Course: Honors Physics

Grade Level: 11-12

Unit 1

Course/Subject: Honors Physics	Grade: 11-12	Unit 1: Units and Measurements	Suggested Timeline: 1.5-3 weeks

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	**Unit 1: Units and Measurements** Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 1: Units and Measurement
Unit Summary	Review of SI Units, algebra skills, use of units in math, calculations using significant figure, as well as the scientific method.

Unit Essential Questions:	**Key Understandings:**
1. How do we use units in our work?	1. Significant figures 2. SI units 3. Scientific notation 4. Metric prefixes 5. Unit conversion

	6. Scientific Method 7. Lab Safety

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.

3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● Seeing units as just labels	● Use of units as algebraic entities

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Significant figures ● SI units ● Scientific notation ● Metric prefixes ● Unit conversion ● Scientific ● Scientific Method ● Lab Safety	● Use significant figures in mathematical problems. ● Use proper SI units for measurement. ● Convert to and from scientific notation. ● Use of metric prefixes to re-write measurements. ● Convert between units. ● Proper way to conduct a lab. ● Proper lab safety protocols	• Critical Thinking • Creativity • Collaboration • Communication

Academic Vocabulary:

● Significant figures ● SI units	● Scientific Notation ● Metric Prefixes	● Scientific Method ● Lab Safety

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:
- Mathematical algebra skills

Additional Resources:
- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 2**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 2:** **1-D Kinematics**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements **Unit 2: 1-D Kinematics** Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 2: 1-D Kinematics
Unit Summary	Learn about the physics of motion, how displacement, velocity, and acceleration are related. Use the kinematic equations to mathematically analyze and determine kinematic measurements of different scenarios.

Unit Essential Questions:	**Key Understandings:**
1. How do we use measured values to predict the way object will move?	1. Reference frames 2. Scalar quantities vs vector quantities 3. Displacement 4. Average velocity 5. Instantaneous velocity 6. Acceleration 7. Constant acceleration 8. Kinematic Equations 9. Graphical analysis of kinematics

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Important Standards Addressed in the Unit:

3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.

3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wavelength.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
• Distance and displacement are the same measurement • Speed and velocity are the same measurement	• Distance measures how far something has traveled, displacement measure how far something is from where it started • Speed measures how fast something is traveling, velocity measures how fast and in what direction something is traveling

Knowledge & Concepts	Skills & Competencies	Dispositions & Practices
• Reference frames • Scalar quantities vs vector quantities • Displacement • Average velocity • Instantaneous velocity • Acceleration • Constant acceleration • Kinematic Equations • Graphical analysis of kinematics	• Use the definition of scalars and vectors to categorize different measurements. • Use displacement, average velocity, instantaneous velocity, and acceleration with constant acceleration and the kinematic equations to determine different properties and measurements of an object's motion. • Use the graphical representation of displacement, velocity, and acceleration to determine different properties of an objects motion.	• Critical Thinking • Creativity • Collaboration • Communication

Academic Vocabulary:

• Reference frames • Displacement • Kinematics	• Scalar • Velocity	• Vector • Acceleration

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 3**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 3: Acceleration Due to Gravity**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics **Unit 3: Acceleration Due to Gravity** Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 3: Acceleration Due to Gravity
Unit Summary	Students will apply the previously learned kinematic equations to objects in free-fall, using them to analyze the motion of objects accelerating from gravity.

Unit Essential Questions:	**Key Understandings:**
1. How does gravity affect the motion of objects?	1. Acceleration due to gravity

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Important Standards Addressed in the Unit:	
3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry

	information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
• Objects fall at different rates • Objects continually move in the air	• All objects fall at a constant 9.8 m/s^2 • At an object's maximum height, it stops moving for an instant

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
• Acceleration due to gravity	• Use the acceleration due to gravity to determine how objects will move while falling.	• Critical Thinking • Creativity • Collaboration • Communication

Academic Vocabulary:

• Reference frames • Displacement • Kinematics	• Scalar • Velocity	• Vector • Acceleration

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 4**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 4:** **2-D Kinematics**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity **Unit 4: 2-D Kinematics** Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 4: 2-D Kinematics
Unit Summary	Students will work with the previously learned kinematic equations and apply them to different forms of two-dimensional motion, such as projectiles, boats crossing rivers, etc.

Unit Essential Questions: 1. How do we calculate motion of objects moving in two dimensions? 2. How does gravity affect the motion of projectiles	**Key Understandings:** 1. Vector addition-graphically and mathematically 2. Parabolic motion

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Important Standards Addressed in the Unit:	
3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry

	information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
• Projectiles accelerate in both the vertical and horizontal directions • Projectiles are continually moving in both the vertical and horizontal directions.	• Objects only accelerate in the vertical direction • A projectile will stop moving in the vertical direction at the top of its parabolic path.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
• Vector addition- graphically and mathematically • Parabolic motion	• Use the unit circle of angles alongside vector notation to add different types of vectors both mathematically and graphically. • Apply the kinematic equations to different types of parabolic motion to determine different qualities of a projectile's motion.	• Critical Thinking • Creativity • Collaboration • Communication

Academic Vocabulary:

• Reference frames • Displacement • Kinematics	• Scalar • Velocity • Unit Circle	• Vector • Acceleration • Parabolic Motion

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 5**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 5:** **Newton's Laws**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics **Unit 5: Newton's Laws** Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 5: Newton's Laws
Unit Summary	Students will use Newton's three laws of motion to analyze how forces acting on objects will affect the object's motion.

Unit Essential Questions: 1. What are Newton's Laws of Motion? 2. How do the different types of forces affect how objects move?	**Key Understandings:** 1. Newton's Laws 2. Classification of forces 3. Free-body diagrams

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Important Standards Addressed in the Unit:	
3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.

3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● If a force is acting on an object, it has to be moving. ● Objects need a force acting on them to continue moving.	● An object will only move if there are unbalance forces acting on it. ● Objects only need a force to act on it to move if another force is also acting on it. A moving object can have zero forces acting on it.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Newton's Laws ● Classification of forces ● Free-body diagrams	● Students will be able to state Newton's Laws of Motion as well as apply their definitions to different scenarios. ● Students will be able to categorize the different forces acting on an object. ● Students will utilize free-body diagrams to determine the way forces will affect the motion of different objects in both one and two dimensions, as well as solve for different forces acting on the object.	● Critical Thinking ● Creativity ● Collaboration ● Communication

Academic Vocabulary:

● Vector ● Force ● Friction force ● Gravitational force ● Tension Force ● Parallel force	● Scalar ● Mass ● Kinetic ● Normal Force ● Inclined Plane ● Spring force	● Acceleration ● Newton ● Static ● Applied force ● Perpendicular force ● Equilibrium

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
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- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 6**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 6:** **Circular Motion**	**Suggested Timeline:** **2-4 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws **Unit 6: Circular Motion** Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 6: Circular Motion
Unit Summary	Students will apply kinematics and Newton's Laws of motion and apply them to objects moving in circular patterns, such as wheels turning and planets in space.

Unit Essential Questions: 1. How do we apply the kinematic equations to circular motion? 2. How do Newton's Laws apply to circular motion? 3. How do predict the motion of the planets?	**Key Understandings:** 1. Kinematics of circular motion 2. Dynamics of circular motion 3. Non-uniform circular motion 4. Newton's Laws of Universal Gravitation 5. Kepler's Laws of Planetary Motion

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● There is both centripetal and centrifugal acceleration.	● Only centripetal acceleration is real.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Kinematics of circular motion ● Dynamics of circular motion ● Non-uniform circular motion ● Newton's Laws of Universal Gravitation ● Kepler's Laws of Planetary Motion	● Students will use the kinematic equations to solve for different quantities of an object's circular motion. ● Students will use Newton's Laws of Motion to create free body diagrams of object moving in circular paths to solve for different qualities of the object's motion as well as the forces acting on the object. ● Students will find different quantities of a mass's motion in space using Newton's Law of Universal Gravitation. ● Students will find different quantities of a mass's motion in space using Kepler's Laws of Planetary Motion	● Critical Thinking ● Creativity ● Collaboration ● Communication

Academic Vocabulary:

• Uniform circular motion • Centripetal acceleration • Frequency • Period	• Friction • Non-uniform circular motion • Law of Universal Gravitation • Orbital radius	• Geosynchronous • Weightlessness • Kepler's Laws of Planetary Motion

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
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- Teacher created resources

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			Course: Honors Physics **Grade Level: 11-12** **Unit 7**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 7: Work and Energy**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion **Unit 7: Work and Energy** Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 7: Work and Energy
Unit Summary	Students will take the previous information from kinematics and Newton's Laws and see how they apply to the concept of energy and its transfer and conservation.

Unit Essential Questions:	**Key Understandings:**
1. How does energy affect us? 2. What are the different types of energies and what do they do?	1. Work done by a constant force 2. The work-energy principle and kinetic energy 3. Potential energy 4. Conservative versus non-conservative forces 5. Conservation of mechanical energy 6. The Law of the Conservation of Energy 7. Dissipative forces and the conservation of energy 8. Power

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).

3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton’s laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● Doing work on an object does not require the object to move.	● The only way to do work on an object is if the object moves.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**

• Work done by a constant force • The work-energy principle and kinetic energy • Potential energy • Conservative versus non-conservative forces • Conservation of mechanical energy • The Law of the Conservation of Energy • Dissipative forces and the conservation of energy • Power	• Students will be able to calculate the work done on an object by a force, and use the work to find the force and distance the object traveled. • Students will be able to use the work-energy principle to determine the amount of work done on an object based on how much the object's kinetic energy changes, as well as use the work to find the kinetic energies of the object. • Students will be able to find the potential energy of an object, and use that energy to find the mass, height, and acceleration due to gravity of the object. • Students will be able to predict how an object will move based on how its mechanical energy is converted, as well as different qualities of the object and its motion. • Students will be able to determine the power output of an object based on the energy is has and the force it exerts and use the power to find the work and force the object exerts.	• Critical Thinking • Creativity • Collaboration • Communication

Academic Vocabulary:

• Work • Joule • Kinetic energy • Work-energy principle • Potential energy • Gravitational potential energy • Elastic potential energy • Chemical energy • Dissipative forces	• Spring force • Spring constant • Conservative force • Non-conservative force • Mechanical energy • Conservation of energy • Thermal energy • Power • Watts	• Horsepower

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
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- Teacher created resources

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			Course: Honors Physics **Grade Level: 11-12** **Unit 8**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 8: Linear Momentum**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy **Unit 8: Linear Momentum** Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 8: Linear Momentum
Unit Summary	Students will study the nature of different types of collisions, seeing how different types of collisions affect an objects velocity, energy, and the forces acting on it.

Unit Essential Questions:	Key Understandings:
1. What is momentum? 2. How is momentum conserved 3. How does impulse affect the motion of an object? 4. What happens when two objects collide? 5. What are the different types of collisions?	1. Momentum 2. Conservation of momentum 3. Impulse and collisions 4. Collisions and conservation of momentum and energy 5. One dimensional elastic collisions 6. Inelastic collisions 7. Two dimensional collisions 8. Center of mass

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and

	describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● An object needs to change direction to change its momentum. ● Two objects with different masses move at the same velocity, so they have the same momentum.	● To change an object's momentum, its velocity, direction of movement, or mass must be changed. ● Both mass and velocity directly impact momentum, so two objects of different masses moving at the same velocity will not have the same momentum.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**

• Momentum • Conservation of momentum • Impulse and collisions • Collisions and conservation of momentum and energy • One dimensional elastic collision • Inelastic collisions • Two dimensional collisions • Center of mass	• Students will be able to calculate the momentum of an object based on its velocity as well as the force acting on it, and find the velocity and mass of the object, the force on the object, and how long the force is acting on the object. • Students will be able to determine different quantities of an object, such as velocity and mass, based on how it collides with another object. • Students will be able to calculate the center of mass of an object based on its dimensions and mass.	• Critical Thinking • Creativity • Collaboration • Communication

Academic Vocabulary:

• Linear Momentum • Conservation of Momentum • Impulse	• Elastic • Inelastic	• Center of Gravity • Center of Mass

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 9**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 9: Rotational Motion**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum **Unit 9: Rotational Motion** Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 9: Rotational Motion
Unit Summary	Students will study how objects travel in rotational dimensions instead of linear dimensions like what has been studied so far. Rotational kinematics, forces, energy, and momentum will be converted from the linear dimensions to the rotational dimensions.

Unit Essential Questions:

1. What is considered rotational motion?
2. How do rotating objects behave differently than object moving linearly?
3. How do we translate our previous equations and measurements into rotational motion?

Key Understandings:

1. Angular quantities
2. Angular kinematics
3. Rolling motion
4. Torque
5. Rotational inertia
6. Rotational kinetic energy

	7. Angular momentum

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1.	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● Circular motion and rotational motion are the same.	● Circular motion measures linear quantities of objects moving in a circular pattern, where rotational motion measures angular quantities of objects moving in a rotational pattern.

Knowledge & Concepts	Skills & Competencies	Dispositions & Practices
● Angular quantities ● Angular kinematics ● Rolling motion ● Torque ● Rotational inertia ● Rotational kinetic energy ● Angular momentum	● Students will be able to use angular quantities to find measurements of objects moving in a rotational pattern. ● Students will translate force into rotational motion using equations based around torque to find rotational and linear quantities of motion of objects. ● Students will take into account rotational kinetic energy when using conservation of energy to determine physical quantities of moving objects. ● Students see the effects changing the velocity or inertia of an object has on the momentum of a system.	● Critical Thinking ● Creativity ● Collaboration ● Communication

Academic Vocabulary:

● Radian ● Angular displacement ● Angular velocity	● Angular acceleration ● Torque ● Moment of inertia	● Rotational kinetic energy ● Angular momentum ● Conservation of angular momentum.

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
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			Course: Honors Physics **Grade Level: 11-12** **Unit 10**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 10: Waves and Simple Harmonic Motion**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion **Unit 10: Waves and SHM** Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 10: Waves and Simple Harmonic Motion
Unit Summary	Students will study the sinusoidal nature of the many different types of waves present in the world, seeing the way waves are present in nature and other aspects of life.

Unit Essential Questions:	**Key Understandings:**
1. Where do we see Simple Harmonic Motion? 2. How do waves affect physical objects?	1. Simple Harmonic Motion 2. Energy and Simple Harmonic Motion 3. The sinusoidal nature of Simple Harmonic Motion 4. Simple pendulums 5. Damped harmonic motion 6. Forced Oscillations 7. Resonance 8. Waves 9. Wave types 10. Waves and energy 11. Transmission and reflection of waves 12. Interference 13. Principle of superposition 14. Standing waves 15. Refraction 16. Diffraction

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.

3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton’s laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● Waves are not physical.	● Waves are physical, they cause movement of the particles of whatever medium they travel through.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**

• Simple Harmonic Motion • Energy and Simple Harmonic Motion • The sinusoidal nature of Simple Harmonic Motion • Simple pendulums • Damped harmonic motion • Forced Oscillations • Resonance • Waves • Wave types • Waves and energy • Transmission and reflection of waves • Interference • Principle of superposition • Standing waves • Refraction • Diffraction	• Students will be able to calculate different measured quantities of waves given different characteristics of the waves. • Students will be able to graphically analyze a wave and determine different qualities of the wave. • Students will be able to differentiate the type of wave based on the medium it is traveling through, as well as calculate different qualities of the different wave types. • Students will be able to calculate the intensity of waves. • Students will be able to determine the way different waves will overlap using the principle of superposition, • Students will be able to calculate the different harmonics of a standing wave based on the length of the wire and the frequency of the wave. • Students will be able to calculate the refraction angle of a wave based on the medium it is traveling from and the medium it is traveling into, and determine the mediums it travels through based on the refraction angle.	• Critical Thinking • Creativity • Collaboration • Communication

Academic Vocabulary:

• Simple Harmonic Motion • Amplitude • Period • Frequency • Simple pendulum • Damping • Underdamped • Overdamped • Critical damping • Shock absorbers • Forced vibrations • Resonance • Transverse wave	• Bulk modulus • Elastic modulus • Crest • Trough • Longitudinal wave • Compressions • Expansions (rarefactions) • Wavelength • Intensity • Interference • Superposition • Density • Destructive interference	• Constructive interference • Diffraction • Standing waves • Nodes • Antinodes • Natural frequency • First harmonic (fundamental frequency) • Overtone

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:
- Mathematical algebra skills

Additional Resources:
- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 11**
Course/Subject: Honors Physics	**Grade:** **11-12**	**Unit 11: Electricity**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM **Unit 11: Electricity** Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 11: Electricity
Unit Summary	Students will study the way charges interact with each other. Students will study the effects the amount of charge as well as the charge's distance from a point have on electric forces and electric fields.

Unit Essential Questions:	**Key Understandings:**
1. What is electricity? 2. How do electric fields physically affect molecules?	1. Static electricity 2. Electric charge 3. Insulators 4. Conductors 5. Coulomb's Law 6. Electric field 7. Gauss's Law

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and

	describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● The electrostatic force created by a charge does not depend on the sign of the charge. ● The electric field generated by a charge does not depend on the sign of the charge.	● The electrostatic force created by a charge does depend on the sign of the charge. ● Electric fields go out of positive charges and into negative charges.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Static electricity ● Electric charge ● Insulators ● Conductors ● Coulomb's Law ● Electric field ● Gauss's Law	● Students will be able to calculate the electric force between two charges using Coulomb's Law, as well as qualities about the charges themselves. ● Students will be able to calculate the strength and direction of an electric field generated by one or more charges, as well as qualities of the charges themselves.	● Critical Thinking ● Creativity ● Collaboration ● Communication

	• Students will be able to calculate the electric flux of a surface using Gauss's Law.	

Academic Vocabulary:

• Electric charge • Point charge • Conductor • Insulator • Conduction	• Induction • Coulomb's Law • Electric field • Principle of superposition • Electric field lines	• Electric flux • Gauss's Law

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 12**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 12: Electric Potential**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity **Unit 12: Electric Potential** Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 12: Electric Potential
Unit Summary	Students will learn how to view electricity from the lens of energy. They will learn why charges interact with each other the way they do as well why charges move from one point to another.

Unit Essential Questions: 1. How do we quantify electricity in terms of energy? 2. How do objects store charge? 3. What makes different objects better at storing charges?	**Key Understandings:** 1. Electric potential energy 2. Equipotential lines and surfaces 3. The Electron Volt 4. Dipoles 5. Capacitance 6. Dielectrics

	7. Storing electric energy

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● The sign of a charge will not affect the electric potential energy created by the charge.	● If a charge is positive it will create positive electric potential energy, and if a charge is negative it will create negative electric potential energy.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Electric potential energy ● Equipotential lines and surfaces ● The Electron Volt ● Dipoles ● Capacitance ● Dielectrics ● Storing electric energy	● Students will be able to calculate the electric potential energy of an electrostatic force. ● Students will be able to calculate the electric field in a location based on the electric potential of the location. ● Students will be able to calculate the electric potential created by point charges. ● Students will be able to calculate the electric potential created by dipoles. ● Students will be able to calculate the capacitance of different types of capacitors. ● Students will be able to calculate the energy stored in a capacitor. ● Students will be able to use the above skills to calculate different qualities of charges.	● Critical Thinking ● Creativity ● Collaboration ● Communication

Academic Vocabulary:

- Electric potential
- Electric potential difference
- Voltage
- Equipotential line
- Equipotential surface
- Electric dipole
- Dipole moment
- Capacitor
- Capacitance
- Dielectric
- Dialectic constant

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 13**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 13: Electric Currents**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential **Unit 13: Electric Currents** Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 13: Electric Currents
Unit Summary	Students will learn how current is generated as well as the way it powers different electric-powered machines. They will look at the different ways current is generated and the different qualities of materials that affect the flow of current.

Unit Essential Questions:	**Key Understandings:**
1. What is current? 2. How is current used to power machines? 3. What causes current to change in different materials?	1. Batteries 2. Electric Current 3. Ohm's Law 4. Resistivity 5. Electric power 6. Powering machines 7. Alternating current 8. Superconductivity

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.

3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● Electrons flow the same direction as the current.	● Electrons flow the opposite way current flows. Current shows the direction a positive charge would flow.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Batteries ● Electric Current ● Ohm's Law ● Resistivity ● Electric power ● Powering machines ● Alternating current ● Superconductivity	● Student will be able to calculate the electric current based on the flow of charge going through a wire. ● Students will be able to calculate voltage, current, and resistance using Ohm's Law. ● Students will be able to calculate the resistance of an object based on the resistivity, length, and cross-sectional area of a wire. Students will also be able to calculate the resistivity, cross-sectional area, and length of a wire.	● Critical Thinking ● Creativity ● Collaboration ● Communication

	• Students will be able to calculate how the resistance and resistivity changes based on the temperature of the wire, and use the values to find the change in temperature as well as the material of a wire. • Students will be able to calculate the power in a wire based on the current, voltage, and resistance. Students will be able to find current, voltage, and resistance using the same equation. • Students will be able to calculate the power, voltage, current, and resistance of objects on an AC line.	

Academic Vocabulary:

• Battery • Electric current • Conventional current • Resistance • Resistor	• Ohm's Law • Ohm • Resistivity • Watt • Kilowatt-hour	• Direct current • Alternating current • Superconductor

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 14**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 14: DC Circuits**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents **Unit 14: DC Circuits** Unit 15: Magnetism Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 14: DC Circuits
Unit Summary	Students will learn how to determine the current, voltage, and resistance at different points of direct current circuits. Parallel and series circuits will be studied.

Unit Essential Questions:	**Key Understandings:**
1. What makes a circuit a circuit? 2. How does the wiring of a circuit affect its performance?	1. Electromotive force 2. Terminal Voltage 3. Resistors in series 4. Resistors in parallel 5. Kirchhoff's rules 6. RC circuits 7. Ammeters 8. Voltmeters

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.

3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● The way resistors and batteries are wired does not affect the performance of the circuit.	● If resistors and batteries are wired in different set-ups, it will change the current, resistance, and voltage of a circuit.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Electromotive force ● Terminal Voltage ● Resistors in series ● Resistors in parallel ● Kirchhoff's rules ● RC circuits ● Ammeters ● Voltmeters	● Students will be able to calculate the internal resistance, electromotive force, and terminal voltage of a battery. ● Students will be able to find the equivalent resistance of resistors in series, parallel, and combinations of the two. ● Students will be able to use Kirchhoff's Rules to calculate the current, voltage, resistance, and power in different parts of a circuit. ● Students will be able to calculate the equivalent capacitance of	● Critical Thinking ● Creativity ● Collaboration ● Communication

	capacitors in series, parallel, and combinations of the two. ● Students will be able to calculate capacitance, resistance, maximum charge, and time to fully charge of RC circuits. ● Students will be able to properly connect ammeters and voltmeters to circuits so the devices get proper readings.	

Academic Vocabulary:

● Electromotive force ● Internal resistance ● Series ● Parallel ● Equivalent resistance	● Kirchhoff's Rules ● Junction ● Loop ● Junction rule ● Loop rule	● RC circuit ● Ammeter ● Voltmeter

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 15**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 15: Magnetism**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits **Unit 15: Magnetism** Unit 16: Sounds and Sound Waves Unit 17: Optics

Unit Title	Unit 15: Magnetism
Unit Summary	Students will study the different way magnets are created, why they behave the way they do, and applications of magnetism. The main focus will be on the behaviors of current and charges in magnetic fields created by magnets.

Unit Essential Questions:	**Key Understandings:**
1. What is a magnet? 2. How do we create magnets? 3. How can we apply magnetism to everyday live?	1. Magnets 2. Magnetic fields 3. Magnetic fields produced by electric current 4. Forces on electric currents in magnetic fields 5. Forces on electric charges moving through an electric field 6. Parallel wires 7. Solenoids 8. Electromagnets 9. Ampère's Law 10. Magnetic moment 11. Applications of magnets 12. Mass spectrometer 13. Ferromagnetism

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of

	energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● A magnet will always be magnetic	● Magnets can be demagnetized in different ways, and certain magnets, such as electromagnets, can lose their magnetism when the electric current stops flowing through them.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Magnets ● Magnetic fields ● Magnetic fields produced by electric current ● Forces on electric currents in magnetic fields ● Forces on electric charges moving through an electric field ● Parallel wires	● Students will be able to use the right hand rule to determine the direction of a magnetic field created by a current going through a wire. ● Students will be able to calculate the magnetic force on a current-carrying wire.	● Critical Thinking ● Creativity ● Collaboration ● Communication

• Solenoids • Electromagnets • Ampère's Law • Magnetic moment • Applications of magnets • Mass spectrometer • Ferromagnetism	• Students will be able to calculate the force on a charge in a magnetic field. • Students will be able to calculate the magnetic field created by a straight wire. • Students will be able to calculate the magnetic force between two parallel wires. • Students will be able to calculate the magnetic field generated by solenoids and electromagnets. • Students will be able to calculate magnetic field using Ampère's Law. • Students will be able to calculate the torque created by magnetic fields. • Students will be able to use the above skills to find properties of the wire and electric fields.	

Academic Vocabulary:

• Poles • Magnetic field • Tesla • Ampère's Law	• Motor • Loudspeaker • Galvanometer • Mass spectrometer	• Ferromagnetic • Domains • Hysteresis loop • Right hand rule

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 16**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 16:** **Sounds and Sound Waves**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism **Unit 16: Sounds and Sound Waves** Unit 17: Optics

Unit Title	Unit 16: Sounds and Sound Waves
Unit Summary	Students will study sound and the way the human ear hears different sounds. The different qualities of the medium the sound is traveling through will be studied to see how those qualities affect the nature of the sound wave.

Unit Essential Questions:	**Key Understandings:**
1. What are sound waves? 2. What affects the way we hear sounds? 3. How does the medium of a sound wave affect a sound wave?	1. Sound characteristics 2. Sound intensity 3. Loudness 4. Sound sources 5. Superposition 6. Interference 7. Beats 8. Doppler effect 9. Shock waves 10. Sonic boom 11. Applications of sound waves

Focus Standards Addressed in the Unit:

Standard Number	*Standard Description*
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.

Important Standards Addressed in the Unit:

3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of

	conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● A sound wave will be the same no matter what medium it travels through.	● A sound wave can change both its frequency and speed depending on the medium it travels through.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**

• Sound characteristics • Sound intensity • Loudness • Sound sources • Superposition • Interference • Beats • Doppler effect • Shock waves • Sonic boom • Applications of sound waves	• Students will be able to calculate the sound level and intensity of different sound waves. • Students will be able to calculate the velocity and frequency of sound waves moving through different mediums. • Students will be able to calculate the beat frequency of multiple sound waves colliding. • Students will be able to calculate the shift in sound waves from moving sources and detectors using the Doppler effect, as well as qualities of the sources and detectors. • Students will be able to calculate the angle of shockwaves created by ultra-sonic movement, as well as qualities of the moving object and the air around it.	• Critical Thinking • Creativity • Collaboration • Communication

Academic Vocabulary:

• Sound • Pitch • Intensity • Sound level • Ultra-sonic	• Open tube • Closed tube • Quality • Beats	• Beat frequency • Doppler effect • Shock wave • Sonic boom

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:

- Mathematical algebra skills

Additional Resources:

- Textbook
- Workbooks
- Online Homework Site
- Equations sheet
- PowerPoints
- Educational Videos
- Self-taught lessons
- Teacher created resources

Created By:
Tyler McManiman

			Course: Honors Physics **Grade Level: 11-12** **Unit 17**
Course/Subject: **Honors Physics**	**Grade:** **11-12**	**Unit 17: Optics**	**Suggested Timeline:** **1.5-3 weeks**

Grade Level Summary	This physics course is designed for the honors-level student. The course will cover the traditional topics of physics with an emphasis on abstract thinking, a high level of problem solving, and conceptual understanding.
Grade Level Units	Unit 1: Units and Measurements Unit 2: 1-D Kinematics Unit 3: Acceleration Due to Gravity Unit 4: 2-D Kinematics Unit 5: Newton's Laws Unit 6: Circular Motion Unit 7: Work and Energy Unit 8: Linear Momentum Unit 9: Rotational Motion Unit 10: Waves and SHM Unit 11: Electricity Unit 12: Electric Potential Unit 13: Electric Currents Unit 14: DC Circuits Unit 15: Magnetism Unit 16: Sounds and Sound Waves **Unit 17: Optics**

Unit Title	Unit 17: Optics
Unit Summary	Students will study the way light rays change based on the medium they travel through. Specifically, lenses and mirrors will be the mediums focused on, seeing how the different types of lenses and mirrors affect the image produce by the light passing through them.

Unit Essential Questions: 1. What is light? 2. How does the shape of a lens or mirror affect the image produced by light?	**Key Understandings:** 1. Light rays 2. Plane mirrors 3. Spherical mirrors 4. Index of refraction 5. Snell's Law 6. Total internal reflection

	7. Thin lenses 8. Ray tracing 9. Combining lenses 10. Application of lenses

Focus Standards Addressed in the Unit:	
Standard Number	*Standard Description*
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.

Important Standards Addressed in the Unit:	
3.2.10.B1.	Analyze the relationships among the net forces acting on a body, the mass of the body, and the resulting acceleration using Newton's Second Law of Motion. Apply Newton's Law of Universal Gravitation to the forces between two objects. Use Newton's Third Law to explain forces as interactions between bodies. Describe how interactions between objects conserve momentum.
3.2.P.B1.	Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.
3.2.12.B1	Analyze the principles of rotational motion to solve problems relating to angular momentum and torque.
3.2.10.B2.	Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationships between work and power.
3.2.C.B2.	Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy).
3.2.P.B2.	Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.
3.2.12.B2.	Explain how energy flowing through an open system can be lost. Demonstrate how the law of conservation of momentum and conservation of energy provide alternate approaches to predict and describe the motion of objects.
3.2.10.B4.	Describe quantitatively the relationships between voltage, current, and resistance to electrical energy and power. Describe the relationship between electricity and magnetism as two aspects of a single electromagnetic force.
3.2.P.B4.	Explain how stationary and moving particles result in electricity and magnetism. Develop

	qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.
3.2.12.B4.	Describe conceptually the attractive and repulsive forces between objects relative to their charges and the distance between them.
3.2.10.B5.	Understand that waves transfer energy without transferring matter. Compare and contrast the wave nature of light and sound. Describe the components of the electromagnetic spectrum. Describe the difference between sound and light waves.
3.2.P.B5.	Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.
3.2.12.B5.	Research how principles of wave transmissions are used in a wide range of technologies. Research technologies that incorporate principles of wave transmission.
3.2.10.B6.	PATTERNS SCALE MODELS CONSTANCY/ CHANGE Explain how the behavior of matter and energy follow predictable patterns that are defined by laws.
3.2.P.B6.	PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.
3.2.12.B6.	CONSTANCY/CHANGE Compare and contrast motions of objects using forces and conservation laws.

Misconceptions:	**Proper Conceptions:**
● All mirrors reflect light the same way	● The shape of a mirror changes the way an image is reflected.

Knowledge & Concepts	**Skills & Competencies**	**Dispositions & Practices**
● Light rays ● Plane mirrors ● Spherical mirrors ● Index of refraction ● Snell's Law ● Total internal reflection ● Thin lenses ● Ray tracing ● Combining lenses ● Application of lenses	● Students will be able to calculate the angle of reflection of light rays bouncing off of mirrors, as well as qualities of the mirrors. ● Students will be able to calculate the height and location of images created by spherical mirrors, as well as qualities of the mirrors. ● Students will be able to calculate the index of refraction. ● Students will be able to calculate the angle of refraction using Snell's Law. ● Students will be able to calculate the focal point of lenses. ● Students will be able to find the focal point of multi-lens systems.	● Critical Thinking ● Creativity ● Collaboration ● Communication

Academic Vocabulary:

- Ray
- Law of reflection
- Image
- Plane mirror
- Spherical mirror
- Concave
- Focal point
- Focal length
- Convex
- Mirror equation
- Real image
- Virtual image
- Index of refraction
- Snell's Law
- Total internal reflection
- Fiber optics
- Critical angle

Evidence: Assessments and Performance Task(s)

- Homework
- Quizzes
- Writing Assignment
- Research Assignment
- Laboratory Assignments
- Unit Test

Interdisciplinary Connections:
- Mathematical algebra skills

Additional Resources:
- Textbook
- Workbooks
- Online Homework Site
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- PowerPoints
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