Escondido Union High School District

Physics

EUHSD Board Approval Date: June 21, 2016

(Updated Instructional Materials) Board Approval Date: February 14, 2017
The EUHSD Physics curriculum document identifies what students should be able to know by grade level in a comprehensive standards-based course of study. The curriculum document is updated annually based on student academic achievement data, research and best practices, and input from stakeholders. The EUHSD curriculum document contains the following documents and/or information:

A. Course Description
B. Course Guidelines/Requirements - graduation credit information, transcript information, adopted materials, adopted technology, assessment outline
C. Instructional Materials References
D. Scope and Sequence Map with Essential Standards outlined by Unit
E. References to key essential design and implementation documents

A comprehensive course of study and/or program is designed so that all students have access to the rigorous curriculum necessary to graduate high school college and career ready. Student-Centered learning provides opportunity for collaboration, communication, and a robust learning environment and provides opportunities for all students to meet the goals of the district’s Instructional Focus at the time of this writing: “All students communicate their thinking, ideas and understanding by effectively using oral, written and/or non-verbal expression.”

A key design consideration in the transition to the new California State Standards is a focus on changes to pedagogy. The English Language Arts instructional shifts guide classroom teaching and learning and the foundation of curriculum and instructional design. Key considerations of the ELA Instructional shifts can be found by visiting the following URL: http://www.corestandards.org/other-resources/key-shifts-in-english-language-arts/

The curriculum document is aligned to the California Next Generation Science Standards and serves to support outcomes evidenced in the College and Career Readiness Standards for students in grades 9-12. A detailed list of resources around which the EUHSD curriculum is designed is as follows:


Escondido Union High School District prohibits discrimination, harassment, intimidation, and bullying based on actual or perceived ancestry, age, color, disability, gender, gender identity, gender expression, nationality, race or ethnicity, religion, sex, sexual orientation, pregnancy, marital or parental status or association with a person or group with one or more of these actual or perceived characteristics.

Dr. Courtney Goode, Assistant Superintendent of Human Resources, Equity and Title IX Compliance Officer
302 N. Midway Drive, Escondido, CA 92027
Office: (760) 291-3281, Email: cgoode@euhsd.org
Physics Course Description

*Physics* is a yearlong college preparatory lab-based course covering a variety of twenty-first century skills and cross cutting concepts outlined within the California Next Generation Science Standards. Students will participate in a hands-on curriculum that covers the major principles of physics such as mechanics, thermodynamics, waves and optics, electromagnetism, theory of relativity, and quantum mechanics. Students will explore the latest discoveries in physics and complete both short- and long-term assignments designed to integrate key ideas and concepts. Through scientific inquiry, students will engage in a study of real-world ideas and concepts requiring both conceptual and procedural understanding and demonstration of learning.

<table>
<thead>
<tr>
<th>Physics Course Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Length:</strong> Year Long</td>
</tr>
<tr>
<td><strong>UC/CSU Requirement:</strong> Meets UCCSU “d” lab science (physical science) requirements</td>
</tr>
<tr>
<td><strong>Course Numbers (Semester A):</strong> 3689</td>
</tr>
<tr>
<td><strong>Course Numbers (Semester B):</strong> 3854</td>
</tr>
<tr>
<td><strong>Credits (Semester A):</strong> 5 Physical Science</td>
</tr>
<tr>
<td><strong>Required Prerequisite/s:</strong> Completion or concurrent enrollment in Algebra 1 or Math 1</td>
</tr>
<tr>
<td><strong>Board Approval Date (Curriculum):</strong> 6/21/16</td>
</tr>
</tbody>
</table>

**Core Instructional Material/s:**
- This course uses Open Educational Resources (OERs) in order to access current digital libraries that are pivoting rapidly to industry needs.

**Supplemental Instructional Material/s:**
- RFID website - [http://www.rfidjournal.com/site/about](http://www.rfidjournal.com/site/about)
- Wave Particle Interaction Website - [http://www.pbslearningmedia.org/resource/lps07.sci.phys.energy.waves/what-is-a-wave/](http://www.pbslearningmedia.org/resource/lps07.sci.phys.energy.waves/what-is-a-wave/)

**Technology Resource/s:**
- Chromebooks and/or access to a computer lab
- Probeware

**Assessment/s:** Completion of required unit assessments as outlined in the Scope and Sequence Guide

**Meeting the needs of EL students:**
- Utilize the student information system to acquire the language levels of EUHSD English Learners.
- In 2012, the CA Department of Education adopted new language level proficiency descriptors and new EL state standards. Visit the following website to learn more about those new descriptors and corresponding standards: [http://www.cde.ca.gov/sp/el/er/documents/elstdspublication14.pdf](http://www.cde.ca.gov/sp/el/er/documents/elstdspublication14.pdf)
- In 2013, the CA Department of Education adopted new ELA-ELD Frameworks, with specific strategies designed to meet the needs of EL students. Visit the following URL to learn more about the new frameworks: [http://www.cde.ca.gov/ci/rl/er/documents/elaeldftwchapter11.pdf](http://www.cde.ca.gov/ci/rl/er/documents/elaeldftwchapter11.pdf)
## Physics Scope and Sequence Guide

The Scope and Sequence Guide is a California standards-based document that delineates the standards-based skills students are expected to know and do in order to meet College and Career Readiness expectations outlined within the California Next Generation Science Standards. Each unit of study in the Scope and Sequence document is designed to build upon the previous unit and/or prerequisite coursework in support of student mastery of specific standards-based skills. The Scope and Sequence document provides the framework of understanding for key assignments, key assessments, and instructional resources and strategies that serve to assist students in meeting unit learning objectives. EUHSD teachers will meet annually to review and refine the curriculum.

In coursework requiring reading and writing, the following standards are not specifically stated in any one unit of study but are the result of implementation throughout the curriculum as students participate in reading, writing, and speaking/listening standards-based activities.

- **By the end of grade 11,** students will read and comprehend literary nonfiction in the grades 11-CCR text completely and proficiently, with scaffolding as needed at the high range. (Reading Informational Text Standard 10)
- **Students will write routinely over extending time frames** (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks and purposes. (Writing Standard 10)
- “**To be college and career ready,** students must have ample opportunities to take part in a variety of rich and structured conversations – as part of a whole class, in small groups, and with a partner – build around important content in various domains. **They must be able to contribute appropriately to conversations, make comparisons and contrasts, and analyze and synthesize a multitude of ideas according to the standards of evidence appropriate to a particular discipline.**” (Standards for ELA Anchor Standards for Speaking/Listening)

The Scope and Sequence document provides references to timeframes for unit implementation.

---

<table>
<thead>
<tr>
<th>Mathematics Scope and Sequence Guide</th>
</tr>
</thead>
</table>
| The Scope and Sequence Guide is a California standards-based document that delineates the standards-based skills students are expected to know and do in order to meet College and Career Readiness expectations outlined within the California Next Generation Science Standards. Each unit of study in the Scope and Sequence document is designed to build upon the previous unit and/or prerequisite coursework in support of student mastery of specific standards-based skills. The Scope and Sequence document provides the framework of understanding for key assignments, key assessments, and instructional resources and strategies that serve to assist students in meeting unit learning objectives. EUHSD teachers will meet annually to review and refine the curriculum.  
| In coursework requiring reading and writing, the following standards are not specifically stated in any one unit of study but are the result of implementation throughout the curriculum as students participate in reading, writing, and speaking/listening standards-based activities.  
| **By the end of grade 11,** students will read and comprehend literary nonfiction in the grades 11-CCR text completely and proficiently, with scaffolding as needed at the high range. (Reading Informational Text Standard 10)  
| **Students will write routinely over extending time frames** (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks and purposes. (Writing Standard 10)  
| “**To be college and career ready,** students must have ample opportunities to take part in a variety of rich and structured conversations – as part of a whole class, in small groups, and with a partner – build around important content in various domains. **They must be able to contribute appropriately to conversations, make comparisons and contrasts, and analyze and synthesize a multitude of ideas according to the standards of evidence appropriate to a particular discipline.**” (Standards for ELA Anchor Standards for Speaking/Listening)  
| The Scope and Sequence document provides references to timeframes for unit implementation.  
| {4} |
Physics Scope and Sequence
Unit 1 – Introduction to Physics (S1)

<table>
<thead>
<tr>
<th>Unit Description: “Introduction to Physics” Unit 1 provides students with an introduction to physics and to the lab workspace and safety features of the classroom lab experience. Topics including dimensional analysis, lab safety, and unit conversions will be covered.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Unit Standards:</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are no discrete NGSS Disciplinary Core Ideas standards for this unit, which serves as a foundation for introduction to Physics.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mathematical Practices:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• MP4 – Model with mathematics</td>
</tr>
<tr>
<td>• N-Q 1-3 – Reason quantitatively and use units to solve problems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning Objectives:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will be able to…</td>
</tr>
<tr>
<td>• describe and demonstrate lab safety protocols.</td>
</tr>
<tr>
<td>• quantitatively convert within a system of measurement.</td>
</tr>
<tr>
<td>• use dimensional analysis to convert between different units of measurement.</td>
</tr>
<tr>
<td>• demonstrate proper use of measurement tools.</td>
</tr>
<tr>
<td>• properly use terminology associated with experimentation (variables, hypothesis, purpose, and data).</td>
</tr>
<tr>
<td>• demonstrate appropriate work habits both independently and when working with others.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Unit Assignment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Lab Safety and Equipment Scavenger Hunt: Students will be provided with a list of questions relating to lab safety and equipment, students will look around the physical classroom to identify and locate the pre-written answers to each question. (See Unit 1 resource folder.)</td>
</tr>
<tr>
<td>• Students will participate in a written lab safety test. Students must complete the test with at least 80% accuracy.</td>
</tr>
<tr>
<td>• In order to understand dimensional analysis, students will complete a variety of measurement conversion exercises and activities designed to introduce them to the type of measurement utilized within the physics classroom. (See Unit 1 resource folder.)</td>
</tr>
<tr>
<td>• Students will use their Office 365 student account and EUHSO email to create a digital portfolio that will serve as storage of their lab reports, research projects (short and long term), and other key documents. Teachers may choose to utilize a print notebook.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Unit Assessment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Written Safety Test with at least 80% accuracy.</td>
</tr>
<tr>
<td>• Demonstration of measurement conversion and/or mini assessment.</td>
</tr>
</tbody>
</table>
Instructional Resources:
- Physics online free resources - http://www.physicsclassroom.com
- Khan Academy Video Resources - https://www.khanacademy.org/science/physics

Lab Resources for Unit 1:
- Meter sticks and rulers
- Digital balances

Instructional Strategies:
- Lecture on specific content topics
- Group work and pair activities for labs
- Vocabulary strategies - http://www.marzanoresearch.com/vocabulary
- Demonstrations of various lab and safety equipment
- EUHSD Content Literacy strategies for introduction to text types.
Physics Scope and Sequence
Unit 2 – Kinematics and Forces (S1)

**Unit Description:** “Kinematics and Forces” Unit 2 will focus on forces and motion, including vector and scalar quantities while practicing using the kinematic equations. Kinematic equations can be derived from inquiry-based investigations between variables such as position, velocity, time and acceleration where extensions will include graphing and diagrammatic models. Newton’s three laws of motion describe how the motion of objects is dependent on inertial mass and net force. Graphing and linear motion relationships will be explored.

In unit 2, students will describe, other quantitatively and qualitatively, how objects move. Through planned investigations, practice problems, and guided inquiry students will study Newton’s three laws of motion. They will plan and carry out their own investigations and summarize their findings in a lab report. Students will read a variety of informational text and participate in small and large group discussions on the content, as well as write a summary reflection of their experience.

**Probing Question:**
- What causes the motion of an object?

<table>
<thead>
<tr>
<th>Unit Standards:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance Expectations:</strong></td>
</tr>
<tr>
<td>HS-PS2-1: Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.</td>
</tr>
<tr>
<td>HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including costs, safety, reliability and aesthetics, as well as possible social, cultural and environmental impacts.</td>
</tr>
<tr>
<td><strong>DCI:</strong></td>
</tr>
<tr>
<td>PS2A: Forces and Motion</td>
</tr>
<tr>
<td>- Newton’s second law accurately predicts changes in the macroscopic objects.</td>
</tr>
<tr>
<td>ETS1.B: Developing Possible Solutions</td>
</tr>
<tr>
<td>- When evaluating solutions, it is important to take into account a range of constraints, including costs, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.</td>
</tr>
<tr>
<td><strong>CCC:</strong></td>
</tr>
<tr>
<td>- Systems and system models</td>
</tr>
<tr>
<td>- Cause and Effect: Mechanisms and Explanations</td>
</tr>
<tr>
<td>- Patterns</td>
</tr>
<tr>
<td>- Scale, Proportion and Quantity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning Objectives: Students will be able to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- use appropriate academic content language in written evaluation and discussions.</td>
</tr>
<tr>
<td>- plan and carry out investigations involving forces and kinematics.</td>
</tr>
<tr>
<td>- develop and use graphical models to explain or predict data.</td>
</tr>
<tr>
<td>- use mathematics and computational thinking to quantify variables (velocity, acceleration, displacement, force, and mass).</td>
</tr>
<tr>
<td>- obtain, evaluate and communicate information based on Newton’s three laws.</td>
</tr>
<tr>
<td>- identify and explain scalar and vectors.</td>
</tr>
<tr>
<td>- qualitatively predict the effect of angle on displacement.</td>
</tr>
<tr>
<td>- apply Newton’s 3 laws to various scenarios.</td>
</tr>
<tr>
<td>- draw and label free body diagrams to predict motion of objects.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Unit Assignments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- <strong>Constant Velocity Lab:</strong> In this constant velocity lab students will plan and carry out an investigation to determine the relationship between position and time of constant velocity cars. Students will analyze and interpret the data to develop and use graphical models that will identify the pattern between position and time. Students will present their findings on a chart to share out with the class.</td>
</tr>
<tr>
<td>- <strong>Acceleration Lab:</strong> In this acceleration lab students will plan and carry out an investigation to determine the relationship between velocity and time of pull back cars using probe ware (motion detector). Students will analyze and interpret the data to develop and use graphical models that will identify the pattern between position and time. Students will use mathematical and computational thinking to</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Unit Assessments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Constant Velocity Lab Presentation and Rubric</td>
</tr>
<tr>
<td>- Kinematic graphing activity worksheet</td>
</tr>
<tr>
<td>- Newton’s Second Law LAB REPORT</td>
</tr>
<tr>
<td>- Summative End of Unit Assessment</td>
</tr>
<tr>
<td>- Quick write/reflection on High Speed Rail</td>
</tr>
</tbody>
</table>
Engaging in argument from evidence  
Developing and using models  
Planning and carrying out investigations  
Analyzing and Interpreting data  
Using mathematics and computational thinking  
Asking questions and defining problems  
Constructing explanations and designing solutions  
Obtaining, evaluating and communicating information

determine that acceleration of the car. At the conclusion of their lab, students will then be given various graphs in which they can qualitatively and quantitatively construct explanations for the motion of the object.

- **Newton’s Second Law Lab**: In this lab students will plan and carry out an investigation using spring scales (or force probes) to determine the relationship between acceleration, mass of the object and net force acting on an object. Students will pull various objects with a constant force varying mass OR constant mass varying force to study this relationship. Students will collect and analyze data. They will submit a formal lab report of their data.

- **High Speed Rail Evaluation**: Students will read a variety of documents about the high-speed rail proposal in California. They will form an opinion about this project based on cost, safety, reliability, aesthetics as well as social, cultural and environmental impacts. Students will share out in a Socratic seminar then write a short defense of their position, with evidence.

### Instructional Resources:
- [http://www.physicsclassroom.com/class](http://www.physicsclassroom.com/class)
- Khan Academy Video Resources - [https://www.khanacademy.org/science/physics](https://www.khanacademy.org/science/physics)
**Lab Resources for Unit 2:**
- Constant velocity cars
- Timers
- Pull back cars
- Car tracks
- Motion detectors
- Vernier LabQuest2 interface
- Chromebooks/computer
- Spring scales
- Force meter
- Mass sets

**Instructional Strategies:**
- Lecture on specific content topics
- Group work and pair activities for labs
- Vocabulary strategies - [http://www.marzanoresearch.com/vocabulary](http://www.marzanoresearch.com/vocabulary)
- Demonstrations of various lab and safety equipment
- EUHSD Content Literacy strategies for introduction to text types.
Physics Scope and Sequence  
Unit 3 – Gravity and Circular Motion

**Unit Description:** "Gravity and Circular Motion" Unit 3 students will investigate Newton's Universal Law of Gravitation, Kepler's Laws, and circular motion. Newton's laws of motion and kinematic principles are applied to describe and explain the motion of objects moving in circles. Emphasis will be on identifying and explaining what creates and effects the force of gravity between objects, explaining the motion of orbiting objects and solving for net force on an object experiencing circular motion.

**Probing Question:**  
- What causes objects to orbit?

**Unit Standards:**

<table>
<thead>
<tr>
<th>Performance Expectations</th>
<th>Learning Objectives: Students will be able to…</th>
<th>Key Unit Assignment:</th>
<th>Key Unit Assessment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS-ESS-1-4: Use mathematical or computational representation to predict the motion of orbiting objects in the solar system.</td>
<td>explain how gravity effects or controls the motion of the solar system.</td>
<td>Phet Gravity Force Lab Simulation: In this activity, students will use an online simulation to model and predict how mass and distance effect the force of gravitation between two objects. Students will collect and analyze data on the gravity force worksheet, supporting their understanding using free body diagrams as models and computational thinking to generate quantitative data.</td>
<td>Gravity Force Worksheet</td>
</tr>
<tr>
<td>HS-PS2-1: Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass and its acceleration.</td>
<td>identify the variables that effect the strength of gravity.</td>
<td>Phet Simulation Gravity and Orbits: In this activity students will observe planetary motion to support Kepler’s Laws. Students will change the location of the planet in relation the sun while studying the path shape and gravitational and velocity vectors associated with orbiting motion. Students will record their findings and present to class or teacher.</td>
<td>Rubric for Flier &amp; flyer</td>
</tr>
<tr>
<td>HS-PS2-4: Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the gravitational and electrostatic forces between objects.</td>
<td>mathematically solve for the gravitational force between two objects.</td>
<td>Propaganda Flier Project: After discussing and defining propaganda and examining examples of propaganda flyers designed to invoke emotion. (Ethos, Pathos, Logos) Students</td>
<td>Unit assessment (FBD comparing circular and elliptical motion, relating force of gravity and centripetal force)</td>
</tr>
<tr>
<td>HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</td>
<td>relate gravitational force to mass and distance.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCI: PS2.A: Forces and Motion</td>
<td>identify Kepler's three laws and state their importance to orbits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PS2.B: Types of Interactions</td>
<td>draw force diagrams of objects experiencing circular motion and determine net force.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESS1.B Earth and the Solar System</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kepler’s Law describes common features of the motion of orbiting objects including their elliptical paths around the sun. Orbits may change due to gravitational effects from or collisions with other objects in the solar system.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ETS1.A: Defining and Delimiting Engineering Problems</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **DCI:** PS2.A: Forces and Motion  
- **PS2.B: Types of Interactions**
- **ESS1.B Earth and the Solar System**
- **ETS1.A: Defining and Delimiting Engineering Problems**
• Criteria and constraints also include satisfying any requirements sets by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
• Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

**CCC:**
- System and system models
- Scale Proportion and Quantity
- Stability and change
- Cause and effect: mechanisms and explanations
- Patterns

**SEP**
- Using mathematical and computational thinking
- Engaging in argument from evidence
- Developing and Using models
- Analyzing and interpreting data
- Constructing explanations and designing solutions

**Instructional Resources:**
- Physics online free resources - [http://www.physicsclassroom.com](http://www.physicsclassroom.com)
- Khan Academy Video Resources - [https://www.khanacademy.org/science/physics](https://www.khanacademy.org/science/physics)

**Lab Resources for Unit 3:**
- Laptops/computers
- Elastic sheet with large ring structure (hula hoop)

**Instructional Strategies:**
- Lecture on specific content topics
- Group work and pair activities for labs
- Vocabulary strategies - [http://www.marzanoresearch.com/vocabulary](http://www.marzanoresearch.com/vocabulary)
- Demonstrations of various lab and safety equipment
- EUHSD Content Literacy strategies for introduction to text types.
Unit Description: "Energy" Unit 4 will focus on the identification and quantification of different forms of energy. The law of conservation of energy will be used to qualitatively and quantitatively study energy transformation, specifically focusing on gravitational potential and kinetic energy.

Probing Questions:
- What is energy and how does it interact with matter?

Unit Standards:

Performance Expectations:

HS-PS3-1: Create a computational model to calculate the change in energy of one component in a system when the change in energy of the other components and energy flows in and out of the system are known.

HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

HS-PS3-3: Design, build and refine a device that works within the given constraints to convert one form of energy into another form of energy.

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

DCI: PS3.A: Definitions of Energy
- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within the system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved. Even as, within the system, energy is continually transferred from one object to another and between its various possible forms.
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
- These relationships are better understood at the macroscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases, the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Learning Objectives:
- Students will be able to:
  - create and use models to explain how energy transfers within a system.
  - define and describe the various types of energy.
  - mathematically solve for variables with energy and energy conservation.
  - design, build and refine a device that transfers energy.
  - plan and carry out an investigation that relates concepts from motion and force to energy.
  - analyze and interpret energy diagrams in order to predict what might have caused the energy transformations.

Key Unit Assignments:
- Energy Bar Charts: In order to demonstrate energy conservation, students will generate qualitative energy conservation equations by completing an energy bar chart analysis of a given system. They will then solve for mathematical variables associated with various types of energy. Students will complete their energy worksheet.
- Roller Coaster Cars: Using matchbox cars and track, students will design a lab and test the minimum amount of energy needed to get a car around a loop. They will provide models to energy and forces to support their data. They will mathematically solve for velocity, KE and PE at various points on the track, calculate centripetal force and centripetal acceleration at the top of the loop. Students will then complete a lab write up and submit it to their online portfolio.
- Car Design: Students will read about the energy.

Key Unit Assessments:
- Energy worksheets (teacher developed resource)
- Lab write-up
- Project report/Rubric and worksheets
- Cumulative Final Written Assessment
PS3.B: Conservation of Energy and Energy Transfer

- Conservation of energy means that the total change in energy in any system is always equal to the total energy transferred into or out of the system.
- Energy cannot be created or destroyed but it can be transported from one place to another and transferred between systems.
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g., Relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.
- The availability of energy limits what can occur in any system.

PS3.D: Energy in Chemical Processes

- Although energy cannot be destroyed, it can be converted to less useful form – for example, to thermal energy in the surrounding environment.

ETS1.C: Optimizing the Design Solution

- Criteria may need to break down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.

CCC:
- Energy and matter: flows, cycles, and conservation
- System and system models
- Patterns
- Stability and change
- Scale, Proportion and Quantity
- Cause and Effect: Mechanisms and Explanations

SEP
- Constructing explanations and designing solutions.
- Analyzing and interpreting data.
- Planning and carrying out investigations.
- Developing and using models.

Instructional Resources:
- Khan Academy Video Resources - https://www.khanacademy.org/science/physics
- Physics online free resources - http://www.physicsclassroom.com

efficiency of cars that have been engineered to be streamlined. They will then be given a car-like device that is box shaped (van). Their task is to design a solution to make this car more energy efficient. The cars will be run down a track, all starting the same height with the same mass, and same size wheels. (Legos?)
Lab Resources for Unit 4:
- Matchbox tracks
- Matchbox cars
- Car kits/wheels
- Whiteboards and markers
- Mass sets

Instructional Strategies:
- Lecture on specific content topics
- Group work and pair activities for labs
- Vocabulary strategies - [http://www.marzanoresearch.com/vocabulary](http://www.marzanoresearch.com/vocabulary)
- Demonstrations of various lab and safety equipment
- EUHSD Content Literacy strategies for introduction to text types.
## Unit Description:
“Momentum” Unit 5 students will investigate the impulse-momentum change theorem and the law of conservation of momentum. Students will analyze momentum. Quantitative analysis of momentum and momentum conservation will apply to elastic and inelastic collisions. Students will apply their understanding of the relationship between change in momentum, force and time of impact to engineer a device that minimizes force.

### Probing Questions:
- What is the difference between inertia and momentum?
- What is momentum and how is it conserved?

### Unit Standards:

#### Performance Expectations:
- **HS-PS2-2**: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
- **HS-PS2-3**: Apply scientific and engineering ideas to design, evaluate, and refine a devise that minimizes the force on a macroscopic object during a collision.
- **HS-ETS1-2**: Design a solution to a complex real-world problem by breaking it down into smaller more manageable problems that can be solved through engineering.

#### DCI PS2.A: Forces and Motion
- Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. In any system, total momentum is always conserved.
- If a system interacts with objects outside of itself, the total momentum of the system can change; however, any such change is balanced by changes in momentum of objects outside of the system.

#### ETS1.A: Defining and Delimiting Engineering Problems
- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.

#### ETS1.C: Optimizing the Design Solution
- Criteria may need to be broken down into simpler ones that can be

### Learning Objectives:
**Students will be able to...**
- use mathematical thinking to apply conservation of momentum to elastic and inelastic collisions.
- calculate the momentum of an object.
- design, build and test a device to decrease the force of impact during a collision by applying their understanding of impulse.
- analyze and interpret data from collisions in order to determine impulse.
- report data findings both orally and in writings.

### Key Unit Assignments:
- **Collision Cart Simulation**: Students will use the online interactive tools in the resources to participate in a virtual experiment, gather evidence on their worksheet that can be used to support a claim that total system momentum is or is not conserved in elastic or inelastic collisions. Students will be given word problems to mathematically solve for variables associated with conservation of momentum and will then check the answers using an additional simulation.
- **Crash Lab**: Students will design, build and refine a device to minimize the force experienced during a collision. Using predetermined materials and size constraints, students engineer this device that would fit on a guard rail. Using force sensors and dynamic carts and low friction tracks, students will collect data to analyze the effectiveness and compare to the force experienced during a collision without their device present.

### Key Unit Assignments:
- **Collision cart worksheet (simulation and word problems)**
- **Crash Lab Conclusion with a prompt/rubric**
approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.

**CCC:**
- Structure and function
- Systems and system models
- Patterns
- Energy and matter: flows, cycles and conservation
- Stability and change
- Cause and effect: mechanism and explanation
- Scale, Proportion and quantity

**SEP**
- Using mathematics and computational thinking.
- Analyzing and interpreting data.
- Planning and carrying out investigations.
- Constructing explanations and designing solutions.
- Asking questions and defining problems.

**Instructional Resources:**
- Khan Academy Video Resources - [https://www.khanacademy.org/science/physics](https://www.khanacademy.org/science/physics)
- Physics online free resources - [http://www.physicsclassroom.com](http://www.physicsclassroom.com)

**Lab Resources for Unit 5:**
- Other supplies:
- Dynamic carts
- Dynamic tracks
- Force sensors
- Building materials (foam, cardboard, tape, scissors, paper, etc.)

**Instructional Strategies:**
- Lecture on specific content topics
- Group work and pair activities for labs
- Vocabulary strategies - [http://www.marzanoresearch.com/vocabulary](http://www.marzanoresearch.com/vocabulary)
- Demonstrations of various lab and safety equipment
- EUHSD Content Literacy strategies for introduction to text types.
# Physics Scope and Sequence
## Unit 6 - Thermodynamics

**Unit Description:** "Thermodynamics" Unit 6 will focus on types of heat transfer, building on models previously developed in “Energy unit”. Students will be able to qualitatively and quantitatively describe energy transfer as heat. Mechanisms through which heat transfers within the Earth’s interior are explained.

**Probing Questions:**
- What is thermal energy?
- How does thermal energy transfer?

<table>
<thead>
<tr>
<th>Unit Standards: Performance Expectations:</th>
<th>Learning Objectives: Students will be able to...</th>
<th>Key Unit Assignments:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HS-PS3-1:</strong> Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.</td>
<td>- differentiate between convection, conduction and radiation.</td>
<td><strong>Solar Oven:</strong> With a given list of supplies (recyclables), students will design, build and refine a solar oven to convert light energy into thermal energy. Students will attempt to heat up a set amount of water and quantitatively determine the amount of heat that was transferred to the water. Students will analyze and compare results with other groups within the class to determine which solar oven is the most efficient at heat transfer. Students will then generate an LOL diagram to model the energy flow within the system (system is defined as the water/cup/earth). Students will be provided with a rubric in order to analyze their own results. Students will put their findings in their lab notebook.</td>
</tr>
<tr>
<td><strong>HS-PS3-3:</strong> Design, build and refine a device that works within given constraints to convert one form of energy into another form of energy.</td>
<td>- design and develop a model to describe the cycling of matter of Earth's interior by thermal convection.</td>
<td><strong>Earth's Interior Mini Research and Presentation:</strong> Students will utilize the Internet and research and cite at least two primary sources to create a model to describe the cycle of matter within the earth by thermal convection. Students will work in groups and/or pairs and use the articles to create a list of content-based questions and share with at least two other partner groups.</td>
</tr>
<tr>
<td><strong>HS-ESS2-3:</strong> Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.</td>
<td>- design a solution to a real-world problem.</td>
<td></td>
</tr>
<tr>
<td><strong>HS-ETS1-2:</strong> Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DCI PS3.A:</strong> Definitions of Energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light and thermal energy.</td>
<td></td>
<td>- Solar Oven rubric</td>
</tr>
<tr>
<td><strong>PS3.B:</strong> Conservation of Energy and Energy Transfer</td>
<td></td>
<td>- Earth's Interior Model and follow-up questions/whiteboard/discussion</td>
</tr>
<tr>
<td>- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Uncontrolled systems always evolve toward more table states, that is, toward more uniform energy distribution (e.g. water flows downhill, objects hooter than their surrounding environment cool down.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PS3.D:</strong> Energy in Chemical Processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ESS2.A: Earth Materials and Systems
- Evidence from deep probes, seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle, and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior.

### ETS1.C: Optimizing the Design Solution
- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

### CCC
- Stability and change
- Structure and function
- Energy and matter
- System and system models
- Cause and effect: Mechanisms and explanations

### SEP
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information
- Developing and using models
- Asking and defining problems
- Planning and carrying out investigations
- Analyzing and interpreting data

### Instructional Resources:
- Khan Academy Video Resources - [https://www.khanacademy.org/science/physics](https://www.khanacademy.org/science/physics)
- Physics online free resources - [http://www.physicsclassroom.com](http://www.physicsclassroom.com)

### Lab Resources for Unit 6:
- Thermometer probes
- Cardboard
- Aluminum foil
- Tape
• Cups to hold water
• Computer/laptops

**Instructional Strategies:**
• Lecture on specific content topics
• Group work and pair activities for labs
• Vocabulary strategies - [http://www.marzanoresearch.com/vocabulary](http://www.marzanoresearch.com/vocabulary)
• Demonstrations of various lab and safety equipment
• EUHSD Content Literacy strategies for introduction to text types.
### Unit 7 - Waves

#### Unit Description:
"Waves" In unit 7, students will be able to identify between the wave and particle model for electromagnetic radiation. They will participate in a hands-on lab, conduct online research, and summarize and report out findings. Unit 7 will provide students with the basic understanding of wave types as well as wave properties, with emphasis on the application of sound and electromagnetic waves in society. Electromagnetic radiation may be useful to understanding using either a wave or particle model. Radio frequency identification poses advantages and disadvantages to the storage and transmission of information in society.

#### Probing Questions:
- How can we describe waves that help us predict its behavior?
- How do waves effect or play a role in technology?

#### Unit Standards:

##### Performance Expectations:

| HS-PS4-1 | Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. |
| HS-PS4-2 | Evaluate questions about the advantages of using a digital transmission and storage of information. |
| HS-PS4-3 | Evaluate the claims, evidence and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than another. |
| HS-PS4-4 | Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. |
| HS-ESS1-2 | Construct and explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. |

#### Learning Objectives:

- Students will be able to...
  - compare and contrast types of waves.
  - mathematically solve for variables associated with waves (frequency, period, speed).
  - evaluate claims about digital storage and transmission.
  - draw conclusions about the dangers of electromagnetic waves.
  - explain how medium affects wave speed.
  - differentiate between the wave and particle model and assess when to use each.
  - describe the outcome of constructive and destructive interference.
  - identify and explain red shift as evidence of the Big Bang theory.
  - qualitatively describe and provide examples of diffraction, refraction, dispersion, and reflection.
  - conduct short-term research

#### Key Unit Assignments:

- **Slinky Lab:** After reading, writing, and lesson on the different types and shapes of waves, students will identify the anatomy of a transverse and longitudinal wave then plan and carry out an investigation to determine the relationship between frequency and wavelength. The speed of the wave depends on the medium. Students will generate a graph to support that frequency and wavelength are inversely proportion by keeping wave speed constant.

- **Electromagnetic Effects on the Human Body:** Students will work in collaborative teams to research information about a specific band of different frequencies of electromagnetic waves to determine wavelength, usage in society, and effects on the human body (dangerous vs not dangerous and justify). Using the information from their research, students will generate a poster, infographic or digital display to provide the information to an audience of their peers. Students will share their findings with all groups. As student groups present, the students will then fill out a form to acquire information for all types

#### Key Unit Assessments:

- Slinky Graph with rubric
- Model analysis rubric
- Socratic seminar rubric
- Presentation
- Waves can add or cancel one another as they cross, depending on their relative phase, but they emerge unaffected by each other.

**PS4.B: Electromagnetic Radiation**
- Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.
- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.
- Photoelectric materials emit electrons when they absorb light of a high-enough frequency.

**ESS1.A: The Universe and Its Stars**
- The big bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.

**CCC**
- Cause and effect
- Stability and Change
- System and System models
- Energy and matter

**SEP**
- Asking questions and defining problems.
- Using mathematics and computational thinking.
- Engaging in argument from evidence.
- Constructing explanations and designing solutions.
- Obtaining, evaluating and communicating information.
- Developing and using models.

**Instructional Resources:**
- RFID website - [http://www.rfidjournal.com/site/about](http://www.rfidjournal.com/site/about)
- Wave Particle Interaction Website - [http://www.pbslearningmedia.org/resource/lps07.sci.phys.energy.waves/what-is-a-wave/](http://www.pbslearningmedia.org/resource/lps07.sci.phys.energy.waves/what-is-a-wave/)
<table>
<thead>
<tr>
<th>Lab Resources for Unit 7:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Computers/Laptops</td>
</tr>
<tr>
<td>• Large metal Slinky</td>
</tr>
<tr>
<td>• Wave demonstration springs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructional Strategies:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Lecture on specific content topics</td>
</tr>
<tr>
<td>• Group work and pair activities for labs</td>
</tr>
<tr>
<td>• Vocabulary strategies - <a href="http://www.marzanoresearch.com/vocabulary">http://www.marzanoresearch.com/vocabulary</a></td>
</tr>
<tr>
<td>• Demonstrations of various lab and safety equipment</td>
</tr>
<tr>
<td>• EUHSD Content Literacy strategies for introduction to text types.</td>
</tr>
</tbody>
</table>
Unit Description: “Electricity and Magnetism” Unit 8 discusses the flow of charge through electric circuits. Students will start off defining the fundamental unit of charge and relate electrical force to other variables, thus using Coulomb’s law to predict the force acting on a charged particle. The variables which cause and hinder the rate of charge flow (Ohm’s Law) are explained and the mathematical application of electrical principles to series, parallel and combination circuits is presented. Through research while carrying out an engineering task, students will understand the principles that allow for the function of solar cells and DC motors.

Probing Questions:
- How can we model electrical and magnetic fields?
- What is electricity and what causes it?
- How does electrical energy convert into other forms of energy?

Unit Standards:

Performance Expectations:

**HS-PS2-5:** Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

**HS-PS2-6:** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

**HS-PS3-3:** Design, build and refine a device that works within given constraints to convert one form of energy into another form of energy.

**HS-PS3-5:** Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

**HS-PS4-5:** Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

**HS-ETSE1-3:** Evaluate a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

**DCI PS1.A: Structure and Properties of Matter**
- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.

Learning Objectives:

Students will be able to:
- identify and explain the fundamental unit of charge.
- use field lines to explain and predict the magnitude of force and direction of an electric or magnetic field (related to Coulomb’s law).
- compare and contrast series and parallel circuits.
- quantitatively and qualitatively describe variables associated with Ohm’s law.
- predict current by manipulating voltage and resistance.
- describe how a magnet can induce a current.
- describe how an electrical current can generate a magnetic field.
- compare and contrast conductors, insulators, and semiconductors.
- explain how solar energy can be converted into other forms of useable energy.
- design, build and refine a device to convert solar into mechanical energy.

Key Unit Assignments:

**Solar Car:** Using solar cells and commonly available materials, in group of 3 or 4 students will design, build and refine a device that converts solar energy into mechanical energy. Students will develop a model to explain how solar cells convert light into electrical energy and how a motor works to convert electrical energy into mechanical energy.

**Building a Hand Generator:** Students will use available tools to analyze DC motors that have been disassembled and explain how the components of a motor function to generate a current. Students will design and build a device that converts mechanical energy into electrical energy. They will measure the current output as well as the ability to power light bulbs. Students will complete a lab report.

**Conductivity of Different Materials Lab:** Students will plan and carry out an investigation how to complete a circuit using various materials of different conductive.

Key Unit Assessments:

- Solar Car Design Rubric and explanation?
- Electric Field Lines Models Worksheet
- Cumulative Final Exam
• The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.

**PS2.B: Types of Interactions**
- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.
- Forces at a distance are explained by fields permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.
- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties and transformations of matter, as well as the contact forces between material objects.

**PS3.A: Definitions of Energy**
- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another between its various possible forms.
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, light, sound, and thermal energy.
- These relationships are better understood at the microscopic scale at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases, the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes, radiation a phenomenon in which energy in fields, moves across space.
- “Electrical energy” may mean energy stored in a battery or energy stored in electrical currents.

**PS3.C: Relationship Between Energy and Forces**
- When two objects interacting through a field change relative position, the energy stored in the field is changed.
<table>
<thead>
<tr>
<th>PS3.D: Energy</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Solar cells are human made devices that likewise capture the sun’s energy and produce electrical energy. (Secondary to HS-PS4-5)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PS4.B Electromagnetic Radiation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Electromagnetic radiation (e.g. radio, microwave, light) can be modeled as a wave of changing electric and magnetic fields.</td>
<td></td>
</tr>
<tr>
<td>• Photovoltaic materials emit electrons when they absorb light of a high enough frequency.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESS3.A: Natural Resources</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• All forms of energy production and other resource extraction have associated economic, social, environmental and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ETS1.B: Developing Possible Solutions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• When evaluating solutions, it is important to take into account a range of constraints including costs, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CCC</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cause and Effect</td>
<td></td>
</tr>
<tr>
<td>• Structure and function</td>
<td></td>
</tr>
<tr>
<td>• Systems and System models</td>
<td></td>
</tr>
<tr>
<td>• Patterns</td>
<td></td>
</tr>
<tr>
<td>• Energy and Matter</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Asking questions and defining problems.</td>
<td></td>
</tr>
<tr>
<td>• Developing and using models.</td>
<td></td>
</tr>
<tr>
<td>• Planning and carrying out investigations.</td>
<td></td>
</tr>
<tr>
<td>• Analyzing and interpreting data.</td>
<td></td>
</tr>
<tr>
<td>• Engaging in argument from evidence.</td>
<td></td>
</tr>
<tr>
<td>• Using math and computational thinking.</td>
<td></td>
</tr>
<tr>
<td>• Constructing explanations and designing solutions.</td>
<td></td>
</tr>
<tr>
<td>• Obtaining, evaluating and communicating information.</td>
<td></td>
</tr>
</tbody>
</table>
Instructional Resources:

Lab Resources for Unit 8:
- Power supplies
- Wires/alligator leads
- Multimeters
- DC motors
- 2-in-1 gear box (Kelvin)
- Lightbulbs/circuit kits
- Resistors
- Capacitors
- Various conductive materials
- Magnets
- Compasses
- Magnetic force sensor
- Solar car kits
- Van de Graaf generator

Instructional Strategies:
- Lecture on specific content topics
- Group work and pair activities for labs
- Vocabulary strategies - http://www.marzanoresearch.com/vocabulary
- Demonstrations of various lab and safety equipment
- EUHSD Content Literacy strategies for introduction to text types.