Spearfish School District Curriculum -- Physics

Science and Engineering Practices

1. Asking Questions (For Science) and Defining Problems (For Engineering)
2. Developing and Using Models
3. Planning and Carrying out Investigations
4. Analyzing and Interpreting Data
5. Using Mathematics and Computational Thinking
6. Constructing Explanations (For Science) and Designing Solutions (For Engineering)
7. Engaging in Argument from Evidence
8. Obtaining, Evaluating, and Communicating Information

Cross Cutting Concepts

1. Patterns
2. Cause and Effect
3. Scale, Proportion, and Quantity
4. Systems and System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Disciplinary Core Ideas

The Core ideas of the Middle School Physical Science standards include:

- Matter and Its Interactions
- Motion and Stability: Forces and Interactions
- Energy
- Waves and Their Applications in Technologies for Information Transfer

The Core ideas of the Middle School Life Science standards include:

- From Molecules to Organisms: Structures and Processes
- Ecosystems: Interactions, Energy, and Dynamics
- Heredity: Inheritance and Variation of Traits
- Biological Unity and Diversity

The Core ideas of the Middle School Earth and Space Science standards include:

- Earth's Place in the Universe
- Earth's Systems
- Earth and Human Activity

The Core ideas of the High School Physical Science standards include:

- Matter and Its Interactions
- Motion and Stability: Forces and Interactions
- Energy
- Waves and Their Applications in Technology for Information Transfer

The Core ideas of the High School Life Science standards include:

- From Molecules to Organisms: Structures and Processes
- Ecosystems: Interactions, Energy, and Dynamics
- Heredity: Inheritance and Variation of Traits
- Biological Unity and Diversity

The Core ideas of the High School Earth and Space Science standards include:

- Earth's Place in the Universe
- Earth's Systems
- Earth and Human Activity

Instructional Focus (Unit/Topic/Concept/Lesson)	Focus Summary	Instructional Focus (Unit/Topic/Concept/Lesson)	Focus Summary
1 **The Science of Energy** **Suggested time frame: 1 day**	• Science in Today's World • Content of Physics	8 **Law of Heat Exchange and Thermal Effects** **Suggested time frame: 9-10 Days**	• Heat • Thermal Expansion • Measuring Heat • Phase Change
2 **Measurement and Problem Solving** **Suggested time frame: 5 days**	• Units of Measurement • Making & Recording Measurement • Solving Problems	9 **Fluid Mechanics** **Suggested time frame: 5 Days**	• Fluid Statics • Fluid Dynamics
3 **Nature and Cause of Motion**	• Velocity • Acceleration • Newton's Laws of Motion • Gravitation	10 **Wave Mechanics**	• Nature of Waves • Wave Interactions

Suggested time frame: 9-10 Days		**Suggested time frame: 9-10 Days**	
4 **Resolution and Composition of Forces** **Suggested time frame: 9-10 Days**	• Vector Analysis • Composition of Forces • Friction • Parallel Forces	11 **Sound Waves** **Suggested time frame: 9-10 Days**	• Nature of Sound • Characteristics of Sound Waves
5 **Curvilinear and Harmonic Motion** **Suggested time frame: 6 Days**	• Circular Motion • Rotary Motion • Simple Harmonic Motion	12 **Nature of Light** **Suggested time frame: 9-10 Days**	• Waves and Particles • Illumination
6 **Conservation of Energy and Momentum** **Suggested time frame: 7 Days**	• Work, Machines, and Power • Energy • Momentum	13 **Physics for the 21st Century (On line Text)**	• Unit 1--The Basic Building Blocks of Matter
7 **Materials** **Suggested time frame: 3 Days**	• Stress • Strain • Young's Modulus	14 **Physics for the 21st Century (On line Text)**	• Unit 2--Fundamental Interactions

High School Physical Science Standards (Grades9-12)	
HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. (SEP: 2; DCI: PS1.A, PS2.B; CCC: Patterns)
HS-PS1-2	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. (SEP: 6; DCI: PS1.A, PS1.B; CCC: Patterns)
HS-PS1-3	Plan and carry out an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. (SEP: 3; DCI: PS1.A, PS2.B; CCC: Patterns)
HS-PS1-4	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. (SEP: 2; DCI: PS1.A, PS1.B; CCC: Energy/Matter)
HS-PS1-5	Construct an explanation based on evidence about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. (SEP: 6; DCI: PS1.B; CCC: Patterns)
HS-PS1-6	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.* (SEP: 6; DCI: PS1.B, ETS1.C; CCC: Stability/Change)

HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. (SEP: 5; DCI: PS1.B; CCC: Energy/Matter, Nature of Science/Consistency)
HS-PS1-8	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. (SEP: 2; DCI: PS1.C; CCC: Energy/Matter)
HS-PS2-1	Analyze data to support the claim that Newton's Second Law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. (SEP: 4; DCI: PS2.A; CCC: Cause/Effect)
HS-PS2-2	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. (SEP: 5; DCI: PS2.A ; CCC: Systems)
HS-PS2-3	Design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.* (SEP: 6; DCI: PS2.A, ETS1.A, ETS1.C; CCC: Cause/Effect)
HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. (SEP: 5; DCI: PS2.B; CCC: Patterns)
HS-PS2-5	Plan and carry out an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. (SEP: 3; DCI: PS2.B, PS3.A; CCC: Cause/Effect)
HS-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* (SEP: 8; DCI: PS1.A, PS2.B; CCC: Structure/Function)
HS-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. (SEP: 5; DCI: PS3.A, PS3.B ; CCC: Systems)
HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). (SEP: 2 ; DCI: PS3.A; CCC: Energy/Matter)
HS-PS3-3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. (SEP: 6; DCI: PS3.A, PS3.D, ETS1.A; CCC: Energy/Matter, Technology)
HS-PS3-4	Plan and carry out an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (Second Law of Thermodynamics). (SEP: 3; DCI: PS3.B, PS3.D; CCC: Systems)
HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. (SEP: 2; DCI: PS3.C; CCC: Cause/Effect)
HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. (SEP: 5; DCI: PS4.A; CCC: Cause/Effect)
HS-PS4-2	Evaluate questions about the advantages of using a digital transmission and storage of information. (SEP: 1; DCI: PS4.A; CCC: Stability/Change, Technology)
HS-PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. (SEP: 7; DCI: PS4.A, PS4.B; CCC: Systems)
HS-PS4-4	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. (SEP: 8; DCI: PS4.B; CCC: Cause/Effect)
HS-PS4-5	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.* (SEP: 8; DCI: PS3.D, PS4.A, PS4.B, PS4.C; CCC: Cause/Effect, Technology)

Spearfish School District Curriculum -- Physics

Instructional Focus 1	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS | LS | ESS | ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
1 **The Science of Energy** ● Science in Today's World ● Content of Physics **Suggested time frame: 1 day**	☒Systems and System Models ☒Energy ☒Earth's Place in the Universe ☒Scientific Explanations	HS-PS3-3	**Essential Questions:** ● What is Physics? ● What is a Law? ● What is a Theory?	● Science ● Technology ● Research Development ● Law ● Principle ● Theory ● Hypotheses ● Properties ● Mass ● Inertia ● Period ● Matter ● Density ● Conditions ● Energy ● Potential Energy ● Kinetic Energy ● Law of Conservation of Energy ● Einstein's Mass-energy equation	1) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

Assessments: How do my students demonstrate their understanding and how do I measure their learning?

Formative: Worksheet Solutions, Observations, Homework, Question Answer Sessions, Laboratories

Summative: Chapter Exam

Instructional Focus 2	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Measurement and Problem Solving ● Units of Measurement ● Making & Recording Measurement ● Solving Problems **Suggested time frame: 5 days**	☒Systems and System Models ☒Stability and Change ☒Energy ☒Waves and Their Applications ☒Asking Questions and Defining Problems ☒Analyzing and Interpreting Data ☒Mathematics and Computation ☒Scientific Explanations	HS-PS3-1 HS-PS4-2	● Students will apply the scientific method to solve problems. ● Students will recognize metric base units. ● Students will describe motion using vectors. ● Students will use kinematics to calculate velocity and acceleration problems. ● Students will define, develop and understand Newtonian Laws. ● Students will use basic equations to build working equations. ● Students will understand dimensional analysis. ● Students will apply dimensional analysis.	● Conceptual Unit ● Standard Unit ● Fundamental quantities ● SI ● Length ● Time ● Mass ● Force ● Significant Figures ● Scientific Notation ● Order of Magnitude ● Directly proportional ● Inversely proportional ● Density ● Scalar ● Basic Equation ● Resultant ● Working Equation ● Dimensional Analysis	2) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

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Summative: Chapter Exam

Instructional Focus 3	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Nature and Cause of Motion ● Velocity ● Acceleration ● Newton's Laws of Motion ● Gravitation **Suggested time frame: 9-10 Days**	☒Patterns ☒Systems and System Models ☒Cause and Effect ☒Motion and Stability: Forces and Interactions ☒Analyzing and Interpreting Data ☒Mathematics and Computation	HS-PS2-1 HS-PS2-4	● Students will distinguish the difference between distance and displacement. ● Students will distinguish the difference between speed, velocity, average speed, and average velocity. ● Students will distinguish the difference between speed, velocity, acceleration average speed, average velocity, and average acceleration. ● Students will identify the difference between a scaler and a vector. ● Students will determine the difference between the Newtonian Laws. ● Students will apply the Newtonian Laws. ● Students will use the Universal Law of Gravitation in calculations.	● Displacement ● Linear Motion ● Rotary Motion ● Speed ● Average Speed ● Instantaneous Speed ● Velocity ● Constant Velocity ● Instantaneous Velocity ● Acceleration ● Uniform Acceleration ● Instantaneous Acceleration ● Scaler ● Vector ● Force ● Newton's 1st Law of Motion ● Newton's 2nd Law of Motion ● Newton's 3rd Law of Motion ● Universal Law of Gravitation ● Gravitational Constant ● Gravity ● Gravitational Field	3) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

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Summative: Chapter Exam

Instructional Focus 4	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Resolution and Composition of Forces ● Vector Analysis ● Composition of Forces ● Friction ● Parallel Forces **Suggested time frame: 9-10 Days**	☒Patterns ☒Systems and System Models ☒Cause and Effect ☒Motion and Stability: Forces and Interactions ☒Analyzing and Interpreting Data ☒Argumen-tation from Evidence ☒Scientific Explanations ☒Mathematics and Computation	HS-PS2-1 HS-PS2-2 HS-PS2-4	● Students will resolve vectors. ● Students will analyze more than two forces efficiently. ● What is resultant? ● Students will distinguish the difference between translational and rotational equilibrium.	● Force ● Resolution of ● forces ● Normal Force ● Concurrent Forces ● Resultant Force ● Vector Analysis ● Equilibrium ● Translational equilibrium ● Rotational equilibrium ● Equilibrant ● Force ● Friction ● Static Friction ● Kinetic Friction ● Coefficient of Friction. ● Parallel Forces ● Center of Mass ● Moment ● Fulcrum ● Torque ● Couple	4) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

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Summative: Chapter Exam

Instructional Focus 5	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS | LS | ESS | ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Curvilinear and Harmonic Motion ● Circular Motion ● Rotary Motion ● Simple Harmonic Motion **Suggested time frame: 6 Days**	☒Patterns ☒Systems and System Models ☒Cause and Effect ☒Motion and Stability: Forces and Interactions ☒Analyzing and Interpreting Data ☒Argumen-tation from Evidence ☒Mathematics and Computation ☒Scientific Explanations	HS-PS2-1 HS-PS2-2 HS-PS2-4	● What is the difference between curvilinear and harmonic motion? ● Students will use rotary kinematics to calculate circular motion. ● Students will understand conservation of angular momentum.	● Curvilinear Motion ● Uniform Circular Motion ● Variable Circular Motion ● Velocity Maximum ● Velocity Minimum ● Critical velocity ● Centripetal Acceleration ● Centripetal Force ● Centrifugal Force ● Frame of ● Reference ● Inertial Frame ● Non-inertial ● Rotary Motion ● Uniform Rotary Motion ● Circular Motion ● Angular Velocity ● Radian ● Right Hand Rule ● Angular ● Acceleration ● Moment of Inertia ● Periodic Motion ● Simple Harmonic Motion ● Peak to Peak Amplitude ● Peak Amplitude ● RMS Amplitude ● Period ● Frequency ● Equilibrium Position ● Pendulum	5) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

Instructional Focus 5	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
				• Physical Pendulum • Center of Oscillation	

Assessments: How do my students demonstrate their understanding and how do I measure their learning?

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Summative: Chapter Exam

Instructional Focus 6	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Conservation of Energy and Momentum • Work, Machines, and Power • Energy • Momentum **Suggested time frame:** **7 Days**	☒Systems and System Models ☒Energy and Matter ☒Energy ☒Developing and Using Models ☒Planning and Carrying out Investigations ☒Mathematics and Computation	HS-PS3-1 HS-PS3-2 HS-PS3-3	• What is conservation of energy and momentum? • Students will understand work, machines, and power. • What is energy? • What is momentum?	• Work • Efficiency • Mechanical Advantage • Power • Potential Energy • Kinetic Energy • Total Energy • Law of Conservation of Mechanical Energy • Conservative forces • Non-Conservative Forces • Kinetic Energy in Rotary Motion • Momentum Law of conservation of Momentum • Impulse	6) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

Instructional Focus 6	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS | LS | ESS | ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
	☒Scientific Explanations			• Inelastic Collision • Elastic Collision • Angular Momentum • Angular Impulse	

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Summative: Chapter Exam

Instructional Focus 7	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS | LS | ESS | ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Materials • Stress • Strain • Young's Modulus **Suggested time frame: 3 Days**	☒Energy and Matter ☒Structure and Function ☒Motion and Stability: Forces and Interactions ☒Energy	HS-PS2-6 HS-PS3-2	• What is stress? • What is strain? • Students will be able to calculate stress, strain and Young's Modulus of materials.	• Matter • The Atomic Theory • Molecule • Atom • Atomic Mass Units • Mass Number • Kinetic Theory of Matter • Crystalline Solids • Amorphous Solids • Diffusion • Cohesion • Adhesion • Tensile Strength • Ductility	7) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

Instructional Focus 7	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
	☒Developing and Using Models ☒Obtaining, Evaluating, Communicating Information			• Malleability • Elasticity • Elastic Limit • Stress • Stain • Shear Strain • Volume Strain • Hooke's Law • Brownian movement • Meniscus • Capillary • Adhesion • Surface Tension • Melting • Melting Point • Freezing • Freezing Point • Expansion • Pressure • Diffusion • Vaporization • Evaporation • Sublimation • Condensation • Relative Humidity • Boiling	

Assessments: How do my students demonstrate their understanding and how do I measure their learning?

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Summative: Chapter Exam

Instructional Focus 8	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Thermal Effects ● Thermal Expansion ● Measuring Heat ● Change of Phase **Suggested time frame: 9-10 Days**	☒Systems and System Models ☒Energy and Matter ☒Energy ☒Developing and Using Models ☒Planning and Carrying out Investigations ☒Mathematics and Computation ☒Scientific Explanations	HS-PS3-1 HS-PS3-2 HS-PS3-3 HS-PS3-4	● Students will calculate linear, area, volumetric expansion of solids, liquids and gases. ● Students will understand the law of heat exchange. ● Students will take materials through phase changes.	● Thermal Energy ● Heat ● Temperature ● Calorie ● Coefficient of Linear Expansion-- ● Coefficient of Area Expansion ● Coefficient of Cubic ● Expansion ● Liquid Volume Expansion-- ● Water Expansion ● Water Contraction ● Gas Expansion ● Charles Law ● Boyle's Law ● Gay Lussac's Law ● Ideal Gas Law ● Mole ● Heat Capacity ● Specific Heat ● Endothermic ● Exothermic. ● Law of Heat Exchange ● Melting ● Freezing ● Heat of Fusion ● Heat of Vaporization	8) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

Assessments: How do my students demonstrate their understanding and how do I measure their learning?

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Summative: Chapter Exam

Instructional Focus 9	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Fluid Mechanics ● Statics ● Dynamics **Suggested time frame: 5 Days**	☒Patterns ☒Cause and Effect ☒ Matter and Its Interactions ☒Motion and Stability: Forces and Interactions ☒Planning and Carrying out Investigations ☒Analyzing and Interpreting Data	HS-PS1-3 HS-PS2-1	● Students will gain understanding of fluid statics and fluid dynamics including the equation on continuity and bernoulli's equation.	● Density ● Specific Gravity ● Pressure ● Pascal ● Absolute Pressure ● Gauge Pressure ● Pascal's Law ● Archimedes' Principle ● Buoyant Force ● Equation of Continuity ● Bernoulli's Equation	9) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

Assessments: How do my students demonstrate their understanding and how do I measure their learning?

Formative: Worksheet Solutions, Observations, Homework, Question Answer Sessions, Laboratories

Summative: Chapter Exam

Instructional Focus 10	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Waves ● Charactristics ● Interactions **Suggested time frame: 9-10 Days**	☒Systems and System Models ☒Cause and Effect ☒Waves and Their Applications ☒Mathematics and Computation ☒Argumen-tation from Evidence ☒Obtaining, Evaluating, Communicating Information	HS-PS4-1 HS-PS4-3 HS-PS4-5	● Students will be interduced to the wave equations, simple harmonic motion and the characteristics of waves. ● Students will study wave interactions.	● Wave ● Periodic Motion ● Simple Harmonic Motion ● Mechanical Wave ● Electromagnetic Waves ● Transverse Wave ● Crest ● Trough ● Pulse ● Continuous Wave ● Longitudinal Wave ● Compression ● Rarefaction Wave Terminology ● Periodic ● Phase ● Electricity ● Frequency ● Period ● Wavelength ● Speed ● Dispersive Wave ● Amplitude ● Energy of a Wave ● Damping ● Wave Fronts ● Rectilinear Propagation ● Circular Wave ● Reflected ● The Law of Reflection ● Strings ● Impedance ● If impedance is zero ● If impedance is infinite	10) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

Instructional Focus 10	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
				● If the impedance exactly matches ● Refraction ● Diffraction ● Superposition ● Principle ● Constructive Wave Interference ● Destructive Wave Interference ● Nodes ● Anti-nodes ● Standing Wave	

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Summative: Chapter Exam

Instructional Focus 11	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Sound Waves ● Properties of Sound ● Characteristics of sound waves ● Laws of Stings ● Tubes	☒Systems and System Models ☒Cause and Effect ☒Waves and Their Applications	HS-PS4-1 HS-PS4-3 HS-PS4-5	● Students will learn about the properties and characteristics of sound waves. ● Students will study the four laws of waves on strings. ● Studenst will study open and closed wave resonance.	● Sonic Spectrum ● Sound ● Audio Spectrum ● Ultrasonic ● Infrasonic ● Sound ● Intensity ● Loudness ● Threshold of Hearing	11) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

Instructional Focus 11	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Suggested time frame: 9-10 Days	☒Mathematics and Computation ☒Argumen-tation from Evidence ☒Obtaining, Evaluating, Communicating Information			• Threshold of Pain • Frequency • Pitch • Noise • Doppler Effect • Fundamental • Harmonic • Octave • Node • Anti-node • Quality • Law of Lengths • Law of Diameters • Law of Tensions • Law of Densities • Forced Vibration • Resonance Frequency • Closed Tubes • Open Tubes • Beats • Beat Frequency	

Assessments: How do my students demonstrate their understanding and how do I measure their learning?

Formative: Worksheet Solutions, Observations, Homework, Question Answer Sessions, Laboratories

Summative: Chapter Exam

Instructional Focus 12	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS | LS | ESS | ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
The Nature of Light ● Particle Wave Duality ● Electromagnetic Theory ● Quantim Mechanical Model ● Illumination **Suggested time frame: 9-10 Days**	☒Systems and System Models ☒Cause and Effect ☒Energy ☒Waves and Their Applications ☒Developing and Using Models ☒Mathematics and Computation ☒Argumen-tation from Evidence ☒Obtaining, Evaluating, Communicating Information	HS-PS3-5 HS-PS4-1 HS-PS4-3 HS-PS4-4 HS-PS4-5	● Students will study the particle wave duality of light, electromagnetic and quantum mechanical model. ● Students will calculate the illumination of an object by a source.	● The Corpuscular Theory ● Particle ● Rectilinear Propagation ● Reflection ● Refraction ● The Wave Theory ● Huygens Principle ● The ElectromagneticTheory ● Electromagnetic Wave ● Electromagnetic Energy ● The Photoelectric Effect ● Photoelectrons ● The First Law of Photoelectric Emission ● The cut-off potential ● The Second Law of Photoelectric Emission ● The Third Law of Photoelectric Emission ● The Quantum Theory ● Photons ● Planks Constant, ● Bright line spectra. ● The uncertainty principal ● Incoherent ● Polychromatic ● Coherent ● Monochromatic ● Thermal radiation ● Luminous ● Transparent ● Translucent ● Opaque ● Ray ● Beam ● Diverging Light	12) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

Instructional Focus 12	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS | LS | ESS | ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
				• Converging Light • Focus • Photometry • Luminous Intensity • Candle • Luminous Flux • Lumen • Illumination • The inverse square law	

Assessments: How do my students demonstrate their understanding and how do I measure their learning?

Formative: Worksheet Solutions, Observations, Homework, Question Answer Sessions, Laboratories

Summative: Chapter Exam

Instructional Focus 13	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS | LS | ESS | ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Modern Physics	☒Patterns ☒Energy and Matter ☒ Matter and Its Interactions ☒Developing and Using Models	HS-PS1-2 HS-PS1-3 HS-PS1-4 HS-PS1-5 HS-PS1-7 HS-PS1-8	• Students will be introduced to modern physics including dark matter, dark energy and the standard model. • Students will study the standard model including the three generations. • Students will be introduced to the multiple particles of particle physics.	• Dark matter • Standard Model • Dark energy • Beta particles • Radioactive • Decays • Alpha particles, • The positron • Anti-matter • Quantum mechanics • Annihilates: • The muon • Leptons.	13) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

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	☒Planning and Carrying out Investigations ☒Mathematics and Computation ☒Scientific Explanations			• Electron • Mesons, • Quarks. • Anti-quarks. • Baryons • Pion • Kaon • Neutrino • Boson • Strangeness • Isospin • Hadron • Gluons • *Resonance*, • Neutrinos • Flavor oscillation • Weak interaction, • The CP operation • Charge conjugation • Parity • Majorana • Dirac • Higgs boson	

Assessments: How do my students demonstrate their understanding and how do I measure their learning?

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Summative: Chapter Exam

Instructional Focus 14	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
Modern Physics	☒Patterns ☒Energy and Matter ☒ Matter and Its Interactions ☒Developing and Using Models ☒Planning and Carrying out Investigations ☒Mathematics and Computation ☒Scientific Explanations	HS-PS1-2 HS-PS1-3 HS-PS1-4 HS-PS1-5 HS-PS1-7 HS-PS1-8	• Students will continue the immersion of modern physics including the chompton effect, the majorana particle. • Students will study modern experiments at the Sanford Underground Research Facility including LUX, LZ, Majorana Demonstrator, CASPAR, DUNE, LBNE	• Electro-magnetism • Gravity • Strong nuclear force • Weak force • Quantum field theory (QFT) • Conservative-- forces • Non-conservative forces • Relativistic limit • Big Bang • Scatter • Cross section • Elastic scattering. • Coupling • Force carrier • Heisenberg uncertainty principle • Feynman diagrams • A field • Space-time • General relativity • Angular momentum • Quantum mechanics, • Quantized • Planck's constant • Fermions • Bosons. • Quarks and • Leptons • Standard Model • Baryons • Mesons • Pions • Relativistic particle • Photon • Quantum electrodynamics • Rutherford • Compton scattering • Nuclear fission • Quark	14) Online Curriculum a) Notes b) Equations c) Assignments d) Board Problems e) Lectures f) Videos

Instructional Focus 14	Dimensions Cross Cutting Concepts Disciplinary Core Ideas Science and Engineering Practices	Targeted Standards based Essential Skills & Concepts PS / LS / ESS / ED	Learning Goals / Essential Questions For Instructional Focus	Essential Vocabulary	Resources
				• Antiquarks • Kaons. • Muon • Muon neutrino, tau • Tau neutrino. • Quantum chromodynamics • Gluon • Jet • Spontaneous symmetry breaking • Nambu-Goldstone theorem. • Beta decay • Weak interaction. • Weak force carriers • Weak scale. • Parity • Charge conjugation	

Assessments: How do my students demonstrate their understanding and how do I measure their learning?

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