MST Physics Summer Project

While you are enjoying your well deserved summer break, I want you to observing the world around you - as you walk through the mall or along the beach, when you look up at the night sky, when you brush your teeth, when you read about a current medical breakthrough or AI development - ask yourself - *What does this make me wonder? Why does that happen? How does that work? What would I change? Can I make something better or less expensive or more environmentally friendly?*

PART 1: Brainstorm List - jot down random thoughts, questions, sketches, or ideas that pop into your head onto the organizer found on page 2 of this document. Start now and keep adding to it! The main purpose is to generate a great project idea. The secondary purpose is to be more intentionally observant - so document at least 10 different items.

PART 2: Research - Choose TWO of your ten observations to explore. For those two ideas - list a few subtopics you could explore, some details about what has already been done and some specific ideas about what you could further investigate. Compile this research into the table on page 3 of this document. The Louisville Public Library has a host of research tools. Document your sources (links are fine). A paragraph or two for each idea is sufficient.

PART 3: Generate TWO Potential Research Questions (or Engineering Goals) - they can flow from Part 2, or could be totally different - the key is that they are ACTIONABLE! Consider the following to decide if your question/goal is actionable:

1. Is this feasible ?
    a. What materials will I need and can I reasonably get them?
    b. How much time will it take and is this possible with my schedule?
    c. Do I have the skills I'll need or can I reasonably develop them?
    d. When is the best time of year to conduct this experiment (hint - plants grow best over the summer!)? You can get early approval for any project - email Mr. Hutchins or Mr. Woosley your proposal (john.hutchins@jefferson.kyschools.us, jordan.woosley@jefferson.kyschools.us)
2. What is the real-world application of the learning from this project? As a freshman, it is okay if the conclusions are already known, as long as you can design and conduct a well-controlled experiment and statistically analyze and interpret the results.
3. What different conditions(independent variable) can I set up that will likely show different results?
4. What **quantifiable (numeric)** measurement (dependent variable) will I make?
5. In order to **statistically analyze** your data, you need to have multiple measurements of the dependent variable in each group. Can you reasonably run the experiment multiple times (or do multiple trials all at once for each condition)?

Note: Freshman are not permitted to do a survey or mold project - ISEF prohibits those at home and we have had low/no success at school. Otherwise, your ideas can be in any of the 22 ISEF Categories!

Observation	Thoughts/Questions

Observation:

What has already been done and what could you further investigate?

Research links:

Observation:

What has already been done and what could you further investigate?

Research links:

Potential Research Question #1:

1. **Feasibility:** *is this a question you can answer with resources available to you?* YES / NO

2. What is the **real-world application** of the learning from this project?

3. What different conditions (**independent variable**) will you change for each stage of your experiment?

4. What quantifiable (numerical) measurement (**dependent variable**) will you make?

5. Can you reasonably run the experiment multiple times (or do multiple trials all at once for each condition)? This is a requirement to **statistically analyze** your results! YES / NO

Potential Research Question #2:

1. **Feasibility:** *is this a question you can answer with resources available to you?* YES / NO

2. What is the **real-world application** of the learning from this project?

3. What different conditions (**independent variable**) will you change for each stage of your experiment?

4. What quantifiable (numerical) measurement (**dependent variable**) will you make?

5. Can you reasonably run the experiment multiple times (or do multiple trials all at once for each condition)? This is a requirement to **statistically analyze** your results! YES / NO

Example Research Question: How does temperature affect the strength of a magnet?

Is this feasible and what materials will I need? It is reasonable to accomplish as I can purchase 50 small magnets for $10 and can borrow thermometers from Mr. Woosley. I can conduct this either at home or at school using a refrigerator, freezer, and warming oven.

The real-world issue: Magnets are critical to the generation of electricity, leveraging the effect of temperature could increase efficiency (I will do research about this!) and for me, this is a great example of a first-time project where I can gather a lot of data for analysis and I like magnets :)

What different conditions(independent variable) can I set up?
I can place magnets in the refrigerator, in the freezer, in a slightly warm oven and on the counter at room temperature. I can readily measure the exact temperature in each of these places. My independent variable is temperature, with 4 different temperatures (which is 4 independent variable (IV) levels and I can place 15 magnets in each temperature (so that's 15 trials for each IV level).

What quantifiable measurement will I make?
I had some choices here - my question involves evaluating magnet strength. So, I did research and found that there are sensors that can measure this - I could ask Mr. Woosley if we have any, but, I can easily set up a grid on the table and measure (to the nearest millimeter) how close I have to move the magnet to get a paper clip to move. I will record that distance for each magnet tested.

Statistical Analysis - I need to repeat the measurements - that's why I put 15 magnets in each temperature condition and then I can find the average distance at each temperature. Mr. Woosley will teach us how to do variance, standard deviation and t tests.
Note 1: Generally, a minimum of 10 trials for each independent variable level is required, but, when practical MORE is better!
Note 2 : Some projects do warrant different types of statistical analysis, e.g, many system software projects involve percent accuracy, confusion matrices or regression analysis.

This is not one size fits all!!! If you have a good idea, do some research and then email your instructor to get assistance to get from the idea phase to the project question/goal point. Everyone will need to propose their specific science fair project topic and general methodology by the date set in class and hopefully, this summer assignment will help you to select a project that you will enjoy working on your freshman year!

Resources to consider:

https://www.sciencenews.org/ for the latest science news
https://www.societyforscience.org/research-at-home/ and https://www.stemy.org/innovation for ideas
https://projectboard.world/isef to search the projects from the 2024 ISEF competition for inspiration

Parts 1, 2, 3 are due on your first day of MST Physics class (Google classroom or on paper)