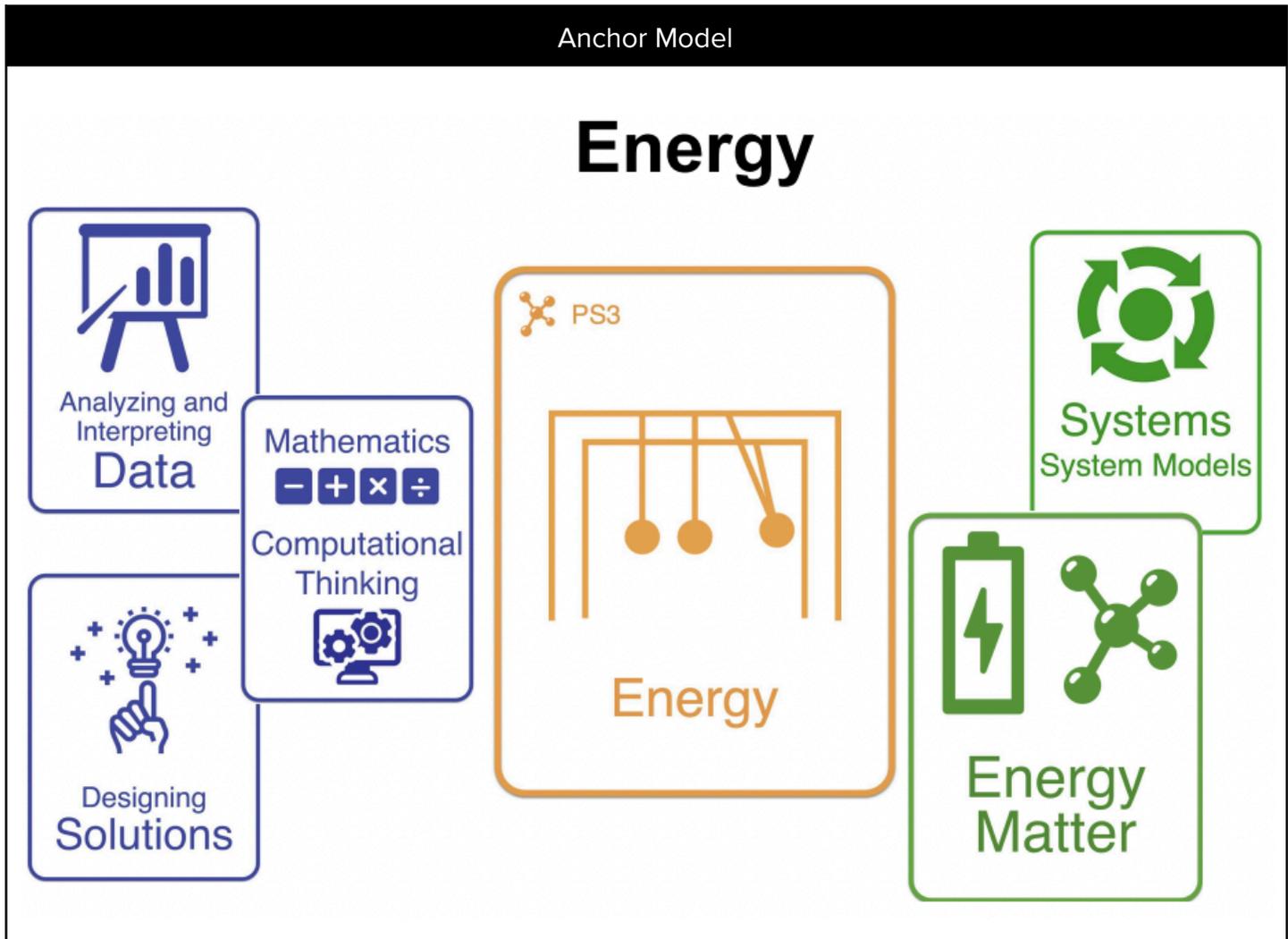


Storyline Unit Design

Understanding by Design (UbD) Template*

Unit	Designing Energy	Course(s)	Integrated Science 10
Designed by	Sean, Scott, Sahar	Time Frame	4 weeks
 This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.			



*UbD Unit Planner is from Wiggins, Grant and McTighe, Jay. Understanding by Design Guide to Creating High-Quality Units. Alexandria, VA: Association for Supervision and Curriculum Development. 2011.

Stage 1: Desired Results

Performance Expectations

HS-PS3-1: Energy Change in Components of a System

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. (Systems and System Models)

HS-PS3-2: Macroscopic Energy Due to Particle Position and Motion

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). (Energy and Matter)

HS-PS3-3: Energy Conversion Device Design

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. (Energy and Matter)

Anchoring Phenomenon

[Anchoring Phenomenon Worksheet](#)

Design a Device to create an electric current from some other form of energy.

Enduring Understandings

Type Here

Essential Questions

Type Here



Stage 2: Assessments

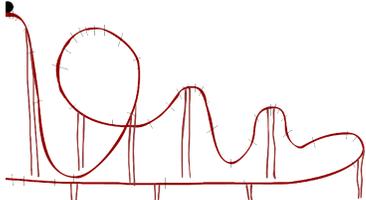
[Assessment Screening Tool Slides](#)

Backward Design Elements

What new skills (practices) will students need to learn?	What thinking concepts will students need to learn?	What science concepts will students need to learn?
<ul style="list-style-type: none"> ● <i>Create a computational Model of a system or device.</i> ● <i>Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.</i> ● <i>Design, evaluate, and/or refine a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations</i> 	<ul style="list-style-type: none"> ● <i>Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.</i> ● <i>Science assumes the universe is a vast single system in which basic laws are consistent.</i> ● <i>Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems.</i> ● <i>Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.</i> ● <i>Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.</i> 	<ul style="list-style-type: none"> ● Definition of energy ● Conservation of energy ● Energy can be transported and transferred. ● Mathematical calculations of PE (based on position of objects) and KE (based on mass and velocity of objects) ● The availability of energy limits what can occur in any system. ● Types of macroscopic energy ● Modeling energy requires a consideration of kinetic types and potential types. ● Although energy cannot be destroyed, it can be converted to less useful forms — for example, to thermal energy in the surrounding environment. ● 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. (secondary)



Stage 3: Learning Plan

 <p>Phenomenon or Problem</p>	 <p>Learning Performance - What will they do?</p> <p>The three dimensions woven together into a single learning performance.</p>	 <p>Why is this important?</p> <p>How does this activity help build understanding of the anchoring phenomenon.</p>	 <p>Learning Experience - How will they do it?</p> <p>Graphic organizers, protocols, scaffolds, labs, mini-lesson, student discourse, etc.</p>
<p>Energy conversion device.</p>	<p>Pre Assessment on Energy Research ideas for their device.</p>	<p>Students will design a device that converts one type of energy into electrical energy using a small actuator (turbine)</p>	<p>Pre Assessment is a paper test on MS standards (PS1-4, 2-3, 2-4, 2-5, 3-1, 3-2, 3-3, 3-4, 3-5) E Transfer Device Challenge</p>
<p>Formative Assessment - What information are you collecting to know that they met the target?</p>			
<p>Roller Coaster</p>	<p>Construct an explanation about how a roller coaster uses energy to complete a circuit.</p> 	<p>Energy flows through a system.</p>	<p>Watch the video (beginning to 2:30) Why can't this go backwards In pairs discuss</p> <p>Direct instruction on KE and PE Direct instruction on LOL diagrams</p> <p>Mini Lesson on Energy flows in a system ?</p>
<p>Formative Assessment - What information are you collecting to know that they met the target?</p>		<p>If the car is the system, where is the energy at points 1, 2 and 3, where 1 and 2 are at the tops of the 'loops' and 3 is at the bottom? LOL Diagram set up... First L with KE and PE (zero and zero), second L with KE and PE (high KE, low PE)</p>	
<p>Pendulum investigation</p>	<p>Collect Data and make calculations of PE, KE, and TE at various points in the swing of a pendulum.</p>	<p>Predict the energy changes when inputs change</p>	<p>Using equations and a lab setup</p> <p>Calculation of gravitational potential energy ($E=mgh$). Build LOL Diagrams to describe energy at various stages in the swing.</p>
<p>Day 2</p>	<p>Build a Computational Model to describe and predict the Energy of a pendulum at any moment in time during a swing.</p>		<p>Google Sheets and formula entry. Create columns for time (s), height (m), KE, PE, and TE (J). Cells for g ($m\ s^{-2}$) and mass (kg) Iterate at 0.1 s, 0.05s, and 0.01s</p> <p>Example Spreadsheet.</p>



Formative Assessment - What information are you collecting to know that they met the target?		Computational Model and written explanation of how this model helps predict the energy at any point in the swing (for example @7.02 s) and the limitations of the model. How could you make this model more precise? (examples include accounting for the non-linear height change, account for air resistance/ loss of energy to surroundings)	
Application of Energy Conversion - States of Matter	Conduct an Investigation to investigate how adding or removing energy from a pure substance changes the state of matter.	Changes in state are a consequence of changes in the PE and KE of the particles in a substance.	Determine the MP and FP of water and 1 or 2 fatty acids. Collect data and produce graphs of temp vs time (energy added at a constant rate)
Day 2	Apply LOL diagrams and particulate models to Explain the change in state as a result of changing positions and motions of the particles in a substance	Modeling particle position and movement to explain changes in state.	Develop and revise models in small groups (2 max)
Formative Assessment - What information are you collecting to know that they met the target?		LOL/Particulate Models to explain the changes seen in the fatty acid or water. Written explanation of model	
Summative Assessment What information are you collecting to know that they met the target?		PS3-1/PS3-2 test	
Energy Conversion Device	Build and test your device to transform one type of energy into electrical energy	Engineering Design Process - work within constraints to design a device.	Build and test time for devices.
Presentation of devices.			Present Devices
Summative Assessment What information are you collecting to know that they met the target?		Project Writeup	

Materials / Resources

Vocabulary

HS-PS3-1

System and boundaries
Components
Energy (thermal energy, kinetic energy, and/or the energies in

HS-PS3-2

System and surroundings
Energy flow

HS-PS3-3

Energy Device (e.g. wind turbine, solar cell, generator)
Energy conversion
Energy loss



gravitational, magnetic, or electric fields)
Energy flow

Macroscopic energy (e.g. motion, light, sound, thermal energy, potential energy or energy in fields)
Microscopic energy
- motion of particles (e.g. nuclei and electrons)
- position of particles (potential energy) in fields
- energy in fields
Conservation of energy
Energy and Matter

Efficiency

Mini Lessons

[System Level 5 - Simulating Systems Mini-Lesson](#)
[System Level 5 - Simulating Systems Thinking Slides](#)
[Matter and Energy Level 5 - Cycles and Flows](#)
[Matter and Energy Level 5 - Cycles and Flows Thinking Slides](#)
[Energy Level 6 - Conservation of Energy](#)
[Energy Level 6 - Conservation of Energy Thinking Slides](#)

Graphic Organizers

[Phenomena Observation Graphic Organizer](#)
[Questioning Graphic Organizer](#)
[Modeling Graphic Organizer](#)
[Planning an Investigation Organizer - Experimental](#)
[Planning an Investigation Organizer - Observational](#)
[Investigation Evidence Organizer](#)
[Engaging in Argumentation Organizer](#)

Differentiation / Modifications



◀ **HS-PS3-1 - Energy Change in Components of a System**

◀ **HS-PS3-2 - Macroscopic Energy Due to Particle Position and Motion**

◀ **HS-PS3-3 - Energy Conversion Device Design**

◀ **Local and Relevant**

◀ **Favorite**

◀

◀

Solar Cells ◀◀◀◀◀

Alternative energy sources ◀◀

OIL ◀◀

Wind ◀◀

Turbines ◀◀◀

Electricity ◀

Circular Farms -stuff grows in the desert ◀◀◀

****NEOM/The Line** ◀◀◀◀◀◀ [LINK](#)

-how does we make it sustainable/self sufficient

Electric Cars ◀◀

Magnets

Hand boiler ◀

Drinking bird ◀

Water hammer [link](#) ◀◀

Happy/Sad Balls ◀

Batteries ◀◀◀

Oobleck/ Slime/ Ketchup/ Non-Newtonian Fluids ◀

Hot/Cold Plates ◀

AC ◀◀◀◀

Ferrari Experience in Abu Dhabi Roller Coasters ◀◀◀◀

Project - Energy Change Device - Design a device to create electricity from some other form of energy. ◀◀◀◀◀



HS-PS3-1: Energy Change in Components of a System

[Evidence Statement](#)

Assessment: Algodoo Ball Bounce ([Google Template](#))

Reflections: <i>Type Here</i>			
	No	Partial	Yes
1. The assessment contains a phenomenon (science) or a problem (engineering)			
2. The prompts match the Science and Engineering Practice (SEP) and engage students in sense making.			
3. The stimuli have multiple and sufficient information needed to utilize the SEP . (e.g. multiple data sets to analyze)			
4. The prompts elicit observable understanding of the Disciplinary Core Idea (DCI) .			
5. The prompts explicitly mention the Crosscutting Concept (CCC) .			

6. The prompts include language (i.e. bullets) from grade appropriate progressions. (SEP) (DCI) (CCC)			
7. The graphic organizers provide space for the observable features (e.g. 1, 2, 3...) in the evidence statement. (e.g. claim, evidence and reasoning)			
8. The entire assessment contains information that is scientifically accurate and properly attributed. (e.g. don't make up data and include the source)			
9. The prompts point in the direction of explaining a phenomenon (science) or designing a solution (engineering).			
10. The phenomenon or problem is authentic, interesting, and requires students to figure something out.			
11. The phenomenon or problem is novel to show the transfer of knowledge. (i.e. not in the unit)			



HS-PS3-2: Macroscopic Energy Due to Particle Position and Motion

[Evidence Statement](#)

Assessment: Heat During Launch and Reentry ([Google Template](#))

Reflections:			
	No	Partial	Yes
1. The assessment contains a phenomenon (science) or a problem (engineering)			
2. The prompts match the Science and Engineering Practice (SEP) and engage students in sense making.			
3. The stimuli have multiple and sufficient information needed to utilize the SEP . (e.g. multiple data sets to analyze)			
4. The prompts elicit observable understanding of the Disciplinary Core Idea (DCI) .			
5. The prompts explicitly mention the Crosscutting Concept (CCC) .			
6. The prompts include language (i.e. bullets) from grade appropriate progressions. (SEP) (DCI) (CCC)			
7. The graphic organizers provide space for the observable features (e.g. 1, 2, 3...) in the evidence statement. (e.g. claim, evidence and reasoning)			
8. The entire assessment contains information that is scientifically accurate and properly attributed. (e.g. don't make up data and include the source)			
9. The prompts point in the direction of explaining a phenomenon (science) or designing a solution (engineering).			
10. The phenomenon or problem is authentic, interesting, and requires students to figure something out.			
11. The phenomenon or problem is novel to show the transfer of knowledge. (i.e. not in the unit)			



HS-PS3-3: Energy Conversion Device

[Evidence Statement](#)

Assessment: Renewable Energy Prototype ([Google Template](#))

Reflections:			
	No	Partial	Yes
1. The assessment contains a phenomenon (science) or a problem (engineering)			
2. The prompts match the Science and Engineering Practice (SEP) and engage students in sense making.			
3. The stimuli have multiple and sufficient information needed to utilize the SEP . (e.g. multiple data sets to analyze)			
4. The prompts elicit observable understanding of the Disciplinary Core Idea (DCI) .			
5. The prompts explicitly mention the Crosscutting Concept (CCC) .			
6. The prompts include language (i.e. bullets) from grade appropriate progressions. (SEP) (DCI) (CCC)			
7. The graphic organizers provide space for the observable features (e.g. 1, 2, 3...) in the evidence statement. (e.g. claim, evidence and reasoning)			
8. The entire assessment contains information that is scientifically accurate and properly attributed. (e.g. don't make up data and include the source)			
9. The prompts point in the direction of explaining a phenomenon (science) or designing a solution (engineering).			
10. The phenomenon or problem is authentic, interesting, and requires students to figure something out.			
11. The phenomenon or problem is novel to show the transfer of knowledge. (i.e. not in the unit)			

