The Pizza Box Solar Oven

Introduction

Creating and adapting new ways of utilizing renewable resources is becoming increasingly important. One of the most abundant sources of renewable energy comes from the sun in the form of solar radiation. The Pizza Box Solar Oven is just one example of how we can use the sun's energy as a clean source of power. Every step in creating the Solar Oven represents an important concept about how energy from the sun is harnessed.

The Components of the Solar Oven

Aluminum Foil: Reflects the light from the sun into the oven.

Black Construction Paper: Absorbs the light reflected off of the aluminum foil. Black construction paper is used instead of other colors because black absorbs all the colors in the visible spectrum. Since black absorbs the most wavelengths, it absorbs the most amount of the sun's energy. When the sun's light strikes the black paper, the molecules in the paper get excited. When molecules get excited they create friction which produces heat. In the solar oven, the light energy from the sun is transferred into heat energy when it strikes the black construction paper. The transformation of light energy into heat energy demonstrates the first law of thermodynamics which states that energy cannot be created or destroyed but can be transformed from one state into another.

Plastic Wrap: The plastic wrap is used as an insulator. It traps the heat that is radiated from the black construction paper causing the air temperature inside the pizza box to rise.

Pizza Box: The cardboard pizza box will be used as the physical oven. Due to the cardboard's construction (lots of tiny air pockets within the cardboard) it also serves as a good insulator of heat.

The Science Behind the Solar Oven

Radiation - The sun emits energy in the form of electromagnetic radiation. When electromagnetic radiation comes into contact with an object, the energy from the radiation

excites the molecules within the object and the object heats up. The now warm object reradiates the energy it received from the sun into the surrounding environment in the form of infrared (heat) radiation.

Angle of Insolation: The angle of insolation is the angle at which the sun's radiation strikes the Earth's surface. The angle of insolation plays an important role in how much of the sun's energy can be absorbed by an object. The optimum angle of insolation is 90 degrees. At an angle of 90 degrees, the most radiation will strike the Earth's surface since only a small amount of the energy will be reflected or refracted away. As the angle decreases, more of the incoming radiation will be reflected and refracted away which reduces the amount of energy that can be absorbed by the Earth.

Conduction - Conduction occurs when an object transfers heat to another object through direct contact. Our atmosphere obtains its heat through conduction with the Earth's surface. In the solar oven, conduction occurs when the hot black construction paper comes into contact with the oven bag.

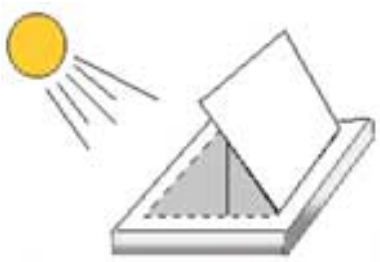
Convection - In both the solar oven and the atmosphere heat circulates due to convection. Convection occurs when warm air, which is less dense and has a lower pressure than cold air, rises, and the colder, denser air sinks to take its place. Cold air sinks because the denser and heavier air has a greater gravitational pull than the warm air.

Note: Convection is also responsible for circulation of heat in the oceans.

Greenhouse Effect - The greenhouse effect occurs when thermal radiation from the Earth's surface is absorbed and reradiated by greenhouse gasses in the atmosphere. In the solar oven, the plastic wrap simulates the atmosphere by trapping the heat that is being radiated by the black construction paper. Since the plastic wrap prevents the heat from escaping into the surrounding environment, the air inside the pizza box continues to heat up enabling the solar oven to cook food

a) Pizza box solar oven.

b) Solar oven using the sun's light to cook food.



During the second part of my internship, I worked with Mr. Zamm at William Cullen Bryant High School in Astoria, and Edward R. Murrow High School in Midwood, Brooklyn. At Bryant High School I assisted Mr. Zamm in teaching the students about NYC's watershed. We taught the students about where New York City gets its water from, about the importance of water conservation, as well as how the city treats and disposes of its waste water. At the conclusion of the watershed module the students built model watersheds. At Murrow High school I helped Mr. Zamm teach a module on energy, and assisted the students in building and testing their solar ovens.

III. The Purpose of the Solar Oven, What it Teaches, and How it Applies to the Real World.

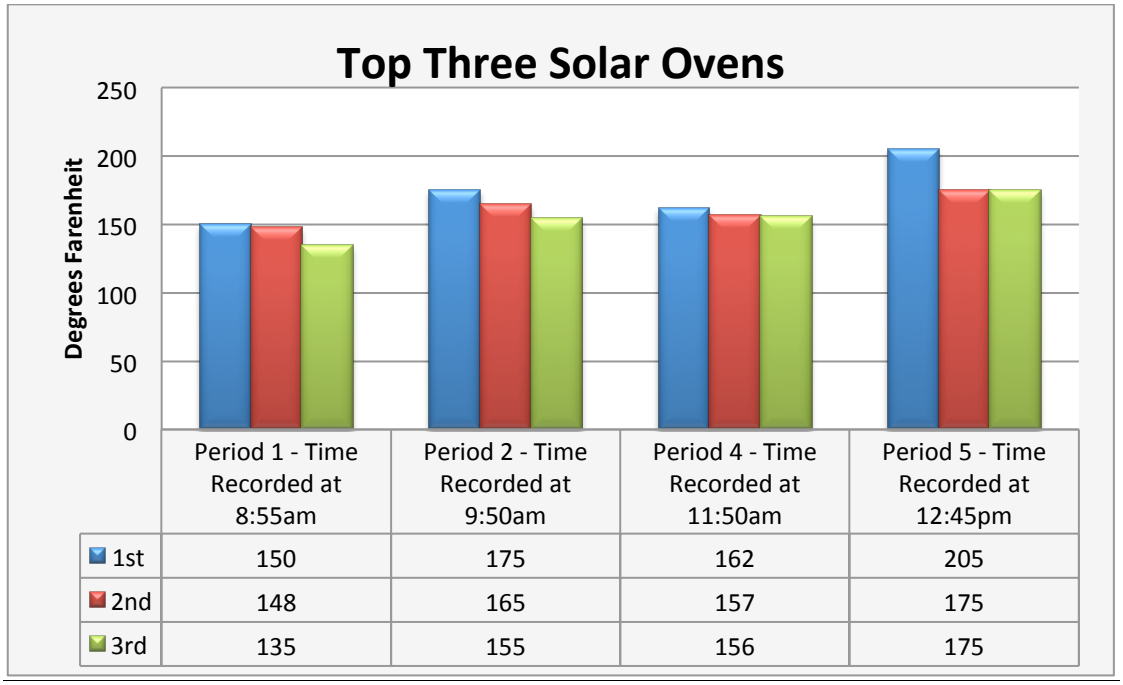
The pizza box solar oven unit is a valuable teaching tool because it touches on many different areas of science. The unit covers key concepts such as electromagnetic spectrum, wavelength, the angle of insolation, the Greenhouse Effect, the solstices and equinoxes, absorption of light energy by color and texture, specific heat, conduction, convection, and radiation. Of all the science concepts that can be learned from the solar oven unit the most prominent is the Greenhouse Effect. The Greenhouse Effect is a very important concept for students to learn today as global climate change is quickly becoming the defining issue of our time. The solar oven simulates the same Greenhouse Effect that is happening in our atmosphere but on a smaller scale that a student can easily observe and understand.

IV. The Teaching of the Solar Oven Unit at Edward R. Murrow High School.

At Edward R. Murrow High School in Midwood, Brooklyn, the students built their own pizza box solar ovens and tested them on the roof as part of the solar oven unit. During the one week module, the students learned about energy consumption, and how clean renewable energy sources could be harnessed and be used instead of fossil fuels. One the first day of the module Mr. Zamm from GrowNYC, and Mrs. Silverman (earth science/environmental science teacher at

Murrow HS), gave a lesson about current U.S. and global energy consumption. The students were given work sheets about energy usage discussed how alternatives such as solar could be used to power their lives. The following three days the students worked on building their solar ovens. One the last day of the unit, they tested their solar ovens out on the roof of the school and cooked smores. The best performing ovens from Mrs. Silverman's classes were selected to compete at the Con Edison Energy Fair on May 13th at the Union Square Greenmarket.

Edward R. Murrow High School - Time and Temperatures for the Best Performing Solar Ovens



	Period 1 - Time Recorded at 8:55am	Period 2 - Time Recorded at 9:50am	Period 4 - Time Recorded at 11:50am	Period 5 - Time Recorded at 12:45pm
1st	150	175	162	205
2nd	148	165	157	175
3rd	135	155	156	175