Taking Steps to Solve the Water Crisis

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Unit Overview

Target Audience: Grades 1 - 3	**Est. Time:** Four 45 minutes class periods	**Content Area(s):** Science and Engineering

Abstract:

Design challenges centered on identifying and solving real-world problems add relevance to the classroom by showing students science in their own world and guiding them to sense making of science concepts. This lesson will focus science instruction on the 21st century problem of access to clean water. Using children's literature, Nya's Long Walk, as a starting point this lesson will guide students through identifying the global challenge that not all people have easy access to clean water, figure out why and how it happens and brainstorm potential solutions for providing access to clean water. The session will engage students in an abbreviated STEM design challenge aligned with science and engineering practices (SEPs) as well as Indiana content standards. Participants will create blueprints for a solar cooker and explain how it can create clean water, justifying their response with scientific evidence and concepts.

Unit Goals/Objectives:

1. Brainstorm solutions to solve a clean water crisis
2. Investigate and record temperatures to determine the materials that absorb and reflect heat
3. Design and construct a solar cooker

Lesson Summaries:

Lesson 1: Read Aloud, Problem Scoping, Blue Prints

Driving Question: What problems does Nya face on her long walk and what are possible solutions?

1. Brainstorm 21st century problems
2. Suggest solutions to the problems.
3. Create "BluePrints" for a solar cooker

Lesson 2: What materials absorb heat?

Driving Question: What materials will make the best solar cooker?

1. Conduct an investigation with four different materials
2. Record data
3. Make a claim based on evidence collected

Lesson 3: Design, Make, and Test Solar Cooker

Driving Question: Can you make a solar cooker that will cook a s'more?

1. Design and construct a solar cooker with recycled materials
2. Evaluate a design to determine if it meets criteria.
3. Analyze data from tests and explain why some designs were more effective.
4. Create new designs by looking at test results to improve solar cooker

Lesson Timeline:

Lesson 1 (45 minutes): Read Aloud, Problem Scoping, Blue Prints

- Read Nya's Long walk: 10 minutes
- Brainstorm problems Nya faced: 5 minutes
- Water crisis video: 5 minutes https://youtu.be/LSqan1xmMpY
- Brainstorm solutions: 5 minutes

- Introduce solar cookers: 5 minutes
- Create solar cooker Blueprints and share: 10 minutes
- Wrap up: 5 minutes

Lesson 2 (45 minutes): What materials absorb heat?

- Introduction: 5 minutes
- Review: 5 minutes
- Fair test investigation for Properties of matter, white paper, black paper, foil (25)
- Wrap up : Scaffolded CER

Lesson 3 (2 x 45 minutes): Design, Make, and Test Solar Cooker

Day 1:

- Introduction: 5 minutes
- Review: 5 minutes
- Intro to design challenge: 5 minutes
- Design and make solar cookers: 20 minutes
- Accurately calculate budget: 10 minutes

Day 2:

- Test the cookers with S'mores: 20 minutes
- Students share/ communicate ideas/ give feedback: 20 minutes
- Discuss results: 5 minutes

Standards:

NGSS standards for K-2:

2-PS Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

K-2 ETS1-1 Ask questions, make observations, and gather information about a situation people want to change and define a simple problem that can be solved through the development of a tool.

K-2-ETS1-2. Develop a simple sketch, drawing or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3 Analyze data from tests of two objects designed to solve the same problem to compare strengths and weaknesses of how each performs

Science and Engineering Process Standards (SEPS)

SEPS.1 Posing questions (for science) and defining problems (for engineering)

SEPS.2 Developing and using models and tools

SEPS.3 Constructing and performing investigations

SEPS.4 Analyzing and interpreting data

SEPS.6 Constructing explanations (for science) and designing solutions (for engineering)

SEPS.7 Engaging in argument from evidence

SEPS.8 Obtaining, evaluating, and Communicating information

STEM Integration within the Unit:

In my Integrated STEM through AFNR, *Taking Steps to solve the Clean Water Crisis,* three of the STEM disciplines are deeply integrated; science, engineering, and mathematics. Technology is integrated at a minimal level with room for expanding in future iterations of the lesson. There is also literacy and social studies integration in this 21st century problem solving unit. For both science and engineering, students engage in multiple science and engineering practices SEPs; including asking questions and defining problems, constructing explanations and designing a solution,

developing and using models, engaging in argument from evidence and obtaining evaluating and communicating information (chart outlining how these present in the classroom is attached). The specific science concepts students focus on are highlighted on day two 1) creating a fair investigation to test what materials will work best for the solar cooker 2) Energy: heat and light 3) using the tools of a scientist: thermometer, stop watch. For engineering, students complete an engineering design challenge and construct their own solar cooker. This process begins on day one and continues on days 3, 4, and 5. Math integration is implemented through the use of a budget. Students have to calculate how much money is spent on their solar cooker design. Simple technology, such as using a thermometer and a heat lamp to test the solar cooker are implemented during the testing phase of the unit.

Lesson 1: *Read Aloud: Nya's Long Walk*

Est. Time: 45 minutes

Lesson Learning Goals/Objectives:

1. Students will engage in problem scoping for the Nya's long walk and define a problem
2. Students will create a reasonable diagram model for a solar cooker.
3. Students will use evidence based reasoning to explain their diagram

Standards:

K-2 ETS1-1 Ask questions, make observations, and gather information about a situation people want to change and define a simple problem that can be solved through the development of a tool.

K-2-ETS1-2. Develop a simple sketch, drawing or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem

Assessments

Formative:

Student Log Book

Concept Prerequisites or Background Knowledge Needed:

Vocabulary:

blueprint, solar

Materials & Technology Needed:

Nya's Long Walk

Student graphic organizer/ log book- This item is critical in guiding the unit and appears in lessons 1 & 3

Video: https://www.youtube.com/watch?v=teX2l_E40mw

Lesson guiding Slide Deck- This is critical in guiding the unit and appears in all three lessons

National Geographic Video: https://youtu.be/Ofn7jqPDTeY

Lesson Component	Instructions	Materials
Introduction *15 minutes*	**Read Aloud (10 minutes)** ● Before reading have students look at the cover of the book and brainstorm predictions ● Ask students to listen for challenges that Nya faces in the story. ● Record them as they read the story. **Brainstorm Problems Nya Faced (5 minutes)** ● Class shares out ideas	Nya's Long Walk Student graphic organizer/ log book- This item is critical in guiding the unit and appears in lessons 1 & 3

	• Generate a list on the white board Watch video: https://www.youtube.com/watch?v=teX2l_E40mw	Video: https://www.youtube.com/watch?v=teX2l_E40mw Lesson guiding Slide Deck- This is critical in guiding the unit and appears in all three lessons
Instructional Activities *25 minutes*	**Introduce Solar Cookers (5 minutes)** • Begin with scaffolding questions guiding students to solar cookers (slide deck) • National Geographic Video: https://youtu.be/Ofn7jqPDTeY	National Geographic Video: https://youtu.be/Ofn7jqPDTeY Link in slide deck
	Create Solar Cooker BluePrints (20 minutes) • Brainstorm possible materials that could be used for a solar cooker • Draw a detailed, labeled "blueprint" • Define blueprint (Detailed, labeled drawing of solar cooker)	Student log book
Wrap Up, Synthesis/Closure *5 minutes*	Formative assessment: Complete a one minute quick write responding to "What did you do and why?"	Student log book

Resources:

Lesson 2: *What materials make the best solar cooker? Absorb the most heat?*

Est. Time: 45 minutes	
Lesson Learning Goals/Objectives: 1. Students will be able to record and communicate observations and measurements 2. Students will make claims from evidence 3. Students will demonstrate an understanding of a fair test	**Standards:** **2-PS** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
Assessments **Formative:** Student Log Book, discussions	
Concept Prerequisites or Background Knowledge Needed: Awareness of global challenges and solar cookers	
Vocabulary:	

hypothesis, phenomena
Materials & Technology Needed: Nya's Long Walk Solar cooker Materials Investigation sheet Lesson guiding Slide Deck Fair test investigation sheets Thermometers Black paper White paper foil Graphic Organizer/ Investigation sheet

Lesson Component	Instructions	Materials
Introduction *10 minutes*	(5 minutes) Begin with the story about my students in Hawaii practicing for a May Day performance on the black top and racing to the cement in between rounds. ● Ask students if they have even been outside on a hot day in a black T-shirt. What happens to the T-shirt? Is it different from a white T-shirt? ● As a group write a prediction on a white board explaining this phenomena. Review Solar Cookers (5 minutes) ● Remember our lesson last time? ● Can you think of a connection to the scenario we just described and solar cooker materials.	Nya's Long Walk Solar cooker Materials Investigation sheet Lesson guiding Slide Deck
Instructional Activities *25 minutes*	**Develop Fair test Investigation as a class (10 minutes)** Scaffold a fair test investigation with students for materials ● Black paper ● White paper ● foil Write a hypothesis Create a "fill in the blank" procedure as a class Create a data table as a class	Fair test investigation sheets Thermometers Black paper White paper foil
	Conduct Fair Test Investigation (15 minutes) ● Record Data ● Discuss Data ● What do the results tell us?	Graphic organizer/ Investigation sheet
Wrap Up, Synthesis/Closure *10 minutes*	Formative Assessment: Write a claim evidence reasoning statement to answer the driving question	Graphic Organizer/ Investigation sheet

Resources:

Lesson 3: *Design, Make and Test Solar Cooker (2 x 45-50 minute lessons)*

Est. Time: 45 minutes

Lesson Learning Goals/Objectives:	**Standards:**
1. Students will design, construct and test a solar cooker 2. Students will determine how their design could be improved in the future. 3. Students will communicate their ideas with classmates 4. Students will give written feedback to peer engineers.	**K-2 ETS1-1** Ask questions, make observations, and gather information about a situation people want to change and define a simple problem that can be solved through the development of a tool. **K-2-ETS1-2.** Develop a simple sketch, drawing or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. **K-2-ETS1-3** Analyze data from tests of two objects designed to solve the same problem to compare strengths and weaknesses of how each performs

Assessments

Formative:

Criteria Check:Restate the task (bottom of log book p. 2)

Summative:

Summative assessment: Complete the back page of the student log book

Concept Prerequisites or Background Knowledge Needed:

Lesson 1 - 2 content

Vocabulary:

solar, criterion, budget

Materials & Technology Needed:

Student log book (below)
Slides
Log books
Lesson guiding Slide Deck
Foil
Tape
Saran wrap
Cardboard
Black paper
Skewer
Paper bowl
Craft sticks
Box

Other recyclables Heat lamps Laundry baskets Skewers Marshmallows Chocolate Graham crackers Stop watches Solar cookers Solar cooker feedback form

Lesson Component	Instructions	Materials
Day 1		
Introduction *5 minutes*	● We need to think of a way to test our solar cookers! ● Have you ever cooked anything outside of the kitchen? ● Think- Pair-Share ● S'mores article from scholastic science world (link in slide deck)	Student log book
Instructional Activities *35 minutes*	**Introduce Criteria and Constraints and how to test (5 minutes)** ● Read aloud criteria and constraints ● Discuss what they mean ● Develop a test scale: gooeyness? Temp of marshmallow? ● Reference temperatures from Science World Article	Student Log book
	Background Solar Cooker Info (5 minutes) ● Share background solar cooker info slides with class while calling on volunteers complete page two brainstorm/ background boxes ● Record responses in Student log book ● Formative Assessment: Criteria Check:Restate the task (bottom of log book p. 2)	Log books Lesson guiding Slide Deck
	Design and Budget (10 minutes) ● With your partner decide on the design you want to create ● Include a detailed Labeled drawing of your cooker. ● Determine the budget based on the supplies used. ○ Work through an example together to make sure students understand how to calculate budget.	Log book
	Construct (15 minutes) ● When students can share a completed budget and labeled design they may collect their materials to begin constructing their solar cooker with a partner.	Foil Tape Saran wrap Cardboard Black paper Skewer Paper bowl Craft sticks Box

		Other recyclables
Wrap Up, Synthesis/Closure *5 minutes*	Formative assessment: Complete Criteria Check before storing solar cooker in a safe place until testing day.	Log Book
Day 2: Testing Solar Cookers		
Instructional Activities *40 minutes*	**Test Solar Cookers (15 minutes)** ● Test and record data ● Follow slide deck procedure for testing, ● Set up test areas with heat lamps and laundry baskets. ● If it is a sunny day- set the test up outside!	Heat lamps Laundry baskets Skewers Marshmallows Chocolate Graham crackers Stop watches
	Share Designs (15 minutes) ● Partners present their solar cookers to the class ● Explain design ● Share budget and data Engineer Feedback Complete during design share ● Write about another classmates design ● What did they do well and why? ● Complete feedback form for one or more other teams	Solar cookers Solar cooker feedback forms
	Analysis (10 minutes) ● Summative assessment: Complete the back page of the student log book	Log book slides
Wrap Up, Synthesis/Closure *5 minutes*	Revisit essential question: Can a solar cooker help solve the clean water crisis? How?	

Resources:

TAKING STEPS TO SOLVE THE CLEAN WATER CRISIS

AFNR 545

Spring 2022

Elizabeth Andrew Thiel

Read Aloud: Nya's Long Walk

Driving Question: What challenges does Nya face and what are possible solutions?

Before the story: Look at the cover of the book. What predictions can you make about this story?

During the story: Pause and Ponder
What challenges does Nya face?
Record as many as you can on your log book.

After the story: Share out ideas and brainstorm possible solutions.

Did you know?

- Nya's situation is not uncommon for a lot of the world.
- https://www.youtube.com/watch?v=teX2I_E40mw
- Question to think about for the next video:
- Can you make a connection with the access to clean water challenge?
- https://www.youtube.com/watch?v=0fn7jqPDTeY

Solar Cooker Brainstorm Session

Materials: What materials would be good for a solar cooker?

Blueprints: Draw a detailed, labeled design of a solar cooker. Be sure to include materials we brainstormed.

Driving Question Two: Can you develop a fair test science investigation to determine which materials would make the best solar cooker?

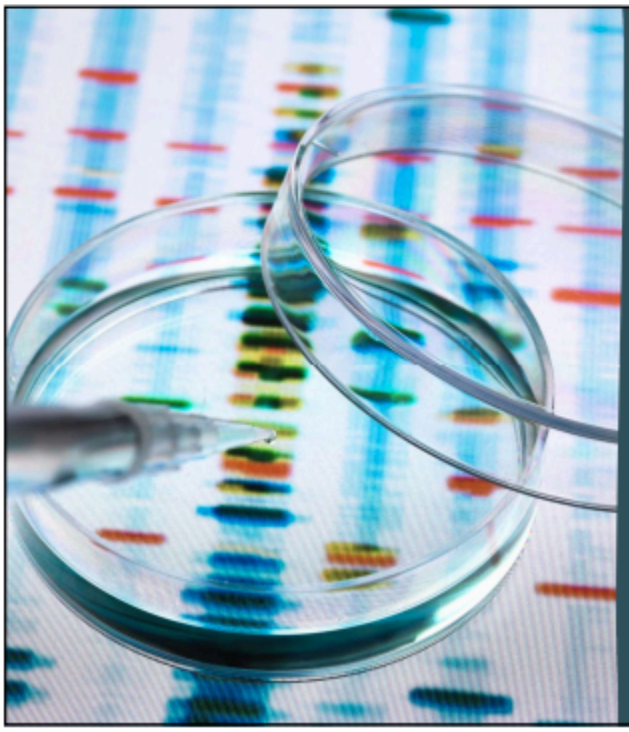
Engage: https://scienceworld.scholastic.com/issues/2017-18/090417/the-science-of-smores.html

Brainstorm: What needs to happen so we can melt chocolate and marshmallows?

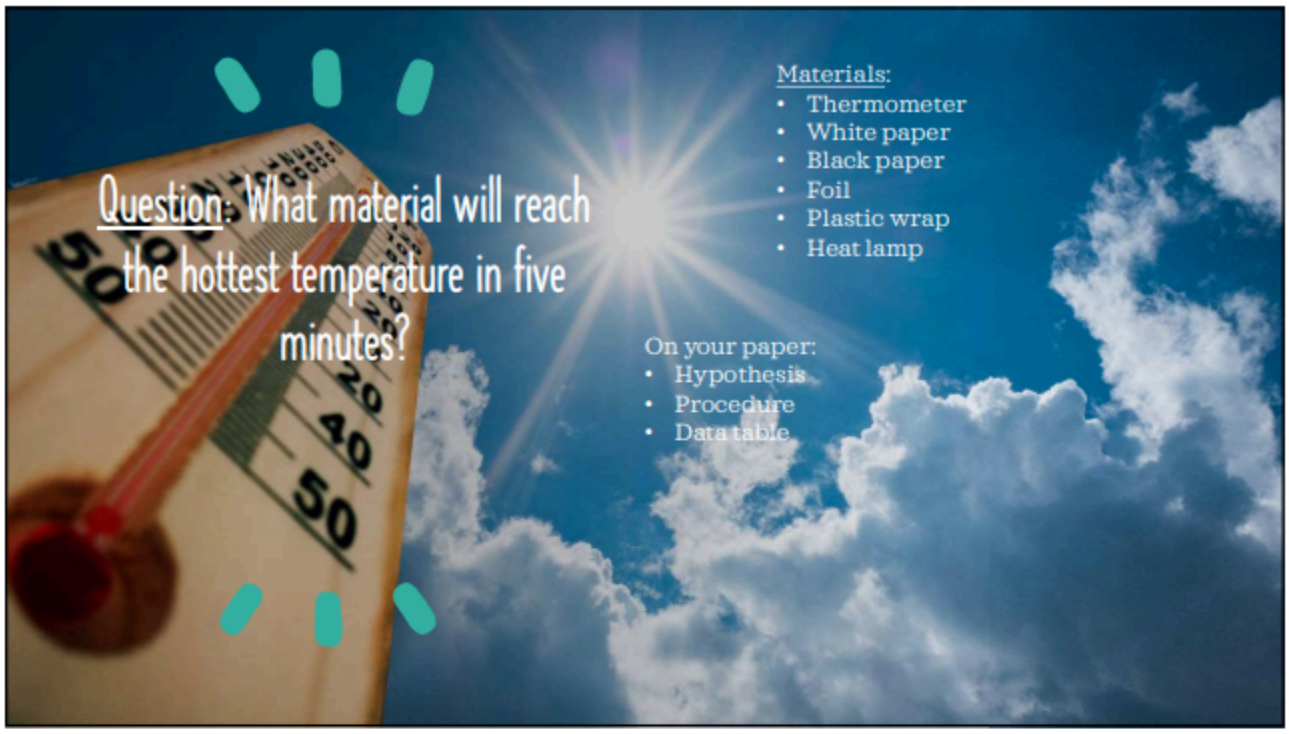
How could we test the best way to do that?

What will we measure?

What materials will we test?

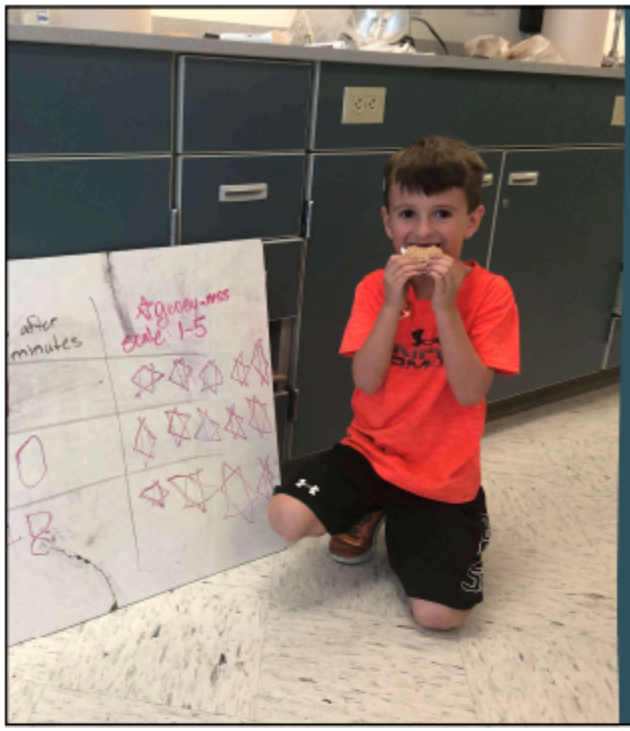


Fair Test Investigation



Solar Cooker Design Challenge

Challenge: You and your team have been challenged to design a model solar cooker from simple recycled materials. The World Health Organization will provide grant money to teams that are able to design a prototype solar cooker that can cook food (heats a marshmallow) and can purify water.

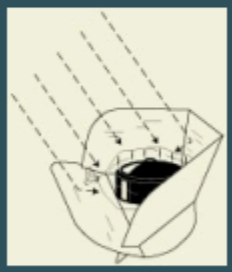


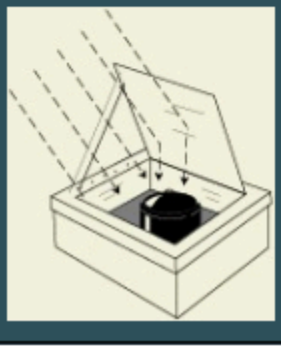
Why Solar Cook?

In your logbook complete the background information with words or pictures.

Shapes that capture extra sunlight

- One or more shiny surfaces reflect extra sunlight onto the pot, increasing its heat potential.





Remember this when designing your cooker.

Box cookers

- Box cookers cook at moderate to high temperatures and often accommodate multiple pots. Worldwide, they are the most widespread. There are several hundred thousand in India alone.

Curved concentrator cookers

- Curved concentrator cookers, or "parabolics," cook fast at high temperatures.
- Several hundred thousand exist, mainly in China. They are especially useful for large-scale institutional cooking.

Panel cookers

- Panel cookers incorporate elements of box and curved concentrator cookers. They are simple and relatively inexpensive to buy or produce.

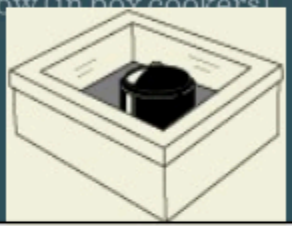
How does a solar cooker work?

Most solar cookers work on basic principles: light energy from the sun is converted to heat energy that is retained for cooking.

Cooker Materials

Dark surfaces get very hot in sunlight, whereas light surfaces don't. Food cooks best in dark, shallow, thin metal pots with dark, tight-fitting lids to hold in heat and moisture.

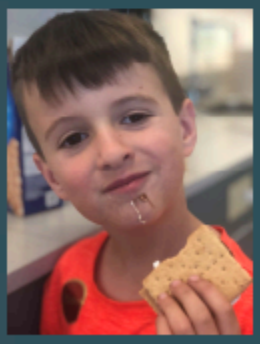
A transparent heat trap around the dark pot lets in sunlight, but keeps in the heat. This is a clear, heat-resistant plastic bag or large inverted glass bowl (in panel cookers) or an insulated box with a glass or plastic window (in box cookers)



Are you ready for the challenge?

Criteria: 1) Create a solar cooker that can cook a s'more (melting the chocolate and the marshmallow) 2) Marshmallow and chocolate can easily move in and out of solar cooker 3) Marshmallow and chocolate do not leave a mess behind in the cooker

Constraints: 1) You may only use the materials provided: Tape, foil, construction paper, folders, saran wrap, assorted recycled materials, skewer, marshmallow and chocolate 2) $15.00 3) Time



GOOD LUCK!!

Rubric for Lesson 2: Fair Test Investigation

Criteria	Smoke Alarm (1)	Pretty Hot (2)	On Fire! (3)	Points Earned
Records and communicates observations and data	Student is unable to record of communicate observations	Student records of communicates observations, but they are unclear or incomplete	Student records and communicates observations in a clear and thorough manner using words, pictures, or both	
Makes claims from evidence	Student is unable to make claims	Student makes claims that are unsupported by evidence	Students make claims about plans needed from observing patterns in data.	
Demonstrates understanding of fair test	Students are unable to demonstrate understanding of a fair test.	Students recognize that the test needs to be fair but cannot identify factors to control.	Student identifies how to design a fair test and can identify controls	
Total				

Solar Cooker Materials Investigation

Name: _____

Question: What material will reach the hottest temperature in five minutes?

Materials:

· Thermometer · White paper · Black paper	· Aluminum Foil · Plastic wrap · Heat lamp

Hypothesis:

If we test four different materials *then* _____ will get hot the fastest *because*

_____.

Procedure:

1. Take white paper and fold in half. Place _____ inside.
2. Put paper and thermometer _____
3. Record temperature after ____ minutes.
4. Repeat with black paper, _____, _____, and plastic wrap.

Data Table:

Material	**Temperature after five minutes**

Think about it (Analysis):

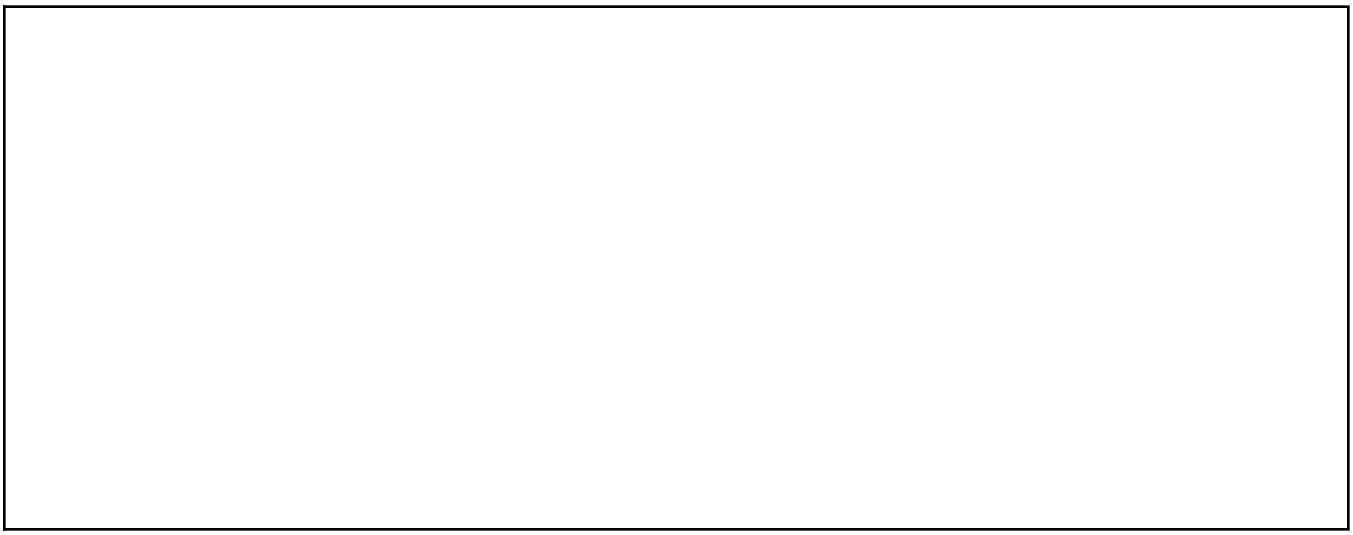
1. Which material had the hottest temperature? _____

2. What temperature is needed to melt marshmallows? _____

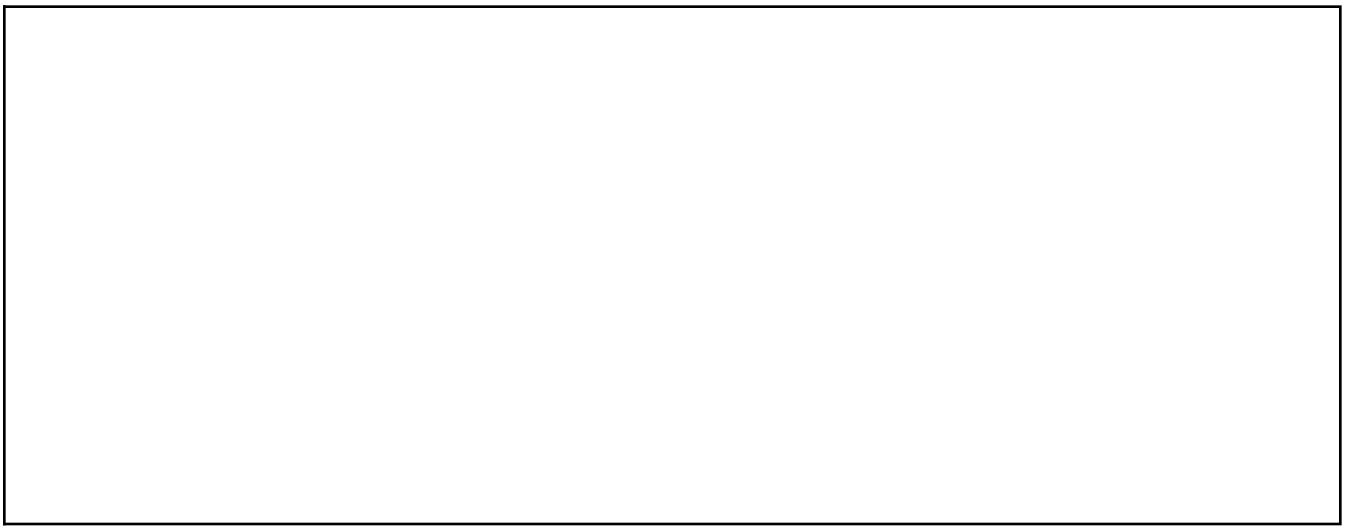
Use the information above to write a CER (Claim, Evidence, Reasoning) Statement.

Question: What material will reach the hottest temperature in 5 minutes?	
Claim: My hypothesis was (Correct/ Incorrect) because _____ reached the hottest temperature.	
Evidence: I know this because _____was _____ degrees and that is (higher/ lower) than ___ of the other temperatures recorded.	**Reasoning**: This evidence supports my claim because

3. How can this information help us design and create a solar cooker?



Draw a picture below to show an idea of how the materials we tested could help someone stay cool outside on a hot day. (Think of clothing, hats, tents/shades, umbrellas)



Solar Cooker Feedback

Reviewer's Name _____

Solar cooker team: _____

Problem: _____

List or draw one thing the Engineers did well	List one or more improvement the engineer could make

Does the solar cooker meet the criteria?	Yes	No
What was the budget for the cooker?		

Make an inference about what rating the World Health Organization will give this play solar cooker (fill in the stars for rating)

Think about your design.

1) Was your cooker successful? How do you know?

_____

_____

2) Look at another group's successful cooker. What is one good idea they had? _____

_____

Redesign Ideas

Remember this??!! To make water safe to drink it needs to boil at 100°C.

Analysis

Use scientific evidence to explain how your design can make water that is safe to drink.

I claim that my design can make water safe to drink because _____ _____

A young scientist's quest for clean water:

_____'s

Taking Steps to Solve the Water Crisis

Listen to the Story, *Nya's Long Walk* and respond

What do you think will happen in this story? (Predictions):	Challenges Nya faces:

Blueprints (Detailed drawing of a solar cooker model):

What did you do? Why?

I_____

because _____

Criteria: 1) Create a solar cooker that can cook a s'more (melting the chocolate and the marshmallow) 2) Marshmallow and chocolate can

easily move in and out of solar cooker 3) Marshmallow and chocolate do not leave a mess behind in the cooker

Constraints: 1) You may only use the materials provided: Tape, foil, construction paper, folders, saran wrap, assorted recycled materials, skewer, marshmallow and chocolate
2) $6.00 3) Time

Brainstorm Boxes/ Background Info:

How can solar cookers help save lives?	
Describe a solar cooker design idea.	
What materials are best for cooking with sunlight?	Why?
How do solar cookers work?	

Design Brief/ Planning:

What do you need to do? (Restate the task)

Materials:

Materials	Cost	How many?	Total cost
1 sheet of foil	$1		
1 piece of paper	$1		
1 cardboard	$2		
Saran wrap	$1		
skewer	$1		
Paper bowl	$2		
box	$2		
Craft sticks (2)	$1		
Total cost:			

Draw your plan below. Label all materials.

Criteria Check:

- Did you plan a way for the s'more to go in? Yes No
- Can you cook a s'more with your plan? Yes No
- No mess left behind? Yes No

DATA

Temperature (°C)	Time to melt	Gooeyness (1-5)
_____ °C		