

March activities

Solar Spring Month

The sun's awesome power helps fuel and sustain life. It also powers experiments, sparks inventions and lights up our communities! Even though we're already putting solar power to good use, scientists and engineers are always working to discover new and better ways to harness the sun's energy. This month, we're going to put on our lab coats and have some fun finding out how solar energy works. Then, we'll start thinking about ways we can put solar power to work in our school and community.

Solar Balloons

During this simple but powerful experiment, students will discover how color affects solar absorption. The guided questions below are based on the scientific method — question, hypothesize, experiment, observe and draw conclusions — and will help your students have a conversation about the sun's power. The instructions below are written for a full class; if conducting in a small group setting, please modify quantity of materials and instructions as needed.

Materials needed:

- Two (2) – 2-liter soda bottles.
- Two (2) – 9" latex balloons of the same color.
- Black spray paint or black duct tape.
- White spray paint or white duct tape.



Pre-experiment setup:

- Check the weather and select a warm and sunny day for the experiment.
- Make sure both bottles are completely dry before conducting the experiment.
- Spray paint (or duct tape) one of the bottles **black**.
- Spray paint (or duct tape) the other bottle **white**.



Experiment instructions:

1. Take your students and the prepared materials (white bottle, black bottle and two balloons) outside on a warm, sunny day.
2. Share an overview of the experiment. (Question):

Instructor: How powerful do you think the sun is? Today we're going to find out!! We're also going to find out how color affects how the sun's rays are absorbed or reflected. Can anyone give me an example of something that absorbs or is absorbed? (Examples could include sponge, paper towel, cotton ball.)

Instructor: Can anyone give an example of reflection? (Examples could include a mirror, radar or an echo.)

Instructor: In this experiment, we have one empty white soda bottle and one empty black soda bottle. We're going to put a balloon over the top of each bottle. Then, we're going to observe what happens.

3. Ask your students to share what they think will happen to the balloon on the white bottle. (Hypothesize)
4. Ask them what they think will happen to the balloon on the black bottle. (Hypothesize)
5. Then, in a shaded area, put one balloon over the top of the white bottle. (Experiment)
6. Put the other balloon over the top of the black bottle. (Experiment)
7. Place the bottles in direct sunlight. (Experiment)
8. After a few minutes, observe how solar energy is affecting each of the balloons. (Observe)

NOTE: As the bottles heat up, the balloons should begin to expand. The balloon on the black bottle should expand more quickly than the balloon on the white bottle.

**It is important to put the balloons on the bottles while outdoors!
DO NOT put the balloons on the bottles indoors.**



Post-experiment conversation guide:

Visit kids.britannica.com/kids/article/alternative-energy/476218 for a few talking points about alternative and renewable energy.

Start drawing conclusions by discussing the experiment and the effects of sun and solar energy. Be prepared to discuss other renewable energy sources such as wind and water as well. Depending on the grade level and the participation, students may need some direction. Point out the benefits of using the sun to create energy. (*Hint: It's safe and renewable!*)

- What do you observe happening to the balloons?
- How are they reacting similarly?
- What's different about the balloons?
- Why do you think this reaction is occurring?
- What effect does the bottle color have on the balloons?
- Where else — outside of this experiment — do we observe the power of the sun?
 - (Examples may include the warm interior of a car on a sunny day, playground equipment on sunny days or pool/lake temperatures in the summer versus winter.)

Use the questions below to continue drawing conclusions about solar energy! Below is a sample script, including answers, to help guide your dialogue.

Q: Based on our experiment today, would you say that the sun produces energy?

A: Yes! The sun does have power.

Q: How can you tell?

A: We can see that it has the power to blow up balloons, can't we? Did you know that scientists and engineers are always looking for better ways to capture the sun's heat and light to use it as a power source for generating electricity?

Q: If we wanted to catch some of the energy from the sun to power our school, how would we do this? Do you know what catches it?

A: Solar panels catch the energy and convert it into electricity. Like our black bottle, solar panels are good at collecting sunlight.

Q: *Has anyone seen a solar panel?*

A: *[If there's no response, be prepared with examples of solar energy you have noticed in your area. Consider examples you could show, such as a solar power calculator.]*

Q: *Do you think catching sunlight and using it for electricity is a good idea?*

A: *Yes! The main reason people are excited about sun energy — or solar energy — is because no matter how much we collect, the sun keeps creating sunshine! Because we won't run out of it, we call it a renewable energy source.*

Q: *Can you think of other sources of renewable energy?*

A: *Wind and water!*

Spring break Power Down

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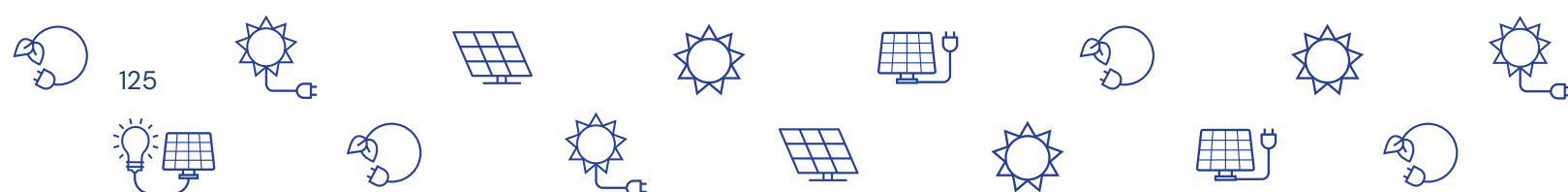
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- What do you observe happening to the balloons?
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Use the questions below to continue drawing conclusions about solar energy! Below is a sample script, including answers, to help guide your dialogue.

Q: Based on our experiment today, would you say that the sun produces energy?

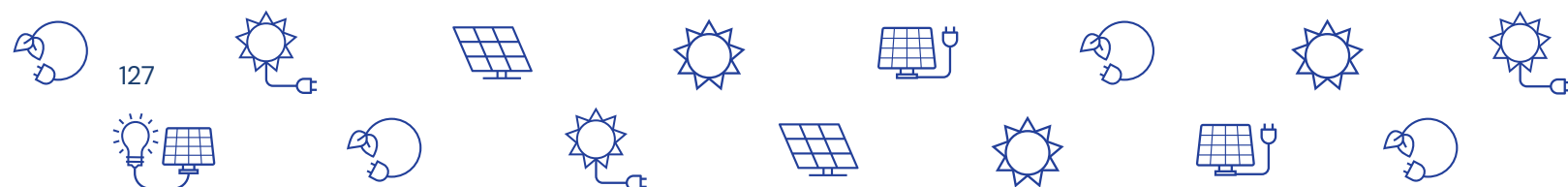
A: Yes! The sun does have power.

Q: How can you tell?

A: We can see that it has the power to blow up balloons, can't we? Did you know that scientists and engineers are always looking for better ways to capture the sun's heat and light to use it as a power source for generating electricity?

Q: If we wanted to catch some of the energy from the sun to power our school, how would we do this? Do you know what catches it?

A: Solar panels catch the energy and convert it into electricity. Like our black bottle, solar panels are good at collecting sunlight.



Q: *Do you think capturing sunlight and using it for electricity is a good idea?*

A: *Yes! The main reason people are excited about sun energy — or solar energy — is because no matter how much we collect, the sun keeps creating sunshine! Because we won't run out of it, we call it a renewable energy source.*

Q: *Have you seen solar energy used anywhere in our community?*

A: *[Answers will depend on your location. Be prepared with some examples.]*

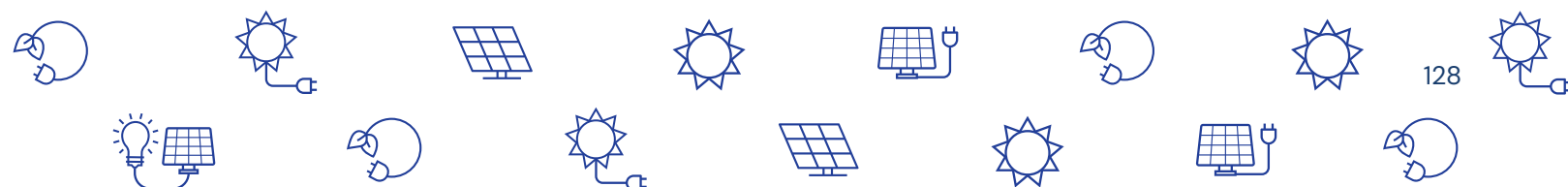
Q: *Can you think of other sources of renewable energy?*

A: *Wind and water!*

Spring break Power Down

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Solar Savings

With the help of a solar calculator, students will examine the impact solar power could have on their homes and school. This activity helps students calculate the cost of installation, pay-off period and other factors related to solar power. In addition to calculating system size, annual electricity production and estimated costs and payback, the activity will help students learn how to read and understand electricity bills. This activity can be implemented in the classroom (especially science or math) or in an after-school club or program.

Facilitator preparation:

1. Familiarize yourself with the TVA Solar Calculator, available online at EDT.TVA.gov. Be prepared to instruct students on how to use it (see step four under Activity instructions section below).
2. Find a copy of your home energy bill and use it as an example. (Review step six in the Activity instructions section below.)
3. Request a copy of your school's electricity bill or obtain the following information from your school for the *Solar Savings Worksheet*:
 - a. Average monthly bill: _____
 - b. Average kWh used each month: _____
 - c. What is your electricity rate in cents/kWh? _____

Materials needed:

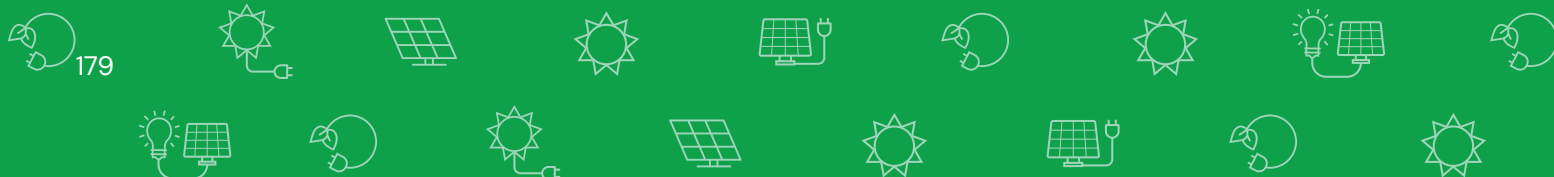
- Copies of the *Solar Savings Worksheet* for each student. The worksheet is available at the end of this section or available for download at EnergyRight.com/school-uplift-resources.



- Sample residential electricity bill.
- School electricity usage data or electricity bill.
- Computer or mobile device for each student or group.

Activity instructions:

1. Start with an introduction to solar energy. Lead a discussion by asking questions that prompt students to share what they already know. (Prepare for this discussion by reviewing content for your own knowledge. The U.S. Department of Energy can provide a good foundation: energy.gov/eere/solar/how-does-solar-work)
Questions could include:
 - a. How would you define solar energy?
 - b. Do you see solar energy used anywhere? If so, where and how is it being used?
 - c. Why do you think people decide to use solar energy?
 - d. Solar energy is a renewable energy source. What makes solar energy renewable?
 - e. What other types of renewable energy can you think of?
2. After the discussion, introduce the *Solar Savings Worksheet* and solar calculator. This worksheet prompts students to consider the current energy use and possible future solar energy use of their school and homes.
3. Introduce TVA's Solar Calculator, available online at EDT.TVA.gov.
4. Demonstrate how to use the calculator by clicking the navy blue Get Started button. Then, click the light blue Advanced Options button. (Fill in the information that you have available. If you don't have all the data you need, the form auto-populates with average TVA rates. You can find printable instructions for using the calculator at EDT.TVA.gov/manuals/How%20to%20use%20the%20Solar%20Calculator.pdf.)
5. Point out how the *Solar Savings Worksheet* aligns with the information needed to use the calculator.
6. Demonstrate how to use the calculator by inputting information from your home/ residential electric bill.
7. Provide students with information from the school's electricity bill.
8. With students working in groups or on their own, provide 10–15 minutes to use the TVA Solar Calculator and add the information to the corresponding lines within the worksheet.



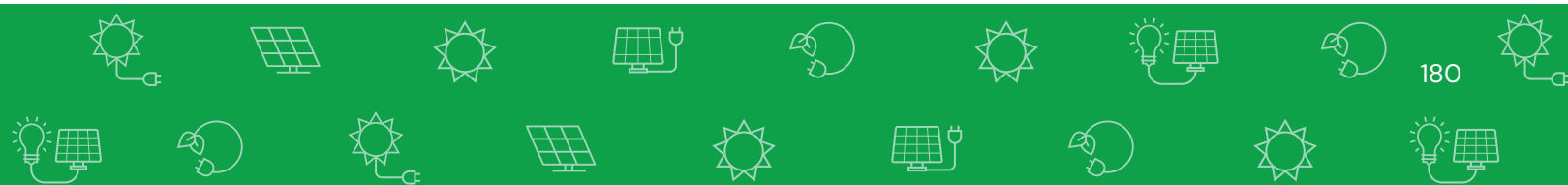
9. Encourage your students to experiment with the “Percentage of electricity use covered by solar” to see how it impacts system size, generation and payback.
10. Review the findings with the whole class.
11. Ask students to share their thoughts on the benefits and obstacles of converting to solar energy.
12. Assign students to complete the bottom of the worksheet and explore solar energy solutions for their homes. Prepare students to ask parents or guardians to find the first three questions for the home section of the worksheet:
 - a. Average monthly bill: _____
 - b. Average kWh used each month: _____
 - c. What is your electricity rate in cents/kWh? _____
13. Encourage students to do their best to find this information and to follow up if they are running into problems. If students are unable to find utility information for their homes, we’ve provided sample electric bills at the end of this section. They’re also available for download at EnergyRight.com/school-uplift-resources.

The Next Big Solar Invention

All over the world, scientists and inventors are coming up with new and exciting ways to use solar energy to make the world a better, cleaner place. This month, challenge your students to dream big and come up with The Next Big Solar Invention! Students will spend a week brainstorming their world-changing energy inventions, then they’ll spend a week creating visuals or prototypes to demonstrate their ideas. By the end of the month, they should be ready to present and demonstrate their inventions.

Facilitator preparation:

1. Print copies of the presentation rubric for each student in your class. This rubric can be found at the end of this section and is available for download at EnergyRight.com/school-uplift-resources.



2. Review examples of recent solar energy inventions or innovations to share during the activity. See step one in Activity instructions below for more information. Below are website resources for finding recent solar innovation news:
 - a. The National Renewable Energy Library: nrel.gov/solar.
 - b. SolarReviews: solarreviews.com/blog/solar-panel-technologies-that-will-revolutionize-energy-production.
3. Decide on a prize or incentive for the winning competition. (Free pizza, school store credit, gift certificates, school attire passes, extra credit, homework passes, etc.)
4. Schedule and plan for The Next Big Solar Invention presentations. If you're using class time for the presentations, you may need to spread them out over several days. If your classroom isn't big enough, reserve a space for the completed invention prototypes and presentations.

Activity instructions:

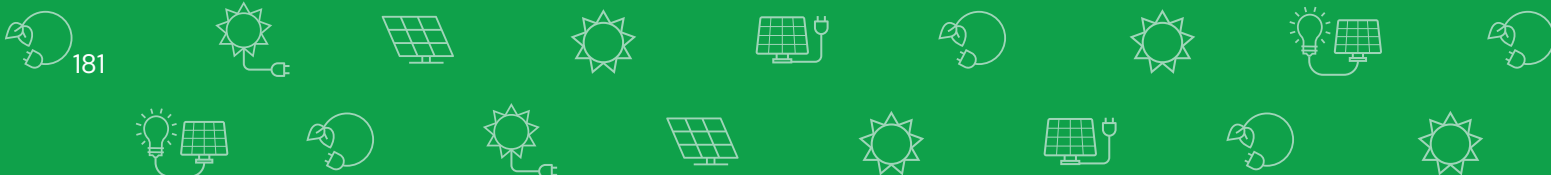
The following instructions are intended for use in a classroom setting; however, The Next Big Solar Invention can also be held as a school-wide competition or as an after-school club activity. Adjust the instructions to fit your context.

1. Share examples of recent discoveries or advancements in the field of solar energy. Alternative: Instead of providing examples, have your students do this research as part of the innovation stage of the competition.

Announce The Next Big Solar Invention contest:

Instructor: *Feeling inspired? Now it is your turn to innovate and invent. I'm going to split the class up into groups of three or four. As a small group, your challenge is to design The Next Big Solar Invention! First, we'll spend a week brainstorming and ideating solar inventions. Then, we'll spend a week developing our plans and creating PowerPoints, posters or building prototypes. The choice is yours! Finally, we'll spend a week polishing and presenting our work. The Next Big Solar Invention culminates in a judged competition. The winner or winners will receive [INSERT INCENTIVE/PRIZE]*

Divide students into groups of three or four and provide each student with a copy of the presentation rubric.



2. While specifics can vary, explain that groups will be asked to follow three stages:

a. Ideate (week one):

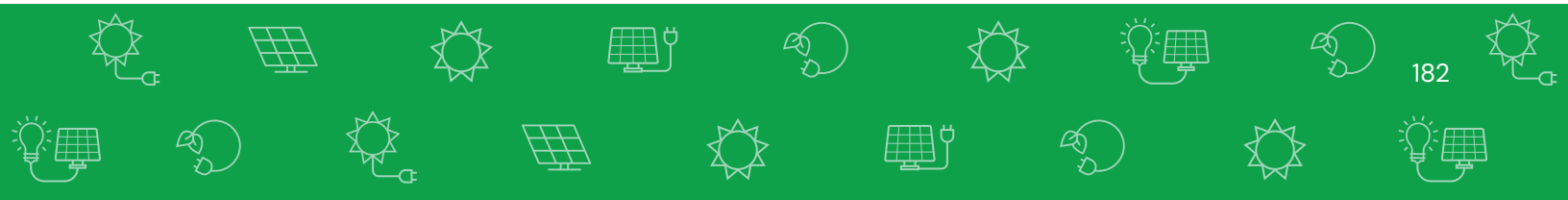
Instructor: During ideate week, you'll brainstorm solar energy ideas together. Consider how traditional or non-renewable energy sources are currently used. Then, think about how to use solar energy as a supplemental or alternative energy source. Alternatively, is there a power problem that solar energy could help solve? Think big!

b. Build (week two):

Instructor: In week two, your group will select one solution identified in the Ideate stage and expand on the idea. What would this idea look like in practice? How would it help? How would it be implemented? Your group should be able to physically demonstrate the solution you developed by building a prototype, creating a detailed poster or developing a PowerPoint presentation. Use your imagination during the build week and create a visual representation of your idea. Prototypes or models should be as realistic as possible, but do not need to be operational.

c. Presentation preparation (week three):

Instructor: During presentation preparation week, your group will spend time refining your invention and planning your presentation. Your group's presentation should walk the audience through the development process and answer questions such as: Why did you choose this solution? How does this idea help improve energy efficiency or save money? What does this idea look like in practice? How does it work? What questions remain?



3. Presentation week: At the end of the month, reserve some class time each day for a few five- to 10-minute presentations. After each presentation, allow a few minutes for questions and feedback from the audience (student peers, special guests and fellow teachers).
4. Choose the winners: Points should be awarded based on presentation rubric. Consider having multiple awards (e.g., most out-of-the-box idea, best prototype).

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SOLAR SAVINGS WORKSHEET

Use the worksheet below to determine the cost and benefits of adding solar panels to the following locations: your school and home

SCHOOL

Average monthly bill: _____

Average kWh used each month: _____

What is your electricity rate in cents/kWh? _____

What system size would be needed? _____

How many solar panels would be needed? _____

How much annual production would be needed? _____

How much would it cost to install a solar energy system? _____

How long would it take to pay off the installation costs? _____

HOME

Average monthly bill: _____

Average kWh used each month: _____

What is your electricity rate in cents/kWh? _____

What system size would be needed? _____

How many solar panels would be needed? _____

How much annual production would be needed? _____

How much would it cost to install a solar energy system? _____

How long would it take to pay off the installation costs? _____

THE NEXT BIG SOLAR INVENTION

PRESENTATION RUBRIC

Scoring Instructions: Each section is worth 10 possible points. Groups can score up to two points per question. For each question, score using the following criteria: • Zero points if the question wasn't addressed or if the response was inadequate. • One point if the presenters addressed the question adequately. • Two points if the presenters exceeded expectations in their response. The presentation should address the following areas:		Build stage evaluation (10 points possible) Score	
		1. Did the group present a visual model or working prototype that represented their idea?	
		2. Did the group share their initial research question(s) that shaped the visual model or prototype they developed?	
		3. Did the group describe the obstacles they encountered while developing their prototype or working model?	
		4. Did the group explain how they found solutions to these obstacles?	
		5. Did the group work together as a team to develop the visual model or prototype?	
Ideate stage evaluation (10 points possible) Score		Presentation preparation evaluation (10 points possible) Score	
1. Did the group explain how they came up with their solar energy idea and how they conducted research to develop this idea?		1. Was the group prepared to present their idea?	
2. Did the group share ideas they didn't pursue?		2. Did the group take the activity seriously?	
3. Did the group explain why they ultimately chose this idea?		3. Were all group members involved with the presentation?	
4. Were group members collaborative, supportive and receptive to others' ideas?		4. Did the presentation include clear introduction (problem), content (solution) and conclusion segments?	
5. Does this solution solve a current energy problem or create a realistic solution that could lead to less waste and better performance?		5. Was the group able to answer any follow-up questions?	
		TOTAL SCORE	