Title: A Science Unit on Energy

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Science Standards Addressed:

4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object.

DCI: Definitions of Energy

CCC: Energy and Matter

SEP: Constructing Explanations and Designing Solutions

4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

DCI: Definitions of Energy, Conservation of Energy and Energy Transfer

CCC: Energy and Matter

SEP: Planning and Carrying Out Investigations

4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide

DCI: Definitions of Energy, Conservation of Energy and Energy Transfer, Relationship Between Energy and Forces

CCC: Energy and Matter

SEP: Asking Questions and Defining Problems

What are your Unit Concepts and Generalizations? List here:

Goal: By the end of this unit, students will have a thorough understanding of what energy is, how it is used in our everyday lives, and how it impacts the world.

Unit Objectives:

Students will describe potential and kinetic energy in relation to speed.

Students will create simple circuits to light a lightbulb.

Students will identify and describe energy transfer.

As a result of this unit, the students will *know*: that there are different kinds and forms of energy and that energy can be transferred and conserved between them.

As a result of this unit, the students will *understand that*: energy is found all around them and essential for everyday life.

As a result of this unit, the students will *be able to*: identify different forms of energy and describe why they are important/useful.

Instructional Strategies Used:

- Questioning and Discussion
- Predicting
- Self-Discovery
- Observation
- Various i-TPSI student configurations
- Cooperative Group Learning
- Pick-a-Stick
- Think-Pair-Share
- Used different modalities for presenting information
- Exit Tickets
- Using visuals
- Re-voicing
- Learner Choice
- Jigsaw Activities
- Kahoot Games

Sample Supporting Materials Provided: incorporating Lit., Math, Geography, and/or Social Studies, list books you could read to Engage or otherwise support your lessons.
Place the titles of: textbooks; article titles and any printed materials you use within your unit and page numbers in the table below. An example shows you what you need to do:

Title	*Page(s)*	*Subject Incorporated*
1. ***Energy Island*** by Allan Drummond	All	Literature/SS
2. ***Generating Wind Power*** by Niki Walker	All	Literature/SS
3. ***Harnessing Power from the Sun*** by Niki Walker	All	Literature/SS
4. ***Geothermal Energy: Using Earth's Furnace*** by Carrie Gleason	All	Literature/SS
5. ***Biomass: Fueling Change*** by Niki Walker	All	Literature/SS
6. ***Water Power*** by Tea Benduhn	All	Literature/SS

Unit Overview

LESSON	WHOLE-CLASS COMPONENTS	DIFFERENTIATED COMPONENTS and/or incorporation of Lit., Math, Geography, Art, and/or Social Studies
LESSON 1 **Title:** What Is Energy? **Pre-Assessment:** Students play a Kahoot game with energy facts and forms of energy **List your supplies:** Kahoot game *2 class periods*	**Engage:** Students will play a Kahoot game that includes true/false questions about the nature of energy (e.g. There are many forms of energy; Light energy travels in straight lines; etc.) and whether or not different scenarios are examples of energy (e.g. Does a ball moving through the air have energy? Does a ball sitting on the ground have energy? Does a cup of hot chocolate have energy? etc.). This will get students thinking about different forms of energy. **Day:** 1 **Time in minutes:** 5-10	. **Teacher will read each question aloud for students who may have trouble reading the board.
Supplies: Picture Sort materials	**Explore - Experiment 1 Steps:** Forms of Energy Picture Sort: Prior to the lesson, the teacher will have placed 6 headings on the walls around the room: Mechanical Energy, Electrical Energy, Light Energy, Thermal/Heat Energy, & Sound Energy. The class will be divided into groups of 3-4. Each group will be given a set of photos and each photo represents one of the forms of energy (there may be more than 1 picture per form of energy & some pictures may fit more than one form of energy). Students must work together as a group to determine which form of energy they think is portrayed in each photo. Then they will tape the photos under the headings they have chosen. While the students are sorting, the teacher will float around the room and observe group discussions. Groups will then have an opportunity to explain why they sorted the pictures the way they did. **Day:** 1 **Time in minutes**: 15	**Teacher will ensure that headings are in places easily accessible to all students. **Groups will be a mix of high and low level students. **Teacher may want to label photos for English Language Learners.
Supplies:		

Guided notes worksheet **Supplies:**	**Explain:** The teacher will explain that the photos they just sorted are all forms of energy. The teacher will then define energy and explain the 5 different forms. Students will fill in the M.E.L.T.S. acronym and key information on their worksheets as the teacher explains. The teacher will also identify which photos from the Explore activity go with which form of energy. **Day:** 1 **Time in minutes:** 15-20	**Information will be presented in visual form (e.g. PowerPoint) **Students with disabilities/special needs may need guided notes
iPads App: Pic Kids	**Elaborate - Experiment 2 Steps:** For this activity, students will go outside and use their iPads to take photos of items that fit the five forms of energy (e.g. swing set = mechanical, sun = thermal, fire alarm = electrical, etc.). Students will then return inside and use the "Pic Kids" app to create a collage of their photos. Each photo should have a description of why it fits that form of energy. Students will then share their collages in small groups of 3-4. **Day: 2** **Time in minutes:** 25-30 min	**[Art/Technology]** Students use an iPad app to create a collage of different forms of energy they see outside.
Supplies: iPads App: Pic Kids	**Evaluate:** Students will be assessed based on the content of their Pic Collages. Students should have at least 1 photo for each form of energy and a short description explaining why that picture fits that form of energy. **Day:** 2 **Time in minutes:** 0	

LESSON 2 **Title:** Energy & Speed **Supplies:** Exploration Worksheet Hot Wheels cars *2 class periods*	**Engage:** Students will be seated in groups of four. Each student will be asked to draw a picture on their worksheet of a ramp that they think would get the car moving as fast as possible. **Day:** 3 **Time in minutes:** 5-7	**[Art]** Students draw a picture of a ramp. **Energy & Speed lesson based on Hot Wheels Speedometry 5E lesson plan found at: www.hotwheels.com
Supplies: Exploration worksheet Hot Wheels cars Meter sticks Butcher paper for class bar graph	**Explore - Experiment 1 Steps:** 1) In their groups, the students will share their drawings with their peers and the group will decide as a whole how they would like to build their ramp. 2) Using whatever materials they can find, each group will build a ramp for their car. They will complete 2-3 trials with the ramp at differing heights. 3) For each trial, the students will predict the distance their car will travel and record the height of their ramp and the distance it travels in inches on their worksheet. 4) After completing their trials, each group will select a student to come up to the front of the room and draw their results on a class bar graph that was prepared by the teacher. **Day:** 3 **Time in minutes:** 35-40	**Groups that work quickly will continue doing trials at different heights until every group has completed at least 2 trials. **[MATH]** Students create a bar graph to represent their findings
Supplies: Exploration worksheet YouTube Video Poster paper	**Explain:** Think-Pair-Share: What pattern do you see in the bar graphs? Teacher will use Pick-a-Stick to ask students to share their observations. Teacher will introduce potential and kinetic energy and show the students a short video about how they work. As a class, come up with definitions for potential and kinetic energy and have the students write the definitions on their worksheet. Demonstrate a few real world examples of potential and kinetic energy then have students label where they would find the most potential and kinetic energy on their original ramp drawings. **Day:** 3 **Time in minutes:** 10-15	Video Link: https://www.youtube.com/watch?v=IqV5L66EP2E

Supplies: Exploration worksheet Small scale Hot Wheels cars Ramp materials	**Elaborate - Experiment 2 Steps:** Students will start by making predictions about what would happen to their exploration data if their car had weighed more. The groups of students will then pick out a car that weighs more than the car they used during the exploration phase. (They can check the weights using a small scale) Next, they will repeat the exploration experiment using the same heights as before. After they complete their trials and record the data, the students will compare their new data with their original data. Students will determine if more weight increases or decreases the car's energy. **Day:** 4 **Time in minutes:** 20	**For the sake of time, if the elaboration experiment is done on a different day than the exploration, the teacher may choose to provide students with Hot Wheels ramps instead of having students build their own again.
Supplies: Exit ticket	**Evaluate:** Students will complete an exit ticket worksheet over potential and kinetic energy: 2 fill in the blank questions (4 pts), 1 multiple choice question (1 pt.), & 2 short answer questions (3 & 2 pts). Criteria for success: 7/10 pts Teacher will walk around and answer questions as needed **Day:** 4 **Time in minutes:** 10	**Scaffolding: Students will be able to draw from a word bank for the fill in the blank questions **Students who have difficulty writing their answers to the short answer questions will be allowed to demonstrate their knowledge orally
LESSON 3 **Title:** Transferrable Energy **Supplies:** Dominos *2 class periods*	**Engage:** Before the lesson, the teacher will set up a line of dominos. The teacher will gather the students around the table with the dominos and ask them to watch closely as she knocks them over by pushing the first domino. Have the students discuss where they observed potential energy, kinetic energy, and how they know. Ask: What was going on in terms of energy during this chain reaction? **Day:** 5 **Time in minutes:** 5	

Supplies: Grooved rulers 3 marbles per student pairing Observation worksheet	**Explore - Experiment 1 Steps:** Students will be seated in pairs. Each pairing will receive a grooved ruler and 3 marbles of similar size. Students will place one marble toward one end of the ruler and place the other two touching each other in the middle of the ruler. On their observation worksheet, students will individually predict what will happen when they flick the marble on the end of the ruler toward the other two. The pairs of students will then take turns flicking/pushing the single marble at the other two marbles. They will write their observations on their worksheet as they go. The teacher will then use Pick-a-Stick to call on at least 3 students to share what they observed about the marbles. On their worksheets, students will then individually write down why they think the marbles reacted the way they did. **Day:** 5 **Time in minutes:** 15-20	**After placing the marbles on the ruler, students should not touch the materials again until after they make their predictions.
Supplies: YouTube video Observation worksheets	**Explain:** The teacher will introduce the concept of transferrable energy by showing the students a short video clip. The teacher will then write the definition for transferable energy on the board. The whole class will then walk through the marble activity step by step to explain how energy was transferred from marble to marble. Students will then self-assess their rationale from the exploration phase in regards to why the marbles reacted the way they did. Students will correct their answers as needed. **Day:** 5 **Time in minutes:** 10	Video Link: https://www.youtube.com/watch?v=h90xizaRTOg
Supplies: Grooved rulers Small marbles Observation worksheets	**Elaborate - Experiment 2 Steps:** Students will experiment with transferrable energy using different numbers of marbles. (Ex. Flicking 2 marbles at 3 marbles makes 2 marbles move) This will introduce the concept of conservation of energy: a rolling marble can only transfer the amount of energy	**Some student pairings may need more help/guidance in determining how many marbles to use.

	it already has. Students should record their observations on their worksheets. **Day:** 6 **Time in minutes:** 10	
Supplies: Observation worksheets	**Evaluate:** Ask: Where did we see a transfer of energy during our Hot Wheels cars and ramps experiment? Students will then be asked to think about where they see energy being transferred in their everyday lives. Students should write down at least two examples on their observation worksheets. The teacher will answer questions as needed. **Day:** 6 **Time in minutes:** 10	
LESSON 4 **Title:** Simple Circuits **Supplies:** Flashlight Batteries *2 class periods*	**Engage:** Students will be shown a flashlight without batteries. It will be passed around the class as they try to make it light up. After they figure out it's missing batteries, insert the batteries and turn on the flashlight. Explain that they will be investigating how to light a bulb. **Day:** 7 **Time in minutes:** 5	
Supplies: Exploration Worksheet Wires Batteries Lightbulbs	**Explore - Experiment 1 Steps:** 1) On their worksheet, students will brainstorm how to light a bulb and will draw a picture of it. 2) In groups of four, students will be given a battery, two wires, and a small lightbulb. They will use these materials to attempt to light the bulb. 3) As students try different configurations, they should draw at least one that was successful in lighting the bulb and one that was not on their worksheet.	**Students who experience difficulty holding circuit components in place to create a complete circuit will be given holders for the batteries and/or lightbulbs. **Groups who finish early are to continue trying different configurations to see which ones work and which do not.

	4) After each group has successfully lit their bulb, have a volunteer from each group draw their circuit on the board. 5) As a class, discuss how the circuit needed to be set up to light the bulb **Day:** 7 **Time in minutes:** 15-20	
Supplies: Exploration Worksheet PowerPoint presentation	**Explain:** Explain that what the students built is called a circuit. Display the definition and diagram on the board. Students should write the definition on their worksheet. Think-Pair-Share: Why did the wires have to touch two different parts of the lightbulb in order to complete the pathway? After discussing, project a diagram of a lightbulb onto the board and label the most important components while students fill in the blanks on their own diagrams on their worksheets. **Day:** 7 **Time in minutes:** 10	**Diagram with blank spaces for vocabulary will already be on students' worksheets.
Supplies: Exploration worksheet Batteries Wires Lightbulbs	**Elaborate – Experiment 2 Steps:** Each group will be allowed to choose one of the following challenges to complete: 1) Create a circuit that will light up the bulb using only one wire. 2) Create a circuit that will make the lightbulb twice as bright. Students may use as many batteries/wires/lightbulbs as they need. **Day:** 8 **Time in minutes:** 15-20 min	**If students created a circuit during the Explore phase that would complete one of these challenges, they are to complete the other challenge **After students successfully complete the challenge, they will raise their hands and the teacher will gather their materials to minimize distractions.
Supplies: Exploration worksheet	**Evaluate:** After successful completion of a challenge, students will draw their circuit on their worksheet and explain why it worked in the space provided. Criteria for describing why the challenge circuit was successful: 1) Accurately describes the circuit 2) Describes the flow of energy/transfer of energy 3) Identifies potential and kinetic energy in their circuit	**Students who struggle with writing will be allowed to orally demonstrate their knowledge to the teacher

	Teacher will walk around the classroom while students work and answer questions as needed. **Day:** 8 **Time in minutes:** 10-15	
LESSON 5 **Title:** Energy & the World **Supplies:** "Energy Island" *2 class periods*	**Engage:** The teacher will read "Energy Island" to the class. Students will be asked to pay special attention to how the people in the book made their world better. After reading the book, the students will complete a Before/After graphic organizer to describe life on the island of Samsø before and after they started using renewable energy sources. **Day:** 9 **Time in minutes:** 10	**[Literature/SS]** The teacher reads a book to the class about the true story of the Danish Island of Samsø.
Supplies: Frayer model graphic organizers Informational texts on energy sources	**Explore - Experiment 1 Steps:** The class will be divided into 5 groups for a Jigsaw activity. Each student will be given a Frayer model graphic organizer, and each group will be given an informational text over one of the five renewable energy sources: water, wind, solar, geothermal, or biomass. As a group, the students should read the text and fill out their graphic organizers. The four sections of the graphic organizer they should fill out are: Definition, Characteristics/How It Works, Examples, and Advantages/Disadvantages. **Day:** 9 **Time in minutes:** 40	**[Social Studies]** Each group will be given one of the 5 informational texts about renewable energy listed at the top of this unit plan. They will research the advantages/disadvantages of each and how they impact communities/the world. **Groups will be a mix of higher and lower level students **Students may look on the internet for additional resources **To ensure student participation, for each section of the graphic organizer, a different student must be in charge of holding the book and directing group reading.
Supplies: Guided notes worksheet	**Explain:** Students will have worksheets to take notes on as each group of students presents their research to the class. Each student must participate in the presentation. The teacher will re-voice and add additional key information as needed. After each group has presented, students will discuss in their small groups why renewable energy is important. **Day:** 9 **Time in minutes:** 20-25	**Worksheets will include guided notes to accommodate for lower level students or students with disabilities

Supplies: Kahoot quiz	**Elaborate - Experiment 2 Steps:** For this phase, students will gain a new perspective on the amount of resources we use in a day (specifically, water). The students will participate in a Kahoot game where they are asked to guess how much water in gallons they think they use when taking a shower, taking a bath, washing their hands, brushing their teeth (both with water running and not), flushing the toilet, running the dishwasher, etc. Students will then discuss in small groups: "Why is it important to be aware of how much of a resource we're using? How can you reduce the amount of water you use in a day? **Day:** 10 **Time in minutes:** 20	**[Social Studies]** Students discuss the impact of using too much of one resource and how they can be proactive in reducing consumption.
Supplies: Graphic organizers	**Evaluate:** Students will be evaluated based on the completion of their graphic organizer, the content of their group presentation, and their participation throughout the lesson. **Day:** 10 **Time in minutes:** 0	

Your Own Evaluation

You stated how you would evaluate each lesson; now describe how you will evaluate the unit. What is your evaluation? (how will you know that the students understand the concepts you intended?):

The students will demonstrate a knowledge of what energy is, how it is used in our everyday lives, and how it impacts the world through their final group presentations and individual writings throughout the unit. Since this is an authentic assessment and not a selected response, the teacher will probably need to use a rubric for grading. (Depending on the school/class/teacher, the teacher may wish to incorporate a selected response unit test as well)

How did the lessons and evaluations address the Standard/Goal/Objective?

Each lesson is specifically tailored to meet one or more NGSS standards, and each lesson introduces a new subcategory of energy, as students gradually build up their knowledge until they can eventually demonstrate mastery of the unit goal. They start by learning about forms of energy and energy found immediately around them, and throughout the unit their perspective gradually expands until they can apply their knowledge on a global scale. In each lesson, students are allowed to draw on their prior knowledge, discover new concepts for themselves, and apply it to new or real life situations. Throughout the unit, students are continually asked to make explicit connections between new knowledge and prior knowledge.

Teacher Reflection on Designing the Unit:

- **Discuss any changes you may make if you teach this:**
    - With this unit, a lot of flexibility is required, especially in regards to time. If I taught this unit, there may be times when certain activities may need to be shortened or modified. I would also incorporate science journals. The students do a fair amount of writing in this unit, and it would be nice to allow the students to have all their data and writing in one place.

- **Discuss why you feel the experiments you choose were the best for your students:**
    - I feel like the experiments and activities I chose do a good job of using different strategies/modalities and letting students discover new ideas and concepts for themselves. They are also very hands-on and kinesthetic. I also tried to use different groupings throughout the unit and incorporate plenty of cooperative group learning and discussions.

- **Discuss why you feel your evaluations were the best ways to evaluate your students' new knowledge:**
    - Most of my evaluations are authentic assessments rather than quizzes or tests. Not only does this lower the pressure on the students, it allows them to demonstrate their knowledge and ability to apply new concepts to their own lives, which is something extremely important with a topic like Energy. I also used multiple intelligences (linguistic, visual-spatial, verbal, interpersonal, intrapersonal, logical-mathematical, & bodily-kinesthetic) throughout my evaluations to give every student an opportunity to express their learning in a way that makes them feel confident in their abilities.