AP PHYSICS UNIT 2 - DYNAMICS

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Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

AP PHYSICS 11,12

DYNAMICS

Belleville Board of Education

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Unit Overview

In Unit 2, students are introduced to the term force, which is the interaction of an object with another object. Part of the larger study of dynamics, forces are used as the lens through which students analyze and come to understand a variety of physical phenomena. This is accomplished by revisiting and building upon the representations presented in Unit 1, specifically the introduction to the free-body diagram. Translation, however, is key in this unit: Students must be able to portray the same object–force interactions through different graphs, diagrams, and mathematical relationships. Students will continue to make meaning from models and representations that will help them further analyze systems, the interactions between systems, and how these interactions result in change. Alongside mastering the use of specific force equations, Unit 2 also encourages students to derive new expressions from fundamental principles to help them make predictions in unfamiliar, applied contexts. The skill of making predictions will be nurtured throughout the course to help students craft sound scientific arguments.

Enduring Understanding

A gravitational field g at the location of an object with mass m causes a gravitational force of magnitude mg to be exerted on the object in the direction of the field.
On Earth, this gravitational force is called weight.
The gravitational field at a point in space is measured by dividing the gravitational force exerted by the field on a test object at that point by the mass of the test object and has the same direction as the force.
If the gravitational force is the only force exerted on the object, the observed freefall acceleration of the object (in meters per second squared) is numerically equal to the magnitude of the gravitational field (in Newtons/kilogram) at that location.
Contact forces result from the interaction of one object touching another object, and they arise from interatomic electric forces. These forces include tension, friction, normal, spring , and buoyant.
Inertial mass is the property of an object or system that determines how its motion changes when it interacts with other objects or systems.
Objects and systems have properties of inertial mass and gravitational mass that are experimentally verified to be the same and that satisfy conservation principles.
Forces are described by vectors.
Forces are detected by their influence on the motion of an object.
Forces have magnitude and direction.
A force exerted on an object is always due to the interaction of that object with another object.
An object cannot exert a force on itself.
Even though an object is at rest, there may be forces exerted on that object by other objects.
The acceleration of an object, but not necessarily its velocity, is always in the direction of the net force exerted on the object by other objects.
If one object exerts a force on a second object, the second object always exerts a force of equal magnitude on the first object in the opposite direction.
If an object of interest interacts with several other objects, the net force is the vector sum of the individual forces.
Free-body diagrams are useful tools for visualizing forces being exerted on a single object and writing the equations that represent a physical situation.
An object can be drawn as if it were extracted from its environment and the interactions with the environment were identified.
A force exerted on an object can be represented as an arrow whose length represents the magnitude of the force and whose direction shows the direction of the force.
A coordinate system with one axis parallel to the direction of the acceleration simplifies the translation from the free-body diagram to the algebraic representation.
Free-body or force diagrams may be depicted in one of two ways—one in which the forces exerted on an object are represented as arrows pointing outward from a dot, and the other in which the forces are specifically drawn at the point on the object at which each force is exerted.
The linear motion of a system can be described by the displacement, velocity, and acceleration of its center of mass. The variables x, v, and a all refer to the center-of-mass quantities.
The acceleration is equal to the rate of change of velocity with time, and velocity is equal to the rate of change of position with time.
The acceleration of the center of mass of a system is directly proportional to the net force exerted on it by all objects interacting with the system and inversely proportional to the mass of the system.
Force and acceleration are both vectors, with acceleration in the same direction as the net force.
The acceleration of the center of mass of a system is equal to the rate of change of the center of mass velocity with time, and the center of mass velocity is equal to the rate of change of position of the center of mass with time.
The variables x, v, and a all refer to the center-of-mass quantities.

Forces that the systems exert on each other are due to interactions between objects in the systems. If the interacting objects are parts of the same system, there will be no change in the center-of-mass velocity of that system.
An unbalanced force must be present to cause any change in an object's state of motion or rest.
Inertia is the property of matter that resists change in motion.
Gravitational force between two masses strengthens as the masses become more massive and rapidly weakens as the distance between them increases.
When one object exerts an action force on a second object, the second object exerts a reaction force on the first object. Forces always occur in action-reaction pairs.

Essential Questions

Explain how something can have no forces acting on it, yet still be moving.
If two cars of different masses had the same exact engine, which one would you want to buy and why?
If they both feel an equal and opposite force, why is a car not affected as much as a fly when they collide?
How does the presence of a net force determine the acceleration of an object?
What is the nature of friction and how does it factor into an object's acceleration?
How can an Atwood's machine be used to calculate the acceleration of gravity?
What is Newton's 1st Law and how does it explain static equilibrium?
How is knowledge of the net force essential to understanding an object's constant velocity?

Exit Skills

By the end of Unit 1 Students will:

- Define force.
- Use Newton's second law to solve problems.
- Explain the meaning of Newton's first law.
- Describe how the weight and the mass of an object are related.
- Differentiate between actual weight and apparent weight.
- Define Newton's third law.
- Explain the tension in ropes and strings in terms of Newton's third law.
- Define the Normal Force.
- Determine the value of the normal force by applying Newton's second law.
- Define Friction Force.
- Distinguish between static and kinetic friction.
- Relate the height, time in the air, and initial vertical velocity of a projectile using its vertical motion
- Explain how the trajectory of the projectile depends upon the frame of reference from which it observed.
- Explain why an object moving in a circle at a constant speed is accelerated.
- Describe how centripetal acceleration depends up on the object's speed and the radius of the circle.
- Identify the force that causes centripetal acceleration.

• Use the Law of Universal Gravitation to solve problems.

New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

SCI.HS-PS2	Motion and Stability: Forces and Interactions
SCI.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.
SCI.HS.PS2.A	Forces and Motion
SCI.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.
SCI.HS.PS2.A	Forces and Motion
SCI.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.
SCI.HS.PS2.A	Forces and Motion
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-PS2-5	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.
SCI.HS.PS2.B	Types of Interactions
SCI.HS-ESS2	Earth's Systems
SCI.HS.ESS2.D	Weather and Climate
SCI.HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere,

	atmosphere, geosphere, and biosphere.
SCI.HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
SCI.HS-ESS3	Earth and Human Activity
SCI.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.
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
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
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.
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.1a	Interpret parts of an expression, such as terms, factors, and coefficients.
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.
LA.RH.11-12.8	Evaluate an author's claims, reasoning, and evidence by corroborating or challenging them with other sources.
MA.A-APR	Arithmetic with Polynomials and Rational Expressions
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.11-12.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
MA.A-APR.C	Use polynomial identities to solve problems
MA.G-SRT	Similarity, Right Triangles, and Trigonometry
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.11-12.2.A	Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
LA.WHST.11-12.2.C	Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
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.

Learning Objectives

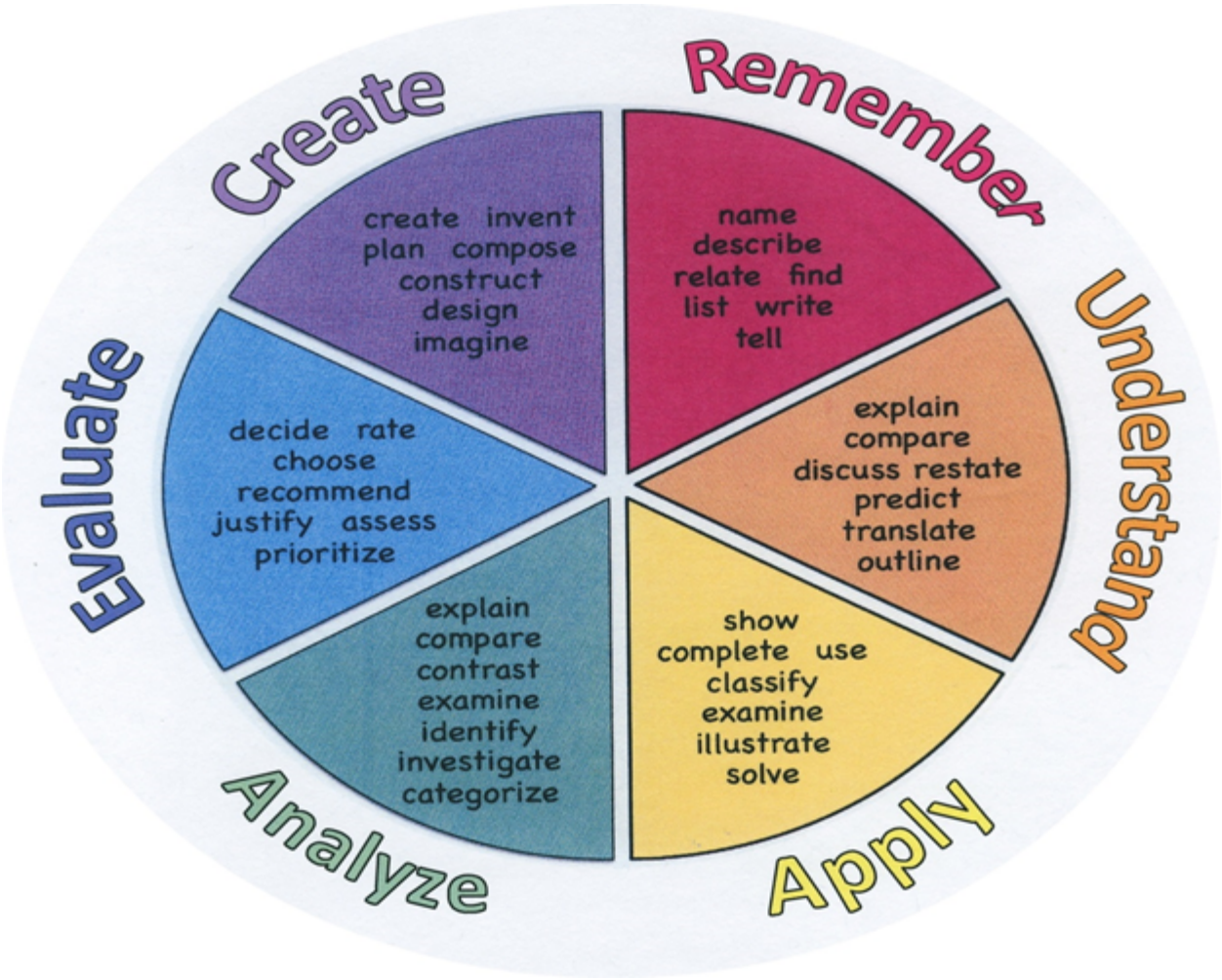
Model verbally or visually the properties of a system based on its substructure and relate this to changes in the system properties over time as external variables are changed.
Apply F = mg to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems.
Make claims about various contact forces between objects based on the microscopic cause of these forces.
Explain contact forces (tension, friction, normal, buoyant, spring) as arising from interatomic electric forces and that they therefore have certain directions.
Design an experiment for collecting data to determine the relationship between the net force exerted on an object, its inertial mass, and its acceleration.
Design a plan for collecting data to measure gravitational mass and inertial mass and to distinguish between the two experiments.
Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation.
Analyze a scenario and make claims (develop arguments, justify assertions) about the forces exerted on an object by other objects for different types of forces or components of forces.
Challenge a claim that an object can exert a force on itself.
Describe a force as an interaction between two objects, and identify both objects for any force.
Construct explanations of physical situations involving the interaction of bodies using Newton's third law and the representation of actionreaction pairs of forces.
Use Newton's third law to make claims and predictions about the action-reaction pairs of forces when two objects interact.
Analyze situations involving interactions among several objects by using free-body diagrams that include the

application of Newton's third law to identify forces.
Predict the motion of an object subject to forces exerted by several objects using an application of Newton's second law in a variety of physical situations, with acceleration in one dimension.
Design a plan to collect and analyze data for motion (static, constant, or accelerating) from force measurement, and carry out an analysis to determine the relationship between the net force and the vector sum of the individual forces.
Re-express a free-body diagram into a mathematical representation, and solve the mathematical representation for the acceleration of the object.
Create and use free-body diagrams to analyze physical situations to solve problems with motion qualitatively and quantitatively.
Use representations of the center of mass of an isolated two-object system to analyze the motion of the system qualitatively and semi-quantitatively.
Evaluate, using given data, whether all the forces on a system or all the parts of a system have been identified.
Apply Newton's second law to systems to calculate the change in the center-of-mass velocity when an external force is exerted on the system.
Use visual or mathematical representations of the forces between objects in a system to predict whether or not there will be a change in the center-of-mass velocity of that system.
Define force.
Use Newton's second law to solve problems.
Explain the meaning of Newton's first law.
Describe how the weight and the mass of an object are related.
Differentiate between actual weight and apparent weight.
Define Newton's third law.
Explain the tension in ropes and strings in terms of Newton's third law.
Define the Normal Force.
Determine the value of the normal force by applying Newton's second law.
Interpret position-time graphs for motion with constant acceleration.
Apply graphical and mathematical relationships to solve constant –acceleration problems.
Differentiate between actual weight and apparent weight.
Determine the value of the normal force by applying Newton's second law.
Evaluate the sum of two or more vectors in two dimensions, graphically.
Determine the components of vectors.
Solve for the sum of two or more vectors, algebraically, by adding the components of the vectors.
Define Friction Force.
Distinguish between static and kinetic friction.
Relate the height, time in the air, and initial vertical velocity of a projectile using its vertical motion.
Explain how the trajectory of the projectile depends upon the frame of reference from which it observed.
Determine the force that produces equilibrium when two to three forces act on an object.
Analyze the motion of an object on an inclined plane with and without friction.
Recognize that the vertical and horizontal motions of a projectile are independent.
Relate the height, time in the air, and initial vertical velocity of a projectile using its vertical motion, and then determine the range using the horizontal motion.
Explain how the trajectory of the projectile depends upon the frame of reference from which it observed.
Solve relative velocity problems.
Investigate the issue of climate change through discussion, experimentation and observation

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

Changing Representations; Have students consider an accelerating two-object system from everyday life (e.g., person pushes a shopping cart, car pulls a trailer). Have them draw the forces on one object, then on the other, and then the external forces acting on the two-object system.

Desktop Experiment Task; Have students measure the coefficient of static friction of their shoe on a wood plank or metal track. Level 1: Use a spring scale. Level 2: Use a pulley, a spring, a toy bucket, and an electronic balance. Level 3: Use a protractor.

Desktop Experiment Task; Give students a yo-yo, a low mass, low friction pulley, 50 paper clips, and a scale. Have them find the acceleration of the falling, unrolling yo-yo and then determine the mass of the paper clips to attach to the free end of the string so that the paper clips stay at rest even as the yo-yo falls and the string

passes over the pulley.

Working Backward; Student A writes a Newton's second law equation either with symbols or plugged-in numbers including units. Student B must then describe a situation that the equation applies to, including the object's velocity direction and how velocity is changing, a diagram, and a free-body diagram.

Troubleshooting; Students take some force-related problem from the homework or textbook (one that requires setting up Newton's second law and maybe more). Students write out a detailed solution that has exactly one mistake in it (not a calculation error). Post everyone's problems/ solutions, and then ask students to identify everyone else's errors. The last student to have his or her error found wins.

Balancing forces using force table.
Measuring coefficient of static friction.
Measuring coefficient of kinetic friction.

Global Warming; Calculating acceleration of Sea-Level Rise.

How LGBTQ Scientists made a difference in our society.

Assessment Evidence - Checking for Understanding (CFU)

Student must be able to graph fundamental quantities forces on Cartesian coordinate plane. (Formative)

Students must be able to read map and calculate tension in the rope between two moving object. (Formative)

Students must be able to calculate the net force after drawing a free body diagram. (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 acceleration of a falling object.

Students must be able to use force tabler to balance forces.

Students must be able to use virtual labs to solve dynamics problems.

Albert.io

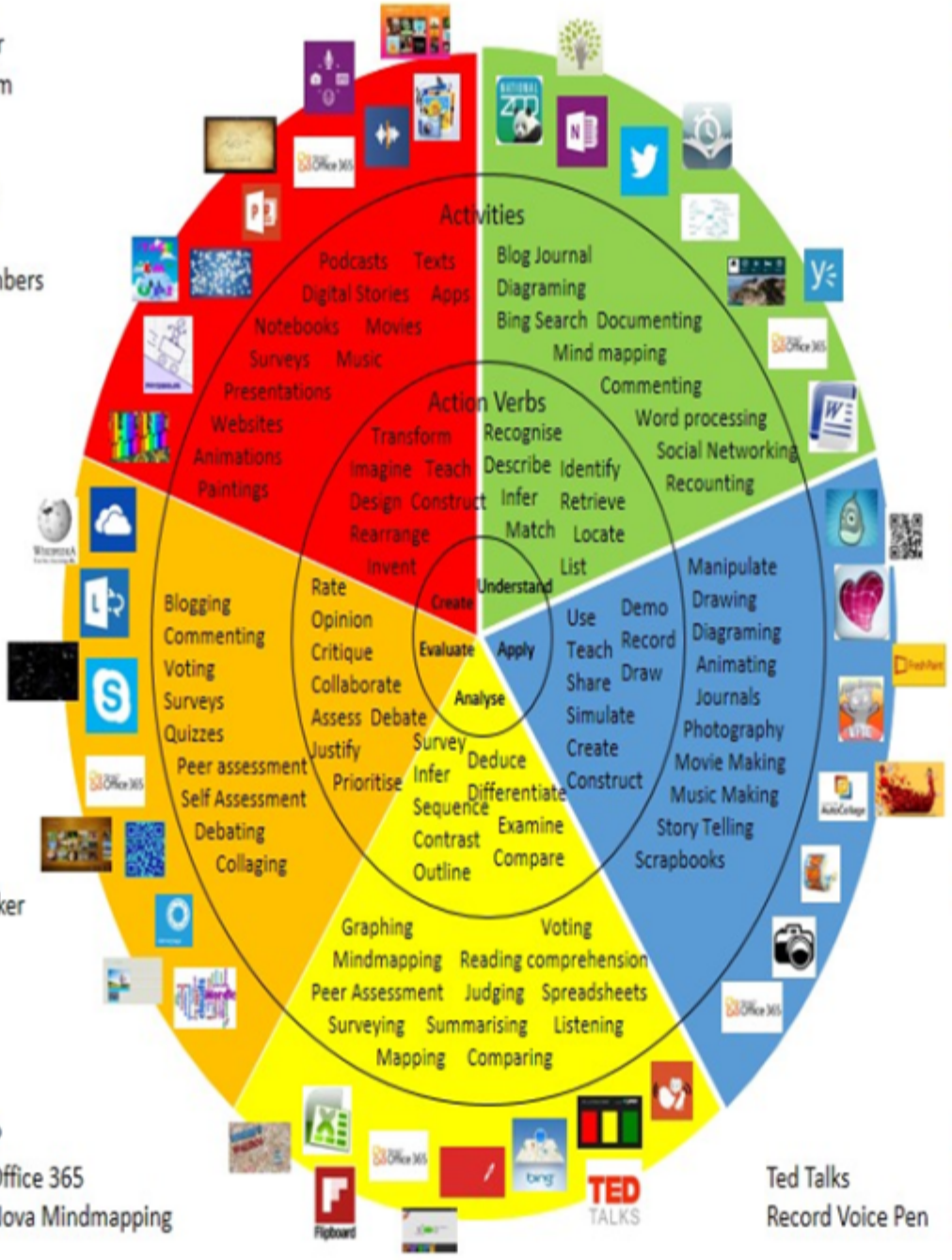
AP Collegeboard

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

TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.2.12.D.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
TECH.8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).

Alignment to 21st Century Skills & Technology

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)

- Students must be able to balance forces using inclined plane.

- 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)

- Drawing free bofy diagram of moving objects

- Students are provided with glossary in their native language.

- Spanish speaking students may utilize Spanish Edition of a Textbook

- 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

Calculating acceleration of a single step question.

- 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)

- Students must be able to solve problems by using trigonometric functions.

- 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: UNIT 2 DYNAMICS

NJSLS: 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, global warming and climate change

Statement of Objective:

The students will demonstrate the ability to differentiate static and kinetic friction by solving spring-mass systems problems with 90% accuracy.

Anticipatory Set/Do Now: from cm to m.

Lecture –rules of significant figures

Classroom activities – measure quantities with different significant figures

Final review of safety rules

Student Assessment/CFU's:

The Kinematics Review test will be given in the AP Classroom.

Materials: Wood blocks, sand paper

Safety equipment.

PowerPoint. Physics in daily life;

21st Century Themes and Skills: Critical thinking and problem solving

Differentiation: Different level of questions

Students must be able to solve calculus based problems. (Gifted and Talented)

Students must be able to set the apparatus to perform the lab. (Special Ed)

Integration of Technology:PowerPoint, Google Classroom for exit ticket