Grade 8 Science – Course 3
Unit 1 – Physical Science
Topic 3 Forces and Motion – 19 Days

Unit Overview - Students will look at patterns as they explore atomic theory, structure, bonding, and acids and bases. This will lead to an understanding of chemical reactions and how materials are created. The final topic of forces and motion allow for students to build upon prior knowledge while having students construct and study models to explain the relationship between speed, velocity, and acceleration.

Topic Essential Question How is the motion of an object affected by forces that act on it?

Lessons

- Topic Launch/Quest Kickoff
- Lesson 1 Describing Motion and Force
- Lesson 2 Speed, Velocity, and Acceleration
- Lesson 3 Newton's Laws of Motion
- Lesson 4 Friction and Gravitational Interactions
- Topic Close – Assessment, Quest Findings

NYSSLS Performance Expectations

MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*[Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]

MS-PS2-2. Plan and conduct an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system (including simple machines), qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]

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 and the distance between them. [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]

MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]

Topic Opener **PE:** MS-PS2-1	**Savvas**

<table>
<tr>
<td>
SEP: Constructing Explanations and Designing Solutions
DCI:
PS2.A – Forces and Motion
• 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). (MS-PS2-1)
PS3.C – Relationship Between Energy and Forces
• When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)
CCC – Systems and System Models
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Highlighted labs are important to the understanding of the instructional concepts in this lesson and must be completed during Science instructional time.

• Topic Readiness Test
• uConnect Lab – Identifying Motion
• Quest Kickoff Video – How can take the crash out of a collision?
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<td>
<u>Lesson 1 – Describing Motion and Force</u>
PE:MS-PS2-2
SEP: Planning and Carrying Out Investigations; Analyzing and Interpreting Data
DCI:
PS2.A – Forces and Motion
• 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. (MS-PS2-2)
• 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. (MS-PS2-2)
CCC: Stability and Change

zSpace Activities (code)
Chain Reaction (Newton's 3 Law's) (A502)
Chain Reation (Newton's 3 Laws) - Teacher Activity Plan
Students will use their knowledge about Newton's Laws along with ramps, platforms, launchers, and balls to create a chain reaction.
Chain Reaction (Newton's 3 Law's) - Student Worksheet
Chain Reaction (Newton's 3 Law's) - Student Worksheet GoogleDoc

Gravitational Force (A401)
Chain Reation (Newton's 3 Laws) - Teacher Activity Plan
Students will explore and compare the effects of Earth's gravitational force in Newton's Park. They will release balls with varied masses from drop towers of equal height to prove that all objects, regardless of their mass, accelerate at the same rate under Earth's gravitational force unless an outside variable such as wind resistance or friction is applied.
Gravitational Force - Student Worksheet
Gravitational Force - Student Worksheet GoogleDoc
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Savvas
Guiding Objectives:
• Students will construct an explanation using reasoning that motions is a change in position relative to a reference point.
• Students will describe how balanced and unbalanced forces affect the motion of an object.
Literacy Connection
• Draw Evidence
Vocabulary
• motion
• reference point
• force
• newton
• friction
• gravity
• net force
Academic Vocabulary
• relative
Connect - TE/SB p.120
• Connect It!
• Quest Connection
• Inquiry Warm-Up Lab – Is the Force With You?
Investigate - TE/SB pp.121-126
• uInvestigate Lab – Motion Commotion*
• Video – Describing Motion and Force
• Interactivity – Relative Motion
• Interactivity – Levers
• Virtual Lab – Launching a Spacecraft into Motion
• Model It! (p.125)
• Literacy Connection (p.124)
• Reading Checks (pp.121; 122;124)
• Math Toolbox (p.126)
Synthesize - TE/SB pp. 126-127
• Interactivity – Explore Forces
• Quest Check-In Interactivity – Define Criteria and Constraints
• Quest Check-In
Demonstrate – TE/SB p.127
• Lesson 1 Check
• Lesson Quiz 1
*Denotes accompanying lab video
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Games Around the Solar System (A474) Games Around the Solar System - Teacher Activity Plan Students will experience what it is like to play sports on different celestial bodies. They will explore how gravity affects the movement of balls during each sport and compose an argument explaining which celestial bodies are best for different sports. Games Around the Solar System - Student Worksheet Games Around the Solar System - Student Worksheet 2 Games Around the Solar System - Student Worksheet GoogleDoc **Gravity Investigation (A467)** Gravity Investigation - Teacher Activity Plan Students will observe and calculate the force of Earth's gravity on balls of various masses. They will then repeat their tests against the gravity of other celestial bodies. Students will learn to distinguish between the effect of the force of gravity and the acceleration of an object due to gravity. Gravity Investigation - Student Worksheet 1 Gravity Investigation - Student Worksheet 2 Gravity Investiagtion - Student Worksheet GoogleDoc **Blast Off (A451)** Blast Off! - Teacher Activity Plan Students will construct a roller coaster by changing the height of the ramps and manipulating the strength and angle of the initial force. Students will analyze a problem and design a solution to the problem. Blast Off! - Student Worksheet 1 Blast Off! - Student Worksheet GoogleDoc	

Lesson 2 – Speed, Velocity, and Acceleration

PE: MS-PS2-2
SEP: Planning and Carrying Out Investigations
DCI:
PS2.A – Forces and Motion

- 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. (MS-PS2-2)
- 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. (MS-PS2-2)

CCC: Stability and Change

zSpace Activities (code)

Graphing Speed vs. Time Part 1 (A486)
Graphing Speed vs. Time Part 1 - Teacher Activity Plan
In this activity, students will analyze the speed of a ball in two separate experiments. The ball will roll down two separate ramp setups with different slopes. Students will determine the speed of the ball at various points in time then graph the speed of the ball in relation to the time to show an understanding of change in speed.
Graphing Speed vs. Time Part 1 - Student Worksheet 1
Graphing Speed vs. Time Part 1 - Student Worksheet 2
Graphing Speed vs. Time Part 1 - Student Worksheet GoogleDoc

Graphing Speed vs. Time Part 1 (A487)
Graphing Speed vs. Time Part 2 - Teacher Activity Plan
Students will demonstrate their knowledge of slope, speed, and time by creating an experiment that produces results matching a pre-made graph.
Graphing Speed vs. Time Part 2 - Student Worksheet 1
Graphing Speed vs. Time Part 2 - Student Worksheet 2
Graphing Speed vs. Time Part 2 - Student Worksheet GoogleDoc

Graphing Speed vs. Time: Gravity- Student Wkst 2
Graphing Speed vs. Time: Gravity - Student Worksheet GoogleDoc

Savvas
Guiding Objectives:

- Students will determine the average speed of an object: From calculations; using distance-versus-time graphs.
- Students will use text evidence to compare velocity, speed, and acceleration.
- Students will interpret graphs to determine acceleration.

Literacy Connection

- Determine Conclusions

Vocabulary

- speed
- slope
- velocity
- acceleration

Academic Vocabulary

- average
- variable

Connect - TE/SB p. 128

- Connect It!
- Quest Connection
- Write – Forces From Motion

Investigate - TE/SB pp.129-134

- Video – Speed, Velocity, and Acceleration
- *uI*nvestigate Lab – Walking the Walk*
- Interactivity – Falling for Velocity
- Interactivity – Motion Graphs
- Model It! (p.133)
- Reading Check (pp.130; 132;)
- Math Toolbox (p.131)

Synthesize - TE/SB pp. 134 - 137

- Interactivity – How Forces Affect Motion
- Quest Check-In Lab – Mass, Speed, and Colliding Cars
- Literacy Connection (p.135)
- Reading Check (p.136)
- Math Toolbox (136)
- Quest Check-In

Demonstrate – TE/SB p.137

- Lesson 2 Check
- Lesson 2 Quiz

*Denotes accompanying lab video

Lesson 3 – Newton's Laws of Motion

PE: MS-PS2-2
SEP: Planning and Carrying Out Investigations
DCI:
PS2.A – Forces and Motion

- 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. (MS-PS2-2)
- 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. (MS-PS2-2)

CCC: Stability and Change

zSpace Activities (code),
Gravitational Force (A401)
Chain Reation (Newton's 3 Laws) - Teacher Activity Plan
Students will explore and compare the effects of Earth's gravitational force in Newton's Park. They will release balls with varied masses from drop towers of equal height to prove that all objects, regardless of their mass, accelerate at the same rate under Earth's gravitational force unless an outside variable such as wind resistance or friction is applied.
Gravitational Force - Student Worksheet
Gravitational Force - Student Worksheet GoogleDoc

Forces and Motion (A468)
Forces and Motion - Teacher Activity Plan
This activity will help students understand how force can affect an object's motion. They will launch balls in four different force fields that have varied force values and observe each ball's movement. They will explore ways that multiple forces interact and affect the motion of the balls. They will answer questions using numerical data to back up their reasoning.
Forces and Motion - Student Worksheet 1
Forces and Motion - Student Worksheet GoogleDoc2

Design a Roller Coaster (A472)
Design a Roller Coaster - Teacher Activity Plan
Roller coasters come in all different shapes and sizes, but they all have one thing in common: they are thrilling! Whether it is the speed, loops, or dips, roller coasters keep people coming back for more! Students will use ramps, platforms, launchers, and balls to build a unique roller coaster.
Design a Roller Coaster - Student Worksheet 1
Design a Roller Coaster - Student Worksheet GoogleDoc

Savvas
Guiding Objectives:

- Students will identify and describe evidence that: An object's motion remains the same if forces on it are balanced; an object's motion changes if forces on it are unbalanced.
- Students will model how factors affect an object's motion to predict the relationship between force, mass, and acceleration.
- Students will construct explanations using reasoning to describe the effect of action and reaction forces on an object's motion.

Literacy Connection

- Use Information

Vocabulary

- inertia

Academic Vocabulary

- derived

Connect - TE/SB p.140

- Connect It!
- Quest Connection
- Poll – The Ball Stops Rolling

Investigate - TE/SB pp. 141-146

- *u*Investigate Lab – Newton Scooters
- Video – Newton's Laws of Motion
- Interactivity – How are Mass, Force, and Motion Related?
- Literacy Connection (p.141)
- Reading Check (pp.142; 144)
- Model It! (p.92)
- Math Toolbox (p.144)

Synthesize - TE/SB pp. 146-148

- Interactivity – Going, Going, Gone!
- Quest Check-In Interactivity – Applying Newton's Laws of Motion
- Reading Check (p. 146)
- Question It (p. 147)
- Quest Check-In

Demonstrate – TE/SB p.148

- Lesson 3 Check
- Lesson 3 Quiz

Motion Depends on Force and Mass (A402) Motion Depends on Force and Mass - Teacher Activity Plan In this activity, students first observe the effects of force and mass on motion. Students then design a demonstration showing that the mass of an object and the sum of the forces acting on the object are factors in the object's motion. Motion Depends on Force and Mass - Student Wkst 1 Motion Depends on Force and Mass - Student Worksheet GoogleDoc	
Lesson 4 – Friction and Gravitational Interactions **PE:** MS-PS2-4; MS-PS3-2 **SEP:** Developing and Using Models; Engaging in Argument from Evidence **DCI:** **PS2.B –** Types of Interactions ● 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. (MS-PS2-4) **PS3.A** – Definitions of Energy ● A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) **PS3.C –** Relationship Between Energy and Forces ● When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2) **CCC**: Systems and System Models **zSpace Activities (code)** **Exploring Motion and Collisions (E441)** Exploring Motion and Collisions - Teacher Activity Plan Contains 3 activities: "Graphing", "Designing a Solution - Middle School", and "Designing a Solution - High School". Exploring Motion and Collisions - Student Worksheet 1 Exploring Motion and Collisions - Student Worksheet 2	**Savvas** **Guiding Objectives:** ● Students will analyze and interpret data to predict how surface texture and the amount of force used to push surfaces together affect the amount of friction. ● Students will analyze and interpret data to predict how the mass and distance between two objects affect the gravitational force they exert on each other. ● Students will develop a model to demonstrate the relationship between gravitational potential energy and kinetic energy. **Literacy Connection** ● Evaluate Information **Vocabulary** ● weight **Academic Vocabulary** ● associate **Connect -** TE/SB p.150 ● Connect It! ● Quest Connection ● Write – You Can't Always Coast on Your Bicycle **Investigate -** TE/SB pp. 151-156 ● *u*Investigate Lab – Observing Friction ● *u*Investigate Lab – Sticky Sneakers ● Interactivity – Exploring Gravity ● Video – Friction and Gravitational Interactions ● Reading Check (pp.152; 154) ● Literacy Connection (p.155) ● Math Toolbox (p.156) **Synthesize -** TE/SB pp. 157-158 ● Interactivity – The Patterns of the Tides ● Quest Check-In Lab: Bumping Cars, Bumper Solutions ● Model It! (p.157) ● Quest Check-In **Demonstrate –** TE/SB p.158 ● Lesson 4 Check ● Lesson 4 Quiz

Topic 3 Close

- Topic 3 Assessment and Remediation TE/SB pp. 160-163
- Quest Finding and Reflection TE/SB p. 163

Topic 3 Enrichment

Topic 3 - Lesson 1 Enrichment

- Enrichment – Reducing Friction

Topic 3- Lesson 2 Enrichment

- Enrichment – Describing Motion
- Case Study – Finding Your Way with GPS (pp.138-139)

Topic 3 - Lesson 3 Enrichment

- Enrichment – Newton's Laws of Motion
- Career Video – Mechanical Engineer
- *u*Engineer It! – Generating Energy from Potholes (p.149)

Topic 3 – Lesson 4 Enrichment

- Enrichment – Gravitational Force of the Sun
- Extraordinary Science – Spacetime Curvature and Gravitational Waves (p.159)

Topic 3 Close

- *u*Demonstrate Lab – Stopping on a Dime (pp.164-165)

English Language Learners (ELL) Enhancements

To access hyperlinked material, you must be logged into your BPS Google Drive

Listening

- **Cross- Linguistic Practices:** Gives students opportunities to make connections between what they hear and their home language (For example, allow students to listen to a passage and identify cognates).
- **Activating Prior Knowledge** Activating prior knowledge means both eliciting from students what they already know and building initial knowledge that they need in order to access upcoming content**.**
- **Visuals** - GIFs, pictures- will assist students in understanding what they are listening to. Use **visual thinking strategies** to set the lens for learning.
- Video to review or introduce a topic – use **closed captioning** to help students see the words and pronunciations while they listen to the content.
- **Word stretching / Vowel stretching** when instructing allows students to listen closely to the pronunciation of the word.
- **Performance Level Descriptors** this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of listening. Scroll for grade 8.

Speaking

- **Sentence Stems/Frames** - to begin a sentence - such as *Evolution is…* or *I think that evolution is…*
- **Academic Conversation Starters:** Have a visual of a list of academic sentence starters that students can refer to in a discussion.
- **Choral Reading** - To build fluency, self-confidence and motivation with reading/speaking.
- Create **movement** to go with the word. Movement can be a motivating factor, as well as a kinesthetic tool for conceptualizing the rhythm and flow of fluent reading while triggering brain function for optimal learning.
- **Performance Level Descriptors** This document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of speaking. Scroll for grade 8.

Reading

- Supplementary Text to help reinforce concepts.
- **Visual Aids** - Pictures or models to support vocabulary words and concepts
- Video to review or introduce a topic - use **closed captioning** to help students read along while they listen to the content.
- **4 Square / Frayer models** to help students gain a deeper understanding of vocabulary.
- **Highlighting** important text to assist students in answering questions after the reading.
- **Chunking**-Break reading of text into chunks or paragraphs

	• **Vocabulary Morphology**- Morphology relates to the segmenting of words into affixes (prefixes and suffixes) and roots or base words, and the origins of words. Understanding that words connected by meaning can be connected by spelling can be critical to expanding a student's vocabulary. • **Performance Level Descriptors** this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of reading. Scroll for grade 8.
	Instructional Accommodations (depending on the student's needs) • **Extended time** for tests in class, projects and assignments • **Directions read.** Broken down as necessary • **Model** how to complete the activity in the lesson • **Oral simplification** of directions or questions • **Translated version** of test when available. Student may have both version English and native language version • Use of **approved bilingual glossaries** from NYS in each subject
Special Education Modifications Special Education students must have accommodations as per Individual Educational Plan (IEP)	**Instructional** • **Pre-teach** vocabulary • Use **picture vocabulary** • Scaffold **Depth of Knowledge** questions • Provide copy of notes/**notes in "cloze"** form • Use of **Think, Pair, and Share** strategy to help process information • **Scaffold** written assignments with the use of **graphic organizers** • Allow for **multiple ways to respond** (verbal, written, response board) • Provide **model of performance task** • **Modify informational text** to fit the needs of the students • Provide a digital or paper i**nteractive notebook** • Present complex **tasks in multiple ways** • Provide **mnemonic strategies** for scientific concepts
	Technology: • **Audio** reading of text • **Text to type** functions • **Videos** to clarify/visualize science concepts • **Record class lecture/discussions** and make accessible to student • **Nearpod**- interactive presentations of notes
	In Class Assessments • Provide **multiple options** for projects • **Use of timer** in class • Break all complex tasks into chunks
Step Up to Writing Step Up to Writing Materials can be found in BPS Science K-12 Schoology Folder Grade 8 Resources Grade 8 SUTW materials	• Easy Two-Column Notes • Breaking Down Definitions • Paragraph Frame- What I Learned • **Performance Level Descriptors** this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of writing. Scroll for grade 8.
Culturally and Linguistically Responsive	• Materials, resources, and/or discussions address diverse cultural backgrounds and real-world applications • Artifacts (posters, charts, etc.) in the science classroom are representative of the cultures of the student population

Teaching (CLRT) in the Science Classroom	• All students are given an opportunity to engage in science discourse • Teacher demonstrates high expectations for all students