Unit 4 Forces and Motion

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Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

ADVANCED PHYSICAL SCIENCE, GRADE 6

FORCES and MOTION

Belleville Board of Education

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Unit Overview

Unit 4, Forces and Motion, students will encounter:

Part 1 Forces and Motion

- forces as a push or a pull on an object that is at rest or in motion.
- the effect of unbalanced and balanced forces in a system.
- examples of how forces or gravity, friction, and air resistance affect motion.
- equal and opposite forces, and the forces exerted on falling objects.
- principles of force and motion in real world application.
- Newton's theory of Gravity and Einstein's theory of space-time.
- results of the impact of forces exerted on moving objects.

Part 2 Magnetism and Electricity

- Newton's Laws of Motion
- motion relative to a reference point, speed, velocity, and acceleration.
- how gravitational force causes objects to move.
- relationship between force, mass, and accelration.
- magnetic domains and how magnets interact.
- magnetic materials and the distance at which magnets attract or repel.
- the diffences between permanent and temporary magnets.
- how static electricity is generated.
- human and animal utilization fo the earth's magnetic field for navigation.
- electric forces and how they affect neutral or charged objects.
- equal and opposite forces, and the forces exerted on falling objects.
- the application of electromagneticism in instruments such as MRI's.

Enduring Understanding

- Forces exerted by interacting (colliding) objects on each other are equal in magnitude but oposite in direction (Newton's 3rd

Law of Motion)

- The sum of all of the forces acting on an object determine it's motion.
- If the total of all the forces acting on an object is not equal to zero (unbalnced forces), its motion will change. There will be no change if they equals zero (balanced forces).
- Position and direction of force and motion must be described in arbitrarily chosen reference points, in order to share information with others.
- Electric and Magnetic forces can be attractive or repulsive.
- The magnitude of the force is dependent on the strenght of the charge or current and the distance between objects.
- Gravity is a force of attraction between any two masses.
- There is a direct relationship bewteen the amount of mass and the magnitude of it's gravity.
- Forces that act at a distance such as electricity, magneticism, and gravity can be explained by fields that exted through space. They can be mapped by their effect on a test object.

Essential Questions

- Why do some objects move and others stay motionless?
- What would happen if you push a moving object harder?
- How can we use pushing or puling forces to help us do work?
- How have you experienced gravity?
- Compare and contrast electric and/or magnetic forces.
- How can magnets lose thaie charge?
- How is magneticism used to produce electricity?
- What kind of problems can be solved by applying electric or magnetic force?
- How would the universe be different if or more of the laws of motion were suspended?
- How does a Van ce Graaff ball generate electricty?
- Compare and contrast Newton’s and Einstein’s theories on gravity.
- How do seat belts help keep us safe in moving vehicles?
- How can we utilize models to help us evaluate safety devices in moving objects?
- What are some practical real world applications of electromagnetic waves?

Exit Skills

By the end of Grade 6, Science Unit 3, the student should be able to:

- Use modeling and measurement to predict that the impact of objects will have on each other.
- Draw force diagrams to model relationships between forces and motion.
- Use an image of an object as a system model to identify the types of forces involved in its motion and predict its path.
- Calaculate the effects of opposing forces.
- Gather evidence to explain the behavior of falling objects.
- Design system models to explain the characteristics of force.
- Use sytem models to support the Laws of Motion.
- Record and present data on tables and graphs.
- Use grahic and written illustrations to explain magnetic, electric, and gravitational fields.

New Jersey Student Learning Standards (NJSLS-S)

6-8.MS-PS2-1	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
6-8.MS-PS2-5	Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
6-8.MS-PS2-4	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
6-8.MS-PS2-3	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
6-8.MS-PS2-3.1	Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
6-8.MS-PS2-3.1.1	Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
6-8.MS-PS2-5.2.1	Cause and effect relationships may be used to predict phenomena in natural or designed systems.
6-8.MS-PS2-3.2.1	Cause and effect relationships may be used to predict phenomena in natural or designed systems.
6-8.MS-PS2-5.3	Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.
6-8.MS-PS2-2.3	Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.
6-8.MS-PS2-2.3.1	Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
6-8.MS-PS2-5.3.1	Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.
6-8.MS-PS2-2.3.2	Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.
6-8.MS-PS2-1.4.1	Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.
6-8.MS-PS2-4.4.1	Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.
6-8.MS-PS2-1.6	Constructing Explanations and Designing Solutions
6-8.MS-PS2-1.6.1	Apply scientific ideas or principles to design an object, tool, process or system.
6-8.MS-PS2-4.7	Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.
6-8.MS-PS2-4.7.1	Construct and present oral and written arguments supported by empirical evidence and

	scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
6-8.MS-PS2-2.7.1	Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.
6-8.MS-PS2-1.PS2.A.1	For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).
6-8.MS-PS2-2.PS2.A.1	The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.
6-8.MS-PS2-2.PS2.A.2	All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.
6-8.MS-PS2-3.PS2.B.1	Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.
6-8.MS-PS2-5.PS2.B.1	Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).
6-8.MS-PS2-4.PS2.B.1	Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.

Interdisciplinary Connections

LA.RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts.
LA.RST.6-8.2	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
LA.RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
LA.RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
LA.RST.6-8.5	Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
LA.RST.6-8.6	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.
LA.RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
LA.RST.6-8.8	Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
LA.RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
LA.RST.6-8.10	By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text

	complexity band independently and proficiently.
LA.WHST.6-8.1	Write arguments focused on discipline-specific content.
LA.WHST.6-8.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.6-8.3	(See note; not applicable as a separate requirement)
LA.WHST.6-8.4	Produce clear and coherent writing in which the development, organization, voice, and style are appropriate to task, purpose, and audience.
LA.WHST.6-8.5	With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
LA.WHST.6-8.6	Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.
LA.WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
LA.WHST.6-8.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
LA.WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research.
LA.WHST.6-8.10	Write routinely over extended time frames (time for research, reflection, metacognition/self correction, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Learning Objectives

- Explain and the effects of a force or a combination of forces on and object.
- Differentiate the effects of balanced and unbalanced forces on an object on a system.
- Infer the cause and effect relationship between forces and motion and velocity and accelration
- Analyze different types of interactions to predict how motion will be affected.
- Explain that interactions involving gravity or friction depend on the properties of objects.
- Differentiate bewteen mass and weight in relation to how they relate to gravity.
- Discover way to increase or decrease surface friction.
- Model and describe how unbalanced forces cause change in motion.
- Explain and desacribe motion in terms of speed velocity, and accelration; using illustrations, graphs and models.
- Evaluate competing design slutions to a problem involving collisions.
- Identify the variables that effect the strength and direction of magnetic force
- Differentiate between magnetic materials and magnets, in terms of magnetc domains and fields.
- Identify and measure the variables that affect the strength and direction of electric force.
- Investigate and model the effects of electric, magnetic, and gravitational fields on objects.
- Predict the cause and effect relationship between charges and fields.
- Explore electromagnetism and electro magnets t determine how they interact.

Suggested Activities

From HMH Curriculum Activities:

- Engage: Lesson Phenomenons
- Explore/Explain: Hands on Labs and Engineer It
- Unit Projects
- Unit Performance Tasks

From Defined Stem:

- Performance Tasks
- Literacy Tasks
- Constructed Response

Evidence of Student Learning - Checking for Understanding (CFU)

- Admit Tickets
- Anticipation Guide
- Common benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Teacher Observation Checklist

- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit tests

Primary Resources & Materials

HMH Module I Workbook

Laboratory Kits and Materials

Defined Stem

BrainPop

Ancillary Resources

Guest Speakers

Other Internet sources

Outdoor area of school

Laptop Carts for further research

Technology Infusion

- Smart board
- DefinedStem.com
- Document Camera
- Pod-casts video streams
- Discovery Education video streams
- You Tube video streams
- Brain-pop video streams
- Laptops
- Khan Academy
- Power Point presentation
- MS Word

Alignment to 21st Century Skills & Technology

These skills will be aligned to the following core content areas:

- English Language Arts; reading informational text, following procedural steps, orally presenting predictions and opinions, and creating written laboratory reports
- Mathematics; measuring
- Science and Scientific Inquiry (Next Generation); see above
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics; hisitory of science and how the Scientific method has connections to World and American history expansion. Discuss the impactof scence on society and what kind of moral questions scientists must address.
- World languages; discussion of root words and linguistic origin of vocabulary words.
- Technology; see above
- Visual and Performing Arts: oral and graphic presentation of procedures, results, and conclusion.

21st Century/Interdisciplinary Themes

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

21st Century Skills

- 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

Differentiation

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 - Science Dollars
- Guided Notes
- Teacher reads assessments allowed
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Dictation to scribe

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Multiple texts
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
-

Lo-Prep Differentiations:

- Exploration by interest
- Flexible grouping
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Varied journal prompts
- Correcting summative and formative assessments
- Retaking the test

Intervention Strategies

- 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

Special Education Learning

- 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
- multiple test sessions

- multi-sensory presentation
- preferential seating
- preview of content, concepts, and vocabulary
- 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

- 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
- Provide native language translation when possible
- 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

Sample Lesson

Unit Name: Forces & Motion

NJSLS: See link

Interdisciplinary Connection: ELA SWDAT read informative science text

Statement of Objective: SWDAT

Anticipatory Set/Do Now: Einstein Brianpop video. https://www.brainpop.com/science/energy/alberteinstein/

Learning Activity: Einstien's Birthday 3/14
1) Do Now

2) SW work in preassigned groups (sorted by grade point avarage and compatability concerns) to research a topic related to the accomplishments of Albert Einstein.
3) TW provide leveled readings based on groups ability. As this is an advanced class, most groups will be homogenous working on the timeline activity.
4) **Low group** will read http://gardenofpraise.com/ibdeinst.htm and fill out a questionaire prepared by the teacher.
Medium group will read text extracted from bio.com article and answer questions on teacher prepared questionaire.
Higher group will gather information from E=mc2 Timeline.pdf and create a timeline of scientists that set the stage for Einstein's formula.

Student Assessment/CFU's: Do Now Activity, questinaire's and timeline.

Materials: SmartBoard, Laptop Cart, teacher-prepared worksheets, reading packets, spackle tape, colored pencils,

21st Century Themes and Skills: Civic Literacy, Global Awareness, Communication and Collaboration, Creativity and Innovation

Differentiation: Small group activity, center based learning, verbal and visual directions, rephrase directions

Integration of Technology: SmartBoard, Laptop

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6-8.MS-PS2-3.2.1	Cause and effect relationships may be used to predict phenomena in natural or designed systems.
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