Physical Science – Part 2

Michigan State High School Science Content Expectations

Course Description

This course is designed to introduce two areas of study: chemistry and physics. The student will investigate topics surrounding matter, atomic structure, bonds, chemical reactions and the periodic table. The physics segment will involve motion, forces, energy, waves and electricity.

Text Book

Frank, David, Michael Wysession, and Sophia Yancopoulos. *Physical Science*, *Concepts in Action*. Upper Saddle River: Prentice Hall, 2004.

Unit 1 Description

This unit will challenge the learner to explore the concepts of motion and forces. The learner will compare the similarities and differences between distance and displacement, speed and velocity, and types of forces. Through this study, the learner will develop skills in and investigate the foundations of physics.

Essential Content and Skills

The learner will:

- Compare distance and displacement.
- Contrast speed and velocity.
- Examine acceleration.
- Explore forces and Newton's laws.
- Analyze force and pressure in fluids.

Unit 1 Michigan State Content Expectations

Click here to view the Michigan DOE Curriculum Content Standards.

Unit 1 Lesson 1: Distance and Displacement

State Standard	Description
P2.2A	Distinguish between the variables of distance, displacement, speed, velocity, and acceleration.
P2.3a	Describe and compare the motion of an object using different reference frames.

Unit 1 Lesson 2: Speed and Velocity

State Standard	Description
P2.2A	Distinguish between the variables of distance, displacement, speed, velocity, and acceleration.
P2.2C	Describe and analyze the motion that a velocity-time graph represents, given the graph.

Unit 1 Lesson 3: Acceleration

State Standard	Description
P2.2A	Distinguish between the variables of distance, displacement, speed, velocity, and acceleration.
P2.2B	Use the change of speed and elapsed time to calculate the average acceleration for linear motion.
P2.2D	State that uniform circular motion involves acceleration without a change in speed.
P2.2e	Use the area under a velocity-time graph to calculate the distance traveled and the slope to calculate the acceleration.
P2.2f	Describe the relationship between changes in position, velocity, and acceleration during periodic motion.

Unit 1 Lesson 4: Forces

State Standard	Description
P3.1A	Identify the force(s) acting between objects in “direct contact” or at a distance.
P3.1d	Identify the basic forces in everyday interactions.

Unit 1 Lesson 5: Newton’s First and Second Law of Motion

State Standard	Description
P3.1A	Identify the force(s) acting between objects in “direct contact” or at a distance.
P3.2A	Identify the magnitude and direction of everyday forces (e.g., wind, tension in ropes, pushes and pulls, weight).
P3.2C	Calculate the net force acting on an object.
P3.4C	Solve problems involving force, mass, and acceleration in linear motion (Newton’s second law).

Unit 1 Lesson 6: Newton's third Law of Motion and Momentum

State Standard	Description
P3.3A	Identify the action and reaction force from examples of forces in everyday situations (e.g., book on a table, walking across the floor, pushing open a door).
P3.3b	Predict how the change in velocity of a small mass compares to the change in velocity of a large mass when the objects interact (e.g., collide).
P3.5a	Apply conservation of momentum to solve simple collision problems.

Unit 1 Lesson 7: Universal Forces

State Standard	Description
P3.4D	Identify the force(s) acting on objects moving with uniform circular motion (e.g., a car on a circular track, satellites in orbit).
P3.6A	Explain earth-moon interactions (orbital motion) in terms of forces.
P3.6d	Calculate force, masses, or distance, given any three of these quantities, by applying the Law of Universal Gravitation, given the value of *G*.
P3.7B	Explain why acquiring a large excess static charge (e.g., pulling off a wool cap, touching a Van de Graaff generator, combing) affects your hair.

Unit 1 Lesson 8: Fluid Pressure

State Standard	Description
P3.1A	Identify the force(s) acting between objects in "direct contact" or at a distance.
P3.3A	Identify the action and reaction force from examples of forces in everyday situations (e.g., book on a table, walking across the floor, pushing open a door).

Unit 1 Lesson 9: Forces and Pressures in Fluids

State Standard	Description
P3.1A	Identify the force(s) acting between objects in "direct contact" or at a distance.

Unit 1 Lesson 10: Buoyancy

State Standard	Description
P3.1A	Identify the force(s) acting between objects in "direct contact" or at a distance.

Unit 2 Description

This unit will challenge the learner to examine concepts of work, power and energy. The learner will investigate theoretical and practical aspects of mechanical advantage, machines, energy resources, and heat. Through this, the learner will develop skills in and investigate the basic properties of energy and all of its forms.

Essential Content and Skills

The learner will:

- Contrast work and power.
- Analyze simple machines.
- Examine energy conversion.
- Compare energy resources.
- Examine thermal energy properties.
- Investigate methods of heat transfer.

Unit 2 Michigan State Content Expectations

Unit 2 Lesson 1: Work and Power

State Standard	Description
P3.2B	Compare work done in different situations.
P4.1c	Explain why work has a more precise scientific meaning than the meaning of work in everyday language.
P4.1d	Calculate the amount of work done on an object that is moved from one position to another.

Unit 2 Lesson 2: Work and Machines

State Standard	Description
P4.1c	Explain why work has a more precise scientific meaning than the meaning of work in everyday language.
P4.1d	Calculate the amount of work done on an object that is moved from one position to another.
P4.1e	Using the formula for work, derive a formula for change in potential energy of an object lifted a distance *h*.
P4.2B	Name devices that transform specific types of energy into other types (e.g., a device that transforms electricity into motion).

Unit 2 Lesson 3: Mechanical Advantage and Efficiency

State Standard	Description
P4.1c	Explain why work has a more precise scientific meaning than the meaning of work in everyday language.
P4.1d	Calculate the amount of work done on an object that is moved from one position to another.
P4.1e	Using the formula for work, derive a formula for change in potential energy of an object lifted a distance *h*.
P4.2B	Name devices that transform specific types of energy into other types (e.g., a device that transforms electricity into motion).

Unit 2 Lesson 4: Simple Machines

State Standard	Description
P4.1c	Explain why work has a more precise scientific meaning than the meaning of work in everyday language.
P4.1d	Calculate the amount of work done on an object that is moved from one position to another.
P4.1e	Using the formula for work, derive a formula for change in potential energy of an object lifted a distance *h*.
P4.2B	Name devices that transform specific types of energy into other types (e.g., a device that transforms electricity into motion).

Unit 2 Lesson 5: Energy and Its Forms

State Standard	Description
P4.3A	Identify the form of energy in given situations (e.g., moving objects, stretched springs, rocks on cliffs, energy in food).
P4.3B	Describe the transformation between potential and kinetic energy in simple mechanical systems (e.g., pendulums, roller coasters, ski lifts).
P4.3C	Explain why all mechanical systems require an external energy source to maintain their motion.

Unit 2 Lesson 6: Energy and Conservation

State Standard	Description
P4.1A	Account for and represent energy into and out of systems using energy transfer diagrams.
P4.2A	Account for and represent energy transfer and transformation in complex processes (interactions).
P4.2B	Name devices that transform specific types of energy into other types (e.g., a device that transforms electricity into motion).
P4.2C	Explain how energy is conserved in common systems (e.g., light incident on a transparent material, light incident on a leaf, mechanical energy in a collision).

Unit 2 Lesson 7: Energy Resources

State Standard	Description
P4.2A	Account for and represent energy transfer and transformation in complex processes (interactions).
P4.2B	Name devices that transform specific types of energy into other types (e.g., a device that transforms electricity into motion).
P4.2C	Explain how energy is conserved in common systems (e.g., light incident on a transparent material, light incident on a leaf, mechanical energy in a collision).
E2.2A	Describe the Earth's principal sources of internal and external energy (e.g., radioactive decay, gravity, solar energy).
E2.2B	Identify differences in the origin and use of renewable (e.g., solar, wind, water, biomass) and nonrenewable (e.g., fossil fuels, nuclear [U-235]) sources of energy.
E2.2C	Describe natural processes in which heat transfer in the Earth occurs by conduction, convection, and radiation.
E2.2D	Identify the main sources of energy to the climate system.
E2.2e	Explain how energy changes form through Earth systems.

Unit 2 Lesson 8: Thermal Energy and Matter

State Standard	Description
P4.11a	Calculate the energy lost to surroundings when water in a home water heater is heated from room temperature to the temperature necessary to use in a dishwasher, given the efficiency of the home hot water heater.
P4.11b	Calculate the final temperature of two liquids (same or different materials) at the same or different temperatures and masses that are combined.

Unit 2 Lesson 9: Heat and Thermodynamics

State Standard	Description
E2.2C	Describe natural processes in which heat transfer in the Earth occurs by conduction, convection, and radiation.

Unit 2 Lesson 10: Using Heat

State Standard	Description
P4.10A	Describe the energy transformations when electrical energy is produced and transferred to homes and businesses.
P4.10B	Identify common household devices that transform electrical energy to other forms of energy, and describe the type of energy transformation.

Unit 3 Description

This unit will enable the learner to investigate the ideas of mechanical and electromagnetic waves. The learner will develop an understanding of the properties and behavior of multiple wave types. The learner will investigate theoretical and practical aspects of sound, light and other waves. He or she will gain the ability to describe different aspects of waves including quantitative and qualitative properties.

Essential Content and Skills

The learner will:

- Examine the properties and behavior of mechanical waves.
- Investigate the mechanism of sound and hearing.
- Analyze types of electromagnetic waves.
- Compare and contrast wave types.
- Observe the behavior of light and color.

Unit 3 Michigan State Content Expectations

Unit 3 Lesson 1: Mechanical Waves

State Standard	Description
P4.4A	Describe specific mechanical waves (e.g., on a demonstration spring, on the ocean) in terms of wavelength, amplitude, frequency, and speed.
P4.4B	Identify everyday examples of transverse and compression (longitudinal) waves.
P4.4C	Compare and contrast transverse and compression (longitudinal) waves in terms of wavelength, amplitude, and frequency.
P4.5A	Identify everyday examples of energy transfer by waves and their sources.
P4.5B	Explain why an object (e.g., fishing bobber) does not move forward as a wave passes under it.

Unit 3 Lesson 2: Properties of Mechanical Waves

State Standard	Description
P4.4d	Demonstrate that frequency and wavelength of a wave are inversely proportional in a given medium.
P4.4e	Calculate the amount of energy transferred by transverse or compression waves of different amplitudes and frequencies (e.g., seismic waves).

Unit 3 Lesson 3: Behavior of Waves

State Standard	Description
P4.8A	Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.
P4.8B	Predict the path of reflected light from flat, curved, or rough surfaces (e.g., flat and curved mirrors, painted walls, paper).
P4.8c	Describe how two wave pulses propagated from opposite ends of a demonstration spring interact as they meet.
P4.8d	List and analyze everyday examples that demonstrate the interference characteristics of waves (e.g., dead spots in an auditorium, whispering galleries, colors in a CD, beetle wings).

Unit 3 Lesson 4: Sound and Hearing

State Standard	Description
P4.5C	Provide evidence to support the claim that sound is energy transferred by a wave, not energy transferred by particles.
P4.6D	Explain why we see a distant event before we hear it (e.g., lightning before thunder, exploding fireworks before the boom).

Unit 3 Lesson 5: Electromagnetic Waves

State Standard	Description
P4.4d	Demonstrate that frequency and wavelength of a wave are inversely proportional in a given medium.
P4.4e	Calculate the amount of energy transferred by transverse or compression waves of different amplitudes and frequencies (e.g., seismic waves).
P4.6A	Identify the different regions on the electromagnetic spectrum and compare them in terms of wavelength, frequency, and energy.
P4.6B	Explain why radio waves can travel through space, but sound waves cannot.
P4.6C	Explain why there is a delay between the time we send a radio message to astronauts on the moon and when they receive it.

Unit 3 Lesson 6: Electromagnetic Waves

State Standard	Description
P4.r9d	Describe evidence that supports the dual wave - particle nature of light. (recommended)

Unit 3 Lesson 7: Electromagnetic Spectrum

State Standard	Description
P4.6A	Identify the different regions on the electromagnetic spectrum and compare them in terms of wavelength, frequency, and energy.
P4.6B	Explain why radio waves can travel through space, but sound waves cannot.
P4.6C	Explain why there is a delay between the time we send a radio message to astronauts on the moon and when they receive it.

Unit 3 Lesson 8: Behavior of Light

State Standard	Description
P4.8A	Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.
P4.8B	Predict the path of reflected light from flat, curved, or rough surfaces (e.g., flat and curved mirrors, painted walls, paper).
P4.9A	Identify the principle involved when you see a transparent object (e.g., straw, piece of glass) in a clear liquid.
P4.9B	Explain how various materials reflect, absorb, or transmit light in different ways.

Unit 3 Lesson 9: Color

State Standard	Description
P4.8A	Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.
P4.8B	Predict the path of reflected light from flat, curved, or rough surfaces (e.g., flat and curved mirrors, painted walls, paper).
P4.9A	Identify the principle involved when you see a transparent object (e.g., straw, piece of glass) in a clear liquid.
P4.9B	Explain how various materials reflect, absorb, or transmit light in different ways.

Unit 3 Lesson 10: Sources of Light

State Standard	Description
P4.8A	Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.
P4.8B	Predict the path of reflected light from flat, curved, or rough surfaces (e.g., flat and curved mirrors, painted walls, paper).
P4.9A	Identify the principle involved when you see a transparent object (e.g., straw, piece of glass) in a clear liquid.
P4.9B	Explain how various materials reflect, absorb, or transmit light in different ways.

Unit 4 Description

This unit will challenge the learner to explore the fields of optics, electricity and magnetism. The learner will compare and contrast mirrors, lenses and optical instruments. He/she will investigate the basic properties and applications of electricity including electric charge, current, and circuits. The learner will also identify characteristics of magnets and magnetic fields and will examine electrical energy generation and transmission.

Essential Content and Skills

The learner will:

- Explore properties of mirrors and lenses.
- Examine the properties of optical instruments.
- Study the eye and vision.
- Investigate electric charge and static electricity.
- Practice using Ohm's law.
- Identify electric currents.
- Interpret magnetics and magnetic fields.
- Investigate electrical energy generation and transmission.

Unit 4 Michigan State Content Expectations

Unit 4 Lesson 1: Mirrors

State Standard	Description
P4.8A	Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.
P4.8B	Predict the path of reflected light from flat, curved, or rough surfaces (e.g., flat and curved mirrors, painted walls, paper).

Unit 4 Lesson 2: Lens

State Standard	Description
P4.8A	Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.
P4.8B	Predict the path of reflected light from flat, curved, or rough surfaces (e.g., flat and curved mirrors, painted walls, paper).
P4.8e	Given an angle of incidence and indices of refraction of two materials, calculate the path of a light ray incident on the boundary (Snell's Law).
P4.8f	Explain how Snell's Law is used to design lenses (e.g., eye glasses, microscopes, telescopes, binoculars).

Unit 4 Lesson 3: Optical Instruments

State Standard	Description
P4.8e	Given an angle of incidence and indices of refraction of two materials, calculate the path of a light ray incident on the boundary (Snell's Law).
P4.8f	Explain how Snell's Law is used to design lenses (e.g., eye glasses, microscopes, telescopes, binoculars).

Unit 4 Lesson 4: The Eye and Vision

State Standard	Description
P4.8e	Given an angle of incidence and indices of refraction of two materials, calculate the path of a light ray incident on the boundary (Snell's Law).
P4.8f	Explain how Snell's Law is used to design lenses (e.g., eye glasses, microscopes, telescopes, binoculars).

Unit 4 Lesson 5: Electrical Charge and Static Electricity

State Standard	Description
P3.7A	Predict how the electric force between charged objects varies when the distance between them and/or the magnitude of charges change.
P3.7B	Explain why acquiring a large excess static charge (e.g., pulling off a wool cap, touching a Van de Graaff generator, combing) affects your hair.
P3.7c	Draw the redistribution of electric charges on a neutral object when a charged object is brought near.
P3.7d	Identify examples of induced static charges.

Unit 4 Lesson 6: Electric Current and Ohm's Law

State Standard	Description
P4.10D	Discriminate between voltage, resistance, and current as they apply to an electric circuit.
P4.10e	Explain energy transfer in a circuit, using an electrical charge model.
P4.10f	Calculate the amount of work done when a charge moves through a potential difference, *V*.
P4.10g	Compare the currents, voltages, and power in parallel and series circuits.

Unit 4 Lesson 7: Electric Circuits

State Standard	Description
P4.10D	Discriminate between voltage, resistance, and current as they apply to an electric circuit.
P4.10e	Explain energy transfer in a circuit, using an electrical charge model.
P4.10f	Calculate the amount of work done when a charge moves through a potential difference, *V*.
P4.10g	Compare the currents, voltages, and power in parallel and series circuits.

Unit 4 Lesson 8: Magnets and Magnetic Fields

State Standard	Description
P4.r7a	Calculate and compare the energy in various electromagnetic quanta (e.g., visible light, x-rays). (recommended)

Unit 4 Lesson 9: Electromagnetism

State Standard	Description
P3.p8A	Create a representation of magnetic field lines around a bar magnet and qualitatively describe how the relative strength and direction of the magnetic force changes at various places in the field. (prerequisite)
P3.8b	Explain how the interaction of electric and magnetic forces is the basis for electric motors, generators, and the production of electromagnetic waves.

Unit 4 Lesson 10: Electrical Energy Generation and Transmission

State Standard	Description
P4.10A	Describe the energy transformations when electrical energy is produced and transferred to homes and businesses.
P4.10B	Identify common household devices that transform electrical energy to other forms of energy, and describe the type of energy transformation.