Unit 3 Motion, Stability, Forces, and Interactions
Grade level: 8th
Length of lesson: 14 Days

Content Standards

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. P**lan 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, 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.A

Big Ideas:	**Essential Question(s):**
● Kinetic energy is the energy of motion and depends on the speed and mass of the object ● Potential energy is stored energy and depends on the position of the object	● Determine the forces acting on an object and use the information to describe the motion and changes in motion of the object ● Describe gravity and its influence on objects ● List the forms of potential energy ● Explain how potential energy of an object can change based on the object's position

Student objectives (outcomes):
Students will be able to:

- Identify the difference between motion and a reference point
- Understand speed, velocity, and acceleration
- Understand the different kinds of forces
- Understand balanced and unbalanced forces
- Explain friction and types of friction
- Define gravity, the universal law of gravitation, and the difference between mass/weight

Assessment Evidence

Performance Task(s):

- LAB: Dominoes Activity
- LAB: Friction
- LAB: Mass vs. Weight
- LAB: Roller Coaster

Other Evidence:

- Quick LAB: Average Speed with Marbles and Ruler

Learning Plan

Learning Activities:

- Notes on motion, speed, average speed
- Quick Lab calculating average speed using marbles and rulers
- Notes on velocity and acceleration
- Notes on forces, balanced forces, and unbalanced forces
- LAB: Dominoes Activity with forces, motion, acceleration, speed, and velocity
- Notes on Friction and the types of friction
- LAB: Friction and Forces
- Notes Mass vs. Weight
- LAB: Mass vs. Weight
- LAB: Roller Coasters
- Review Worksheet
- Whiteboard Review
- TEST on Matter in Motion

Resources:

- Science Spot Physics Information: http://sciencespot.net/Pages/kdzphysics.html
- Force and Motion resources: http://science-class.net/archive/science-class/Physics/force_motion.htm
- **cK-12 Online Textbook: http://www.ck12.org/saythanks**
- **http://www.ck12.org/book/CK-12-Physical-Science-Concepts-For-Middle-School/**
- Puzzle Makers http://www.puzzlemakers.net/samples.html
- Grade 8 Holt Science and Technology Textbook, Copyright 2002

Unit 3 Topic Forces in Motion and Newton's Laws
Grade level: 8th
Length of lesson: ___ Days

Content Standards

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.*]

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MS-PS2.A

Big Ideas:

- Newton's 3rd Law describes the forces exerted by two interacting objects
- The motion of an object depends on the forces acting on it and the mass of the object
- Gravity always pulls and changes based on the masses of the objects involved.

Essential Question(s):

- What is Newton's 3rd Law and how it can be used to solve a problem involving two colliding objects?
- Determine the forces acting on an object and use the information to describe the motion and changes in motion of the object
- Describe gravity and its influence on objects

Student objectives (outcomes):
Students will be able to:

- Explain how gravity and air resistance affect the acceleration of falling objects.
- Understand and describe the forces involved in forming an orbit
- Understand and describe projectile motion
- Understand and apply Newton's laws of Motion
- Explain and understand momentum of objects and the conservation of momentum.

Assessment Evidence

Performance Task(s):	Other Evidence:
• LAB: Newton's Laws Internet Activity • LAB: Newton's Laws	• Quick Labs: Newton's Laws • Class Demos

Learning Plan

Learning Activities:

- Notes on Gravity, Acceleration, air resistance, terminal velocity, free fall,
- Notes on forming orbits and projectile motion and Phet Physics Animations
- Notes on Newton's 1st, 2nd, and 3rd laws of motion
- Finish Notes and Quick Lab on Newton's 1st law: Table cloth pull
- Newton's Laws of Motion Mini Lab Demonstrations and Bike Wheel Demo
- LAB: Newton's Laws Internet Activities
- Newton's Laws video from Bozeman Science on You tube and Discovery Education
- LAB: Newton's Laws (2-3 days) Various stations that students work at
- Review Assignment
- Whiteboard Review for the test or Senteo response clicker questions for a review
- Test on Forces in Motion and Newton's Laws

Resources:

- Phet's Simulations from the University of Colorado: https://phet.colorado.edu/en/simulations/category/physics
- Bozeman Science on Newtons Laws on youtube.
- Science Spot Physics Resource Links: http://sciencespot.net/Pages/kdzphysics.html
- Discovery Education Videos on Newton's Laws: http://www.discoveryeducation.com/
- **cK-12 Online Textbook: http://www.ck12.org/saythanks**
- **http://www.ck12.org/book/CK-12-Physical-Science-Concepts-For-Middle-School/**
- Grade 8 Holt Science and Technology Textbook, Copyright 2002

Students who demonstrate understanding can:

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MS-PS2-2. **Plan 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, 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.*]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*

Science and Engineering Practices

Asking Questions and Defining Problems

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.

Planning and Carrying Out Investigations

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.

- 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. (MS-PS2-2)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1)

Disciplinary Core Ideas

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)
- 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)

Crosscutting Concepts

Systems and System Models

- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1)

Stability and Change

- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2)

Connections to Engineering,Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-PS2-1)