

**Physics** 





### **Physics Standards**

The Cobb Teaching and Learning Standards (CT & LS) for science are designed to provide foundational knowledge and skills for all students to develop proficiency in science. The Project 2061's *Benchmarks for Science Literacy* and the follow up work, *A Framework for K-12 Science Education* were used as the core of the standards to determine appropriate content and process skills for students. The Cobb Teaching and Learning Standards focus on a limited number of core disciplinary ideas and crosscutting concepts which build from Kindergarten to high school. The standards are written with the core knowledge to be integrated with the science and engineering practices needed to engage in scientific inquiry and engineering design.

The Cobb Teaching and Learning Standards drive instruction. Hands-on, student-centered, and inquiry-based approaches should be the emphasis of instruction. The standards are a required minimum set of expectations that show proficiency in science. However, instruction can extend beyond these minimum expectations to meet student needs.

Science consists of a way of thinking and investigating, as well a growing body of knowledge about the natural world. To become literate in science, students need to possess sufficient understanding of fundamental science content knowledge, the ability to engage in the science and engineering practices, and to use scientific and technological information correctly. Technology should be infused into the curriculum and the safety of the student should always be foremost in instruction.

The Cobb Teaching and Learning Standards are designed to continue student investigations of the physical sciences that began in grades K-8, and provide students the necessary skills to be proficient in physics. These standards include more abstract concepts such as nuclear decay processes, interactions of matter and energy, velocity, acceleration, force, energy, momentum, properties and interactions of matter, electromagnetic and mechanical waves, and electricity, magnetism and their interactions. Students investigate physics concepts through experiences in laboratories and field work using the process of inquiry.



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Physics Teaching & Learning Framework							
Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
2 wks BL/4 wks YR	3 wks BL/6 wks	2 wks BL/4 wks YR	2 wks BL/4 wks	2 wks BL/4 wks	3 wks BLOCK/6 wks YR	2 wks BL/4 wks YR	1 wk BL/2 wks
	YR		YR	YR			
Kinematics	Forces	Application of Forces	Momentum,	Work, Power,	Sound, Waves and Light	Electricity and Magnetism	Modern Physics
SP1	SP2	SP1/SP2	Impulse, Collisions	Energy	SP4	SP5	SP6
			SP3	SP3			
SP1. Obtain, evaluate,	SP2. Obtain,	SP1. Obtain, evaluate, and communicate	SP3. Obtain,	SP3. Obtain,	SP4. Obtain, evaluate, and communicate	SP5. Obtain, evaluate, and	SP6. Obtain,
and communicate	evaluate, and	information about the relationship	evaluate, and	evaluate, and	information about the properties and applications	communicate information about electrical and	evaluate, and
information about the relationship between	communicate information about	between distance, displacement, speed, velocity, and acceleration as functions of	communicate information about	communicate information about	of waves.  a. Develop and use mathematical models to	magnetic force	communicate information about
distance,	how forces affect	time.	the importance of	the importance of	explain mechanical and electromagnetic waves as a	interactions.	nuclear changes of
displacement, speed,	the motion of	d. Analyze and interpret data of two-	conservation laws	conservation laws	propagating disturbance that transfers energy.	a. Develop and use	matter and related
velocity, and	objects.	dimensional motion with constant	for mechanical	for mechanical	(Clarification statement: Mathematically describe	mathematical models and	technological
acceleration as	a. Construct an	acceleration.	energy and linear	energy and linear	how the velocity, frequency, and wavelength of a	generate diagrams to	applications. a.
functions of time.	explanation based on	Resolve position, velocity, or	momentum in	momentum in	propagating wave are related.)	compare and contrast the	Develop and use
a. Plan and carry out	evidence using	acceleration vectors into components (x	predicting the	predicting the	b. Develop and use models to describe and	electric and gravitational	models to explain,
an investigation of	Newton's Laws of	and y, horizontal and vertical).	behavior of physical	behavior of	calculate characteristics related to the interference	forces between two	compare, and
one-dimensional	how forces affect the	<ul> <li>Add vectors graphically and</li> </ul>	systems.	physical systems.	and diffraction of waves (single and double slits).	charged objects.	contrast nuclear
motion to calculate	acceleration of a	mathematically by adding components.	a. Ask questions to	a. Ask questions to	c. Construct an argument that analyzes the	b. Plan and carry out	processes including
average and	body.	Interpret problems to show that	compare and	compare and	production and characteristics of sounds waves.	investigations to	radioactive decay,
instantaneous speed	Explain and predict	objects moving in two dimensions have	contrast open and	contrast open and	(Clarification statement: Includes, but not limited	demonstrate and	fission, and fusion.
and velocity.	the motion of a body	independent motions along each	closed systems.	closed systems.	to, Doppler Effect, standing waves, wavelength, the	qualitatively explain charge	b. Construct an
Analyze one- dimensional problems	in absence of a force and when forces are	coordinate axis.  • Design an experiment to investigate the	d. Construct an argument supported	b. Use mathematics and computational	relationship between amplitude and the energy of the wave, and the relationship between frequency	transfer by conduction, friction, and induction.	argument to compare and
involving changes of	applied using	projectile motion of an object by	by evidence of the	thinking to analyze,	and pitch.)	c. Construct an explanation	contrast
direction, using	Newton's 1st Law	collecting and analyzing data using	use of the principle	evaluate, and apply	d. Plan and carry out investigations to characterize	based on evidence of the	mechanisms and
algebraic signs to	(principle of inertia).	kinematic equations.	of conservation of	the principle of	the properties and behavior of electromagnetic	behavior of charges in	characteristics of
represent vector	Calculate the	Predict and describe how changes to	momentum to	conservation of	waves. (Clarification statement: Properties of	terms of electric potential	radioactive decay.
direction.	acceleration for an	initial conditions affect the resulting	<ul> <li>explain how the</li> </ul>	energy and the	waves include, but not limited to, amplitude,	energy.	(Clarification
Apply one-	object using	motion.	brief application of a	Work-Kinetic	frequency, wavelength, and the relationship	d. Plan and carry out an	statement: Include
dimensional kinematic	Newton's 2nd Law,	Calculate range and time in the air for a	force creates an	Energy Theorem.	between frequency or wavelength and the energy	investigation of the	alpha, beta, and
equations to situations	including situations	horizontally launched projectile	impulse.	Calculate the	of the wave.)	relationship between	gamma decays and
with no acceleration,	where multiple		<ul> <li>describe and</li> </ul>	kinetic energy of an	e. Plan and carry out investigations to describe	voltage, current, and	their effects.)
and positive, or	forces act together.	SP2. Obtain, evaluate, and communicate	perform calculations	object.	common features of light in terms of color,	power for direct current	c. Develop and use
negative constant	Identify the pair of	information about how forces affect the	involving one	Calculate the	polarization, spectral composition, and wave speed	circuits. (Clarification	mathematical
acceleration.	equal and opposite	motion of objects.	dimensional momentum.	amount of work	in transparent media.	statement: Application of Ohm's Law to different	models and representations to
b. Analyze and interpret data using	forces between two interacting bodies	c. Use mathematical representations to calculate magnitudes and vector	connect the	performed by a force on an object.	Analyze experimentally and mathematically aspects of reflection and refraction of light waves	circuit configurations, not	calculate the
created or obtained	and relate their	components for typical forces including	concepts of	c. Plan and carry	and describe the results using optical ray diagrams.	limited to parallel and	amount of
motion graphs to	magnitudes and	gravitational force, normal force, friction	Newton's 3rd law	out an investigation	Perform calculations related to reflections from	series, and calculations of	substance present
illustrate the	directions using	forces, tension forces, and spring forces.	and impulse.	demonstrating	plane surfaces and focusing using thin lenses.	equivalent resistance are	after a given
relationships among	Newton's 3rd Law.	d. Plan and carry out an investigation to	experimentally	conservation and	f. Plan and carry out investigations to identify the	expected.)	amount of time
position, velocity, and	b. Develop and use a	gather evidence to identify the force or	compare and	rate of transfer of	behavior of light using lenses. (Clarification	e. Plan and carry out	based on its half-
acceleration, as	model of a Free Body	force component responsible for causing	contrast inelastic and	energy (power) to	statement: Investigations concerning Snell's Law,	investigations to clarify the	life and relate this
functions of time.	Diagram to represent	an object to move along a circular path.	elastic collisions.	solve problems	optical ray diagrams, and thin lens equation should	relationship between	to the law of
c. Ask questions to	the forces acting on	Calculate the magnitude of a centripetal		involving closed	be conducted.)	electric currents and	conservation of
compare and contrast	an object (both	acceleration.		systems.	g. Plan and carry out investigations to describe	magnetic fields.	mass and energy.
scalar and vector	equilibrium and non-	e. Develop and use a model to describe			changes in diffraction patterns associated with	(Clarification statement:	
quantities.	equilibrium).	the mathematical relationship between			geometry and wavelength for mechanical and	This includes coils and their	
		mass, distance, and force as expressed by Newton's Universal Law of Gravitation			electromagnetic waves	importance in the design of motors and generators.)	
		140 W COLL 2 CHINACISM LAW OF GLAVICATION				motors and generators.	



## SP1. Obtain, evaluate, and communicate information about the relationship between distance, displacement, speed, velocity, and acceleration as functions of time.

- a. Plan and carry out an investigation of one-dimensional motion to calculate average and instantaneous speed and velocity.
  - Analyze one-dimensional problems involving changes of direction, using algebraic signs to represent vector direction.
  - Apply one-dimensional kinematic equations to situations with no acceleration, and positive or negative constant acceleration.
- b. Analyze and interpret data using created or obtained motion graphs to illustrate the relationships among position, velocity, and acceleration, as functions of time.
- c. Ask questions to compare and contrast scalar and vector quantities.
- d. Analyze and interpret data of two-dimensional motion with constant acceleration.
  - Resolve position, velocity, or acceleration vectors into components (x and y, horizontal and vertical).
  - Add vectors graphically and mathematically by adding components.
  - Interpret problems to show that objects moving in two dimensions have independent motions along each coordinate axis.
  - Design an experiment to investigate the projectile motion of an object by collecting and analyzing data using kinematic equations.
  - Predict and describe how changes to initial conditions affect the resulting motion.
  - Calculate range and time in the air for a horizontally launched projectile.

### SP2. Obtain, evaluate, and communicate information about how forces affect the motion of objects.

- a. Construct an explanation based on evidence using Newton's Laws of how forces affect the acceleration of a body.
  - Explain and predict the motion of a body in absence of a force and when forces are applied using Newton's 1st Law (principle of inertia).
  - Calculate the acceleration for an object using Newton's 2nd Law, including situations where multiple forces act together.
  - Identify the pair of equal and opposite forces between two interacting bodies and relate their magnitudes and directions using Newton's 3rd Law.
- b. Develop and use a model of a Free Body Diagram to represent the forces acting on an object (both equilibrium and non-equilibrium).
- c. Use mathematical representations to calculate magnitudes and vector components for typical forces including gravitational force, normal force, friction forces, tension forces, and spring forces.
- d. Plan and carry out an investigation to gather evidence to identify the force or force component responsible for causing an object to move along a circular path.
  - Calculate the magnitude of a centripetal acceleration.
- e. Develop and use a model to describe the mathematical relationship between mass, distance, and force as expressed by Newton's Universal Law of Gravitation.



# SP3. Obtain, evaluate, and communicate information about the importance of conservation laws for mechanical energy and linear momentum in predicting the behavior of physical systems.

- a. Ask guestions to compare and contrast open and closed systems.
- b. Use mathematics and computational thinking to analyze, evaluate, and apply the principle of conservation of energy and the Work-Kinetic Energy Theorem.
  - Calculate the kinetic energy of an object.
  - Calculate the amount of work performed by a force on an object.
- c. Plan and carry out an investigation demonstrating conservation and rate of transfer of energy (power) to solve problems involving closed systems.
- d. Construct an argument supported by evidence of the use of the principle of conservation of momentum to:
  - explain how the brief application of a force creates an impulse,
  - describe and perform calculations involving one dimensional momentum,
  - connect the concepts of Newton's 3rd law and impulse, and
  - experimentally compare and contrast inelastic and elastic collisions.

### SP4. Obtain, evaluate, and communicate information about the properties and applications of waves.

- a. Develop and use mathematical models to explain mechanical and electromagnetic waves as a propagating disturbance that transfers energy. (*Clarification statement:* Mathematically describe how the velocity, frequency, and wavelength of a propagating wave are related.)
- b. Develop and use models to describe and calculate characteristics related to the interference and diffraction of waves (single and double slits).
- c. Construct an argument that analyzes the production and characteristics of sound waves.
- (Clarification statement: Includes, but is not limited to, Doppler Effect, standing waves, wavelength, the relationship between amplitude and the energy of the wave, and the relationship between frequency and pitch.)
- d. Plan and carry out investigations to characterize the properties and behavior of electromagnetic waves.
- (*Clarification statement:* Properties of waves include, but are not limited to, amplitude, frequency, wavelength, and the relationship between frequency or wavelength and the energy of the wave.)
- e. Plan and carry out investigations to describe common features of light in terms of color, polarization, spectral composition, and wave speed in transparent media.
  - Analyze experimentally and mathematically aspects of reflection and refraction of light waves and describe the results using optical ray diagrams.
  - Perform calculations related to reflections from plane surfaces and focusing using thin lenses.
- f. Plan and carry out investigations to identify the behavior of light using lenses.
- (Clarification statement: Investigations concerning Snell's Law, optical ray diagrams, and thin lens equation should be conducted.)
- g. Plan and carry out investigations to describe changes in diffraction patterns associated with geometry and wavelength for mechanical and electromagnetic waves.



### SP5. Obtain, evaluate, and communicate information about electrical and magnetic force interactions.

a. Develop and use mathematical models and generate diagrams to compare and contrast the electric and gravitational forces between two charged objects.

(Clarification statement: Coulomb's and Universal Gravitation Law should be addressed.)

- b. Plan and carry out investigations to demonstrate and qualitatively explain charge transfer by conduction, friction, and induction.
- c. Construct an explanation based on evidence of the behavior of charges in terms of electric potential energy.
- d. Plan and carry out an investigation of voltage, current, and power for direct current circuits.

(Clarification statement: Application of Ohm's Law to different circuit configurations, not limited to parallel and series, and calculations of equivalent resistance are expected.)

e. Plan and carry out investigations to clarify the relationship between electric currents and magnetic fields.

(Clarification statement: This includes coils and their importance in the design of motors and generators.)

#### SP6. Obtain, evaluate, and communicate information about nuclear changes of matter and related technological applications.

- a. Develop and use models to explain, compare, and contrast nuclear processes including radioactive decay, fission, and fusion.
- b. Construct an argument to compare and contrast mechanisms and characteristics of radioactive decay.

(Clarification statement: Include alpha, beta, and gamma decays and their effects.)

**c.** Develop and use mathematical models and representations to calculate the amount of substance present after a given amount of time based on its half-life and relate this to the law of conservation of mass and energy.