KINDERGARTEN CURRICULUM

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Ending project: Testing and Cooking with Solar Hot Water

Lesson I: Kindergarten
What is Energy?
- Brainstorming activities to begin discussion
- Discussing 1 form of energy: mechanical

Lesson 2: Kindergarten
Energy Conversion
- Introduce thermal and electrical energy
- Experiments to explore energy conversions, for example:
    - Mechanical energy into thermal energy (rubbing hands together, running in place)
    - Mechanical energy into electrical energy (dynamo flashlight–hand powered flashlight)

Lesson 3: Kindergarten
Energy Theatre
- Students learn and act in an Action Story about energy conversion
- The cast of characters: Energy, Mechanical Energy, Thermal Energy, Embodied Energy, and Chemical Energy

Lesson 4: Kindergarten
What is Potential Energy?
- Discuss potential energy of food and sun and their uses in our daily life
- Brainstorm why might we heat water
- Brainstorm different ways to heat water

Lesson 5: Kindergarten
International Study: Reading Books
- Read 3 books introducing how people live throughout the world (2 books by Ann Morris and 1 book by Barbara Kerly)

Lesson 6: Kindergarten
International Water Study
3 Focus Countries
Discuss location, climate, daily life, and water use of Kenya, India, and Haiti

Lesson 7: Kindergarten
Energy Potential: Different Ways to Heat Water
- Brainstorm what different ways people might heat water in Kenya, India, and Haiti
- Discuss different sources of fuel: wood and sun

Lesson 8: Kindergarten

Testing Water Temperature: Using the Sense of Touch

- Students will "measure" water temperature through their sense of touch
- Arrange and compile findings

Lesson 9: Kindergarten

Solar Hot Water

Comparison Study

- Using a solar hot water bag (Solar Shower) to heat water measure temperature of water every 1/2 hour
- Record and graph findings

Lesson 10: 1st Grade

Solar Hot Water

Making Treats

- Heat water in the solar hot water bag (Solar Shower)
- Make drinks and soup with the heated water

Lesson I: K
What is Energy?

Lesson Overview: All life and action in the world involves some form of energy.
Lesson Concept: Any physical process that takes place in the world involves mechanical energy.

Materials:
- Large white paper for note-taking
- Hand bell (to ring)
- Wooden unit blocks or other large blocks to set up as "dominoes"
- Large plastic tub
- Water toys

Standards:
- English:
  - IX.11.EE.1 (Inquiry & Research: Generate questions about important issues that affect them or topics about which they are curious, and use discussion to narrow questions for further exploration).
- Mathematics:
  - III.1.EE.4 (Data Analysis & Statistics: Identify what data are needed to answer a particular question or solve a given problem, and design and implement strategies to obtain, organize and present those data).
- Science:
  - IV.1.EE.4 (Use Scientific Knowledge from the Physical Sciences in Real-World Contexts: Identify forms of energy associated with common phenomena).

Timeline: 1 class period (30 – 50 minutes)

Class Structure: whole class experiments (body movements)

Assessment Strategy: EEK! Daily Assessment
General Assessment Strategy #1

Lesson I: K
What is Energy?

This lesson is an introduction and exploration of what is energy. This lesson focuses on physical movement–student's moving their bodies and moving objects with their bodies–as one way of beginning to think about energy.

Lesson Overview: All life and action in the world involves some form of energy.
Lesson Concept: Any physical process that takes place in the world involves mechanical energy.

Supplies Needed:
- Large white paper for note-taking
- Hand bell (to ring)
- Wooden unit blocks or other large blocks to set up as "dominoes"
- Large plastic tub
- Water toys

Background Information:
The primary focus is on mechanical energy / our bodies in motion. Often, physical movement is a good starting point for introducing larger–more complex–issues. During this lesson, the focus is for students to realize that 'energy' is an integral part of their life–they cannot live and move without 'energy'.

Mechanical energy can be understood as the moving of any mass through space (air). This basically includes any physical actions that take place in the world. Therefore, using our bodies as examples to demonstrate mechanical energy is a good starting place. But, please do not stress that our bodies are machines. Mechanical does not mean mechanistic. We are much more that machines, even in the world of physics.

CLASS EXERCISE:

I. Brainstorming 'What is Energy?' with the class

Begin the class by asking the question: "What is energy?"
Write down all the responses on a large piece of paper that you can keep posted in the classroom or hang up during the subsequent lessons for reference.

Prompts:
- Does your body use energy? When?
- Where does your energy come from?
- How do plants grow? What do they need in order to grow and be healthy?
- How does your body grow? What do you need in order to grow and be healthy?
- What do you do that requires energy?

II. Hands-on experiments

Conduct the following experiments. At this point, we are not introducing energy conversion but just the final form of energy (the end result) in each experiment.

1. Listening to Sounds: sound energy is mechanical energy. The following explanation is a simplification of the process of hearing sound: Sound waves (vibrations) move through the air, reach the ear, then vibrate the inner ear (this is where sound amplification takes place), and we hear sound.
    a. Hands clapping
    b. Feet stomping on the floor
    c. Ringing a bell
2. Turning on the light switch: electrical energy
3. Moving their bodies: mechanical energy
    a. Jumping in place
    b. Waving hands in the air
    c. Dancing
4. Domino effect: mechanical energy
    a. Set up a row of large unit blocks and demonstrate chain reaction by pushing them over
5. Move objects with falling water: mechanical energy
    a. Set up a large tub filled with water and toys, pour the water from a variety of directions to move the toys

*Teacher's Note: It is very important to use the scientifically accepted language from the very beginning of introducing a concept. Hence, not saying "sound energy", but instead "sound energy is actually mechanical energy because we are moving air with vibrations–we hear these vibrations as sounds."

Lesson 2: K
Energy Conversion

Lesson Overview: All life and action in the world involves some form of energy conversion.
Lesson Concept: Energy conversion processes are happening in / with our body constantly.

Materials:
- Dynamo flashlight
- Hot plate
- Small pan to heat water
- Tea kettle with a functioning whistle
- 3 different colors of construction paper or poster board
- Black marker

Standards:
- English:
  - IX.11.EE.1 (Inquiry & Research: Generate questions about important issues that affect them or topics about which they are curious, and use discussion to narrow questions for further exploration).
- Mathematics:
  - III.1.EE.4 (Data Analysis & Statistics: Identify what data are needed to answer a particular question or solve a given problem, and design and implement strategies to obtain, organize and present those data).
- Science:
  - IV.1.EE.4 (Use Scientific Knowledge from the Physical Sciences in Real-World Contexts: Identify forms of energy associated with common phenomena).

Timeline: 1 class period (30 – 50 minutes)

Class Structure: whole class or small group experiments

Assessment Strategy: EEK! Daily Assessment
General Assessment Strategy #1

Lesson 2: K
Energy Conversion

This lesson builds directly on Lesson 1 by discussing energy conversions. Also, students will learn that when we discuss 'energy' we are actually discussing energy conversion. This lesson will introduce sequence of events for energy conversion–starting point, action(s), result. Potential energy will not be introduced until Lesson 4.

Lesson Overview: All life and action in the world involves some form of energy conversion.
Lesson Concept: Energy conversion processes are happening in / with our body constantly.

Supplies Needed:
- Dynamo flashlight
- Hot plate
- Small pan to heat water
- Tea kettle with a functioning whistle
- 3 different colors of construction paper or poster board
- Black marker

Background Information:
Refer to the Energy Conversion Matrix Chart from the Teacher's Introduction (posted below):

From → To ↓	**Electromagnetic (Solar)**	**Chemical**	**Thermal**	**Mechanical**	**Electrical**
Electromagnetic (Solar)					Light bulb
Chemical	Photosynthesis		Boiling		
Thermal	Solar hot water Solar hot air			Friction	
Mechanical			Steam turbine	Gears	Electric motors
Electrical	Solar cells Solar calculator	Batteries		Dynamo flashlight	Electrical circuit

CLASS EXERCISE:
I. Have the students create the following experiments:

1. Rubbing Hands Together–mechanical into thermal
   Rubbing your hands together creates friction. Whenever two 'things' create friction, heat is created.
2. Running in Place–mechanical into thermal
   You run (mechanical) and your body begins to increase in temperature (thermal) and create body heat.

3. Dynamo Flashlight–mechanical into electrical

   Pumping your hand on the handle (mechanical energy) moves gears inside the flashlight (mechanical energy to mechanical energy) the gears spark an electrical current (mechanical energy into electrical energy) and the light turns on as long as you continue to pump the handle.

4. Heating Water on a Hot Plate–electrical into thermal

   The hot plate uses electricity (electrical energy). As the water molecules are excited (mechanical energy) the water becomes hot (thermal energy).

5. Boiling Water in a Kettle–thermal into mechanical

   The hot water (thermal energy) boils (chemical energy) and forces steam (chemical energy) through the whistle on the kettle and produces a sound (mechanical energy).

II. Stating results:

After completing the experiments use 18 x 24 sheets of colored paper to create your own Energy Conversion Matrix Chart. Designate one color of paper to be one form of energy. For example:

- Blue Paper = Mechanical Energy
- Red Paper = Thermal Energy
- Orange Paper = Electrical Energy

Then, arrange the sheets of construction paper to represent the energy conversion of each experiment and write the experiment on each paper.

Experiment #1:	Blue, Red	(Rubbing Hands Together)
Experiment #2:	Blue, Red	(Running in Place)
Experiment #3:	Blue, Orange	(Dynamo Flashlight)
Experiment #4:	Orange, Red	(Heating Water on a Hot Plate)
Experiment #5:	Red, Blue	(Boiling Water in a Kettle)

*Teacher's Note for Pre-Readers: You may want to create symbols with the class that represent each form of energy to use with the words: mechanical, thermal, chemical, and electrical energy.

Lesson 3: K
Energy Theatre

Lesson Overview: All life and action in the world involves some form of energy conversion.
Lesson Concept: Energy conversion processes are happening in / with our body constantly.

Materials:
- Students
- Enthusiasm

Standards:
- Science:
  - II.1.EE.2 (Reflect on the Nature, Adequacy, and Connections Across Scientific Knowledge: Show how science concepts can be interpreted through creative expression such as language arts & fine arts).
  - IV.1.EE.4 (Use Scientific Knowledge from the Physical Sciences in Real-World Contexts: Identify forms of energy associated with common phenomena).

Timeline: 1 class period (30 – 50 minutes)

Class Structure: whole class action theatre

Assessment Strategy: EEK! Daily Assessment
General Assessment Strategy #1

Lesson 3: K
Energy Theatre

This lesson recaps Lessons 1 & 2 through performing an Action Story with the class.

Lesson Overview: All life and action in the world involves some form of energy conversion.
Lesson Concept: Energy conversion processes are happening in / with our body constantly.

Supplies Needed:
- Students
- Enthusiasm

Background Information:
Embodied energy (potential energy) is introduced in the action story even though the first lesson discussing this concept in detail is in Lesson 4. Essentially, embodied energy is *how much potential energy something has inside of it*. In order to explain this idea, ask the class, what could burn longer: a small log or a big log? (For this question, we are assuming that both logs are the same–dryness, density, etc.).

CLASS EXERCISE: AN ACTION STORY

Directions
The play is in the form of an action story–the teacher reads the script and the students "act out" the play with simple hand (or body) motions. The following motions are suggested for each form of energy. Also, as a class project, the students could create their own motions.

Word:	Action:
Energy	Hands on top of head, throw arms into the air in a 'Y'
Mechanical energy	Standing in one place, wriggle body all around
Thermal energy	Standing in one place, rub hands all over crossed arms (as when you rub your arms when cold and trying to get warm)
Embodied energy	Stand with knees bent, bend down over your knees and wrap your hands around your knees, with head down
Chemical energy	Hands held in front of body head high, large rolling motion with hands rolling out from the face (similar to the "wheels on the bus go 'round and 'round but with a large rolling motion)

Introduction: A Story About Energy

There are many forms of energy in the world. All energy is constantly changing from one form to another. And this is great, because in order for us to get any work done, energy must change from one form to another. One form of energy is mechanical energy. Another form of energy is thermal energy. And, yet another form of energy is chemical energy. All 'things' in the world have potential energy stored inside of them. This is a story about a few forms of energy changing from one form to another. . . .

A Story About Energy (hands in the air)

One day, mechanical energy (wriggle) was walking through the forest. Suddenly, mechanical energy (wriggle) heard a loud, rumbling, roar (wriggle) from behind one of the trees. Mechanical energy (wriggle) started to run. But, the loud, rumbling roar (wriggle) became louder and louder. So, mechanical energy (wriggle) ran faster and faster and faster (lots of wriggling) and became thermal energy (rubbing hands around body). Just then, the loud, rumbling roar (wriggle) stopped and said, in a very friendly and melodic voice, "Thank you, mechanical energy (wriggle) for becoming thermal energy (rubbing hands around body), I was feeling very cold and needed something to warm me up." And then the loud, rumbling roar (wriggle)–who was now very quiet–snuggled (wriggle) close to thermal energy (rubbing hands around the body) for just a moment and then disappeared.

Now, at the same time all of this was happening, two rabbits were hopping (wriggle) through the forest. The rabbits were hungry–very hungry, actually. They had been doing some fast hopping (wriggle) and were now hot (rubbing hands around body) and tired and hungry. "Let's eat (wriggle) something, " said one rabbit. "Okay, " said the other. "Let's eat (wriggle) these yummy, purple lollipop ferns (bending duck and cover) over here." "No, I would rather eat (wriggle), this delicious cheese sandwich tree bark (bending duck and cover) over here," said the other rabbit. "You're right, that would give us much more energy (hands in the air) and we could run (wriggle) for a long, long time." So, the two rabbits ate (wriggle) the cheese sandwich tree bark and after a half hour rest–so their food could digest (rolling hands)–they set off (wriggle) at record speed through the forest.

The End

Let's hear it for our cast of characters:
Energy (hands in the air), **Mechanical Energy** (wriggle), **Thermal Energy** (rubbing hands around the body), **Embodied Energy** (bending duck and cover) and **Chemical Energy** (rolling hands). And remember, sound energy is mechanical energy. (Everyone cheer and wriggle!)

Lesson 4: K
Potential Energy

Lesson Overview: All 'things' in the world have potential energy.
Lesson Concept: Everything has potential energy but there are many possibilities for how the potential energy is converted into useable energy.

Materials:
- Dynamo flashlight
- Colored construction paper
- Scissors
- Glue
- Student hand-out

Standards:
- English:
  - IX.11.EE.1 (Inquiry & Research: Generate questions about important issues that affect them or topics about which they are curious, and use discussion to narrow questions for further exploration).
- Science:
  - I.1.EE.1 (Construct New Scientific and Personal Knowledge: Generate reasonable questions about the world based on observation).

Timeline: 1 class period (30 – 50 minutes)

Class Structure: whole class experiments

Assessment Strategy: EEK! Daily Assessment
General Assessment Strategy #1
General Assessment Strategy #3

Lesson 4: K
Potential Energy

This lesson introduces the concept of 'potential energy'. This concept builds on the previous understanding of energy and energy conversion.

Lesson Overview: All 'things' in the world have potential energy.
Lesson Concept: Everything has potential energy but there are many possibilities for how the potential energy is converted into useable energy.

Supplies Needed:
- Dynamo flashlight
- Colored construction paper
- Scissors
- Glue
- Student hand-out

Background Information:
Everything in the world has potential energy that can be converted into useable forms of energy. Your body, for example, has potential energy. It can move objects, squeeze flashlight handles, jump in the air. Here is another way to think about potential energy: Food has potential energy stored inside of it. We eat the food and are able to run, jump, and think. The sun has potential energy and it can heat objects that absorb its energy.

Teacher's Note: This lesson offers many possible ways to discuss potential energy with the students. You may want to use part II and not part IV or vice versa. But, it is important to brainstorm different ways to heat water and why do we heat water for future lessons.

CLASS EXERCISES:

I. Potential Energy Chart
Ask the students, "What If" questions based on the chart below.
- What if you ate a really good meal, what could you do?
- What if the sun was shining outside, what might happen to the ground or the air or a pool of water?
- What if there was a pile of logs on the ground, what could you do with them?
- What if it was a windy day, what might happen to the trees outside or sand in the sandbox or to a pinwheel?
- What if we made a waterfall, what might happen to things below that the waterfall was falling on?

Potential	Possible Result
Food	Running, jumping, playing, thinking
Sun	Heating, things get hot
Logs	Burning, fire
Wind	Turns things
Water	Moves things

II. Creating Symbols

With the class, create symbols to represent the 'potential' side of the chart above. After you have symbols for food, sun, logs, wind, and water, discuss the different possible results learned from the answers to the "What If" questions.

- Create a Potential and Possible Result Chart completely made from symbols

III. Brainstorm different ways to heat water

a. Write down all the responses from the class
b. Discuss the energy conversion that takes place in each of the examples
c. If it hasn't been suggested: suggest heating water over a fire, burning wood

IV. Creating Posters

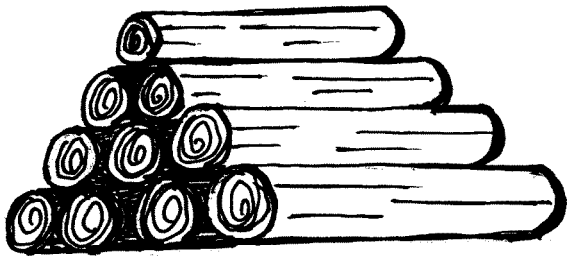
Make copies of the Student Handout illustrating different ways to heat water. Discuss with the students that there is a cause (potential energy source) and an effect (result).

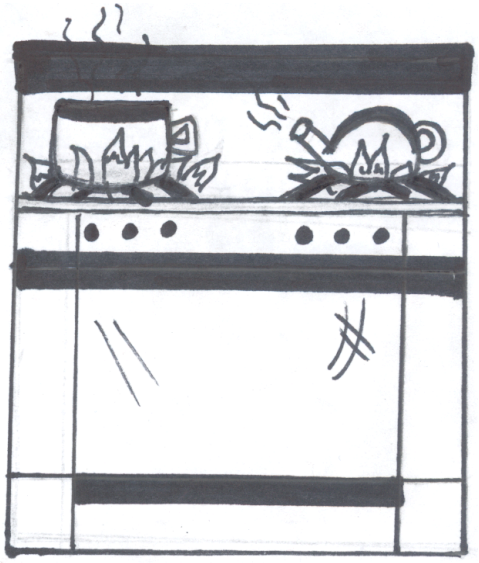
a. Cut & paste pictures in sequence order: potential and result (pictures of process of heating water: 2 step cause & effect)

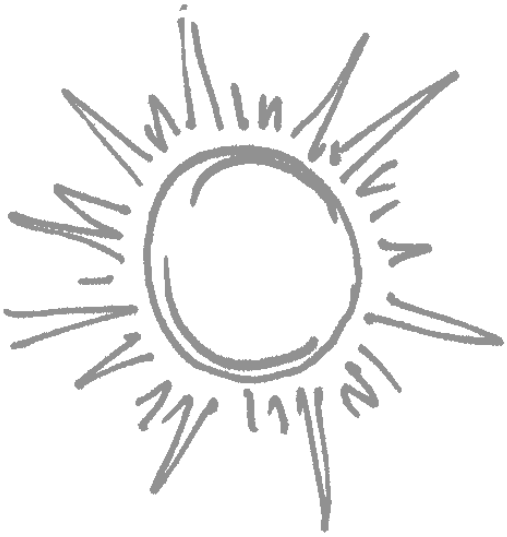
V. Brainstorm why do we heat water?

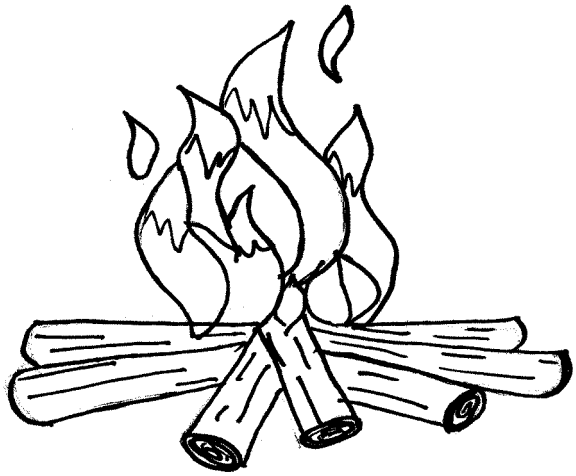
a. Write down all the responses from the class
b. Make food and drink, wash dishes, wash ourselves

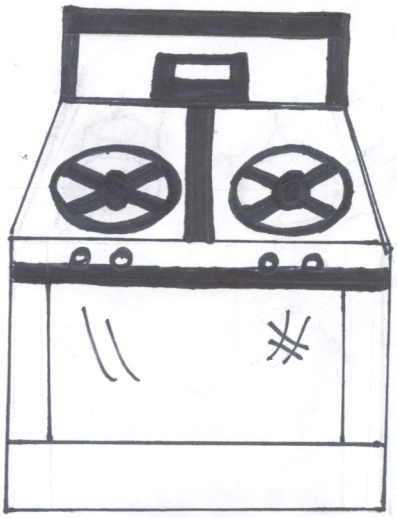
Student Handout











Lesson 5: K
International Study: Reading Books

Lesson Overview: Everyone around the world is connected through energy.
Lesson Concept: Everyone around the world needs and uses energy.

Materials:
- *House and Homes* by Ann Morris
- *Bread Bread Bread* by Ann Morris
- *A cool drink of Water* by Barbara Kerly
- *Women in the Material World* by Faith D'Aluisio and Peter Menzel

Standards:
- English:
  - VII.9.EE.1 (Depth of Understanding: Explore and reflect on universal themes and substantive issues from oral, visual, and written texts).
  - VIII.10.EE.3 (Ideas in Action: use oral, written, and visual texts to identify and explore school and community issues and problems, and discuss how one individual or group can make a difference).
  - IX.11.EE.1 (Inquiry and Research: Generate questions about important issues that affect them or topics about which they are curious, and use discussion to narrow questions for further exploration).
- Science:
  - II.1.EE.2 (Reflect on the Nature, Adequacy, and Connections Across Scientific Knowledge: Show how science concepts can be interpreted through creative expression such as language arts & fine arts).
  - II.1.EE.4 (Reflect on the Nature, Adequacy, and Connections Across Scientific Knowledge: Develop an awareness of and sensitivity to the natural world).
  - III.2.EE.4 (Use Scientific Knowledge from the Life Sciences in Real-World Contexts: Compare and contrast food, energy, and environmental needs of selected organisms).
  - III.5.EE.3 (Use Scientific Knowledge from the Life Sciences in Real-World Contexts: Describe the basic requirements for all living things to maintain their existence).
  - III.5.EE.5 (Use Scientific Knowledge from the Life Sciences in Real-World Contexts: Describe positive and negative effects of humans on the environment).
  - IV.1.EE.4 (Use Scientific Knowledge from the Physical Sciences in Real-World Contexts: Identify forms of energy associated with common phenomena).
- Social Studies:
  - II.2.EE.1 (Geographic Perspective: Describe how people use the environment to meet human needs and wants).
  - II.2.EE.2 Geographic Perspective: Describe the ways in which their environment has been changed by people, and the ways their lives are affected by the environment).

Timeline: 1 class period (45 – 50 minutes)

Class Structure: whole class circle time

Assessment Strategy: Pre-module Assessment Questions #1, #2, & EEK! Daily Assesment

Lesson 5: K
International Study: Reading Books

This lesson is an extended Circle Time–reading and discussing the following books with the class. These books are also good for the students to read together in small groups and then come together as a class to discuss.

Lesson Overview: Everyone around the world is connected through energy use.
Lesson Concept: Everyone around the world needs and uses energy.

Supplies Needed:
- *House and Homes* by Ann Morris
- *Bread Bread Bread* by Ann Morris
- *A cool drink of Water* by Barbara Kerly
- *Women in the Material World* by Faith D'Aluisio and Peter Menzel

Background Information:

Teacher's Note: The books that have been chosen show daily life of different people around the world. Kenya, India, and Haiti are included in these books though none of these include photographs of Kenyans cooking or gathering water. Ethiopia, while very different from Kenya, is a neighboring country and there are photographs in *Women In the Material World* showing typical cooking methods from Ethiopia.

The following books have been chosen to introduce different cultures throughout the world. While they all are not discussing water per say, they provide a platform to discuss how we are all connected as people throughout the world. This lesson's main intent is to begin developing empathy and understanding that how we live in the United States may be (and often is) different from how many people throughout the world live. And, we are all equals.

Possible Lead Questions
- Where does water come from? (faucet, sky)
- Where could you find water? (house, puddle, river, ocean, lake)
- Where might you get water if you didn't have running water in your home?
- What do you use water for?
- How often do you use water?
- Is water important? Why?

CLASS EXERCISE:
Read and discuss the following books with the class:
- *House and Homes* by Ann Morris

India and Kenya are included in this book as well as the housing of many other cultures.
- *Bread Bread Bread* by Ann Morris

Breads of India are included in this book as well as breads eaten around the world.
- *A cool drink of Water* by Barbara Kerly

Photographs from India as well as from around the world are included in this book.
- *Women in the Material World* by Faith D'Aluisio and Peter Menzel

Photographs of daily life from around the world. Read an excerpt from one country and have the students look through the photographs.

Lesson 6: K
International Water Study: 3 Focus Countries

Lesson Overview: Everyone in the world needs and uses water.
Lesson Concept: There are many different ways people throughout the world heat water.

Materials:
- World map
- Student hand-outs (3) of average U.S. water use
- *Women in the Material World* by Faith D'Aluisio and Peter Menzel
  Everyone around the world needs and uses energy.

Standards:
- English:
  - IX.11.EE.1 (Inquiry and Research: Generate questions about important issues that affect them or topics about which they are curious, and use discussion to narrow questions for further exploration).
- Science:
  - III.2.EE.4 (Use Scientific Knowledge from the Life Sciences in Real-World Contexts: Compare and contrast food, energy, and environmental needs of selected organisms).
  - III.5.EE.3 (Use Scientific Knowledge from the Life Sciences in Real-World Contexts: Describe the basic requirements for all living things to maintain their existence).
  - III.5.EE.5 (Use Scientific Knowledge from the Life Sciences in Real-World Contexts: Describe positive and negative effects of humans on the environment).
  - V.2.EE.4 (Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts: Describe uses of water).
- Social Studies:
  - II.2.EE.1 (Geographic Perspective: Describe how people use the environment to meet human needs and wants).
  - II.2.EE.2 Geographic Perspective: Describe the ways in which their environment has been changed by people, and the ways their lives are affected by the environment).

Timeline: 1 class period (45 - 50 minutes)

Class Structure: whole class discussion

Assessment Strategy: Pre-module Assessment Questions #3
EEK! Daily Assessment
General Assessment Strategy #1
General Assessment Strategy #3

Lesson 6: K
International Water Study: 3 Focus Countries

In this lesson, we will discuss safe drinking water in 3 countries: Kenya, India, and Haiti.

Lesson Overview: Everyone in the world needs and uses water.
Lesson Concept: There are many different ways people throughout the world heat water.

Supplies Needed:
- World map
- Student hand-outs (3) of average U.S. water use
- *Women in the Material World* by Faith D'Aluisio and Peter Menzel

Background Information: (please refer to UNICEF for further statistics (www.unicef.org))

Kenya's Water:
Water is scarce in Kenya. According to recent statistics from UNICEF, 47% of Kenyans do not have access to safe drinking water sources. When clean, safe drinking water is not available, illnesses increase–especially in children–and death rates rise.

India's Water:
Today, India has the second highest population (only China has more people) in the world. There are nearly 5 times more people living in India than the United States. In 1997, 19% of the total population did not have access to safe drinking water sources. Today, according to UNICEF, that figure has risen to 26% of the total population. Given the impacts of such population density, India is also on the verge of water stress. Compared to the United States, India has nearly one-half of the available water supply per person (as that of the average American).

Haiti's Water:
As of 1997, 69% of the total population did not have access to safe drinking water sources.
Today, according to UNICEF, that figure has risen to 82% of the total population.

CLASS EXERCISE:
I. Mapping
Using the world map, discuss where Kenya, India, and Haiti are located. Use the following lead questions to help the class discussion. After discussing where each country is located on the map with the students, refer to the book, *Women in the Material World,* and show the students pictures of families living in each country.

Possible lead questions:
- Where is each country located in the world?
    - Have students make a mark where each country is located on their hand-outs
- What do you think the climate (weather) is like in each country?
- What do you think the average daily life is like for the children in these countries?
- How might their lives be different from yours?

- Think of a your daily life, what do you use water for? How many times a day do you use water? *(Teachers: compile students' answers on the board and discuss in detail.)*
- Imagine if you didn't have clean water any time you wanted, how would your life be different?
- What do you think is the typical way to heat water?
    - Kenya: wood, charcoal, dung
    - India: wood, gas
    - Haiti: wood, charcoal, dung

II. Average U.S. Water Use

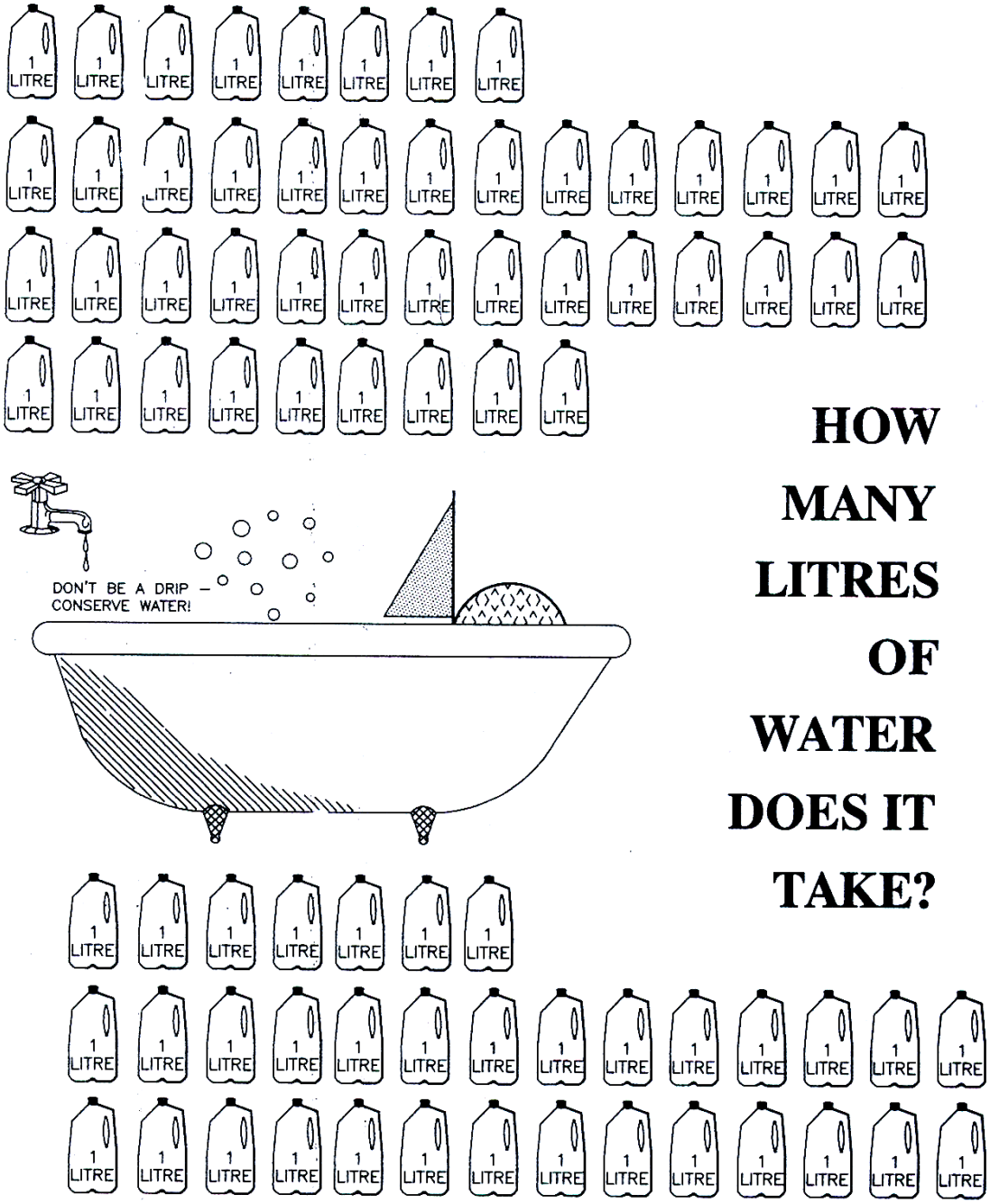
Hold up a 1 litre plastic container and then ask the class, "How much water do you think it takes to:

- fill up your bath?
- spend 1 minute in the shower?
- wash your laundry in the washing machine?

After each question hold up your container and say more than 10 or less than 10 of these containers? Then, hand out Student Handouts #1, #2, and #3 and have the students count how many of litres are on each page and write the amount on the top of the page.

Student Handout #1

This hand-out is from a coloring book originally titled "Learning About Water Usage with Captain Sewer" from the Little Rock Wastewater Utility, Little Rock Arkansas. Illustrator: Evangeline O'Neal. For more information, please contact: Water Environment Federation www.wdf.org



HOW MANY LITRES OF WATER DOES IT TAKE?

TO TAKE A BATH...

Student Handout #2

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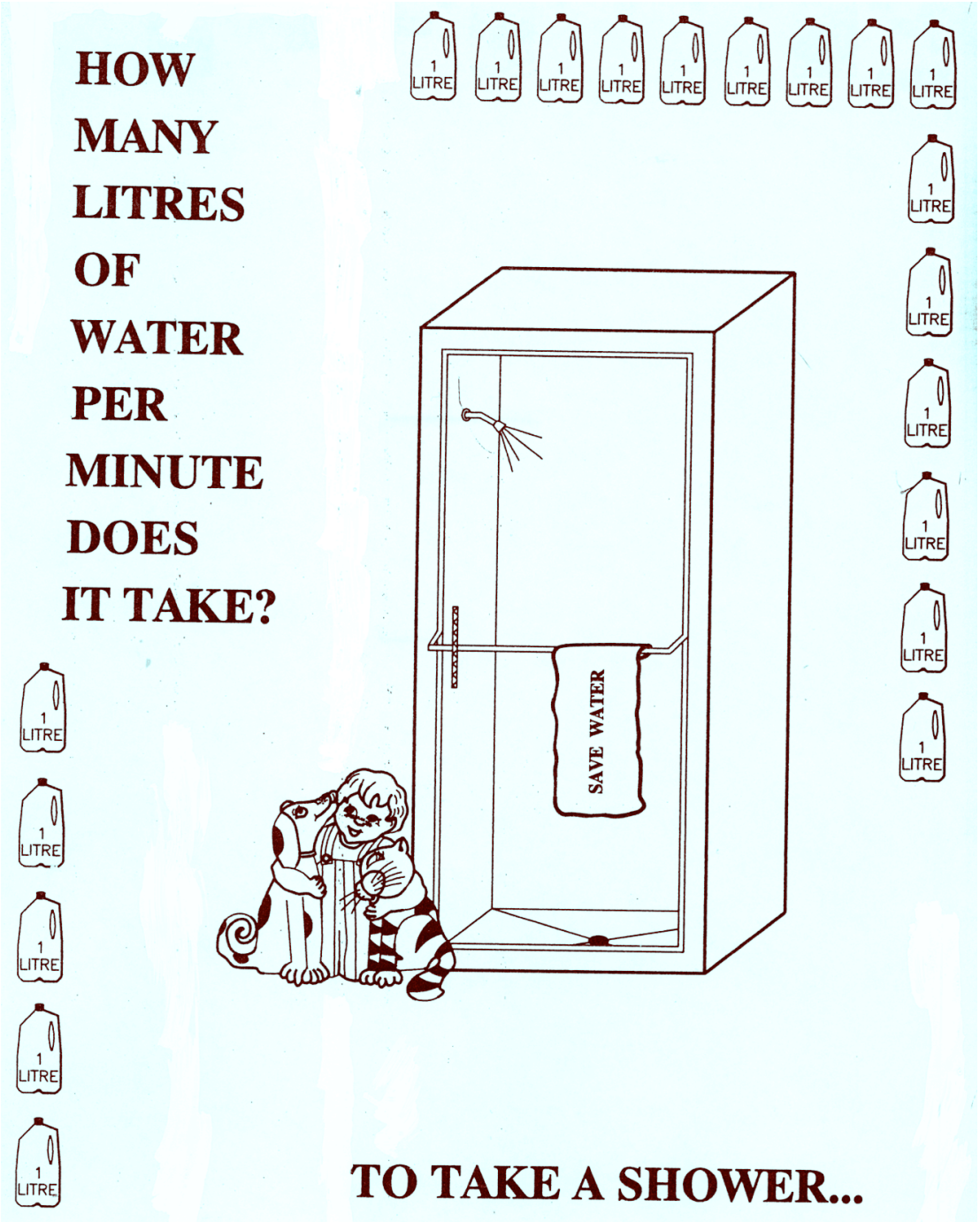

Student Handout #3

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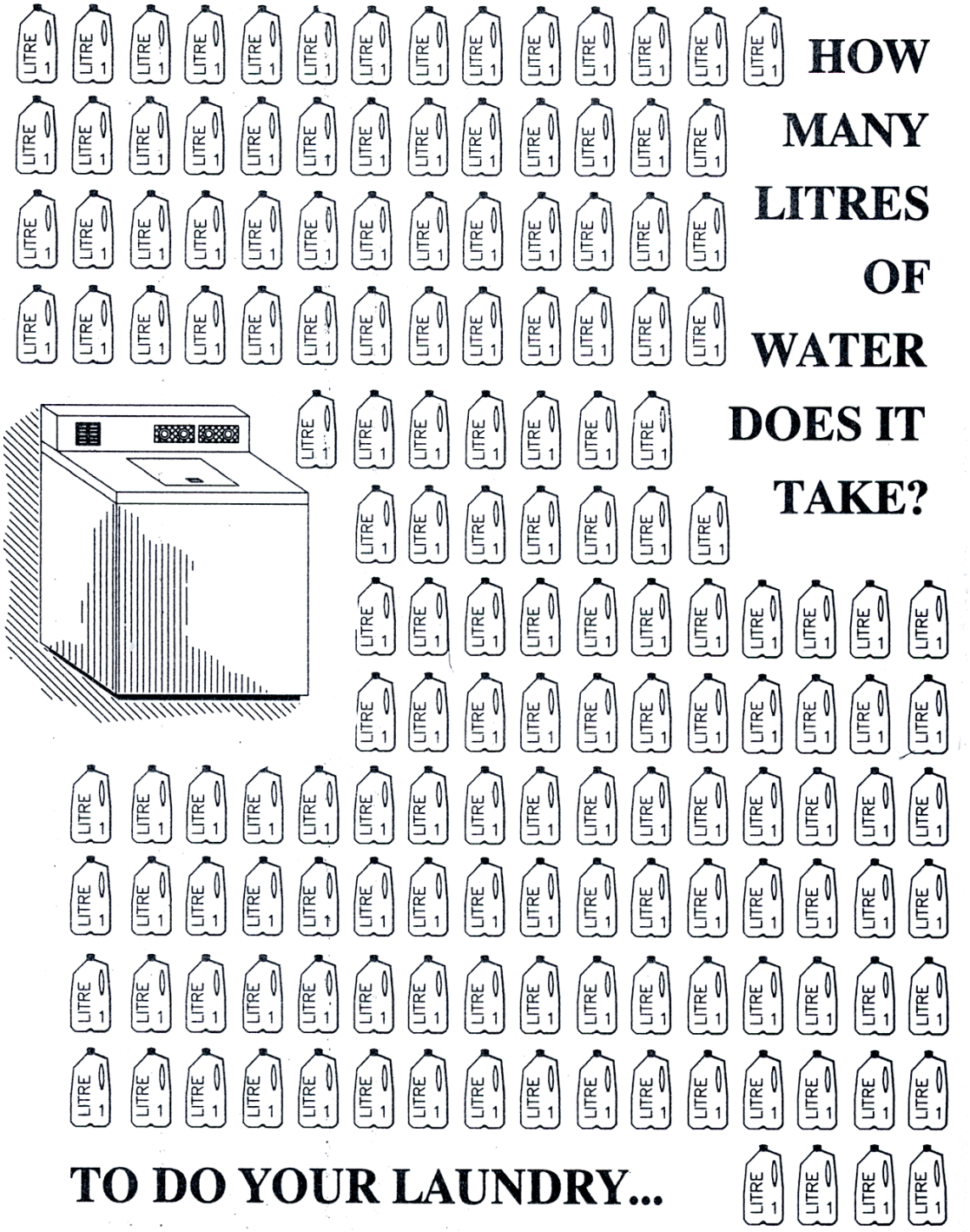

Lesson 7: K
Energy Potential: Different Ways to Heat Water

Lesson Overview: People living all around the world need and use hot water.
Lesson Concept: There are many different ways to heat water. There are many different energy sources used to heat water.

Materials:
- Dry erase markers / chalk for teacher note taking on board
- White construction paper
- Markers / crayons / pencils

Standards:
- English:
  - IX.11.EE.1 (Inquiry and Research: Generate questions about important issues that affect them or topics about which they are curious, and use discussion to narrow questions for further exploration).
- Science:
  - V.2.EE.4 (Use Scientific Knowledge from the Earth and Space Sciences in Real-World Contexts: Describe uses of water).
- Social Studies:
  - II.2.EE.1 (Geographic Perspective: Describe how people use the environment to meet human needs and wants).
  - II.2.EE.2 Geographic Perspective: Describe the ways in which their environment has been changed by people, and the ways their lives are affected by the environment).

Timeline: 1 class period (45 - 50 minutes)

Class Structure: whole class discussion

Assessment Strategy: EEK! Daily Assessment

Lesson 7: K
Energy Potential: Different Ways to Heat Water

This lesson picks up the theme of exploring potential energy discussed in Lesson 4. During this lesson, the students as a class will create an Energy Matrix Chart for how Kenya, India, and Haiti typically heat water.

Lesson Overview: People living all around the world need and use hot water.
Lesson Concept: There are many different ways to heat water. There are many different energy sources used to heat water.

Supplies Needed:
- Dry erase markers / chalk for teacher note taking on board
- White construction paper
- Markers / crayons / pencils

Background Information:
The three countries we are using as examples for comparison are: Kenya, India, and Haiti. Though Kenya and Haiti supplement using wood for fuel with charcoal and dung and India supplements with gas for this lesson focus on using wood as the main fuel source for all three countries.

CLASS EXERCISE:
I. Begin the lesson by placing the class brainstorming ideas of how water could be heated on the board or wall in full class view (from Lesson 4).
- Go over the class brainstorming ideas of how water could be heated

II. Discuss how students think water is usually (or might be) heated in Kenya, India, and Haiti.
- The answer is wood though other methods are also used (dung in Haiti and Kenya (if the family has animals) and gas (if available) in India).

III. Discuss the fuel sources for heating the water: wood
- Determine the energy conversion taking place to heat the water
    - Wood is burned to create heat
    - Chemical energy is converted into thermal energy
    - Chemical energy is available in anything that is or has been alive–plants or animals

IV. Determine the source of potential energy in a wood fire
- The wood is the potential energy

V. Create an energy conversion chart for heating water over a wood fire by drawing pictures depicting chemical energy (wood) converting to thermal energy (fire)

From → **To ↓**	**Chemical Energy**
Thermal Energy	Wood fire

Or another way: Chemical Energy to Thermal Energy
Wood to Fire

Lesson 8: K
Testing Water Temperature: Using the Sense of Touch

Lesson Overview: Using the sense of touch to measure difference.
Lesson Concept: Sequence information from cool to warm.

Materials:
- 6 plastic containers
- 6 pieces of different colored construction paper
- Pieces of construction paper (cut or torn) of each color for every student
- 6 towels

Standards:
- Mathematics:
  - III.1.EE.1 (Data Analysis and Statistics: Collect and explore data through counting, measuring an conducting surveys and experiments).

Timeline: 1 class period (45 - 50 minutes)

Class Structure: whole class experiment

Assessment Strategy: EEK! Daily Assessment
General Assessment Strategy #1
General Assessment Strategy #2

Lesson 8: K
Testing Water Temperature: Using the Sense of Touch

In this lesson, students will use their hands to "measure" water temperature.

Lesson Overview: Using the sense of touch to measure difference.
Lesson Concept: Sequence information from cool to warm.

Supplies Needed:
- 6 plastic containers
- 6 pieces of different colored construction paper
- Pieces of construction paper (cut or torn) of each color for every student
- 6 towels

Background Information:
The idea for this lesson is to determine subtle temperature differences by feel before measuring the water temperature with a thermometer for Lesson 9.

CLASS ACTIVITY:

I. Fill 6 plastic containers partially full with water varying the temperature from cool to warm.
- Place a colored piece of construction paper in front of each container.
- Place a towel next to each container.
- Give each student a "pack" of the colored construction paper (2 x 2 squares of each color).
- Have students place their hand in each container.
- After they test each container have the students dry their hands before trying the next container.
- Have the students arrange their color packs in order from cool to hot.
- Discuss their results–they will most likely be varied.

Teacher's Note: You can choose to use more or less containers. I chose six to represent: 2 colder, 2 warmer, and 2 hotter buckets of water.

Lesson 9: K
Solar Hot Water: Comparison Study

Lesson Overview: Measuring water temperature with thermometers.
Lesson Concept: Electromagnetic (solar) energy can be converted into thermal energy–water can be heated with the sun.

Materials:
- 1 solar hot water heating bag
- Short piece of rope (for hanging the bag if necessary)
- Plastic measuring cup
- Large reading thermometers (1 for every 3 students)
- White construction paper
- Markers / crayons / pencils
- Rulers?

Standards:
- Mathematics:
  - III.1.EE.1 (Data Analysis and Statistics: Collect and explore data through counting, measuring an conducting surveys and experiments).
  - III.3.EE.2 (Data Analysis and Statistics: conduct surveys, samplings and experiments to solve problems and answer questions of interest to them).

Timeline: 1 entire school day–testing 1x/hour

Class Structure: whole class experiment

Assessment Strategy: EEK! Daily Assessment
General Assessment Strategy #3
General Assessment Strategy #4

Lesson 9: K
Solar Hot Water: Comparison Study

In this lesson students will create a time-data study by measuring water temperature every hour that is being heated by solar energy.

Lesson Overview: Measuring water temperature with thermometers.
Lesson Concept: Electromagnetic (solar) energy can be converted into thermal energy–water can be heated with the sun.

Supplies Needed:
- 1 solar hot water heating bag
- Short piece of rope (for hanging the bag if necessary)
- Plastic measuring cup
- Large reading thermometers (1 for every 3 students)
- White construction paper
- Markers / crayons / pencils
- Rulers?

Background Information:
This lesson can only be successful on a sunny day. If sunny days are scarce, you could also conduct the experiment by heating water on a hotplate and measuring the temperature every minute. But, that method though would not demonstrate the intent of the lesson: to demonstrate the potential energy of the sun.

CLASS EXERCISE:
I. Fill the solar hot water heater bag and hang in a sunny location
- Measure 1/2 c of water into a container
- Have students measure the temperature with a thermometer
- This will be the baseline temperature

II. Measure the temperature every hour
- Continue measuring 1/2 c of water every hour
- Record all temperatures
- Create a graph detailing findings

*Note to Teachers: this is not exact science since the total amount of water will continue to decrease as the experiment progresses, but the students will gain the general idea of an increase in water temperature over time and they can graph how much change occurs from the beginning to the end of the experiment.

Lesson 10: K
Solar Hot Water: Making Treats

Lesson Overview: Electromagnetic (solar) energy can be converted into thermal energy–water can be heated with the sun.

Lesson Concept: Electromagnetic (solar) energy can be converted into thermal energy–water can be heated with the sun.

Materials:
- solar hot water bag
- 1 cup for every student
- dried soup mix OR
- powdered cocoa mix OR
- any dried treat you can mix & serve using warm water

Standards:
- Science:
  - II.1.EE.4 (Reflect on the Nature, Adequacy, and Connections Across Scientific Knowledge: Develop an awareness of and sensitivity to the natural world).

Timeline: 1 class period (with 4 hours minimum to heat water in solar hot water bag)

Class Structure: whole class experiment

Assessment Strategy: Post-module Assessment Questions #1, #2, & #3
EEK! Daily Assessment

Lesson 10: K
Solar Hot Water: Making Treats

This lesson is a day of celebration and can only take place on a sunny day. Fill the solar hot water heater bag and hang in a sunny location early in the day. By the end of the day, you can make tea, cocoa, or dried soups for a solar water heating celebration!

Lesson Overview: Electromagnetic (solar) energy can be converted into thermal energy–water can be heated with the sun.
Lesson Concept: Electromagnetic (solar) energy can be converted into thermal energy–water can be heated with the sun.

Supplies Needed:

- solar hot water bag
- 1 cup for every student
- dried soup mix OR
- powdered cocoa mix OR
- any dried treat you can mix & serve using warm water