

Grade 8

Unit 2—Force and Motion (SEPUP *Force and Motion* Module)

Time needed: 7-8 weeks

Essential Question: How can we understand Newton’s Laws (force and motion) in the content of our daily lives?**Key Idea 5: Energy and matter interact through forces that result in changes in motion.****Performance Indicator 5.1: Describe different patterns of motion of objects.****Major Understandings:**

- 5.1a The motion of an object is always judged with respect to some other object or point. The idea of absolute motion or rest is misleading.
- 5.1b The motion of an object can be described by its position, direction of motion, and speed.
- 5.1c An object’s motion is the result of the combined effect of all forces acting on the object. A moving object that is not subjected to a force will continue to move at a constant speed in a straight line. An object at rest will remain at rest.
- 5.1d Force is directly related to an object’s mass and acceleration. The greater the force, the greater the change in motion.
- 5.1e For every action there is an equal and opposite reaction.

Performance Indicator 5.1: Observe, describe, and compare effects of forces (gravity, electric current, and magnetism) on the motion of objects.**Major Understandings:**

- 5.2a Every object exerts gravitational force on every other object. Gravitational force depends on how much mass the objects have and on how far apart they are. Gravity is one of the forces acting on orbiting objects and projectiles.
- 5.2b Electric currents and magnets can exert a force on each other.
- 5.2c Machines transfer mechanical energy from one object to another.
- 5.2d Friction is a force that opposes motion.
- 5.2e A machine can be made more efficient by reducing friction. Some common ways of reducing friction include lubricating or waxing surfaces.
- 5.2f Machines can change the direction or amount of force, or the distance or speed of force required to do work.
- 5.2g Simple machines include a lever, a pulley, a wheel and axle, and an inclined plane. A complex machine uses a combination of interacting simple machines, e.g., a bicycle.

Grade 8**General Skills (from NYS Core Curriculum)**

- GS 1. follow safety procedures in the classroom and laboratory
- GS 2. safely and accurately use the following measurement tools: metric ruler, balance, stopwatch, graduated cylinder, thermometers, spring scale, voltmeter
- GS 3. use appropriate units for measured or calculated values
- GS 4. recognize and analyze patterns and trends
- GS 5. classify objects according to an established scheme and a student-generated scheme
- GS 6. develop and use a dichotomous key
- GS 7. sequence events
- GS 8. identify cause-and-effect relationships
- GS 9. use indicators and interpret results

Physical Setting Skills

- PS 1. given the latitude and longitude of a location, indicate its position on a map and determine the latitude and longitude of a given location on a map
- PS 2. using identification tests and a flow chart, identify mineral samples
- PS 3. use a diagram of the rock cycle to determine geological processes that led to the formation of a specific rock type
- PS 4. plot the location of recent earthquake and volcanic activity on a map and identify patterns of distribution
- PS 5. use a magnetic compass to find cardinal directions
- PS 6. measure the angular elevation of an object, using appropriate instruments
- PS 7. generate and interpret field maps including topographic and weather maps
- PS 8. predict the characteristics of an air mass based on the origin of the air mass
- PS 9. measure weather variables such as wind speed and direction, relative humidity, barometric pressure, etc.
- PS 10. determine the density of liquids, and regular- and irregular-shaped solids
- PS 11. determine the volume of a regular- and an irregular-shaped solid, using water displacement
- PS 12. using the periodic table, identify an element as a metal, nonmetal, or noble gas
- PS 13. determine the identity of an unknown element, using physical and chemical properties
- PS 14. using appropriate resources, separate the parts of a mixture
- PS 15. determine the electrical conductivity of a material, using a simple circuit
- PS 16. determine the speed and acceleration of a moving object

Grade 8

		Title	Key Concepts & Processes	Advance Prep Notes to Teachers	Teaching Periods ¹	Assessment	Alignment to NYS Core Curriculum
WEEK 1	1	Choosing a Safe Vehicle Students compare the specifications of two vehicles to see which one is safer.	Analyzing data, evidence, trade-offs, using literacy	Copy student sheets, help students set up science notebooks. <i>Homework:</i> Analyze car ads (optional).	1-2		5.2g
	2	Measuring Speed Students use carts, ramps, and tracks to design an investigation to measure the effect of ramp height on the speed of carts.	Distance, time, speed, rate, constant variable, experimental design, using mathematics	Need masking tape and meter sticks, copies of Science Skill Sheet 5, “Elements of Good Experimental Design.”	2-3	Procedure: DI (p. TR-128)	5.1b, 5.1c, GS 2, GS 3, PSS 16
WEEK 2	3	Interpreting Motion Graphs Students construct and interpret distance vs. time graphs.	Acceleration, deceleration, motion graphs, speed, using mathematics	Copy student sheets. <i>Homework:</i> Students make trip strips for their own trips to/from school.	1-2	AQ 2: UC (p. TR-147)	5.1b
	4	Speed and Collisions Students use a ramp and cart to simulate vehicle collisions at different speeds.	Speed, force	Need meter sticks.	2-3		5.1c, GS 2

¹ Teaching periods are based on a 45-50 minute class period. Times are estimates and actual time needed may vary.

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WEEK 3	5	Mass and Collisions Students design and carry out investigations to discover the effect of mass on the severity of accidents.	Mass, Force, experimental design	<i>Homework:</i> Internet research on role of vehicle weight in car accidents.	2-3	Procedure: DI (p. TR-128) Quick check	5.1d, GS 2
	6	Force, Acceleration, and Mass Students investigate the relationship between force, mass, and acceleration.	Acceleration, force and mass, Newton's 2 nd Law, graphing, using equations <i>Mathematics</i>	Copy student sheets, get large cart, chairs and masses.	2-3		5.1c, 5.1d, 5.2a, GS 3
WEEK 4	7	Inertia around a Curve Students first observe a marble moving around a circular track and then predict the path taken by the marble once a section of the track is removed.	Inertia, Newton's first Law	Gather trays (optional).	2-3	Quick check	5.1c
	8	Laws of Motion Students read about Newton's discoveries of the fundamental relationships between forces, including Newton's three laws and friction.	Inertia, force, acceleration, friction, Newton's laws, balanced and unbalanced forces, net force <i>Literacy</i>	Copy student sheets. <i>Homework:</i> Internet research on Newton's Life (optional).	2-3	AQ 2: UC (p. TR-147) Quick check	5.1c, 5.1d, 5.1e, 5.2d

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WEEK 5	9	The Net Force Challenge Students use force meters to investigate the effect of more than one force on a block.	Net force, direction of forces, force diagrams		2-3		5.1b, 5.1c, GS 2, GS 3
	10	Braking Distance To simulate the effect of speed on braking distance, students measure the distance that carts travel after encountering a high friction surface.	Initial speed, braking distance, friction	<i>Homework:</i> Internet research on braking distance (optional, see NYS DMV website).	2-3	AQ 3: RE (p. TR-148)	5.2d, GS 2, GS 3
WEEK 6	11	Coming to a Stop Students learn about stopping distance and then calculate and graph data for different road and driver conditions.	Graphing and analyzing data, reaction time, friction <i>Mathematics,</i> <i>Literacy</i>	Get graph paper and colored pens.	2-3	AQ 6: AD (p. TR-146)	5.1c, 5.2d, 5.2e, GS 3
	12	Decelerating Safely Students learn about vehicle safety features that decelerate the body more slowly than it would ordinarily experience in an accident.	Deceleration, rate, impact force <i>Literacy</i>	Copy student sheets.	2-3		5.1a, 5.1c, 5.1d

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		Title	Key Concepts & Processes	Advance Prep Notes to Teachers	Teaching Periods ¹	Assessment	Alignment to NYS Core Curriculum
WEEK 7	13	Crash Testing Students design and present the specifications for a crash test dummy. They weigh the advantages and disadvantages of using different sized dummies.	Deceleration, force, engineering <i>Literacy</i>		2-3	Procedure: CM (p. TR-150)	5.1a, 5.1c
	14	Investigating Center of Mass Students compare the stability of carts with different center-of masses as they collide with a stationary barrier.	Mass, center of mass, stability	<i>Homework:</i> Students research SUV rollover type accidents, using internet (optional).	2-3	Quick check	5.1c, 5.1e
WEEK 8	15	Fatal Accidents Students investigate types of car accidents and fatality rates by analyzing actual accident data.	Rate, analyzing data	<i>Homework:</i> Students prepare for class presentations for activity 16.	1-2	AQ 5: AD (p. TR-146)	5.1c, 5.1d, 5.1e
	16	Safety for All Students recommend a solution to the problem of increased injuries and damage related to vehicle incompatibility during collisions.	Weighing evidence and trade-offs <i>Literacy</i>	Copy student sheets.	2-3	AQ 2: ET (p. TR-149)	5.1c, 5.1d