# AP PHYSICS UNIT 6 - SIMPLE HARMONIC MOTION

Content Area: **Science**
Course(s): **Physics AP w/Lab**
Time Period: **March**
Length: **10 Days**
Status: **Published**

**Title Section**

## Department of Curriculum and Instruction

**Belleville Public Schools**

**Curriculum Guide**

# AP PHYSICS 11,12

# SIMPLE HARMONIC MOTION

**Belleville Board of Education**

**56 Ralph Street**

**Belleville, NJ 07109**

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## Unit Overview

In Unit 6, students will continue to use the same tools, techniques, and models that they have been using throughout this course. However, they will now use them to analyze a new type of motion: simple harmonic motion. Although simple harmonic motion is unique, students will learn that even in new situations, the fundamental laws of physics remain the same. Energy bar charts, as well as free-body diagrams, become increasingly important as students work toward determining which model is most appropriate for a given physical situation. Preconceptions—such as the relationship between the amplitude and period of oscillation—will also be addressed to provide students with a more nuanced awareness of simple harmonic motion. Students are expected to use the content knowledge they gained in the first five units to make and defend claims while also making connections in and across the content topics and big ideas. Because Unit 6 is the first unit in which students possess all the tools of force, energy, and momentum conservation, it's important that teachers scaffold lessons to help them develop a better understanding of each fundamental physics principles as well as its limitations. Throughout this unit, students will be asked to create force, energy, momentum, and position versus time graphs for a single scenario and to make predictions based on their representations.

## Enduring Understanding

Restoring forces can result in oscillatory motion. When a linear restoring force is exerted on an object displaced from an equilibrium position, the object will undergo a special type of motion called simple harmonic motion. Examples include gravitational force exerted by Earth on a simple pendulum and mass-spring oscillator.
For a spring that exerts a linear restoring force, the period of a mass-spring oscillator increases with mass and decreases with spring stiffness.
For a simple pendulum, the period increases with the length of the pendulum and decreases with the magnitude of the gravitational field.
Minima, maxima, and zeros of position, velocity, and acceleration are features of harmonic motion. Students should be able to calculate force and acceleration for any given displacement for an object oscillating on a spring.
A system with internal structure can have internal energy, and changes in a system's internal structure can result in changes in internal energy.
A system with internal structure can have potential energy. Potential energy exists within a system if the objects within that system interact with conservative forces.
The work done by a conservative force is independent of the path taken. The work description is used for forces external to the system. Potential energy is used when the forces are internal interactions between parts of the system.
Changes in the internal structure can result in changes in potential energy. Examples include mass-spring oscillators and objects falling in a gravitational field.
The change in electric potential in a circuit is the change in potential energy per unit charge.
The internal energy of a system includes the kinetic energy of the objects that make up the system and the potential energy of the configuration of the objects that make up the system.
Since energy is constant in a closed system, changes in a system's potential energy can result in changes to the system's kinetic energy.
The changes in potential and kinetic energies in a system may be further constrained by the construction of the system.
- A wave is a traveling disturbance that transfers energy and momentum.

- A periodic wave is one that repeats as a function of both time and position

- A periodic wave can be described by its amplitude, frequency,wavelength, speed, and energy.

## Essential Questions

What are the different ways energy can be transmitted through space?
Where do waves come from?

How do you know that waves carry energy?
Explain how knowledge of waves helps us understand our world better and improve the quality of our lives?
Why do sound waves need a medium through which to travel?
What are the differences between simple harmonic motion and circular motion?
What are the similarities between simple harmonic motion and circular motion?
What properties affect the motion of an object in SHM?
How can SHM be modeled as a wave?
How do waves/vibrations carry energy?
What physical characteristics of a system govern its period of oscillation?

## Exit Skills

1. Describe the force in an elastic spring.
2. Determine the energy stored in an elastic spring.
3. Compare simple harmonic motion and the motion of a pendulum.
4. Identify how waves transfer energy without transferring matter.
5. Relate wave speed, wavelength, and frequency.
6. Relate a wave's speed to the medium and refracted at boundaries between media.
7. Apply the principle of superposition to the phenomenon of interference.
8. Relate the physical properties of sound waves to our perception of sound.
9. Develop the ray model of light.
10. Predict the effect of distance on light's luminance.
11. Solve problems involving the speed of light.

## New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

| | |
|---|---|
| SCI.HS-PS2 | Motion and Stability: Forces and Interactions |
| SCI.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. |
| SCI.HS.PS2.B | Types of Interactions |
| SCI.HS.PS2.B | Types of Interactions |
| SCI.HS.PS3.A | Definitions of Energy |
| | Energy and Matter |
| SCI.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. |
| SCI.HS.PS3.A | Definitions of Energy |
| | Energy and Matter |
| SCI.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). |
| SCI.HS.PS3.B | Conservation of Energy and Energy Transfer |
| SCI.HS.PS3.C | Relationship Between Energy and Forces |
| SCI.HS.PS4.A | Wave Properties |
| SCI.HS.PS4.B | Electromagnetic Radiation |
| SCI.HS-LS2 | Ecosystems: Interactions, Energy, and Dynamics |
| | Energy and Matter |
| | Systems and System Models |
| SCI.HS.PS4.A | Wave Properties |
| SCI.HS.ESS3.D | Global Climate Change |
| SCI.HS-ESS3-6 | Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change). |
| SCI.HS.ESS2.D | Weather and Climate |
| SCI.HS.ESS3.D | Global Climate Change |
| SCI.HS-ETS1-4 | Use a computer simulation to model the impact of proposed solutions to a complex real- |

| | |
|---|---|
| | world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. |
| | Systems and System Models |
| CS.9-12.8.1.12.DA.2 | Describe the trade-offs in how and where data is organized and stored. |
| CS.9-12.ETW | Effects of Technology on the Natural World |

## Interdisciplinary Connections

Please list all and any additional **Interdisciplinary Connections/Cross-Curricular** New Jersey Student Learning Standards that link to this unit, and which are not included in the NJSLS section above.

| | |
|---|---|
| MA.A-SSE | Seeing Structure in Expressions |
| MA.A-SSE.A | Interpret the structure of expressions |
| MA.A-SSE.A.1 | Interpret expressions that represent a quantity in terms of its context. |
| LA.RH.11-12.1 | Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of primary and secondary sources, connecting insights gained from specific details to develop an understanding of the text as a whole. |
| MA.A-SSE.A.1a | Interpret parts of an expression, such as terms, factors, and coefficients. |
| LA.RH.11-12.2 | Determine the theme, central ideas, information and/or perspective(s) presented in a primary or secondary source; provide an accurate summary of how key events, ideas and/or author's perspective(s) develop over the course of the text. |
| MA.A-SSE.A.1b | Interpret complicated expressions by viewing one or more of their parts as a single entity. |
| LA.RH.11-12.4 | Determine the meaning of words and phrases as they are used in a text, including analyzing how an author uses and refines the meaning of a key term over the course of a text (e.g., how Madison defines faction in Federalist No. 10). |
| LA.RH.11-12.7 | Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, qualitatively, as well as in words) in order to address a question or solve a problem. |
| MA.A-APR.A | Perform arithmetic operations on polynomials |
| LA.RST.11-12.1 | Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. |
| LA.RST.11-12.2 | Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. |
| LA.RST.11-12.7 | Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. |
| LA.RST.11-12.8 | Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. |
| LA.RST.11-12.9 | Synthesize information from a range of sources (e.g., texts, experiments, simulations) into |

| | |
|---|---|
| | a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. |
| LA.WHST.11-12.1.A | Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. |
| LA.WHST.11-12.6 | Use technology, including the Internet, to produce, share, and update writing products in response to ongoing feedback, including new arguments or information. |
| LA.WHST.11-12.9 | Draw evidence from informational texts to support analysis, reflection, and research. |

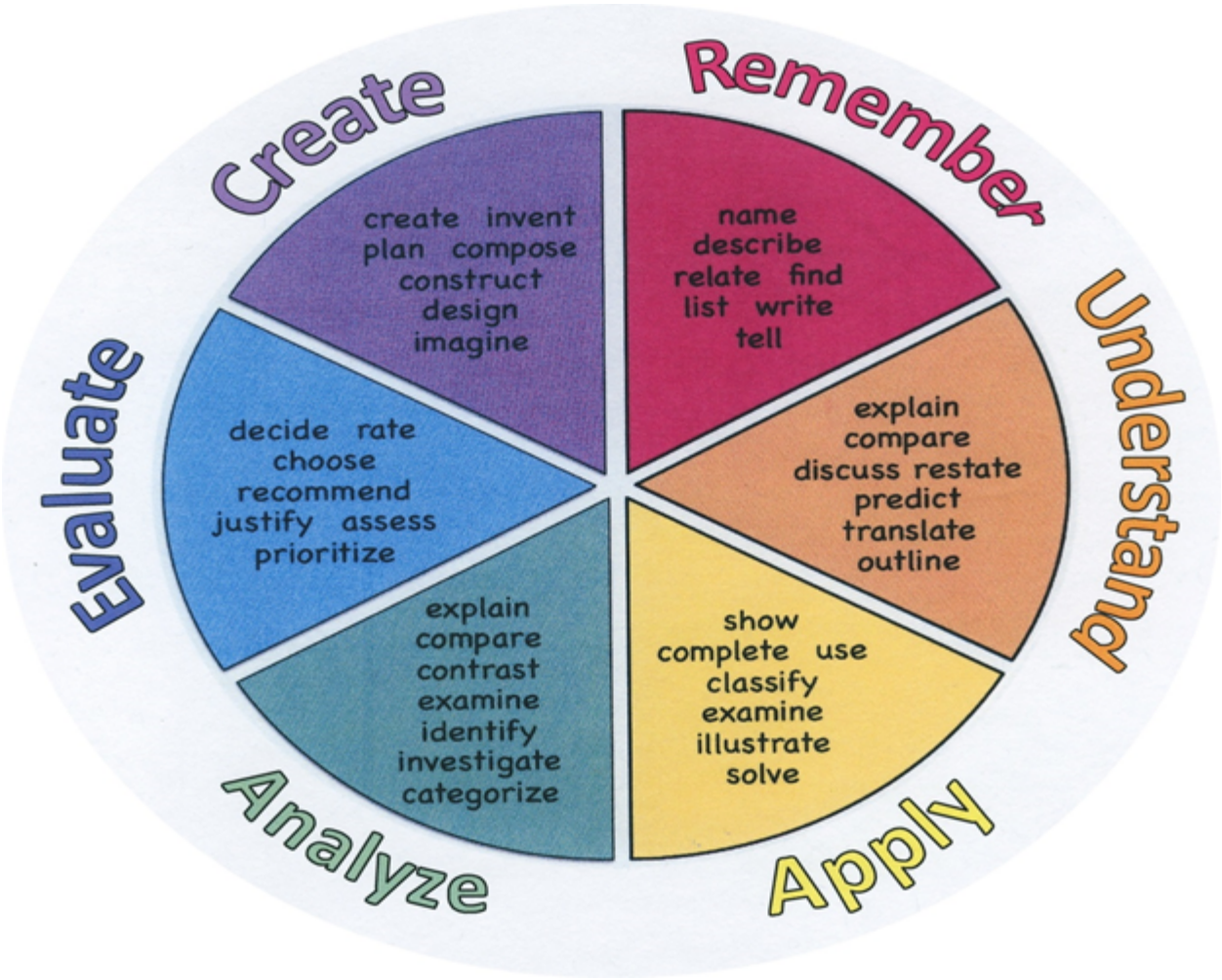
## Learning Objectives

**Students will be able to...**

Predict which properties determine the motion of a simple harmonic oscillator and what the dependence of the motion is on those properties.
Design a plan and collect data in order to ascertain the characteristics of the motion of a system undergoing oscillatory motion caused by a restoring force.
Analyze data to identify qualitative and quantitative relationships between given values and variables (i.e., force, displacement, acceleration, velocity, period of motion, frequency, spring constant, string length, mass) associated with objects in oscillatory motion and use those data to determine the value of an unknown.
Construct a qualitative and/ or quantitative explanation of oscillatory behavior given evidence of a restoring force.
Calculate the expected behavior of a system using the object model (i.e., by ignoring changes in internal structure) to analyze a situation. Then, when the model fails, the student can justify the use of conservation of energy principles to calculate the change in internal energy due to changes in internal structure because the object is actually a system.
Describe and make qualitative and/or quantitative predictions about everyday examples of systems with internal potential energy.
Make quantitative calculations of the internal potential energy of a system from a description or diagram of that system.
Apply mathematical reasoning to create a description of the internal potential energy of a system from a description or diagram of the objects and interactions in that system.
Describe and make predictions about the internal energy of systems.
Calculate changes in kinetic energy and potential energy of a system using information from representations of that system.
Compare simple harmonic motion and the motion of a pendulum.
Describe the force in an elastic spring.
Determine the energy stored in an elastic spring.
Identify how waves transfer energy without transferring matter.
Relate wave speed, wavelength, and frequency.
Contrast transverse and longitudinal waves.
Relate a wave's speed to the medium and refracted at boundaries between media.
Apply the principle of superposition to the phenomenon of interference.
Develop the ray model of light.
Solve problems involving the speed of light.
Describe how diffraction demonstrates that light is a wave.
Investigate a case study that illustrates the impact of climate change on a community of our human population

**Action Verbs:** Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

| Remember | Understand | Apply | Analyze | Evaluate | Create |
|---|---|---|---|---|---|
| Choose | Classify | Choose | Categorize | Appraise | Combine |
| Describe | Defend | Dramatize | Classify | Judge | Compose |
| Define | Demonstrate | Explain | Compare | Criticize | Construct |
| Label | Distinguish | Generalize | Differentiate | Defend | Design |
| List | Explain | Judge | Distinguish | Compare | Develop |
| Locate | Express | Organize | Identify | Assess | Formulate |
| Match | Extend | Paint | Infer | Conclude | Hypothesize |
| Memorize | Give Examples | Prepare | Point out | Contrast | Invent |
| Name | Illustrate | Produce | Select | Critique | Make |
| Omit | Indicate | Select | Subdivide | Determine | Originate |
| Recite | Interrelate | Show | Survey | Grade | Organize |
| Select | Interpret | Sketch | Arrange | Justify | Plan |
| State | Infer | Solve | Breakdown | Measure | Produce |
| Count | Match | Use | Combine | Rank | Role Play |
| Draw | Paraphrase | Add | Detect | Rate | Drive |
| Outline | Represent | Calculate | Diagram | Support | Devise |
| Point | Restate | Change | Discriminate | Test | Generate |
| Quote | Rewrite | Classify | Illustrate | | Integrate |
| Recall | Select | Complete | Outline | | Prescribe |
| Recognize | Show | Compute | Point out | | Propose |
| Repeat | Summarize | Discover | Separate | | Reconstruct |
| Reproduce | Tell | Divide | | | Revise |
| | Translate | Examine | | | Rewrite |
| | Associate | Graph | | | Transform |
| | Compute | Interpolate | | | |
| | Convert | Manipulate | | | |
| | Discuss | Modify | | | |
| | Estimate | Operate | | | |
| | Extrapolate | Subtract | | | |
| | Generalize | | | | |
| | Predict | | | | |




## Suggested Activities & Best Practices

Desktop Experiment Task; Have students determine the spring constant of a spring using (1) known masses and meterstick only and then (2) known masses and stopwatch only.

Desktop Experiment Task; Have students use a pendulum to measure the acceleration of gravity. Ask them to refine the experiment from single-trial calculation, to taking an average, to making a graph of linearized data.

Predict and Explain; Make a pendulum bob oscillate with the other end of the string “clamped” between your fingers. While the bob oscillates, pull the string through your fingers so that the string length is shortened. Before doing this, ask students what will happen to the period of the oscillation and the amplitude (measured

in degrees), and then explain why the period decreases and the amplitude angle increases.

Construct an Argument; A cart wiggles on a horizontal spring. A blob of clay is dropped on the cart and sticks (could be when the cart is at the center or at one end). Ask students to explain what happened to the period, total energy, amplitude of motion, and maximum speed?

Create a Plan; Students choose a song and find its tempo (beats per minute). Students then must build a pendulum so that it swings back and forth on each beat. Students are then given a spring. They must find the spring's constant and then find the amount of mass necessary to make the spring-mass oscillate on each beat.

Calculating period and frequency of a pendulum

Pendulum Lab; Length vs period

Pendulum Lab; Amplitude vs period

Pendulum Lab; Mass vs period

Construct waves with different wavelength

Construct waves with different amplitude

Analysing how generating electricity from ocean waves affects climate change

## Assessment Evidence - Checking for Understanding (CFU)

Student must be able to graph fundamental quantities; period and mass of a pendlum (Formative)

Student must be able to graph fundamental quantities; period and length of a string of a pendlum (Formative)

Student must be able to graph fundamental quantities; period and angle of a string of a pendlum (Formative)

Common, Department Quarterly Benchmarks (Benchmark)

Oncourse Assessment Tools (Formative)

Unit Test/Quiz (Summative)

"Do Now/Exit Ticket" Activity (Formative)

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Learning Center Activities
- Multimedia Reports
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist

- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep
- Unit tests
- Web-Based Assessments
- Written Reports

## Primary Resources & Materials

Textbook, Giancoli AP Edition

Internet

AP Physics Exam, Princeton Review

Masteringphysics.com

Please list all district-provided Primary Resources & Materials and/or those outside that are accessed with district resources.

## Ancillary Resources

Teacher Prepared Materials

Lab Materials

Study Guide Materials

United Streaming Videos

The Physics Classroom: www.thephysicsclassroom.com

STEM Lab

AP Central Resources.

Please list all additional resources that will be used to strengthen this unit's lessons.

## Technology Infusion

Students must be able to use the photogates to measure the velocity of an object moving in a simple harmonic motion

Students must be able to use the stopwatch to measure the period of an object moving in a simple harmonic motion

Students must be able to use the stopwatch to measure the frequency of an object moving in a simple harmonic motion

Students must be able to use the protractor to measure the angle of an object moving in a simple harmonic motion

Albert.io

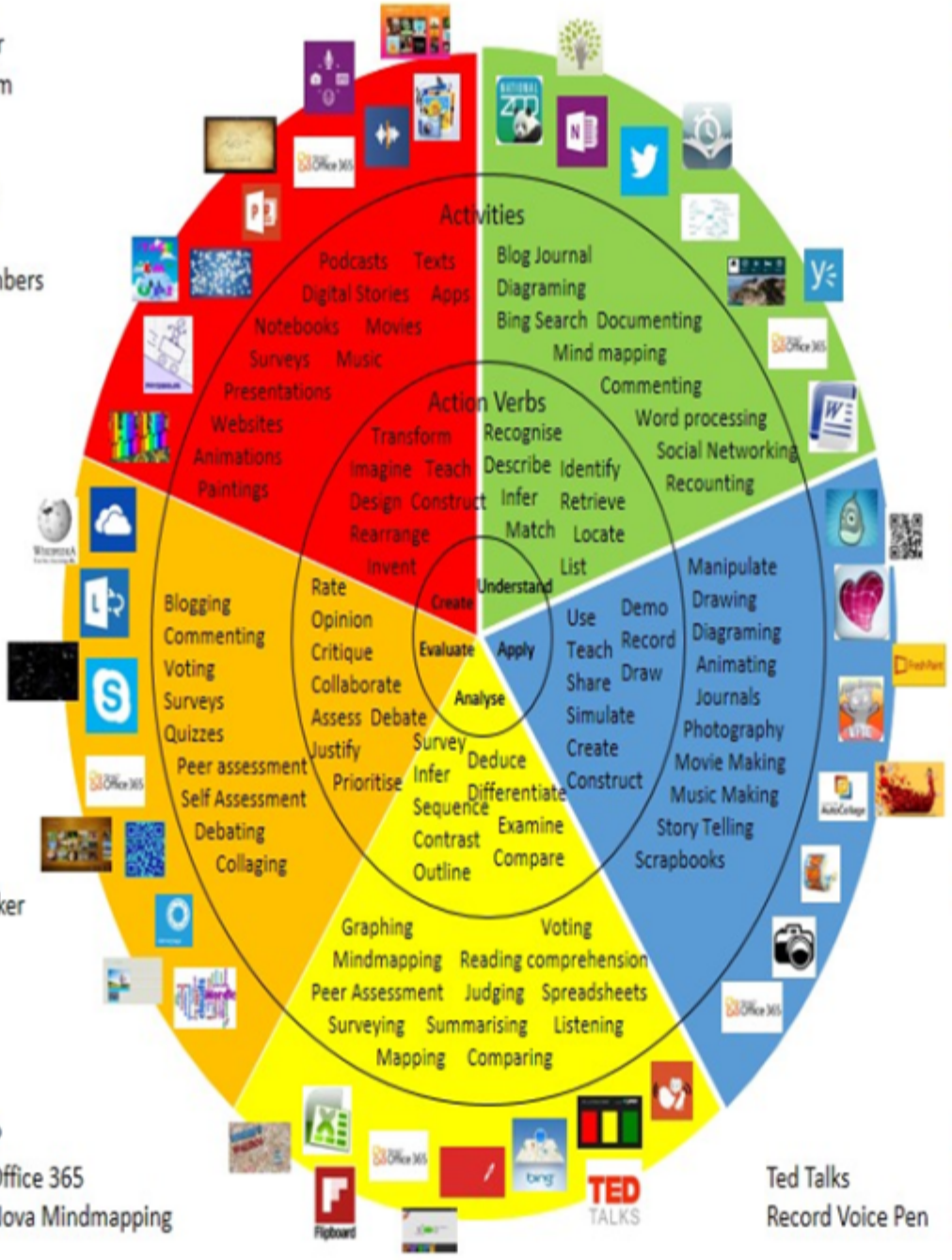
AP Collegeboard

What **Technology Infusion** and/or strategies are integrated into this unit to enhance learning? Please list all hardware, software and strategies. Please find a technology pedagogy wheel for assistance while completing this section.

# Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts
Photostory 3
Kid Story Builder
Music Maker Jam
Paint A Story
Office 365
MS PowerPoint
Stack 'Em Up
NqSquared Numbers
Physamajig
Xylophone 8

Wikipedia
Skydrive
Lync
SkyMap
Skype
Office 365
Puzzle Touch
Easy QR
Memorylage
Life Moments
Word Cloud Maker




Where's Waldo?
MS Excel Office 365
Flipboard Nova Mindmapping

Ted Talks
Record Voice Pen

Originally taken from http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

## Alignment to 21st Century Skills & Technology

Upon completion of this section, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

Mastery and infusion of **21st Century Skills & Technology** and their Alignment to the core content areas is essential to student learning. The core content areas include:

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- World languages;
- Technology;
- Visual and Performing Arts.

| | |
|---|---|
| WRK.9.2.12.CAP.1 | Analyze unemployment rates for workers with different levels of education and how the economic, social, and political conditions of a time period are affected by a recession. |
| WRK.9.2.12.CAP.2 | Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs. |
| WRK.9.2.12.CAP.3 | Investigate how continuing education contributes to one's career and personal growth. |
| WRK.9.2.12.CAP.4 | Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment. |
| WRK.9.2.12.CAP.13 | Analyze how the economic, social, and political conditions of a time period can affect the labor market. |
| TECH.9.4.12.CI.1 | Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a). |
| TECH.9.4.12.CI.2 | Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8). |
| TECH.9.4.12.CI.3 | Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1). |
| TECH.9.4.12.CT.1 | Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3). |
| TECH.9.4.12.CT.2 | Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a). |
| TECH.9.4.12.CT.3 | Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice). |
| TECH.9.4.12.DC.1 | Explain the beneficial and harmful effects that intellectual property laws can have on the creation and sharing of content (e.g., 6.1.12.CivicsPR.16.a). |

| | |
|---|---|
| TECH.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.). |
| TECH.9.4.12.GCA.1 | Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3). |

## 21st Century Skills/Interdisciplinary Themes

Upon completion of this section, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

Please list only the **21st Century/Interdisciplinary Themes** that will be incorporated into this unit.

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

## 21st Century Skills

Upon completion of this section, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

Please list only the **21st Century Skills** that will be incorporated into this unit.

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

## Differentiation

Please remember: Effective educational **Differentiation** in a lesson lies within content, process, and/or product.

Please identify the ones that will be employed in this unit.

**Differentiations:**

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

**Hi-Prep Differentiations:**

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning

- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

**Lo-Prep Differentiations**

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

## Special Education Learning (IEP's & 504's)

Please identify the **Special Education Learning** adaptations that will be employed in the unit, using the ones identified below.

- Students must be able to construct pendula using different masses.

- Students must be able to construct pendula using different string length.

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes

- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

## English Language Learning (ELL)

Making a Newton disc to demonstrate that white light is mixture of other colors.

Representing light spectrum in English and in their own language.

- teaching key aspects of a topic.  Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student’s learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher’s notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test

- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

## At Risk

Making a wave model by using gummy bears, string and straws.

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

## Talented and Gifted Learning (T&G)

Please identify the **Talented and Gifted** adaptations that will be employed in the unit, using the ones identified below.

- Students must be able to solve calculus based problems.

- Above grade level placement option for qualified students
- Advanced problem-solving

- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

## Sample Lesson

Unit Name: SIMPLE HARMONIC MOTION

NJSLS: SCI.HS-PS4.A, SCI.HS-PS4.B, SCI.HS-PS3.A, SCI.HS-PS3.B, SCI.HS-PS3.C, SCI.HS-PS2, SCI.HS-PS2-1, SCI.HS-PS2-2, SCI.HS.PS2.A, LA.RH.11-12.7, LA.RH.11-12.9, LA.RST.11-12.1, LA.RST.11-12.2, MA.A-APR.A, MA.A-CED.A.1, MA.A-CED.A.2

Interdisciplinary Connection:Vocabulary and algebra contents

Statement of Objective: The students will demonstrate the ability to debate how waves are produced characterized by comparing objects in simple harmonic motion with 90% accuracy.

Anticipatory Set/Do Now: convert 400 km into cm

https://www.youtube.com/watch?v=d8Jkhqghb_8&feature=related

Gummy Bear Wave Machine

Lecture –properties of waves

Small groups activity: debate how waves are produced characterized by comparing objects in simple harmonic motion
Final review: units for waves

Student Assessment/CFU's: Survey

Materials: Chromebook

Safety equipments.

Power Point.

21st Century Themes and Skills: Critical thinking and Problem Solving

Differentiation:Different level of questions

Students must be able to draw sine and cosine functions of wave function. (Gifted and Talented)

Students must be able to build wave model . (Special Ed)

Integration of Technology:Power Point