Marietta City Schools

District Unit Planner

Everything on the unit planner must be included on the unit curriculum approval statement.

Accelerated Physical Science

Unit title	*Forces & Motion*	**MYP year**	*3*	**Unit duration (hrs)**	*20 Hours*

Mastering Content and Skills through INQUIRY (Establishing the purpose of the Unit): ***What will students learn?***

GSE Standards

Standards

SPS8. Obtain, evaluate, and communicate information to explain the relationships among force, mass, and motion.

a. Plan and carry out an investigation and analyze the motion of an object using mathematical and graphical models. (*Clarification statement:* Mathematical and graphical models could include distance, displacement, speed, velocity, and acceleration.)

b. Construct an explanation based on experimental evidence to support the claims presented in Newton's three laws of motion. (*Clarification statement:* Evidence could demonstrate the relationships among force, mass, velocity, and acceleration.)

c. Analyze and interpret data to identify the relationship between mass and gravitational force for falling objects.

d. Use mathematics and computational thinking to identify the relationships between work, mechanical advantage, and simple machines.

MCS Gifted Standards:

- **MCS.Gifted.S5B.** Recognize and build upon strengths and limitations.
- **MCS.Gifted.S5C.** Develop and practice critical analysis in judgment of one's actions, feelings and thoughts.
- **MCS.Gifted.S6C.** Persevere in the face of obstacles.
- **MCS.Gifted.S6D.** Take initiative to pursue opportunities to share and use abilities.

Prior Student Knowledge: (REFLECTION – PRIOR TO TEACHING THE UNIT)

Students taking this course as 8th graders have not been exposed to the 8th grade Physical Science GSE.

In fourth grade, students are expected to:

S4P3. Obtain, evaluate, and communicate information about the relationship between balanced and unbalanced forces.

a. Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results.

b. Construct an argument to support the claim that gravitational force affects the motion of an object.

c. Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks. (*Clarification statement:* The use of mathematical formulas is not expected.

Teacher Background Info:
1-D Kinematics: Describing the Motion of Objects

Concepts/Skills to be Mastered by Students

- Forces and motion
- Newton's Laws
- Simple machines
- Gravitational force
- Energy
- Energy transformations

Key Vocabulary: (KNOWLEDGE & SKILLS)
Displacement, distance, direction, velocity, speed, acceleration, acceleration due to gravity, proportional, constant, increasing, decreasing, non-zero, force, Newton, balanced, unbalanced, mass, weight, inertia, Newton's First Law, Newton's Second Law, Newton's Third Law, stationary, at rest, gravity, spring scale, friction, applied force, normal force, net force, magnitude, work, mechanical advantage, effort distance, resistance distance, resistant force, effort force, gravitational force, simple machine, inclined plane, lever, fulcrum, pulley, screw, wedge, wheel and axle

Key Formulas & Constants:

Newton: $1N = 1\ kg \times (m/s^2)$

Joule: $1J = 1N \times m$

Acceleration due to gravity: $g \sim 10m/s^2$

Velocity = displacement/time [$v=d/t$]

Acceleration = (final velocity – initial velocity)/time [$a = (v_f - v_i)/t$]

Weight = mass x acceleration due to gravity [$W=mg$]

Force = mass x acceleration [$F=ma$]

W = force x distance [$W = Fd$]

Mechanical Advantage = [effort distance/resistance distance] = [resistance force/effort force]; $MA = d_e/d_r = f_r/f_e$

Year-Long Anchoring Phenomena: (LEARNING PROCESS)
How does matter and energy interact within the universe?

Unit Phenomena (LEARNING PROCESS)
How can we use our understanding of Newton's Laws, Work, and Simple Machines to evaluate the mechanical advantage of common tools?

Possible Preconceptions/Misconceptions: (REFLECTION – PRIOR TO TEACHING THE UNIT)

- Students may confuse distance with displacement.
- Students may have difficulty interpreting and using distance vs. time and velocity vs. time graphs to determine an object's motion, velocity, and/or acceleration.
- Students may have difficulty identifying all of the forces acting on an object when attempting to support claims in Newton's First Law of Motion.
- Students may have difficulty conceptualizing the fact that action-reaction pairs act on two different objects in opposite directions, but with equal magnitudes.
- Students may confuse mass with weight, or use the terms interchangeably.
- Students may confuse the acceleration due to gravity (g) with the force of gravity (w).
- Students often think that simple machines reduce the mass of the item being moved or they reduce the amount of work being done.
- Students may have difficulty defining an object's weight as the resistance force in a simple machine scenario.
- Students may have difficulty rearranging force and motion equations to solve for a different variable.

Key concept	Related concept(s)	Global context
Relationships Relationships are the connections and associations between properties, objects, people and ideas— including the human community's connections with the world in which we live. Any change in relationship brings consequences—some of which may occur on a small scale, while others may be far-reaching, affecting large networks and systems such as human societies and the planetary ecosystem.	Movement (MYP/CCC)	**Scientific and Technical Innovation** Students will explore the natural world and its laws; the interaction between people and the natural world; how humans use their understanding of scientific principles; the impact of scientific and technological advances on communities and environments; the impact of environments on human activity; how humans adapt environments to their needs.

Statement of inquiry

Advances in science and technology have furthered humans' understanding of the relationship between forces, mass, and motion (velocity and acceleration) in systems.

Inquiry questions

Factual

How do I define speed, distance, velocity, and acceleration?
What is the difference between distance and displacement?

What are Newton's Laws of Motion?
What are some types of forces?
What units are used to measure force?
What are balanced and unbalanced forces?
What is inertia?
What factors impact the strength of the gravitational force between two objects?
How does an object's mass differ from its weight?
What is work?
What are some examples of simple machines?
What is mechanical advantage?

Conceptual

How can I view the relationships between speed and distance, and velocity and acceleration using motion graphs?
How are force, mass, and acceleration related?
How are force, mass, and acceleration calculated?
How can I model the forces acting on an object?
How can I determine the net force of a system?
How can I use Newton's Laws to predict an object's motion?
How do simple machines change the size and direction of the force needed to do work?

Debatable

Which simple machine produces the most amount of mechanical advantage based on the least amount of variable change?
Which class of lever would commonly provide the most amount of mechanical advantage as a regular design?
Which of Newton's 3 laws is the most important? Why?

MYP Objectives	**Assessment Tasks**	
*What specific MYP **objectives** will be addressed during this unit?*	***Relationship** between summative assessment task(s) and statement of inquiry:*	*List of common formative and summative assessments.*
Science A: Knowing and Understanding I. describe scientific knowledge Ii. apply scientific knowledge and understanding to solve	SOI: Advances in science and technology have furthered humans' understanding of the relationship between forces, mass, and motion (velocity and acceleration) in systems. In this unit, students will explore and examine the relationships between the concepts of forces, motion, Newton's Laws, work, and mechanical advantage in systems to create visual, mathematical, and graphical models. They will use their understanding of the relationships between force, mass, and acceleration to evaluate multiple scenarios and calculate net forces, force, mass, and	**Formative Assessment(s):** NA **Summative Assessment(s):** Forces & Motion Unit Assessment

problems set in familiar and unfamiliar situations Science B: Inquiring and Designing Iv. design scientific investigations Science C: Processing and Evaluating: I. present collected and transformed data Ii. interpret data and results using scientific reasoning Science D: Reflecting on the Impacts of Science I. apply scientific language effectively	acceleration as appropriate. They will also investigate the scientific definition of work and how science and technology has leveraged the relationship between force and distance by using simple machines to simplify tasks. Students will also reflect upon science's role in preventing and minimizing injuries during collisions through modeling and laboratory exercises.	Work, Mechanical Advantage, and Simple Machines Unit Assessment
Approaches to learning (ATL)		
Category: Research **Cluster:** Information Literacy Skills **Skill Indicator:** Collect and analyze data to identify solutions and make informed decisions.		

Learning Experiences Add additional rows below as needed.		
Objective or Content	**Learning Experiences**	**Personalized Learning and Differentiation**
SPS8. Obtain, evaluate, and communicate information to explain the relationships among force, mass, and motion. **a.** Plan and carry out an investigation and analyze the motion of an object using mathematical and graphical models. (*Clarification statement:* Mathematical and graphical models could include distance, displacement, speed, velocity, and acceleration.)	Exploring Motion using Ticker Tape Lab Analyzing and Interpreting Motion Graphs	• Discovery Education High School Physics Science Techbook • NGSS Case Studies for Differentiated Learners • Next Generation Science Standards: "All Standards, All Students" • Extensions – Enrichment Tasks/Projects All information included by PLC in the differentiation box is the responsibility and ownership of the local school to review and approve per Board Policy IKB. Task-Specific Differentiation • Scaffolding of Practice • Modeling (Visual, Graphical, Mathematical) • Small Group • Multiple Means of Engagement • Multiple Means of Content Representation (laboratories, SIM, DE Techbook) • Multiple Means of Action and Expression
SPS8. Obtain, evaluate, and communicate information to explain the relationships among force, mass, and motion. **b.** Construct an explanation based on experimental evidence to support the claims presented in Newton's three laws of motion. (*Clarification statement:* Evidence could demonstrate the relationships among force, mass, velocity, and acceleration.)	Forces and Motion PHET Newton's 3 Laws Choice Stations	
SPS8. Obtain, evaluate, and communicate information to explain the relationships among force, mass, and motion. **c.** Analyze and interpret data to identify the relationship between mass and gravitational force for falling objects.	Analyzing and Interpreting Motion Graphs Forces and Motion PHET	

SPS8. Obtain, evaluate, and communicate information to explain the relationships among force, mass, and motion. **d.** Use mathematics and computational thinking to identify the relationships between work, mechanical advantage, and simple machines.	Elaboration: Mechanical Advantage Problems Simple Machines and Calculating AMA/IMA Lab	

Content Resources

GaDOE Instructional Segment: Force and Motion

PhET: Masses and Springs

Discovery Education Physics Techbook:

Unit 1: Introduction to Force and Motion

- Concept 1.1: Fundamental Forces
- Concept 1.2: Gravity
- Concept 1.6: Work and Power

Unit 2: Motion

- Concept 2.1: Using Vectors and Scalars to Describe Motion (Scalars Only!!)
- Concept 2.2: Understanding and Describing Motion
- Concept 2.3: Newton's First Law of Motion
- Concept 2.4: Newton's Second Law of Motion
- Concept 2.5: Newton's Third Law of Motion
- Concept 2.6: Applying Newton's Laws of Motion
- Concept 2.7: Free Body Diagrams
- Concept 2.8: Solving Motion Problems

The Physics Classroom:

-1-D Kinematics

-Newton's Laws

-Work and Energy