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Correlated to:
Hawaii Content & Performance Standards – Physics
(High School)

Hawaii Content & Performance Standards - Science
Hawaii Content & Performance Standards – Physics
Strand – Physics
Standard 1: Scientific Investigation - Discover, invent, and investigate using the skills necessary to engage in the scientific process
Topic - Scientific Inquiry
Benchmark SC.PH.1.1 - Describe how a testable hypothesis may need to be revised to guide a scientific investigation
SE / TE: 3, 8-9, 124, 262
Sample Performance Assessment (SPA)
The student: Describes a testable hypothesis and how it might be revised based on data from physics investigations and primary sources (e.g., results, class data, information from a reputable source).
SE / TE: 2-4, 8, 124, 262
Benchmark SC.PH.1.2 - Design and safely implement an experiment, including the appropriate use of tools and techniques to organize, analyze, and validate data
Sample Performance Assessment (SPA)
The student: Prepares a physics lab report documenting the procedure(s) and the safe and appropriate use of tools (e.g., computer probes, meter sticks, timers) and techniques (e.g., repeated trials, statistics, significant figures, spreadsheets, databases) to organize, analyze, and validate data.
Opportunities to address this standard can be found on the following pages: **SE / TE:** 12, 28, 46, 68, 86, 106, 124, 144, 170, 188, 212, 232, 262, 282, 302, 324, 344, 362, 382, 406, 430, 450, 468, 490, 514, 532, 534, 578, 602, 622, 644, 664, 680, 702, 720, 766, 782, 808
Benchmark SC.PH.1.3 - Defend and support conclusions, explanations, and arguments based on logic, scientific knowledge, and evidence from data
SE / TE: 2, 4-5, 29-30, 32-33, 35, 38, 97, 105, 130, 146, 235-236, 238, 252, 254, 282, 328, 331-332, 349, 390, 392, 469, 476, 492, 502, 519, 533-534, 623, 629, 645, 654, 671, 684, 720, 723, 726, 767, 740-741, 751, 754-755, 767-768, 770-773, 776, 795, 897, 899, 902, 904
Sample Performance Assessment (SPA)
The student: Prepares a physics lab report that draws logical conclusions, including error analysis, and formulates explanations and arguments from the results of investigations.
Opportunities to address this standard can be found on the following pages: **SE / TE:** 12, 28, 46, 68, 86, 106, 124, 144, 170, 188, 212, 232, 262, 282, 302, 324, 344, 362, 382, 406, 430, 450, 468, 487, 490, 496, 514, 532, 534, 578, 602, 622, 644, 664, 680, 702, 720, 766, 782, 808

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Hawaii Content & Performance Standards - Science
Benchmark SC.PH.1.4 - Determine the connection(s) among hypotheses, scientific evidence, and conclusions
SE / TE: 4, 23, 31
Sample Performance Assessment (SPA)
The student: Prepares a physics lab report that supports or refutes a hypothesis based on an analysis of experimental data.
Opportunities to address this standard can be found on the following pages: **SE / TE:** 12, 28, 39, 46, 68, 86, 106, 124, 144, 170, 188, 212, 232, 262, 282, 302, 324, 344, 362, 382, 406, 430, 450, 468, 487, 490, 496, 514, 532, 534, 578, 602, 622, 644, 664, 680, 702, 720, 766, 782, 808
Benchmark SC.PH.1.5 - Communicate the components of a scientific investigation, using appropriate techniques
SE / TE: 12, 28, 46, 55, 68, 75-76, 86, 88, 97, 106, 109, 124, 132, 144, 147, 170, 173, 179, 188, 190, 200, 212, 215, 232, 253, 262, 267, 282, 302, 324, 326, 344, 352, 362, 364, 369, 382, 387, 406, 409, 419, 430, 433, 435-436, 450, 455, 468, 471, 478, 490, 494, 514, 532, 539, 544, 554, 559, 563, 578, 581, 590, 602, 615, 622, 627, 632, 644, 655, 664, 680, 702, 720, 725, 740, 766, 782, 808
Sample Performance Assessment (SPA)
The student: Presents the question, testable hypothesis, experimental design, analysis of data, and conclusions to the physics class using appropriate methods of communication (e.g., PowerPoint, essay, oral presentation, poster board, lab report, research paper).
Opportunities to address this standard can be found on the following pages: **SE / TE:** 12, 28, 39, 46, 68, 86, 106, 124, 144, 170, 188, 212, 232, 262, 282, 302, 324, 344, 362, 382, 406, 430, 450, 468, 487, 490, 496, 514, 532, 534, 578, 602, 622, 644, 664, 680, 702, 720, 766, 782, 808
Benchmark SC.PH.1.6 - Engage in and explain the importance of peer review in science
SE / TE: 3, 258, 465, 482
Sample Performance Assessment (SPA)
The student: Examines a peer's physics investigation for logic and validity based on evidence. Explains the importance of peer review to the process of scientific inquiry.
SE / TE: 3, 204, 258, 260, 285, 307, 317, 319, 465, 482, 496
Topic - Scientific Knowledge
Benchmark SC.PH.1.7 - Revise, as needed, conclusions and explanations based on new evidence
SE / TE: 3, 644

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Sample Performance Assessment (SPA)
The student: Based on new evidence from valid sources, revises conclusion and explanations as needed.
SE/TE: 3, 644
Benchmark SC.PH.1.8 - Describe the importance of ethics and integrity in scientific investigation
SE/TE: 2-3, 5, 9, 236, 496, 756
Sample Performance Assessment (SPA)
The student: Identifies and describes the importance of ethical experimentation, citation, and conclusions (e.g., ethics provides guidelines concerning appropriate methods of experimentation; ethics/integrity reduces bias and ensures fair credit of authorship).
SE/TE: 2-3, 9, 496, 756
Benchmark SC.PH.1.9 - Explain how scientific explanations must meet a set of established criteria to be considered valid
SE/TE: 3, 204, 260, 285, 307
Sample Performance Assessment (SPA)
The student: Describes how a published study meets the criteria of scientific explanations (e.g., they must be consistent with experimental and observational evidence about nature, make accurate predictions about systems being studied, be logical, abide by the rules of evidence, be open to questions and modifications, be based on historical and current scientific knowledge, and make a commitment to making the knowledge public) in order to draw conclusions about the study's validity.
Opportunities to address this standard can be found on the following pages: **SE/TE:** 32, 235, 533
Topic - Using Mathematics
Benchmark SC.PH.1.10 - Use quadratic equations and simple trigonometric, exponential, and logarithmic functions to solve problems
SE/TE: 58, 519, 782, 840-842, 849, 852, 857, 861, 864, 866
Sample Performance Assessment (SPA)
The student: Solves problems involving simple trigonometric functions to solve physics problems.
SE/TE: 849, 852, 859, 861, 864, 866

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Hawaii Content & Performance Standards - Science
Standard 2: Nature of Science - Understand that science, technology, and society are interrelated
Topic - Science, Technology, and Society
Benchmark SC.PH.2.1 - Explain how scientific advancements and emerging technologies have influenced society
SE / TE: 5, 163, 204, 236, 248, 275, 481, 526, 648, 727, 756
Sample Performance Assessment (SPA)
The student: Describes a current scientific advancement or emerging technology (e.g., related to transportation or communication) and lists its key features and uses, and its possible impact on society.
SE / TE: 248, 275, 481, 727, 756
Benchmark SC.PH.2.2 - Compare the risks and benefits of potential solutions to technological issues
SE / TE: 163, 248, 481, 816, 910
Sample Performance Assessment (SPA)
The student: Compares risks and benefits (e.g., in terms of the impact on populations, resources, health, disease, environment) of alternative solutions to a specific current technological issue (e.g., food irradiation).
SE / TE: 163, 248, 481, 816, 910
Standard 3: Matter and Energy Conservation - Understand the nature of momentum and energy transformations
Topic – Matter
Benchmark SC.PH.3.1 - Measure or determine physical quantities such as density and mass of samples
SE / TE: 36-38, 346-348, 357-361, 377-378, 380-381, 389, 397-399, 870, 872
Sample Performance Assessment (SPA)
The student: Calculates the density of a given sample of material, after measuring its mass and volume.
SE / TE: 346-348, 357, 360-361
Benchmark SC.PH.3.2 - Differentiate among mass, weight, and inertia
SE / TE: 36-38, 40-41, 43, 45, 844

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Sample Performance Assessment (SPA)
The student: Compares the mass, weight, and inertia of a given object with varying values for gravitational force, such as an object that is on the earth and the moon.
SE/TE: 37, 45, 867-868
Topic - Energy and Momentum
Benchmark SC.PH.3.3 - Differentiate between energy and momentum both quantitatively and conceptually, and recognize that both are conserved
SE/TE: 130-132, 137-143, 153-155, 163-164, 166, 168-169, 269, 374, 470-471, 483, 742, 749, 754, 859
Sample Performance Assessment (SPA)
The student: Compares the energy and momentum of objects, given their velocity and mass.
SE/TE: 166
Benchmark SC.PH.3.4 - Describe ways that energy can be transformed from one form to another (e.g., potential energy to kinetic energy)
SE/TE: 11, 144, 149, 153-155, 158-161, 164-169, 305, 470-471, 652, 670, 699, 745, 757, 813, 859
Sample Performance Assessment (SPA)
The student: Explains the transformation of the potential energy of a given object to kinetic energy.
SE/TE: 165, 169, 281
Benchmark SC.PH.3.5 - Use the equations for changes in kinetic energy (KE = 1/2 mv22) and gravitational potential energy (PE = mgh) to calculate changes in energy
SE/TE: 149-150, 164, 168, 207, 858, 860-861
Sample Performance Assessment (SPA)
The student: Calculates the change of energy of an object with given mass, velocity, and height, using the equations for kinetic and potential energy.
SE/TE: 149-150, 165-166, 168-169
Benchmark SC.PH.3.6 - Differentiate between different energy manifestations (e.g., kinetic [KE = 1/2 mv2], gravitational potential [PE = mgh], thermal, chemical, nuclear, electromagnetic, or mechanical)
SE/TE: 165, 676

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Sample Performance Assessment (SPA)
The student: Compares the relative magnitudes and sources of different forms of energy manifestations, such as nuclear energy and chemical energy.
SE / TE: 161-163, 166, 169, 318-319
Topic - Conservation Laws
Benchmark SC.PH.3.7 - Use the conservation of energy law to solve problems involving an energy transformation
SE / TE: 165, 168-169, 483, 530
Sample Performance Assessment (SPA)
The student: Calculates the final velocity of a given object, given its initial velocity, mass, height, final height, and the amount of work done to it by external forces.
Opportunities to address this standard can be found on the following pages: **SE / TE:** 51-52, 61, 65, 67, 83, 856-857
Benchmark SC.PH.3.8 - Use the conservation of energy and momentum laws to predict both quantitatively and qualitatively the results of interactions of objects within simple systems
SE / TE: 130-132, 137-143, 153-155, 163-164, 166, 168-169, 269, 374, 470-471, 483, 742, 749, 754, 859
Sample Performance Assessment (SPA)
The student: Solve problems by diagramming the initial and final directions and velocities of two objects involved in inelastic collisions, using the conservation of energy law and conservation of momentum law.
SE / TE: 132-134, 138, 142
Benchmark SC.PH.3.9 - Describe circumstances under which each conservation law (i.e., energy, momentum, mass) may be used
SE / TE: 130-132, 136, 137, 140-142, 153-154, 166, 221, 269, 379, 470-471, 483, 530, 855
Sample Performance Assessment (SPA)
The student: Explains when it is appropriate to use conservation laws.
SE / TE: 130-132, 136, 137, 140-142, 153-154, 166, 221, 269, 379, 470-471, 483, 530, 855

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Standard 4: Force and Motion - Understand the relationship between force, mass, and motion of objects
Topic – Motion
Benchmark SC.PH.4.1 - Solve problems using the universal law of gravity
SE / TE: 237-241, 251-254, 256-261
Sample Performance Assessment (SPA)
The student: Determines the force of gravitational attraction between two objects given their masses and distance apart.
SE / TE: 240-241, 256-261
Benchmark SC.PH.4.2 - Solve two-dimensional trajectory problems
SE / TE: 73-79, 80-85
Sample Performance Assessment (SPA)
The student: Calculates the horizontal range, the time to reach the maximum height, and the components of the final velocity of a projectile given its initial velocity, angle, and height.
SE / TE: 74-79, 81-85
Benchmark SC.PH.4.3 - Solve two-dimensional problems involving balanced forces (i.e., statics)
SE / TE: 18-19, 23-24
Sample Performance Assessment (SPA)
The student: Use the equations of force and motion to solve a two dimensional problem in which the sum of all forces upon a given object is zero.
SE / TE: 24, 44, 118
Benchmark SC.PH.4.4 - Analyze motion in terms of position, time, velocity and acceleration, both quantitatively and qualitatively
SE / TE: 46-60, 61-67, 73-79, 80-85
Sample Performance Assessment (SPA)
The student: Predicts and describes the motion of a given object.
SE / TE: 62-68, 75, 81-86, 88, 97, 99-106, 118-123, 170, 182-187, 302

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Benchmark SC.PH.4.5 - Describe the nature of centripetal force and centripetal acceleration (e.g., the formula a = v2/r), and use these ideas to predict the motion of an object
SE/TE: 170, 175-180, 181-182, 184-186, 224, 862-864, 869
Sample Performance Assessment (SPA)
The student: Explains centripetal acceleration and predicts the acceleration of a given object, using the equation a = v2/r.
SE/TE: 175, 186, 224, 863
Topic - Relationship between force, mass, and motion
Benchmark SC.PH.4.6 - Use Newton's Laws (e.g., F = ma) together with the kinematic equations to predict the motion of an object
SE/TE: 33-34, 40-45, 88-89, 98-105, 108-111, 116-123
Sample Performance Assessment (SPA)
The student: Determines the displacement of an object, given its initial and final velocities, direction of motion, and acceleration, using the kinematic equations.
SE/TE: 61-62
Benchmark SC.PH.4.7 - Resolve two dimensional vectors into their components, and use the resultant vectors to solve problems involving force and motion, both graphically and quantitatively
SE/TE: 20-24, 44-45, 70-72, 80-81, 83-84, 176, 186, 195, 893
Sample Performance Assessment (SPA)
The student: Uses two dimensional vectors to solve a problem involving force and motion, both graphically and quantitatively.
SE/TE: 69-72, 77, 81-85, 109, 176-177, 186
Standard 5: Heat and Thermodynamics - Understand the laws of thermodynamics, and their applications
Topic - Heat and Temperature
Benchmark SC.PH.5.1 - Explain that heat flow and work are two forms of energy transfer between systems
SE/TE: 145, 470-471, 482-483
Sample Performance Assessment (SPA)
The student: Describes the heat flow between two closed systems in terms of energy transfer.
SE/TE: 468, 470, 482-483

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Hawaii Content & Performance Standards - Science
Benchmark SC.PH.5.2 - Differentiate between heat, specific heat, and temperature
SE / TE: 407-409, 411-414, 424, 427, 473
Sample Performance Assessment (SPA)
The student: Compares heat to specific heat and temperature in two different simple systems (e.g. heating water and boiling water).
SE / TE: 424, 426, 466
Topic - Laws of Thermodynamics
Benchmark SC.PH.5.3 - Explain the laws of thermodynamics, and describe some practical applications
SE / TE: 470-471, 474-481, 482-487, 877-878
Sample Performance Assessment (SPA)
The student: Describes the three laws of thermodynamics, and gives a practical application of each of the laws.
SE / TE: 470-471, 474-481, 482-485
Topic - Heat Engines
Benchmark SC.PH.5.4 - Calculate heat flow, work, and efficiency in an ideal heat engine, and understand that real heat engines lose some heat to surroundings
SE / TE: 475-478, 483-484
Sample Performance Assessment (SPA)
The student: Determines the heat flow, work and efficiency of an ideal heat engine quantitatively.
SE / TE: 475-478, 483-487
Benchmark SC.PH.5.5 - Use the first law of thermodynamics to describe the work cycle of a heat engine
SE / TE: 475-478, 483
Sample Performance Assessment (SPA)
The student: Applies the first law of thermodynamics, using the formula ?U = Q - W as well as conceptual understanding, to explain the work cycle of a given heat engine.
Opportunities to address this standard can be found on the following pages: **SE / TE:** 471, 476, 482-483, 487, 878

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Benchmark SC.PH.5.6 - Explain how the law of conservation of energy applies to work in a heat engine
SE / TE: 475-478, 482-484, 487, 877
Sample Performance Assessment (SPA)
The student: Describes the forms of energy that are put into and produced by a given heat engine, and explains that they are equal in accordance with the law of conservation of energy.
SE / TE: 475-478, 484
Standard 6: Waves - Understand the nature of waves, including the characteristic properties of the electromagnetic spectrum, optics, and sound waves
Topic - Mechanical Waves
Benchmark SC.PH.6.1 - Analyze transverse and longitudinal waves in mechanical (e.g., springs, wave tanks) and non-mechanical media (e.g., seismic waves, sound waves)
SE / TE: 497-498, 501, 507-511
Sample Performance Assessment (SPA)
The student: Compares transverse and longitudinal waves produced by various mechanical media, to waves such as sound or seismic waves.
SE / TE: 497-498, 507-508, 511, 514-515, 522-523, 542, 544, 838
Topic – Calculations
Benchmark SC.PH.6.2 - Solve problems involving wavelength, frequency, amplitude, speed, absorption, reflection, and refraction
SE / TE: 445, 508, 510, 528, 530, 550, 552, 575-576, 597-601, 779
Sample Performance Assessment (SPA)
The student: Calculates the wavelength of a wave, given its frequency and speed.
SE / TE: 510, 513, 553, 878-879
Topic – Optics
Benchmark SC.PH.6.3 - Use the concepts of wave motion to predict qualitatively and quantitatively the various properties of a simple optical system
SE / TE: 603-610, 618-621

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Sample Performance Assessment (SPA)
The student: Draws an accurate ray diagram of a given simple optical system.
SE/TE: 606-609, 618-620
Topic - The Electromagnetic spectrum
Benchmark SC.PH.6.4 - Describe the range of the electromagnetic spectrum (e.g., radio waves, microwaves, infrared radiation)
SE/TE: 438, 536, 548, 552, 632, 880
Sample Performance Assessment (SPA)
The student: Explains the range of wavelengths that exist on the electromagnetic spectrum.
SE/TE: 536, 552, 632, 880
Standard 7: Electric and Magnetic Phenomena - Understand the nature and applications of electricity and magnetism
Topic - Electrical and Magnetic Fields
Benchmark SC.PH.7.1 - Describe the relationships among charged particles, electrical current, electrical potential, electric fields, and magnetic fields
SE/TE: 665-667, 669-671, 675-679, 682, 722-729, 734-739
Sample Performance Assessment (SPA)
The student: Explains and gives examples of the relationships among charged particles, electrical current, electrical potential, electric fields, and magnetic fields.
SE/TE: 665-667, 669-671, 675-679, 682, 722-729, 734-739
Benchmark SC.PH.7.2 - Demonstrate and explain how to determine the direction of a magnetic field produced by a current flowing in a straight wire or in a coil
SE/TE: 726-727, 734-738
Sample Performance Assessment (SPA)
The student: Describes how the right hand rule works.
SE/TE: 728, 738
Benchmark SC.PH.7.3 - Explain how currents are induced in conductors by changing magnetic fields
SE/TE: 741-742, 751, 762

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Sample Performance Assessment (SPA)
The student: Describes how magnetic fields induce currents.
SE/TE: 741-742, 745, 747, 751, 757-760, 762
Benchmark SC.PH.7.4 - Describe how electric and magnetic fields contain energy and act as vector force fields
SE/TE: 666, 676, 678, 839
Sample Performance Assessment (SPA)
The student: Represents a magnetic field using a diagram.
SE/TE: 666, 676, 678, 839
Benchmark SC.PH.7.5 - Calculate the force on a charged particle in an electric field using the formula F=qE, where E is the electric field at the position of the particle
SE/TE: 665, 677, 884
Sample Performance Assessment (SPA)
The student: Determines the force on a charged particle in a given electric field.
SE/TE: 665, 677, 884
Benchmark SC.PH.7.6 - Calculate the magnitude of the force on a moving particle with charge q in a magnetic field, using the formula F = qvBsina, where v and B are the magnitudes of vectors v and B and a is the angle between v and B
SE/TE: 908
Sample Performance Assessment (SPA)
The student: Uses the formula F = qvBsina to determine the magnitude of force on a moving particle in a magnetic field.
SE/TE: 908
Topic - Electrical Circuits
Benchmark SC.PH.7.7 - Analyze simple arrangements of components (e.g., resistors, capacitors, transistors) in series or parallel circuits, both quantitatively and qualitatively
SE/TE: 704-707, 709-711, 713-718, 886

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Sample Performance Assessment (SPA)
The student: Diagrams a simple circuit containing resistors, transistors, or capacitors, showing the direction and value of current at all points in the circuit.
SE / TE: 709-711, 718
Benchmark SC.PH.7.8 - Predict the current, voltage, and power in simple direct current electric circuits
SE / TE: 693-695, 698-701
Sample Performance Assessment (SPA)
The student: Analyzes a simple direct current circuit, showing the values of power, voltage drops, and current at all points in the circuit.
SE / TE: 693-695, 698-701
Topic - Coulomb's Law
Benchmark SC.PH.7.9 - Solve problems involving the forces between two electric charges (Coulomb's Law)
SE / TE: 648-650, 659-663, 883
Sample Performance Assessment (SPA)
The student: Calculates the forces between two electric charges using Coulomb's Law.
SE / TE: 648-650, 659-663, 883
Standard 8: Modern Physics - Understand the general concepts related to the theory of special relativity, and the constituent particles that make up atoms
Topic – Relativity
Benchmark SC.PH.8.1 - Explain the general concepts related to the theory of relativity (e.g., nothing can travel faster than the speed of light in a vacuum)
SE / TE: 284-286, 292-293, 296-297, 303, 318
Sample Performance Assessment (SPA)
The student: Describes the general concepts related to the theory of relativity
SE / TE: 297, 318

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Topic - Newton's laws
Benchmark SC.PH.8.2 - Explain that Newton's Laws are not exact but give a very good approximation unless an object is moving close to the speed of light or is small enough
SE / TE: 307, 316, 776
Sample Performance Assessment (SPA)
The student: Describes under what circumstances Newton's laws of motion can and cannot be used.
SE / TE: 316, 307, 776
Topic - Quantum physics
Benchmark SC.PH.8.3 - Describe the constituent particles that make up matter, and the scale at which quantum effects become important
SE / TE: 766-768, 771-772, 774-781
Sample Performance Assessment (SPA)
The student: Explains the scale at which quantum effects are apparent.
SE / TE: 768, 779
http://standardstoolkit.k12.hi.us/index.html