DESIGN YOUR OWN

Now You're Cooking!

Cooperative Learning Activity

Group size: 3–4 students

Group goal: To demonstrate how to efficiently collect and use solar energy by building a solar cooker.

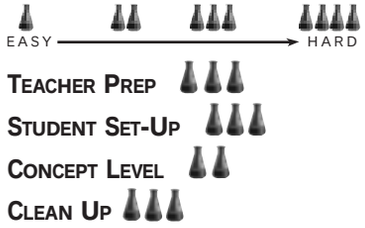
Positive interdependence: Each group member should choose a role, such as recorder, discussion leader, research coordinator, or materials coordinator.

Individual accountability: After the contest, each group member should be able to discuss what worked and what didn't work in the research, design, and performance stages of this project.

Time Required

Four to six 45-minute periods
A suggested pacing guide is provided on page 100.

Lab Ratings



Advance Preparation

Before beginning this project, you may wish to review the principles of reflection and absorption of radiant energy with students. Mention that dark and matte surfaces tend to absorb the sun's rays, while shiny and light surfaces tend to reflect them.

Choose a date, time, and location for the contest. The class will need two days outside—one for testing and one for the cook-off. To ensure adequate space and sunlight, consider locations such as an open field or a parking lot. Be sure to choose a rain date in case of inclement weather. Keep in mind that this activity works well at lunch time! Allow for cooking time of up to an hour.

Distribute copies of the lab to students the day before they begin the lab. Give them the opportunity to read through the lab and come to class with questions.

You may need to schedule time in the library for students to conduct their research. To shorten research time, prepare a website bibliography or compile information on solar cookers that you can distribute to students.

You may wish to have additional precooked hot dogs available for students to enjoy after the activity.

Safety Information

Students should use extreme caution when using sharp objects, such as scissors and cooking thermometers. Goggles should be worn when working with sharp objects. Students should wear goggles and aprons while cooking. Oven mitts should be worn when handling hot materials. Caution students not to touch hot thermometer probes after cooking. Analyze cooker designs and advise students on modifications needed for safe operation and handling.

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CLASSROOM TESTED & APPROVED

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Teaching Strategies

Encourage students to be resourceful and thrifty in choosing materials. Ensure contest fairness by limiting the supplies budget for each team to $5, and by supplying students with identical thermometers and hot dogs. The thermometers should have a dial and should be able to measure the internal temperature of the hot dog to at least 100°C.

Before students begin their design phase, clearly communicate the contest rules. You may wish to add your own rules to the following:

CONTEST RULES

- Do not touch anyone else's cooker.
- No electricity or flames may be used.
- All teams will wait for the teacher's signal to begin cooking.

Once all of the teams have finished cooking, encourage a class discussion to evaluate each cooker design.

Evaluation Strategies

For help evaluating this lab, see the Rubric for Technology Projects in the *Assessment Checklists & Rubrics*. This rubric is also available in the *Classrooom Management CD-ROM*.

Suggested Pacing Guide

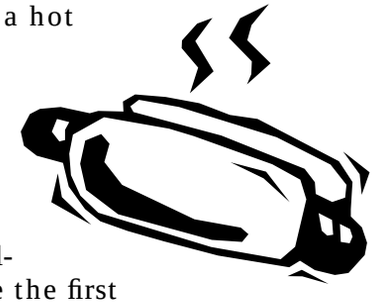
Days 1–2	Days 3–4	Day 5	Day 6
Research Class divided into teams of 3–4. Each team member chooses a role. Students brainstorm ideas, and begin research. Students finish research, discuss and evaluate findings, and chose one cooker design. Each team submits a proposal and materials list to teacher for approval.	**Testing and construction** Students gather materials and begin construction of approved solar cooker designs. Completed cookers are tested, adjusted, and retested as needed. Students prepare for cook-off.	**The Great Solar Cook-Off!** The team whose cooker heats the hot dog to 100°C first-wins.	**Evaluation** Class discussion to evaluate the performance and results of each team's cooker. Students evaluate team progress and results independently.

Name _____ Date _____ Class _____

LAB 21 STUDENT WORKSHEET

DESIGN YOUR OWN

Now You're Cooking!



Have you ever walked barefoot across a black surface on a hot summer day? Ouch! The black surface gets much hotter than the air around you because the surface is an effective absorber of the sun's rays, or solar energy. The pavement absorbs solar energy and stores it as heat.

Solar energy can be used to cook other things besides your feet. In this project, you will be part of a team that will compete to build the best solar energy collector for cooking a hot dog. The winning cooker will be the first one to raise the internal temperature of a hot dog to 100°C. The planning and construction of the cooker is up to you, so put your hot ideas to work!

MATERIALS

- boxes with removable tops
- reflective emergency blanket
- oven cooking bag
- aluminum foil
- newspaper
- white glue
- scissors
- masking tape
- pen or marker
- metric ruler
- 2 oven mitts
- cooking thermometer
- 2 hot dogs or other food items
- hot dog buns, mustard, relish, etc.

SCIENTIFIC METHOD

Ask a Question

What kind of solar cooker will most effectively heat a hot dog to 100°C?

Brainstorm

As a team, determine how you will solve the above problem. Ask yourself questions such as the following:

- What size and shape should your cooker be in order to collect sunlight most effectively?
- What is the best way to trap heat in the cooker?
- Should you include a lid in the design?
- How will different materials, colors, thicknesses, and textures affect your cooker's performance?
- Will you need to adjust your cooker as the position of the sun changes?
- Will your cooker work well in partial sunlight?

Form a Hypothesis

Based on your discussion, record a hypothesis in your ScienceLog about what kind of solar cooker will best accomplish your goal.

Name _____ Date _____ Class _____

Project Checklist for Now You're Cooking!

COLLECT DATA

SAFETY ALERT!

Don't be poisoned!

Do not use polystyrene foam as a construction material—it can release toxic fumes when heated.

Don't be blinded!

The reflection of sunlight in your eyes can burn your retina. The damage is painless but permanent, and can result in blindness.

Don't burn yourself!

Solar cookers can get extremely hot. Be sure to use oven mitts when handling a hot cooker, tools, or food.

___ 1. **Research solar cookers.** Consult periodicals, the Internet, and encyclopedias to learn about various types of solar cookers. Pay special attention to how each cooker works and how each was constructed.

___ 2. **Discuss your research.** Present your research to your team. Tell about the important components of each possible design, including the methods of collecting radiant energy and retaining heat. Discuss the pros and cons of how each design collects radiant energy and retains heat. Discuss how simple or complex each cooker will be to build.

___ 3. **Develop your design.** Decide which solar cooker design you want to use. You may decide to combine elements from several of the cookers researched or use your own ideas to improve a cooker design. Make sure that your design includes a thermometer inside the cooker that will be readable from the outside.

___ 4. **Write a design proposal.** Provide input to the recorder, who will write a short report describing how your solar cooker will work and explaining why your team chose this particular design.

___ 5. **Create a materials list.** Provide input to your materials coordinator so that he or she can generate a supplies list and attach it to the proposal.

___ 6. **Submit your team's proposal to the teacher for approval.**

DATE DUE: _____

___ 7. **Gather your materials.** After your design is approved, your materials coordinator should assign each team member specific items to obtain.

CONDUCT AN EXPERIMENT

___ 8. **Build the cooker.** Begin construction of the cooker. Each team member should have a specific task in the process.

___ 9. **Test your design.** Your recorder should keep track of the time it takes to heat the hot dog to 100°C.

___ 10. **Adjust/modify your design.** Discuss your test results and evaluate any problems in the design. Make the necessary adjustments to improve the cooker.

Name _____ Date _____ Class _____

Project Checklist for Now You're Cooking! continued

___ **11. Compete in the Great Solar Cook-Off!** Have your thermometer and hot dog ready to go. Carefully push the thermometer point lengthwise through the end of the hot dog so that the tip is centered in the hot dog. Ask your teacher to check your hot dog-thermometer assembly.

On your teacher's signal, place the hot dog in the cooker, making sure that you can still read the thermometer. Your recorder will note the temperature every 5 minutes. As soon as the thermometer reads 100°C, the recorder should record the time and notify your teacher immediately.

ANALYZE THE RESULTS

___ **12. Evaluate you solar cooker.** Once your hot dog is cooked, evaluate your cooker's performance. What worked? What didn't? How easy was your cooker to transport and set up? How expensive and available were the materials? How does you final design compare with the one described in your initial hypothesis? Record your notes in your ScienceLog.

COMMUNICATE RESULTS

___ **13. Communicate what you learned.** Each group member should write a Research and Design report in his or her ScienceLog. Some questions to consider:

- How long did it take to cook the hot dog?
- What surprised you?
- What problems developed, and why didn't you find the problems in your initial testing?
- What worked and what didn't work in the creation and operation of the cooker?
- How did your cooker compare in operation and appearance with other cookers from the class?
- If you could, how would you change your design or approach to the project?
- How does this cooking method compare with others?

___ **14. Turn your report in to your teacher.**

DATE DUE: _____