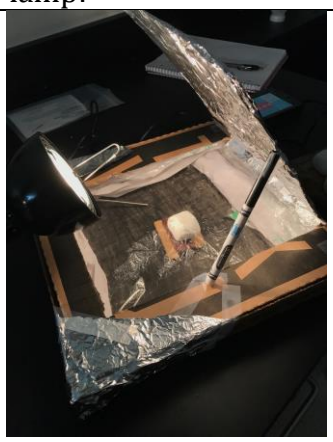
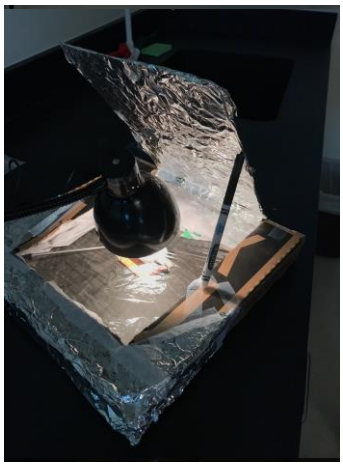
A Sample Science Notebook Entry

Investigation Title:	**Solar Ovens**
Description of Investigation Include purpose and/or research question and briefly describe investigation *(5 points)*	**Purpose/Question:** How could we best design a solar oven to cook a S'more? **Description:** We started by gathering our materials. My group used a small pizza box, aluminum foil, plastic wrap, black markers, newspaper, scissors, and clear tape. We began creating our oven by cutting a flap in the top of the pizza box. Then we covered with aluminum foil. Next we colored the inside of the pizza box with black marker and lined the sides with pieces of rolled up paper. We finished our oven by using a pen to prop up the flap so that it was angled down towards the bottom of the box. We placed the S'mores in the middle of the box and bent the lamp so that it was facing the aluminum foil flap. We then placed the thermometer in the side of the box. We covered the opening of the flap we made with plastic wrap and taped it down securely. Finally, we turned on the lamp!
Evidence Report observations/data. Include tables, graphs, drawings, and models where appropriate. Insert pictures when possible. *Do not interpret data.* *(5 points)*	 **Evidence:** The top left photo shows the position of the lamp when we started cooking our s'mores in the  solar oven. We faced the lamp directly at the aluminum foil so that it would aim the light to the bottom of the oven**. Our ovens' starting temperature was 71 degrees F which is about room temperature. We found that our oven was heating up rather slowly and had only made it to 74 degrees F when we decided we wanted to adjust the position of the lamp.** We angled it a slight bit further down so that it was still facing the foil flap

	but was also aiming down towards the s'more. After doing so, we found that the temperature of the oven began heating up faster. **Within the 10 minutes after moving the lamp, the oven gained 9 degrees, and we ended with a final temperature of 83 degrees F.** The picture to the right shows the position of our lamp after we took our ending temperature. Our group wanted to see if facing the lamp directly down at the s'mores would have increased our temperature at all. Instantly, the temperature increased by two degrees. When we took our s'more out of the oven, the chocolate was slighty soft and a little bit melted and the marshmallow was slightly warm. We did not sucessfully melt the marshmallow or the chocolate.
Claim and Reasoning Analyze your data. *Based on the data reported, can you make a claim (answer the research question)? How can you use the data as evidence to support this claim?* *(5 points)*	**Claim** (conclusion/answer to research question)**:** **The most effective solar ovens were created with smaller boxes, sealed well and insulated using rolled paper tubes along the sides, and had positioned the lamp so it was aimed directly into the oven.** **Reasoning** (support claim with evidence)**:** Some of the other groups' ovens were more successful than ours at achieving a higher temperature because of the placement of their lamps and the effectiveness of their oven design. We chose to cover our flap in foil because it reflects light and started out with our lamp facing the flap, so that the light from that the lamp radiated onto the foil would then be aimed into the box with the S'more. We colored the bottom of the box black because the color black absorbs the light. We insulated the box by covering the top opening with plastic wrap. After observing other groups and comparing results, here is an analysis of our design including our reasoning as to why these designs were more effective. I do not think that one layer of plastic wrap acted as a good insulator. **If we had used a few layers rather than just one I think it would have had more layers to keep from escaping**. We also insulated the sides of the box with the paper but we only balled paper up. The more successful design had rolled paper tubes that were sealed at the ends. **The rolled tubes insulated better because the trapped**

	air did not allow the warm air in the oven to easily transfer heat to the outside. Some successful ovens were smaller than ours, as well. **Smaller ovens were more effective because there was less air to heat up**. Other groups also placed their lamps facing down on the S'mores in the oven instead of aiming the light onto the aluminum foil flap. **The groups who used lamps facing down into the box were more successful because the oven received more direct light.** Overall, I think our group created a solar oven that could have been more successful if we had been more thoughtful and used our materials better.
Connections Demonstrate your understanding of the physical science content by connecting this investigation to your readings *(10 points)*	**Connections:** The process began when the energy from the light was transferred into the box through infra-red radiation (Hazen & Trefil 2009). Once the energy had entered the box, the light was absorbed by the black paper and other surfaces. This caused the molecules in these surfaces to vibrate more. The black bottom of the box absorbed radiant light, which heated up the bottom. The air in the box began to move quickly and air molecules bounced off the bottom of the box, causing the air molecules to heat up and eventually bounce off of the S'more. This process, also known as convection, caused the S'more to begin heating up. Convection is a process where warmer matter moves to cooler matter (Hazen & Trefil, 2009). In this case, the warm air bouncing off the black bottom moved to the cooler matter, which was the S'more. Heat was also transferred from the black bottom of the box directly to the s'more that was touching it. This was the process of conduction and conduction is classified as warmer matter that collides with cool matter (Hazen & Trefil, 2009). In this case the warmer matter was the black bottom and the cooler matter was the s'more. During this investigation, radiant energy was transformed into heat. Heat can be defined as energy that moves because of a difference in temperature. During this investigation, there was a difference in temperature between the black bottom as well as the air particles trapped in the box. When we measured the temperature of the oven with our thermometer, we were actually measuring the average kinetic energy or

	the average movement of the molecules in the box. The more the oven heated up, the faster the molecules began to vibrate, which caused the overall temperature of the oven to rise. Insulation of the oven was a huge part of this investigation because the insulation helped to hold all of the hot air inside and cooler air outside. We used the plastic wrap and paper as our insulators, but I do not believe we used enough of the materials to keep all the air from going in and out. If we had better insulated our oven and started out with the lamp directly radiating its light onto the s'more, I believe our final temperature would have been higher, as I explained above. Hazen, R. M., & Trefil, J. (2009). *Science Matters: Achieving scientific literacy.* New York: Anchor Books.