



## GREEN MOUNTAIN ENERGY™ SUN CLUB™ SOLAR CHAMPION PATCH

### Purpose of Patch

To allow girls to DISCOVER what solar energy is; CONNECT the importance of solar energy with their lives and the lives of other people and the planet; and to TAKE ACTION with what they've learned to use solar energy as a renewable and pollution-free resource.

### Instructions on how to earn patch

1. Complete the activities and discussions listed in the DISCOVER, CONNECT, and TAKE ACTION sections below. If girls want to continue to explore solar energy, there are activities in the KEEP IT GOING section.
2. Volunteers, use the RESOURCES section to facilitate conversations, answer questions, and lead activities.
3. Then, use the REPORTING section to tell us about your experience and get your own Sun Club patches.

### Activity Instructions

#### **DISCOVER**

- First, let's learn about the sun and solar energy.
- The sun is a large ball of burning gas in the center of our solar system. It's made of mostly hydrogen that burns very hot. Hotter than you could ever imagine.
- It is the largest source of energy in the solar system.
- More energy from the sun hits the earth in one hour than the ENTIRE world uses in a year. That's a LOT of energy!
- This energy is called solar energy. Solar means from the sun.

#### **CONNECT**

- EVERYTHING that lives on the earth is here because of the sun.
- Without solar energy the world would be a dark, cold, lifeless rock floating in space.
- The earth is exactly the right distance from the sun to support life and liquid water.
- Everything on earth depends on solar energy, from plants which make their own food from it (photosynthesis), to people who depend on it for warmth, to tiny microbes deep

down in the ocean where there is no sun at all. That's because the ocean temperature is controlled by solar energy, too. If we were further away the ocean would be a block of ice. Or if we were closer the oceans would evaporate.

- The more solar energy your part of the world receives determines how warm or cold your weather is. People who live closer to the top or bottom of the earth, (the poles) live in colder climates because they receive less sunlight throughout the year. People who live closer to the middle of the earth (the equator) live in warmer climates because they receive more solar energy throughout the year.
- The seasons are also dictated by the amount of solar energy the world receives as it orbits the sun. Seasons vary throughout the year and are different if you live above the equator (Northern Hemisphere) and below the equator (Southern Hemisphere). The differences in seasons also depend on how close you live to the equator. The closer you live, the less difference you see throughout the seasons. That's all because the change in the amount of solar energy that hits your part of the world does not vary greatly throughout the year when you live near the equator.

### **TAKE ACTION**

*(Facilitators: Answers to these questions are found in the RESOURCES section at the end of this document.)*

- Humans have been using solar energy since the dawn of civilization. What are some of the ways ancient societies used the energy from the sun?
- How does the sun contribute to the human food chain?
- What is the difference between fossil fuels and renewable energy?
- What does pollution-free mean?
- How does a modern electricity plant use generators to create electricity?
- How can solar energy be used to create electricity?
- Explain how these other solar technologies provide energy for human use:
  - Passive Solar
  - Concentrated Solar
  - Solar Thermal
- Why is it important for the planet that we find ways to make electricity without causing pollution?
- How can energy from the sun be dangerous to humans or the planet?

### **Keep It Going**

*Daisy Activities (Kindergarden-1<sup>st</sup> grade) and Brownie Activities (2<sup>nd</sup>-3<sup>rd</sup> grades)*

- **Discover Solar Energy in Your Environment**
  - Look for examples of solar energy around you. If you're indoors where can you feel the sun's energy?
  - If it's a sunny day go outside and feel different objects in the sun and in the shade. Touch each one softly first to make sure you don't burn your hand. What objects were hot? Cold? Warm? Cool? If you have an outdoor thermometer,

measure the temperature in the sun and in the shade. How much of a difference is there?

- The heat from the sun turns water into water vapor - tiny drops of water in the air that you can't see. Heat makes water vapor rise in the air. This is called evaporation. Try the following experiment: Fill a dark cup or glass half-full of water. Stretch some plastic wrap tightly over the top. Put the cup where it is sunny and leave it alone. Look at it again in an hour. What happened?
- What happens when you put different objects and materials in the sun? How fast does it take them to get warm? What type of material gets hot the fastest?
- Put an ice cube in the sun and one in shade. Which melts fastest? Does it make a difference if the sun is behind the clouds?
- **Make a Sun Fan**
  - Materials: paper plate, popsicle stick, glue/tape, crayons or markers
  - Instructions: draw your own sun on both sides of plate. Give it a face, or use wild colors. Make it as crazy as you want—it's your sun! Then glue or tape the popsicle stick to the bottom to use as a handle. Use it when you're outside in the sun getting hot from all that solar energy!

*Junior Activities (4<sup>th</sup>-5<sup>th</sup> grades), Cadette Activities (6<sup>th</sup>-8<sup>th</sup> grades)*

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  - The heat from the sun turns water into water vapor - tiny drops of water in the air that you can't see. Heat makes water vapor rise in the air. This is called evaporation. Try the following experiment: Fill a dark cup or glass half-full of water. Stretch some plastic wrap tightly over the top. Put the cup where it is sunny and leave it alone. Look at it again in an hour. What happened?
  - What happens when you put different objects and materials in the sun? How fast does it take them to get warm? What type of material gets hot the fastest?
  - Put an ice cube in the sun and one in shade. Which melts fastest? Does it make a difference if the sun is behind the clouds?
- **Make S'mores with the Sun!**
  - *Follow the instructions for making a solar oven in the RESOURCES section of this document.*

Senior Activities (9<sup>th</sup>-10<sup>th</sup> grades), Ambassador Activities (11<sup>th</sup>-12<sup>th</sup> grades)

- **Be the Teachers!**
  - It's your job to teach the younger girls about solar energy. Make sure you have all your solar research ready and accurate. Run them through this program, guide them to the correct information, and help them with the hands-on projects.
- **Make S'mores with the Sun!**
  - *Follow the instructions for making a solar oven in the RESOURCES section of this document.*

## RESOURCES:

### Questions/Answers

- **What are some of the ways ancient societies used the energy from the sun?**
  - *Ancient civilizations learned how to use building techniques to store the sun's energy during the day to keep their homes warm at night*
  - *They even used glass and mirrors to light fires and has a weapon*



- **How does the sun contribute to the human food chain?**
  - *Everything on the earth depends on the sun for food because the bottom of the food chain does. Microscopic critters in the ocean use the sun to*

create their own food and those are eaten by larger creatures which are eaten by larger creatures all the way up to fish which are eaten by people.

- Plants make their own food from the sun through a process called photosynthesis. Animals eat plants and people eat those animals as well as the plants.

- **What is the difference between fossil fuels and renewable energy?**

- Fossil fuels include anything that is burned to make energy and cannot be used again. They also make pollution when burned. They include, wood, coal, natural gas, oil/gasoline.
- Renewable energy comes from sources which replenish themselves and do not produce pollution like, wind, water, geothermal and solar.

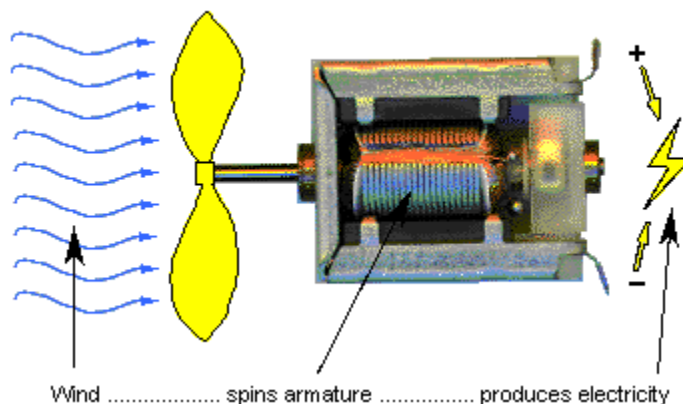
- **What does pollution-free mean?**

- It does not contain nor does it add any pollutants into the air, ground or water.

- **How does a modern electricity plant use generators to create electricity?**

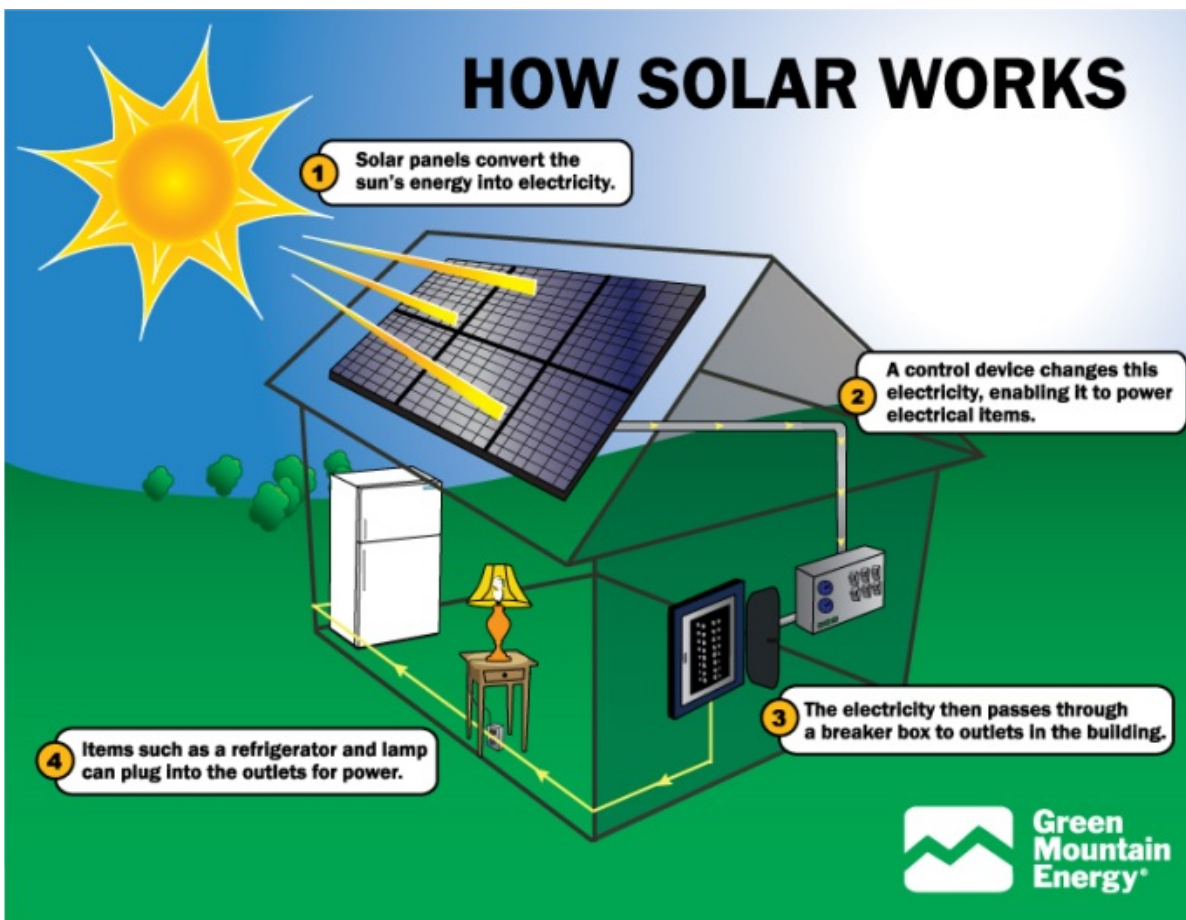
- A generator is a machine that makes electricity. Electric generators contain large amounts of copper wire spinning around very fast inside giant magnets. This causes the electrons (charged particles) to move within the coil of wire.
- When this happens an electric current is made.

### Generator produces electricity



- Some generators use heat or steam from burning oil, gas or coal to spin the copper wires around the magnets. Some use wind or water to turn the generators.

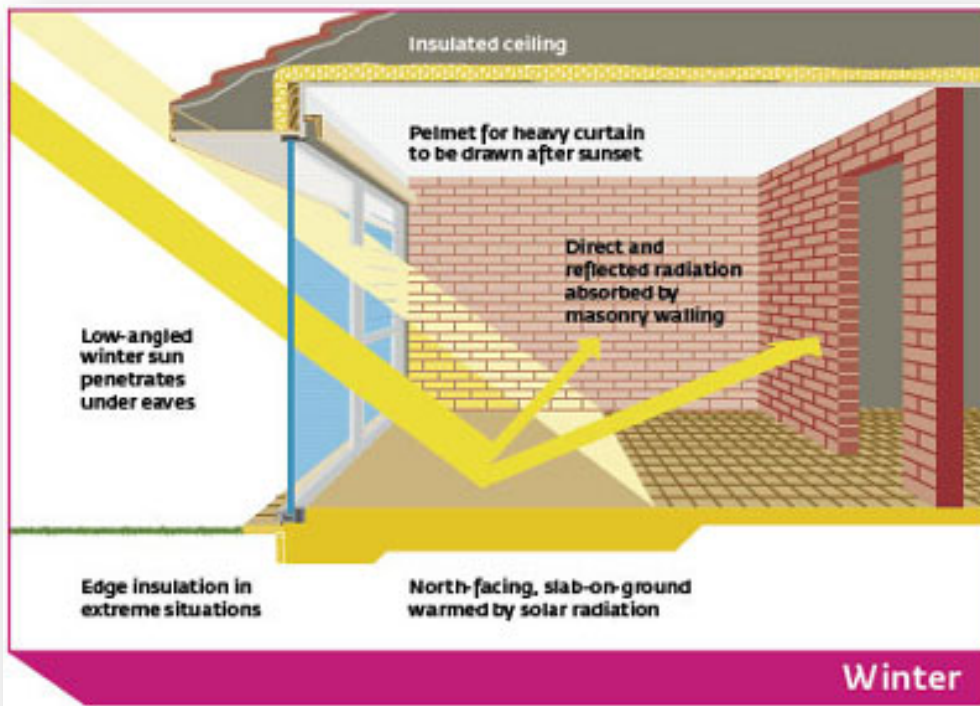
- **How can solar energy be used to create electricity?**
  - Let's say you want to add solar to your house. It's best to add the array to a roof that faces west or south to get the maximum amount of sunlight throughout the day. When the sun hits the photovoltaic solar panels, material inside, most likely silicon, absorbs the energy. This causes its atoms to get very excited and start dancing around. When this happens, electrons break away from the atoms and travel through the copper wire inside the solar panel. This is called electricity! (The underlined blue sentence is a clickable link to an article with more information.)
  - A control device called an inverter then changes this electricity from DC current to AC current, enabling it to power electrical items. The electricity then passes from breaker boxes to outlets throughout the building. Electrical items, such as your computer and lights, can then run on this pollution-free solar power! Whatever you don't use goes back into the grid and distributed to someone else.





- **Explain how these different solar technologies provide energy for human use:**
  - **Passive Solar**
    - *Doesn't involve the use of mechanical and electrical devices*
    - *Windows, walls, and floors collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer*
    - *The air inside a closed container left in the sun, such as your car, can passively absorb the sun and retain its heat. Water in a black tank can absorb the sun's energy, too, and heat up.*





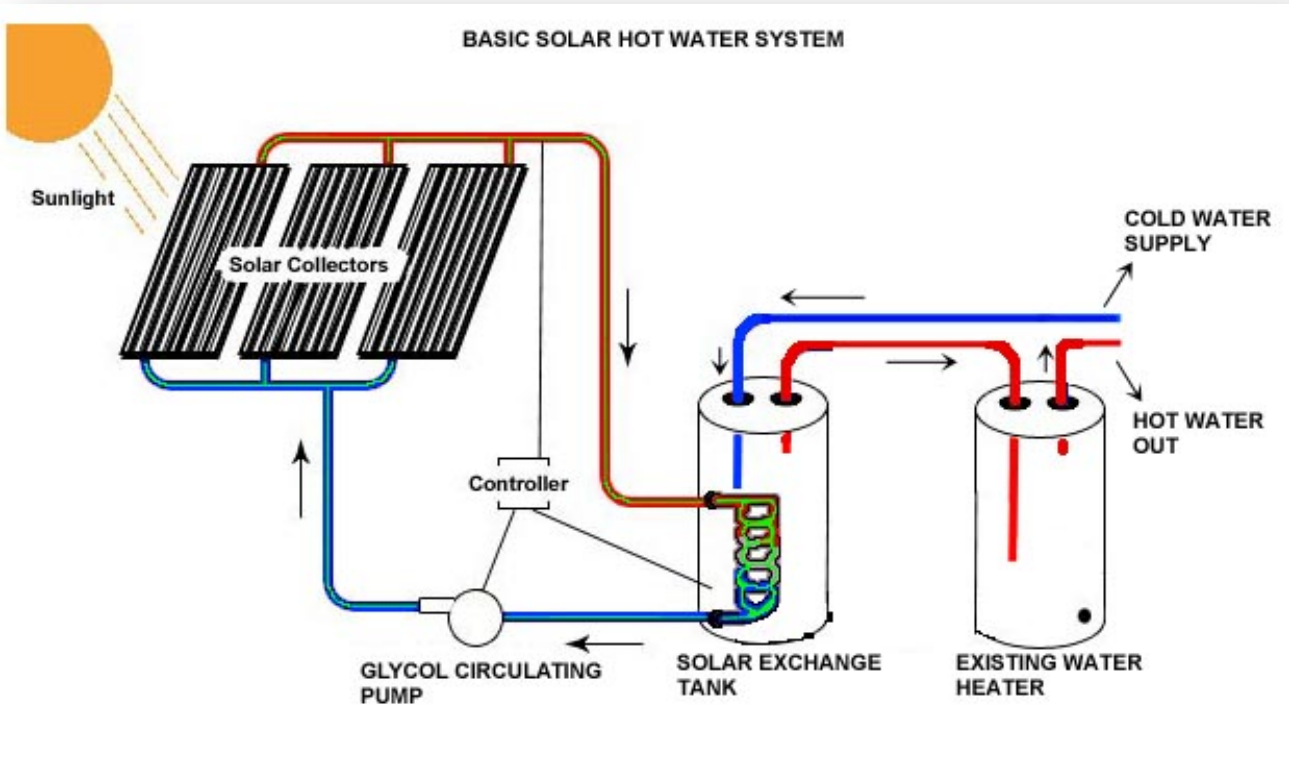
- **Concentrated Solar**
  - *Technology for producing electricity from the sun using mirrors (heliostats)*
  - *Concentrate a large area of sunlight, or solar thermal energy, onto a small area.*
  - *Electrical power is produced when the concentrated light is converted to heat, which drives a heat engine (usually a steam turbine) connected to an electrical power generator*





- **Solar Thermal**

- *Technology for harnessing the sun's energy to heat water for human use*
- *A liquid called glycol pumps through tubes in panels on the roof, absorbing the sun's energy and getting very hot.*
- *Hot glycol travels to a water tank in pipes and flows through a coil. The coil gets very hot and transfers the heat from the glycol to the cold water, heating it up.*
- *The hot water travels to pipes in the building to be used and the glycol, now cold, travels back to the roof to absorb more solar energy.*





**Why is it important for the planet that we find ways to make electricity without causing pollution?**

- *Causes smog in the air which can hurt people (especially those with breathing issues), plants and animals*
- *Causes acid rain which harms wildlife and their eggs*
- *Pollutes our lakes and rivers where we get our drinking water and food*
- *Destroys the natural habitat when we mine it out of the ground*
- *Causes a slight heating of the world called global warming which is leading to climate change, more drastic weather, melting polar ice caps, rising sea levels*
- *It can be made locally without depending on other countries to supply it for us*

**How can energy from the sun be dangerous to humans?**

- *Even short exposure to the sunlight can burn the skin and eventually cause skin cancer. This is why it's important to use sun screen!*
- *Causes premature aging of the skin*
- *Creates heat waves in the summer which kill crops, dry up water supplies and harm people who have no way to keep cool*
- *If you're in the sun too much you can get a sickness called heat stroke which can be very dangerous! It's important to take breaks when you're outside on warmer days, sit in the shade and drink lots of water to stay cool.*

## Solar S'Mores Oven Instructions

### What You Need:

- Cardboard pizza box (the kind delivered pizza comes in)
- Aluminum foil
- Clear tape
- Plastic wrap
- Black construction paper
- Ruler, wooden spoon or stick
- Graham crackers, chocolate bars, marshmallows



### What You Do:

1. Cover the inner side of the cover and bottom of the box with aluminum foil so that it will reflect rays from the sun. To do this, tightly wrap foil around it, then tape it to the back, or outer sides.
2. Line the bottom of the box with black construction paper where the s'mores will be placed— black absorbs heat.
3. Place the s'mores ingredients in the box as shown in the picture.
4. Use clear plastic wrap to create an airtight window for sunlight to enter into the box. Do this by opening the box and taping a double layer of plastic wrap over the inside of the box as seen in the picture above. Leave about an inch of plastic overlap around the sides and tape each side down securely, sealing out air.
5. The best hours to set up your solar oven are when the sun is high overhead - from 11 am to 3 pm. Take it outside to a sunny spot and adjust the flap until the most sunlight possible is reflecting off the aluminum foil and onto the plastic-covered window. Use a ruler, wooden spoon or stick to prop the lid at the right angle. Reposition your solar oven when needed, so that it faces direct sunlight. You should be checking periodically on your oven, to make sure it is in the sun. Make sure that the foil-covered flap is reflecting light into the pizza box, through the plastic-covered window.
6. Wait until the chocolate gets soft and the marshmallows are warm and toasty. Then peel back the plastic, combine the s'mores together and enjoy your warm, tasty treat from the sun!

### What Happened?

The heat from the sun was trapped inside of your solar oven and it started to get very hot in there. Ovens like this one are called collector boxes, because they collect the sunlight inside. As it sat out in the sun, your oven eventually heated up enough to melt the chocolate and marshmallow! How does it happen? Rays of light are coming to the earth at an angle. The foil reflects the ray, and bounces it directly into the opening of the box. Once it has gone through the plastic wrap, it heats up the air that is trapped inside. The black paper absorbs the heat at the bottom of the oven, and the plastic wrap kept it inside instead of escaping out the sides of the oven.

Your solar oven will reach about 200° F on a sunny day, and will take longer to heat things than a conventional oven. Although this method will take longer, it is very easy to use, and it is safe to leave alone while the energy from the sun cooks your food.

# REPORTING

## Instructions on Where and How to Get the Patches

The patches are provided free to the first 8,750 girls who complete this patch program, thanks to the Green Mountain Energy™ Sun Club™, which has a mission to help non-profit organizations install solar energy systems and promote solar energy. This entire program and its content was created and funded by the Sun Club™ with cooperation and guidance from the Girl Scouts of Greater South Texas Council. To learn more about the Sun Club please visit [www.gmsunclub.com](http://www.gmsunclub.com).

After the first 8,750 free patches, each patch will cost \$1.50.

To receive your patch(es), please provide answers to the questions below and submit this form to Penny Falian by fax (361-883-5038), email at [pfalian@gsgst.org](mailto:pfalian@gsgst.org) or by mail to : Penny Falian, GSGST, 2410 Bevecrest St, Corpus Christi, TX 78415.

1. What is your troop number?
2. How many girls completed the patch requirements?
3. What was the most interesting thing you learned from this program that you didn't already know?
4. Was the content interesting? If no, why?
5. Were the activities fun and educational? If not, what could have made them better?
6. Is there anything about solar energy that you still don't understand or want to explore further?
7. Do you like the design of the Solar Champion patch? If not, what would you change?
8. Do you think other Girl Scouts will be excited to earn this patch?