### Reading Focus: Informational, Literature
Writing Focus: Narrative, Informative/Explanatory

### Unifying Concept:
Students will understand relationships between motion and force; the laws that govern these relationships.

### Quarter 1

#### Enduring Understandings:
The movement of an object can be analyzed using mathematical relationships that exist among position, velocity, and acceleration.

Without an outside force, a system will remain in stasis.

The change in the system is directly related to the inertia of the system.

All forces in the universe come in interactive pairs between two systems (Newton’s 3rd Law).

#### Essential Questions:
- How does physics serve to improve our understanding of physical systems?
- How do the principles of physics affect your daily life?
- What types of questions and hypotheses can be answered by science?
- How can we ensure that scientific investigations are both safe and consistent with standard scientific practice?
- How do we know whether the conclusions of a scientific investigation are valid?
- How do forces explain motion?

#### Academic Vocabulary:
- Movement
- Analyze Position
- Acceleration
- Force
- Stasis
- Inertia
- Universe
- Interactive pairs
- Newton’s 3rd Law
- Physical systems
- Motion
- Mathematical relationships

#### Standards

<table>
<thead>
<tr>
<th>Highly-Leveraged Standards</th>
<th>Supporting Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strand 5: Physical Science</strong></td>
<td><strong>Strand 5: Physical Science</strong></td>
</tr>
<tr>
<td>HS.SS.C2 Motions and Forces: Analyze relationships between forces and motion.</td>
<td>HS.SS.C3: Conservation of Energy and Increase in Disorder</td>
</tr>
<tr>
<td>PO1. Determine the rate of change of a quantity (e.g., rate of erosion, rate of reaction, rate of growth, velocity).</td>
<td>Understand ways that energy is conserved, stored, and transferred.</td>
</tr>
<tr>
<td>PO2. Analyze the relationships among position, velocity, acceleration, and time:</td>
<td>PO 3. Recognize that energy is conserved in a closed system.</td>
</tr>
<tr>
<td>• Graphically</td>
<td>PO 7. Explain how molecular motion is related to temperature and phase changes.</td>
</tr>
<tr>
<td>• Mathematically</td>
<td></td>
</tr>
<tr>
<td>PO3. Explain how Newton’s 1st Law applies to objects at rest or moving at constant velocity.</td>
<td></td>
</tr>
<tr>
<td>PO4. Using Newton’s 2nd Law applies to objects at rest or moving at constant velocity.</td>
<td></td>
</tr>
<tr>
<td>• Graphically</td>
<td></td>
</tr>
<tr>
<td>• Mathematically</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Office of Curriculum, Instruction, and Professional Development
### PO5. Use Newton’s 3rd Law to explain forces as interactions between bodies (e.g., a table pushing up on a vase that is pushing down on it; an athlete pushing on a basketball as the ball pushes back on her).

### PO6. Analyze the two-dimensional motion of objects by using vectors and their components.

### PO7. Give an example that shows the independence of the horizontal and vertical components of projectile motion.

### PO10. Describe the nature and magnitude of frictional forces.

### Constant Standards

**Strand 1: Inquiry Process (HLS-34%)**

**HS.S1.C1 Observations, Questions, and Hypotheses:** Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.  
**PO1.** Evaluate scientific information for relevance to a given problem  
**PO2.** Develop questions from observations that transition into testable hypotheses.  
**PO3.** Formulate a testable hypothesis.  
**PO4.** Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).

**PO1.** Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, organisms) and behavior in all science inquiry.  
**PO2.** Identify the resources needed to conduct an investigation.  
**PO3.** Design an appropriate protocol (written plan of action) for testing a hypothesis:  
- Identify dependent and independent variables in a controlled investigation.  
- Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes).  
- Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators).  
**PO4.** Conduct a scientific investigation that is based on a research design.  
**PO5.** Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.

**HS.S1.C3 Analysis, Conclusion, and Refinements:** Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.  
**PO1.** Interpret data that show a variety of possible relationship between variables, including:  
- Positive relationship  
- Negative relationship  
- No relationship  
**PO2.** Evaluate whether investigational data support or do not support the proposed hypothesis.  
**PO3.** Critique reports of scientific studies (e.g., published papers, student reports).  
**PO4.** Evaluate the design of an investigation to identify possible sources of procedural error, including:  
- Sample size  
- Trials
• Controls
• Analyses

**PO5.** Design models (conceptual or physical) of the following to represent “real world” scenarios:
- Carbon cycle
- Water cycle
- Phase change
- Collisions

**PO6.** Use descriptive statistics to analyze data, including:
- Mean, Frequency and Range

**PO7.** Propose further investigations based on the findings of a conducted investigation.

**HS.S1.C4 Communication:** Communicate results of investigations.

**PO1.** For a specific investigation, choose an appropriate method for communicating the results.
**PO2.** Produce graphs that communicate data.
**PO3.** Communicate results clearly and logically.
**PO4.** Support conclusions with logical scientific arguments.

**Strand 2: History and Nature of Science**

**HS.S2.C1 History of Science as a Human Endeavor:** Identify individual, cultural, and technological contributions to scientific knowledge.

**PO1.** Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.
**PO2.** Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.
**PO3.** Analyze how specific changes in science have affected society.
**PO4.** Analyze how specific cultural and/or societal issues promote or hinder scientific advancements.

**HS.S2.C2 Nature of Scientific Knowledge:** Understand how science is a process for generating knowledge.

**PO1.** Specify the requirements of a valid, scientific explanation (theory), including that it be:
- Logical
- Subject to peer review
- Public
- Respectful of rules of evidence

**PO2.** Explain the process by which accepted ideas are challenged or extended by scientific innovation.
**PO3.** Distinguish between pure and applied science.
**PO4.** Describe how scientists continue to investigate and critically analyze aspects of theories.

**Strand 3: Science in Personal and Social Perspectives**

**HS.S3.C2 Science and Technology in Society:** Develop viable solutions to a need or problem.

**PO1.** Analyze the costs, benefits, and risks of various ways of dealing with the following needs or problems:
2018-2019 Science Curriculum Map, Physics, Q1

- Various forms of alternative energy
- Storage of nuclear waste
- Abandoned mines
- Greenhouse gases
- Hazardous wastes

PO2. Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.

PO3. Support a position on a science or technology issue.

PO4. Analyze the use of renewable and nonrenewable resources in Arizona.
- Water, land, soil, minerals, air

PO5. Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology).


PO1. Analyze social factors that limit the growth of a human population, including:
- Affluence, education, access to health care, cultural influences

PO2. Describe biotic (living) and abiotic (nonliving) factors that affect human populations.

PO3. Predict the effect of a change in a specific factor on a human population.

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Crosscutting Concepts (CCC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practices describe a robust process for how scientists investigate and build models and theories of the natural world or how engineers design and build systems.</td>
<td></td>
</tr>
<tr>
<td>• Ask questions and define problems</td>
<td></td>
</tr>
<tr>
<td>• Develop and use models</td>
<td></td>
</tr>
<tr>
<td>• Plan and carry out investigations</td>
<td></td>
</tr>
<tr>
<td>• Analyze and interpret data</td>
<td></td>
</tr>
<tr>
<td>• Use mathematics and computational thinking</td>
<td></td>
</tr>
<tr>
<td>• Construct explanations and design solutions</td>
<td></td>
</tr>
<tr>
<td>• Engage in argument from evidence</td>
<td></td>
</tr>
<tr>
<td>• Obtain, evaluate, and communicate information</td>
<td></td>
</tr>
<tr>
<td>Cross boundaries between science disciplines and provide an organizational framework to connect knowledge from various disciplines into a coherent and scientifically based view of the world.</td>
<td></td>
</tr>
<tr>
<td>Patterns</td>
<td>Cause &amp; Effect</td>
</tr>
<tr>
<td>Stability &amp; Change</td>
<td>Systems &amp; System Models</td>
</tr>
<tr>
<td>Scale, Proportion, &amp; Quantity</td>
<td>Energy &amp; Matter</td>
</tr>
</tbody>
</table>

Social Justice Standards

Identity
Students will know their family history and cultural background and can describe how their own identity is informed and shaped by their membership in multiple identity groups. (ID.9-12.2)
Students will know that all their group identities and the intersection of those identities create unique aspects of who there are and that this is true for other people too. (ID.9-12.3)
Students will express pride and confidence in their identity without perceiving or treating anyone else as inferior. (ID.9-12.4)

Diversity
Students will use language and knowledge to accurately and respectfully describe how people (including themselves) are both similar to and different from each other and others in their identity groups. (DI.9-12.7)

Students will respectfully express curiosity about the history and lived experiences of others and will exchange ideas and beliefs in an open-minded way. (DI.9-12.8)

Students will relate to and build connections with other people by showing them empathy, respect and understanding, regardless of their similarities or differences. (DI.9-12.9)

**Justice**

Students will be aware of the advantages and disadvantages they have in society because of their membership in different identity groups, and their knowledge of how this has affected their lives. (JU.9-12.14)

**Action**

Students express empathy when people are excluded or mistreated because of their identities and concern when they personally experience bias. (AC.9-12.16)

Students have the courage to speak up to people when their words, actions or views are biased and hurtful, and they will communicate with respect even when others disagree. (AC.9-12.18)

**Teaching Tolerance Anti-Bias Framework**  [https://www.tolerance.org/frameworks](https://www.tolerance.org/frameworks)

---

### Adopted Texts and Materials

**Textbook:**
- Holt Physics Textbook
- Serway-Faughn Instructor Demos
- Sci Links
- Other titles may be available; please see TUSD Textbook Distribution Center on TUSD website

**Instructional and Assessment Guides**

**Additional Instructional Resources**

### Culturally Responsive Practices (TUSD SPARKS, SPARKS Strategies)

**Pre/Post Unit Assessment Examples:**
- Physics Lab Practicums (e.g. Atwood’s Machine, Personal Power)
- Sample Assessments
- Physics Sample Test

**Formative & Performance Assessment Examples**
- LABS- Lab activity assessments
- Quick writes

---

### Instructional Resources:

- Safety in the Science Classroom
- High School Lab Safety
- Serway-Faughn Instructor Demos
- The Physics Front
- Newtonian Mechanics
- Kinematics
- MIT Physics Labs
- Socratic Seminar
- DOK Levels
- DOK Stems
- **Lab Reports** (e.g. Gravitational Force, Frictional Force, Modified Atwood’s Machine, Elastic Energy, Energy Transfer)
- **Engage in arguments with evidence and reasoning - Tools** (e.g. to support or refute subject related claims).

- **Hess’s Matrix**
- **Science and Engineering Practices**
- **Reading and Writing in the Science Classroom**
- **Newton’s Laws with Learning Cycles**
- **National Science Digital Library**

---

1**Highly-Leveraged Standards** are essential for students to learn because they have endurance (knowledge and skills relevant throughout a student’s lifetime); leverage (knowledge and skills used across multiple content areas); and essentiality (knowledge and skills necessary for success in future courses or grade levels). This definition for Highly-Leveraged Standards was adapted from the “power standard” definition on the website of the Millis Public Schools, K-12, Massachusetts, USA, 2016.

2**Supporting Standards** are emphasized during the quarter as they are integral to achieve mastery of the Highly Leveraged Standards. Mastery of these standards are measured using classroom assessments.

3**Constant Standards** are repeatedly addressed to reinforce grade-level mastery.
**Reading Focus: Informational, Literature**  
**Writing Focus: Narrative, Informative/Explanatory**

**Unifying Concept:**  
Students will understand the relationships between force, work, and energy; the conservation of energy in a system; the laws of thermodynamics.

**Quarter 2**

**Enduring Understandings:**
- Energy is conserved in a closed system and energy can be quantitatively determined.  
- Momentum is changed by an impulse exerted on a system.  
- The total momentum is conserved during a collision or recoil situation.  
- Heat is energy that is transferred between objects at different temperatures.  
- Energy is conserved for any system and its environment as described by the first law of thermodynamics.  
- The total entropy of the universe is always increasing.

**Essential Questions:**
- Which explanations account for how things behave in nature?  
- What is energy?  
- How does our understanding of the properties and motion of objects change when those objects are very small (subatomic particles), very large or far apart (stars, galaxies), or moving very fast (particles moving at or close to the speed of light)?  
- How is energy transferred and conserved?  
- How are different energy sources measured and used in real world applications?

**Academic Vocabulary:**
- Energy  
- conserved  
- closed system  
- quantitative  
- Momentum  
- exerted  
- System  
- collision  
- recoil situation  
- transferred  
- environment  
- entropy  
- universe  
- nature  
- relationships  
- force  
- work  
- properties  
- objects  
- stars  
- galaxies  
- particles  
- subatomic particles  
- laws of thermodynamics

### Standards

**Highly-Leveraged Standards**

**Strand 5: Physical Science**

**HS.SS.C2 Motions and Forces:** Analyze relationships between forces and motion.

- **PO13.** Analyze the impulse required to produce a change in momentum.  
- **PO14.** Quantify interactions between objects to show that the total momentum is conserved in both collision and recoil situations.

**HS.SS.C3 Conservation of Energy and Increase in Disorder:** Understand ways that energy is conserved, stored, and transferred.

- **PO1.** Describe the following ways in which energy is stored in a system.
  - Mechanical, electrical, chemical, nuclear  
- **PO2.** Describe various ways in which energy is transferred from one system to another (e.g., mechanical contact, thermal conduction, electromagnetic radiation).

**Supporting Standards**

**HS.SS.C2 Motions and Forces:** Analyze relationships between forces and motion.

- **PO1.** Determine the rate of change of a quantity (e.g., rate of erosion, rate of reaction, rate of growth, velocity).  
- **PO2.** Analyze the relationships among position, velocity, acceleration, and time:
  - Graphically  
  - Mathematically  
- **PO3.** Explain how Newton’s 1st Law applies to objects at rest or moving at constant velocity.  
- **PO4.** Using Newton’s 2nd Law applies to objects at rest or moving at constant velocity:
  - Graphically  
  - Mathematically
PO3. Recognize that energy is conserved in a closed system.
PO4. Calculate quantitative relationships associated with the conservation of energy.
PO5. Analyze the relationship between energy transfer and disorder in the universe (2nd Law of Thermodynamics).
PO6. Distinguish between heat and temperature.
PO7. Explain how molecular motion is related to temperature and phase changes.

Understand the interactions of energy and matter.
PO8. Describe the relationship among electric potential, current, and resistance in an ohmic system.
PO9. Quantify the relationships among electric potential, current, and resistance in an ohmic system.

PO5. Use Newton’s 3rd Law to explain forces as interactions between bodies (e.g., a table pushing up on a vase that is pushing down on it; an athlete pushing on a basketball as the ball pushes back on her).
PO6. Analyze the two-dimensional motion of objects by using vectors and their components.
PO7. Give an example that shows the independence of the horizontal and vertical components of projectile motion.
PO10. Describe the nature and magnitude of frictional forces.

Constant Standards

Strand 1: Inquiry Process (HLS-34%)

HS.S1.C1 Observations, Questions, and Hypotheses: Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.
PO1. Evaluate scientific information for relevance to a given problem
PO2. Develop questions from observations that transition into testable hypotheses.
PO3. Formulate a testable hypothesis.
PO4. Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).

PO1. Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, organisms) and behavior in all science inquiry.
PO2. Identify the resources needed to conduct an investigation.
PO3. Design an appropriate protocol (written plan of action) for testing a hypothesis:
  - Identify dependent and independent variables in a controlled investigation.
  - Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes).
  - Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators).
PO4. Conduct a scientific investigation that is based on a research design.
PO5. Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.

HS.S1.C3 Analysis, Conclusion, and Refinements: Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.
PO1. Interpret data that show a variety of possible relationship between variables, including:
  - Positive relationship
• Negative relationship
• No relationship
**PO2.** Evaluate whether investigational data support or do not support the proposed hypothesis.

**PO3.** Critique reports of scientific studies (e.g., published papers, student reports).

**PO4.** Evaluate the design of an investigation to identify possible sources of procedural error, including:
• Sample size
• Trials
• Controls
• Analyses

**PO5.** Design models (conceptual or physical) of the following to represent “real world’ scenarios:
• Carbon cycle
• Water cycle
• Phase change
• Collisions

**PO6.** Use descriptive statistics to analyze data, including:
• Mean, Frequency and Range

**PO7.** Propose further investigations based on the findings of a conducted investigation.

**HS.S1.C4 Communication:** Communicate results of investigations.

**PO1.** For a specific investigation, choose an appropriate method for communicating the results.

**PO2.** Produce graphs that communicate data.

**PO3.** Communicate results clearly and logically.

**PO4.** Support conclusions with logical scientific arguments.

**Strand 2: History and Nature of Science**

**HS.S2.C1 History of Science as a Human Endeavor:** Identify individual, cultural, and technological contributions to scientific knowledge.

**PO1.** Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.

**PO2.** Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.

**PO3.** Analyze how specific changes in science have affected society.

**PO4.** Analyze how specific cultural and/or societal issued promote or hinder scientific advancements.

**HS-S2-C2 Nature of Scientific Knowledge:** Understand how science is a process for generating knowledge.

**PO1.** Specify the requirements of a valid, scientific explanation (theory), including that it be:
• Logical
• Subject to peer review
• Public
• Respectful of rules of evidence
PO2. Explain the process by which accepted ideas are challenged or extended by scientific innovation.

PO3. Distinguish between pure and applied science.

PO4. Describe how scientists continue to investigate and critically analyze aspects of theories.

Strand 3: Science in Personal and Social Perspectives

HS.S3.C2 Science and Technology in Society: Develop viable solutions to a need or problem.

PO1. Analyze the costs, benefits, and risks of various ways of dealing with the following needs or problems:
   - Various forms of alternative energy
   - Storage of nuclear waste
   - Abandoned mines
   - Greenhouse gases
   - Hazardous wastes

PO2. Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.

PO3. Support a position on a science or technology issue.

PO4. Analyze the use of renewable and nonrenewable resources in Arizona.
   - Water, land, soil, minerals, air

PO5. Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology).


PO1. Analyze social factors that limit the growth of a human population, including:
   - Affluence, education, access to health care, cultural influences

PO2. Describe biotic (living) and abiotic (nonliving) factors that affect human populations.

PO3. Predict the effect of a change in a specific factor on a human population.

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Crosscutting Concepts (CCC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practices describe a robust process for how scientists investigate and build models and theories of the natural world or how engineers design and build systems.</td>
<td>Cross boundaries between science disciplines and provide an organizational framework to connect knowledge from various disciplines into a coherent and scientifically based view of the world.</td>
</tr>
<tr>
<td>• Ask questions and define problems</td>
<td>Patterns</td>
</tr>
<tr>
<td>• Develop and use models</td>
<td>Cause &amp; Effect</td>
</tr>
<tr>
<td>• Plan and carry out investigations</td>
<td>Structure &amp; Function</td>
</tr>
<tr>
<td>• Analyze and interpret data</td>
<td>Stability &amp; Change</td>
</tr>
<tr>
<td>• Use mathematics and computational thinking</td>
<td>Systems &amp; System Models</td>
</tr>
<tr>
<td>• Construct explanations and design solutions</td>
<td>Scale, Proportion, &amp; Quantity</td>
</tr>
<tr>
<td>• Engage in argument from evidence</td>
<td>Energy &amp; Matter</td>
</tr>
<tr>
<td>• Obtain, evaluate, and communicate information</td>
<td></td>
</tr>
</tbody>
</table>

Social Justice Standards
**Identity**
Students will know their family history and cultural background and can describe how their own identify is informed and shaped by their membership in multiple identity groups. (ID.9-12.2)
Students will know that all their group identities and the intersection of those identities create unique aspects of who there are and that this is true for other people too. (ID.9-12.3)
Students will express pride and confidence in their identity without perceiving or treating anyone else as inferior. (ID.9-12.4)

**Diversity**
Students will use language and knowledge to accurately and respectfully describe how people (including themselves) are both similar to and different from each other and others in their identity groups. (DI.9-12.7)
Students will respectfully express curiosity about the history and lived experiences of others and will exchange ideas and beliefs in an open-minded way. (DI.9-12.8)
Students will relate to and build connections with other people by showing them empathy, respect and understanding, regardless of their similarities or differences. (DI.9-12.9)

**Justice**
Students will be aware of the advantages and disadvantages they have in society because of their membership in different identity groups, and their knowledge of how this has affected their lives. (JU.9-12.14)

**Action**
Students express empathy when people are excluded or mistreated because of their identities and concern when they personally experience bias. (AC.9-12.16)
Students have the courage to speak up to people when their words, actions or views are biased and hurtful, and they will communicate with respect even when others disagree. (AC.9-12.18)

**Teaching Tolerance Anti-Bias Framework**  [https://www.tolerance.org/frameworks](https://www.tolerance.org/frameworks)

### Adopted Texts and Materials

<table>
<thead>
<tr>
<th>Textbook:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Holt Physics Textbook</td>
</tr>
<tr>
<td>• Serway-Faughn Instructor Demos</td>
</tr>
<tr>
<td>• Sci Links</td>
</tr>
<tr>
<td>• Other titles may be available; please see TUSD Textbook Distribution Center on TUSD website</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Instructional Resources:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Physics Classroom</td>
</tr>
<tr>
<td>• Energy and Momentum</td>
</tr>
<tr>
<td>• Kinematics Equations</td>
</tr>
<tr>
<td>• Online Resources and Tools</td>
</tr>
<tr>
<td>• Phet Simulations</td>
</tr>
<tr>
<td>• AMTA Modeling Instruction Materials</td>
</tr>
<tr>
<td>• Hyper Physics</td>
</tr>
<tr>
<td>• Physics online tools</td>
</tr>
<tr>
<td>• Physics Simulations</td>
</tr>
<tr>
<td>• Rotational Motion</td>
</tr>
<tr>
<td>• Open source Physics Text</td>
</tr>
</tbody>
</table>

### Instructional and Assessment Guides

<table>
<thead>
<tr>
<th>Culturally Responsive Practices (TUSD SPARKS, SPARKS Strategies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Standards for Literacy in Science</td>
</tr>
<tr>
<td>• Science and Engineering Practices</td>
</tr>
<tr>
<td>• Safety in the Science Classroom</td>
</tr>
</tbody>
</table>

### Pre/Post Unit Assessment Examples:

Office of Curriculum, Instruction, and Professional Development  Page 13  Last Edited: 3/15/2018
**Highly-Leveraged Standards** are essential for students to learn because they have endurance (knowledge and skills relevant throughout a student’s lifetime); leverage (knowledge and skills used across multiple content areas); and essentiality (knowledge and skills necessary for success in future courses or grade levels). This definition for Highly-Leveraged Standards was adapted from the “power standard” definition on the website of the Millis Public Schools, K-12, Massachusetts, USA, 2016.

**Supporting Standards** are emphasized during the quarter as they are integral to achieve mastery of the Highly Leveraged Standards. Mastery of these standards are measured using classroom assessments.

**Constant Standards** are repeatedly addressed to reinforce grade-level mastery.

---

<table>
<thead>
<tr>
<th><strong>Formative &amp; Performance Assessment Examples</strong></th>
<th><strong>Assessment Resources</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
</tr>
</tbody>
</table>

- Lab Practical with Formal Report
- Physics Quizzes/Unit Exams

- LABS- Lab activity assessments
- Lab Report format
- Writing Prompts
- Interactive quizzes; Bell work; Closure activities; KWL
- Database online tool for assessments
- Concept Maps; Presentations using PowerPoint, Prezi or similar technologies

- Science Assessment Tool
- http://pals.sri.com/
- MOSART
- Writing about Graphs

- High School Lab Safety
- Hess’s Matrix
- Socratic Seminar
- Physics Resources
- Virtual Lab: Gas Laws
- Reading and Writing in the Science Classroom
**Reading Focus:** Informational, Literature
**Writing Focus:** Narrative, Informative/Explanatory

**Unifying Concept:**
Students will understand the relationship between circular motion and universal gravitation.

**Quarter 3**

**Enduring Understandings:**
- Gravitational pull is universal.
- Gravitational pull/force can be quantified and calculated using Newton's Law of Universal Gravitation.
- The speed of light is constant and nothing travels faster than the speed of light.
- Velocity, acceleration, and force adhere to the same laws when on a circular path as on a straight path.

**Essential Questions:**
- What is Newton’s Law of Universal Gravitation and why is it important?
- What does it mean when we say that gravitation is universal?
- What is the ultimate speed limit?
- What is the difference between centrifugal and centripetal? Why is this important?
- What is the relationship among velocity, acceleration, and force when traveling in a circle/on a curve?

**Academic Vocabulary:**
- Gravity
- Gravitational pull
- Universal
- Force
- Pull
- Quantified
- Calculate
- Speed
- Newton’s Law of Universal Gravitation
- Velocity
- Curve
- Acceleration
- Straight path
- Circular path
- Centripetal
- Centrifugal

### Standards

#### Highly-Leveraged Standards

**Strand 5: Physical Science**

**HS.SS.C2 Motions and Forces:** Analyze relationships between forces and motion.

**PO4.** Using Newton’s 2nd Law applies to objects at rest or moving at constant velocity.
- Graphically
- Mathematically

**PO8.** Analyze the general relationships among force, acceleration, and motion for an object undergoing uniform circular motion.

**PO11.** Using the Law of Universal Gravitation, predict how the gravitational force will change when the distance between two masses changes or the mass of one of them changes.

#### Supporting Standards

**Strand 5: Physical Science**

**HS.SS.C2 Motions and Forces:** Analyze relationships between forces and motion.

**PO1.** Determine the rate of change of a quantity (e.g., rate of erosion, rate of reaction, rate of growth, velocity).

**PO2.** Analyze the relationships among position, velocity, acceleration, and time:
- Graphically
- Mathematically

**PO3.** Explain how Newton’s 1st Law applies to objects at rest or moving at constant velocity.

**PO4.** Using Newton’s 2nd Law applies to objects at rest or moving at constant velocity.
- Graphically
- Mathematically

**PO5.** Use Newton’s 3rd Law to explain forces as interactions between bodies (e.g., a table pushing up on a vase that is pushing down on it; an athlete pushing on a basketball as the ball pushes back on her).

**PO6.** Analyze the two-dimensional motion of objects by using vectors and their components.
<table>
<thead>
<tr>
<th>Constant Standards³</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strand 1: Inquiry Process (HLS-34%)</strong></td>
</tr>
<tr>
<td><strong>HS.S1.C1 Observations, Questions, and Hypotheses</strong>: Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.</td>
</tr>
<tr>
<td><strong>PO1.</strong> Evaluate scientific information for relevance to a given problem</td>
</tr>
<tr>
<td><strong>PO2.</strong> Develop questions from observations that transition into testable hypotheses.</td>
</tr>
<tr>
<td><strong>PO3.</strong> Formulate a testable hypothesis.</td>
</tr>
<tr>
<td><strong>PO4.</strong> Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).</td>
</tr>
<tr>
<td><strong>PO1.</strong> Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, organisms) and behavior in all science inquiry.</td>
</tr>
<tr>
<td><strong>PO2.</strong> Identify the resources needed to conduct an investigation.</td>
</tr>
<tr>
<td><strong>PO3.</strong> Design an appropriate protocol (written plan of action) for testing a hypothesis:</td>
</tr>
<tr>
<td>- Identify dependent and independent variables in a controlled investigation.</td>
</tr>
<tr>
<td>- Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes).</td>
</tr>
<tr>
<td>- Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators).</td>
</tr>
<tr>
<td><strong>PO4.</strong> Conduct a scientific investigation that is based on a research design.</td>
</tr>
<tr>
<td><strong>PO5.</strong> Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.</td>
</tr>
<tr>
<td><strong>HS.S1.C3 Analysis, Conclusion, and Refinements</strong>: Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.</td>
</tr>
<tr>
<td><strong>PO1.</strong> Interpret data that show a variety of possible relationship between variables, including:</td>
</tr>
<tr>
<td>- Positive relationship</td>
</tr>
<tr>
<td>- Negative relationship</td>
</tr>
<tr>
<td>- No relationship</td>
</tr>
<tr>
<td><strong>PO2.</strong> Evaluate whether investigational data support or do not support the proposed hypothesis.</td>
</tr>
<tr>
<td><strong>PO3.</strong> Critique reports of scientific studies (e.g., published papers, student reports).</td>
</tr>
<tr>
<td><strong>PO4.</strong> Evaluate the design of an investigation to identify possible sources of procedural error, including:</td>
</tr>
<tr>
<td>- Sample size</td>
</tr>
<tr>
<td>- Trials</td>
</tr>
<tr>
<td>- Controls</td>
</tr>
<tr>
<td>- Analyses</td>
</tr>
<tr>
<td><strong>PO5.</strong> Design models (conceptual or physical) of the following to represent “real world” scenarios:</td>
</tr>
<tr>
<td>- Carbon cycle</td>
</tr>
<tr>
<td>- Water cycle</td>
</tr>
</tbody>
</table>

**PO7.** Give an example that shows the independence of the horizontal and vertical components of projectile motion.  
**PO10.** Describe the nature and magnitude of frictional forces.
- Phase change
- Collisions

**PO6.** Use descriptive statistics to analyze data, including:
- Mean, Frequency and Range

**PO7.** Propose further investigations based on the findings of a conducted investigation.

**HS.S1.C4 Communication:** Communicate results of investigations.

**PO1.** For a specific investigation, choose an appropriate method for communicating the results.

**PO2.** Produce graphs that communicate data.

**PO3.** Communicate results clearly and logically.

**PO4.** Support conclusions with logical scientific arguments.

**Strand 2: History and Nature of Science**

**HS.S2.C1 History of Science as a Human Endeavor:** Identify individual, cultural, and technological contributions to scientific knowledge.

**PO1.** Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.

**PO2.** Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.

**PO3.** Analyze how specific changes in science have affected society.

**PO4.** Analyze how specific cultural and/or societal issues promote or hinder scientific advancements.

**HS.S2.C2 Nature of Scientific Knowledge:** Understand how science is a process for generating knowledge.

**PO1.** Specify the requirements of a valid, scientific explanation (theory), including that it be:
- Logical
- Subject to peer review
- Public
- Respectful of rules of evidence

**PO2.** Explain the process by which accepted ideas are challenged or extended by scientific innovation.

**PO3.** Distinguish between pure and applied science.

**PO4.** Describe how scientists continue to investigate and critically analyze aspects of theories.

**Strand 3: Science in Personal and Social Perspectives**

**HS.S3.C2 Science and Technology in Society:** Develop viable solutions to a need or problem.

**PO1.** Analyze the costs, benefits, and risks of various ways of dealing with the following needs or problems:
- Various forms of alternative energy
- Storage of nuclear waste
- Abandoned mines
- Greenhouse gases
- Hazardous wastes

**PO2.** Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.

**PO3.** Support a position on a science or technology issue.

**PO4.** Analyze the use of renewable and nonrenewable resources in Arizona.
- Water, land, soil, minerals, air

**PO5.** Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology).

**HS.S3.C3 Human Population Characteristics:** Analyze Factors that affect human populations.

**PO1.** Analyze social factors that limit the growth of a human population, including:
- Affluence, education, access to health care, cultural influences

**PO2.** Describe biotic (living) and abiotic (nonliving) factors that affect human populations.

**PO3.** Predict the effect of a change in a specific factor on a human population.

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Crosscutting Concepts (CCC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practices describe a robust process for how scientists investigate and build models and theories of the natural world or how engineers design and build systems.</td>
<td>Cross boundaries between science disciplines and provide an organizational framework to connect knowledge from various disciplines into a coherent and scientifically based view of the world.</td>
</tr>
<tr>
<td>- Ask questions and define problems</td>
<td>Patterns</td>
</tr>
<tr>
<td>- Develop and use models</td>
<td>Cause &amp; Effect</td>
</tr>
<tr>
<td>- Plan and carry out investigations</td>
<td>Structure &amp; Function</td>
</tr>
<tr>
<td>- Analyze and interpret data</td>
<td>Stability &amp; Change</td>
</tr>
<tr>
<td>- Use mathematics and computational thinking</td>
<td>Systems &amp; System Models</td>
</tr>
<tr>
<td>- Construct explanations and design solutions</td>
<td>Scale, Proportion, &amp; Quantity</td>
</tr>
<tr>
<td>- Engage in argument from evidence</td>
<td>Energy &amp; Matter</td>
</tr>
<tr>
<td>- Obtain, evaluate, and communicate information</td>
<td></td>
</tr>
</tbody>
</table>

**Social Justice Standards**

**Identity**

Students will know their family history and cultural background and can describe how their own identify is informed and shaped by their membership in multiple identity groups. (ID.9-12.2)

Students will know that all their group identities and the intersection of those identities create unique aspects of who they are and that this is true for other people too. (ID.9-12.3)

Students will express pride and confidence in their identity without perceiving or treating anyone else as inferior. (ID.9-12.4)

**Diversity**

Students will use language and knowledge to accurately and respectfully describe how people (including themselves) are both similar to and different from each other and others in their identity groups. (DI.9-12.7)

Students will respectfully express curiosity about the history and lived experiences of others and will exchange ideas and beliefs in an open-minded way. (DI.9-12.8)
Students will relate to and build connections with other people by showing them empathy, respect and understanding, regardless of their similarities or differences. (DI.9-12.9)

**Justice**

Students will be aware of the advantages and disadvantages they have in society because of their membership in different identity groups, and their knowledge of how this has affected their lives. (JU.9-12.14)

**Action**

Students express empathy when people are excluded or mistreated because of their identities and concern when they personally experience bias. (AC.9-12.16)

Students have the courage to speak up to people when their words, actions or views are biased and hurtful, and they will communicate with respect even when others disagree. (AC.9-12.18)

Teaching Tolerance Anti-Bias Framework [https://www.tolerance.org/frameworks](https://www.tolerance.org/frameworks)

<table>
<thead>
<tr>
<th>Adopted Texts and Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Textbook:</strong></td>
</tr>
<tr>
<td>• <a href="#">Holt Physics Textbook</a></td>
</tr>
<tr>
<td>• <a href="#">Serway-Faughn Instructor Demos</a></td>
</tr>
<tr>
<td>• <a href="#">Sci Links</a></td>
</tr>
<tr>
<td>• Other titles may be available; please see TUSD Textbook Distribution Center on TUSD website</td>
</tr>
<tr>
<td><strong>Instructional and Assessment Guides</strong></td>
</tr>
<tr>
<td>• <a href="#">Physics Classroom</a></td>
</tr>
<tr>
<td>• <a href="#">One Dimensional Motion</a></td>
</tr>
<tr>
<td>• <a href="#">Kinematics Equations</a></td>
</tr>
<tr>
<td>• <a href="#">Online Resources and Tools</a></td>
</tr>
<tr>
<td>• <a href="#">Phet Simulations</a></td>
</tr>
<tr>
<td>• <a href="#">AMTA Modeling Instruction Materials</a></td>
</tr>
<tr>
<td>• <a href="#">Hyper Physics</a></td>
</tr>
<tr>
<td>• <a href="#">Physics online tools</a></td>
</tr>
<tr>
<td>• <a href="#">Physics Simulations</a></td>
</tr>
<tr>
<td>• <a href="#">Open source Physics Text</a></td>
</tr>
<tr>
<td>• <a href="#">Physics Help</a></td>
</tr>
<tr>
<td>• <a href="#">Online Labs</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Instructional Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office of Curriculum, Instruction, and Professional Development</td>
</tr>
</tbody>
</table>
| Culturally Responsive Practices (TUSD SPARKS, SPARKS Strategies) | Standards for Literacy in Science  
| Pre/Post Unit Assessment Examples:  
| - Lab Practical with Formal Report  
| - Physics Quizzes/Unit Exams  |
| - Physics Quizzes/Unit Exams  | - Science and Engineering Practices  
| Formative & Performance Assessment Examples  
| - Labs: Lab activity assessments  
| - Interactive quizzes; Bell work; Closure activities; KWL  
| - Database online tool for assessments  
| - Simulations; Cloud Computing; Modeling software programs; computer presentations and other educational technologies  
| - Concept Maps; Presentations using PowerPoint, Prezi or similar technologies  
| - Engage in Arguments with Evidence and Reasoning (e.g. to support or refute subject related claims)  |
| - Labs: Lab activity assessments  
| - Interactive quizzes; Bell work; Closure activities; KWL  
| - Database online tool for assessments  
| - Simulations; Cloud Computing; Modeling software programs; computer presentations and other educational technologies  
| - Concept Maps; Presentations using PowerPoint, Prezi or similar technologies  
| - Engage in Arguments with Evidence and Reasoning (e.g. to support or refute subject related claims)  |
| Assessment Resources  
| - Science Assessment Tool  
| - Rubrics in Physics  
| - http://pals.sri.com/  
| - MOSART  
| - Writing about Graphs  
| - Standards for Literacy in Science  
| - Science and Engineering Practices  
| - Hess’s Matrix  
| - Physics Central  
| - Physics Simulations  
| - Momentum Virtual Lab  
| - AAPT Physics articles  
| - Waves Labs  
| - Teaching Resources  
| - NSF Physics Resources  
| - Contributions of Women in Physics  
| - Reading and Writing in the Science Classroom  |

1Highly-Leveraged Standards are essential for students to learn because they have endurance (knowledge and skills relevant throughout a student’s lifetime); leverage (knowledge and skills used across multiple content areas); and essentiality (knowledge and skills necessary for success in future courses or grade levels). This definition for Highly-Leveraged Standards was adapted from the “power standard” definition on the website of the Millis Public Schools, K-12, Massachusetts, USA, 2016.

2Supporting Standards are emphasized during the quarter as they are integral to achieve mastery of the Highly Leverage Standards. Mastery of these standards are measured using classroom assessments.

3Constant Standards are repeatedly addressed to reinforce grade-level mastery.
### reading Focus: Informational, Literature

**Writing Focus:** Narrative, Informative/Explanatory

### quarter 4

**Enduring Understandings:**
- Sound is a wave.
- Light is both a wave and a particle.
- Harmonic motion and waves share common principles such as frequency, amplitude and period.
- Electrons can be excited by discrete, measurable photons of light.

**Essential Questions:**
- What is harmonic motion?
- What is a wave?
- What is the wave-particle duality?
- What is the relationship between frequency and wavelength?
- What is the relationship between electrons and photons?

**Academic Vocabulary:**
- Sound
- Wave
- Light
- Harmonic motion
- Particle
- Frequency
- Amplitude
- Discrete
- Electrons
- Measureable
- Photons of light
- Wave-particle duality
- Wavelength
- Relationship
- Inquiry

### Standards

#### Highly-Leveraged Standards

**HS.S5.C5 Interactions of Energy and Matter:** Understand the interactions of energy and matter.

**PO2.** Describe the following characteristics of waves:
- Wavelength, frequency, period, amplitude

**PO3.** Quantify the relationships among the frequency, wavelength, and the speed of light.

**PO7.** Explain the relationship between the wavelength of light absorbed or released by an atom or molecule and the transfer of a discrete amount of energy.

#### Supporting Standards

**HS.S5.C2: Motions and Forces:** Analyze relationships between forces and motion.

**PO1.** Determine the rate of change of a quantity (e.g., rate of erosion, rate of reaction, rate of growth, velocity).

**PO2.** Analyze the relationships among position, velocity, acceleration, and time:
- graphically
- mathematically

**PO3.** Explain how Newton’s 1st Law applies to objects at rest or moving at constant velocity.

**PO4.** Using Newton’s 2nd Law of Motion, analyze the relationships among the net force acting on a body, the mass of the body, and the resulting acceleration:
- graphically
- mathematically

**PO5.** Use Newton’s 3rd Law to explain forces as interactions between bodies (e.g., a table pushing up on a vase that is pushing down on it; an athlete pushing on a basketball as the ball pushes back on her).

**PO6.** Analyze the two-dimensional motion of objects by using vectors and their components.

**PO7.** Give an example that shows the independence of the horizontal and vertical components of projectile motion.
### Constant Standards

#### Strand 1: Inquiry Process (HLS-34%)

**HS.S1.C1 Observations, Questions, and Hypotheses:** Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.

- **PO1.** Evaluate scientific information for relevance to a given problem
- **PO2.** Develop questions from observations that transition into testable hypotheses.
- **PO3.** Formulate a testable hypothesis.
- **PO4.** Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).


- **PO1.** Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, organisms) and behavior in all science inquiry.
- **PO2.** Identify the resources needed to conduct an investigation.
- **PO3.** Design an appropriate protocol (written plan of action) for testing a hypothesis:
  - Identify dependent and independent variables in a controlled investigation.
  - Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes).
  - Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators).
- **PO4.** Conduct a scientific investigation that is based on a research design.
- **PO5.** Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.

**HS.S1.C3 Analysis, Conclusion, and Refinements:** Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.

- **PO1.** Interpret data that show a variety of possible relationship between variables, including:
  - Positive relationship
  - Negative relationship
  - No relationship
- **PO2.** Evaluate whether investigational data support or do not support the proposed hypothesis.
- **PO3.** Critique reports of scientific studies (e.g., published papers, student reports).
- **PO4.** Evaluate the design of an investigation to identify possible sources of procedural error, including:
  - Sample size
  - Trials
  - Controls
  - Analyses
- **PO5.** Design models (conceptual or physical) of the following to represent “real world” scenarios:
  - Carbon cycle
  - Water cycle
  - Phase change
  - Collisions
- **PO6.** Use descriptive statistics to analyze data, including:
  - Mean, Frequency and Range
PO7. Propose further investigations based on the findings of a conducted investigation.

**HS.S1.C4 Communication:** Communicate results of investigations.
PO1. For a specific investigation, choose an appropriate method for communicating the results.
PO2. Produce graphs that communicate data.
PO3. Communicate results clearly and logically.
PO4. Support conclusions with logical scientific arguments.

**Strand 2: History and Nature of Science**

**HS.S2.C1 History of Science as a Human Endeavor:** Identify individual, cultural, and technological contributions to scientific knowledge.
PO1. Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.
PO2. Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.
PO3. Analyze how specific changes in science have affected society.
PO4. Analyze how specific cultural and /or societal issues promote or hinder scientific advancements.

**HS.S2.C2 Nature of Scientific Knowledge:** Understand how science is a process for generating knowledge.
PO1. Specify the requirements of a valid, scientific explanation (theory), including that it be:
   - Logical
   - Subject to peer review
   - Public
   - Respectful of rules of evidence
PO2. Explain the process by which accepted ideas are challenged or extended by scientific innovation.
PO3. Distinguish between pure and applied science.
PO4. Describe how scientists continue to investigate and critically analyze aspects of theories.

**Strand 3: Science in Personal and Social Perspectives**

**HS.S3.C2 Science and Technology in Society:** Develop viable solutions to a need or problem.
PO1. Analyze the costs, benefits, and risks of various ways of dealing with the following needs or problems:
   - Various forms of alternative energy
   - Storage of nuclear waste
   - Abandoned mines
   - Greenhouse gases
   - Hazardous wastes
PO2. Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.
PO3. Support a position on a science or technology issue.
PO4. Analyze the use of renewable and nonrenewable resources in Arizona.
   - Water, land, soil, minerals, air
PO5. Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology).

**HS.S3.C3 Human Population Characteristics**: Analyze Factors that affect human populations.

PO1. Analyze social factors that limit the growth of a human population, including:
- Affluence, education, access to health care, cultural influences

PO2. Describe biotic (living) and abiotic (nonliving) factors that affect human populations.

PO3. Predict the effect of a change in a specific factor on a human population.

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Crosscutting Concepts (CCC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Practices describe a robust process for how scientists investigate and build models and theories of the natural world or how engineers design and build systems.</strong></td>
<td><strong>Cross boundaries between science disciplines and provide an organizational framework to connect knowledge from various disciplines into a coherent and scientifically based view of the world.</strong></td>
</tr>
<tr>
<td>• Ask questions and define problems</td>
<td>Patterns</td>
</tr>
<tr>
<td>• Develop and use models</td>
<td>Cause &amp; Effect</td>
</tr>
<tr>
<td>• Plan and carry out investigations</td>
<td>Structure &amp; Function</td>
</tr>
<tr>
<td>• Analyze and interpret data</td>
<td>Stability &amp; Change</td>
</tr>
<tr>
<td>• Use mathematics and computational thinking</td>
<td>Systems &amp; System Models</td>
</tr>
<tr>
<td>• Construct explanations and design solutions</td>
<td>Scale, Proportion, &amp; Quantity</td>
</tr>
<tr>
<td>• Engage in argument from evidence</td>
<td>Energy &amp; Matter</td>
</tr>
<tr>
<td>• Obtain, evaluate, and communicate information</td>
<td></td>
</tr>
</tbody>
</table>

**Social Justice Standards**

**Identity**
Students will know their family history and cultural background and can describe how their own identity is informed and shaped by their membership in multiple identity groups. (ID.9-12.2)
Students will know that all their group identities and the intersection of those identities create unique aspects of who there are and that this is true for other people too. (ID.9-12.3)
Students will express pride and confidence in their identity without perceiving or treating anyone else as inferior. (ID.9-12.4)

**Diversity**
Students will use language and knowledge to accurately and respectfully describe how people (including themselves) are both similar to and different from each other and others in their identity groups. (DI.9-12.7)
Students will respectfully express curiosity about the history and lived experiences of others and will exchange ideas and beliefs in an open-minded way. (DI.9-12.8)
Students will relate to and build connections with other people by showing them empathy, respect and understanding, regardless of their similarities or differences. (DI.9-12.9)

**Justice**
Students will be aware of the advantages and disadvantages they have in society because of their membership in different identity groups, and their knowledge of how this has affected their lives. (JU.9-12.14)

**Action**
Students express empathy when people are excluded or mistreated because of their identities and concern when they personally experience bias. (AC.9-12.16)
Students have the courage to speak up to people when their words, actions or views are biased and hurtful, and they will communicate with respect even when others disagree. (AC.9-12.18)

**Teaching Tolerance Anti-Bias Framework** [https://www.tolerance.org/frameworks](https://www.tolerance.org/frameworks)

### Adopted Texts and Materials

**Textbook:**
- Holt Physics Textbook
- Serway-Faughn Instructor Demos
- Sci Links
- Other titles may be available; please see TUSD Textbook Distribution Center on TUSD website

**Additional Resources:**
- Physics Classroom
- One Dimensional Motion
- Kinematics Equations
- Online Resources and Tools
- Phet Simulations
- AMTA Modeling Instruction Materials
- Hyper Physics
- Physics online tools
- Physics Simulations
- Open source Physics Text

### Instructional and Assessment Guides

**Culturally Responsive Practices** *(TUSD SPARKS, SPARKS Strategies)*

**Pre/Post Unit Assessment Examples:**
- Physics assessments
- Physics Units review
- Concept Maps; Simulations; Cloud Computing; Modeling software programs; computer presentations and other educational technologies

**Formative & Performance Assessment Examples:**
- Closure Activities
- Quick Writes (e.g. definitions and examples of subject specific topics).
- Conduct Research and construct explanations using words, visuals, and data (e.g. concept posters, lab experiments and lab reports)
- Engage in Arguments with Evidence and Reasoning (Tools) (e.g. to support or refute subject related claims).
- Experimental Design--Design and conduct a fair test experiment identifying and controlling variables and using safe procedures

**Assessment Resources:**
- Physics Self-Check Quizzes

**Additional Instructional Resources**
- Standards for Literacy in Science
- Science and Engineering Practices
- Hess’s Matrix
- Serway-Faughn Instructor Demos
- Activity Based Physics
- Heat & Thermodynamics Virtual Labs
- Contributions of Women in Physics
- Reading and Writing in the Science Classroom
- AAPT Physics articles
- Physics Interactive Simulations-PhET
- Physics Labs online
• **Science Assessment Tool**
• **MOSART**
• **Writing about Graphs**

---

¹**Highly-Leveraged Standards** are essential for students to learn because they have endurance (knowledge and skills relevant throughout a student’s lifetime); leverage (knowledge and skills used across multiple content areas); and essentiality (knowledge and skills necessary for success in future courses or grade levels).*

²**Supporting Standards** are emphasized during the quarter as they are integral to achieve mastery of the Highly Leveraged Standards. Mastery of these standards are used measured using classroom assessments.

³**Constant Standards** are repeatedly addressed to reinforce grade-level mastery.

*This definition for Highly-Leveraged Standards was adapted from the “power standard” definition on the website of the Millis Public Schools, K-12, Massachusetts, USA, 2016*