THE ABSTRACT – HOW TO WRITE IT

ABSTRACT

Introduction The **abstract** is the reader's first encounter with your paper. Reviews will form first impressions of your research by reading the abstract. Day (1994) states, "Usually, a good abstract is followed by a good paper; a poor abstract is a harbinger of woes to come."

Sequence *Write the abstract after the paper is completed. Make sure it accurately reflects the paper's contents.*

Definition The **abstract** is a:

- brief summary of the principal findings of the paper.
- preview of the paper.
- stand-alone, self-contained document that can be read independent of the paper.

Contents The **abstract** will consist of 4 sections:

(a) The purpose of the research or the research problem.
(b) A general overview of the procedures used
(c) The principal findings from the data
(d) Conclusions

While it is difficult to be both concise and descriptive at the same time, That is exactly what you should strive for when writing an abstract. Say only what is essential, using no more words than necessary to convey the meaning.
Examine every word carefully.

Rules ***The abstract should be:***

- four paragraphs for each of the above descriptive sections.
- 150 to 250 words in length.

The abstract should:

- ***not*** include subheadings such as "Purpose" or "Results". You will simply have 4 indented paragraphs.
- ***not*** use first person, ex. "I" Use the third person past tense.
  Say: "The height was measured using…..".
  Do not say: "I measured the height using…….". **(See the abstract example below.)**
- ***not*** include information or conclusions that are not stated in the paper.
- ***not*** emphasize minor details.
- ***not*** contain bibliographic references, figures, or tables.
- *not* use jargon or abbreviations (unless they are commonly used and do not require explanation, ex. DNA or UV light).

I have listed below some guidelines about how to write an abstract. I have also given you examples of each of the four sections.
After the notes on each section, I have given you 3 different abstracts from 3 different projects. You can view hundreds of abstracts by going to edline and clicking on the link to PVPSEF abstracts. You will then be able to find an abstract for a project in the same area as yours. Now go to the next page.

Writing the Abstract
(250 word limit)

Your abstract will be read, ***prior to the Science Fair***, by persons assigned to judge your project. The abstract represents the first exposure the judges will have to your project research. Therefore, first impressions are very important!

The following items must be included in your abstract:

Objective or Goal:
State the objective, goal, or hypothesis upon which your project is based.
(See examples below.)

Materials and Methods:
Indicate the materials, methods, and experimental design used in your project. Briefly describe your experiment or engineering methods.
(See examples below.)

Results:
Summarize the results of your experiment and indicate how these results pertain to your objective.
(See examples below.)

Conclusion/Discussion:
Indicate if your results supported your hypothesis or enabled you to attain your objective. Discuss briefly how information from this project expands our knowledge about the category subject.
(See examples below.)

Examples of Objective or Goal:

1. This project was designed to discover the seed preferences of California scrub jays (*Aphelocoma californica*) visiting my backyard bird feeder.

2. My objective was to write a computer program for PC computers that would help a student memorize Spanish vocabulary words.

Examples of Materials and Methods Section:

1. Fifty-gram soil samples were collected from the A horizons of five 1 m square lawns, initially fertilized with WonderGrow Super Fertilizer. Similar samples were collected from five 1 m square lawns, initially fertilized with coffee grounds. The samples were analyzed for nitrogen, phosphorus, and potassium content. This comparison was repeated once a month for four months, between November and February. Changes in soil composition over time were compared.

2. I constructed a maglev track, using 40 neodymium magnets, spaced .5 cm apart and glued to a plywood board. The track was mounted at an angle of 10 degrees, forming a ramp. I then designed a balsa wood vehicle with 5 neodymium magnets below the wooden base. To test its weight-bearing capacity, the vehicle was loaded with different weights and tested at each weight ten times. The weights compared were: no load, 2g, 4g, 6g, and 8g. I used a ruler to measure how far down the track the vehicle was able to go, after being released at the top of the track.

3. A survey form was distributed during science classes, asking a total of 50 sixth, 50 seventh, and 50 eighth graders to estimate how long each of three musical pieces were played. Participants were asked to leave their names off of the surveys, to keep data anonymous. Results were then compared to see whether ability to estimate playing time improves with participant age.

Examples of Results Section:

1. Aluminum and wooden baseball bats were compared to see how far a regulation baseball would travel when struck. In all but one of the 25 trials, the baseball went further after being hit with an aluminum bat. On average, the ball traveled 4.5 cm further with the aluminum bat. In the one trial where the wooden bat made the ball go farther, the wind may have been blowing against the ball during part of the aluminum bat portion of the test.

2. The height of cookies made in 3 ways was compared after baking. Cookies made without baking powder were an average of 3 mm in height at their highest point. Cookies made with baking powder were an average of 10 mm at their highest point. Cookies made with my homemade rising formula rose an average of 4.5 mm. In this series of tests, baking powder was a much better leavening agent than my homemade formula. However, my homemade formula was slightly better than using no leavening at all.

3. Combining the results of the first 3 trials, after 15 minutes, there were 75 mealworm beetles (*Tenebrio molitor*) in the darkened area and 5 in the lighted area. Combining results of the second 3 trials, there were 89 mealworm beetles in the darkened area and 11 in the lighted area.

Examples of Conclusions/Discussion Section:

1. My hypothesis that the beetles would be more likely to move to the darkened area was strongly supported by the results. It would be interesting to repeat this experiment with mini darkling beetles (*Tenebrio obscurus)* to see if they act in a similar way.

2. Before doing the experiment, I thought iron would be a better conductor of electricity than silver. My results indicate the opposite. The results do not support my hypothesis. Next time, I would like to see if copper is also a better conductor than iron.

3. After reviewing my results, I could find no consistent pattern in my data. There was no clear advantage or disadvantage to doing homework while listening to Justin Bieber songs. My hypothesis that it would be helpful was not supported by the results. It might be useful to try again, substituting another kind of music, such as rap or jazz.

EXAMPLES OF FULL ABSTRACTS

Example 1: In the Category of Behavioral and Social Sciences

THE STROOP EFFECT

The objective of this project was to analyze the Stroop Effect on 13-15 year old females and 13-15 year old males. The main purpose of this experimentation was to determine if the females could perform the Stroop Effect dominantly than the males or vice versa. This test is used to measure an individual's selective attention, cognitive flexibility, and processing speed. The participants would be able to learn that the Stroop Effect could be used to improve the abilities of individuals and increase the changes of good judgment and decisions in actual life situations.

In order to test the Stroop Effect on genders, 10 females and 10 males from Palos Verdes Peninsula High School were needed. The individuals were given the test and were timed. Precautions were taken into account and made sure that no participant was color blind. The results were anonymous and recorded in seconds. After, the average of the time was taken for each gender to read the Stroop Effect and compared.

The data collected showed that the males had an average of 12.39 seconds to read the Stroop Effect and the females had an average of 13.67. Therefore, the 13-15 year old males performed the Stroop Effect faster than the 13-15 year old females with only a 1.28 second difference.

The results show that 13-15 year old males have sharper selective attention and speed than their female counterparts. These teenagers of both genders can still be analyzed together and can generally conclude that teenager's minds can deal with interference if an effort is made.

Example 2: In the category of Chemistry

Increasing the Efficiency of DMFCs Using Different Supply Conditions, Temperatures, and Catalysts

This project was designed to improve the efficiency of Direct Methanol Fuel Cells by testing different factors including oxygen flow rate, methanol solution concentration, temperature, and catalyst used.

I constructed two different fuel cells by pressing two pieces of Teflon-coated carbon paper around a Nafion film. In both cells, the cathode was painted with a platinum black catalyst and the anode was painted with a carbon-supported platinum and ruthenium black catalyst. A commercial anode catalyst was purchased and compared to one synthesized in the lab with a novel 90% carbon, 10% tantalum carbide support. This membrane-electrode assembly (MEA) was then placed within a fuel cell housing, and the entire fuel cell, using tubing, was fed with a methanol solution at the anode and oxygen at the cathode. After conditioning the cells, data collection began by evaluating current and voltage output at various oxygen flow rates, temperatures, and methanol solution concentrations. All of the data was collected on the computer using a fuel cell test system.

The maximum power density attained was about 55 mW/cm^2. The cell did perform better at higher temperatures, as expected. The cell with the lab-synthesized catalyst was able to produce higher power density at lower currents. The stronger methanol solution also enabled the fuel cells to perform better. Overall, the second fuel cell with the synthesized catalyst performed better.

Ultimately, my hypothesis was supported and the synthesized catalyst allowed the cell to perform better than the commercial catalyst; more research could lead to its use in commercial cells.

Example 3: In the category of ENGINEERING

A MAXIMUM POWER POINT TRACKING HARDWARE WITH AN IMPROVED HILL CLIMBING ALGORITHM

The objective of this project was to develop maximum power point tracking (MPPT) hardware to optimize the efficiency of the solar photovoltaic (PV) panel. The PV panel converts solar energy into electricity and the MPPT hardware enables the PV panel to operate at its maximum power point. Popular MPPT algorithms such as the perturb-and-observe (P&O) and hill climbing (HC) algorithms suffer from various deficiencies which were addressed in this project.

An improved HC algorithm was developed and implemented in the MPPT hardware. For each perturbation cycle, the algorithm sampled the PV panel output power for multiple duty cycles of the switched DC-DC converter then dwelled at the duty cycle which resulted in the highest power. This duty cycle was also used as the midpoint of the next set of perturbations. Hardware including a PV panel, a boost DC-DC converter, an LED load circuit, and a TMS320F28335 microcontroller was assembled to validate the algorithm.

Step-up voltage conversion of the DC-DC converter was demonstrated, and the sensitivity of output power over the perturbation of switch duty cycle was characterized. Efficient and robust maximum power point tracking was achieved at all irradiance conditions. At constant irradiation levels, the output power achieved by the MPPT algorithm was >98% of that achieved by manually setting the PWM duty cycle to the optimal values.

The improved algorithm of this project was significant because it addressed the deficiencies of popular algorithms with simple modifications. The sample-select-dwell process minimized oscillations, improved tracking speed, and reduced sensitivity to voltage noises.

Example 4: In the category of ZOOLOGY

Effects of Different Light Wavelengths on Food Consumption in *Hippolytidae*

This project was designed in order to determine the effects of exposing Hippolytidae (broke back shrimp) under red and blue lights on the food consumption of brine shrimp. The project stemmed from an earlier experimental idea to see the varying pigmentation patterns on spot prawns under differing lights. However, maturation of the larval prawns had setbacks, and a more viable test organism was found in the broke back shrimps. Taking the basis idea of lightings effect on organisms, this modified project seeks to extend the lighting environment to stimulate differing depths in the ocean. Therefore, experimentation provided a broader understanding to these species environmental surroundings.

In order to obtain quantifiable data from experimentation food density was calculated prior to and after each twenty-minute feeding period. Brine shrimp proved to be readily counted, by sampling portions of the food mixture and counting brine shrimp per portion under a TEC microscope. From this known concentration of food mixture a counting after feeding was used to see the change in food density, which would thus indicate how much food was consumed in each tank under specific lighting conditions. Brine shrimp are known to be phototactic, moving to the area of light, so light was placed equally distributive over the tanks.

The initial experimental data of shrimp was taken from gravid females, however they soon became gravid and further experimentation continued with solely non-gravid shrimp. However, comparison between gravid and non-gravid shrimps was noted. For the gravid shrimp the greatest food consumed was seen in the tank exposed to blue light, the difference in food density was 13.00 brine/ 10mL as opposed to the shrimp in red light whose food density only equated to 5.50 brine/10mL. Data indicates gravid females prefer deeper ocean depth, an environment chosen for larval dispatching. As expected, the non-gravid shrimp had a greater difference in food density when under the red light. The difference between all trials of non-gravid shrimp averaging to 12.00 brine/10mL in red light tanks compared to 6.60 brine/10mL in blue light tanks. This data supports the hypothesis that shrimps use phototaxic cues during feeding, and thus being at a shallower ocean depth is ideal.

The knowledge gained from this project not only helps distinguish effects between gravid and non-gravid shrimp, but also better related oceanic feeding. The gravid shrimp, preferring deeper depth to hatch larvae were consumed more under blue light simulating the deeper depth. Non-gravid shrimp not inclined to deeper oceanic depth consumed most in their preferred shallow habitat. Analysis of experimental data was used to further accommodate these species in aquarium environments, assimilating the shrimps to man-made conditions.