Michigan High School Science
Contents statements mapping

PHYSICS	Boardworks High School Physics Presentations
P2.1 Position — Time	
P2.1a Calculate the average speed of an object using the change of position and elapsed time.	Speed and Velocity
P2.1b Represent the velocities for linear and circular motion using motion diagrams (arrows on strobe pictures).	Circular Motion Displacement, Velocity and Acceleration
P2.1c Create line graphs using measured values of position and elapsed time.	Displacement, Velocity and Acceleration
P2.1d Describe and analyze the motion that a position-time graph represents, given the graph.	Displacement, Velocity and Acceleration
P2.1e Describe and classify various motions in a plane as one dimensional, two dimensional, circular, or periodic.	Circular Motion
P2.1f Distinguish between rotation and revolution and describe and contrast the two speeds of an object like the Earth.	–
P2.1g Solve problems involving average speed and constant acceleration in one dimension.	Displacement, Velocity and Acceleration Speed and Velocity
P2.1h Identify the changes in speed and direction in everyday examples of circular (rotation and revolution), periodic, and projectile motions.	Circular Motion Projectiles
P2.2 Velocity — Time	
P2.2a Distinguish between the variables of distance, displacement, speed, velocity, and acceleration.	Displacement, Velocity and Acceleration Speed and Velocity
P2.2b Use the change of speed and elapsed time to calculate the average acceleration for linear motion.	Acceleration Displacement, Velocity and Acceleration
P2.2c Describe and analyze the motion that a velocity-time graph represents, given the graph.	Displacement, Velocity and Acceleration
P2.2d State that uniform circular motion involves acceleration without a change in speed.	Circular Motion
P2.2e Use the area under a velocity-time graph to calculate the distance traveled and the slope to calculate the acceleration.	Displacement, Velocity and Acceleration
P2.2f Describe the relationship between changes in position, velocity, and acceleration during periodic motion.	Displacement, Velocity and Acceleration
P2.2g Apply the independence of the vertical and horizontal initial velocities to solve projectile motion problems.	Projectiles Vectors and Scalars
P2.3x Frames of Reference	
P2.3a Describe and compare the motion of an object using different reference frames.	–
P3.1 Basic Forces in Nature	

P3.1a Identify the force(s) acting between objects in “direct contact” or at a distance.	Friction Gravity Newton's First Law Newton's Second Law Newton's Third Law
P3.1x Forces	
P3.1b Explain why scientists can ignore the gravitational force when measuring the net force between two electrons.	Gravity
P3.1c Provide examples that illustrate the importance of the electric force in everyday life.	Magnetism, Current and Force Motors
P3.1d Identify the basic forces in everyday interactions.	Friction Gravity Newton's First Law Newton's Second Law Newton's Third Law
P3.2 Net Forces	
P3.2a Identify the magnitude and direction of everyday forces (e.g. wind, tension in ropes, pushes and pulls, weight).	Friction Gravity Mass and Weight Newton's First Law Newton's Second Law Newton's Third Law
P3.2b Compare work done in different situations.	Work
P3.2c Calculate the net force acting on an object.	Newton's Second Law
P3.2d Calculate all the forces on an object on an inclined plane and describe the object’s motion based on the forces using free-body diagrams.	Newtons Second Law
P3.3 Newton’s Third Law	
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).	Newton's Third Law
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).	Changes in Momentum
P3.3c Explain the recoil of a projectile launcher in terms of forces and masses.	–
P3.3d Analyze why seat belts may be more important in autos than in buses.	–
P3.4 Forces and Acceleration	

P3.4a Predict the change in motion of an object acted on by several forces.	Changes in Momentum Newton's First Law Newton's Second Law
P3.4b Identify forces acting on objects moving with constant velocity (e.g. cars on a highway).	Newton's First Law
P3.4c Solve problems involving force, mass, and acceleration in linear motion (Newton's second law).	Newton's Second Law
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).	Circular Motion
P3.4e Solve problems involving force, mass, and acceleration in two-dimensional projectile motion restricted to an initial horizontal velocity with no initial vertical velocity (e.g. ball rolling off a table).	Projectiles
P3.4f Calculate the changes in velocity of a thrown or hit object during and after the time it is acted on by the force.	Changes in Momentum Displacement, Velocity and Acceleration Momentum Projectiles
P3.4g Explain how the time of impact can affect the net force (e.g. air bags in cars, catching a ball).	Changes in Momentum
P3.5x Momentum	
P3.5a Apply conservation of momentum to solve simple collision problems.	Conservation of Momentum Momentum
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P3.6b Predict how the gravitational force between objects changes when the distance between them changes.	Gravitational Potential Energy Gravity
P3.6c Explain how your weight on Earth could be different from your weight on another planet.	Mass and Weight
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.	–
P3.6e Draw arrows (vectors) to represent how the direction and magnitude of a force changes on an object in an elliptical orbit.	Gravity Vectors and Scalars
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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.	Static Electricity
P3.7x Electric Charges — Interactions	
P3.7c Draw the redistribution of electric charges on a neutral object when a charged object is brought near.	Static Electricity
P3.7d Identify examples of induced static charges.	Static Electricity

P3.7e Explain why an attractive force results from bringing a charged object near a neutral object.	Static Electricity
P3.7f Determine the new electric force on charged objects after they touch and are then separated.	Static Electricity
P3.7g Propose a mechanism based on electric forces to explain current flow in an electric circuit.	Current and Potential Difference
P4.1 Energy Transfer	
P4.1c Explain why work has a more precise scientific meaning than the meaning of work in everyday language.	Work
P4.1d Calculate the amount of work done on an object that is moved from one position to another.	Work
P4.1e Using the formula for work, derive a formula for change in potential energy of an object lifted a distance h.	Gravitational Potential Energy Work
P4.2 Energy Transformation	
P4.2a Account for and represent energy transfer and transformation in complex processes (interactions).	Energy Transfers
P4.2b Name devices that transform specific types of energy into other types (e.g. a device that transforms electricity into motion).	Energy Transfers
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).	Conservation of Energy Conservation of Momentum
P4.2d Explain why all the stored energy in gasoline does not transform to mechanical energy of a vehicle.	Energy Transfers
P4.2e Explain the energy transformation as an object (e.g. skydiver) falls at a steady velocity.	Newton's First Law
P4.2f Identify and label the energy inputs, transformations, and outputs using qualitative or quantitative representations in simple technological systems (e.g. toaster, motor, hair dryer) to show energy conservation.	Conservation of Energy Energy Transfers
P4.3 Kinetic and Potential Energy	
P4.3a Identify the form of energy in given situations (e.g. moving objects, stretched springs, rocks on cliffs, energy in food).	Energy Transfers Gravitational Potential Energy Kinetic Energy
P4.3b Describe the transformation between potential and kinetic energy in simple mechanical systems (e.g., pendulums, roller coasters, ski lifts).	Conservation of Energy Energy Transfers Gravitational Potential Energy Kinetic Energy
P4.3c Explain why all mechanical systems require an external energy source to maintain their motion.	–
P4.3x Kinetic and Potential Energy — Calculations	
P4.3d Rank the amount of kinetic energy from highest to lowest of everyday examples of moving objects.	–
P4.3e Calculate the changes in kinetic and potential energy in simple mechanical systems (e.g., pendulums, roller coasters, ski lifts) using the formulas for kinetic energy and potential energy.	Conservation of Energy Gravitation and Potential Energy Kinetic Energy

P4.3f Calculate the impact speed (ignoring air resistance) of an object dropped from a specific height or the maximum height reached by an object (ignoring air resistance), given the initial vertical velocity.	Projectiles Speed and Velocity
P4.4 Wave Characteristics	
P4.4a Describe specific mechanical waves (e.g. on a demonstration spring, on the ocean) in terms of wavelength, amplitude, frequency, and speed.	Transverse Waves Waves
P4.4b Identify everyday examples of transverse and compression (longitudinal) waves.	Longitudinal Waves Transverse Waves Waves
P4.4c Compare and contrast transverse and compression (longitudinal) waves in terms of wavelength, amplitude, and frequency.	Transverse Waves Longitudinal Waves
P4.4x Wave Characteristics — Calculations	
P4.4d Demonstrate that frequency and wavelength of a wave are inversely proportional in a given medium.	Electromagnetic Waves
P4.4e Calculate the amount of energy transferred by transverse or compression waves of different amplitudes and frequencies (e.g. seismic waves).	–
P4.5 Mechanical Wave Propagation	
P4.5a Identify everyday examples of energy transfer by waves and their sources.	Longitudinal Waves Sound Transverse Waves Waves
P4.5b Explain why an object (e.g. fishing bobber) does not move forward as a wave passes under it.	Transverse Waves
P4.5c Provide evidence to support the claim that sound is energy transferred by a wave, not energy transferred by particles.	Longitudinal Waves Sound Waves
P4.5d Explain how waves propagate from vibrating sources and why the intensity decreases with the square of the distance from a point source.	–
P4.5e Explain why everyone in a classroom can hear one person speaking, but why an amplification system is often used in the rear of a large concert auditorium.	–
P4.6 Electromagnetic Waves	
P4.6a Identify the different regions on the electromagnetic spectrum and compare them in terms of wavelength, frequency, and energy.	Electromagnetic Waves Gamma Rays Waves X-rays
P4.6b Explain why radio waves can travel through space, but sound waves cannot.	Electromagnetic Waves Sound

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.	–
P4.6d Explain why we see a distant event before we hear it (e.g., lightning before thunder, exploding fireworks before the boom).	–
P4.6x Electromagnetic Propagation	
P4.6e Explain why antennas are needed for radio, television, and cell phone transmission and reception.	–
P4.6f Explain how radio waves are modified to send information in radio and television programs, radio-control cars, cell phone conversations, and GPS systems.	–
P4.6g Explain how different electromagnetic signals (e.g. radio station broadcasts or cell phone conversations) can take place without interfering with each other.	Electromagnetic Waves Interference
P4.6h Explain the relationship between the frequency of an electromagnetic wave and its technological uses.	Electromagnetic Waves Gamma Rays X-rays
P4.r7x Quantum Theory of Waves	
P4.r7a Calculate and compare the energy in various electromagnetic quanta (e.g. visible light, x-rays).	–
P4.8 Wave Behavior — Reflection and Refraction	
P4.8a Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.	Reflection Refraction
P4.8b Predict the path of reflected light from flat, curved, or rough surfaces (e.g. flat and curved mirrors, painted walls, paper).	Reflection
P4.8x Wave Behavior — Diffraction, Interference, and Refraction	
P4.8c Describe how two wave pulses propagated from opposite ends of a demonstration spring interact as they meet.	Interference Superposition and Interference
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).	Interference
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).	Lenses Refraction Refraction Index
P4.8f Explain how Snell's Law is used to design lenses (e.g. eye glasses, microscopes, telescopes, binoculars).	Lenses Refraction Refraction Index
P4.9 Nature of Light	
P4.9a Identify the principle involved when you see a transparent object (e.g. straw, piece of glass) in a clear liquid.	Refraction
P4.9b Explain how various materials reflect, absorb, or transmit light in different ways.	Reflection Refraction

P4.9c Explain why the image of the Sun appears reddish at sunrise and sunset.	–
P4.r9x Nature of Light — Wave-Particle Nature	
P4.r9d Describe evidence that supports the dual wave - particle nature of light.	The Photoelectric Effect Wave Properties of Particles
P4.10 Current Electricity — Circuits	
P4.10a Describe the energy transformations when electrical energy is produced and transferred to homes and businesses.	Energy Transfer Fossil Fuels
P4.10b Identify common household devices that transform electrical energy to other forms of energy, and describe the type of energy transformation.	Energy Transfer
P4.10c Given diagrams of many different possible connections of electric circuit elements, identify complete circuits, open circuits, and short circuits and explain the reasons for the classification.	Circuit Diagrams Current Voltage and Resistance Series and Parallel Circuits
P4.10d Discriminate between voltage, resistance, and current as they apply to an electric circuit.	Current and Potential Difference Current Voltage and Resistance
P4.10x Current Electricity — Ohm's Law, Work, and Power	
P4.10e Explain energy transfer in a circuit, using an electrical charge model.	Circuit Diagrams
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P4.10g Compare the currents, voltages, and power in parallel and series circuits.	Current Voltage and Resistance Series and Parallel Circuits
P4.10h Explain how circuit breakers and fuses protect household appliances.	–
P4.10i Compare the energy used in one day by common household appliances (e.g. refrigerator, lamps, hair dryer, toaster, televisions, music players).	–
P4.10j Explain the difference between electric power and electric energy as used in bills from an electric company.	–
P4.11x Heat, Temperature, and Efficiency	
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.	–
P4.12 Nuclear Reactions	
P4.12a Describe peaceful technological applications of nuclear fission and radioactive decay.	Nuclear Fission Radioactive Dating Uses of Radiation
P4.12b Describe possible problems caused by exposure to prolonged radioactive decay.	–

P4.12c Explain how stars, including our Sun, produce huge amounts of energy (e.g. visible, infrared, ultraviolet light).	Nuclear Fusion
P4.12x Mass and Energy	
P4.12d Identify the source of energy in fission and fusion nuclear reactions.	Nuclear Fission Nuclear Fusion