SOLAR OVEN SCIENCE FAIR PROJECT

Student Project Ideas:

- The effect of insulation type on cooking temperature
- The effect of lining color on cooking temperature
- The effect of oven depth on cooking temperature
- The effect of reflector type on cooking temperature
- The effect of different transparent cover materials on cooking temperature

Step 1: Background Research

Directions

- You need at least 10 sources(works) cited.
- Create at least one NoodleTools Notecard for each question/term listed below.
- You may not have multiple questions/terms on a single notecard.
- Each notecard must be linked to a source and have a 'Direct Quotation' and 'Paraphrase or Summary'.
  (A source citations must be created before you can create a notecard on that source)
- At least half of your notecards must have the 'My Ideas' section filled in.

Questions to answer:

1. What are some of the advantages of using sunlight as a source of energy compared to other sources, such as coal or nuclear energy?
2. What are some reasons to use a solar cooker?
3. Describe how heat is transferred and used in a solar cooker.
4. How do the types of solar cookers differ?
5. What are the important properties of a good solar cooker? What are their purposes?
6. Come up with a question of your own to answer.

Terms to define: **(in your own words!)**

1. Solar Power/Energy
2. Conduction
3. Convection
4. Radiation
5. Renewable Energy
6. Greenhouse Effect
7. Insulation
8. Transmit
9. Absorb
10. Reflect
11. Thermal Energy
12. Thermal Mass
13. Passive Solar Energy
14. Solar Oven
15. Parabolic Cooker
16. Box Cooker
17. Panel Cooker
18. Come up with at least one more word to define.

Background Research Links

- **Cooking with the Sun**- A document that has great information on solar ovens with a list of important vocabulary to know. There are also possible designs with procedures and materials for each.
- **Let The Sun Shine!**- An article about how the sun can be used for energy. Learn about passive solar heating, lighting and cooking, and active solar engineering technologies.
- **Passive Solar Design**- An article about ways to use solar energy. Learn about passive solar design
- **Adventures in renewable energy technology: Solar Oven Project**- This site has great resources for building solar oven
- **Solar Heat Backgrounder**- This is an article from the 'Adventures in renewable energy technology' website that is great for basic information on solar heat.
- **Principles of Solar Box Cooker Design**-This paper summarizes the basic principles that are used in the design of solar box cookers
- **Solar Cookers World Network**- Tons of information and resources, you can search this site for specific topics as well.
- **Solar Cookers: How to make, use and enjoy**- A booklet from Solar Cookers International
- **Solar Cookers International FAQ**- Frequently asked questions about solar cookers, a great place to find answers for questions you have about solar cookers.
- **Solar Cooker Simulation**- This website shows the different temperatures that box cookers can reach if made from different materials.
- **Baking in the Sun**- An article from Earth Observatory (NASA) on using solar cookers in underdeveloped countries
- **Solar Household Energy**- Solar cooking for human development and environmental relief
- **Energy Kids, Solar Basics**- A great resource for learning about solar energy, created by the U.S. Energy Information Administration
- **FSEC Solar Cooker Development & Testing Program**- An advanced site that has great resources for choosing topics and designing solar cookers
- **Pizza Box Solar Oven**- Great basic info on the principles involved in solar cooking as well as directions to make a simple oven.
- **Solar cooking in Kenya**- This site talks about how solar cookers are used in Kenya

Step 2: Introduction

The introduction makes the connection between the background research and the research variables. It combines and contains all of the important background research to lead the reader to the same logical hypothesis that the student has identified. After reading the introduction, we should know the importance of the problem being addressed.

Your final has to be in paragraph form and will be at least one and a half pages (double spaced, times new roman, 12pt font). Your paper must also be in your own words, only quote when necessary, and **do not plagiarize**. **You may not use personal pronouns** like 'I, my, we, our' in the writing of your introduction unless otherwise stated.

Copy the questions below into your Google Doc. All of the questions should be answered in your introduction in the order listed below:

1. What is the title of the project?
2. What new terms or concepts are being explored in the research project? Define these using your background research. (Choose terms that you defined in your notecards that relate to your topic. Like all of the other questions, this question must be written in paragraph form in your final draft)
3. What question/problem is being answered in the experiment?
4. What do you find interesting about this topic? (only time you can use personal pronouns)
5. Have others tried to answer this question in the past? If so, what research have they found to answer the question?
6. What independent variable is to be tested?
7. Why was this independent variable chosen?
8. What background research supports the choice of the independent variable? (This should be a long answer, you should have a lot of information from your notecards to write here.)
9. What is the dependent variable?
10. What research supports this choice of dependent variable?
11. What is the hypothesis for this experiment? (be sure to use the "if…then…because" format)

Step 3: Materials and Methods

Definitions:

Materials- all of the equipment and items that you used to conduct your experiment

Procedures/Methods- a sequence of precisely stated steps that describe how an experiment was done, including the materials and equipment used. The procedures should clearly incorporate the independent and dependent variables, the control group and the constants.

Directions:

1. Working as a group, make a detailed list of all materials you used in your experiment. You may need to revise this once you have written out your procedures.
2. As a group write the main steps that must be followed to complete your experiment. Your first step should not be, "Collect materials." That is a given.
3. You do not have to write out the steps for setting up the bottle rocket launcher, instead you can refer to the directions that come with the launcher in your procedures.
4. Once you have written the main steps, then go back by yourself and revise those steps, adding materials, constants and variables.
5. Be certain to include the number of trials for each level of the independent variable.
6. Answer the following questions to evaluate your procedures:
    a. Is the list of steps complete?
    b. Are the materials and equipment included?
    c. Is the procedure written for one level of the independent variable?
    d. Is the number of repeated trials indicated?

e. Are the words spelled correctly? Is the grammar correct?

7. Once you have written the procedures, give them to someone else to read. Ask if he/she would be able to perform the experiment based on how well the procedures are written. If they say no, revise your procedures to include more details.

Materials and Methods Check List

- ☐ Titled "Materials and Methods"
- ☐ Material list written before procedures- detailed with # of each material, brand
  - (if applicable), size/shape, etc.
- ☐ Double spaced, times new roman, 12-point font, 1" margins
- ☐ Steps are numbered
- ☐ Do not write one of your steps as 'Collect materials'
- ☐ Steps are detailed- give procedures to someone else to read. Tell them to explain to you what they would do during the experiment to see if it is detailed enough. The more detailed, the better your grade!
- ☐ Procedures include materials
- ☐ Describe how to use equipment/tools and which metric units to use
- ☐ Direct the experimenter to record and analyze data
- ☐ Includes # trials that should be completed
- ☐ Includes procedures on how to collect data for each level of the independent variable
- ☐ NO personal pronouns
- ☐ Written as directions on how to do the experiment; don't use the word 'you'
- ☐ Spelling and grammar are checked

Step 4: Data and Analysis

After you collect your data, you will be analyzing and graphing your results. Data analysis and graphing are two of the most important tasks that you will complete after conducting your research. Graphs not only help you see trends and results, but ultimately they end up on your website that communicates your research to others. It is important that you take time to understand how to analyze the data and how it can be expressed and shared with others.

Measures of Central Tendency

- **Mean** – is the arithmetic average of a set of data; calculated by dividing the sum of the elements by the number of elements
- **Median** – the middle element in a data set once the elements have been ordered by magnitude (for an even number of elements, the median is the mean of the middle two elements)
- **Mode –** the most frequent data value, it can be found for categorical or quantitative data.

Measures of Variation

- **Range** – the difference between the greatest and the least values in the set
- **Frequency Distribution** – depicts the number of cases falling into each category, can be used to summarize qualitative data

- **Standard Deviation** – measures how closely the individual points cluster around the mean.

Graph Selection - Graphs communicate in pictorial form the data collected from an experiment. You will need to select a graph that will best communicate your data.

- **Bar Graph** – common way to show categorical data or data that is in distinct categories with a non-standard scale, compares one data set over categories
- **Histogram** – data elements can assume any value in a range; data values are on the horizontal axis and the height of the bar represents the frequency of elements in that interval
- **Line Graph** – used for continuous data with a standard scale to show the change in a variable over time
- **Scatter Plot** – used when two measurements are made for each element in the sample, helps to determine if two characteristics are correlated
- **Box-and-Whiskers Plot** – displays a five-point summary of the data (the greatest and least values, the median and the first and third quartiles), used to show the variance in a single data set.

Creating a Graph - You may not hand draw your graph you can either use excel or another graphing program or go to http://nces.ed.gov/nceskids/graphing/ and create a graph online.

Requirements- Please attach this paper with your Data and Analysis. For an example of what this part of your project should look like please go our GT Project website.

Data Table Rubric:

Requirement	Points
The data table is for the average altitude reached	/3
The table is set up correctly using the template on our GT website	/3
All of the required data is present in the table	/3
All calculations to find the altitudes were done correctly	/3
The averages were calculated correctly	/3
Total	/15

Graph Rubric:

Requirement	Points
Independent Variable is on the x-axis	/2
Dependent Variable is on the y-axis	/2
Only the averages of each trial are graphed	/2
The title is written in the format 'The effect of … on…'	/2
The correct units were used	/2

The correct data was graphed	/2
The graph is digital, not hand drawn	/2
Is the scale on your graph appropriate and logical?	/2
Is your graph easy to read?	/2
Is the type of graph logical and appropriate?	/2
Total	/20

Data Analysis Rubric:

Requirements	Points
A topic sentence stating the variables and a reference to graphs and tables	/3
A sentence describing the correlation between the variables if one exists	/4
Sentences comparing the measures of central tendencies of the groups	/4
Sentences describing the variation within the groups	/4
Total	/15

Step 5: Conclusion

Guide to Writing A Conclusion

You should be familiar with writing a conclusion from labs. You are the expert of your experiment and for that reason you must be very thorough with your conclusion. You cannot assume that a person who is reading the conclusion will understand what happened. Begin by competing the Conclusion Planning Sheet and provide further detail using the following four-question method to write a conclusion. As a reminder, DO NOT use personal pronouns.

Question	What to include in your answer
1. Write a topic sentence stating the purpose of your experiment.	What were you trying to figure out by conducting this experiment?
2. Write **sentence(s)** stating your major findings.	What did you learn from conducting this experiment? What does your data suggest?
3. Write **sentences** stating the extent to which your hypothesis was supported by the data.	Restate your hypothesis. Did your data support your hypothesis? If not, do you have an explanation for this?

4. Write **sentences** that provide possible explanations for your findings.	Why do you think your data shows what it shows? What could account for your findings?
5. Write **sentences** stating how your findings compare with other researchers.	Think back to your background research, what did the rocket simulators or other researchers find in relation to your topic. Did what you find match their findings?
6. Write **sentences** proposing ways of improving your experiment and suggestions for further study.	Were there any errors made during your data collection? How could you fix those mistakes? Would there be any other constants you would add? Did you conduct enough trials? Did you choose a good variable to measure? Did you use the best tools to measure the variable? What new ideas do you have that build on the data you gathered from this experiment?