Unit 1 - Motion and Forces

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Belleville Public Schools

Curriculum Guide

Integrated Science

Unit 1 - Motion and Forces and Energy

Belleville Board of Education

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Unit Overview

This unit covers the concepts of vectors along with describing how objects move and graphically and mathematically in 1 dimension and 2 dimension. This unit explores how and why things move and discusses how Newton's Three Laws relate to motion. It also describes circular motion and the law of gravitation affecting orbital motion. Lastly this unit will examine energy theorem, power, and concepts of conservation of energy and conservation of momentum and impulse momentum.

Enduring Understanding

1. Students will understand how vectors play a role in determining motion.
2. Students will understand the relationship between displacement, velocity, acceleration.
3. Students will understand how Newton's Three Laws of motion govern the principles as why things move certain ways.
4. Students will understand how a centripetal force can cause a centripetal acceleration.
5. Students will understand how to use the law of gravitation mathematically to discover how different objects interact with

each other with gravitational forces.

6. Students will understand how the work done on an object relates to the amount energy transferred to or from an object.
7. Students will understand how power is related to work done on an object in a certain time.
8. Students will understand the principles of Conservation of Energy.
9. Students will understand the principles of Conservation of Momentum.
10. Students will understand the principles of Impulse and Momentum.

Essential Questions

1. How can I determine how fast is something moving?
2. How do things fall and how does mass and position effect how something falls?
3. How are Newton's Laws applied or seen in everyday life?
4. How are things pushed or pulled?
5. How do you calculate total force?
6. Why do people "stick" to the walls at the gravity ride at the carnival?
7. What forces actually causes an object to spin in a circle?
8. What is really gravity?
9. What is work?
10. If energy is conserved where does it go?
11. What are the differences in hitting a ball from a position (as on a tee) or a pitched ball?

Exit Skills

Students will know -

- The difference between a vector and a scalar
- The difference between distance traveled and displacement
- The difference between speed and velocity
- The difference between instantaneous speed and average speed
- How displacement relates to velocity
- How velocity changing relates to acceleration
- How units affect the presentation of their answer
- How motion is affected differently in the X and Y axis
- Newton's Three Laws of Motion and give real world examples of each
- What friction is and the difference between static and kinetic friction
- What inertia is, how it relates to mass, and how it affects the motion of an object
- How force, mass, and acceleration are related to each other
- That a centripetal force causes a centripetal acceleration
- The difference between centripetal force and centrifugal force

- The Law of Gravitron and how it affects objects in the universe
- The definition of work and how it relates to energy
- The definition of power and how it relates to th rate at which work is done
- What energy is and the main different types of energy
- How energy can be transformed from one form to another
- Define the Law of Conservation of Momentum
- Define the Law of Conservation of Momentum and relate it to collisions
- Definition of impulse and how it relates to a change in momentum
- How to decrease the force acting on an object while keeping the impulse the same

1. Graphically and mathematically adding and subtracting vectors.
2. Calculating displacement, velocity, and acceleration using the 3 kinematic equations.
3. Calculate the motion of an object in 2 dimensions.
4. Solving Newton's Law Problems.
5. Solving equations for work and power
6. Solving for the three different types of energy.
7. Solving for different variables such as velocity, height, etc. in conservation of energy problems.
8. Solving collision problems using the principles of momentum and energy.
9. Solving impulse problems.

New Jersey Student Learning Standards (NJSLS-S)

HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
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.
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.

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.
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-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 motion of particles (objects) and energy associated with the relative position of particles (objects).

Interdisciplinary Connections

MA.S-ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
MA.S-ID.A.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
MA.A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
MA.S-ID.B.6	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
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.
LA.RH.11-12.9	Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.
MA.S-ID.C.7	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
MA.S-ID.C.8	Compute (using technology) and interpret the correlation coefficient of a linear fit.
MA.S-ID.C.9	Distinguish between correlation and causation.
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.

Learning Objectives

1. Graphically add and subtract vectors.
2. Calculate 1-D Kinematic problems; conceptually describe the motion of an object in 1D.
3. Describe the difference between distance traveled/displacement, mathematically calculate both and also explain the difference between speed and velocity.
4. Describe how acceleration relates to a change in velocity and understand what the acceleration is due to gravity on the surface of the Earth.
5. Identify which kinematic equation to use in a given situation applied to kinematics in 1- Dimension, along witgh solving that equation for the correct variable.
6. Graph motion on position v time and velocity v time graph, as well as analyze graphs to interpret the motion that is being described.
7. Solve kinematic problems involving objects experiencing free fall motion.
8. Describe what projectile motion is and how and why objects move in project.
9. Apply Newton's Three Laws of Motion conceptually and mathematically to a variety of scenarios in 1-D.
10. Describe what a force is, some different types of forces,and the difference between balanced/unbalanced forces; along with drawing free body diagrams to visually describe these forces.
11. List all three of Newton's Laws of Motion, and give examples of each related to their everyday lives.
12. Use Newton's Second Law and Kinematics to solve for the Force, Mass, and Acceleration of moving objects.
13. Solve for the centripetal force required to make a certain turn, and determine whether or not a turn can be made at a certain speed given a specific centripetal force.
14. Describe how the G-force acting on an object can affect it and how the G-force is calculated.
15. Define work and solve basic work problems.
16. Define Power and solve basic power problems, along with solving for their own power output climbing up the stairs.
17. Describe how energy and work are related qualitatively and quantitatively.
18. Describe how energy and work are related qualitatively and quantitatively.
19. Solve momentum problems in 1-D and 2-D, and demonstrate an understanding of the conservation of momentum principal.
20. Describe what momentum is and solve a basic momentum problem using the equation p=mv.
21. Explain how impulse relates to a change in momentum, solve impulse problems and relate an increase in stopping time to a decrease in force equaling the same impulse.
22. Describe how the law of conservation of momentum affects moving objects and solve collision problems dealing with the law of conservation of momentum in 1 dimension.

Suggested Activities & Best Practices

- Lab Reports
- Worksheets
- PowerPoints with Notes
- Homework and Classwork Activities
- Group Activities
- In Class Discussion
- Do Nows and Closures
- Class PollingObservation

Assessment Evidence - Checking for Understanding (CFU)

Chapter Quizzes and Tests (Summative)

Socratic Questioning (Formative)

Lab Journal (Alternative)

Common Department Benchmark (Benchmark)

Oncourse Assessment Tools (Formative)

Do Now and Exit Tickets (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
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports
- Newspaper Headline

- 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

Inspire Physical Science McGraw Hill

Ancillary Resources

Teacher and Publisher supplied power points, notes, guides, labs, and worksheets

Resource manuals

Internet Resources

Computer Activities

Technology Infusion

Gizmos

Near POD

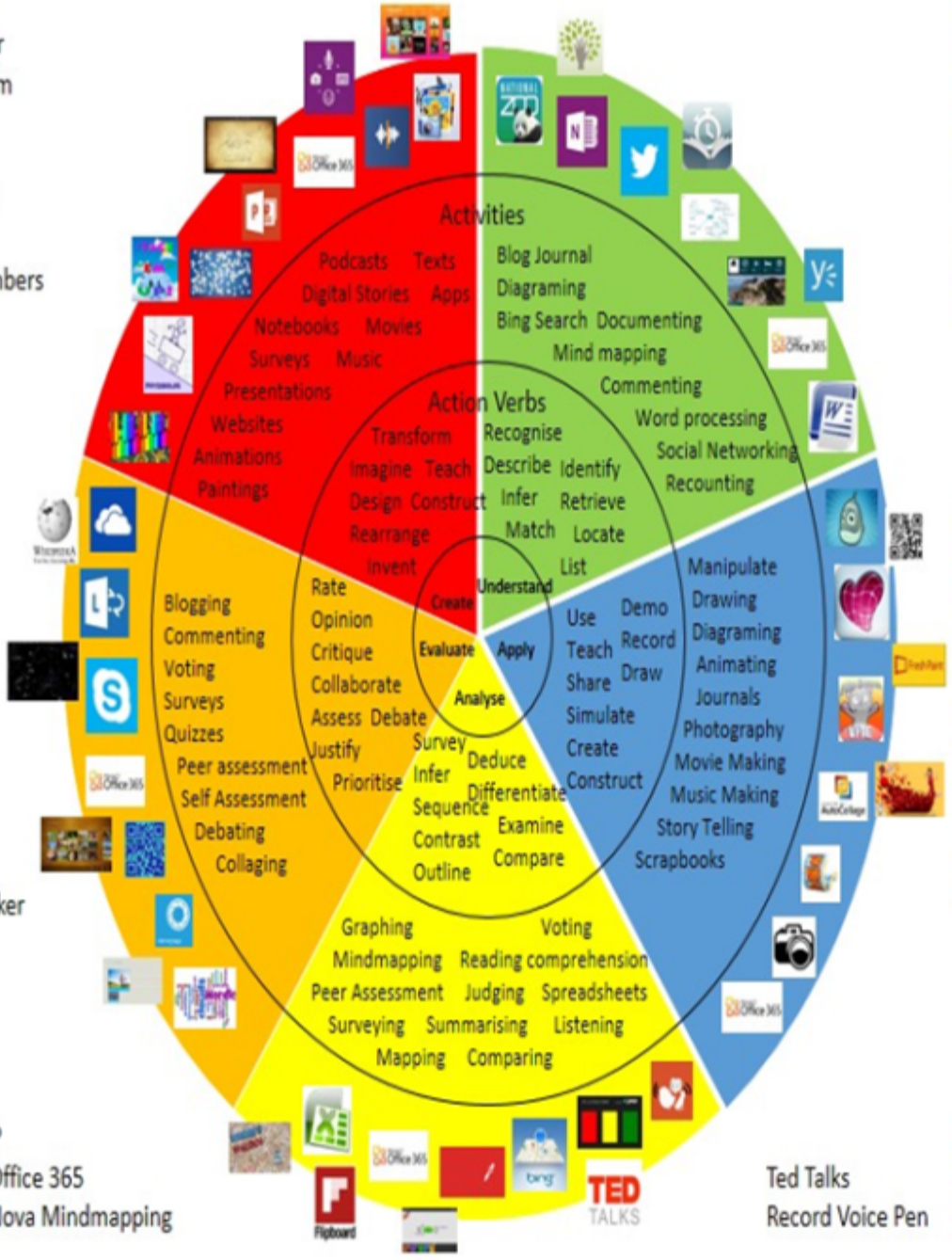
Google Classroom

JamBoards

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

- 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.

CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP3.1	Career-ready individuals understand the relationship between personal health, workplace performance and personal well-being; they act on that understanding to regularly practice healthy diet, exercise and mental health activities. Career-ready individuals also take regular action to contribute to their personal financial well-being, understanding that personal financial security provides the peace of mind required to contribute more fully to their own career success.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CAEP.9.2.12.C.1	Review career goals and determine steps necessary for attainment.
CAEP.9.2.12.C.2	Modify Personalized Student Learning Plans to support declared career goals.
CAEP.9.2.12.C.3	Identify transferable career skills and design alternate career plans.
CAEP.9.2.12.C.4	Analyze how economic conditions and societal changes influence employment trends and future education.
CAEP.9.2.12.C.5	Research career opportunities in the United States and abroad that require knowledge of

	world languages and diverse cultures.
CAEP.9.2.12.C.6	Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business.
CAEP.9.2.12.C.7	Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace.
TECH.8.1.12.A.1	Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
TECH.8.1.12.A.2	Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
TECH.8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.

21st Century Skills/Interdisciplinary Themes

- 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

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

Differentiation

Small Group Instruction

Study Guides

Project Based Learning

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)

Quiz and Test Study Guides

Graphic Organizers

Powerpoints posted on google classroom

- 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)

Peer to assist students

Allow tests and quizzes to be taken in ESL room with extra time

Students allowed to use electronic devices for translation

Word Lists provided

- 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

Provide modified test

Tutoring times offered

Allow students to correct test for partial credit

Extended time for assignments

- 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)

Provide enrichment articles and assignments

Allow students to complete independent study assignments

- 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:Analyzing Data (ChemLab- Use Density To Date A Coin)

NJSLS: 9-12.HS-PS1-3.3.1

Interdisciplinary Connection: LA.RST.9-10.7

Statement of Objective: Student will use density to determine whether a penny was minted before 1982.

Anticipatory Set/Do Now: Read and complete lab safety form.

Learning Activity: Students are tasked with finding the density of a penny. Using this information they will determine is a penny was minted before 1982.

Student Assessment/CFU's: Lab journal

Materials: water, graduated cylinder, balance, pennies, ruler, graph paper

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

Differentiation/Modifications: Link a lab safety video for students to view before lab. Link a lab example video for students to view before lab.

Integration of Technology: Student will use computer software to graph and analyze data.