of a transistor |
| | | | | 483 | p-n junction is a diode | | |
| | | | | 484 | half-wave rectifier is a single diode AC-DC converter | | |
| | | | | 485 | transistors act as electronic switches | | |
| | | | | 486 | a transistor amplifier | | |
| | | | | 487 | electronic logic and transistor circuits | | |
| | | | | 495 | knowing a diode's bias voltage | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|---|---|--|---|--------------------|---|---------------------|---|
| 3PCAE3.3.a Energy and Its Effects | Production /Consumption/ Application of Energy | The increase in energy demand has environmental consequences, and societal expectations for a sustainable environment will require new, cleaner technologies for the production of energy. | Working in groups, explore examples of the environmental impact of energy sources used extensively in the past such as peat, wood, or water and the societal and technological changes which altered their use. Using this as background, propose approaches ... | 12 | engineers design practical devices for solving problems | 143 | the cost of using electrical appliances |
| | | | | 31 | use of nanotechnology | | |
| | | | | 72 | antilock brakes application | | |
| | | | | 112 | designing a bridge | | |
| | | | | 138 | use of robots | | |
| | | | | 155 | geostationary satellites | | |
| | | | | 196 | environmental impacts of hydroelectric power | | |
| | | | | 196 | hydroelectric power application | | |
| | | | | 209 | range of power for common devices | | |
| | | | | 216 | energy from ocean tides | | |
| | | | | 217 | advantages of tidal energy | | |
| | | | | 217 | research into tidal power | | |
| | | | | 219 | using energy efficient products | | |
| | | | | 228 | seat belts and air bags | | |
| | | | | 235 | jet engines application | | |
| | | | | 257 | quartz crystals application | | |
| | | | | 280 | microwave ovens application | | |
| | | | | 293 | uses of Doppler radar | | |
| | | | | 311 | invention of electric light | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

| Standard #: Standard | Topic | Content Standard | Performance Standard | student text pg | detail | investigation pg | detail |
|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 325 | the printing press | | |
| | | | | 349 | the telescope | | |
| | | | | 378 | importance of electricity | | |
| | | | | 392 | hybrid cars combine advantages of gasoline fuel and electric power | | |
| | | | | 392 | hybrid gas/electric cars application | | |
| | | | | 413 | wiring application | | |
| | | | | 434 | how television works application | | |
| | | | | 451 | MRI application | | |
| | | | | 490 | why computers are useful | | |
| | | | | 534 | energy-efficient building application | | |
| | | | | 534 | energy-efficient building application | | |
| | | | | 602 | hydrogen as a fuel | | |
| | | | | 608 | alternate fuels to gasoline | | |
| | | | | 618 | power released by radioactive decay | | |
| | | | | 623 | creation of CAT scans | | |
| | | | | 631 | nuclear power application | | |
| | | | | 632 | nuclear energy | | |
| | | | | 634 | comparison of fission and fusion | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

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|--|---|---|--|---|--|---------------------|-----------------------------|
| 3TCE3.1.a Energy and Its Effects | Transformation and Conservation of Energy | Energy can be transformed from one form into another, but the total energy is constant in a closed system. The amount of energy involved in any process, and the rate at which it is generated or consumed can be discussed qualitatively and measured... | Measure the heat released when the energy stored in fuels (or foods) is released upon combustion. Discuss and account for the energy balance in the process. | 190 194 194 194 195 196 202 203 205 206 212 213 215 219 227 | conversions of energy the law of conservation of energy conservation of energy explained energy transformations conservation of energy in a closed system energy transformation hydroelectric plant efficiency and energy conversions efficiency and conservation of energy efficiency in biological systems connection between efficiency and time energy conversion the conversion process of energy flow energy flows in biological systems energy flow of a model solar car kinetic energy conservation for elastic collisions | 72 | draw an energy flow diagram |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

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|-------------------------|-------|------------------|----------------------|--------------------|---|---------------------|--------|
| | | | | 256 | resonant systems accumulate energy | | |
| | | | | 277 | waves propagate by exchanging energy between two forms | | |
| | | | | 320 | photosynthesis converts light energy to chemical energy | | |
| | | | | 324 | light from chemical reactions | | |
| | | | | 356 | electromagnetic waves exchange energy between electricity and magnetic parts | | |
| | | | | 370 | relationship and conservation of mass and energy | | |
| | | | | 393 | conversion of energy in regenerative braking | | |
| | | | | 400 | energy conversions in a series circuit | | |
| | | | | 451 | MRI--energy exchange by a nucleus in a magnetic field | | |
| | | | | 464 | electric motor uses electromagnets to convert electrical energy to mechanical energy | | |
| | | | | 467 | electric generators transform mechanical energy into electric energy | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

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|-------------------------|-------|------------------|----------------------|--------------------|--|---------------------|--------|
| | | | | 469 | energy conservation and Faraday's law | | |
| | | | | 509 | temperature change and thermal energy | | |
| | | | | 513 | definition of calorie | | |
| | | | | 513 | transfer of thermal energy | | |
| | | | | 514 | the heat equation | | |
| | | | | 515 | thermodynamics and conservation of energy | | |
| | | | | 516 | refrigerator application | | |
| | | | | 517 | air conditioners | | |
| | | | | 535 | sources of heat transfer in buildings | | |
| | | | | 552 | conservation of energy in fluids | | |
| | | | | 553 | energy conservation and Bernoulli's equation | | |
| | | | | 597 | the energy of chemical bonds is described | | |
| | | | | 603 | chemical reactions and energy | | |
| | | | | 610 | energy in reaction of dynamite | | |
| | | | | 625 | energy changes in nuclear reactions | | |
| | | | | 626 | source of energy in nuclear reactions | | |
| | | | | 627 | energy of fusion reactions | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

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|-------------------------------------|---|---|---|--------------------|--|---------------------|--------|
| | | | | 628 | energy of fission reactions | | |
| | | | | 629 | conservation of energy in nuclear reactions | | |
| 3TCE3.1.b Energy and Its Effects | Transformation and Conservation of Energy | Energy can be transformed from one form into another, but the total energy is constant in a closed system. The amount of energy involved in any process, and the rate at which it is generated or consumed can be discussed qualitatively and measured... | Determine the amount of heat required to change the temperature or phase of a material (e.g., the latent heat of a phase change for various materials). | 509 | heat of fusion | | |
| | | | | 509 | changing from solid to liquid | | |
| | | | | 509 | temp vs. time graph for phase change of ice to water | | |
| | | | | 509 | temp vs. time graph for phase change of ice to water | | |
| | | | | 509 | heat of fusion | | |
| | | | | 510 | heat of vaporization | | |
| | | | | 510 | changing from liquid to gas | | |
| | | | | 510 | heat of vaporization | | |
| | | | | 511 | evaporation and condensation | | |
| | | | | 519 | temp vs. time graphs for various materials | | |
| | | | | 520 | temp vs. time curve question | | |
| | | | | 606 | energy from sunlight stored through photosynthesis | | |

Correlation to Delaware Science Standard Grades 9 - 12

Foundations of Physics

Student Text and Investigation Manual

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|--|---|---|---|---------------------------------|--|-----------------------------|---------------|
| 3TCE3.2.a Energy and Its Effects | Transformation and Conservation of Energy | Energy can be transferred from one place to another by gross movement of material (e.g. wind, waterfalls, thrown ball), by mechanical waves moving through a material medium (e.g., sounds, earthquakes, tidal waves), or by electromagnetic waves... | Discuss in terms of the properties of waves, the apparent change in a train whistle as the train passes. Research and discuss the application of these properties in the measurement of distance and relative movement(e.g.of stars, of local weather systems). | 293 294 307 638 639 | definition of the Doppler effect Doppler effect and supersonic and subsonic motion understanding of Doppler effect Doppler effect and red shift the big bang | | |

Correlation to Delaware Science Standard Grades 9 - 12

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Student Text and Investigation Manual

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|--|---|--|--|--|---|---------------------|------------------------------------|
| 3TCE3.3.a Energy and Its Effects | Transformation and Conservation of Energy | Mass is converted to large quantities of energy in the processes of nuclear fission and fusion. The energy released can be calculated using the equation $E=mc^2$. The total of energy and mass is constant in these processes. | Compare the energy release from a material (e.g., 1gm. of hydrocarbon) burned as a chemical fuel to the energy available if the same mass were converted through nuclear decay ($E=mc^2$). | 370 597 616 625 625 626 627 628 629 647 | Einstein's mass-energy formula the energy of chemical bonds is described energy and radioactivity energy changes in nuclear reactions nuclear reactions can convert mass into energy source of energy in nuclear reactions energy of fusion reactions energy of fission reactions energy is stored as mass in nuclear reactions energy released in reactions between matter and antimatter | 128 | the equivalence of mass and energy |