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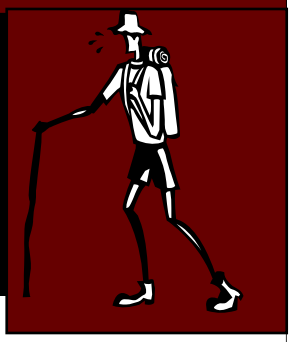
Survivor International



Things are heating up around here!

Although the sun is the most powerful energy source in our solar system, its heat can be used to replace nonrenewable fossil fuels. As engineers for a the company Survivor International, we were given the task of trying to harness the sun's energy that will be an alternative to fossil fuels. Our project leader, Ms. Stembel, decided the contest would be centered around designing a solar cooker. What followed was a very interesting process.

Our research first took us to the Internet where we found many different types of solar cookers. At sights like solarcooking.org the number of styles and designs became overwhelming. So we decided to design and test our own.

The trials and errors that we encountered were very interesting and in our newsletter we hope to explain our thinking and planning. As engineers, we had to rely on the science to lead our process. The sun is a very powerful source of energy, so understanding our closest star was a priority.

As you will see in this newsletter, we had to learn much more than how to just cook and egg.

"Heaven's Flame" Solar Cooker

Triple Threat: Heat

There are three types of heat, and all three are used to build a solar cooker.

Conduction is the transfer of heat through matter, particle by particle. Molecules move when heated, and collide with one another. As a result of the collision, energy and momentum are exchanged and transferred from one particle to another, transferring heat.

Convection is the transfer of heat through the movement of gases or liquids ("fluids"). This circulatory movement occurs when a non-uniform temperature exists in a fluid. Warmer, less dense fluid is pushed away from the source of heat by cooler, denser matter. The moving fluid carries energy with it.

Radiation is the transfer of heat that does not require matter in transmission. It is energy traveling as electromagnetic waves.

What we found was that all three were needed.

Special points of interest:

- Conduction
- Convection
- Radiation
- Design Issues
- Reflections
- Related Links

Inside this issue:

Survivor International

Our Project

Welcome to the construction phase of our solar cooker project.

Absorbing the Heat

The inside is painted flat black. Dark material absorbs heat, and dullness causes no light to be reflected away. The panels on top are large and shiny. They reflect a lot of sunlight into the box.

Keeping the Heat

You can't see it, but the box has two walls and is insulated with folded cardboard. A glass lid lets light in, and keeps heat from escaping.

Capturing the Sun

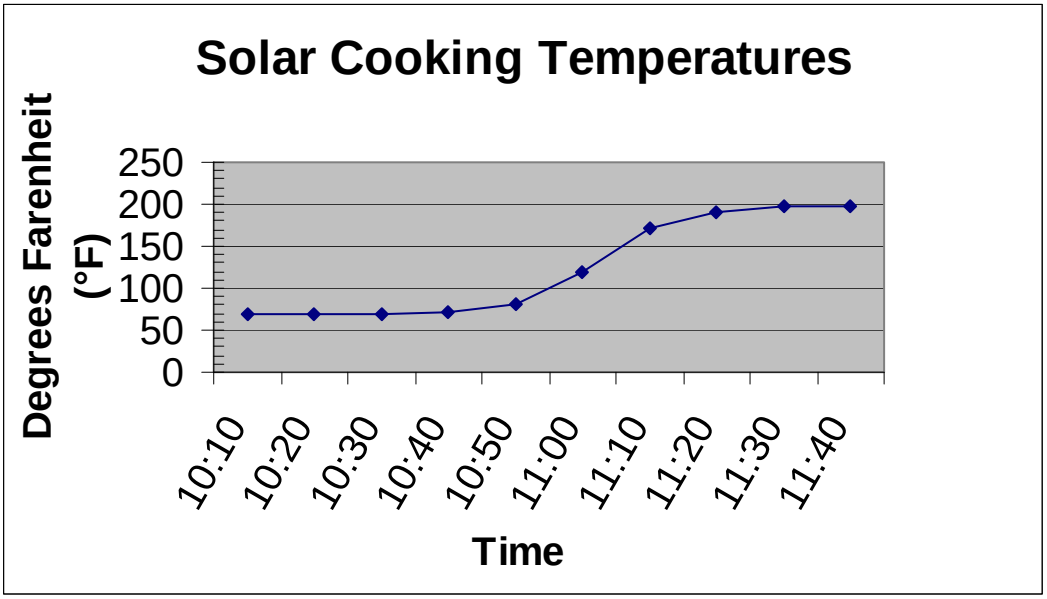
Rocks and a book help slant the cooker so it aims at the sun. Reflectors are aluminum foil over cardboard. They are fragile, so duct tape adds strength.

Heating Our Cooker

During the first hour the cooker didn't get very hot. In the second hour it got hot fast for two reasons: One, we moved the cooker, and two, it was closer to noon, so the sun's rays were stronger.

See chart below.

"Dark material absorbs heat, and dullness causes no light to be reflected away."



Top Five Reasons to Replace Fossil Fuels

Our research took us to many Web sites that explained how awful fossil fuels are for our environment. Below are our top five reasons to not use fossil fuels.
#1 Pollution from fossil fuels
#2 Limited supply
#3 Destroys natural lands
#4 Fossil fuels are messy
#5 Fossil fuels produce waste

Now it is your turn. Go to these Web sites and develop your own top five.

www.darvill.clara.net/altenerg/fossil.htm

www.energyquest.ca.gov/story/chapter08.html

www.ucsusa.org/clean_energy/health_and_environment/page.cfm?pageID=88

ecarta.msn.com/related_761577413_2/Fossil_Fuels_major_contributor_to_air_pollution.html

Our Project

As engineers, we had to have a clear plan. Below we have attempted to explain how we reached our goal.

Choosing a Design

We chose the Heaven's Flame cooker after looking at a pizza box cooker and a parabolic cooker. It seemed to be in-between these two kinds of cookers.

The PB cooker was very simple, but the Web site didn't tell how hot it would cook. It didn't look up to the job. The parabolic cooker gets really hot and has great plans, but it looked really hard to make, and took special materials.

Another group made a Heaven's Flame cooker, too.

Construction

Maria's mom helped us get materials and build our cooker.

We bought the glass and families donated everything else.

It took all the time we had and some more at recess to get it built. Measuring angles for the reflectors was the hardest part. Stitching the panels was hard, too (but it was fun).

Troubleshooting

Measurement day was cloudy, so we had to wait a day.

We used what we learned from shadow plots to decide how to point the cooker.

Temperature measuring was great, because we got a cooker hot enough to cook an egg (we thought…), 194°F.

We had trouble moving the glass on and off, so we made a tab handle out of duct tape.

The Challenge

The class agreed to start heating the cookers at 11:00 a.m.

At 11:50 our cooker was 170°F. We couldn't seem to get it hotter, so we put the egg in a custard cup.

The egg white turned solid at the edges, but not in the middle. It got kind of dry on top, but that's it.

Other eggs cooked better than ours. One oven got up to 250°F. It cooked great.

Conclusion and Reflection

The other Heaven's Flame cooker turned out like ours. We think the angle of the reflectors needs to stay in one place—they kind of flopped.

There's another problem with our box. The inside is really small. If we want to cook anything bigger than an egg, we need two boxes that are closer to the same size and thinner insulation. Maybe we'll use thin bricks like another group did.

We liked solar cooking a lot. It takes planning and patience to cook with solar, but it can save energy.

"Temperature measuring was great, because we got a cooker hot enough to cook an egg (we thought…),

Important Vocabulary

Solar Energy: The sun's energy relies on nuclear fusion, which is an atomic reaction in which the centers of atoms (nuclei) of one kind combine together to make a larger atom of a different kind. One result of this bashing together is the release of a great amount of energy. In the sun, hydrogen is converted to helium. In solar atomic fusion four hydrogen nuclei join together to form a single helium nucleus.

Heat: Heat is the energy associated with the random motions of the atoms or molecules (or even smaller units) that compose matter. Heat causes substances to rise in temperature, fuse, evaporate, expand, or undergo various other related changes.

Cold: Cold is the absence of heat, nothing more. This is an important point! When you chill something, you don't "add" cold, you "subtract" heat.

Heat Transfer: Conduction, convection, and radiation are the three ways in which heat

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Related Links

A Viirtual Tour of the Sun: www.astro.uva.nl/demo/od95

Youkoh Satellite Sun Monitoring Outreach Program (great tours of the sun and many solar topics): www.lmsal.com/YPOP/Classroom/index.html

The Sun: http://seds.lpl.arizona.edu/nineplanets/nineplanets/sol.html

Newton's Apple, Solar Energy Activities: www.pbs.org/ktca/newtons/14/olympicsolar09.html

Solar Energy Basics: www.eren.doe.gov/RE/solar_basics.html

The Sun Zoom Astronomy: www.enchantedlearning.com/subjects/astronomy/sun

Using the Full Option Science System (FOSS) Solar Energy kit created by the Lawrence Hall of Science: www.pausd.palo-alto.ca.us/k6science/solar/solar.html

To study Earth's position, tilt and seasonal differences: http://faldo.atmos.uiuc.edu/w_unit/LESSONS/seasons.html

To study how we can use the changing shadows caused by Earth's revolution on it's axis use: www.exploratorium.edu/science_explorer/sunclock.html

Vocabulary *(continued)*

is transferred from one place to another.

The Laws of Thermodynamics These laws describe the system of heat energy. They encompass these (and other) ideas: Energy is never created or destroyed but is converted from one form to another. At times, energy dissipates and it is hard to measure, but it is never "lost." Heat energy flows in one direction, from warmer matter to cooler, until equilibrium is struck. Also, when energy is transferred or transformed, part of energy assumes a form that cannot pass on any further.

What We Learned From This Project:

It was amazing when we started to really look into what it would take to use the sun to cook an egg. It was easier than we thought once we understood the theories of heat. Radiation is a wave that can move through cold space and reach Earth and still be hot. By trapping the radiated waves in our cooker the conduction and convection could be fueled. There is no doubt in our mind that "Heaven's Flame" Solar Cooker could be used in a survival situation. The sun is very powerful and its energy is far more useful than dangerous. The solar energy could be a real replacement for fossil fuels and we hope our product can spark future research. Please feel free to contact us if you have more questions.