



Township of Ocean Schools

Assistant Superintendent
Office of Teaching and Learning

SPARTAN MISSION:

Meeting the needs of all students with a proud tradition of academic excellence.

DEPARTMENT: **Science**

COURSE: **Physics**

Curriculum Development Timeline

School: Ocean Township High School

Course: Physics

Department: Science

Board Approval	Supervisor	Notes
July 2008	Patrick Sullivan	Born Date
January 2009	Patrick Sullivan	Revisions
August 2011	Patrick Sullivan	Revisions
July 2016	Patrick Sullivan	Revisions
March 2019	Patrick Sullivan	Review
August 2022	Patrick Sullivan	Alignment to Standards
August 2024	Patrick Sullivan	Updated to include New State Mandates

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Township of Ocean Pacing Guide			
Week	Marking Periods 1-2	Week	Marking Periods 3-4
1	Forces & Motion (Nature of Science)	11	Fundamental Forces
2	Forces & Motion (Language of Physics)	12	Fundamental Forces
3	Forces & Motion (Scalars/Vectors; 1-D Motion)	13	Circular Motion & Orbital Mechanics
4	Forces & Motion (Kinematics; 2-D Motion)	14	Energy
5	Forces & Motion (Free-Fall; Projectiles)	15	Energy
6	Forces & Motion (Newton's Laws)	16	Wave Properties
7	Forces & Motion (Newton's Laws)	17	Wave Properties
8	Forces & Motion (Friction)	18	Electromagnetic Radiation
9	Forces & Motion (Momentum)	19	Electricity & Magnetism
10	Forces & Motion (Momentum)	20	Electricity & Magnetism

Climate Change: Electromagnetic Radiation (NJSLS-S: HS-ESS3-5)

Core Instructional & Supplemental Materials including various levels of Texts

Texts:

Physics: Principles with Applications (Giancoli) - AP Physics 1 (Honors) & 2

Physics : Principles and Problems (Glencoe) - Advanced Physics

Conceptual Physics (Hewitt) - College Prep Physics

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Digital Resources Across All Levels: (D=differentiated)

Edpuzzle (D)
Gizmo (D)
YouTube videos
New York Times Articles
PhET Interactive Simulations (D)
Science News Articles
The Physics Classroom
Ted Talks
OTHS Science Resources Learning Library

Time Frame	10 Weeks
Topic	
Forces and Motion	
Alignment to Standards	
HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. HS-PS2-2: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. HS-ESS2-1: Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	
Learning Objectives and Activities	
Learning Objectives: • What is the Language of Physics and what is the Nature of Science? Metric System? Powers of Ten? Unit Conversions? • What are scalars and vectors and how can they be incorporated to solve problems? • How can motion be described and predicted mathematically/graphically in 1-D & 2-D? • How can uniform and accelerated linear & projectile motion be described and analyzed?	

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- How are kinematic equations/graphs used to describe an object's motion?
- What is free-fall and what are the laws governing projectiles?
- What is force and how does it cause a change in motion?
- How can Newton's laws be utilized to describe an object's motion?

Learning Activities:

- Introduction to Measurement lab
- Graphical Analysis of Motion lab
- Vector Scavenger Hunt
- Instantaneous Velocity lab
- Free fall lab (reaction time, hang time)
- Newton's Second Law lab (Atwood's machine)
- Friction & Coefficient of Friction Experiment
- Mass versus Weight lab
- Egg-Drop Activity (Momentum and Impulse)
- Collisions and Explosions lab (Conservation of Momentum)
- Center of Mass Activity
- Define velocity and acceleration operationally
- Describe and apply Newton's 2nd Law of Motion and the relationship between force, mass and acceleration
- Describe the effect of air resistance on a falling object
- State Newton's third law of motion, and identify action and reaction forces
- Define momentum and impulse, and explain the impulse-momentum relationship
- State the law of conservation of momentum

Assessments

Formative:

- Do Now/Warm-up: Kinematic equations, Newton's second law, Conservation of momentum
- Perform dimensional analysis
- Draw and use motion diagrams to describe motion
- Differentiate between scalar and vector quantities

Summative:

- Interpret graphs of position, velocity and acceleration as functions of time
- Use kinematic equations to solve problems involving motion with constant velocity or constant acceleration, including free fall
- Analyze collisions using the law of conservation of momentum

Benchmark:

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- A pre and post-test will be given to measure skills and knowledge with core course concepts

Alternative:

- Students apply physics concepts and problem-solving techniques to solve problems involving free fall, mechanical equilibrium and projectile motion and then test their solutions using lab equipment
- Concept Builders from PhysicsClassroom.com: Kinematics, Newton's Laws, Vectors and Projectiles, Momentum and Collisions

Interdisciplinary Connections

ELA

RI.CT.11-12.8. Analyze and reflect on (e.g. practical knowledge, historical/cultural context, and background knowledge) documents of historical and scientific significance for their purposes, including primary source documents relevant to U.S. and/or global history and texts proposing scientific or technical advancements.

Math

A.REI.C.6 Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables.

S.IC.B.6 (+) Evaluate reports based on data (e.g. interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed).

Career Readiness, Life Literacies, and Key Skills

9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.

Technology Integration

Career Education

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CRP-2: Students use knowledge and skills through their lab work

CRP-12: Students work productively in collaborative groups using culturally global competence

Time Frame	2 Weeks
Topic	
Fundamental Forces	
Alignment to Standards	
HS-PS2-4: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.	
Learning Objectives and Activities	
<u>Learning Objectives:</u> • How does Newton's Law of Universal Gravitation provide a mathematical model that will describe and predict the effects of the gravitational forces between objects? • How does Coulomb's Law provide a mathematical model that will describe and predict the effects of electrostatic forces between objects? • How do objects accumulate charge? • What are fields described as, and how are they used? • What is the Inverse-Square Law? • What are the strong and weak nuclear forces? <u>Learning Activities:</u> • Gizmos: Coulomb's Law • Electrostatics Lab • Inertial Balance Lab • Phet Gravity Simulated Lab • There are fundamental forces in nature other than gravity • Protons and electrons can exert forces and transfer energy • Recognize that objects that are charged exert forces, both attractive and repulsive • Describe/explain conservation of charge • Describe the differences between conductors and insulators • Use Coulomb's law to solve problems relating to electrical force	

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COURSE: **Physics**

- Develop a model of how charged objects can attract a neutral object
- Define and measure an electric field
- Solve problems relating to charge, electric fields and forces
- Diagram electric field lines
- Define and calculate electric potential difference

Assessments

Formative:

- Do Now/Warm-up: Gravitation, Coulomb's law
- Describe the method Cavendish used to measure G and their results of knowing G
- Describe gravitational fields
- Distinguish between inertial mass and gravitational mass
- Contrast Newton's and Einstein's views about gravitation

Summative:

- Summarize the relationship between forces and charges
- Describe how an electroscope detects electric charge
- Explain how to charge by conduction and induction

Benchmark: N/A

Alternative:

- Concept Builders from PhysicsClassroom.com: Newton's law of gravity, Name That Charge

Interdisciplinary Connections

ELA:

W.IW.11-12.2. Write informative/explanatory texts (**including the narration of historical events, scientific procedures/ experiments, or technical processes**) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Mathematics:

A.REI.C.6 Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables.

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Career Readiness, Life Literacies, and Key Skills
Technology Integration
9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.)..
Career Education
CRP-2: Students use knowledge and skills through their lab work. CRP-12: Students work productively in collaborative groups using culturally global competence.

Time Frame	1 Week
Topic	
Circular Motion & Orbital Mechanics	
Alignment to Standards	
HS-ESS1-4: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. HS-PS2-4: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.	
Learning Objectives and Activities	
<u>Learning Objectives:</u> • What is uniform circular motion? • What are centripetal forces and centripetal accelerations? • How can orbital motion be described mathematically? • How can Newton's Universal Law of Gravitation and Kepler's Laws be applied to describe/predict motions of orbiting objects?	
<u>Learning Activities:</u> • Uniform Circular Motion Lab	

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COURSE: **Physics**

- Mercury Orbit Activity
- Space Station Design Project
- Relate Kepler's laws of planetary motion to Newton's law of universal gravitation
- Calculate the periods and speeds of orbiting objects

Assessments

Formative:

- Do Now/Warm-up: Centripetal Acceleration, Speed of a Satellite, Kepler's Third Law
- Strategic Questioning
- Post Lab Analysis Questions

Summative:

- Solve problems involving orbital speed and period
- Chapter Quizzes (Free Response)

Benchmark: N/A

Alternative:

- Concept Builders from PhysicsClassroom.com : Circular Logic, Case Studies in Circular Motion

Interdisciplinary Connections

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A.REI.C.6 Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables.

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Career Readiness, Life Literacies, and Key Skills

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COURSE: **Physics**

Technology Integration
Career Education
CRP-2: Students use knowledge and skills through their lab work. CRP-12: Students work productively in collaborative groups using culturally global competence.

Time Frame	2 Weeks
Topic	
Energy	
Alignment to Standards	
HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. HS-PS3-4: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	
Learning Objectives and Activities	
<u>Learning Objectives:</u> What are Work and Power and how are they related to everyday activities?	

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COURSE: **Physics**

- What is Energy and how is it transferred and conserved?
- What is the Work-Energy Theorem and how can it be applied?
- What are the types of Mechanical Energy and how are they described conceptually/mathematically/graphically?
- How can Energy concepts be applied to describe and predict motion?

Learning Activities:

- Energy Transfer Lab (Marble on Incline Plane)
- Energy Transfer Lab 2 (Swinging Pendulum)
- Energy Transfer Lab 3 (Springs - Elastic Potential Energy)
- Online Lab Simulation (Energy transfer during elastic/inelastic collisions)
- Roller Coaster Design Project
- Simple Machines Labs (Pulley & Ramp)
- Differentiate between work and power and correctly calculate power used
- Demonstrate knowledge of why simple machines are useful
- Calculate the kinetic energy of a moving object
- Determine how to find the gravitational potential energy of a system

Assessments

Formative:

- Do Now/Warm-up: Work & Power, Horsepower, Conservation of Energy
- Describe the relationship between work and energy
- Display an ability to calculate work done by a force
- Google Questions

Summative:

- Identify ways in which elastic potential energy is stored in a system
- Solve problems using the law of conservation of energy
- Chapter Quizzes (Free Response)

Benchmark: N/A

Alternative:

- Concept Builders from PhysicsClassroom.com: Energy Ranking Tasks, Energy Bar Charts

Interdisciplinary Connections

ELA





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Math

S.IC.B.4 (+) Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling

S.IC.B.6 (+) Evaluate reports based on data (e.g. interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed).

Career Readiness, Life Literacies, and Key Skills

9.4.12.CI.1: Demonstrate the ability to reflect, analyze and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

Technology Integration

Career Education

CRP-2: Students use knowledge and skills through their lab work.

CRP-12: Students work productively in collaborative groups using culturally global competence.

Time Frame	2 Weeks
Topic	
Wave Properties	
Alignment to Standards	
HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength and speed of waves traveling in various media.	

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COURSE: **Physics**

Learning Objectives and Activities

Learning Objectives:

- What is a wave?
- How are wave properties modeled conceptually/mathematically/graphically?
- What is the relationship between wave velocity, frequency and wavelength?
- How are waves categorized and what types of waves are found in nature?
- What is sound and how can the wave model be used to explain the properties of sound?

Learning Activities:

- Period of a simple pendulum lab
- Wave on a string lab
- Speed of sound lab
- Compare/contrast transverse and longitudinal waves
- Relate wave speed, wavelength and frequency
- Describe reflection, diffraction and superposition properties of waves
- Demonstrate knowledge of the nature of sound waves and the properties sound shares with other waves
- Define the Doppler shift and identify some of its applications
- Demonstrate an understanding of resonance, especially as applied to air columns
- Determine why beats occur

Assessments

Formative:

- Do Now/Warm-up: Work & Power, Horsepower, Conservation of Energy
- Strategic Questioning
- Identify how waves transfer energy without transferring matter
- Post Lab Analysis Questions

Summative:

- Solve problems relating the frequency, wavelength and velocity of sound
- Explain why there is a variation among instruments and among voices using the terms timbre, resonance, fundamental and harmonic
- Chapter Quizzes (Free Response)

Benchmark: N/A

Alternative:

- Waves & Sound Presentation Project

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Interdisciplinary Connections

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Math

S.IC.B.4 (+) Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling

S.IC.B.5 (+) Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

Career Readiness, Life Literacies, and Key Skills

9.4.12.CI.1: Demonstrate the ability to reflect, analyze and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

Technology Integration

Career Education

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Time Frame

1 Week

Topic

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Electromagnetic Radiation

Alignment to Standards

HS-PS4-2: Evaluate questions about the advantages of using a digital transmission and storage of information.

HS-PS4-3: Evaluate the claims, evidence and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model and that for some situations one model is more useful than the other.

HS-PS4-4: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

HS-PS4-5: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

HS-ESS1-1: Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.

HS-ESS1-2: Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies and composition of matter in the universe.

HS-ESS1-3: Communicate scientific ideas about the way stars, over their life cycle, produce elements.

HS-ESS1-4: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

HS-ESS3-5: Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

Learning Objectives and Activities

Learning Objectives:

- How and why do we see what we see?
- What categories is the electromagnetic spectrum broken up into and what are the properties of these categories?
- How are light waves used to transfer energy and send and store information?
- What are the physical properties of light?
- How is the electromagnetic spectrum used to learn more about the universe?
- What is optics? What are ray diagrams?
- How can Snell's Law of Refraction be described mathematically/conceptually and how can it be applied to describe real-world phenomena?

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- Describe the societal issue of climate change and its impacts on earth's systems

Learning Activities:

- Ray tracing lab (plane mirror)
- Refraction of Light/Speed of Light in Glass lab
- Converging lens lab
- Index of Refraction for Water/Unknown Liquids
- Climate Change scenarios
- Trace and define the historical development of light
- Identify the source of all light relative to electromagnetic radiation
- Calculate speeds, frequencies and velocities of light waves
- Natural and man-made causes of climate change

Assessments

Formative:

- Do Now/Warm-Ups: frequency, wavelength and energy ranking tasks
- Strategic Questioning
- Describe how the speed of light is measured
- Post-Lab Analysis Questions

Summative:

- Chapter Test (Multiple Choice and Free Response)
- Chapter Quizzes (Free Response)
- Explain the particle-wave duality model of light
- Presentation on climate change (i.e. causes of and steps to mitigate)

Benchmark: N/A

Alternative:

- Light & Optics Presentation Project
- SETI Assignment
- Climate Change public announcement

Interdisciplinary Connections

ELA

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Math

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S.IC.B.5 (+) Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

ELA Climate Change

W.WR.9–10.5. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Math Climate Change

N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

Career Readiness, Life Literacies, and Key Skills

9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.

Technology Integration

Career Education

CRP-2: Students use knowledge and skills through their lab work.

CRP-12: Students work productively in collaborative groups using culturally global competence.

Time Frame	2 Weeks
Topic	
Electricity and Magnetism	

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Alignment to Standards

HS-PS2-5: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

HS-PS3-5: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS-ESS2-3: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

Learning Objectives and Activities

Learning Objectives:

- What is current?
- How do magnets or electric currents cause magnetic fields?
- How do electric charges or changing magnetic fields cause electric fields?
- What are the properties and components of electric circuits?
- What is the relationship between voltage, current and resistance?
- How can energy be transmitted by electric currents?
- What are the properties of magnets and magnetic fields?
- What phenomena in nature and in modern-day technologies can be described with magnetism concepts?

Learning Activities:

- Series & Parallel Circuit Lab
- Lemon Battery Lab
- Magnetic Observation Activity
- Build an Electromagnet Activity
- Describe conditions that create current in an electric circuit
- Draw circuits and recognize they are closed loops
- Define resistance and describe Ohm's law
- Calculate current, voltage drops and equivalent resistance for devices connected in series and in parallel

Assessments

Formative:

- Do Now/Warm-Ups: Circuit Diagrams, Magnetic Force Lines
- Define the electric current and the ampere.
- Strategic Questioning

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Summative:

- Describe both a series connection and a parallel connection and state the important characteristics of each
- Chapter Quizzes (Free Response)

Benchmark: N/A

Alternative:

- Lemon Battery Project
- Electromagnet Project

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competence.

Modifications (ELL, Special Education, At Risk Students, Gifted & Talented, & 504 Plans)

ELL:

- Work toward longer passages as skills in English increase
- Use visuals
- Introduce key vocabulary before lesson
- Teacher models reading aloud daily
- Provide peer tutoring
- Use of Bilingual Dictionary
- Guided notes and/or scaffold outline for written assignments
- Provide students with English Learner leveled readers.

Supports for Students With IEPs:

- Allow extra time to complete assignments or tests
- Guided notes and/or scaffold outline for written assignments
- Work in a small group
- Allow answers to be given orally or dictated
- Use large print books, Braille, or books on CD (digital text)
- Follow all IEP modifications

At-Risk Students:

- Guided notes and/or scaffold outline for written assignments
- Introduce key vocabulary before lesson
- Work in a small group
- Lesson taught again using a differentiated approach
- Allow answers to be given orally or dictated
- Use visuals / Anchor Charts
- Leveled texts according to ability

Gifted and Talented:

- Create an enhanced set of introductory activities (e.g. advance organizers, concept maps, concept puzzles)
- Provide options, alternatives and choices to differentiate and broaden the curriculum
- Organize and offer flexible small group learning activities

Home of the Spartans!
#spartanlegacy





Township of Ocean Schools

Assistant Superintendent
Office of Teaching and Learning

SPARTAN MISSION:

Meeting the needs of all students with a proud tradition of academic excellence.

DEPARTMENT: **Science**

COURSE: **Physics**

- Provide whole group enrichment explorations
- Teach cognitive and methodological skills
- Use center, stations, or contracts
- Organize integrated problem-solving simulations
- Propose interest-based extension activities
- Expose students to beyond level texts.

Supports for Students With 504 Plans:

- Follow all the 504 plan modifications
- Text to speech/audio recorded selections
- Amplification system as needed
- Leveled texts according to ability
- Fine motor skill stations embedded in rotation as needed
- Modified or constrained spelling word lists
- Provide anchor charts with high frequency words and phonemic patterns

