WESTERN UPPER PENINSULA
SCIENCE FAIR
Thursday, March 14, 2002
Memorial Union Ballroom
Michigan Technological University

STUDENT PLANNING GUIDE
GRADES 6-9

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Sponsored by:
Western UP Center for Science, Mathematics and Environmental Education
and
MTU Omega Chi Epsilon Chemical Engineering Honor Society.
GENERAL RULES

Projects must meet all general rules on this page in order to be eligible for entry.

1. Science fair projects are to be designed and carried out by the student entering the Western UP Science Fair. The project idea and its execution should belong to the student, although students should seek guidance from parents and teachers as they research and complete their projects.

2. Students are responsible for transporting and setting up their projects on the day of the fair, starting at 4:00 pm EST, Thursday, March 14, 2002. Judging will start at 5:00 pm EST. Students will need to be available to explain their projects to the judges from 5:00 to 7:00 pm EST.

3. A Science Project Registration Form is required for each project. This form must have the teacher’s signature. It must be returned to the teacher by Wednesday, February 6, 2002. No school or last names should appear anywhere on the second page of this form. On the day of the fair, each project will be assigned a number. The judges will refer to each project by number, so that the judges do not know the identity of the student.

4. Each student participant must also turn in a signed Parent Consent Form to the classroom teacher by Wednesday, February 6, 2002. This form is on the back of the Student Registration Form.

5. Projects should fit in a space enclosed by a standard size display board: 36” (height) by 48” (width). Standard size white display boards can be purchased from Western UP Center for $1.00 each. (catalog price $1.99) Please see classroom teacher or contact Loret Roberts at 482-4520 or loret@remc1.k12.mi.us

6. No commercial kits are allowed and no computer programs are allowed except in support of data of the project.

7. Safety first! Do not use any materials or techniques that harm you, others or the environment. No live vertebrate animals are allowed in your display.
REQUIREMENTS FOR PROJECTS.

A science fair project is a presentation of an experiment conducted by the student using the scientific method. A science fair project submitted to the Western UP Science Fair must have these three parts:

- Display Unit
- Experimental Science Fair Report

Display Unit
The display unit forms the background for the project. It should be built of sturdy materials to provide a structure for the title of the project, vertical display of graphs, charts, photographs and other printed materials. It is usually three sided and free standing; that is, it must stand on its own for several days. (See rule #6 on General Rules page.)

Materials, items, devices and samples shown in front of the display unit can contribute to the project. Safety First! These items should present no hazards to observers who may be viewing the display. No breakable or dangerous items should be included. Avoid using open containers of liquids or smelly items, as they may be a hazard to observers and neighboring displays.

The following information from the written report should be on the display unit in a NEAT and CONCISE manner.

First name of students only and grade
Purpose: The problem stated in the form of a question with in the independent and dependent variable. This is the title of your project.
Hypothesis: An educated guess of how the experiment will turn out worded in terms of the independent and dependent variable.
Procedure and materials list: A summary of the procedure that was followed and the materials used.
Results: What did the student learn during and after their investigation? Photographs, charts, graphs, data or drawings that support the information in the project.
Conclusion: A statement that summarizes the investigation and addresses the original purpose. It should include also any discoveries that were not originally planned.
Science Fair Report

It is important to follow the scientific method when you design your science fair project. The **scientific method** is a series of steps that must be followed in order to properly design your science experiment and reported your findings.

The following worksheets will help you to do each step of the scientific method. Use the information from the completed worksheets to write your science fair report and put together your display. The report should be 4-6 pages long including the title page, abstract, graphs and data tables. An example report is given at the end.

**Title Page:** It should include the problem to investigate from Worksheet 1, first name and grade of the student only.

**Worksheet 1:** State the problem in the form of a question.
Ask a very specific question about the problem that you want to investigate. State your question in terms of independent and dependent variables.

**Worksheet 2: Gather information about your topic and bibliography.**
Gather information from at least three different books, magazines or websites. The bibliography should list all the printed materials you consulted in carrying out the project. Items should be listed in alphabetical order in a standard format.

**Worksheet 3: Develop a hypothesis.**
Write down your prediction of how you think the experiment will turn out. Write your prediction using an if-then statement using the independent and dependent variables.
**Worksheet 4: Designing the experiment.**
Design an experiment that looks at the effect of change in the independent variable on the dependent variable. It is important that one independent variable is changed at a time and that one dependent variable is measured at a time. Determine in what increment the independent variable will change and how to measure numerically the results of the change, the dependent variable. Appropriate units should be used on all measurements. It should include a detailed procedure and materials list, so that it is clear to others how to do the experiment.

**Worksheet 5: Conducting the experiment and keeping records:**
Conduct the experiment and record the data collected and what you observed during the experiment. You should also include any errors that may have occurred during the experiment.

**Worksheet 6: Analyzing the results**
Analyzed the collected data so that a pattern can be noticed and a conclusion written. The data gathered may not support the original hypothesis. This happens to scientist all the time and it is a normal part of the scientific method. The goal of a good experiment is a clear repeatable procedure and result.

**Worksheet 7: Developing a conclusion.**
Develop a conclusion that tells whether the data supports the hypothesis or not. The conclusion represents what you actually learned by conducting the experiment. Suggestion for improvement in the design of the experiment and a statement of the importance of the experiment should also be included.

**Worksheet 8: Abstract**
This page is a summary of your project that contains: the hypothesis, brief description of procedure; and brief description of results. This worksheet should be completed last after the experiment is done and the rest of the worksheets are completed. The abstract is the second page of the report after the title page.
Worksheet 1: State the Problem in the Form of a Question.

Asks a very specific question about the problem you wish to investigate in the terms of independent and dependent variables.

Variables are conditions of the experiment that are either kept the same, changed or are the measure of the change.

- The independent variable is the variable that is changed by the experimenter and tested.

- The dependent variable is the measure of change.

- Constant variables are conditions of the experiment that are kept the same.

Topic or problem you wish to investigate. ________________________

____________________________________________________

What is the independent variable for your problem? (the variable you will change in the experiment.)

____________________________________________________

____________________________________________________

What is the dependent variable for your problem? (the measure of the change)

____________________________________________________

____________________________________________________

State the problem as a specific question with your independent and dependent variable.

____________________________________________________
Worksheet 2: Gather information about your topic.

1. Make a list of everything that you know about the question?

2. Using the list above, search for information on your question in books, magazines, Internet etc. Write down the background information that will be helpful to you in conducting the experiment and is interesting to you. Make sure to write the bibliography information (see standard format for bibliography).

First source bibliography:

First source background information:

Second source bibliography:

Second source background information
Third source bibliography:

Third source background information

**Standard Format for Bibliography**

**Book:**
Author's last name, author's first name. *Title of book*, place of publication: publisher, copyright date, pages used.

**Magazine:**
Author's last name, author's first name. "Title of article", *Name of magazine*, date of publication(day, month, year): page numbers of article.

**Newspaper:**
Author's last name, author's first name. "Title of article", *Name of newspaper*, date of publication(day, month, year): page numbers of article.

**Encyclopedia:**
"Title of article", *Title of encyclopedia*, Edition or version. Date of publication.

**Films and Videotapes:**
*Title*. Kind (film, videocassette). Production company, date. Time length.

**Documents from the internet:**
Author's last name, author's first name. "Title of document". Post date or last update. Site Sponsor. Date accessed. <electronic address>. 
Worksheet 3: Developing a Hypothesis

A Hypothesis is an if-then statement of the expected outcome of the experiment written in the terms of the independent and dependent variable. It is based on the information gathered so far.

Rewrite your problem, as an if-then statement in terms of the independent and dependent variable of what you believe the outcome of the experiment will be. This is your hypothesis.

______________________________________________________
______________________________________________________
______________________________________________________
______________________________________________________
Worksheet 4: Designing the Experiment

Design an experiment, a step-by-step list of what you will do, to test the hypothesis. This list is called an experimental procedure.

- Keep things as simple as possible; use the independent and dependent variable from your hypothesis.
- All other factors in the experiment should not change; they are constant variables.
- Determine in what increment you are going to change the independent variable.
- Also determine how you are going to measure the change in the dependent variable. Make sure that appropriate units are used.

In what increment will your independent variable change? Give units and the device to measure. ______________________________________

How will you measure the change in your dependent variable? Give units and the device to measure. _____________________________________

What are the constant variables in your experiment? ____________________
_________________________________________________________________

2. Each experiment needs a "control" for comparison so that you can see what the change in the independent variable actually did. The control is a standard to test your experimental results against.

What will your control be for your experiment? ____________________
_________________________________________________________________
3. Write a step-by-step procedure that:
   - Lists materials and equipment needed. Make sure to specify the amount of each material in your procedure.
   - Describes how the control is measured.
   - Describe in detail how the independent variable is changed and how the dependent variable is measured.

Write out the materials list for your experiment.

Write out the procedure to measure your control.

Write out the procedure to describe how your independent variable is changed and how your dependent variable is measured. Make sure that the procedure is clear so that someone else can do it.
Worksheet 5: Conducting the Experiment and Keeping Records.

You will need to conduct at least 2 trials of your experimental procedure.
- Record all measurements in the data table.
- Use the same materials and procedure for each trial.
- Use the same measuring device and units to record the changes.
- Record all observations during the experiment, things that happen, problems encountered and errors made. These observations will be valuable when drawing conclusions and locating experimental errors.

Use the data sheet below to record your data. Put name of the variables in the line provided and make sure to include units on all measurements. Calculate the average and record in this table.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Independent variable</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Record your observations in the space below while you are conducting the experiment. Make sure to include any problems or mistakes made.
Worksheet 6: Analyzing the Results

After all of the data has been collected, it should be analyzed so that a pattern can be noticed and a conclusion formulated. Design a graph in the space below, using the values for the independent variable and the dependent variable below.

- Values for the independent variable are placed on the horizontal axis and values for the dependent variable are placed on the vertical axis.
- Label horizontal axis and vertical axis with what the variables stand for. Do not forget to include the units you used to measure each variable in these labels.
- Place a title on the top of your graph.
Worksheet 7: Developing a Conclusion

Using the data, graphs and observations develop a conclusion that addresses the hypothesis. The conclusion represents what you actually learned by conducting the experiment. Suggestions for improvement in experimental design and a statement of the importance of the experiment should also be included.

1. Using your experimental data, graphs and your observations, was your hypothesis correct?
   If yes, what data and observations support your hypothesis?

   If no, explain what data or observations show that your hypothesis is incorrect?

2. What problems did you encounter and what mistakes did you make?

3. How would you improve your procedure?
4. From your data and observations, what other things did you learn?

5. How is the knowledge you gained from this project important to you?
Worksheet 8: Abstract

This is a summary of your project with the following parts.

1. State your hypothesis.

2. Give a brief description of the procedure that was followed.

3. Did your results support your hypothesis?
   If yes, what data and observations support your hypothesis?

If no, explain what data or observations show that your hypothesis is incorrect?
Example Experiment and Written Report

1. State the problem in the form of a question:
   Will the amount of table salt affect the boiling temperature of water?
   independent variable: amount of salt
   dependent variable: boiling temperature of water

2. Review of literature:
   Addition of salt to water effects at what temperature water freezes and boils. Salt water will boil at a higher temperature than pure water. A liquid will boil when the vapor pressure of the liquid equals the atmospheric pressure. Dissolving salt in water decreases the vapor pressure of the water. The more salt you dissolve, the lower the vapor pressure of the water becomes. You’ll have to heat the salt and water solution to a higher temperature to get the solution’s vapor pressure to equal the atmospheric pressure.
   Addition of salt to icy roads will melt the ice. In pure water, the process of freezing and melting can occur at the same rate. This is known as equilibrium. Adding salt to water will disrupt this equilibrium, so melting occurs faster than freezing.

Bibliography:


3. Develop a hypothesis:
If the amount of table salt added to water increases, then the boiling temperature of the water will increase.

4. Designing the experiment:

- Independent variable, the amount of table salt, will be increased by 1 tablespoon.
- Dependent variable, boiling temperature of water, will be measured in °C using a thermometer.
- Constant variables are the amount of water, pot and stove used in the experiment, use of distilled water each time and the thermometer used.
- The control is the boiling point temperature in °C of the water without salt added.

1. Boil one quart of distilled water on a stove. Measure the temperature in °C of the boiling water. Record the highest temperature reading in the data table.
2. Measure out 1 tablespoon of table salt using the measuring spoon. Record the amount of salt with units in data table.
3. Add the measured salt to one quart of water, stir and bring to a boil. Measure the temperature in °C of the boiling water. Record the highest temperature reading with units in the data table.
4. Repeat the procedure above using 2 tablespoons and 3 tablespoons of salt.

5. Conducting the experiment and keeping records:

<table>
<thead>
<tr>
<th>Amount of salt in tablespoons</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0 tablespoons</td>
<td>100°C</td>
<td>100°C</td>
</tr>
<tr>
<td>1 tablespoons</td>
<td>101°C</td>
<td>103°C</td>
<td>102°C</td>
</tr>
<tr>
<td>2 tablespoons</td>
<td>103°C</td>
<td>103°C</td>
<td>103°C</td>
</tr>
<tr>
<td>3 tablespoons</td>
<td>104°C</td>
<td>106°C</td>
<td>105°C</td>
</tr>
</tbody>
</table>
When the salt was added to distilled water it took longer for the water to reach a boil compared to the control. The water with salt in it also boiled more vigorously than the control. If the bulb of the thermometer rested on the bottom of the pot, it read a higher temperature. Heat from the stove burner makes the thermometer read higher. In trial 1, we spilled some of the 1 Tbs. of salt before adding it to the water.

6. Analyzing the results:

7. Developing a conclusion.
The data shows that the boiling temperature of the water increased as more salt was added in each trial. The data supports my hypothesis, “As the amount of table salt added to water increases, the boiling temperature of the water increases.” In addition, water with salt added takes longer to reach a boil than water without salt in it. Also, the water boiled more vigorously with salt in it.
There were problems with doing the experiment. The temperature readings were hard to make. The temperature of the water at the bottom of the pot was hotter than the temperature of the water in the middle of the pot. We had to make sure that we took the temperature at the same place in the pot for each trial. A step needed to be added to my experimental procedure on how to correctly take the temperature of the boiling water. Gloves had to be worn to keep hands from getting hot.

We incorrectly measured the amount of salt in the first trial with one tablespoon of salt. This may have caused the low boiling point temperature in this trial compared to trial 2 for the same amount of salt.

From this experiment, I discovered that the addition of salt to water changes its boiling point. This is the reason. Recipes ask for salt to be added to water before bringing water to boil. When salt is added, water will boil at a higher temperature so that the food cooks quicker. I know that salt is added to roads in the winter to melt the ice. I would like to design an experiment to see how salt affects the freezing point of water.

8. Abstract

If the amount of table salt added to water increases, then the boiling temperature of the water will increase. To test this hypothesis, I conducted the following experiment. Boiled one quart of distilled water on a stove and measured the temperature in °C of the boiling water. This was the control for the experiment. Then for each trial, increasing amount of salt was added to a quart of water and brought to a boil. The boiling temperature in °C was measured for each trial and recorded.

As the amount of salt added to water increased in each trial, the boiling temperature of the water increased. The boiling temperature of the water with salt dissolved in it was always greater than the boiling temperature of pure water. This data supported my hypothesis. In addition, water with salt added takes longer to reach a boil than water without salt in it. Also, the water boiled more vigorously with salt in it.
WESTERN UPPER PENINSULA SCIENCE FAIR
Thursday, March 14, 2002
Memorial Union Ballroom
Michigan Technological University

Schedule: All times are EST.

4:00 to 5:00pm   Students set up projects

5:00 to 7:00pm   Judging of projects. Students will be scheduled for an interview with two judges during one of the time periods: 5:00-6:00pm or 6:00-7:00pm

5:00 to 7:00pm   Dinner- provided for all registered participants

7:00 to 8:00pm   Science Fair open to the public.

7:30 to 8:00pm   Awards Ceremony

8:00 to 8:30 pm  Removal of science fair projects by students and parents.

JUDGING OF PROJECTS.

On the day of the fair, each project will be assigned a number. The judges will refer to each project by number, so that the judges do not know the identity of the student(s). A pair of judges that score the project separately will judge each project. The judges will be looking to see if the project meets all the requirements listed in the Student Planning Guide. The student(s) interview with the judge will be part of the total score for the project. Then each project will receive a composite score of the two judges. Students should be available next to their project during their scheduled interview time. Parents should pick up their children after the judging time is over. Judges will be volunteers from Michigan Technological University and other educators from the community.
WHAT THE JUDGES WILL BE LOOKING FOR.

• Does the project meet all of the requirements given in the Student Planning Guide?

Scientific Thought
• Does the project have a title, problem to be investigated and hypothesis that are clearly stated?
• Does the project represent real study and effort?
• Does the project form conclusions based on the data or information gathered?
• Does the project show that the student is familiar with the topic?

• Does the project follow the scientific method?
• Is the experiment designed to test the stated hypothesis?
• Does the project illustrate controlled experimentation?

Originality
• Does the project demonstrate some ideas arrived at by the student?
• Does the project show a high degree of accomplishment? Is the degree of accomplishment consistent with the student’s age level?
• Is the project primarily the work of the student?

Thoroughness
• Does the project tell a complete story?
• Are all the parts of the project well done, including the visual display and the interview with the judges?

Technical Skill and Neatness
• Does the project show effort and craftsmanship by the student?
• Are the display unit and the written report clear, neat and easy to read?
WESTERN UP SCIENCE FAIR PROJECT REGISTRATION FORM

Please return signed form to your teacher by
Wednesday, February 6, 2002

One form for each project. For group projects, make sure to give the
ame, address and phone number for both students.

Student information: (please print)

1) Student’s Full Name ________________________________
   Home Address _______________________________________
   Phone Number _______________________________________

2) Student’s Full Name ________________________________
   Home Address _______________________________________
   Phone Number _______________________________________

Project Information
Problem to be Investigated (taken from worksheet 1) ______________

___________________________________________________

School _______________________________________________

Grade _________  Electrical power outlet needed?_____ yes _____ no

Brief Description of Project:

Teacher’s Consent
Teacher’s name ________________________________
Teacher’s signature _______________________________
PARENT CONSENT FORM
Please return to classroom teacher by
Wednesday, February 6, 2002

I give my consent for ____________________________ to participate in the Western UP Science Fair on Thursday, March 14, 2002 at Michigan Technological University. I will make sure that their science fair project will be transported to MTU Memorial Union Ballroom on the day of the fair for set up at 4:00pm EST. I will join my child at 7:00pm EST after the judging is complete. I will also make sure that my child’s project is removed by 8:30 pm EST from the MTU Memorial Union Ballroom. My child will follow all of the general rules in the Student Planning Guide.

Parent’s signature ____________________________

Date _______________