Notebook section 1

and examples

Statement of the Problem

Example 1: For years, people have been taking photos of important events in their life. These photos were taken to preserve the moment in time, and act as a reminder of the event. But how could a photo preserve the moment if the photo itself wasn't preserved? Researchers and librarians have conducted many experiments and have come up with numerous conclusions about the best way to preserve black –and-white, and color photographs. Recently, due the lower cost and ease of home use of home printmaking, the classic photograph has been replaced by the homemade inkjet color print. This change has become so definite that one of America's biggest companies, Kodak, has declared bankruptcy. So as people now save their treasures on inkjet prints, new science is needed to find out the best way to preserve these images forever.

It is known that humidity, temperature, and exposure to bright lights can cause damage to photos and to inkjet prints. However, the question still remains whether different types of environmental gases affect the preservation of inkjet prints. If normal environmental gases can cause an inkjet print to fade in color or lose resolution then people must be made aware of this possible threat. People, librarians, and historians can warned of this possible damage and take steps to protect their images.

Example 2: The world is headed into one of the most challenging times we have faced in producing enough food to feed all people. Food production is becoming more difficult due to less fertile land from erosion, increased population, and poor farming practices. Farming on each acre is increasing, but the over-use of pesticides and fertilizer is environmentally harmful. There is an increasing demand for high-quality, fresh vegetables, free of pesticides that are locally grown. In places all over the world, the climate makes it impossible to meet year round needs for local produce. Long distance transport significantly affects quality of the food. It is also very expensive.

The world population is increasing 1.6 percent every year and the amount of space available to grow food down sizing. According to Ecology Action, over the last 40 years, 30% of the world's farmable land has been abandoned due to erosion. For each pound of food that is eaten in the United States, about 6 pounds of fertile soil are lost due to farming practices. In developing countries 12 pounds of fertile soil are lost, and 18 pounds of fertile soil are lost in China due to farming.

About 213,000 people are born every day, requiring 34,000 additional acres to feed the newly born humans. A study by the Food and Agriculture Organization of the U.N. reported that there are over 1 billion people out of our total population of 7 billion, that do not get enough food to eat for a nutritional diet. There is less farmland because of demands by mining, solar and wind generation, and expanding cities are prioritized above farming. There is also a diversion of food to support biofuel, such as ethanol additives made from corn for gas. The "Green" revolution in farming has been a huge increase in food production but relies heavily on water, fuel and fertilizer. In order to meet the needs of the people, it is important to increase economic and environmental efficiency of farms.

People are also seeing a decline in many species of fish in the oceans due to pollution and over fishing. The "Blue" revolution in fish production now allows almost 50% of seafood to be farm raised. While this helps production, there are however, many problems from algae blooms, cage conflicts in the ocean and fish waste.

PURPOSE

Example 1: The purpose of this experiment is to investigate which is the best environmental gas to preserve inkjet prints in and determine which gases can cause the most damage. The gases that will be tested are carbon dioxide, oxygen, nitrogen, and room air because these are the most common environmental gases. Most traditional photographs are kept in room air, and most photographs have a history of eventually fading. It has also been shown that if photographs are laminated, or sealed in some sort of a vacuum, they won't fade as quickly as photos exposed to room air. This information has been useful to many common people and historians who have photographs that they hope to be able to keep for generations.

Research shows that different ink and paper combinations can affect how long the newer inkjet and laser prints will last. However, most people prefer inkjet printers, dye-based inks, and plain or medium quality paper because of its low price. These lower cost and lower quality products do not have the ability to withstand environmental attack as well as the high quality laser or pigmented prints. Since the most common type of print used is the inkjet print, the fading expectancy should be studied under different conditions. To protect these prints, research has shown that prints should be stored in low humidity areas with a minimal amount of exposure to bright light and/or sunlight.

It has been shown that oxidation can ruin a photograph because oxygen may cause the different photographic colors to fade. This effect of oxygen and other environmental gases has not been studied using inkjet prints. The following experiments will help to solve one of the issues of how to keep prints vibrant and looking as though they had just been printed. This research will hopefully show how to keep them in an ideal condition for many years to come.

Example 2: Scientists are strategizing and analyzing ways to change the way humans create food forever. Controlled Environment Agriculture is growing food in a set environment for the best results. Controlled environment agriculture combines horticultural and engineering techniques for the best crop quality, production and efficiency. One emerging approach that is looking at growing both plants and fish in a small space with fewer resources is called aquaponics.

The use of aquaponics provides a more efficient use of natural resources. It is interesting because it is a self-contained ecosystem that is reliable, a great alternative to traditional farming, and it can be setup and used anywhere. The importance of this experiment is that it has a potential impact towards fixing world hunger, minimizes pollution, and is a lower cost towards feeding people. Economic research shows that hydroponics can grow a head of lettuce for 5 cents. Aquaponics can grow a head of lettuce in 12 cents, plus you get fish.

The following experiment will examine if using aquaponics, hydroponics, PH controlled aquaponics, or growing in soil is the most efficient way to grow nutritious and healthy plants in a short amount of time. This problem was selected after researching global issues online and world hunger was found as a major and growing problem. Research on aquaponics was found throughout the searching of this topic and seemed like a very important science that could be proved and expanded on in a science fair project.

(combination): Statement of the Problem and Purpose

Example1: The primary goal of this project is to discover the importance of the Wide Area Augmentation System (WAAS) during the solar maximum. This project will also determine how strongly GPS receivers are impacted by solar flares and other types of solar activity. Space weather could greatly affect GPS receivers and other forms of communication on Earth. Therefore, it is important to understand the effects these space events could have on life on Earth.

Solar flares, coronal mass ejections, solar wind, and other forms of solar activity could cause storms in the Earth's ionosphere, an area in the upper atmosphere. Signals from GPS satellites slow as they travel through the ionosphere, and are affected by any storms. Because the travel times of the signals are affected by storms, this may cause the GPS receiver's calculations to be in error. However, many receivers have WAAS, which is a second set of signals that may help correct for these errors.

Through this project, it is hoped that the impact of solar activity on GPS receivers will be more fully understood, and therefore result in less errors in receivers' calculations. It is hoped that this project will help improve the ease of using GPS during the solar maximum. This project may also aid in understanding the relationship between solar activity and communications devices on Earth.

Solving this problem could bring scientists one step closer to putting an end to catastrophic events caused by solar storms, such as the March 13, 1989 electrical power blackout in Quebec. These storms can cost up to 26 billion dollars per day and can affect millions of people. In addition, modern society greatly relies on satellite technology, which is vulnerable to the effects of solar activity. Satellite technology is also very costly to replace. Understanding the effects of solar activity on GPS devices could, in the future, assist scientists in avoiding severe power blackouts and satellite failures.

Example 2: Statement of problem and purpose

Today, existing solar trackers are very expensive and very complex. The high cost for tracking systems forces people to buy more static solar panels rather than using the more efficient sun trackers. The project's goal is to analyze efficiency of a tracking system and create a sun tracking system that is cost efficient and produces more energy than a static solar panel. The project will analyze the amount of energy being generated from a static solar panel and a solar tracking panel made for this experiment. If price could be reduced, more people would switch to solar energy. Such change can only benefit earth's environment by reducing the reliance on hydrocarbon fuels.

The experiment's purpose is to evaluate the effect of sun angle on the energy generated by a solar panel. If a tracking system does not need to track north to south, the complexity of the tracker can be reduced making it less expensive. In this experiment, solar panel efficiency will be evaluated and a solar tracker will be built using a simple shadow box sun sensor. The experiment will determine whether the loss in efficiency by not tracking north to south is inconsequential. The cost of installation and supplies for each panel will be more than a static system, but fewer panels should be needed to produce the same power. The cost savings from the enhanced efficiency of the system will be evaluated and compared to the excess cost of installation and supplies for the tracking system.

After interviewing representatives of solar installation companies, the gathered information was evaluated to see if there was any pattern. It was discovered that the most popular solar panel is Sunpower because it is the most efficient solar panel on the market. One can conclude from this trend that there is a market for more efficient solar systems. The average number of panels for a 6000 watt system varies from 15 to 25. The average cost for a 6000 watt system is approximately $30,000 to $35,000 before rebates.

Both the Omni-directional differential sun sensor experiment and the Naval Research Laboratory (NRL) spin replenishment and spin axis altitude control system experiment contributed to the project. The Omni-directional differential sun sensor experiment used the cosine in their experiment to estimate solar azimuth and elevation: north to south movement and east to west movement. The Naval Research Laboratory (NRL) spin replenishment and spin axis altitude control system experiment used an inexpensive sun tracker to determine where the sun was. Most solar installation companies do not sell solar tracking systems because the systems are too expensive.

If a tracking system was 39% more efficient as was estimated using the formula that will be tested in this experiment an existing static array of 20 panels costing $30,000 could be reduced to a tracking system with 12 panels. Assuming each panel costs approximately $1,500 installed ($30,000/20 panels), the cost of a tracking system of 12 panels (before additional installation cost and the cost of the tracking system) would be $18,000. If a tracking system could be installed for $12,000 or less, the system would be cost effective. Based on preliminary research, it appears possible to make more solar energy by maintaining the solar panel's perpendicular angle to the sun. The solar tracker will save energy and money by only tracking east to west. It also is believed that this can be accomplished in inexpensively.

Hypothesis : You want to place a little previous information and BOLD the specific quantitative numbers

Kirill Slobodyanyuk, completed an experiment which showed that geomagnetic storms affected GPS precision, and that 24 feet (about 7 meters) was the average amount of error. However, an error of 7 meters would probably have little effect, and is unlikely to cause a person to lose their way. Therefore, it was concluded that a stronger storm would be needed to cause a greater error of about 20 meters, enough to cause confusion for the user of the GPS receiver.

Another previous experiment, carried out by Dr. Keith Groves, revealed that a Kp-index of 8 could affect WAAS, the second set of signals used to correct for errors caused by the ionosphere. Therefore, a storm with a lower Kp-index may not affect WAAS, but could certainly affect a receiver without WAAS. A Kp-index of 6 is a reasonable estimate for the strength of a storm that could cause significant error in a GPS receiver's calculations.

The hypothesis for this project is that a Kp-index of 6 or more, resulting in an error of at least 20 meters, could cause the user of a GPS receiver without WAAS to get lost. This hypothesis was formed using a combination of background research and previous experiments. A Kp-index is a number from zero to nine that describes variation in the geomagnetic field for each three-hour interval. A Kp-index greater than 4 indicates that a geomagnetic storm has occurred. A Kp-index of 6, therefore, would indicate a moderate storm. Anything greater would be a more severe storm. Previous research indicates that there would need to be a moderate to strong storm to have any impact on a GPS receiver.

Hypothesis

The hypothesis for this experiment was decided by many different facts and core science. The same force that was identified to cause a concussion will be delivered to the helmet to see if the helmet can disperse the impact and prevent injury. The blunt impact will be 90 and 100 g's. This is the range within which most concussions occur. When a 90 to 100 g hit occurs, it is similar to a player getting hit at twenty miles per hour. A 90 to 100 g hit will not always cause a concussion. There are many factors to take in to consideration when determining if the impact will cause a concussion.

In this experiment the helmets should be able to prevent most of the paintballs from popping at 90 to 100 G's. The expense of the helmets will also come into play during the experiment because the more expensive helmet or the higher quality helmet will be expected to perform better than the less expensive helmet or the lower quality/beginner helmet. This means that the Pro7 and the undetermined helmet are expected to surpass the clh2 in safety and quality. The age of the design of the helmets also helps predict the overall outcome of the experiment.

The hypothesis for this experiment is that the Pro7 will be able to withstand 10 g's more impact than the average of g's necessary for a concussion and the clh2 will be able to withstand 5 g's more than the average range of g's that cause a concussion. This was decided by evaluating the helmets designs, analyzing protective abilities of helmets, and facts from core science.

VARIABLES AND CONTROLS

Independent Variables

Growing Medium – Soil, Hydroponics Water, Aquaponics Water, pH Controlled Aquaponics Water – This variable will be set in each quadrant.

Plants - Lettuce, Dill, Basil – Similar amounts of seedlings will be placed in each quadrant

Dependent Variables

1. ***Height*** **–** The height of the plants will be measured to see which grows tallest.
2. ***Growth Rate*** **–**The height of the plants will be measured throughout the experiment and the growth rates will be compared.
3. ***Taste*** **–** A blind taste test of the different vegetables will be give and each plant will be rated from 1-4 on best taste.
4. ***Cost Efficiency*** **-** At the end of the experiment al the costs for each method will be tallied up.

Control Group

The soil quadrant will be the control group for this exercise. Aquaponics and Hydroponics will be compared against the plants in the soil.

Controls

1. Seeds used in each experiment
2. Water source for all four tests
3. Amounts of sunlight for each quadrant
4. Weather conditions for each quadrant
5. The same pH Down acid will be used for both the hydroponics and pH controlled aquaponics quadrants

Variables and Controls

I. **Independent Variable: WAAS on/off**

- This variable will be changed by turning the Wide Area Augmentation System (WAAS) off on one receiver using the SiRFDemo.exe program.
- The other receiver will still have WAAS enabled.
- The receiver with WAAS disabled may have error created by the ionosphere. The receiver with WAAS enabled will, however, automatically correct for this error.

II. **Dependent Variable: Altitude Measurements**

- This variable will be measured by the GPS receivers according to the data they collect from the satellites.
- The altitude measurements from the receiver with WAAS and the receiver without WAAS will be compared by computing the altitude difference for each second.

III. **Control Group: Measurements from days without geomagnetic activity**

- The control group will be made up of altitude measurements from days or intervals of time with low geomagnetic activity, and therefore, less chance of error in the GPS receivers' calculations.
- These measurements will show how much solar activity impacts the precision of GPS receivers by providing data for days without much solar activity.
- These days will have a low Kp-index of either zero or one.

IV. **Controls:**

- Same GPS receivers, in the same location and altitude, for each trial
- The location of the satellites should be nearly the same when the measurements are taken at the same period of time each day, within a week of each other.
    1. Alternatively, averaging three hours or more should cancel out the errors caused by differing satellite geometry.
- Same weather (cloudy, sunny, raining, etc.)
- Measurements from WAAS and no WAAS receivers are taken at the same time.

Variables and Controls **(another format available to use)**

I. Experimental Variable: Type of Solar Panel System

- This variable will be changed by using two different types of solar panels.
- The first type will be a static solar panel.
- The second type will be a solar tracking mechanism made for this experiment using a simple shadow box sun sensor.

II. Measured Variables: The Energy Output From the Solar Panel

- This variable will be measured using a volt meter attached to each panel.
- The sun will be simulated using a flashlight or shop light.
- The sun angles will be calculated in 10° increments.

III. Control Group

- A tracking solar panel will be the control group
- The tracking solar panel will not change its angle to the sun

IV. Controls

- The interval time (5 minutes)
- The light source
- The light location
- The solar panel
- The test location

Procedures: **a step by step NUMBERED procedure/single spacing within the step/1.5 spacing between steps**

Part I: Placing Light Traps

1. Find areas with available beehives.
2. Bring all traps, tools, and storage containers to the testing location in the cardboard box or container to keep supplies.
3. Locate hive and observe its surroundings.
4. Take the traps and put them on the ground at least 15ft. away from the hive.
5. Make sure the hives cannot be seen directly from the entrance of the hive.

Part II: Setting and Activating Light Traps

1. Secure the lights on the traps.
2. Make sure they are pointed to the bottom of the funnel part of the trap.
3. Also make sure the light can be seen clearly from the distance of the hive.
4. Turn on lights each night when it becomes dark outside.

Part III: Collecting Findings

1. Go out to the traps the morning after the night they were activated.
2. Remove duct tape and funnel.
3. Use the tweezers to pick bees out of the trap, hold them by the wing.
4. Poke air holes in containers with the thumbtack or needle.
5. Put each bee in a separate storage container.
6. Label each container with the location and date collected.
7. Organize containers by location and date.
8. Create a table to record findings.
9. Fill table accordingly with what was collected.

Part IV: Observing Findings

1. Keep containers with bees at room temperature for 5-13 days.
2. Each day write observations of every collected bee.
3. After the 13^{th} day, if phorid larvae do not emerge, discard the bee.
4. Keep a record of the number of infected, and uninfected bees.
5. Use these results to create a conclusion based on the hypothesis.

Procedures (example showing drawings) Remember: this is a step by step NUMBERED procedure

Part 1: Setup

1. Locate an accessible area with an unobstructed view of the sky, without any objects that may interfere with satellite signal reception.

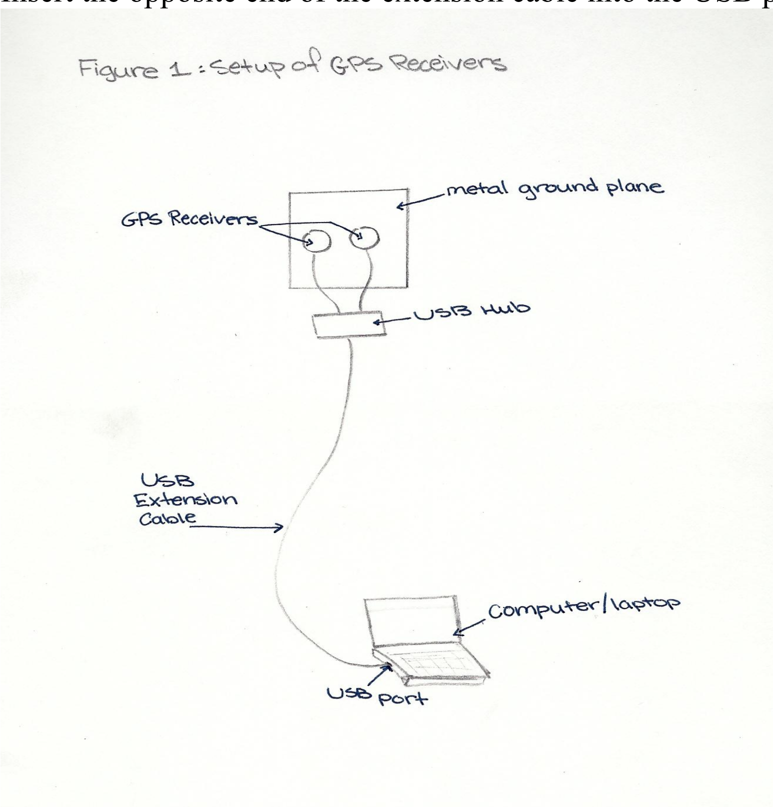
2. Take the two GlobalSat BU-353 WAAS GPS receivers and the square piece of metal to this location, using a ladder if needed.

3. Attach the magnetic part of the GPS receivers to the metal.

4. Place the metal, along with the GPS receivers, in the chosen location so that the metal plate is parallel to the ground and the GPS receivers point upward.

5. Attach the multi-port USB hub to the receivers and the extension cable.

6. Insert the opposite end of the extension cable into the USB port on the computer or laptop.



7. Sign up for solar storm alerts in the 3D Sun Application.

Materials (note: this should be a NUMBERED list)

Light Trap

1. Flower pot or bucket
2. Light source (preferably cordless/battery operated)
3. Tape (preferably duct tape)
4. Funnel to match diameter of pot or bucket
5. Stick or wire (rulers work well)
6. Batteries (if needed for light source)

Collection

1. Ziploc Tupperware containers
2. Label maker or labels
3. Pen or marker (if using regular labels)
4. Tweezers
5. Thumbtack or needle
6. Cardboard box

Observation

1. Room kept at normal room temperature
2. Paper or notebook
3. Pencil or writing utensil