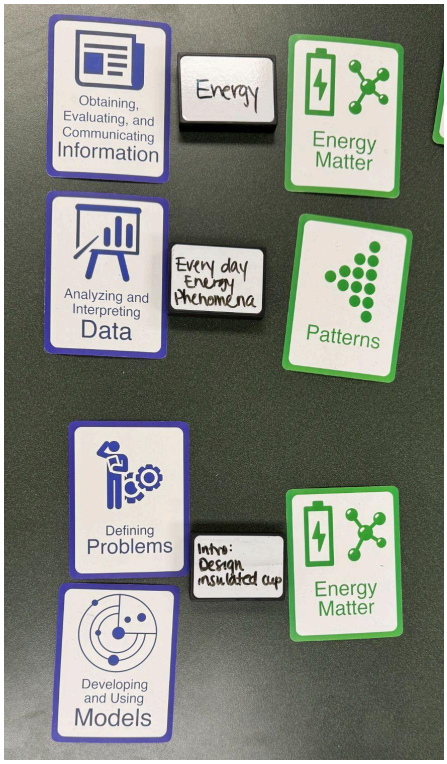
Storyline Unit Design

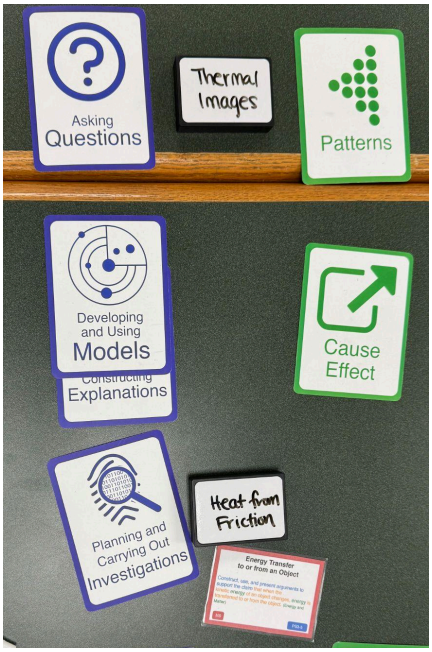
Understanding by Design (UbD) Template*

Unit	**We are Thermal Engineers**	Course(s)	**Grade 6**
Designed by	**Lorrie, Brett, Paul, Katie**	Time Frame	**8 Weeks**

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Anchor Model







*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

MS-PS3-3: Thermal Energy Transfer Solution
Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. (Energy and Matter)

MS-PS3-4: Thermal Energy Transfer
Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. (Scale, Proportion, and Quantity)

MS-PS3-5: Energy Transfer to or from an Object
Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. (Energy and Matter)

Anchoring Phenomenon

Anchoring Phenomenon Worksheet

Enduring Understandings	Essential Questions

Stage 2: Assessments

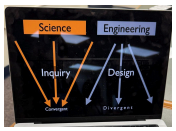
MS-PS3-3 - A Thermal Energy Design Fair
MS-PS3-4 - Investigating Mass and Materials
MS-PS3-5 - Where Did the Energy Go?

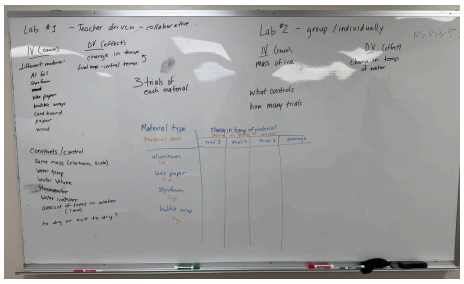
Assessment Screening Tool Slides

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?

Stage 3: Learning Plan			
 Phenomenon or Problem	 Learning Performance - What will they do? The three dimensions woven together into a single learning performance.	 Why is this important? How does this activity help build understanding of the anchoring phenomenon.	 Learning Experience - How will they do it? Graphic organizers, protocols, scaffolds, labs, mini-lesson, student discourse, etc.
Energy Everyday Energy Phenomenon (1-2 days)	Students will obtain information about energy. Students will analyze patterns of everyday items to determine what types of energy are present.	This is our energy unit and this is a review of energy.	4th grade standard direct instruction Cause → Effect Energy → Change Kinetic (Motion) Electricity Light Sound Thermal (Heat) Energy can transform from one form to another Energy - Anything with the ability to cause change Computer example - electricity, key motion, light from screen, sound from speaker Checklist - identify all types of energy in everyday objects (pinwheel, stirling engine, Before and after examples (ie water heater) Graphic Organizer Before → After Types before → Types after Phet simulation
Formative Assessment - What information are you collecting to know that they met the target?			
Thermal Design problem - Insulated cup (1 day)	Students will define a problem about thermal energy loss (coffee or hot chocolate warm).	Understand science to build the cup	Mini lesson on what an engineer vs a scientist is.

	Students will sketch a solution to the thermal energy loss using defined materials.		 Styrofoam Aluminum Foil Wax Paper Bubble Wrap Paper Cardboard
Formative Assessment - What information are you collecting to know that they met the target?			
Thermal Energy Images Crisco on hand in water (2 days) All items in the room are the same temperature	Students will ask questions about patterns in the thermal energy images. Students will develop a model that explains the causes of the patterns in the thermal energy images. Students will use computational models to investigate the cause of the thermal energy transfer. Students will update their insulated cup design solution to show thermal energy transfer.	Heat can move and transfer energy. We will want to limit this in our design. Certain materials (like Crisco) can prevent thermal energy transfer. This will be helpful in our design.	Mini lesson on thermal energy in between questions and models. (cold does not move) Mosa Mack The Solve Observations And Questions Draw temperature scale Lab - hand without and hand with Mini-lesson Heat vs. Temperature Phet simulation that show heat transfer
Formative Assessment - What information are you collecting to know that they met the target?			
Heat from friction (2-3 days)	Students will investigate effects of friction on thermal energy transfer. Students will engage in argumentation about the effects of friction on thermal energy transfer.	Students learn that different materials can transfer heat differently and that would be helpful in the design of the cup.	Hands pre temp, post temp Hands of different surfaces Mini lesson on data table, 3 trials with each surface, take the average Mini lesson on friction (conversion of kinetic energy into sound and thermal energy)

			CER question How does friction cause materials to change temperature?
Formative Assessment - What information are you collecting to know that they met the target?			
Newton Cradles (modified assessment)	Students will construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. (Energy and Matter)		Assessment - Where Did the Energy Go?
Summative Assessment What information are you collecting to know that they met the target?			
Materials Lab	Students will collaboratively plan an investigation to determine the relationships among the energy transferred and the type of material. (quantity)		 Heavily teacher led planning Mini lesson on variables - IV and DV Mini lesson on conductors and insulators at the end of the lab
Formative Assessment - What information are you collecting to know that they met the target?			
Winter clothing (2 days)	Students will analyze patterns in different winter clothing to measure how materials prevent thermal energy transfer. Students will develop models of low and high thermal energy winter clothing pieces. Students will update their insulated cup design solution to show thermal energy transfer.		Go out on a cold day for a set amount time, gather data on temperature of different winter clothing Measure temperature of hands

Formative Assessment - What information are you collecting to know that they met the target?			
Water Lab (Assessment)	Students will collaboratively plan an investigation to determine the relationships among the energy transferred and the type of material. (quantity)		How does the mass of water affect the temperature of water over time. Independent Variable (Cause: Volume (ml) water Dependent variable (Effect): Change in temperature (
Formative Assessment - What information are you collecting to know that they met the target?			
Cup Solution	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. (Energy and Matter)		Poster Problem, Solution Criteria, Constraints Scientific Knowledge Testing (thermal camera image, data from test) Conclusion
Summative Assessment What information are you collecting to know that they met the target?		Poster Problem, Solution Criteria, Constraints Scientific Knowledge Testing (thermal camera image, data from test) Conclusion	

Materials / Resources

Vocabulary

MS-PS3-3
- Thermal energy transfer (hotter object to colder object)
- Thermal energy transfer processes (conduction, convection, and radiation)
- Temperature
- Device
  - Thermal conductor
  - Thermal insulator
- Energy

MS-PS3-4
- Thermal energy transfer
- Type of matter
- Mass
- Temperature (average kinetic energy of particles)
- Environment
- Proportional

MS-PS3-5
- Energy transfer
- Kinetic energy
- Potential energy
- Thermal energy
- Object
- Temperature
- Motion
- Environment
- System

Mini Lessons

Proportion Level 5 - Proportional Relationships
Energy Level 3 - Energy and Energy Transport

Planning & Carrying-Out Investigations Level 3 - Experimental Design
Engage in Argument with Evidence Level 3 - Presenting Arguments

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

Phenomenon Worksheet

Back to Stage 1

◁ **MS-PS3-3 - Thermal Energy Transfer Solution**
◁ **MS-PS3-4 - Thermal Energy Transfer**
◁ **MS-PS3-5 - Energy Transfer to or from an Object**
◁ **Local**
◁ **Favorite**
◁
◁

Screening Tools

Back to Stage 2

MS-PS3-3: Thermal Energy Transfer Solution

Evidence Statement

Assessment: A Thermal Energy Design Fair (Google Template)

Reflections: *Type Here*

	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)			

Screening Tools

Back to Stage 2

MS-PS3-4: Thermal Energy Transfer

Evidence Statement

Assessment: Investigating Mass and Materials (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)			
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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)			

Screening Tools

Back to Stage 2

MS-PS3-5: Energy Transfer to and from an Object

Evidence Statement

Assessment: Where Did the Energy Go? (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)			
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