Appendix 1: Sample Abstracts

Abstract Sample #1

TESTING THE EFFECTS OF BLADE TWIST ON A WIND TURBINE GENERATOR

Last Name, First Name
901 Gilmore Ave, Winona, MN 55987
Winona Senior High School, Winona, MN

The consumption and pollution of fossil fuels and other nonrenewable resources has led to a search for alternative sources of energy. The wind, though intermittent, could be bettered to supply the world with a renewable solution to this crisis. The purpose of this research was to determine whether a twist in the blade shape of a wind turbine would produce greater amounts of wattage compared to a straight bladed turbine. It was hypothesized that the wind turbine with twisted blades would produce greater amounts of wattage compared to a straight bladed turbine. Data was collected by testing both turbines on a generator at all three fan settings. The amount of voltage and amperage produced by the turbines was recorded and multiplied together to discover the wattage outputs of the turbines. Drag and Lift tests were conducted in a wind tunnel to determine the lift to drag ratios of the turbine blades. A relatively high lift to drag ratio is the prime objective in wind turbine design. The lift to drag ratio for the twisted blade (877/283) was higher than that for the straight blade (397/209). The turbine with the twisted blades produced the greatest amount of wattage at all three wind speeds (setting 1: 12.5; setting 2: 67.5; setting 3: 263) compared to the straight bladed turbine (setting 1: 8.01; setting 2: 29.8; setting 3: 78.7) thus supporting the original hypothesis. This was thought to have happened because the angle of attack was less at the tip of the twisted blade than at the base of it which caused the tip to produce less drag as it rotated around the hub of the turbine allowing the turbine to rotate faster, thus producing greater amounts of wattage.

Abstract Sample #2

NITROGEN AND SEDIMENT LOADING TO THE UPPER MISSISSIPPI RIVER: ASSESSMENTS OF 27 WATERSHEDS IN MINNESOTA AND WISCONSIN

Last Name, First Name
901 Gilmore Ave Winona, MN 55987
Winona Senior High School, Winona, Minnesota

This study was designed to test the hypothesis that Southeastern Minnesota and West Central Wisconsin tributaries are contributing disproportionately more sediments and nutrients to pools 5-8 of the Upper Mississippi River during summer, and that these pools would be retaining sediments and exporting nutrients. Turbidity and nitrates were measured monthly at each of 25 tributaries and Lock and Dams 4-8. Discharges were measured at 21 tributaries, whereas discharges at four tributaries and the Lock and Dams were obtained online. GIS watershed and land use data were used to determine percentage row crops in each watershed, and then compared to sediment and nitrate loads to determine if row crop agriculture increased sediment and nitrate stream loads. Tributary drainages comprised 11.8% of the watershed area upstream of Lock and Dam 8, but contributed 22.1% of sediments and 12.4% of nitrates delivered to Lock and Dam 8. When percentages of row crops per watershed were compared to sediment and nitrate loads, no significant ($P>0.40$) correlations were found either on a monthly or total summer basis. Pools 5-8 were exporting sediments, with output (107 metric kilotons) exceeding inputs (100 metric kilotons). Nitrates also were exported, with outputs (17.9 metric kilotons) equaling inputs (17.9 metric kilotons). Disproportionate contributions of sediments and nitrates from the Southeastern Minnesota and West Central Wisconsin tributaries to pools 5-8 of the Mississippi River are degrading the river environment by increasing sediment load and contributing additional nutrients to the Gulf of Mexico Dead Zone.

Abstract Sample #3

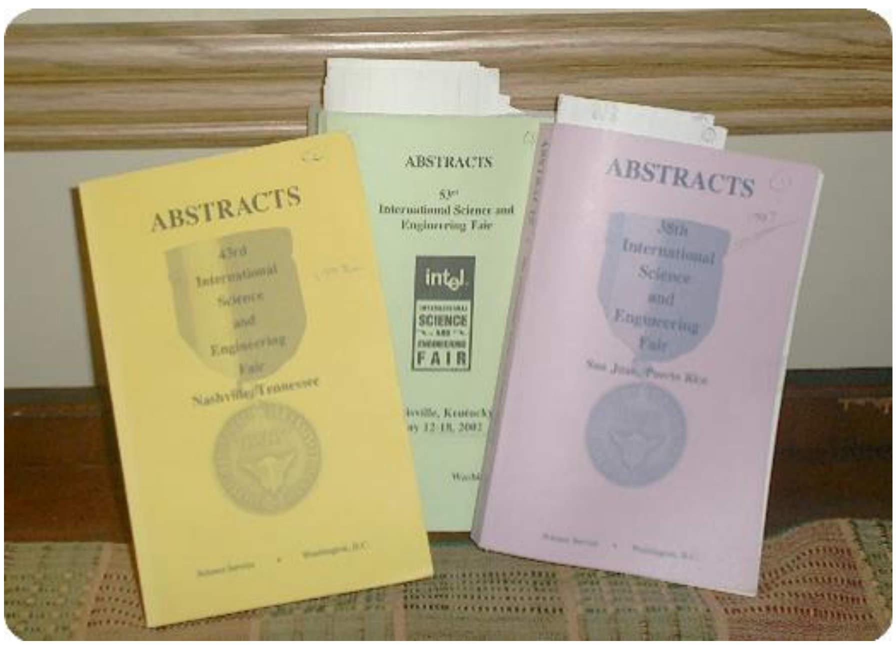
THE IMPACT OF GRASS HEIGHT AND DENSITY ON DUCK NESTING SUCCESS

Last Name, First Name
901 Gilmore Ave Winona, MN 55987
Winona Senior High School, Winona, MN

The Prairie Pothole Region of the United States and Canada is North America's single most important waterfowl breeding area. Dotted with millions of shallow wetlands formed by glaciers 10,000 years ago, the Prairie Pothole Region encompasses over 250,000 square miles and supports more than 50% of the continent's ducks. In some portions of the region, potholes and their associated prairie uplands support over 100 breeding pairs of ducks per square mile. The purpose of this study was to determine the impact of grass height and density on duck nesting success. Duck nests are greatly affected by predation. Mammalian and avian predators are destroying thousands of duck eggs each year (Ducks Unlimited). It was hypothesized that duck nests in denser and taller habitat will be more effective. It is believed to be so because in a denser habitat, the hen can hide in the grass and predators will be less likely to find her and her eggs. All data was collected between June 9, 2003 and June 30, 2003. The Long Lake and Beck Game Production areas, consisting of 3,160 acres were located in the counties of Codington and Brookings, South Dakota. Thirty-five nests were located on the Game Production Areas by either using a 6-foot willow switch or a 25-foot chain (Vaa, 2003). Grass height (cm) and density (stalks per $10cm^2$) were measured. A comparison was made, examining the success of nests in different grass heights, and the nest distance to water. The odds of a nest being successful in high grass height (above 60 cm) were eight times more likely than in low grass. This was statistically significant at .03, using a logistics regression test. The standard p value (.05) was used in this study. Duck nests in high grass height were more successful than nests in low grass height. This is probably due to the fact that visibility is restricted in high grass height. In a high-density situation, nests were more likely to be depredated, than in a low density. The majority of the data collected did support the original hypothesis.

Appendix 2: Sample Research Paper

Analysis Of Statistical Methods Documented In ISEF Project Abstracts



Name
Grade: 9
Category: Behavioral / Social Science
Winona Senior High School

51

ANALYSIS OF STATISTICAL METHODS DOCUMENTED IN ISEF PROJECT ABSTRACTS

Last Name, First Name
901 Gilmore Ave Winona, MN 55987
Winona Senior High School, Winona, MN

Generally speaking there are three classes of statistics. The first class is descriptive followed by the second class, correlation, and class three, inferential statistics. The purpose of this study was to determine which types of statistical testing were used in International Science and Engineering Fair (ISEF) project abstracts. This study also looked at what variables may make an award-winning project. It was hypothesized that the students who ran the highest class of statistics and most complex project would receive the highest awards. 140 abstracts were analyzed from the year 2002. Starting with each category, ten abstracts were analyzed and recorded, five abstracts that won awards, and five that did not. Once the testing began it became apparent that determining the type of statistical testing would not be possible because the projects did not list what type used. However, some of the projects mentioned the use of statistical analysis in their abstract. The variables were project category, whether or not statistics were mentioned, number of factors, number of variables, number of groups, and number of observations. Number of variables was found to be the most interesting results. The more variables in the project, the complexity and level of the award (if any) increased. The overall results slightly supported the hypothesis. Because the type of statistical analysis could not be found, part of the hypothesis could not be answered. However, it was found that the higher the variables and complexity of the project, the higher the award was, supporting the original hypothesis.

INTRODUCTION

For students today, statistics is not even a question; in fact it, does not even exist. Many students do not understand the basic rules of statistics, along with many teachers. In today's world, statistics is a very broad and confusing branch of mathematics to learn. For statistical conclusions to be valid the appropriate statistical methods must be used for the situation. For this reason, it is critical that the students not only be taught the statistics, but also the specific conditions under which each method should be applied.

Generally speaking there are three classes of statistics. With each class, the statistics used become more advanced. The first class describes the results in a process called descriptive statistics. The next class, correlation, compares and looks at different patterns. The final class is inferential statistics or statistical analysis.

Descriptive statistics is the process of collecting data, summarizing it, and then describing its characteristics (Anagnoson, 1996). Students have often used descriptive statistics without even knowing it. Some examples include being a scorekeeper for sports teams, keeping accounts on favorite players, keeping track of boy/girl scout sale records, and finding average grades in school. Usually in this level of statistics, the mean, median, mode, and variance are determined and analyzed.

Central tendency is the measures of the center of a given data set. The mean is the most commonly used measure of central tendency (Journot, 2001). Another measurement of central tendency is the median. The median is often referred to as the middle number and is usually used when the measurements contain an outlier. The mode is a third measure of central tendency and sometimes does not exist in a set of data. The mode is a certain value that occurs more often than any of the other values in a set of data. However, if two values occur the same amount of times in a set of data, the data is is bimodal. It is called multimodal if there are more than two values that occur the same amount of times. The measurement of how a set fluctuates relative to their mean is the variance (Blaisdell, 1993).

The second class of statistics is focused on finding a pattern. First, a guess is made on what pattern exists. Some examples are a line, an exponent, a curve, etc. The correlation is then found, where the data is analyzed to see how close it fits to a pattern. One of the most common ways to see how close the data fits a line is the Pearson's sample product-moment (Quarterman, 2003). This model looks at how close data points can come to a straight line. According to Blaisdell, there are seven properties of Pearson's test that the data must follow in order to determine the pattern of the data.

1. The value of r is always between –1 and 1.
2. r has the same sign as b_1, the slope of the least squares line.
3. r is near +1 when the data points fall close to a straight line that is rising, this is, when y tends to increase as x increases.
4. r is near –1 when the data points fall close to a straight line that is falling, that is, when y tends to decrease and x increases.
5. If all the data points fall exactly on a straight line with positive slops, then r= + 1.
6. If all the data points fall exactly on a straight line with the negative slope, then r = -1.
7. A value of r near 0 indicates little or no linear relationship between y and x.

(Blaisdell, 1993, pg. 121)

The most complex class of statistics is statistical significance or analysis of variance. There are four steps that are identified and used with statistical significance testing. The first step is the null hypothesis, which is a hypothesis about a population parameter (Ott, 1990). The null hypothesis is a prediction that there is no difference between any sets of data. The null hypothesis sometimes is designated by the symbol H_o. A parameter is a numerical characteristic of the population, and the population is the entire collection of elements of interest in a study (Smith, 1997). The second step is the alternative hypothesis, which is a hypothesis that is accepted if the null hypothesis is rejected (Ott, 1990). The alternative hypothesis uses the symbol H_a. The statistical testing is step three, which is a quantity computed from the sample data. The final step is rejection region, which is a set of values for the test statistic that are contradictory to the null hypothesis and imply its rejection (Ott, 1990).

The purpose of this study was to determine which types of statistical testing were used in International Science and Engineering Fair (ISEF) project abstracts. The study looked at age and grade of the students, and what awards the students had won. As a very active math and science student, statistics are often mentioned. However, determining which type of statistics to use has always posed a large problem. This study will answer many of the questions that are frequently asked by both students and teachers. Not only will the study determine what type of statistics to use but it will also give the teachers a better understanding of what to teach their students and at what age level to do so. Another variable that was examined was determining if a correlation exists between statistical content and project success (ISEF grand awards).

It was hypothesized that out of all the ISEF categories that the Mathematics category would conduct the most statistical testing. The older students were hypothesized to have used a higher class of statistics because they are thought to have a better understanding of them. It was further hypothesized that out of the categories that were studied; behavioral/social would have the most variety for the type and class of statistics used. It is also hypothesized that the t-test will be the most common type of statistical testing used. The t-test is a common analysis technique that many teachers show their students. Because the t-test is a very common statistical analysis, there is a lot of information for running the test which is easily accessible. The final hypothesis was that the students who won awards would run a higher level of statistics along with having more variables, factors, groups, and observations (For definitions see Appendix A under key definitions).

MATERIALS AND METHODS

A copy of the International Science and Engineering Fair (ISEF) project abstract books for the year 2002 was obtained. A data collection sheet was constructed that recorded specific variables collected in the project (See Appendix A). There were fourteen categories that were analyzed, which resulted in one hundred and forty copies of the data collection sheet for each year analyzed. The abstracts were placed randomly into the abstract books by category before publication, creating no particular order. Starting with each category, ten abstracts were analyzed and recorded, each on a separate data collection sheet. Five of the abstracts from the category were projects that had won grand awards, five did not. The grand awards included any of the first prize through fourth prize awards, which were presented by Intel. All categories were then analyzed and recorded. Through the comments section on the data collection sheet, the awards that the students won were recorded along with the appropriate class of statistics identified. This was then used in the data analysis.

In all, the following data was collected for each subject, project category, type of statistical testing, age of student (for year 2002), number of factors, number of variables, number of observations, number of groups, and awards won. After one year was completed, the remaining two years were then recorded, analyzed, and then combined into an overall group. Once the data was collected, it was analyzed to determine if a relationship existed between winning an award and one or more of the data items collected. The data was analyzed by graphing results, determining percent differences, and a standard Analysis of Variance (ANOVA) test using an acceptance level of 0.05. The category, year, number of factors, observations, variables, groups, and awards won were compared to the type of statistical testing used in the project.

RESULTS

When collecting the data, it quickly became apparent that the abstracts did not clearly define which types of statistics were used. Fortunately it was discovered that the design of the experiment could be analyzed by researching the abstracts.

From that point forward, the project concentrated on researching the abstracts to identify the number of factors, groups, variables and observations that were used in each of the projects. It is this data that was analyzed to determine any relation to the success of the project.

All graphs can be found in the back of the paper in Appendix B. A table of the raw data can be found in Appendix C.

Graph 1 shows the effect of the amount of factors by categories (14) for grand award winning projects (70 projects) vs. non-winning projects (70 projects). The largest noticeable difference was for the categories of computer science and mathematics. In computer science, the projects that won awards (5 projects for each category) had on average 1.4 more factors then the projects that didn't win awards (5 projects for each category). It was the opposite results in mathematics, the projects that won awards had on average 1.2 less factors than the non-award winners. Results continued to vary depending on the project category.

Graph 2 shows the effect of the amount of groups by categories for grand award winning project vs. non-winning projects. One of the largest differences was in the categories of botany and gerontology. In gerontology the students who won awards had an average amount of 11.20 less groups then the non-winners. The botany students who won awards had an average amount of 7.40 more groups than the non-winners. The amount of groups varied more than the amount of factors for each category. On average, the projects that had fewer groups received awards.

Graph 3 shows the effects of the amount of variables by categories for award winning projects vs. non-award winning projects. In thirteen out of the fourteen categories, the projects that have more variables received awards. The highest amount of variables was in microbiology with 8 variables. The only category where having more variables didn't matter for the awards, was in behavioral science; the projects that had a lower number of variables (2.5 on average) received awards.

Graph 4 shows the effects of the amount of observations by category for award winning projects vs. non-award winning projects. The observations were difficult to graph because some of the abstracts did not mention the amount of observations. The largest noticeable differences were for the behavioral and earth and space science categories. For behavioral, the more observations found (399 on average) the higher the chance for winning an award, whereas for earth and space the smaller amount of observations (91 on average), the higher the chances for winning an award.

Graph 5 shows the effects of statistical analysis being mentioned by category for award winning projects. This graph shows only award winning abstracts. It was found that in behavioral and social, earth and space, engineering, environmental, and mathematics, 80% of the winning projects mentioned the use of statistical analysis (5 projects were analyzed from each category for this graph). For chemistry and medicine and health only 20% mentioned statistical analysis.

Graph 6 shows the effect of statistical analysis being mentioned by category for non-award winning projects. In biochemistry and mathematics none of the projects analyzed (5 abstracts) mentioned statistical analysis. The highest percent of statistical analysis being mentioned was in botany with 60% (3 out of 5).

Because the abstracts did not mention which type of statistical analysis was used, sections of the original hypothesis were not explored. However, the section of the original hypothesis that stated that the students who won awards would have a higher level of statistics along with factors, variables, observations, and groups was partly supported. It was found that the variables had a major impact on the projects success. When looking at the factors, observations, and groups the impact they had could be determined within the categories. It was also found that running statistical analysis might have a positive impact on the project success, depending on the category.

CONCLUSIONS

The purpose of this research was to determine if a correlation exists between the statistical content, project parameters and project success. The original hypothesis was that the higher level of statistics used along with the a type of statistics may increase the likelihood of winning an award. However, research showed that the type of statistical testing was not always listed, but the parameters of the experiment was, along with whether or not statistical analysis was used. Another hypothesis stated that the more factors, groups, observations, and variables in a project, the more likely the project was to win an award.

While looking at the comparison between the categories and amount of awards, the number of variables appeared to have a positive effect. This may be due to the fact that the more items measured, the more advanced the project becomes. With each new variable, the project explores more open options and is able to narrow down the possibilities of further questions. Along with adding more variables, the project may also become more complex, which is what the judges may look for. It is reasonable to assume that the more complex the project, the more time and energy the students put into the project.

Another comparison found between the amount of awards and variables was in the behavioral and social science category. It was found that the smaller amount of variables, the greater the likelihood of winning an award increases. This could be due to the fact that with behavioral studies there are so many variables to look at, and sometimes describing them all can become confusing. With only focusing on two or three variables, the point may be a lot easier to get across.

The original hypothesis stated that the higher the level of statistics run would increase the likelihood of winning awards. Although the type of statistic was unable to be determined, the fact that statistical analysis was run was still evident. With recording that statistical analysis was run, the difference between running statistics and not running them became noticeable. It was found that in a whole running statistics might have a positive impact on project success. I could be thought that with running statistical analysis it is just another way of advancing your project and eliminating many of the confusing or unclear parts in the research.

Another variable that was found while measuring the variables was that certain categories on average had a higher number of no only variables but also observations, factors, and groups. This might be due to the fact that with certain projects it is easier to collect a lot of data and analyze it while for others it is better to collect only a small amount. Every category and project is different and is going to be looking at different things to analyze making a lot of variation.

For future studies it would be nice to take this study to the International Science and Engineering Fair (ISEF) committee and ask to make a standard format for the abstracts. With making a format for the abstracts, it would be easy to learn about the project without having to take a long time to analyze it. It would also make the projects easier to compare to one another and see the differences and similarities. It would also be nice to analyze other years from five, ten or fifteen years back to see if the same trends still existed or of there was a different variables that may have increased project success.

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Dr. Blumberg was another help to my project. She helped me with some of the designing of my project, by helping me lay it all out in front of me and stay organized. She also helped me with data analysis by teaching me how to run the analysis of variance (ANOVA) test.

Mr. Mann has been one of the biggest guides in my projects. He is constantly creating new methods to try to help everybody with their projects. Along with Mr. Mann my classmates and friends have been very supportive with everything and very helpful when I needed them the most.

1.

2.

3. Appendix A

Name Subject Number

9^{th} Grade Date

4. Awards Won:

5. Abstract Information

Procedure: Fill in date (subject numbers have already been randomly assigned). Read through students abstracts. Fill in the correct information below by using the information given in the abstract. If any problems arise write down in the comments section. (bottom)

Category of Project (Circle One)

Behavioral and Social Sciences	Biochemistry
Botany	Chemistry
Computer Science	Earth and Space Sciences
Engineering	Environmental Science
Gerontology	Mathematics
Medicine and Health	Microbiology
Physics	Zoology

Type of Statistical Testing (Circle One)

t test for independent samples	*t* test for dependent samples		analysis of variance
Pearson product correlation	chi square test	median test	Mann-Whitney *U* test
Wilcoxon signed rank test	Kruskal-Wallis test	Friedman test	Spearman's rho

Other: ______________________________

Year of Project (Circle One)

1987

1992

1997

2002

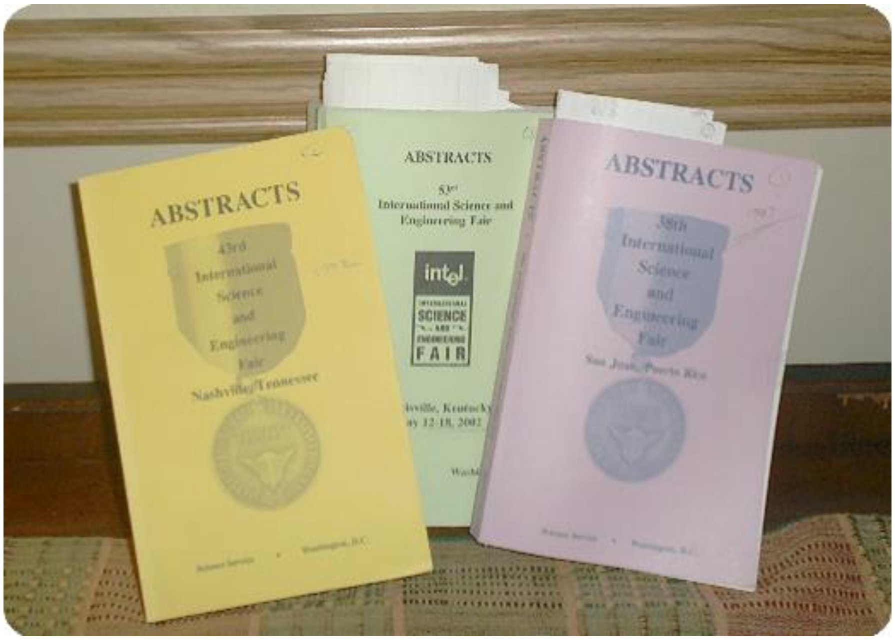
Factors: ___________ Observations: ___________

Groups: ___________ Variables: ______________

Comments:

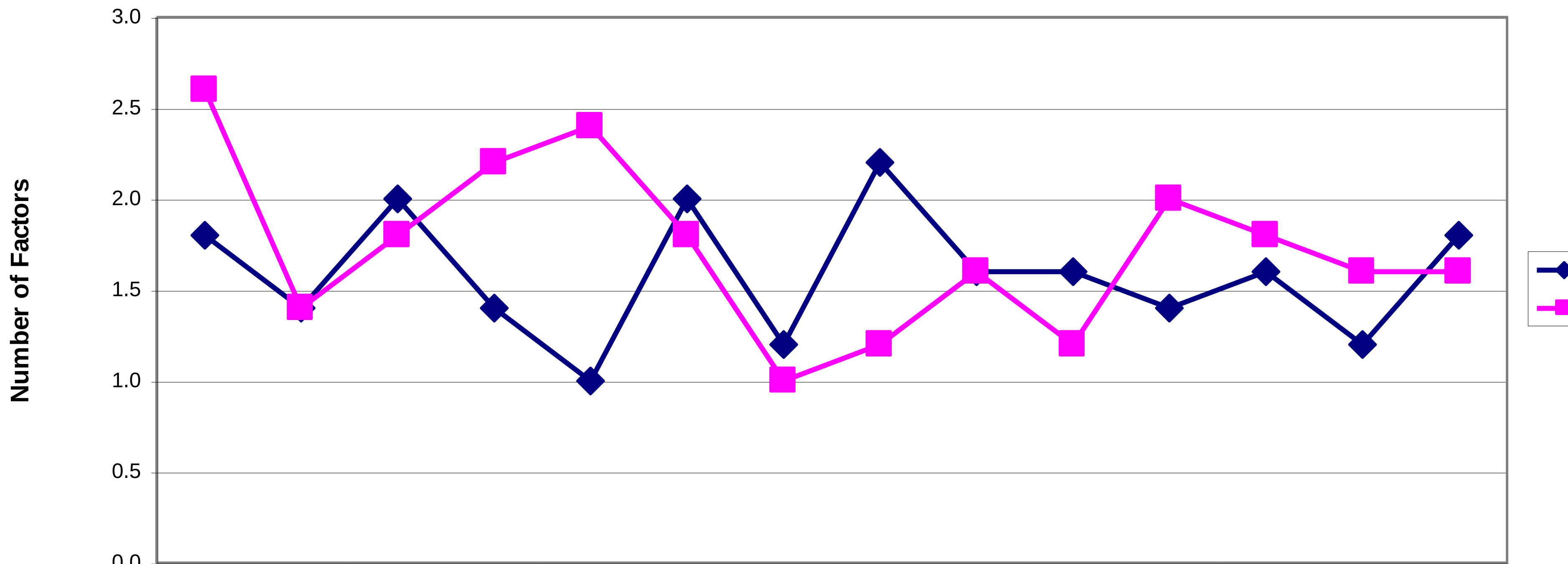
KEY DEFINITIONS

6. Winner/Non Winner
7. Page
8. Subject No
9. Date
10. Category = Subject that the project relates to. (14 categories) determined by ISEF Abstract Book.
11. Statistics Type = See data collection sheet.
12. SAM = Statistical Analysis Mentioned (answered in yes or no)
13. Year
14. Factor = What is Manipulated (e.g. Gender, Grade)
    a. To be Factors in the same experiment, the factors MUST BE MUTUALLY INCLUSIVE
    b. In the Gender and Grade example every 10'th, 11'th and 12'th grader is also a male or female
    c. In Subject 21, pp54 1987 there were 3 levels of additive in two salt solutions and a separate experiment with 5 levels of additive to two levels of a salt/sugar solution. You could not have said there was 3 factors (salt, sugar, additive) because they did not all describe the same data.
15. Levels = Number of distinct Categories for the Factor (e.g. male/female – 9'th, 10'th, 11'th)
16. Groups = SumΣ_1^n Levels in Factor 1 x Levels in Factor 2 x Levels in Factor n (e.g. 2 x 3 = 6)
17. Variable = What is measured (e.g. number of pictures recalled)
18. No of Observations
19. Award


ABSTRACTS
43rd International Science and Engineering Fair
Nashville, Tennessee
ABSTRACTS
53rd International Science and Engineering Fair
intel
SCIENCE
FAIR
ABSTRACTS
38th International Science and Engineering Fair
San Juan, Puerto Rico

Appendix B

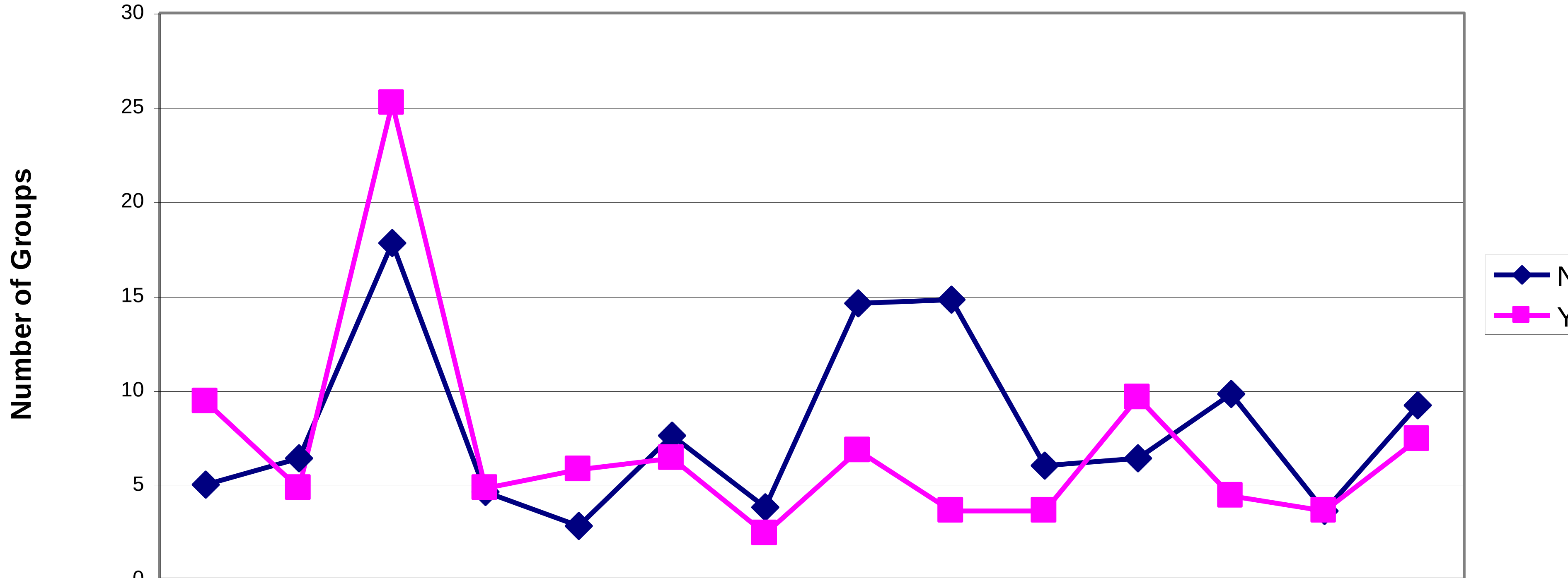
Award vs. No of Factors by Category
(n = 10 for all)



	Behav	Bio Chem	Botany	Chem	Comp Sci	Earth Sci	Engrg	Env Sci	Gerent	Math	Med	Micro Bio	Phys	Zoo
No	1.8	1.4	2.0	1.4	1.0	2.0	1.2	2.2	1.6	1.6	1.4	1.6	1.2	1.8
Yes	2.6	1.4	1.8	2.2	2.4	1.8	1.0	1.2	1.6	1.2	2.0	1.8	1.6	1.6

Category

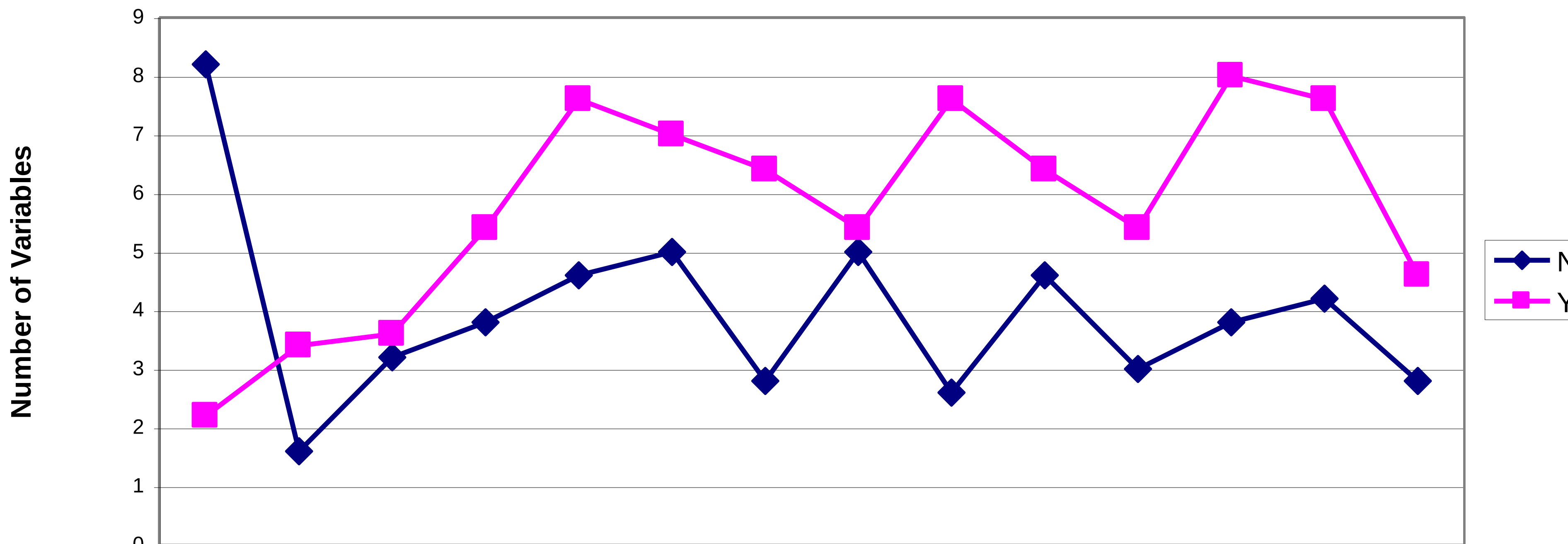
Award vs No of Groups by Category



	Behav	Bio Chem	Botany	Chem	Comp Sci	Earth Sci	Engrg	Env Sci	Gerent	Math	Med	Micro Bio	Phys	Zoo
No	5	6.4	17.8	4.6	2.8	7.6	3.8	14.6	14.8	6	6.4	9.8	3.6	9.2
Yes	9.4	4.8	25.2	4.8	5.8	6.4	2.4	6.8	3.6	3.6	9.6	4.4	3.6	7.4

Category

Award vs No of Variables by Category
(n = 10 for all)

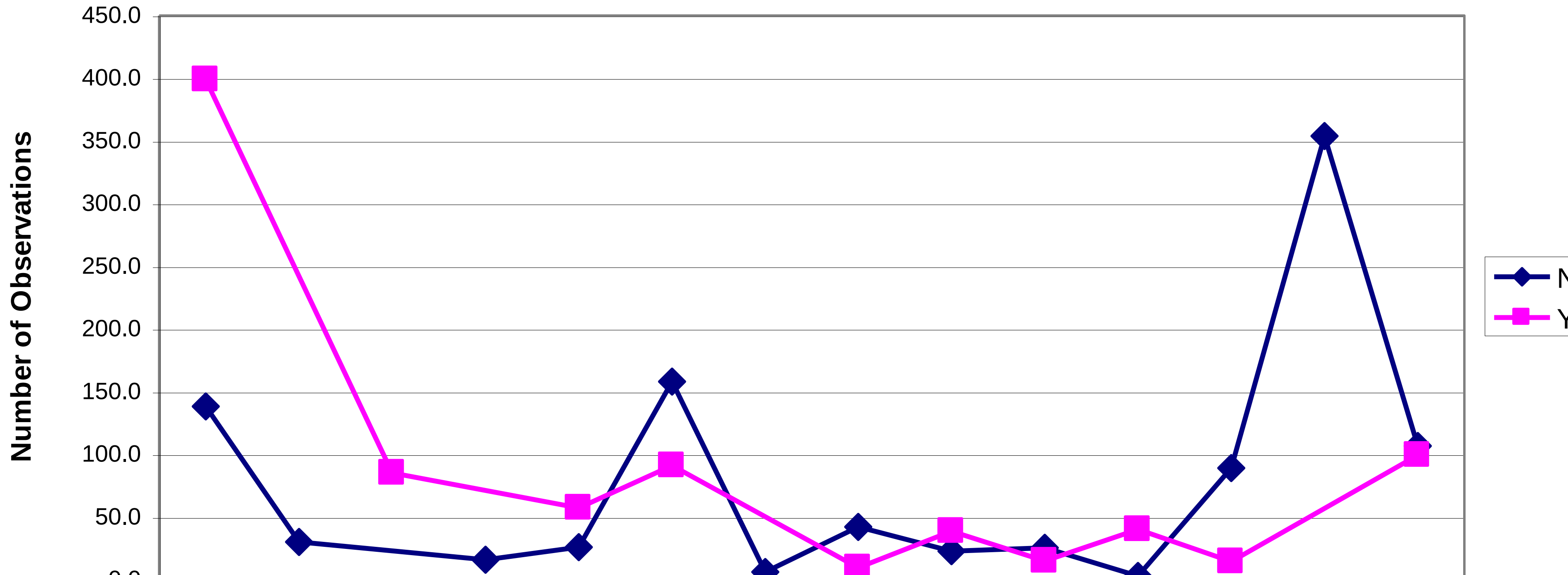


	Behav	Bio Chem	Botany	Chem	Comp Sci	Earth Sci	Engrg	Env Sci	Gerent	Math	Med	Micro Bio	Phys	Zoo
No	8.2	1.6	3.2	3.8	4.6	5	2.8	5	2.6	4.6	3	3.8	4.2	2.8
Yes	2.2	3.4	3.6	5.4	7.6	7	6.4	5.4	7.6	6.4	5.4	8	7.6	4.6

Category

70

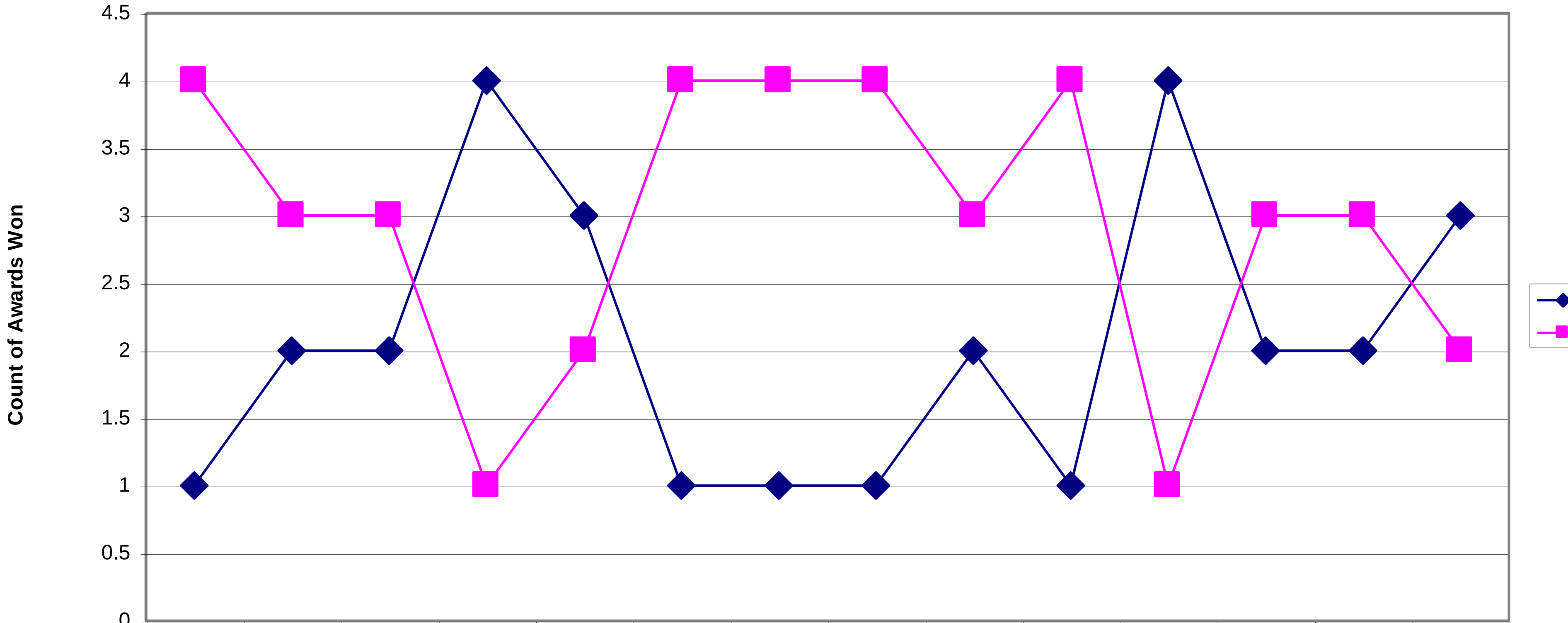
Award vs No of Observations by Category



	Behav	Bio Chem	Botany	CHem	Comp Sci	Earth Sci	Engrg	Env Sci	Gerent	Math	Med	Micro Bio	Phys	Zoo
No	138.3	30.0		16.0	26.0	158.0	6.0	42.0	22.7	25.5	3.0	89.0	354.0	106.7
Yes	399.0		85.0		57.3	91.0		9.5	38.7	15.0	40.0	14.3		99.3

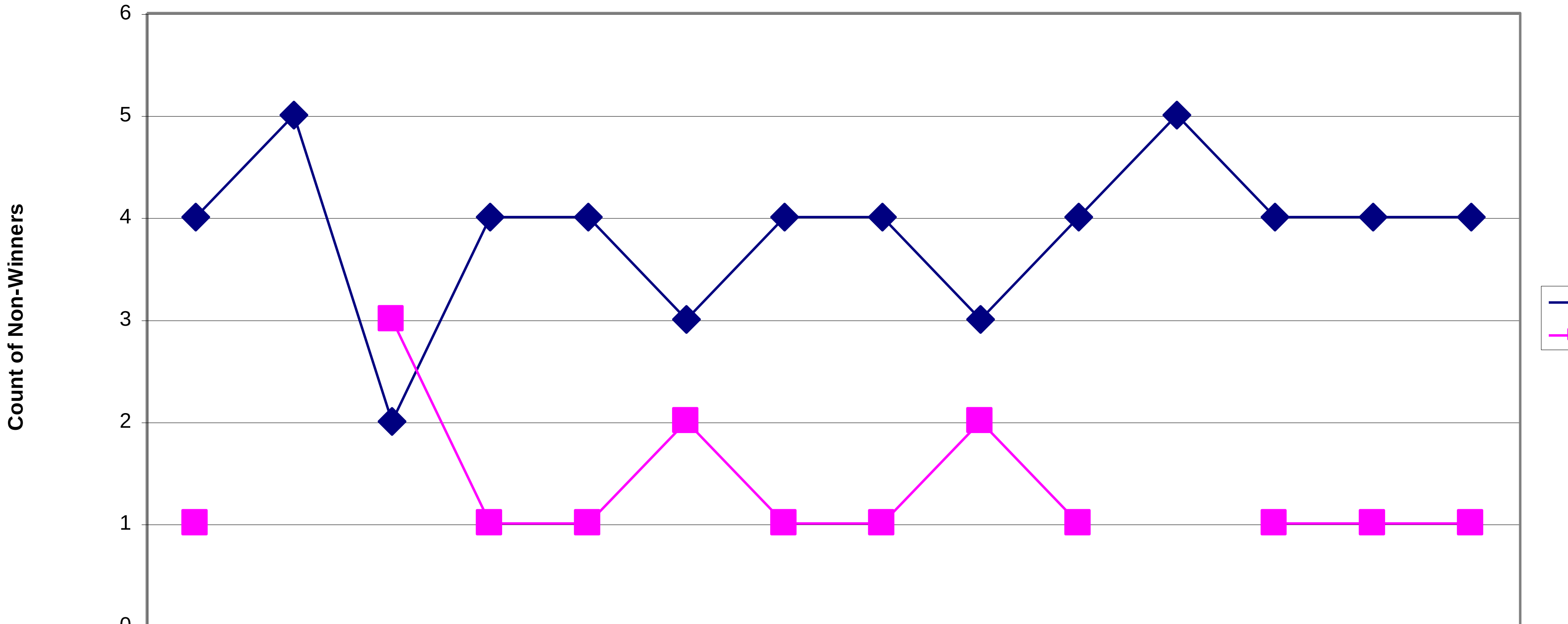
Category

Award Vs Stastistical Analysis Mentioned by Category



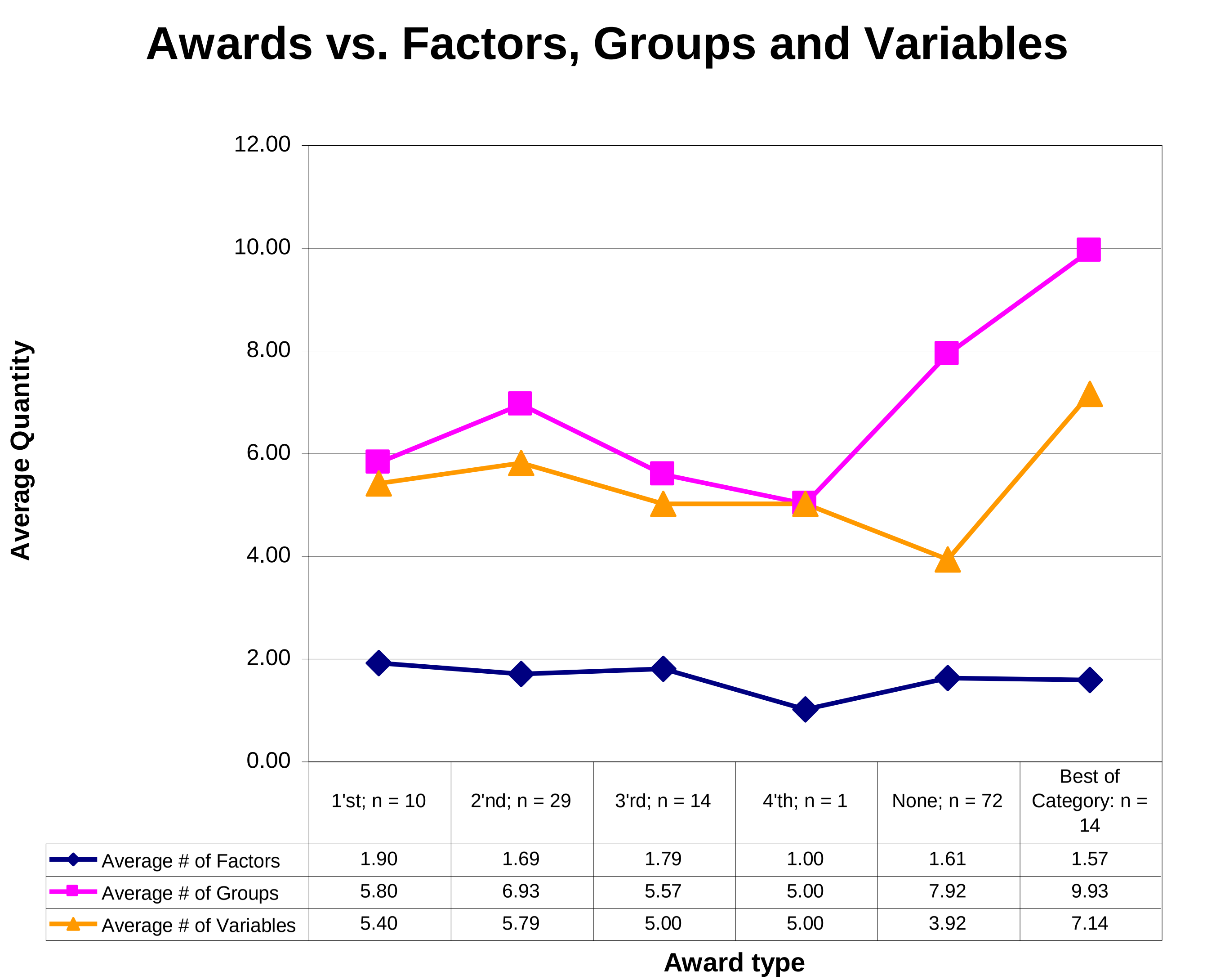
	Behav	Bio Chem	Botany	Chem	Comp Sci	Earth Sci	Engrg	Env Sci	Gerent	Math	Med	Mirco Bio	Physics	Zoo
No	1	2	2	4	3	1	1	1	2	1	4	2	2	3
Yes	4	3	3	1	2	4	4	4	3	4	1	3	3	2

Non Award Vs Statistical Analysis Mentioned by Category

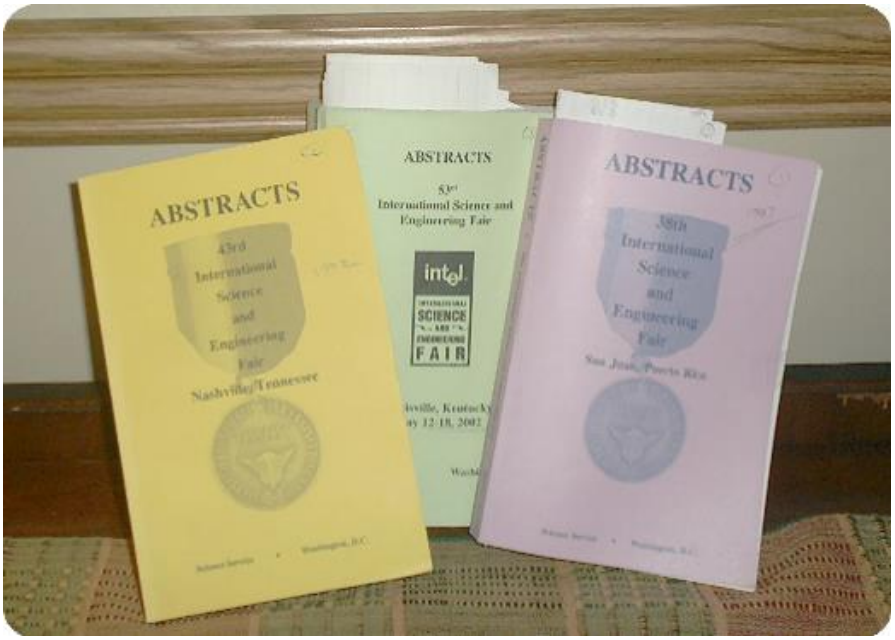


	Behav	Bio Chem	Botany	Chem	Comp Sci	Earth Sci	Engrg	Env Sci	Gerent	Math	Med	Micro Bio	Physics	Zoo
No	4	5	2	4	4	3	4	4	3	4	5	4	4	4
Yes	1		3	1	1	2	1	1	2	1		1	1	1

Category



	1'st; n = 10	2'nd; n = 29	3'rd; n = 14	4'th; n = 1	None; n = 72	Best of Category: n = 14
Average # of Factors	1.90	1.69	1.79	1.00	1.61	1.57
Average # of Groups	5.80	6.93	5.57	5.00	7.92	9.93
Average # of Variables	5.40	5.79	5.00	5.00	3.92	7.14


ABSTRACTS
43rd
International
Science
and
Engineering
Fair
Nashville, Tennessee
ABSTRACTS
53rd
International Science and
Engineering Fair
intel.
INTERNATIONAL
SCIENCE
AND
ENGINEERING
FAIR
ABSTRACTS
38th
International
Science
and
Engineering
Fair
San Juan, Puerto Rico

Appendix C

Subject Number	Page	Yes	Date Collected	Category	Statistics Type	SAM - Yes or No	SAM type	Year	Factors	Groups	Variables	C
1	1	No	11/10/03	Behavioral Science	Unknown	No		2002	2	6	30	
2	1	Yes	11/10/03	Behavioral Science	Unknown	Yes		2002	3	5	4	U
3	2	No	11/10/03	Behavioral Science	Unknown	No		2002	1	2	3	
4	3	Yes	11/14/03	Behavioral Science	Unknown	No		2002	3	28	1	
5	5	No	11/14/03	Behavioral Science	Unknown	No		2002	2	4	3	
6	5	No	11/15/03/	Behavioral Science	Unknown	No		2002	2	9	2	
7	11	Yes	11/15/04	Behavioral Science	Unknown	Yes		2002	5	10	1	U
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9	21	Yes	11/16/03	Behavioral Science	Unknown	Yes		2002	1	2	4	U
10	23	Yes	11/16/03	Behavioral Science	Unknown	Yes		2002	1	2	1	U
11	33	No	11/19/03	Biochemistry	Unknown	No		2002	2	4	1	
12	40	Yes	11/19/03	Biochemistry	Unknown	No		2002	2	4	1	U
13	41	No	11/19/03	Biochemistry	Unknown	No		2002	1	4	1	U
14	45	Yes	11/19/03	Biochemistry	Unknown	Yes		2002	2	9	1	U
15	43	No	11/20/03	Biochemistry	Unknown	No		2002	2	16	1	U
16	44	No	11/22/03	Biochemistry	Unknown	No		2002	1	6	1	
17	49	Yes	11/22/03	Biochemistry	Unknown	Yes		2002	1	5	4	U
18	46	No	11/23/03	Biochemistry	Unknown	No		2002	1	2	4	U
19	47	Yes	11/23/03	Biochemistry	Unknown	No		2002	1	3	6	U
20	62	Yes	11/23/03	Biochemistry	Unknown	Yes		2002	1	3	5	U
21	68	No	11/24/03	Botany	Unknown	Yes		2002	3	3	5	U
22	68	Yes	01/24/04	Botany	Unknown	Yes		2002	2	10	3	
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27	85	Yes	11/29/03	Botany	T for Indep	Yes		2002	2	64	5	
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53	72	Yes	12/26/03	E & S Science	Unknown	Yes		2002	1	6	6	
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77

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88	324	Yes	01/11/04	Gerontology		Yes		2002	1	1	11	
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90		No	01/11/04	Gerontology		No		2002	2	60	1	U
91		No	01/11/04	Mathematics		Yes	Mann-Wh	2002	1	1	4	
92		Yes	01/11/04	Mathematics		Yes		2002	1	2	6	U
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99	346	Yes	01/13/04	Mathematics		Yes		2002	1	2	7	
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130	463	Yes	01/25/04	Physics		Yes		2002	1	4	7	U
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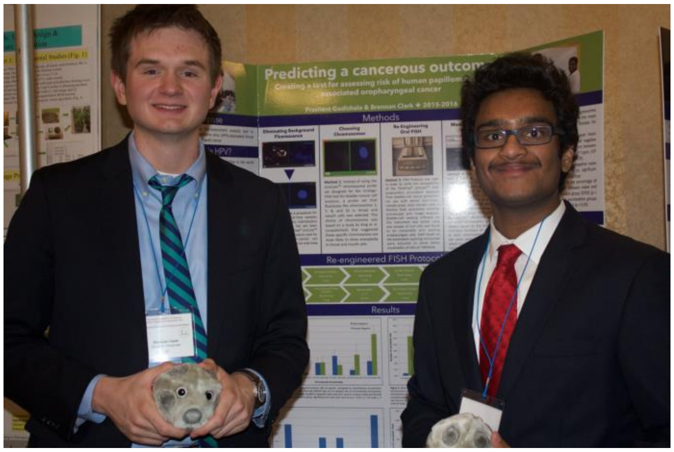
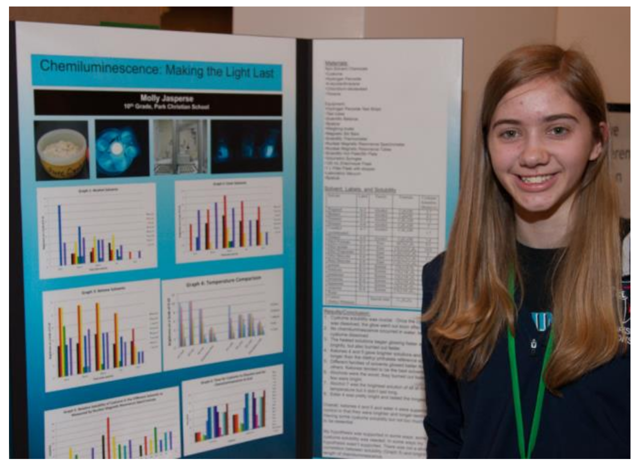
Appendix 3: State Fair Photos


Methods
Results


BACKGROUND
Eutrophication
Phosphorus Sources
Nutrient Reduction Strategy
Stormwater Ponds
Procedure

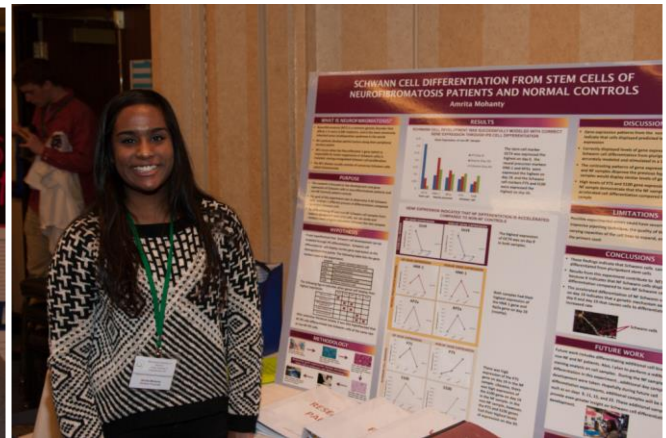

Pitch
Explored
Conclusion
Discussion


Chemiluminescence: Making the Light Last
Molly Jasperse

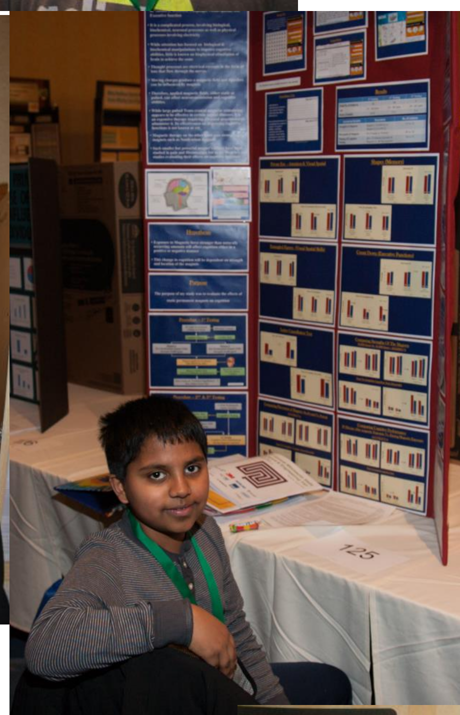

THE EFFECTS
OF VODKA
ON THE
Conclusion
Sources of
Error


PARENTAL
INFLUENCE IN
CHILDREN'S
GRADES
Abstract
Results

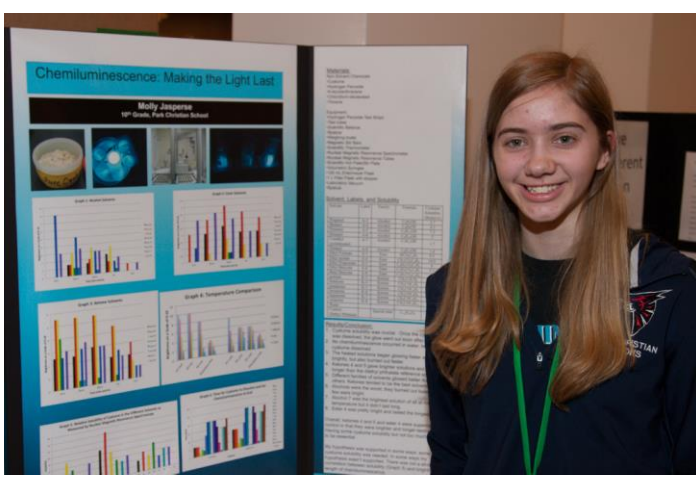

Conclusion


SCHWANN CELL DIFFERENTIATION FROM STEM CELLS OF NEUROFIBROMATOSIS PATIENTS AND NORMAL CONTROLS
Amrita Mohanty
RESULTS
DISCUSSION
LIMITATIONS
CONCLUSIONS
FUTURE WORK


Predictive Modeling of Re-Hospitalization Using Health Care Claims Data


125


Application Testing
Nutri-Grain
RESULTS


Chemiluminescence: Making the Light Last
Molly Jasperse
10th Grade, Park Christian School

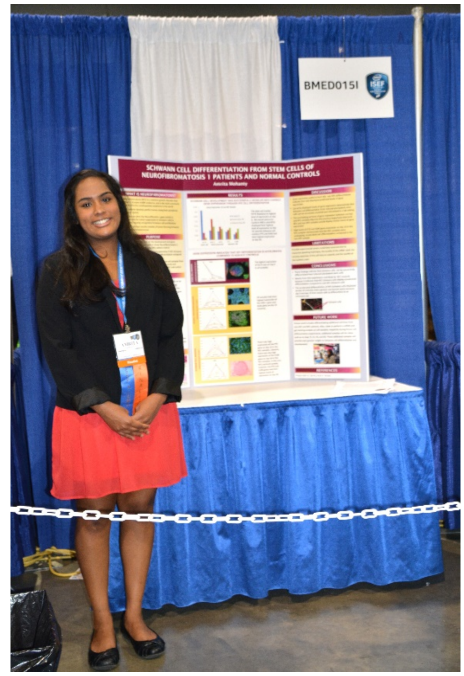

Electricity from Mud:
Optimizing the Microbial Fuel Cell
YEAR II
GENERATOR
9011
9012

Appendix 4: ISEF Photos

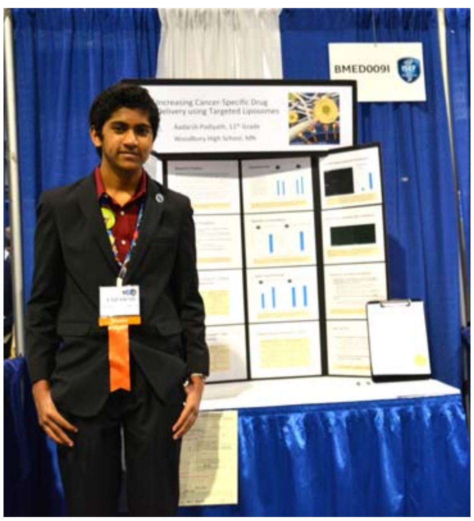
TCRSF Finalists at International Science & Engineering Fair in Pittsburgh, PA 2015 www.tcrsf.org

Finalist 2013, 2014 & 2015 – Western Suburbs
3rd Grand Award in Material Science, $1000
Full scholarship Florida Institute of Technology, valued approx. $150,000
3rd Place at National JSHS, $4,000 scholarship

Finalist 2015 – Western Suburbs

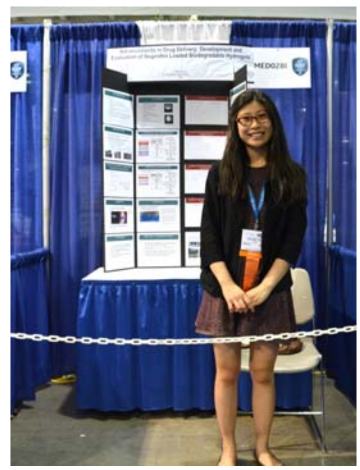


Finalist 2014 & 2015 – Twin Cities

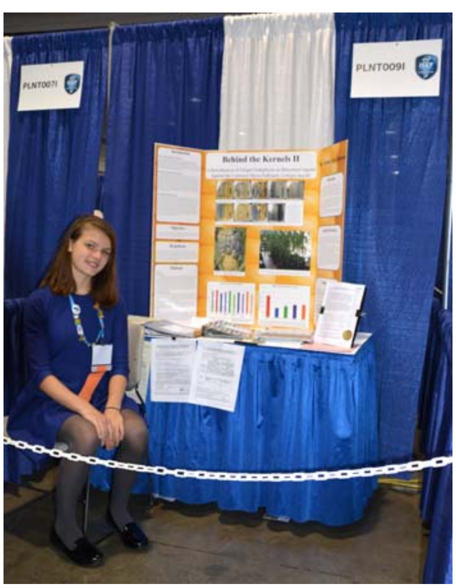


Finalist 2015 – Twin Cities

2nd Grand Award in Energy Chemical
Finalist 2015 – Twin Cities



Finalist 2015 – St. Paul

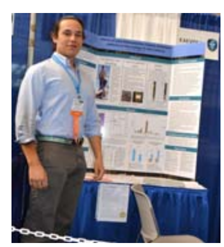


Finalist 2015 – St. Paul

Finalist chosen at State 2014 -2015 -Western Suburbs

Finalist chosen at Native American Nationals 2015 Twin Cities

Finalist chosen at State 2015 -Western Suburbs



Finalist chosen at Native American Nationals 2015 Western Suburbs

Finalist chosen at State 2015 -Western Suburbs National Semifinalist Science Talent Search

Finalist chosen at State 2015 –Twin Cities

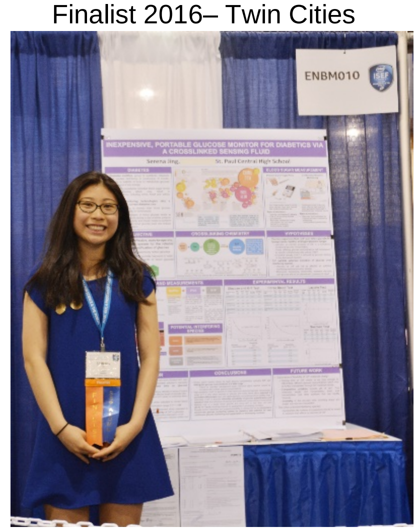
TCRSF Finalists at International Science & Engineering Fair in Phoenix, AZ 2016 www.tcrsf.org

Finalist 2015 & 2016 – Twin Cities

Finalist 2016 – Western Suburbs
Best in Category Translational Medical Science $5000, 1st Grand Award $3000; Intel Foundation Cultural and Scientific Visit to China, Ceres program asteroids named for students, Sigma Xi award $1000. nationals JSHS

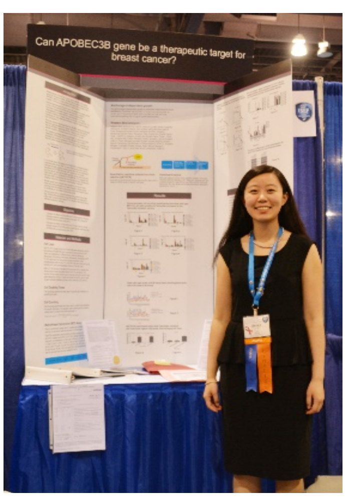
Finalist 2016– Twin Cities

Finalist 2016 – Twin Cities
Arizona State University full scholarship



Finalist 2015 & 2016 – St. Paul
4th Grand Award $500,
China Association for Science & Technology Award $1200

Finalist 2015 & 2016 – St. Paul



Finalist 2016 - Western Suburbs
National Semifinalist
Science Talent Search

◄ Finalist chosen at State 2016 –Western Suburbs
2nd Grand Award Biomedical Engineering & Ceres program asteroids named for students

Finalist 2016 – Western Suburbs

◄ Finalist chosen at State 2016 –Western Suburbs; 2nd Grand Award Computational Biology & Bioinformatics, & Ceres program asteroids named for students

Appendix 5: Illinois JSHS Guidelines

Formerly found at:
See http://www.jshs.org/guidelines.html under
"**Selected articles - Conducting research"** section
on page

Junior Science and Humanities Symposium

Guidelines for Preparation & Presentation of Student Research

This booklet has been prepared as a general guide to writing a research paper for submission to the Junior Science & Humanities Symposium (JSHS).

Written by Linda Martin and Robert Brenstein
College of Science,
Southern Illinois University Carbondale.
Revised 1997, 1998 by Linda Martin.

Contents

The JSHS Research Paper

Definition

The **JSHS research paper** is a written report describing original research results in science, mathematics, or engineering. The paper should rely on previously published literature primarily for background and comparative purposes.

Contents

The typical JSHS paper is organized as follows:

- title page, or cover page
- abstract
- acknowledgments
- table of contents
- list of tables and/or list of figures
- introduction
- materials and methods
- results
- discussion and conclusions
- references, or literature cited
- appendices (optional)

Comment

Please format according to JSHS guidelines. The format for an JSHS paper differs somewhat from a paper submitted to science fair.

- ***Do not*** add separate sections entitled Purpose, Hypothesis, and Review of Literature—include that in the Introduction.
- ***Do not*** include forms from other science competitions, e.g., Safety Sheet.
- ***Do not*** include your name in headers /footers on each page.

Sequence

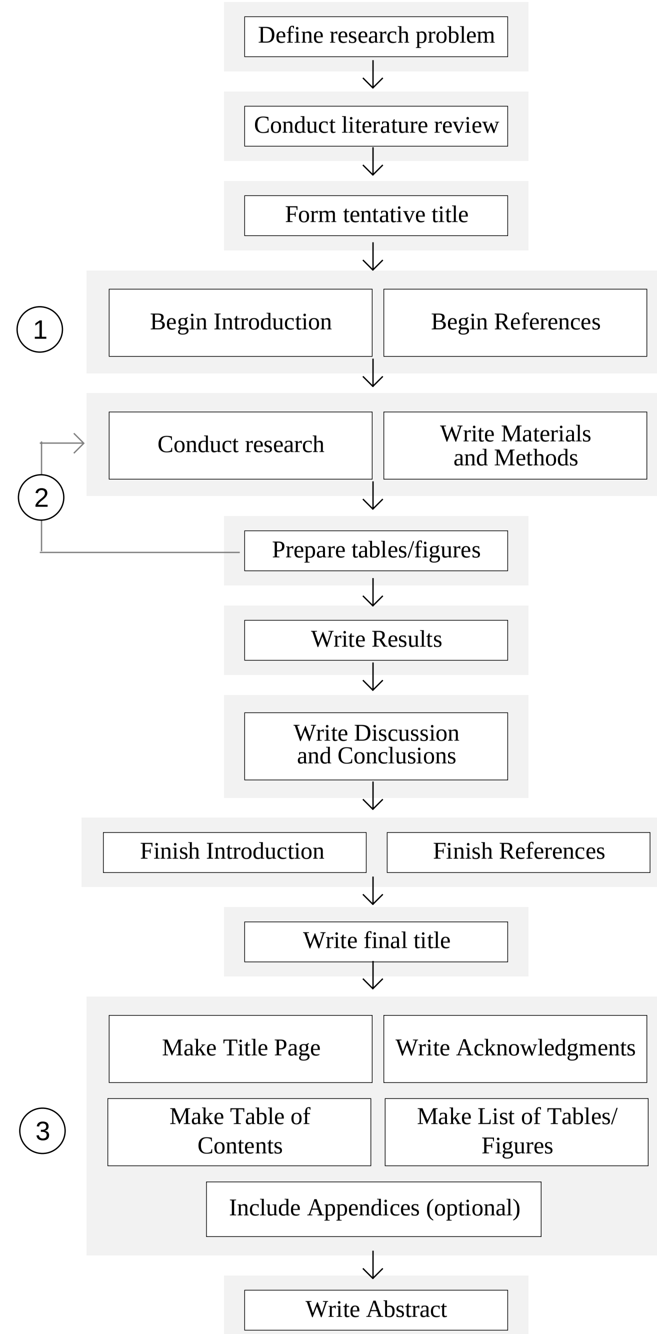
See page 2 for a suggested sequence for conducting the research and writing the paper. Side-by-side blocks indicate concurrent actions. The following comments correspond to numbers on page 2:

① Begin writing the Introduction after you conduct your literature review. You will not *complete* the Introduction, however, until later in the sequence. As you cite sources throughout your paper, add them to the References section.

② When preparing tables or figures, you might notice gaps in your data. If so, return to the experimental mode and collect the missing data.

③ Completed in any order.

Sequence



Title

Introduction

In scientific writing, the title is always intended to *convey information*. Scientific writing is *not* creative writing, nor advertising. A good *scientific* title simply orients the reader to the content of your paper in the fewest words possible.

Definition

The **title** is a concise identification of the main topic of the paper.

Description

A title is:
- concise,
- descriptive, and
- informative.

Rules

When writing a title:
- ***do not*** write the title as a question;
- ***do not*** use abbreviations.
- avoid "excess" words such as *a*, *an*, or *the*, or phrases such as *a study of* or *investigations of*.
- consider its length. A two or three word title may be too short, but a 14 or 15 word title is probably too wordy.

Example

Poor: Bugs and Drugs
Fair: Effects of Antibiotics on Bacteria
Good: Effects of Penicillin on Gram Negative Bacteria
Best: Lysis of Gram Negative Bacteria by Penicillin

The first example is concise, but neither informative nor descriptive. It is not scientific style. The second example is concise but too general. What effects? What antibiotics? What bacteria? The third example is more specific, both in describing the antiobiotic and the bacteria, but it still lacks description. The fourth example is written in scientific style.

Sequence

A tentative title can be written after the literature review. The purpose of writing the title at this early stage is to help you clarify your aims and intentions. Examine your title after the paper has been written and make sure it accurately reflects the content of the paper. (See page 2.)

Abstract

Introduction

The abstract is the reader's first encounter with your paper. Reviewers 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."

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 should *briefly* state:
- the purpose of the research or the research problem (introduction),
- how the problem was studied (methods),
- the principal findings, including statistical analyses (results), and
- what the findings mean (discussion and 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:
- one or two paragraphs,
- no more than 175 words, and
- on the JSHS abstract form.

The abstract should:
- ***not*** include subheadings such as "Purpose" or "Results."
- ***not*** use first person, e.g., "I."
- ***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, e.g., DNA or UV light) .

Sequence

Write the abstract after the paper is completed. Make sure it accurately reflects the paper's contents . (See page 2.)

Acknowledgments

Introduction

As a matter of scholarly courtesy, you should acknowledge those who helped you technically, intellectually, and financially.

Definition

The **Acknowledgments** is a short paragraph where the researcher acknowledges the contributions of others to the research study.

Contents

The Acknowledgments should state:

- where the research was conducted,
- when the research was done, and
- the names of those who provided major assistance with the study, including:
  - ✓ selection of topic,
  - ✓ planning or guiding course of research,
  - ✓ construction of apparatus,
  - ✓ use of equipment or laboratory space, and
  - ✓ other direct assistance.

Note

As a researcher, you are neither rewarded nor penalized by the judges for utilizing special advisors or equipment (Cousens, 1997). However, it is important that you properly acknowledge any assistance.

Table of Contents

Introduction

A Table of Contents is *not* considered a part of a typical scientific research paper and is *not* a numbered page. However, JSHS guidelines require a Table of Contents.

Definition

A **Table of Contents** is an outline that indicates the location of the sections and subsections of the paper.

Purpose

The main purpose of a Table of Contents is to enable the reader to quickly find any section of the paper.

Rules

When making a Table of Contents:

- list *only* the number of the first page of any section, e.g., "1," not "1-4."
- keep the right margin of the column of page numbers even by using a right-aligned tab.
- consider using leaders, a series of horizontal dots, to "lead" the eye across the page to the right number.
- ***do not*** use the word "page" with the number. It is self-explanatory.

List of Tables & List of Figures

Definition

A **List of Tables** and a **List of Figures** are outlines that indicate the location of any tables or figures in the paper.

Rules

When making a List of Tables, include:

- table numbers,
- titles, and
- page numbers.

When making a List of Figures, include:

- figure numbers,
- captions, and
- page numbers.

Comment

If the figure caption has more than one sentence, include *only* the first sentence in the List of Figures.

Introduction

Definition

The **Introduction** is:

- a clear statement of the problem or project and why you are studying it (Dodd, 1986).
- a map of the path you're going to take from problem to solution (Day, 1994).

It is ***not*** simply a literature and concept review.

Contents

The Introduction should contain:

- sufficient background information to allow the reader to understand and evaluate the results of your study (Day, 1994);
- a *brief* literature review. *Cite* and discuss previous research from *relevant* literature, and state how your research relates to or differs from others' work;
- the rationale for your study. Why did you choose that subject, and why is it important? and
- a simple statement of the most important point(s) that you will address in your paper.

Rules

The Introduction should:

- proceed from the general to the specific. It should introduce the problem, present necessary background information, show the continuity between previous work and the work *you* did, and indicate *your* purpose and rationale.
- include only background information and studies that are *relevant* to the present study. ***Do not*** try to include *everything* that you know about the topic.
- cite the relevant literature sources in the text.
- assume that the reader is scientifically literate but *not* familiar with the specifics of the study.

Sequence

A literature review should be done *before* you conduct your research. However, you should not *finish* writing the Introduction until *after* the Discussion and Conclusions section (see page 2).

Materials and Methods

Introduction

The cornerstone of the scientific method is reproducibility (Day, 1994). This section should describe the experimental design with sufficient detail for a trained researcher to replicate your experiments and obtain similar results.

This section should also enable the reader to evaluate the appropriateness of your methods and the reliability and validity of your results (APA, 1994).

Definition

The **Materials and Methods** section describes:

- how you conducted your study,
- what materials and equipment you used, and
- what methods or procedures you followed.

It is ***not*** a numbered list of experimental steps or a cookbook recipe.

Rules

The Materials and Methods section should be written:

- in narrative, paragraph format.
- precisely—be specific. Don't leave the reader with unanswered questions.

The Materials and Methods section should ***not*** include any of the Results.

Materials

Materials are ***not*** listed separately, but rather included in the description of Methods. Include exact technical specifications for:

- chemicals: purity and names of suppliers. Use generic or chemical names, *not* trade names *unless* the known difference is critical.
- apparatus: type, brand, model. Describe your apparatus only if it is not standard and was constructed for your study. Use figures, if appropriate, to help the reader picture the equipment.
- techniques: standardization methods, solvent, concentrations, times, temperature.
- experimental animals, plants, and microorganisms: genus, species, special characteristics such as age and sex.

✓ Use *metric* units for all quantities and temperatures.
✓ Include method of preparation.
✓ Include criteria for selection and an "informed consent" statement when human subjects are used.

Materials and Methods (cont.)

Methods

- include precise description of the sample;
- include methods of data collection;
- provide all needed detail for *new*, *non-standard*, or *modification* of standard methods; and
- cite the literature reference and give only the details specific to your experiment when using a *standard* method.

Example

Make sure you specify your methods precisely. As an example, suppose you collect water samples or collect organisms from lakes, wells, etc.

- What were the criteria for choosing the lakes/ wells? the sampling locations in the lakes?
- Were the lakes/wells different in water quality or some other relevant characteristic?
- Did you include other "kinds" of lakes/wells?
- Were the procedures standardized (controlled)?
- Can you demonstrate that your sampling technique produced a random sample (i.e., that it wasn't biased)?
- What was your period of data collection? How many times did you sample? Dates?
- What were the weather conditions prior to sampling? Had it rained? Was the temperature notably different?
- Take a sample from several lakes/wells to see if you find the same occurrence in all.

Sequence

It is a good practice to write the Materials and Methods section as you conduct your experiments so technical details are fresh in your mind. (See page 2.)

Results

Introduction

The Results present the data, the most important part of the paper. The whole paper must stand or fall on the basis of the Results (Day, 1994).

Definition

The **Results** section contains all the major experimental findings of the study and their statistical analyses, presented in a logical order with text and visuals that complement and supplement the other.

Contents

The Results section contains:

- visuals (tables, figures, and/or illustrations) where necessary for clarity and conciseness,
- text that summarizes the data collected and points out highlights of visuals, and
- any appropriate statistical analyses of the data.

Visuals

The visuals should:

- highlight an important point and be referred to somewhere in the text.
- be well designed so they are clearly understood *without* reference to the text.
- ***not*** be redundant. ***Do not*** present the *same* results in multiple visual formats, e.g., presenting the same results in both a table and a graph. Choose the best format for presentation. Are shapes and trends more important to the readers, or exact values?

Text

The text should:

- summarize the data collected, point out the important features, and connect the results with one another.
- ***not*** *interpret* the results and discuss the conclusions of the results (a trend can be mentioned, but no *interpretation* or extended *discussion* occurs in this section).
- ***not*** include raw data. This data should be in a table or in an appendix.

Sequence

Prepare your tables or figures *before* writing the text. The visual representations will help you clarify your own thinking and make it easier for you to write the Results. This will also help reveal whether there are gaps in the data and whether more experimental work should be done.

Results (cont.)

Tables

Use tables to show large amounts of data (usually numbers) in a small space. If exact values must be listed, a table is normally preferred over a graph.

Rules

- Put table number and title above the table. The word "table" should be all caps (*TABLE 2. Chemical and…*). Tables should be numbered with Arabic numerals (in the order of appearance in text). Numbering will enable the writer to refer to them quite easily (*Table 2 shows that…*).
- Place columns to be compared next to each other, if possible.
- Label each column with a column heading. Make the headings clear but concise. Abbreviations may be used, but do not use periods. Capitalize first words in column headings.
- Include units of measure in the headings if appropriate, e.g., *Nitrates (mg/L)*.
- Use horizontal rules, or lines, if needed. Vertical rules are normally not used; columns are defined by spacing.
- Use single spacing for data and headings. In some instances, you may want to use wide space (extra line) to separate groups of data.
- Align numbers in each column on the right. However, if decimal points are used, the numbers should be aligned on the decimal point.
- Use an initial zero before the decimal (*0.25*).
- Use notes for more extensive explanation of data or headings. Notes are placed below the table and referenced by superscript letters.
- Order the notes to a table in the following sequence:
  - general notes provide information relating to the table as a whole; place the letter reference at the end of the title
  - column (row) notes refer to a particular column (row); place the letter reference at the end of column (row) heading
  - probability level notes indicate the results of tests of significance
- Tables should be placed as near as possible to the discussion in the text.

Figures

Figures are used to convey the overall pattern of the results at a quick glance. The most common figures are graphs, photographs, and diagrams.

Rules

- Make all figures in black and white for reproduction purposes. If color is integral to the research, a request for an exception should be made to the Symposium Director, and *12 copies of each figure must be provided* for the paper reviewers .
- Number all figures with Arabic numerals in order of discussion in the text. Number figures separately from tables.
- Label both axes on graphs with the variable being measured, the units of measurement, and the scale.
- Place the figure caption and legend below the figure. A caption is a brief but descriptive title. For example, *FIGURE 2. Average Nitrate Content of Wells.* A legend consists of one or more sentences that describe what is shown in the figure and point out important features. Sometimes a caption and legend are combined. For example, *FIGURE 2. Average Nitrate Content of Wells. The average of all seven readings of the nitrate level for each well is given. The dotted line represents the maximum contaminant level (MCL) which the EPA has established for public drinking water.*
- Figures should be placed as near as possible to the discussion in the text.

Bar Graphs

Bar graphs are appropriate for showing discrete values and comparisons. They emphasize individual amounts rather than trends or direction. They have the most impact when used to display relatively few values of one or more series (Woolston, 1988).

Line Graphs

Line graphs are used to show trends and relationships. They allow plotting values of a quantity as a function of another variable. The horizontal axis most often depicts time (Woolston, 1988).

Pie Graphs

Pie graphs are 100-percent graphs and are used to show percentage distribution of parts of the whole. They are intended to provide an overview rather than exact values (Woolston, 1988).

Discussion and Conclusions

Introduction

The Discussion and Conclusions can be the hardest section to write because you *interpret* your results in this section and draw conclusions.

Definition

A **Discussion and Conclusions** section is an *analysis* of your results. It is a concise discussion of your most important results in the context of other peoples' work (as reported in the Introduction) and the conclusions drawn based upon your research findings (as reported in the Results).

Contents

It should:

- briefly restate your hypotheses; explain how your data either supported or rejected your initial research question(s);
- show how your results agree (or contrast) with previously published work (include appropriate literature citations);
- state your conclusions as clearly as possible; (Remember: not all papers have earth-shattering conclusions.)
- summarize your evidence for each conclusion;
- acknowledge any limitations which affect the results; discuss any other factors over which you had no control; explain their possible effect on study outcomes;
- include suggestions for procedural improvements, if applicable;
- discuss any theoretical implications or practical applications of your work; and
- make recommendations for future research.

Rules

The Discussions and Conclusions should:

- proceed from most specific (your results), through the more general (others' results), to the most general (implications drawn from your study)
- ***not*** simply *restate* the results. This section should *analyze* the results.

References

Introduction

Virtually all scientific papers rely to some degree on previously published work. When a fact or an idea is borrowed (whether directly or paraphrased) from another source, it must be acknowledged, or cited, in the text and the origin of the information must be revealed.

Definition

A citation is the formal acknowledgment within the text. The citation serves as a link between the text in which it appears and the formal, alphabetical list at the end of the paper called References (Ebel, 1987).

Citing in Text

Although there are several systems for citing in text, the IJSHS follows the author-date system. The citation (author and date) should be placed naturally into the flow of the sentence.

Pascal and co-workers (1981) first isolated a mutant of E. coli K-12 which could no longer ferment glucose.

Examination of codon usage predicts ADH to be a highly expressed protein in E. coli (Ikemura, 1985).

If the name of the author appears as part of the text, as in the first example, cite only the year of publication in parentheses. Otherwise, place both the name and year, separated by a comma, in parentheses as in the second example.

When there are two authors, cite them both (*Smith and Kaplan, 1980)*, but in the case of three or more authors, cite only the name of the first author and indicate the rest by using "et al." (*Lurz et al., 1979*), which is Latin for *and others*.

Rule

All *citations in text* must appear in the *References*; and all references in the *list* must be cited in the *text*. A References list differs from a Bibliography, in which you list everything you have read, whether it is cited or not.

Punctuation

For end-of-sentence citations, the period for the sentence is placed *after* the citation, *not* before it.

The diencephalic structure which controls classification responds better to positive ***reinforcement (Knowlton and Squire, 1993).***

NOT**...** ***reinforcement. (Knowlton and Squire, 1993)***

References (cont.)

Formatting the List

- left justified margin with additional lines indented five spaces (1/2")
- single spaced; double space *between* references
- arranged alphabetically by first author's last name
- Periods separate major components.
- Colons separate titles from subtitles, cities from publishers, and volumes from pages.

Authors

- A single-author entry comes before a multi-author entry if they begin with the same name.
- Works by the same person are arranged chronologically by date of publication.
- When a work has more than one author, their names are listed in the order in which they appear on the title page.
- When a book or pamphlet has no individual author's name, or group of authors' names, and is published by an agency, association, or named group: the name of the group may serve as the author's name in citations in text and in the References list. The name of the group is spelled out in the first citation and abbreviated thereafter.
- Major reference works, such as encyclopedias, with a large editorial board: list the name of the lead editor or directing editor if no author is cited.
- Name of the author or editor is unknown: list alphabetically by the first important word in the title.

Contents

- For *journals*, include author, year of publication, title of article, abbreviated journal name, volume number (if every issue begins with page 1), and page numbers.
- For *books*, include author (or editor), year published, book title, location of publisher, and name of publisher.
- For *sources other than a book or journal*, include enough information so that the source can be identified and located.

Titles

- Article and book titles are capitalized in sentence style.
- Journal titles are capitalized in heading style.
- Book and journal titles are italicized.
- Article titles are **not** italicized or enclosed in quotations.

Misc.

- Locations that are well known can be listed without a state abbreviation, e.g., New York, Boston, Chicago.

Book:	
one author	Day, R.A. 1994. *How to write and publish a scientific paper*. 4th ed. Phoenix: Oryx Press.
more than one author	Woolston, D.C., P.A. Robinson, and G. Kutzbach. 1988. *Effective writing strategies for engineers and scientists*. Chelsea, MI: Lewis Publ.
Dictionary, editor	Urdag, L., ed. 1972. Magnet. In *The Random House college dictionary*. New York: Random House.
Encyclopedia:	
with author	Hart, L.W. 1988. Magnet and magnetism. In *World Book*. Vol. 13. Chicago: World Book.
editor/ no author	Lorimer, L.T., ed. 1993. Magnet and magnetism. In *Encyclopedia Americana*. Vol. 15. New York: Americana Corp.
Internet	Martin, Linda. 08 Nov 1997. General Information. <http://www.science.siu.edu/ijshs/info.html> Accessed 20 Nov 1997.
Interview	Barber, J.D. 8 May 1995. Interview by author. Carbondale, IL.
Journal Article:	
one author	Clark, D.P. 1989. The fermentation pathways of *Escherichia coli*. *FEMS Microbiol. Rev.* 63:223-234.
more than one; title & subtitle	Kohara, Y., K. Akiyama, and K. Isono. 1987. The physical map of the whole E. coli chromosome: application of a new strategy for rapid analysis and sorting of a large genomic library. *Cell* 50:495-508.
Magazine, paginated by issue	Cowley, G. 23 Jan 1995. HIV's raw aggression. *Newsweek*. 75(4):58.
Newspaper:	
no author	Study finds free care used more. May 1989. *APA Monitor*. 14.
discontinuous pages	McDonald, K.A. 15 Dec 1995. Researchers ponder a stormy forecast. *The Chronicle of Higher Education*. A12, A16.
Pamphlet, organization as author	American Society for Microbiology. 1994. Slide and poster requirements. Pamphlet. Washington, DC: ASM.
Telephone conversation	Barber, J.D. 8 May 1995. Personal communication

Appendices (optional)

Introduction

Appendices contain supplemental information such as lists of terms, definitions, and questionnaires that are useful but not essential to the body of the research paper. Most readers will not bother to check appendices.

Rules

Appendices should be included *only* if they help readers to understand, evaluate, or replicate the study (APA, 1994). For example, you have a large table of raw data, but most of it is *not* essential to the discussion in the paper. You could include the complete table as an appendix and a smaller table with a subset of data in the text.

Writing, Revising, and Proofreading

First Draft

Have a clear purpose in mind when you begin writing, but don't try to think of everything at once. Papers are rarely written correctly on the first draft. This means you must be sure to allow yourself enough time for writing *and revising*.

Review

After the first draft is written, set it aside for at least a day or so, then re-read it to yourself. Also, allow enough time in the process to give the draft to your science and English teachers, as well as someone who is not familiar with your research project, for comments. Ask them to mark any section that was confusing or they had to read twice to understand.

Revise

When you revise, aim for improving clarity.

- Use third person in grammar, when possible.
- Examine the verb tenses throughout your paper.
  - ✓ Most or all of the Abstract should be written in past tense.
  - ✓ Present and past tenses are correct in the Introduction.
  - ✓ Past tense or present perfect tense (*researchers have shown*) is appropriate for the literature review and the description of the Materials and Methods.
  - ✓ Use past tense to describe Results .
  - ✓ Use the present tense for the Discussion and Conclusions. The present tense allows your readers to join you in your consideration of the matter at hand.
- Examine your use of pronouns, especially "it." Is the meaning clear?
- Examine your sentences for needless words.

Proofread

Proofread for correct spelling and sentence structure! Computer spell-checkers do not recognize misspelled words if they are valid words, nor do they check the grammar.

Any errors in spelling, grammar, sentence structure, punctuation, or misuse of a word is distracting and affects the reader's confidence in you.

A paper with writing and typing errors may score poorly even if the research itself is excellent.

Typing Specifications

Rules

- All papers must be typed, using standard 12-point, serif typeface (such as Times), and double-spaced.
- Papers must be printed single-sided on 8 1/2 x 11 inch paper with one-inch margins (on all sides).
- Output from dot matrix printers is not acceptable.
- The typical research paper should be between 5 and 12 pages. It may not exceed 20 pages. Lengthy papers are neither necessary nor desired.
- The title page shows the title of the paper, the author's name, school name, and date of submission.
- All pages except the title page, abstract, acknowedgments, and table of contents must be numbered. Type the numbers, using Arabic numerals, within the one-inch margin on the *bottom* of the page. These numerals should be centered and one-half inch from the bottom edge of the paper.
- Do *not* include your name on each page of the paper. The papers are "blind" reviewed, which means that all identifying information such as name and school must be removed prior to paper review.
- Each section of the paper should be identified by a heading, centered within the page margins, and typed using the same typeface and font size as text. All letters are capitalized.
- Use abbreviations sparingly, but if a very long name or term is repeated throughout the paper, an abbreviation is acceptable.
- Abbreviations should be defined the first time they appear in text by placing the abbreviation in parentheses following the spelled-out word. For example, *No molecule with a single 4-member ring was isolated until tetramesityl cyclodisiloxane (TMCDS) obtained by oxidation of disilene. TMCDS was …*

The Oral Presentation

Timing

The presentation may not exceed 15 minutes and is followed by a five (5) minute question-and-answer period.

- A session moderator will aid the student speaker in maintaining the time and in fielding questions from the audience.
- The timing procedure includes a 12-minute warning signal from the moderator, and a 15-minute stop time. At the 15-minute point, the presentation will be stopped, even if the student speaker has not finished.

Answering Questions

Following the presentation, the session moderator will ask for questions from the judges, followed by questions from the audience.

- The speaker *must* repeat or paraphrase each question before answering it so the audience understands the entire dialogue.
- Questions intended to harass the student speakers will not be allowed by the session moderator.

Suggestions

Explain your research in enough detail so the audience understands what you did, how you did it, and what you learned. Be sure your presentation is logical and easy to follow. Make your message clear.

- Avoid jargon or terminology the audience might not understand. If it is essential to use specialized terms, remember to explain them *briefly*. Be prepared to define terminology used, if necessary.
- Graphs, tables and other illustrations may help explain your results. Remember to name the variables on each axis of a graph, and state the significance of the position and shape of the graph. Do not, however, read each number in the table/ figure. Call attention instead to important points.
- Deliver your presentation at a comfortable pace. Time yourself. Classroom practice sessions provide an excellent "live" audience and help build confidence. Videotape the presentation, if possible. Listen and watch for "ah's," "er's," or nervous mannerisms.
- Plan to speak for 12 minutes; that "builds in" time to finish within the allotted 15 minutes.

The Oral Presentation (cont.)

- Acknowledgments are presented at the *end* of an oral presentation.
- No written handouts are permitted.
- Research apparatus may be demonstrated only if it is integral to the presentation and only if the apparatus is hand-held.

Visuals

General Guidelines

- Available audio-visual equipment includes 35 mm slide projector with remote control, overhead projector, laser pointer, and videocassette player (if requested; see restrictions below on using VCR's.)
- Visuals (overhead transparencies or slides) should be laser printed or professionally done.
- Number your visuals in sequence so they can be easily identified. Many times, visuals need to be reshown during questions.
- The first visual should be equivalent to the title page of the paper.
- Visuals should be brief, simple, and uncluttered. Focus on important information. Each visual should make one simple statement and supplement what you are saying while the visual is on the screen.
- Use good judgment in determining the number of visuals and balance their contents. Although you do not want to quickly flash multiple visuals, you should not spend too much time on a single visual either. Typically, a 15-minute presentation will have 5-6 visuals (Ebel, 1987).

Overhead Transparencies

- Be sure that your transparencies are legible from a distance. Titles: at least 18 points and sans serif typeface, e.g., Helvetica. Blocks of text: 16 points (14 points minimum) and serif typeface, such as Times. Recommended line spacing is 1.5 lines.
- Although the stage area of the overhead projector generally measures about 10 by 10 inches, restrict your visual to a rectangular "message area" of about 7 1/2 by 9 1/2 inches.

Overhead Transparencies (cont.)

- Horizontal orientation generally works better. On a square screen, the audience has difficulty seeing the bottom fourth of a vertical format transparency.
- Bulleted items should be no more than 2-3 lines per bullet with extra white space (1/2 to 1 line) between items.
- Commercially-available frames make a transparency easy to handle, and key words can be written on the frame.

Slides

- Use 2 x 2-inch (35 mm) slides.
- When preparing text for slides, use no more than 9 double spaced lines per slide. Each line should be at most 4.5 inches wide (about 50 characters in non-proportional font).
- If you can read the slides without a magnifier, people in the audience can probably read them on the screen. It is better to have the letters too large than too small.
- Thumb spot all slides in the lower left corner when the slide reads correctly on hand viewing. Add sequence numbers.
- Have slides in carousel tray with thumb spot visible in upper right hand corner.

Color Choices

- Color is not required. Color should be used only to clarify or make the visual more legible.
- Overhead transparencies most commonly have black letters on white (clear), but slides are frequently made using other colors.
- Most legible are black letters on yellow. The following are listed in descending order of legibility: green, red, or blue on white (clear); white (clear) on blue; black on white (clear); and yellow on black (Heinich et al., 1993).
- Do not overuse color. Use good judgment.

VCR/Computer Restrictions

Introduction

Students using VCR's and computers during their presentation must abide by the following rules. Improper use will not only distract the audience but also could affect evaluation by the judges.

Rules

- If using computers or video, notify the Symposium Director at least two weeks in advance of the meeting to discuss and review specific technical details (e.g., projection, set-up, etc.) and to allow for availability of video equipment. Students must provide their own computer equipment and software.
- The use of software such as PowerPoint may be used to prepare or to drive slides or overheads.
- Only VHS, 1/2" tape, format is permitted.
- The video component cannot make up more than two (2) minutes of the presentation.
- No audio or background music is permitted other than sounds that are an integral part of the research. Recorded or mechanically produced narration is not permitted. Narration must be done in person by the speaker.
- Computer generated graphics, video (and audio, if any) may be used only for those aspects of the presentation that cannot be adequately presented by slides or overheads.
- Computer-based material must be an integral part of the research and should not be used for presentation of common procedures, illustrating equipment or showing laboratory facilities.
- Videos and computers should illustrate work that was done and should not be used for stimulation or aesthetic value.

Judging Criteria

The Student's Involvement with Science:

Problem & Hypothesis

- originality in identification of problem and hypothesis
- clarity in stating problem
- objectives and reasons for performing the research

Background Information & Prior Research

- acknowledgment of sources

Design of Investigation

- extent of student's involvement in designing the procedures

Investigative Procedures

- identification of important variables; control of variables
- laboratory skills and techniques
- selection of proper equipment for research task
- quantity and quality of data generated by investigative procedures: observations/ measurements/data gathering/statistical analysis
- recognition of the limitations in the accuracy and significance of the results obtained
- interpretation of data; conclusions supported by data
- problem solving

Overall

- creativity/originality
- evidence of student's understanding of the scientific or technological principles employed in investigation
- applications, next steps, or future research

Judging Criteria (cont.)

The Student's Effort and Performance:

Overall

- duration of project and amount of work involved
- acknowledgment of major assistance
- evidence of student's understanding

Written Presentation

- organization of the paper
- composition (spelling, grammar, clarity of thought)
- abstract (content, format, grammar, organization)

Oral Presentation

- clarity in stating problem and hypothesis
- clarity in describing design, procedures, problems, and how they were handled
- clarity in presenting data, interpretations, and conclusions
- overall organization
- definition of terms as necessary
- appropriate use of visual aids
- clarity of enunciation and voice projection
- response to questions

Note

The presentation is important in the evaluation; however, content, not form, will be given the major weight.

The Poster

Definition

The poster is a hybrid between the research paper and the oral presentation.

Comment

Most of the comments from the preceding pages also apply to posters. However, this section will emphasize the differences and unique aspects of poster presentations.

Poster Session

The JSHS Poster Session will be organized similar to those at scientific and professional meetings. The poster session will be scheduled as a regular part of the Symposium with no other activities occurring at the same time.

Submission

To participate in the Poster Session, you must submit the following:

- Up to a five (5) page typed paper describing the original research project and main findings. The paper should have the same sections as the poster, i.e., Introduction, Methods, Results, Conclusions, Acknowledgments.
- An abstract on the JSHS Abstract Form
- A Biographical Sketch form
- A student photo

Comment

The biographical sketch and photo are included, along with the student's abstract, in the program booklet that is distributed to all Symposium participants.

Composition

The poster contains the following sections:
- Title
- Student's name and school
- Abstract
- Introduction
- Methods
- Results
- Conclusions
- Acknowledgments

The Poster (cont.)

Differences

The most important differences are:

- A poster is more concise since the author is present to explain and elaborate. You should typically have a single page for each section.
- There is more emphasis on graphics.
- You can use photographs in addition to other illustrations.
- Figures may be in color.

Display

A display wall (approximately 1 meter wide by 2 meters high) will be provided for each participant.

- All display materials must be attached to the wall. Table space will **not** be available.
- It is best to have materials pre-mounted on large-size (color) mounting boards.
- Posters should be readable from a distance of 4 feet.
- The title should be at least one inch (72 pts.) in height. The student's name and school should be 3/4 inch high (54 pts.). All other lettering should be in 24-point font size.
- Use sans serif typeface (such as Helvetica) for poster title, student's name and school, and major headings.
- Blocks of text should be serif typeface (such as Times).
- The poster should be balanced and organized in a logical, sequential order.
- Determine in advance what you will display and how it will be organized.
- Keep the amount of text to a minimum. Emphasize graphics—tables, charts, graphs, and photos.
- Use white space to make the reading easier.

Presentation

In the poster session, poster presenters remain close to their posters and are available to answer questions and discuss their research.

- Each poster presenter will be given three (3) minutes to highlight the significance of the research to a panel of judges. Questions by the judges will follow.
- Other participants of the Symposium will be viewing the displays during judging.

Poster Judging Criteria

Research Design

- Clarity in stating the problem
- Identification of important variables
- Appropriateness of research equipment
- Recognition of limitations in the data
- Degree to which the data supported the conclusions
- Originality of the research topic

Poster

- Effective use of tables and/or figures in presenting data
- Accuracy of spelling and grammar
- Neatness and organization of poster

Presentation

- Organization of presentation
- Handling of questions from judges

Non-Human Vertebrates

Rules

The Junior Science and Humanities Symposium has adopted the following rules on non-human vertebrate experimentation (adapted from Bonkalski et al., 1994).

- Only animals that are lawfully acquired shall be used in experimentation and their retention and use shall be in every case in strict compliance with state and local laws and regulations.
- Animals used in experimentation must receive every consideration for their bodily comfort; they must be kindly treated, properly fed, and their surroundings kept in a sanitary condition.
- No intrusive techniques may be used, including surgery, injections, or taking of blood.
- When animals are used by students for their education or the advancement of science, such work shall be under the direct supervision of an experienced teacher or an investigator at a research institution with an approved active protocol for the use of vertebrate animals for this research.

Human Subjects

Rules

The Junior Science and Humanities Symposium has adopted the following rules on research involving human subjects (adapted from Bonkalski et al., 1994).

- No project may use drugs, food, or beverages in order to measure their effect on a person.
- Projects that involve exercise and its effect on pulse, respiration rate, blood pressure, and so on are approved if a valid normal physical examination is on file and provided the exercise is not carried to the extreme.
- If your research involves administration of questionnaires or surveys, a proper consent from subjects must be obtained.
- If you are conducting research that involves human subjects and your school has no formal policy regarding such research, contact the JSHS Director for guidelines.

- No cultures involving human cultures of any type–mouth, throat, skin, or otherwise–will be allowed.
- Tissue cultures purchased from reputable biological supply houses or research facilities are suitable.
- The only human blood that may be used is that which is either purchased or obtained from a blood bank, hospital, or laboratory. No blood may be drawn by any person or from any person specifically for a science project. This rule does not preclude a student making use of data collected from blood tests not made exclusively for a science project. Blood may not be drawn exclusively for a science project.

Sample Pages

Pages 31-34

These pages show selected sections of a former research paper (reprinted with permission).

ACKNOWLEDGMENTS

This research was conducted during the months May–December 1998. Research laboratory space, equipment, supplies, and assistance were provided by Dr. Jim Eilers, Dr. Virginia Bryan, Dr. Dennis Kitz, Ms
Illinois University Edwardsville (SIU
regarding statistical analysis. Mr. B
microscope. Dr. Beverly Friend dev
complete this project. Well owners

Abstract Form 20th Annual Illinois Junior Science and Humanities Symposium
Southern Illinois University Carbondale • March 22–24, 1998

Chemical and Microbiological Quality of Private Well Water
Valerie Wappelhorst, 305 Catalpa, Roselle, IL 60172
Lake Park High School, Roselle, IL
Mentor: Dr. Beverly Friend

The chemical and microbiological quality of water from six private wells in Madison and St. Clair counties was evaluated. Samples were collected over an eight-month period and were analyzed for nitrate, pH, total solids, heterotrophic plate count, coliforms, *Escherichia coli (E.coli)*, and fecal streptococci. Microbial isolates were selected and characterized using selective and differential media, biochemical tests, and microscopy.

The nitrate nitrogen values varied from 0 to 21.2 mg/L with one well exceeding the Maximum Contaminant Level (MCL) of 10 mg/L for drinking water. Nitrates were significantly different for wells ($p<0.001$) but not for dates. The pH and solids levels differed significantly for both wells and dates. The heterotrophic counts ranged from 1,200 to >5.7 x 10^6 colony forming units (CFU)/100 ml, and were significantly different for wells ($p<0.05$) but not dates. All samples exceeded the recommendation of 100 CFU/100 ml. Coliforms ranged from 0 to 6,600 CFU/100 ml and were significantly different for wells ($p<0.01$) and dates ($p<0.01$). Over 90% of the samples exceeded the MCL of zero coliforms. *E. coli* was found in three of the wells. The presence of high nitrates and extensive microbial contamination in these wells indicates that well owners should routinely sample and treat their wells.

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Chemical and Microbiological Quality of Private Well Water

Valerie Wappelhorst
Lake Park High School

January 16, 1998

INTRODUCTION

The National Primary Drinking Water Regulations of the United States Environmental Protection Agency (EPA) apply to all public potable water systems in the United States. There are primary regulations establishing a maximum contaminant level (MCL) for microbiological, inorganic, organic, and radiological contaminants and secondary regulations (non-enforceable guidelines) for taste, odor, and aesthetics. There are no primary standards for either pH or total dissolved solids in public drinking water. The secondary standard for pH is 6.5 to 8.5 and for solids is 500 mg/L (35 Illinois Administrative Code).

U.S. obtain drinking water from
s 400,000 private wells supplying
ral areas (Korab, 1993). Since water
typically do not test their wells as
ply wells.
g/L nitrate nitrogen for public

LIST OF TABLES

LIST OF FIGU

1

TABLE OF CONTENTS

TABLE 2
Chemical and Microbiological Content of Well Waters

Sample	Dates	pH (units)	TDS[a] (mg/L)	Nitrate N (mg/L)	HPC[b] (CFU/100ml)	Coliform (CFU/100ml)	*E. coli* (CFU/100ml)	Fecal Strep (MPN/100ml)
MCL		6.5-8.6[c]	500[c]	10[c]	200[c]	0	0	0
Well 1 Madison	5/09	8.0	90	9.3	20600	1200	0	
	6/13	7.2	59	8.2	9100	400	0	
	7/11	7.2	50	7.1	1400	100	0	
	8/08	7.0	30	7.9	3200	600	0	
	9/12	7.1	69	8.0	14000	0	0	170
	11/14	6.5	50	5.6	9300	200	0	30
	12/12	6.2	40	7.8	8800	100	0	
					11100	1200	700	
					83000	1000	500	
					2800	800	600	
					10500	2800	1200	
					3900	0	0	60
					16400	300	0	70
					10000	200	0	
					9400	400	0	
					9600	600	0	
					1200	1000	800	
					2200	100	0	
					337700	0	0	90
					2000	200	0	200
					3050	0	0	
					12300	1600	0	
					3500	600	0	
					15600	600	0	
					51000	4400	0	
					30000	700	0	110
					282500	1500	0	90
					17300	600	0	

RESULTS

As shown in Table 2, the pH levels ranged from 5.6 to 8.3 and were significantly different for both wells ($p<0.001$) and dates ($p<0.001$) as determined by two factor ANOVA using ranked data. Solids ranged from 10 to 140 mg/L and also were significantly different for wells ($p<0.001$) and dates ($p<0.01$). The nitrate nitrogen in the wells varied from 0 to 21.1 mg/L. These values were significantly different for wells ($p<0.001$) but not for dates. The nitrate levels for well 1 (7.7 + 1.2 mg/L) and well 4 (7.4 + 0.8 mg/L) were slightly less than the MCL (10mg/L) and the
mg/L) exceeded the MCL by almost two-fold (Fig

The heterotrophic counts ranged from 1,2
mL and were significantly different for wells (p<0
values are higher than the recommended level of 2
drinking water. The coliforms ranged from 0 to 6,
significantly different for wells (p<0.01) and dates
42) of the samples exceeded the MCL of zero coli
wasfound in four of the seven samples from well 2
from wells 3 and 6. Fecal streptococci (30 to >2.4
present in all wells. The average microbial conten
Figure 4.

A total of 23 isolates were identified on th
morphological and biochemical characteristics (A

9

MATERIALS AND METHODS

Sampling Sites and Protocols

Wells 1-3 were located in Madison County, Illinois, and wells 4-6 were located in St. Clair County, Illinois. Well location, construction, age, and depth are shown in Table 1. None of the wells had been chlorinated. Seven samples from each well were collected in sterile containers and held at 10 °C for no more than 24 hr prior to microbial analysis.

Chemical Analyses

The pH of each sample was determined with an Orion pH meter which was standardized prior to use (American Public Health Association [APHA], 1989). The total dissolved solids were determined in a drying oven using the Total Solids Dried at 103-105 °C Method (APHA, 1989).

Nitrate nitrogen was determined using the NitraVer 5 cadmium reduction method (Hach Company, 1992). All glassware was prewashed in 0.1 N HCl and rinsed in deionized water prior to use. Potassium nitrate standards were prepared at concentrations of 1, 5, 10, and 20 mg/L nitrate. Duplicate 5.0 g portions of each standard and two 5.0 g portions of deionized water (blank) were placed in test tubes. One packet of NitraVer 5 was added to each tube and the tube shaken vigorously for 1 min. The absorbance at 385 nm was determined in a Spec 20 which had been previously zeroed against the blank. Water samples were treated and analyzed the same way as the standard solutions.

Microbiological Analyses

The heterotrophic plate count was determined with Redigel Aerobic Count plates (3M Microbiology Products, 1995). Both 1.0 and 0.1 ml aliquots were plated in duplicate and incubated at 35 $\pm$ 0.5 °C for 24 hrs and counted using standard methods. Coliforms

6

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ion possibly related to the
ange County, Indiana, 1991-

ulture media and reagents for

ey of pesticides in drinking
Washington, DC: EPA.

of nitrate and nitrite in drinking

DISCUSSION AND CONCLUSIONS

The purpose of this project was to evaluate the chemical and microbiological quality of private well water and test the hypothesis that quality varies between wells and sampling dates. The pH, total solids and coliforms were significantly different for both wells and dates, while nitrates and heterotrophs were significantly different for wells only. The nitrate data are consistent with those of Panno et al. (1966) who reported that nitrate levels differed significantly for wells but not for periods. The variabili
fluctuations in both te

Although the
total dissolved solids,
were close to the MCI
of 10 mg/L (Table 1, F
private wells in Illinoi
1966). Water containi
for human adults and
months of age (Bicki
that these levels may
1992; Ward et al., 199

The nitrate le
mg/L found during the

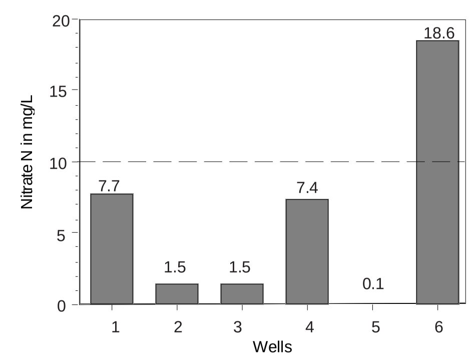

FIG. 2. Average Nitrate Content of Wells. The average of all seven readings of the nitrate level for each well is given. The dotted line represents the maximum contaminant level (MCL) which the EPA has established for public drinking water.

EDITORIAL NOTE: This figure has been enlarged for ease of reading. It would not be scaled as such in an actual paper.

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Appendix 6: Judging Scoresheets - rubrics

Twin Cities Regional Science Fair

Judges' Scoring Sheet for Project Presentation

This sheet is judges' use only. It will not be returned to the students.

Judge Number:
Judge Name:
Project Number:
Student(s):
Title:
Category:

		Max Score	Actual Score
Research Question or Problem: For Science Projects: ☐ Clear and focused purpose ☐ Identifies contribution to field of study ☐ Testable using scientific methods	For Engineering Projects: ☐ Description of a practical need or problem to be solved ☐ Definition of criteria for proposed solution ☐ Explanation of constraints	**(10)**	
Design and Methodology: For Science Projects: ☐ Well-designed plan & data collection methods ☐ Variables and controls defined, appropriate & complete	For Engineering Projects: ☐ Exploration of alternatives to answer need or problem ☐ Identification of a solution ☐ Development of a prototype/model	**(15)**	
Execution: Data Collection, Analysis, and Interpretation For Science Projects: ☐ Systematic data collection & analysis ☐ Reproducibility of results ☐ Appropriate application of mathematical & statistical methods ☐ Sufficient data collected to support interpretation & conclusions	For Engineering Projects: ☐ Prototype demonstrates intended design ☐ Prototype has been tested in multiple conditions / trials ☐ Prototype demonstrates engineering skill & completeness	**(20)**	
Creativity: For Science Projects: ☐ Project demonstrates significant creativity in more or more of the above criteria	For Engineering Projects: ☐ Project demonstrates significant creativity in more or more of the above	**(20)**	
Poster Presentation: (For both science & engineering projects) ☐ Logical organization of material ☐ Clarity of graphics and legends ☐ Supporting documentation displayed		**(10)**	
Interview Presentation: (For both science & engineering projects) ☐ Clear, concise, thoughtful responses to questions ☐ Understanding of basic science relevant to project ☐ Understanding interpretation and limitations of results & conclusions ☐ Degree of independence in conduction project ☐ Recognition of potential impact in science, society and/or economics ☐ Quality of ideas for further research ☐ For team projects, contributions to and understanding of project by all members		**(25)**	
Total:		**(100)**	

Judge #:__________ Project #___________

Improvements & Comments

Check areas that need improvement:

- ☐ Independent thought not clearly demonstrated
- ☐ Communication and understanding of experiment's implications unclear
- ☐ Variables not clearly defined
- ☐ Lack of proper experimental control
- ☐ Statistical analysis missing or not understood
- ☐ Lab notebook not available
- ☐ Bibliography not present or too limited for scope of project
- ☐ Conclusions are not based on repeated observations
- ☐ Scientific understanding has errors or was not clearly communicated
- ☐ For TEAMS only: Team members did not clearly demonstrate individual roles and contributions to the project.

Additional Comments:

____

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Twin Cities Regional Science Fairs
Research Paper Competition Score Sheet

Judge Number: _________ Judge Name: ____

Research Paper Title:____

Paper Author:_____________________________________

Grade: _____ Category:____

Guide for grading scale within each division (middle school or high school):
Excellent (90-100) Good (80-89) Fair (60-79) Poor (1-59)

Possible Points	Evaluation Criteria	Points assigned
(5)	Background of Problem or Objective Source of the idea, evidence of literature search, summary of what others have done on the topic	_____
(5)	Statement of Purpose or Identification of Problem Clear objectives clearly stated, recognition of implications or importance of problem	_____
(25)	Research Design, Procedures (Materials & Methods), Results For Science: Appropriateness of research design & procedures, identification and control of variables, reproducibility, reasonable assumptions, innovative technique For Engineering, Computer Science, Technology: Workable solution that is acceptable to a potential user, recognition of economic feasibility of solution, recognition of relationship between design and end product, design	_____
(20)	Data For Science: Validity, accuracy, precision, recognition of sources of error For Engineering, Computer Science, Technology: Tested for performance under conditions of use, reproducibility, results offer an improvement over previous alternatives	_____
(15)	Discussion and Conclusions Clarity in stating conclusion(s), logical conclusion that is relevant to the research problem or design objective and the results of testing or experimentation, recognizes limits and significance of results or design achievement, evidence of student's understanding of the scientific or technological principles, theoretical or practical implications recognized, what was learned?, relate back to hypothesis or design objective	_____
(5)	Further Ideas Predictions, ideas about refining study or design, ideas about Increasing precision/accuracy, new questions or ideas raised	_____
(25)	Written Presentation – Skill in communicating results (20) Clear presentation, correct grammar, good organization, logical developments, includes bibliography (references, works cited), definition of terms as necessary, appropriate use of diagrams or charts	_____
	(5) Acknowledgement of Sources and Major Assistance Received	_____

TOTAL out of 100 possible: _____

Judge #:__________ Paper #___________

Twin Cities Regional Science Fairs
Research Paper Improvements & Comments

Congratulations on writing a scientific research paper and competing in the Twin Cities regional level! This is a high honor, which few young people will achieve. Here are some specific things that you can work on to help you advance even further next year.

- ☐ Spelling and/or grammar need work.
- ☐ Bibliography/Works Cited is missing or needs work in form or content. Use original sources, not sources that are quoted by your sources. Include the URL and date accessed for web site references. (OR) Acknowledgements statement is missing, if needed. Major help from others (labs, professionals, parents, etc.) must be acknowledged.
- ☐ Pages of the body of the paper must be numbered.
- ☐ Hypothesis and/or Problem (or design objective) needs to be clearly stated.
- ☐ Metric measurements are expected in scientific research.
- ☐ The Scientific Method needs to be apparent in your work. Knowledge of variables, controls, and sources of error should be demonstrated. The experimental work presented must be that of the student. (For design projects, must be a workable solution to design objective – economically or technologically feasible.)
- ☐ Charts and graphs should be clearly labeled.
- ☐ The abstract is missing, not clearly stated, or is over the 250 word limit.
- ☐ Conclusions must be based on repeated observations; design projects must have some sort of testing of the design.

Additional Comments:

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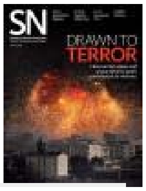

Judging Criteria for Intel ISEF

The following evaluation criteria are used for judging at the Intel ISEF. As shown below, science and engineering have different criteria, each with five sections as well as suggested scoring for each section. Each section includes key items to consider for evaluation both before and after the interview.

Students are encouraged to design their posters in a clear and informative manner to allow pre-interview evaluation and to enable the interview to become an in-depth discussion. Judges should examine the student notebook and, if present, any special forms such as Form 1C (Regulated Research Institution/Industrial Setting) and Form 7 (Continuation of Projects). Considerable emphasis is placed on two areas: *Creativity* and *Presentation,* especially in the *Interview* section, and are discussed in more detail below.

Creativity: A creative project demonstrates imagination and inventiveness. Such projects often offer different perspectives that open up new possibilities or new alternatives. Judges should place emphasis on research outcomes in evaluating creativity.

Presentation/Interview: The interview provides the opportunity to interact with the finalists and evaluate their understanding of the project's basic science, interpretation and limitations of the results and conclusions.

- If the project was done at a research or industrial facility, the judge should determine the degree of independence of the finalist in conducting the project, which is documented on Form 1C.
- If the project was completed at home or in a school laboratory, the judge should determine if the finalist received any mentoring or professional guidance.
- If the project is a multi-year effort, the interview should focus ONLY on the current year's work. Judges should review the project's abstract and Form 7 (Intel ISEF Continuation Projects) to clarify what progress was completed this year.
- Please note that both team and individual projects are judged together, and projects should be judged only on the basis of their quality. However, all team members should demonstrate

significant co an understanding of the project.

Judging Criteria for Science Projects

I. Research Question (10 pts)

___ clear and focused purpose

___ identifies contribution to field of study

___ testable using scientific methods

II. Design and Methodology (15 pts)

___ well designed plan and data collection methods

___ variables and controls defined, appropriate and complete

III. Execution: Data Collection, Analysis and Interpretation(20 pts)

___ systematic data collection and analysis

___ reproducibility of results

___ appropriate application of mathematical and statistical methods

___ sufficient data collected to support interpretation and conclusions

IV. Creativity (20 pts)

___ project demonstrates significant creativity in one or more of the above criteria

V. Presentation (35 pts)

a. Poster 10 pts)

___ logical organization of material

___ clarity of graphics and legends

___ supporting documentation displayed

b. Interview (25 pts)

___ clear, concise, thoughtful responses to questions

___ understanding of basic science relevant to project

___ understanding interpretation and limitations of results and conclusions

_ degree of independence in conducting project

___ recognition of potential impact in science, society and/or economics

___ quality of idea ... rch

___ for team projects, contributions to and understanding of project by all members

Judging Criteria for Engineering Projects

I. Research Problem (10 pts)

___ description of a practical need or problem to be solved

___ definition of criteria for proposed solution

___ explanation of constraints

II. Design and Methodology (15 pts)

___ exploration of alternatives to answer need or problem

___ identification of a solution

___ development of a prototype/model

III. Execution: Construction and Testing(20 pts)

___ prototype demonstrates intended design

___ prototype has been tested in multiple conditions/trials
___ prototype demonstrates engineering skill and completeness

IV. Creativity (20 pts)

___ project demonstrates significant creativity in one or more of the above criteria

V. Presentation (35 pts)

a. Poster (10 pts)

___logical organization of material

___clarity of graphics and legends

___ supporting documentation displayed

b. Interview (25 pts)

___ clear, concise, thoughtful responses to questions

___ understanding of basic science relevant to project

___ understanding interpretation and limitations of results and conclusions

_ degree of independence in conducting project

___ recognition of potential impact in science, society and/or economics

___ quality of ideas for further research

___ for team projects, contributions to and understanding of project by all members

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Junior Science & Humanities Symposium
Judging Score Sheet
Research Paper Presentation

http://www.jshs.org/guidelines.html

Name of Student: ______________________________ Name of Judge: ______________________________

JSHS recognizes students for original research achievements in the sciences, technology, engineering or mathematics (STEM). The overall test is that students demonstrate valid investigation and experimentation aimed at discovery of knowledge. The judging criteria and scoring for JSHS are presented. A total score of 30 points is assigned using the below scale and serves as the basis for discussions among the judging team. Rank each students' oral presentation using the following criteria and weights:

5 = Superior 4 = Excellent 3 = Good 2 = Satisfactory 1=Fair

Judging Criteria	Suggested Weight
Statement and identification of research problem • Is the problem clearly stated? • Does the presenter demonstrate understanding of existing knowledge about the research problem?	1 2 3 4 5

Scientific thought, creativity/originality
• Student demonstrates his or her individual contributions to and understanding of the research problem
• Appropriate duration of collection and data analysis
• Innovation of Original Concept and Scientific Thought/Process
  o Standard Protocol/Design
  o Innovative Protocol/Design
	1 2 3 4 5

Research design, procedures (materials & methods), results 1. Science • Appropriateness of research design and procedures • Process skills demonstrated by the student in the solution to the research problem and/or the research design • Identification and control of variables • Reproducibility 2. Engineering, computer science, technology • Workable solution that is acceptable to a potential user • Recognition of economic feasibility of solution • Recognition of relationship between design and end product • Tested for performance under conditions of use • Results offer an improvement over previous alternatives	1 2 3 4 5
Discussion/Conclusions • Clarity in stating conclusion • Logical conclusion that is relevant to the research problem and the results of experimentation or testing • Recognizes limits and significance of results • Evidence of student's understanding of the scientific or technological principles • Theoretical or practical implications recognized • What was learned?	1 2 3 4 5
Skill in communicating research results-- Oral Presentation and written report • Clarity in communicating research results to non-specialized audience and to judges • Definition of terms as necessary • Appropriate use of audio-visuals • Response to questions from audience and judges	1 2 3 4 5
Includes References/Bibliograhy and major assistance received	1 2 3 4 5
TOTAL SCORE	

Appendix 7: Research Plan Instructions

The research plan is a typed Word document. The updated research plan instruction sheet is provided in the current year forms from Society for Science for ISEF.

See the Rules and Forms at: https://www.societyforscience.org/isef/international-rules/

Research Plan/Project Summary Instructions

A complete Research Plan/Project Summary is required for ALL projects and must accompany Student Checklist (1A).

- All projects must have a Research Plan/Project Summary
  a. Written prior to experimentation following the instructions below to detail the rationale, research question(s), methodology, and risk assessment of the proposed research.
  b. If changes are made during the research, such changes can be added to the original research plan as an addendum, recognizing that some changes may require returning to the IRB or SRC for appropriate review and approvals. If no additional approvals are required, this addendum serves as a project summary to explain research that was conducted.
  c. If no changes are made from the original research plan, no project summary is required.

- Some studies, such as an engineering design or mathematics projects, will be less detailed in the initial project plan and will change through the course of research. If such changes occur, a project summary that explains what was done is required and can be appended to the original research plan.

- The Research Plan/Project Summary should include the following:
  a. **RATIONALE:** Include a brief synopsis of the background that supports your research problem and explain why this research is important and if applicable, explain any societal impact of your research.
  b. **RESEARCH QUESTION(S), HYPOTHESIS(ES), ENGINEERING GOAL(S), EXPECTED OUTCOMES:** How is this based on the rationale described above?
  c. Describe the following in detail:
- **Procedures:** Detail all procedures and experimental design including methods for data collection, and when applicable, the source of data used. Describe only your project. Do not include work done by mentor or others.
- **Risk and Safety:** Identify any potential risks and safety precautions needed.
- **Data Analysis:** Describe the procedures you will use to analyze the data/results.
  d. **BIBLIOGRAPHY:** List major references (e.g. science journal articles, books, internet sites) from your literature review. If you plan to use vertebrate animals, one of these references must be an animal care reference.

Items 1–4 below are subject-specific guidelines for additional items to be included in your research plan/project summary as applicable.

1. Human participants research:
  a. Participants: Describe age range, gender, racial/ethnic composition of participants. Identify vulnerable populations (minors, pregnant women, prisoners, mentally disabled or economically disadvantaged).
  b. Recruitment: Where will you find your participants? How will they be invited to participate?
  c. Methods: What will participants be asked to do? Will you use any surveys, questionnaires or tests? If yes and not your own, how did you obtain? Did it require permissions? If so, explain. What is the frequency and length of time involved for each subject?
  d. Risk Assessment: What are the risks or potential discomforts (physical, psychological, time involved, social, legal, etc.) to participants? How will you minimize risks? List any benefits to society or participants.
  e. Protection of Privacy: Will identifiable information (e.g., names, telephone numbers, birth dates, email addresses) be collected? Will data be confidential/anonymous? If anonymous, describe how the data will be collected. If not anonymous, what procedures are in place for safeguarding confidentiality? Where will data be stored? Who will have access to the data? What will you do with the data after the study?
  f. Informed Consent Process: Describe how you will inform participants about the purpose of the study, what they will be asked to do, that their participation is voluntary and they have the right to stop at any time.

2. Vertebrate animal research:
  a. Discuss potential ALTERNATIVES to vertebrate animal use and present justification for use of vertebrates.
  b. Explain potential impact or contribution of this research.
  c. Detail all procedures to be used, including methods used to minimize potential discomfort, distress, pain and injury to the animals and detailed chemical concentrations and drug dosages.
  d. Detail animal numbers, species, strain, sex, age, source, etc., include justification of the numbers planned.
  e. Describe housing and oversight of daily care.
  f. Discuss disposition of the animals at the end of the study.

- **Potentially hazardous biological agents research:**
  a. Give source of the organism and describe BSL assessment process and BSL determination.
  b. Detail safety precautions and discuss methods of disposal.

4. Hazardous chemicals, activities & devices:
  - Describe Risk Assessment process, supervision, safety precautions and methods of disposal.
  - Material Safety Data Sheets are not necessary to submit with paperwork.

Research Plan Generator

Student Name(s):
Grade (6-12):

RATIONALE:
This is a brief summary of the background that supports your research problem and explain why this research is important. Explain any societal impact of your research.

RESEARCH QUESTION(S) and/or ENGINEERING GOAL(S):
What is your question(s) or engineering goal(s) and how is it based on the rationale described above?

HYPOTHESIS(ES), ENGINEERING GOAL(S) and/or EXPECTED OUTCOMES:

PROCEDURES:
Detail all procedures and experimental design including methods for data collection, and when applicable, the source of the data used. Describe only your project. Do not include work done by mentor or others. However, do detail if you have an adult operate equipment on your behalf for your project and what kind of results you received back from the adult to continue your work/analysis. If you used humans, vertebrates, microorganisms, mold, viruses, other potentially hazardous biological agents, tissues, or bodily fluids please see additional information below the Project Summary section below for additional information required.

RISK and SAFETY (***required for all projects***, even if no risk):
Identify any potential risks and safety precautions needed.

If hazardous chemicals, activities & devices, describe your Risk Assessment process, supervision, safety precautions and methods of disposal.

DATA ANALYSIS:
Describe the procedures you will use to analyze the data/results.

BIBLIOGRAPHY:
List major references (e.g. science journal articles, books, internet sites) from your literature review. Use MLA or APA or Chicago format. For websites, use the exact URL (not just Google, not the main page of the website) *& the date you accessed the information*. If you plan to use vertebrate animals, one of these references must be an animal care reference.

PROJECT SUMMARY:
If changes are made during the research, add those changes to your plan here. If no changes are made from the original research plan, no project summary is required. State "no changes were made to the original research plan." NOTE: Some plan changes may require returning to the IRB or SRC for additional review and approvals. Include any updated approvals with your forms (modified forms signed again) due to changes in your plan and briefly explain in this summary.

If the project contains human participants (if not, leave blank- or you may delete this section):

Human participants research:
Participants: Describe age range, gender, racial/ethnic composition of participants. Identify vulnerable populations (minors, pregnant women, prisoners, mentally disabled or economically disadvantaged).

Recruitment: Where will you find your participants? How will they be invited to participate?

Methods: What will participants be asked to do? Will you use any surveys, questionnaires or tests? If yes, and not your own, how did you obtain these and did it require permissions? If so, explain. What is the frequency and length of time involved for each subject? (Attach copies of all surveys, questionnaires, tests, or photos shown to subjects)

Human Subject Risk Assessment: What are the risks or potential discomforts (physical, psychological, time involved, social, legal, etc.) to participants? How will you minimize risks? List any benefits to society or participants.

Protection of Privacy: Will identifiable information (e.g., names, telephone numbers, birth dates, email addresses) be collected? Will data be confidential/anonymous? If anonymous, describe how the data will be collected. If not anonymous, what procedures are in place for safeguarding confidentiality? Where will data be stored? Who will have access to the data? What will you do with the data after the study?

Informed Consent Process: Describe how you will inform participants about the purpose of the study, what they will be asked to do, that their participation is voluntary and they have the right to stop at any time.

If the project contains non-human vertebrate animal research (if not, leave blank- or you may delete this section):

Vertebrate animal research:
a. Discuss potential ALTERNATIVES to vertebrate animal use and present justification for use of vertebrates.
b. Explain potential impact or contribution of this research.
c. Detail all procedures to be used, including methods used to minimize potential discomfort, distress, pain and injury to the animals and detailed chemical concentrations and drug dosages.
d. Detail animal numbers, species, strain, sex, age, source, etc., include justification of the numbers planned.
e. Describe housing and oversight of daily care
f. Discuss disposition of the animals at the termination of the study.

If the project contains potentially hazardous biological agents (PHBA) (if not, leave blank- or you may delete this section):

Potentially hazardous biological agents research:
a. Give source of the organism and describe BSL assessment process and BSL determination.
b. Detail safety precautions and discuss methods of disposal.

If the project uses potentially hazardous chemicals, activities, and/or devices (if not, leave blank- or you may delete this section):

Hazardous chemicals, activities, & devices:
a. Describe Risk Assessment process, supervision, safety precautions and methods of disposal.
b. Material Safety Data Sheets are not necessary to submit with paperwork. (Keep as reference for student researchers.)