Physics Year-at-a-Glance

ARKANSAS STATE SCIENCE STANDARDS

FIRST SEMESTER		SECOND SEMESTER			
Unit 1 **Motion and Forces**	**Unit 2** **Work, Energy, and Momentum**	**Unit 3** **Rotational Motion**	**Unit 4** **Electricity**	**Unit 5** **Waves and Optics**	**Unit 6** **Heat and Thermodynamics**
11 weeks	7 weeks	3 weeks	9 weeks	4 weeks	4 weeks
• **P-PS1-1AR** • **P-PS2-1AR** • **P-PS2-2AR** • **P-ETS1-2AR**	• **P-PS2-1AR** • **P-PS2-2AR** • **P-PS2-3AR** • **P-PS2-5AR** • **P-PS2-6AR** • **P-PS3-3** • **P-ETS1-4AR**	• **P-PS2-4AR** • **P-ESS1-2AR** • **P-ESS1-4AR**	• **P-PS-1-2AR** • **P-PS2-4** • **P-PS2-5** • **P-PS3-2** • **P-PS5-1AR** • **P-PS5-2** • **P-PS5-3** • **P-ETS1-1**	• **P-PS4-1AR** • **P-PS4-2AR** • **P-PS4-3AR**	• **P-PS3-1** • **P-PS3-1AR** • **P-PS3-2AR** • **P-PS3-3AR** • **P-PS3-4** • **P-ETS1-3**

Recurring

RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
WHST.11-12.1 Write arguments focused on discipline-specific content

Unit 1	Motion and Forces	**Grade Level**	10-12	**Approx length**	11 weeks

CPSD Power Standards with Student Learning Objectives

P-PS1-1AR Create a model of motion and forces, including vectors graphed on the coordinate plane, to describe and predict the behavior of a system.

Student-Friendly Objectives:

- I can draw and label free body diagrams.
- I can use appropriate kinematic equations to solve problems.
- I can graph and add vectors.
- I can calculate the net force acting on an object using trigonometry and predict the movement of an object.
- I can compare and contrast rotational motion and linear motion.
- I can describe the effects of gravity on a system.

P-PS2-2AR Plan and conduct an investigation to provide evidence that work done equals energy stored in a conservative system.

Student-Friendly Objectives:

- I can calculate work and energy.
- I can identify types of energy present in a system.
- I can predict and describe system behavior based on energy conservation.

Learning Indicators of Power Standards

Students will know…	And be able to…
● The difference between scalar and vector quantities ● Kinematic relationships between: speed, velocity, distance, time, and acceleration ● Acceleration is the rate at which an object changes its speed and/or direction ● A net force can cause an acceleration ● Torque is a force that could cause rotation ● The work-kinetic energy theorem ● The total energy of a closed system is conserved ● A conservative system is one in which there are no dissipative forces ● Dissipative forces cause transfer of energy into different forms (for	● Use appropriate kinematic equations to solve problems in 1-dimensional and 2-dimensional motion. ● Graph and add vectors (including using trigonometry). ● Draw and label Free Body Diagrams. ● Differentiate between balanced and unbalanced forces. ● Calculate the net force acting on an object (including using trigonometry). ● Describe and calculate the effects of gravity on a system. ● Compare and contrast rotational motion vs linear motion through conceptual and algebraic methods. ● Use the appropriate formula to calculate work and energy. ● Determine the types of energy present in a system.

example, friction produces heat) ● The types of energy: kinetic, potential ● Forms (sources) of energy: chemical, electrical, mechanical, thermal, wave ● Stored energy depends on position; kinetic energy depends on mass and speed	● Predict when mechanical energy will not be conserved and describe why it is not conserved. ● Use the concept of conservation of energy to predict and describe system behavior.
Additional Arkansas State Standards	
● **P-PS2-1AR** Develop computational and graphical models to calculate and illustrate the work done and changes in energy in a system. ● **P-ETS1-2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	

Unit 2	Work, Energy and Momentum	**Grade Level**	10-12	**Approx Length**	**7 weeks**

CPSD Power Standards with Student Learning Objectives

P-PS2-2AR Plan and conduct an investigation to provide evidence that work done equals energy stored in a conservative system.

Student-Friendly Objectives:

- I can calculate work and energy.
- I can identify types of energy present in a system.
- I can predict and describe system behavior based on energy conservation.

Learning Indicators of Power Standards

Students will know...

- The work-kinetic energy theorem
- The total energy of a closed system is conserved
- A conservative system is one in which there are no dissipative forces
- Dissipative forces cause transfer of energy into different forms (for example, friction produces heat)
- The types of energy: kinetic, potential
- Forms (sources) of energy: chemical, electrical, mechanical, thermal, wave
- Stored energy depends on position; kinetic energy depends on mass and speed

And be able to...

- Use the appropriate formula to calculate work and energy.
- Determine the types of energy present in a system.
- Predict when mechanical energy will not be conserved and describe why it is not conserved.
- Use the concept of conservation of energy to predict and describe system behavior.

Additional Arkansas State Standards

- **P-PS2-1AR** Develop computational and graphical models to calculate and illustrate the work done and changes in energy in a system.
- **P-PS2-3AR** Plan and conduct an investigation to rate the power used in performing work on a system.
- **P-PS2-5AR** Use mathematical representations to support the claim that the change in kinetic energy of a system is equal to the net work performed upon the system.
- **P-PS2-6AR** Use mathematical representations to support the claim that the total impulse on a system of objects is equal to the change in momentum of the system.
- **P-PS3-3** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
- **P-ETS1-4AR** Use a computer simulation to model the impact of proposed solutions to a complex real- world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Unit 3	Rotational Motion	**Grade Level**	10-12	**Approx Length**	3 weeks

Arkansas State Standards

- **P-PS2-4AR** Analyze data to demonstrate the relationship between rotational and linear motion, energy, and momentum.
- **P-ESS1-2** Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system
- **P-ESS1-4** Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

Pacing/Resources (highlight reiteration of power standards with concrete example of how this will be done)

Unit 4	Electrical Circuits	Grade Level	10-12	Approx Length	

CPSD Power Standards with Student Learning Objectives

P-PS5-1AR Use mathematical representations and conduct investigations to provide evidence of the relationships between power, current, voltage, and resistance.

Student-Friendly Objectives:

- I can calculate voltage, resistance, current, and power for series and parallel circuits.
- I can compare and contrast series and parallel circuits.
- I can predict when DC or AC should be used.
- I can describe the role of resistors in a circuit.
- I can working series and parallel circuits.

Learning Indicators of Power Standards

Students will know…

- Materials that obey Ohm's Law show a direct proportionality between voltage and current (R = V/I)
- Power in electrical systems is current times voltage (P=IV)
- Series resistors build resistance additively and have a common current through only one electrical path
- Parallel resistors have more than one path of current flow, therefore the voltage drops across parallel branches are the same, currents add together to get total current, and additional parallel resistances decrease the equivalent resistance of the system
- Voltmeters must be placed parallel to the part of the circuit being measured
- Ammeters are placed in series with the part of the circuit being measured

And be able to…

- Use the appropriate formula to calculate voltage, resistance, current, and power of series and parallel circuits.
- Compare and contrast series and parallel circuits.
- Determine when it is appropriate to use DC vs AC.
- Build and manipulate a circuit to maximize current or voltage output of a system.
- Describe and use resistors in a circuit.
- Use a multimeter to measure voltage, current, and resistance.

Additional Arkansas State Standards

- **P-PS-1-2AR** Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

- **P-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.
- **P-PS2-5** Plan and conduct 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.
- **P-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).
- **P-PS5-2AR** Use mathematical representations and conduct investigations to provide evidence of the relationships between power, current, voltage, and resistance.
- **P-PS5-3AR** Evaluate competing design solutions for construction and use of electrical consumer products.*
- **P-ETS1-1** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

Unit 5	Waves and Optics	**Grade Level**	10-12	**Approx Length**	4 weeks

CPSD Power Standards with Student Learning Objectives

P-PS4-1AR Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, speed, and energy of waves traveling in various media.

Student-Friendly Objectives:

- I can explain how waves transfer energy.
- I can compare and contrast different waves to determine the relationships between wavelength, speed, frequency, and energy.
- I can use the relationships between frequency, speed, wavelength to solve problems.
- I can describe how different types of waves travel through different types of media.

Learning Indicators of Power Standards

Students will know...

- Waves transfer energy, not matter
- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude
- Medium (plural: media) refers to the material through which a wave travels (ex: air, water, etc.)
- Basic measurements of waves: frequency, period, wavelength, wave speed
- Frequency and period are reciprocals of each other
- The speed of a wave depends on the physical structure of the medium through which they travel
- The wavelength and frequency of a wave are related to each other by the speed of the wave, which depends on the type of wave and the medium through which it is passing
- The energy of a wave depends on the amplitude of a wave
- Mechanical waves require a medium through which to travel
- Electromagnetic waves do not require a medium through which to travel

And be able to...

- Explain how waves transfer energy.
- Use appropriate formula to calculate frequency, speed, wavelength, and energy of a wave.
- Compare and contrast different waves to determine the relationships between amplitude, frequency, wavelength, and energy.
- Analyze the change in speed that occurs when waves change the medium through which they are traveling.

Additional Arkansas State Standards

- **P-PS4-2AR** Develop and use models to investigate longitudinal and transverse waves in various media.
- **P-PS4-3AR** Develop and use models to describe the interaction of light with matter.

Unit 6	Heat and Thermodynamics	**Grade Level**	10-12	**Approx Length**	4 weeks

CPSD Power Standards with Student Learning Objectives

P-PS3-1AR Construct an explanation based on evidence of the relationships between heat, temperature, and the Kinetic Molecular Theory.

Student-Friendly Objectives:

- I can compare the average kinetic energies of objects based on temperature.
- I can calculate the specific heat of a material.
- I can relate how temperature and mass affect the amount of heat transferred.
- I can use evidence to describe the relationship between heat, temperature, and the kinetic molecular theory.
- I can interpret phase change diagrams.

Learning Indicators of Power Standards

Students will know…

- The assumptions of kinetic molecular theory
- Heat is the form of energy that flows between materials in thermal contact that are at different temperatures
- Temperature is a measure of the average kinetic energy of the particles of a material

- Measure the temperature of different objects and compare their average kinetic energies.
- Calculate the specific heat of a material based on mass, temperature change, and heat transfer.
- Conduct an experiment relating how temperature and mass affect the amount of heat transferred.
- Use evidence to describe the relationship between heat, temperature, and the kinetic molecular theory.
- Interpret phase change diagrams.

Additional Arkansas State Standards

- **P-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.
- **P-PS3-2AR** Plan and conduct an investigation of the relationships between pressure, volume, temperature, and amount of gas.
- **P-PS3-3AR** Use mathematical representations to model the conservation of energy in fluids.
- **P-PS3-4** Plan and conduct 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).
- **P-ETS1-3** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.