IDEA Public Schools

Unit 02: Force and Motion
UNIT PLAN

TABLE OF CONTENTS

UNIT NARRATIVE

Unit 2 will center around readiness TEKS 8.7B (Investigate and describe how Newton's three laws of motion act simultaneously within systems such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches) with the culmination of students designing and building carnival games that incorporate Newton's 3 laws. The last day of the unit will be a Carnival Day and students will play other groups games and identifying the 3 laws in other groups games.

Lesson 1 will be the unit launch and review what is motion. Lessons 2 and 3 will focus on energy. In lesson 2 students will review the types of potential energy and in Lesson 3 they will review the law of conservation of energy. Lessons 4 and 5 students will revisit the concept of calculating average speed while in lessons 6 and 7 students will measure and objects motion using distance-time graphs. In lesson 08 students will calculate net force and determine if the forces are balanced or unbalanced. Students will then apply their understanding of balanced and unbalanced forces on the state of motion of an object using Newton's first law in Lesson 09. In Lesson 10 students will review Newtson's Third Law of Motion. Lessons 11 and 12 will be new material in which students will learn the relationship between acceleration, net force and mass. Students will apply the formula F= M* A. In Lessons 13-15 students will apply their understanding of how Newton's 3 laws of motion act simultaneously in systems and design and build their carnival games. In the final lesson, lesson 16. Students will participate in a Carnival Day and see other examples of Newton's 3 laws. Lesson 17 will be flex time.

The best science instruction practice is to remember ABC (activity before concept) and CBV (concept before vocabulary.) Students need to engage in investigation, discourse, reading, and writing to discover science concepts not being told the science content. We want students to be doing science, not memorizing science. This may be counter-intuitive to you and may not be the way you learned science, but research proves this is best practice for instruction and learning.

Focus on Disciplinary Literacy

In science, disciplinary literacy is synonymous with the science and engineering practices. The SEPs are the context through which all science concepts should be taught. In the lessons, you will find the Science and Engineering practices icons when the SEPs are being explicitly used by students.

Asking Questions Defining Problems | Developing and Using Models | Planning and Carrying Out Investigations | Analyzing and Interpreting Data | Mathematics Computational Thinking | Constructing Explanations Designing Solutions | Engaging in Argument from Evidence | Obtaining, Evaluating, and Communicating Information

CONTENT

CONTENT STANDARDS

Below are the standards **taught** and **assessed** in this unit.

Readiness Standards
8.7A Calculate and analyze how the acceleration of an object is dependent upon the net force acting on the object and the mass of the object using Newton's Second Law of Motion. 8.7B Investigate and describe how Newton's three laws of motion act simultaneously within systems such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.
Supporting Standards
6.7A identify and explain how forces act on objects, including gravity, friction, magnetism, applied forces, and normal forces, using real-world applications; 6.7B calculate the net force on an object in a horizontal or vertical direction using diagrams and determine if the forces are balanced or unbalanced 6.8B describe how energy is conserved through transfers and transformations in systems such as ~~electrical circuits, food webs,~~ amusement park rides, or ~~photosynthesis~~ 7.7A calculate average speed using distance and time measurements from investigations 7.7B distinguish between speed and velocity in linear motion in terms of distance, displacement, and direction; 7.7C measure (record) and interpret an object's motion using distance-time graphs

UNDERSTANDINGS AND QUESTIONS

Important big ideas and processes for the unit.

Key Understandings
• Motion, direction, distance, and displacement describe and quantify how objects move. (Lesson 01) • Energy is the ability to cause change. Kinetic energy is the energy of motion. Potential energy is stored energy. There are three types of potential energy: gravitational, elastic, and chemical. (Lesson 02) • The different forms of energy are nuclear, mechanical, sound, electrical, chemical, radiant, and thermal. (No mermaid should eat canned red tuna.) (Lesson 03) • The Law of Conservation of Energy states that energy can neither be created nor destroyed; it just changes form. (Lesson 03) • Total energy = potential energy + kinetic energy (TE = PE + KE) (Lesson 03) • Average speed is the total distance traveled by an object over a total amount of time. (Lessons 04 and 05)

- Instantaneous speed is the speed of an object at a particular moment in time. (Lesson 04)
- Repeating multiple trials in an experiment helps to reduce the effect of errors. The more times an experiment is repeated with the same results, the more likely the data is accurate. (Lesson 05)
- A distance vs. time graph shows the distance an object travels over time. They are also referred to as speed graphs because the average speed of an object can be determined from these types of graphs. (Lessons 06 and 07)
- Net force is the combination of all the forces acting on an object. A net force of zero means the forces are balanced and the object's position, motion, or shape does not change. A nonzero net force means that the forces are unbalanced, and that the object's position, motion, or shape is changing. (Lesson 08)
- The net force acting on an object is directly proportional to the acceleration of the object. (As force increases, acceleration increases.) The mass of an object is inversely proportional to the acceleration of the object. (As the mass increases, acceleration decreases.) (Lessons 11 and 12)

Key Questions

- How can you determine if an object is in motion? (Lesson 01)
- How do reference points help us identify if an object is in motion? (Lesson 01)
- What is the difference in distance and displacement? (Lesson 01)
- What factors determine the amount of kinetic energy an object has? (Lesson 02)
- What factors determine the amount of gravitational potential energy an object has? (Lesson 02)
- What factors determine the amount of elastic potential energy an object has? (Lesson 02)
- What factors determine the amount of chemical potential energy an object has? (Lesson 02)
- What happens to energy when it is transferred from one form to another? (Lesson 03)
- What is the difference is average speed and instantaneous speed? (Lesson 04)
- How do we calculate average speed? (Lesson 05)
- What information can you obtain from a distance-time graph? (Lessons 06 and 07)
- When do forces cause an object to change direction or position? (Lesson 08)
- How is net force calculated? (Lesson 08)
- What is acceleration? (Lessons 11 and 12)
- How do force and mass affect the acceleration of an object? (Lessons 11 and 12)

Common Misconceptions
• Using displacement and distance interchangeably (Lesson 01) • Confusing the forms of potential energy (gravitational, elastic, and chemical) (Lesson 02) • Thinking that potential and kinetic energy can be created or destroyed (Lesson 02) • Thinking that gravitational potential energy does not change as a function of height (Lesson 02) • Confusing elastic potential energy and kinetic energy and thinking that when an object is stretched or compressed, its energy is in the form of kinetic energy (Lesson 02) • Thinking that chemical potential energy only exists in living organisms or exclusively with biological systems and failing to recognize its presence in all chemical reactions (Lesson 02) • Thinking that a battery and fuel are not forms of chemical energy (Lesson 03) • Thinking that energy cannot be transformed into more than one type of energy (Lesson 03) • Thinking that energy can be created or destroyed (Lesson 03) • Thinking that the same type of energy cannot transfer to another object without transforming into another type of energy (Lesson 03) • Thinking that sources of energy such as batteries continuously generate energy rather than serving to store or transfer energy (Lesson 03) • Assuming all energy transformations are perfectly efficient, leading to the misconception that there are no losses during energy conversions (Lesson 03) • Thinking average speed represents the speed at any given moment during the investigation (Lessons 04 and 05) • Thinking that changes in speed during different intervals do not affect the overall average speed (Lessons 04 and 05) • Confusing the mathematical relationship between distance, time, and speed (Lessons 04 and 05) • Identifying distance, speed, and time data incorrectly based on the unit of measurement (Lessons 04 and 05) • Confusing which axis should be labeled with which variable. (Lessons 06 and 07) • Incorrectly showing the changes in motion on a graph relative to the mathematics the graph represents. (Lessons 06 and 07) • Thinking that all objects' motion can be represented by the same type of graph. (e.g., a straight line) (Lessons 06 and 07) • Thinking that all unbalanced forces result in no motion or forgetting that constant velocity is a balanced force (Lesson 08) • Adding up all the forces acting on an object without considering their direction (Lesson 08) • Thinking that if two forces have the same magnitude, they are balanced, regardless of their direction (Lesson 08) • Confusing mass and weight and using the terms interchangeably. (Lessons 11 and 12) • It is quite common for students to confuse the concept of acceleration with the concept of velocity or speeding up. (Lessons 11 and 12) • Students may believe that the faster an object moves, the more it accelerates; the slower an object moves, the less it accelerates. (Lessons 11 and 12) • Be aware that students interpret negative acceleration with slowing down. The sign of the acceleration is related to the direction that the object would have to move in order to speed up. A negative acceleration does not necessarily mean the object is slowing down. Therefore, defining deceleration as negative acceleration is incorrect. (Lessons 11 and 12)

ROADMAP

	AT A Glance: Unit 02 Force and Motion			
Day	**Date**	**TEKS**	**Lesson**	**Lesson Title**
There is one flex day built into this unit to use as needed. Flex days can be used for lessons that take longer than one day or for reteaching material the students may not have gotten during tier 1 instruction.				
1		7.7B	01	What is Motion? (Unit Launch)
2		6.8B	02	Law of Conservation of Energy
3		7.7A	03	Calculating Average Speed Part 1
4		7.7A	04	Calculating Average Speed Part 2
5		7.7C	05	Motion Graphs Part 1
6		7.7C	06	Motion Graphs Part 2
7		7.7B	07	Speed Vs. Velocity (New)
8		6.7A	08	How Forces Act on Objects (New)
9		6.7B	09	Balanced and Unbalanced Forces (Net force)
10		8.7B 7.7D	10	Newton's 1st Law Review
11		8.7B 6.7C	11	Newton's 3rd Law Review
12		8.7A	12	Newton's 2nd Law Part 1
13		8.7A	13	Newton's 2nd Law Part 2
14		8.7B	14	Newton's 3 Laws Acting Together Part 1
15		8.7B	15	Newton's 3 Laws Acting Together Part 2
16		8.7B	16	Newton's 3 Laws Acting Together Part 3
17		8.7B	17	Carnival Games Newton's 3 Laws
18			Unit Exam	TX_SCI_8thScience_F25_UE2 Scanning Deadline –

Lesson #01: What is Motion?	**Date:**

Objective

SWBAT describe the motion of objects in terms of distance, displacement, and direction by analyzing diagrams and scenarios.

Standards

TEKS 8.7A Calculate and analyze how the acceleration of an object is dependent upon the net force acting on the object and the mass of the object using Newton's Second Law of Motion.

Vocabulary

Distance
Direction
Displacement
Motion
Reference Point

Science Practices

1. Asking questions and defining problems
5. Using mathematics and computational thinking

Recurring Themes and Concepts

A. Patterns

Instructional Notes

- Students will describe the motion of an object in relation to a reference point.
- Students will explore and describe the motion by viewing a video of carnival rides.
- Students will analyze diagrams and measure and record the direction, distance, and displacement of objects in the diagrams.
- Students will analyze diagrams to differentiate between distance and displacement and describe the motion of an object in terms of distance, displacement, and direction.

Thinking Task (5 min)
Motion in Carnival Rides (10 min)
Introduction to Motion (15 min)
Direction, Distance, and Displacement Practice (20 min)
Exit Ticket (5 min)

Lesson Look Fors

Look for teachers to:

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.
- ☐ Engage students in the PowerPoint and practice

Look or students to:

- ☐ Engage in discourse and productive struggle
- ☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will explore and describe the motion by viewing a video of carnival rides.
- Students will analyze diagrams and measure and record the direction, distance, and displacement of objects in the diagrams.
- Students will analyze diagrams to differentiate between distance and displacement and describe the motion of an object in terms of distance, displacement, and direction.

Know

- Motion is a change in position of an object from one place to another.
- Direction describes the line or course that an object is traveling or is aimed to travel.
- Distance is a description of how far an object travels between two points.
- Displacement is the direction and the distance, in a straight line, from the initial starting point to the ending point.

Lesson #02: Law of Conservation of Energy | **Date:**

Objective

SWBAT describe the conservation of energy during energy transformations by analyzing and interpreting diagrams and scenarios.

Standards

TEKS

6.8B describe how energy is conserved through transfers and transformations in systems such as electrical circuits, food webs, amusement park rides, or photosynthesis

Vocabulary

Law of Conservation of Energy

Science Practices

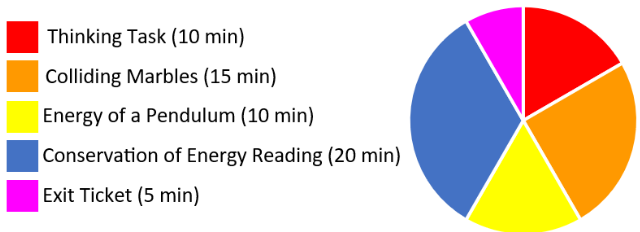
2. Developing and using models
3. Planning and carrying out investigations
8. Obtaining, evaluating, and communicating information

Recurring Themes and Concepts

E. Energy and Matter

Instructional Notes

- Students will review energy transfer through a card sort activity.
- Students explore the law of conservation of energy.
- Students will engage in a reading to learn to deepen their understanding of conservation of energy.
- Students will apply TE = PE + KE to demonstrate the law of conservation of energy.



Lesson Look Fors

Look for teachers to:

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.

Look or students to:

- ☐ Engage in discourse and productive struggle
- ☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Review energy transformations.
- Explore the conservation of energy.
- Engage in a reading to learn and practice to deepen their understanding on conservation of energy.
- Apply TE = PE + KE to demonstrate the law of conservation of energy.

Know

- The different forms of energy are nuclear, mechanical, sound, electrical, chemical, radiant, and thermal. (No mermaid should eat canned red tuna.)
- The Law of Conservation of Energy states that energy can neither be created nor destroyed; it just changes form.
- Total energy = potential energy + kinetic energy (TE = PE + KE)

Lesson #03: Calculating Average Speed Part 1 | **Date:**

Objective

SWBAT describe the motion of an object in terms of average speed and instantaneous speed by analyzing data and graphical representation of data

Standards

TEKS

7.7A calculate average speed using distance and time measurements from investigations.

Vocabulary

Average Speed
Instantaneous Speed
Rate

Science Practices

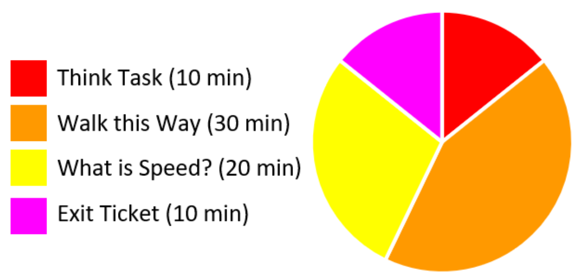
1. Asking questions and defining problems
3. Planning and carrying out investigations
8. Obtaining, evaluating, and communicating information

Recurring Themes and Concepts

A. Patterns

Instructional Notes

- Students will participate in an introductory investigation to collect motion data to being to explore speed.
- Students will graph the data from the investigation and analyze the graphical representations of data and describe what story the data tells about the motion of the walkers.
- Students will participate in a reading to learn and class discussion to connect the concepts from the investigation and the reading.
- Students will distinguish between average speed and instantaneous speed.



Lesson Look Fors

Look for teachers to:

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.

Look or students to:

- ☐ Engage in discourse and productive struggle
- ☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will investigate and collect motion data. Students will then graph and analyze the motion date.
- Students will participate in a reading to learn and class discussion to connect the concepts from the investigation and the reading.

Know

- Average speed is the total distance traveled by an object over a total amount of time.
- Instantaneous speed is the speed of an object at a particular moment in time.

Lesson #04: Calculating Average Speed Part 2 | **Date:**

Objective

SWBAT calculate average speed using distance and time measurements by collecting data from investigations.

Standards

TEKS

7.7A calculate average speed using distance and time measurements from investigations.

Vocabulary

Average Speed

Science Practices

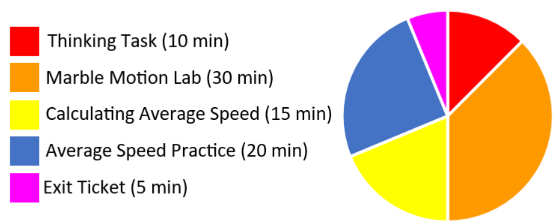
1. Asking questions and defining problems
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking

Recurring Themes and Concepts

C. Scale, Proportion, Quantity

Instructional Notes

- Students will be collecting distance and time data to be used to calculate and graph average speed
- Students will then discuss how to calculate average speed.
- Students will calculate the average speed from the Marble Motion investigation
- Students will complete practice problems where they are given distance and time and asked to calculate the average speed.



Lesson Look Fors

Look for teachers to:

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.

☐ Promote the use of partners and whole class discussion.

Look or students to:

☐ Engage in discourse and productive struggle

☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Collecting distance and time data to be used to calculate and graph average speed
- Calculate the average speed

Know

- Average speed is the total distance traveled by an object over a total amount of time

Lesson #05: Motion Graphs Part 1 | **Date:**

Objective

SWBAT analyze and describe an objects motion using distance-time graphs by graphing data collected from investigations.

Standards

TEKS

7.7C measure, record, and interpret an object's motion using distance-time graphs

Vocabulary

Slope

Science Practices

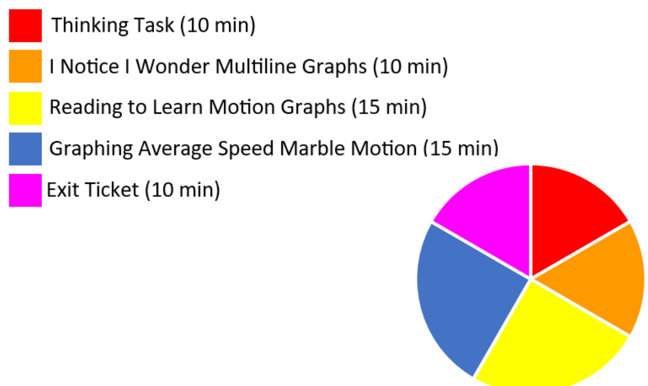
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
8. Obtaining, Evaluating and Communicating Information

Recurring Themes and Concepts

A. Patterns

Instructional Notes

- Students will compare time and distance data of two objects and calculate the average speed of each.
- Students will then analyze a graphical representation of the data and complete a I notice, and I wonder chart. The teacher will lead a class discussion around the graph.
- Students will then complete a reading to learn activity that describes distance time graphs.
- Students will then graph the data from the Marble Motion investigation.
- Students will be given data from an investigation and asked to complete a data table, graph, analyze the graph and calculate the average speed.



Lesson Look Fors

Look for teachers to:

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.

☐ Promote the use of partners and whole class discussion.

Look or students to:

☐ Engage in discourse and productive struggle

☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Analyze a graphical representation of the data.
- Given data from an investigation, complete a data table, graph, and then analyze the graph and calculate the average speed of the object.

Know

- A distance vs. time graph shows the distance an object travels over time. They are also referred to as speed graphs because the average speed of an object can be determined from these types of graphs.

Lesson #06: Motion Graphs Part 2 | **Date:**

Objective

SWBAT analyze and describe an objects motion using distance-time graphs by graphing data collected from investigations.

Standards

TEKS

7.7C measure, record, and interpret an object's motion using distance-time graphs

Vocabulary

Slope

Science Practices

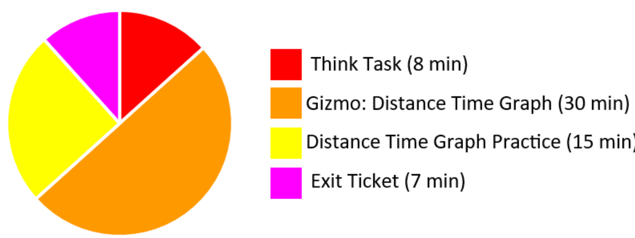
2. Developing and using models
4. Analyzing and interpreting data
5. Using mathematics and computational thinking

Recurring Themes and Concepts

A. Patterns

Instructional Notes

- Students will use an Explore Learning Gizmo to practice creating and interpreting distance-time graphs.
- Students will practice describing the motion of an object by interpreting a distance-time graph.
- Students will be given a description of an object's motion and asked to create a distance-time graph that depicts the object's motions.
- Students will analyze and interpret distance-time graphs to describe an object's motion.



Lesson Look Fors

Look for teachers to:

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.

☐ Promote the use of partners and whole class discussion.

Look or students to:

☐ Engage in discourse and productive struggle

☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Practice creating and interpreting distance-time graphs.
- Practice describing the motion of an object by interpreting a distance-time graph.
- Analyze and interpret distance-time graphs to describe an object's motion.

Know

- A straight line on a distance-time graph indicates that the object is moving at a constant steady speed. The steeper the slope of the line of the graph, the faster the object is moving.
- Curved lines show a change in speed in the objects. An upward curved line shows that the object is increasing in speed. A downward curved line shows that the object is decreasing in speed.
- A flat line represents an object that is not in motion.

Lesson #07: Speed Vs. Velocity | **Date:**

Objective

SWBAT distinguish between speed and velocity and interpret the motion of an object on a displacement-time graph

Standards

TEKS

7.7B distinguish between speed and velocity in linear motion in terms of distance, displacement, and direction;

Vocabulary

Velocity

Science Practices

1. Asking questions and defining problems
2. Developing and using models
4. Analyzing and interpreting data
5. Using mathematics and computational thinking

Recurring Themes and Concepts

Patterns

Instructional Notes

- Students will review displacement
- Students will analyze a displacement-time graph and describe how it is different from a distance-time graph.
- Students will participate in a reading-to-learn exercise to learn how to calculate velocity and interpret a displacement time graph.
- Students will practice interpreting a displacement time graph and calculating average speed and average velocity given data.
- Students will compare and contrast speed and velocity and distinguish between speed and velocity when given descriptions of motion.

Lesson Look Fors

Look for teachers to:

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.

☐ Promote the use of partners and whole class discussion.

Look for students to:

☐ Engage in discourse and productive struggle

☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will calculate average velocity.
- Interpret displacement time graphs
- distinguish between speed and velocity

Know

- Velocity is the rate of change of an object's position (displacement) over a given amount of time. Speed in a given direction.

Lesson #08: How Forces Act on Objects	Date:

Objective

SWBAT

Standards

TEKS

Vocabulary

Science Practices

1.

Recurring Themes and Concepts

Instructional Notes

Lesson Look Fors

Look for teachers to:

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.

Look for students to:

- ☐ Engage in discourse and productive struggle
- ☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

-

Know

-

Lesson #09: Balanced and Unbalanced Forces | **Date:**

Objective

SWBAT calculate the net force acting on an object in both horizontal and vertical directions by analyzing force diagrams.

Standards

TEKS

6.7B calculate the net force on an object in a horizontal or vertical direction <u>using diagrams</u> and determine if the forces are balanced or unbalanced

Vocabulary

Balanced Force
Free Body Diagrams
Force
Net Force
Unbalanced Force
Vectors

Science Practices

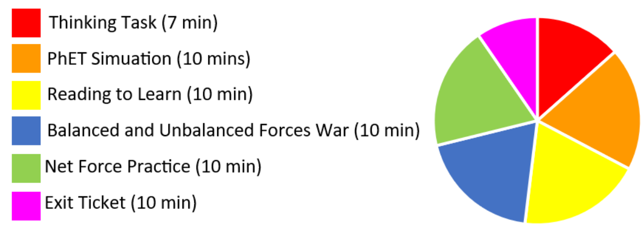
2. Developing and using models
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
8. Obtaining, evaluating, and communicating information

Recurring Themes and Concepts

C. Scale, Proportion, Quantity
D. Systems and System Models

Instructional Notes

- Students will use a PhET simulation to explore and discover when forces are balanced and unbalanced and what type of force causes objects to change motion.
- Students will use a reading to learn activity to deepen their understanding of balanced, unbalanced forces and calculating net force.
- Students will practice calculating net force.
- Students will calculate the net force acting on an object in both horizontal and vertical directions by analyzing force diagrams.



Lesson Look Fors

Look for teachers to:

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.

Look or students to:

- ☐ Engage in discourse and productive struggle
- ☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Explore and discover when forces are balanced and unbalanced and what type of force causes objects to change motion.
- Practice calculating net force.
- Calculate the net force acting on an object in both horizontal and vertical directions by analyzing force diagrams

Know

- Unbalanced forces can cause an object to change shape, direction and/or position.
- When more than one force acts on an object, the forces combine to form a net force. The combination of all the forces acting on an object is the net force.
  - When two forces act in the same direction on an object, the net force is equal to the sum of the two forces.
  - When two unequal forces act in opposite directions on an object, the net force is the difference between the two forces.

Lesson #10: Newton’s First Law of Motion Review | **Date:**

Objective

SWBAT analyze and describe the effects of balanced and unbalanced forces on an object’s motion by applying Newton’s First Law of Motion.

Standards

TEKS

8.7B Investigate and describe how Newton’s three laws of motion act simultaneously within systems such as in vehicle restraints, sports activities, amusement park rides, Earth’s tectonic activities, and rocket launches.

7.7D analyze the effect of balanced and unbalanced forces on the state of motion of an object using Newton’s First Law of Motion

Vocabulary

List

Science Practices

3. Planning and carrying out investigations
8. Obtaining, evaluating, and communicating information

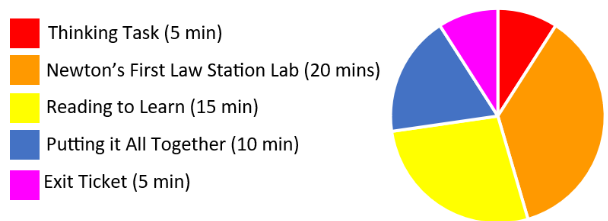
Recurring Themes and Concepts

B. Cause and Effect

G. Stability and Change

Instructional Notes

- Students will complete a station lab where they see examples of Newton’s first law of Motion in action and make observations.
- Students will complete a Reading to Learn to acquire more information about Newton’s first law of motion.
- Students will apply the knowledge they learned in the reading to the station lab to give examples of Newton’s First Law.
- Students will analyze and describe the effects of balanced and unbalanced forces on an object’s motion by applying Newton’s First Law of Motion



Lesson Look Fors

Look for teachers to:

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.

Look or students to:

- ☐ Engage in discourse and productive struggle
- ☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Investigate examples of Newton’s first law of Motion in action and make observations.
- the effects of balanced and unbalanced forces on an object’s motion by applying Newton’s First Law of Motion.

Know

- Newton’s first law of motion states if the net force on an object is zero, an object at rest will stay at rest, and a moving object will continue moving in a straight line with constant speed.
- Balanced forces do not change the motion of an object; unbalanced forces do.
- Because of inertia, an object will resist a change in motion.
- Objects with a greater mass have greater inertia.

Lesson #11: Newton's Third Law Review | **Date:**

Objective

SWBAT identify the action and reaction forces that are equal in magnitude and opposite in direction that result when two objects interact by analyzing scenarios and diagrams.

Standards

TEKS

6.7C identify simultaneous force pairs that are equal in magnitude and opposite in direction that result from the interactions between objects using Newton's Third Law of motion.

Vocabulary

Action Reaction Forces
Magnitude
Newton's Third Law
Normal Force

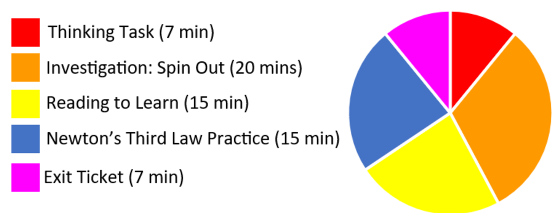
Science Practices

3. Planning and carrying out investigations
5. Using mathematics and computational thinking
8. Obtaining, evaluating, and communicating information

Recurring Themes and Concepts

B. Cause and Effect

- Students will explore Newton's Third law and identify the action and reaction force.
- Students will participate in a reading to deepen their understanding of Newton's Third Law of Motion.
- Students will demonstrate mastery of Newton's third law during independent practice.
- Students will identify the action and reaction forces that are equal in magnitude and opposite in direction that result when two objects interact by analyzing scenarios and diagrams.



Lesson Look Fors

Look for teachers to:

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.

Look or students to:

- ☐ Engage in discourse and productive struggle
- ☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will explore Newton's Third law and identify the action and reaction force.
- Students will identify the action and reaction forces that are equal in magnitude and opposite in direction that result when two objects interact by analyzing scenarios and diagrams.

Know

- Normal force is the force that surfaces exert to prevent solid objects from passing through each other.
- Forces always occur in pairs.
- Newton's Third Law states that when one force acts on the first object, and then another force acts on the second object with equal strength but in the opposite direction

Lesson #12: Newton's Second Law Part 1	Date:

Objective

SWBAT describe how the net force acting on an object and the mass of the object affect the objects acceleration by applying Newton's Second Law of Motion.

Standards

TEKS

8.7A Calculate and analyze how the acceleration of an object is dependent upon the net force acting on the object and the mass of the object using Newton's Second Law of Motion.

Vocabulary

Acceleration
Newton's Second Law

Science Practices

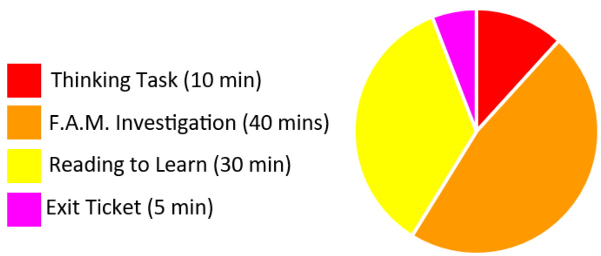
3. Planning and carrying out investigations
4. Analyzing and interpreting data
8. Obtaining, evaluating, and communicating information

Recurring Themes and Concepts

B. Cause and Effect
C. Scale, Proportion, Quantity

Instructional Notes

- Students will explore the relationship between force, mass and acceleration.
- Students will connect the ideas they developed in the investigations and deepen their understanding of Newton's second law of Motion but engaging in a reading to learn.
- Students will describe how the net force acting on an object and the mass of the object affect the object's acceleration by applying Newton's Second Law of Motion.



Lesson Look Fors

Look for teachers to:

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
☐ Promote the use of partners and whole class discussion.

Look or students to:

☐ Engage in discourse and productive struggle
☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will explore the relationship between force, mass and acceleration.
- Students will connect the ideas they developed in the investigations and deepen their understanding of Newton's second law of Motion but engaging in a reading to learn.
- Students will describe how the net force acting on an object and the mass of the object affect the objects acceleration by applying Newton's Second Law of Motion.

Know

- The more mass an object has, the greater its inertia and the more force it takes to change the object's state of motion.
- Acceleration is a change in motion caused by an unbalanced force acting on an object.
- The acceleration of an object depends directly upon the net force acting upon the object. As the force acting upon an object is increased, the acceleration of the object is increased.
- The acceleration of an object depends inversely upon the mass of the object. As the mass of an object is increased, the acceleration of the object is decreased.

Lesson #13: Newton's Second Law Part 2 | **Date:**

Objective

SWBAT calculate the acceleration of an object using the object's mass and the net force acting on it using Newton's Second Law of Motion.

Standards

TEKS 8.7A Calculate and analyze how the acceleration of an object is dependent upon the net force acting on the object and the mass of the object using Newton's Second Law of Motion.

Vocabulary

Acceleration
Newton's Second Law

Science Practices

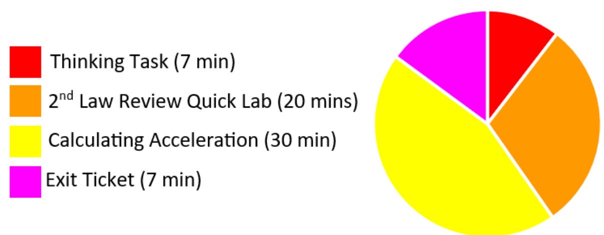
Acceleration
Newton's Second Law

Recurring Themes and Concepts

C. Scale, Proportion, Quantity

Instructional Notes

- Students will review the relationship of force, mass and acceleration by doing a quick lab and analyzing a diagram.
- Students will review how to calculate acceleration. Students will have the opportunity for independent practice.
- Students will calculate the acceleration of an object using the object's mass and the net force acting on it using Newton's Second Law of Motion.



Lesson Look Fors

Look for teachers to:

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
☐ Promote the use of partners and whole class discussion.

Look or students to:

☐ Engage in discourse and productive struggle
☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do

- Students will review the relationship of force, mass and acceleration by doing a quick lab and analyzing a diagram.
- Students will review how to calculate acceleration. Students will have the opportunity for independent practice.
- Students will calculate the acceleration of an object using the object's mass and the net force acting on it using Newton's Second Law of Motion.

Know

- Newton's second law of motion explains the relationship between net force, mass, and acceleration.
- To find acceleration, divide net force by mass.

Lesson #14: Newtons 3 Laws Acting Together Part 1	Date:

Objective	Instructional Notes	Lesson Look Fors
SWBAT		**Look for teachers to:** ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss. ☐ Promote the use of partners and whole class discussion. **Look or students to:** ☐ Engage in discourse and productive struggle ☐ Justify their reasoning and support their ideas with evidence.
Standards		
TEKS		
Vocabulary		
List		
Science Practices		
Recurring Themes and Concepts		**Students Do and Know**
		Do • Know •

Lesson #15 and 16: Newtons 3 Laws Acting Together Part 2 and 3	Date:

Objective

SWBAT

Standards

TEKS

Vocabulary

List

Science Practices

Recurring Themes and Concepts

Instructional Notes

Lesson Look Fors

Look for teachers to:

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.

Look or students to:

- ☐ Engage in discourse and productive struggle
- ☐ Justify their reasoning and support their ideas with evidence.

Students Do and Know

Do
-

Know
-

Lesson #17: Carnival Games	Date:

Objective	Instructional Notes	Lesson Look Fors
SWBAT		**Look for teachers to:** ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss. ☐ Promote the use of partners and whole class discussion.
Standards		
TEKS		**Look or students to:** ☐ Engage in discourse and productive struggle ☐ Justify their reasoning and support their ideas with evidence.
Vocabulary		**Students Do and Know**
List		Do • Know •
Science Practices		
Recurring Themes and Concepts		

UNPACKED STANDARDS

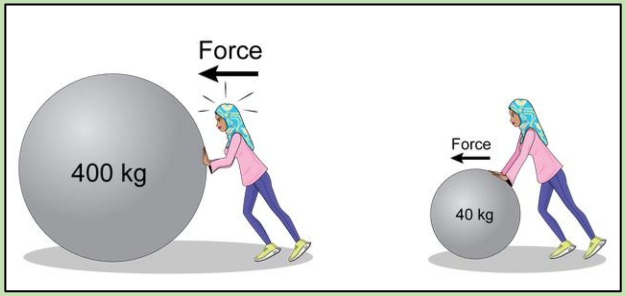
Focus standards for this unit.

<table>
<tr><td>Standard:</td><td colspan="2">8.7A Calculate <u>and analyze</u> how the acceleration of an object <u>is dependent upon the net force acting on the object and the mass of the object using Newton's Second Law of Motion.</u></td></tr>
<tr><td colspan="2">Specificity</td><td>Content Builder</td></tr>
<tr><td colspan="2">Cognition: Calculate
Content: How the acceleration of an object is dependent upon the net force action on the object and the mass of the object

Including, but not limited to:
• Newton' s Second Law of Motion
o Calculate using formula F=ma (Force = mass x acceleration)
o Solve problems involving force, mass, and acceleration using the formula for Newton' s Second Law, F=ma.
o Manipulate the variables in the formula to demonstrate how the mass of an object affects the acceleration of an object.
▪ Inverse relationship: Given a constant force, more mass, less acceleration or less mass, and more acceleration
▪ m=a/F
▪ Manipulate the variables to demonstrate how more or less force applied affects acceleration.
▪ Direct relationship: Given a constant mass, more force = more acceleration or less force = less acceleration

Cognition: Analyze
Content: How the acceleration of an object is dependent upon the net force action on the object and the mass of the object

Including, but not limited to:
• Newton's Second Law of Motion
○ Force ‐ a push or pull on an object
○ Unit of measurement: Newtons (N)
○ Major forces: gravity and friction
○ Net force ‐ measurement of the total forces exerted on an object
○ Read simple force diagrams.
○ Calculate net force using simple force diagrams.
○ Forces in the same direction are added together.
○ Forces in opposite directions are subtracted.
○ Acceleration ‐ change in an object's motion; caused by unbalanced forces</td><td>Newton's second law of motion reveals that an object's acceleration relies on two factors: the net force acting on it and its mass. When a force is applied to an object it accelerates in that direction, and the acceleration's magnitude depends on both the applied force and the object's mass. When you have objects of the same mass, more force equals more acceleration. When you have objects with the same applied force and varying mass, less mass equals more acceleration. Students may struggle when applying the mathematical equation (F = m * a) to calculate these values. Using mathematical calculations is a Scientific and Engineering Practice.



Objects with greater mass require greater forces to cause acceleration. The emphasis is on the net force—the total external force or forces acting on an object.

Net Force:
Newton's second law is a bridge that links force and acceleration, and one must understand what net force is to fully use this law. Net force is the sum of all the forces acting on a single object. Sometimes, the sum of the forces is zero. When this happens, the system is at equilibrium, and there will be no changes to the object's motion. For example, stationary objects and objects traveling in a straight line at a constant speed have a net force of zero and are at equilibrium. When the sum of forces is not zero, the net force equals the product of mass and acceleration, which exemplifies Newton's second law of motion. When objects do not have a zero net force, the objects are speeding up, slowing down, or changing directions. Newton's second law of motion describes the motion of objects acted on by unbalanced forces. Forces are unbalanced when the net force acting on an object does not equal zero.</td></tr>
</table>

- Unit of measurement: m/s^2
- Mass – the amount of matter that an object contains, a measurement of an object's inertia
- Unit of measurement: kilograms (kg)
- Examples of possible activities to experience or view could include: sports activities that involve applying different amounts of force or using
- balls of different masses, toy cars of various sizes, and marble rollercoasters.

Acceleration

The acceleration of an object is a measure of its change in motion; it is defined as the rate at which the velocity of the object changes. Change of direction at constant speed is also acceleration, which does not happen without an unbalanced force. For example, a car racing around the oval of a racetrack at a constant speed is accelerating, due to the constant change in direction. The applied force causes them to accelerate by changing direction.

Instructional Implications

When you teach this concept, remember to:

- Allow students to experience Newton's second law before teaching the content so they can begin to form a deep understanding of the relationships between force, mass, and acceleration without the terms, which will give the terms more meaning when they are introduced.
- Use concrete examples and demonstrations to show Newton's second law in action, using real-life scenarios and simple experiments to highlight how force and mass impact an object's acceleration.
- Provide plenty of practice with the equation F = m * a, guiding students in solving problems related to force, mass, and acceleration in various situations.
- Use models, visual aids, and interactive simulations to help students grasp the relationship between force, mass, and acceleration.
- Relate Newton's second law to real-world applications (e.g., analyzing the motion of objects in sports, transportation, and engineering) to demonstrate its relevance and usefulness.

Possible STAAR Stimuli

Investigation	Graph	Chart/Table
Diagram	Visual/Image/ Illustration	Model
Informational/Text/ List	Formula/Equation	

Student Misconceptions

Students may make the following mistakes:

- Thinking that objects need a continuous force to remain in motion
- Thinking that the amount of force applied to an object determines its speed and forgetting about the influence of mass
- Thinking that acceleration and force are the same and using the terms interchangeably
- Confusing mass and weight and using the terms interchangeably

Standard:	8.7B Investigate and describe how Newton's three laws of motion act simultaneously within systems such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.

Specificity	Content Builder

Cognition: Investigate, Describe
Content: How Newton's Three laws of motion act simultaneously within systems
 	
Including, but not limited to:
• Vehicle restraints
  o Law of inertia – the tendency of an object to resist change in motion unless acted upon by a force
  o When the brakes are applied in a vehicle and the seatbelt locks and stops the people from remaining in motion, the seatbelt acts as the unbalanced force.
  o Law of force and acceleration – When an object that has a constant mass is acted upon by a force, the object will accelerate in the same direction as the force applied.
  o A car with greater mass requires more force to stop than a car with less mass.
  o Law of action-reaction – For every action, there is an equal and opposite reaction.
  o When a car crashes, the person moves against the seatbelt exerting a force on it, and the seatbelt exerts an equal and opposite force back onto the person.
• Sports activities
  o Law of inertia – A ball is kicked across a grassy field. It rolls until the grass slows it to a stop. Friction acts as the unbalanced force.
  o Law of force and acceleration – The more force applied when you kick a ball, the more acceleration it will have.
  o Law of action-reaction – When the ball is kicked, an equal and opposite force is applied to the player's foot.
• Amusement park rides
  o Law of inertia – The roller coaster remains in motion until the brakes are applied at the end of the ride.
  o Law of force and acceleration – The higher the first hill is, the faster the rollercoaster will travel.
  o Law of action-reaction – When the brakes are applied, the rollercoaster stops.
• Earth's tectonic activities
  o Law of inertia – Tectonic plates remain at rest until the pressure builds up to the point enough to cause movement.
  o Law of force and acceleration – The more force that is released when plates move, the greater the impact of the motion (earthquake or tsunami).
  o Law of action-reaction – Continental plates pushing against each other with equal and opposite force, over time, can form mountains.
• Rocket launches
	Newton's three laws of motion govern various systems.
	• Newton's first law states that an object will stay at rest or move with constant speed unless acted upon by an external force.
	• The second law connects force, mass, and acceleration.
	• The third law tells us that every action has an equal and opposite reaction.
	By investigating how these laws interact within systems such as vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches, we witness the simultaneous influence of these fundamental laws. Students may struggle with applying Newton's three laws of motion to different scenarios and recognizing which law is relevant in specific situations.
	
	Instructional Implications
	When you teach this concept, remember to:
	• Use many real-world examples (e.g., vehicle restraints, sports activities, amusement park rides, tectonic activities, and rocket launches) to show how Newton's laws work in practical situations.
	• Conduct hands-on investigations and demonstrations so students can directly observe and experience the effects of Newton's laws.
	• Utilize models, visual aids, and interactive simulations to help students see Newton's laws in action.
	• Include problem-solving activities where students apply Newton's laws to analyze and explain different systems.
	• Provide opportunities for students to explain investigations both verbally and in writing.
	• Help students see the Recurring Theme and Concept of *cause and effect* in this standard.
	
	Student Misconceptions
	Students may make the following mistakes:
	• Thinking that acceleration means only speeding up rather than slowing down or a change in an object's direction
	• Thinking that forces only exist when there is motion and absent when objects are at rest
	• Thinking that forces acting on an object always result in acceleration
	
	Notes
	Students learned about laws 1 and 3 in 6th and 7th grade but these will be reviewed in this unit.

○ Law of inertia – The rocket remains at rest until it ignites and builds up force to move. ○ Law of force and acceleration – The lighter the rocket, the less force that is required to lift it from the launch pad. ○ Law of action-reaction – As the ignition from burning fuel pushes the ground, an equal and opposite thrust force lifts the rocket upward into the air.	**Possible STAAR Stimuli**		
	Investigation	Demonstration	Chart/Table
	Diagram	Visual/Image/ Illustration	Informational/Text/ List
	Formula/Equation		

Standard:	6.7B calculate the net force on an object in a horizontal or vertical direction using diagrams and determine if the forces are balanced or unbalanced
Specificity	**Content Builder**

Cognition: Calculate
Content: The net force on an object in a horizontal or vertical direction.
 	
Including, but not limited to:
• Forces are described with a numeric value and arrow.
  ○ Numeric value provides information about the magnitude / size of the force.
    ▪ The unit for force is Newtons (N).
    ▪ The arrow provides information about the direction of the force.
• Calculate net force by adding all of the forces acting on an object.
• Forces acting in the same direction are added.
• Forces acting in opposite directions are subtracted.
 	
Cognition: Determine
Content: If forces are balanced or unbalanced
 	
Including, but not limited to:
• Calculated net force
• Balanced force
  ○ Net force is zero.
  ○ No change in motion occurs.
• Unbalanced forces
  ○ Net force is not zero.
	To calculate the net force on an object in a horizontal or vertical direction, use diagrams and add up all the forces acting on the object. If the net force is zero, the forces are balanced, and the object remains at rest or moves at a constant velocity. If the net force is non-zero, the forces are unbalanced, and the object accelerates in the direction of the net force. Students may struggle mathematically combining forces with different directions and magnitudes.
	
	Instructional Implications
	When you teach this concept, remember to:
	• Design investigations that enable students to measure forces acting on objects at rest and in motion.
	• Provide opportunities for students to collect data using force sensors, spring scales, or other tools, and record their findings in a data table for analysis and comparison of forces involved.
	• Provide students with diagrams that feature labeled arrows representing the direction and magnitude of forces acting on objects. Have students analyze the arrows to determine the resultant force and its effect on the object's motion.
	• Include a variety of force examples (e.g., friction, gravity, magnetism, applied forces, and normal forces) in your lessons and student investigations. This variety helps students recognize different types of forces and their contributions to the net force acting on an object.
	
	Student Misconceptions

○ Change in motion occurs.	Students may make the following mistakes: • Thinking that all unbalanced forces result in no motion or forgetting that constant velocity is a balanced force • Thinking that addition of positive integers is always required to calculate the net force • Using inconsistent units for force (e.g., mixing Newtons and pounds) • Adding up all the forces acting on an object without considering their direction • Thinking that if two forces have the same magnitude, they are balanced, regardless of their direction
Notes	**Possible STAAR Stimuli**
6.7(B) is eligible for assessment on Grade 8 STAAR. (Note: Standards designated as "readiness" are essential for success in the current grade. Standards may have a different designation when assessed on Grade 8 STAAR.)	Investigation, Demonstration, Graph, Chart/Table, Diagram, Model, Information Text/List, Formula/Equation

Standard:	6.8A compare and contrast gravitational, elastic, and chemical potential energies with kinetic energy

Specificity	Content Builder
Cognition: Compare and Contrast Content: Gravitational, elastic, and chemical potential energies with kinetic energy Including, but not limited to: • Definitions of kinetic and potential energy ○ Kinetic energy – energy due to movement ▪ Types of kinetic energy – electrical, radiant, thermal, sound, mechanical ○ Potential energy – stored energy or energy due to position ▪ Types of potential energy – chemical, gravitational, elastic ○ Compare KE and PE in real life examples, like in: ▪ A pendulum ▪ Roller coasters ▪ A battery in a toy car ▪ A stretched rubber band ▪ Springs stretched vs. not stretched ▪ Gasoline in vehicles ▪ Books on a higher shelf vs. books on a lower shelf ○ Contrast KE and PE in terms of movement. Identify situations where: ▪ KE = 0%, PE = 100% ▪ KE = 100%, PE = 0% ▪ KE = 50%, PE = 50%	Gravitational, elastic, and chemical potential energies are stored energies based on position or configuration, while kinetic energy is the energy of motion. Gravitational potential energy is related to height, elastic potential energy is related to deformation, and chemical potential energy is related to chemical bonds. Kinetic energy depends on an object's mass and velocity. When potential energy is converted, objects can work and undergo changes. The law of conservation of energy states that energy cannot be created or destroyed but only transferred or transformed from one form to another. Students may struggle to identify real-life scenarios where each type of energy is at play, leading to difficulty in drawing comparisons. **Instructional Implications** When you teach this concept, remember to: • Provide numerous real-life examples for each type of energy to help students understand their applications and relevance in everyday situations. • Use models, diagrams, charts, and animations to visually represent the concepts of potential and kinetic energy. • Engage students in hands-on investigations or demonstrations to explore the conversion of potential to kinetic energy and vice versa. • Use card sorts and Venn diagrams or create a table that highlights the differences and similarities between gravitational, elastic, and chemical potential energies with kinetic energy. • Help students see the Recurring Theme and Concept of the *flow of energy* in this standard.

Student Misconceptions	Possible STAAR Stimuli		
Students may make the following mistakes: • Confusing the forms of potential energy (gravitational, elastic, and chemical) • Thinking that potential and kinetic energy can be created or destroyed • Thinking that gravitational potential energy does not change as a function of height • Confusing elastic potential energy and kinetic energy and thinking that when an object is stretched or compressed, its energy is in the form of kinetic energy • Thinking that chemical potential energy only exists in living organisms or exclusively with biological systems and failing to recognize its presence in all chemical reactions • Assuming the absence of motion means no energy is present, and if an object is at rest, it has no energy • Assuming objects with greater mass inherently have more kinetic energy • Thinking that heavier objects always have more kinetic energy, failing to consider factors such as velocity	Investigation	Graph	Chart/Table
	Diagram	Visual/Image/Illustration	Model
	Informational Text/List		

Standard:	6.8B describe how energy is conserved through transfers and transformations in systems such as electrical circuits, food webs, amusement park rides, or photosynthesis
Specificity	**Content Builder**

Cognition: Describe
Content: How energy is conserved through transfer and transformations in systems such as electrical circuits, food webs, amusement park rides, and photosynthesis
 	
Including, but not limited to:
• The law of conservation of energy states that energy can neither be created nor be destroyed. Total energy in the entire universe is constant.
• Energy is conserved during transfers since the amount of energy transferred stays the same.
• Energy transfers occur in:
  ○ Electrical circuits – Electrical energy is passed through wires from one point to another.
  ○ Food webs – Radiant energy (light energy) is used by green plants for photosynthesis.
  ○ Chemical energy from plants is transferred to animals.
  ○ Amusement park rides – Kinetic energy is transferred to gravitational potential energy and vice versa in many rides.
	Energy is conserved in various systems through transfers and transformations. In electrical circuits, energy is transferred as electrical current and transformed into other forms such as light or heat. In food webs, energy moves through the ecosystem as organisms consume and are consumed, maintaining the overall energy balance. Amusement park rides transfer potential energy to kinetic energy, conserving the total energy of the system. In photosynthesis, solar energy is transformed into chemical energy stored in glucose molecules, ensuring energy conservation within the biological system. Students may struggle to grasp the concept of energy conservation and how it applies to different systems.
	
	Instructional Implications
	
	When you teach this concept, remember to:
	Allow students to explore different energy transformations and begin to describe where the energy goes.
	• Demonstrate energy transformations involving different forms of energy. Show examples where energy is transformed from one type to another, including chemical, thermal, light, mechanical, and electrical energy.
	• Provide opportunities for students to apply the law of conservation of energy in various scenarios, including how electrical circuits function, analyzing energy flow

○ Photosynthesis – Radiant energy from the Sun is transferred to the plant and absorbed by chlorophyll. ○ Other examples: ▪ Sound energy is transferred from one place to another via particles in matter. ▪ Thermal energy is transferred by conduction, convection, and radiation. ▪ Kinetic energy of air particles in wind is transferred to movement of leaves. • Energy is conserved during energy transformations since energy is not lost in the entire system. ○ Electrical circuits – Electrical energy may be converted to light (light bulb), heat (wires get heated), sound (buzzer or bell), or kinetic energy (fan) in a circuit. ○ Food webs – Green plants convert radiant (light) energy from the Sun into chemical energy (glucose), and decomposers convert chemical potential energy into heat energy. ○ Amusement park rides – Multiple types of energy conversions occur in the park rides. ○ Photosynthesis – Radiant energy from the Sun is converted into chemical potential energy. ○ Other examples: ▪ When a light is switched on, electrical energy is converted into light and heat energy. ▪ In a hydroelectric dam, kinetic energy of moving water is converted into electrical energy. ▪ When a human being runs, chemical potential energy gets converted into kinetic energy.	in food webs or ecosystems, examining the transformation of potential energy to kinetic energy in amusement park rides, and investigating how energy is transformed and stored during photosynthesis. • Have students create flow charts or diagrams representing energy transfers and changes in everyday situations to help them develop a deeper understanding of energy pathways and transformations. Provide opportunities for students to describe their understanding both verbally and in writing.

Possible STAAR Stimuli		
Investigation	Demonstration	Diagram
Visual/Image/ Illustration	Web/Cycle/Chain	Model
Informational Text/List		

Student Misconceptions

Students may make the following mistakes:

- Thinking that a battery and fuel are not forms of chemical energy
- Thinking that energy cannot be transformed into more than one type of energy
- Thinking that energy can be created or destroyed
- Thinking that the same type of energy cannot transfer to another object without transforming into another type of energy
- Thinking that sources of energy such as batteries continuously generate energy rather than serving to store or transfer energy
- Assuming all energy transformations are perfectly efficient, leading to the misconception that there are no losses during energy conversions
- Neglecting energy flow in ecosystems
- Ignoring losses in electrical circuits

Standard: 7.7A calculate average speed using distance and time measurements from investigations

Specificity

Cognition: Calculate
Content: Average speed using distance and time measurements from investigations

Including, but not limited to:

- Average speed
  - Total distance something has traveled divided by the total time it has traveled
  - $S = d^2 - d^1/t^2 - t^1$
  - $S = d/t$
- Example investigation:
  - Measure the time that it takes for a small toy car or ball to travel a specified distance.

Content Builder

To calculate average speed, divide the total distance traveled by the object during an investigation by the total time taken to cover that distance. The formula for average speed is: Average Speed = Total Distance / Total Time. Students may struggle to interpret which values represent distance and time, leading to errors in the calculation. Using mathematical calculations is a Science and Engineering Practice.

Instructional Implications

When you teach this concept, remember to:

- Explain the concept of speed, which is the rate of change of distance over time. Clarify the relationship between distance, time, and speed.
- Review units of distance and time. Teach students how to perform unit conversions as needed to ensure consistent units in the calculations.
- Guide students on how to collect and organize data from investigations, recording distance and time measurements accurately for each trial or segment.
- Present real-world scenarios where calculating average speed is useful (e.g., measuring the speed of a car, an athlete, or a moving object in different situations).
- Create opportunities for students to solve for average speed using data from investigations and word-problem scenarios.

Student Misconceptions

Students may make the following mistakes:

- Thinking average speed represents the speed at any given moment during the investigation
- Thinking that changes in speed during different intervals do not affect the overall average speed
- Confusing the mathematical relationship between distance, time, and speed
- Identifying distance, speed, and time data incorrectly based on the unit of measurement

Notes

7.7(A) is eligible for assessment on Grade 8 STAAR. (Note: Standards designated as “readiness” are essential for success in the current grade. Standards may have a different designation when assessed on Grade 8 STAAR.)

Possible STAAR Stimuli

Investigation	Graph	Chart/Table
Model	Informational Text/List	Formula/Equation

Standard: 7.7C measure (record) <u>and interpret</u> an object's motion using distance-time graphs

Specificity

Cognition: Measure, Record
Content: An object’s motion using distance-time graphs

Including, but not limited to:

- Distance over time
- Speed over time
- Measure and record

Content Builder

To measure, record, and interpret an object’s motion using distance-time graphs, measure the object’s distance traveled at regular intervals of time, record the data in a table, plot the data on a graph with time on the x-axis and distance on the y-axis, connect the data points with a line or curve, analyze the graph’s slope for speed, and identify constant or changing speed and the direction of motion. Students may struggle to identify changes in an object’s motion based on the shape or slope of the graph. Explain that slope represents velocity, which includes both speed and direction. Clarify that a negative slope signifies the object is moving in the negative direction on the chosen axis (which could be

• Conduct investigations to measure and record data.
• Graph the data, and interpret the lines on the graph for the following scenarios:
  ○ Increasing speed
  ○ Decreasing speed
  ○ Constant speed
  ○ No motion (Object is at rest or stopped.)
 	
Cognition: Interpret
Content: An object's motion using distance-time graphs
 	
Including, but not limited to:
• Interpret an object's motion.
  ○ Distance-time graphs
    ▪ Speeding up
    ▪ Slowing down
    ▪ No motion
    ▪ Constant speed
  ○ Speed-time graphs
    ▪ Speeding up
    ▪ Slowing down
    ▪ No motion
    ▪ Constant speed
  ○ Velocity-time graphs
    ▪ Speeding up
    ▪ Slowing down
    ▪ No motion
    ▪ Constant speed
	either distance or time). Show students that different types of motion (e.g., constant speed, acceleration, deceleration) have distinct graph shapes.
	
	Instructional Implications
	
	When you teach this concept, remember to:
	• Engage students in activities and investigations that involve measuring and recording the motion of objects in real-world scenarios.
	• Demonstrate the process step by step, showing how to plot the data accurately on a distance-time graph. Use visual aids or interactive tools to support understanding.
	• Help students understand the axis of a distance-time graph and how to interpret the scale. Reinforce the idea that time is always plotted on the horizontal axis and distance on the vertical axis.
	• Encourage students to analyze and compare the slopes of different sections of the graph to identify changes in speed or motion.
	• Help students identify and understand key features of a distance-time graph such as constant speed, rest, acceleration, and deceleration. Provide multiple practice examples for students to analyze graphs to recognize these features.

Student Misconceptions	**Notes**
Students may make the following mistakes: • Confusing which axis should be labeled with which variable • Incorrectly showing the changes in motion on a graph relative to the mathematics the graph represents • Thinking that all objects' motion can be represented by the same type of graph (e.g., a straight line)	7.7(C) is eligible for assessment on Grade 8 STAAR. (Note: Standards designated as "readiness" are essential for success in the current grade. Standards may have a different designation when assessed on Grade 8 STAAR.) **Possible STAAR Stimuli** Investigation / Graph / Chart/Table Model / Informational Text/List / Formula/Equation

VERTICAL STANDARDS

This section details the **progression** of key student expectations/standards** in the courses **before** and **after** this course. This will help you understand what **prior knowledge skills to build upon** and guide you in knowing what **skills you are preparing your students** for in the subsequent course.

6th Grade	7th Grade	Course/Grade
6.8A compare and contrast gravitational, elastic, and chemical potential energies with kinetic energy	7.7A calculate average speed using distance and time measurements from investigations.	
6.8B describe how energy is conserved through transfers and transformations in systems such as electrical circuits, food webs, amusement park rides, or photosynthesis	7.7C measure, record, and interpret an object's motion using distance-time graphs	8.7A Calculate and analyze how the acceleration of an object is dependent upon the net force acting on the object and the mass of the object using Newton's Second Law of Motion.
6.7B calculate the net force on an object in a horizontal or vertical direction using diagrams and determine if the forces are balanced or unbalanced		
6.7C identify simultaneous force pairs that are equal in magnitude and opposite in direction that result from the interactions between objects using Newton's Third Law of motion.		8.7B Investigate and describe how Newton's three laws of motion act simultaneously within systems such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.

VOCABULARY GLOSSARY

Domain-specific words and definitions for this unit.

Key Content Vocabulary
List and define key vocabulary terms **Acceleration -** is a change in motion caused by an unbalanced force acting on an object. (Lessons 11 and 12) **Action-reaction forces** - forces that occur simultaneously when a force is applied to an object, and the object applies a force that is equal in magnitude but opposite in direction back on the original object (Lesson 10)

Average speed - total distance traveled by the object in a particular time interval. (Lessons 04 and 05)
Balanced Force: a force that does not change an object's state of motion. (Lesson 08)
Chemical Potential Energy - The energy stored in chemical bonds of a substance. (Lesson 02)
Distance - how far an object travels between two points. (Lesson 01)
Direction - the line or course that an object is traveling or is aimed to travel. (Lesson 01)
Displacement - the direction and the distance, in a straight line, from the initial starting point to the ending point (Lesson 01)
Elastic Potential Energy - Potential energy stored because of deformation of an elastic object, such as the stretching of a spring. (Lesson 02)
Free Body Diagrams: A simple sketch showing all the forces acting on an object with vectors. (Lesson 08)
Force: A push or a pull (Lesson 08)
Gravitational Potential Energy - The energy stored in an object due to its position. (Lesson 02)
Instantaneous speed - the speed of an object at a particular moment in time. (Lessons 04 and 05))
Kinetic Energy - Energy of motion. (Lesson 02)
Law of Conservation of Energy – law that states that energy can neither be created nor destroyed; it just changes form (Lesson 03)
Magnitude - The size or quantity of something (Lesson 10)
Motion - a change in an object's position over a given period of time. (Lesson 01)
Newton's Third Law of Motion - When one object exerts a force on a second object, the second object exerts an equal force in the opposite direction on the first object. (Lesson 10)
Newton's Second Law of Motion - states that when an unbalanced force acts on an object, the object will accelerate at a rate equal to the net force on the object divided by the object's mass. (Lessons 11 and 12)
Normal Force - the force that surfaces exert to prevent solid objects from passing through each other. (Lesson 10)
Potential Energy - Energy that is stored in a system or object. (Lesson 02)
Rate – (rate of change) to how much one quantity changes when another quantity changes. (Lessons 04 and 05)
Reference Point - a place or object used for comparison to determine if something is in motion (Lesson 01)
Slope - the gradient of a line and is a number that describes both the direction and the steepness of the line (lessons 06 and 07)
Unbalanced Force: A force that causes a change in an object's state of motion. (Lesson 08)
Vectors: Arrows that represent the magnitude (or strength) and direction of the forces. (Lesson 08)

Consumable Materials and Lab Supplies for Unit 2 (1 per group of 4 students unless noted)

Lesson	Commercial Vendor or Home	Lab Supplies (Science Vendor)
Lesson 01: What is Motion?	Chart Paper and markers for teacher	Ruler per student
Lesson 02: Law of Conservation of Energy	Small cup to hold the marbles 7 marbles per group	Ruler with groove in the middle
Lesson 03: Calculating Average Speed Part 1	Painter's tape	Stopwatch Meter sticks or open reel measuring tape
Lesson 03: Calculating Average Speed Part 2	Painter's tape 2 marbles with different masses	Stopwatch- 5 per group Balance Meter sticks or open reel measuring tape
Lesson 05: Motion Graphs Part 1		Calculators
Lesson 06: Motion Graphs Part 2		Computer with internet access for Gizmo
Lesson 07: Speed Vs. Velocity		Calculators
Lesson 08: How Forces Act on Objects	None	
Lesson 09: Balanced and Unbalanced Forces		Computer with internet access for pHet
Lesson 10: Newtons First Law Review	Station 1 Marble Box Station 2 Lego Figure Cart (carriage) Station 3 Toy Car Penny Station 4 Hoop (small embroidery hoop) Hex nut Station 5 Cup Pennies Station 6 Flat Metal Washers (6)	Station 4 Erlenmeyer flask
Lesson 11: Newtons Third Law Review	• 2 rolling chairs for thinking task demo • Tray or flat cardboard box (collect from grocery store- kind canned foods are in) • BBs or ROUND beads (pony beads will not work) • Wind up car • Thin piece of cardboard cut slightly larger than the car.	
Lesson 12: Newton's Second Law Part 1	Activity 1 Plastic cup Ping pong ball Golf ball Block	Activity 1 Ruler with center groove Meter stick Balance Activity 2

	Painters tape <u>Activity 2</u> Toy car Craft stick or tongue depressor Painters tape <u>Activity 3</u> 2 Toy cars (different masses) Craft stick or tongue depressor Painters Tape	2 rulers Meter stick <u>Activity 3</u> 2 rulers Meter stick Balance
Lesson 13: Newton’s Second Law Part 2	Marble Round bead Tape	2 test tubes
Lesson 14-17 Newtons Laws Together		