

WESTERN UPPER PENINSULA SCIENCE FAIR

Thursday, March 14, 2002

Memorial Union Ballroom

Michigan Technological University, Houghton, MI

STUDENT PLANNING GUIDE for GRADES 4-5

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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 rules on this page 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 science fair, from 4:00-5:00 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 7:00pm 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 identity of the student and their school is not revealed.
4. Each student participant must also return a signed **Parent Consent Form** to the classroom teacher **by Wednesday, February 6, 2002.** This form is on the back of the Student Project 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). To obtain a display board, see your classroom teacher or contact Loret Roberts at 482-4520 or loret@remc1.k12.mi.us
6. No commercial kits **or** computer programs are allowed, except for analysis of project data.
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.

PROJECT REQUIREMENTS

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 two parts:

- Display Unit
- Science Fair Report

Display Unit

The display unit consists of three parts:

- 1) **Display board** that forms the background for the project. A standard-size display board is 36" (height) by 48" (width). It may be constructed or purchased (see #5, page 1). It is usually three-sided and sturdy enough to stand on its own for several days. Various parts of the written report, graphs, charts, photographs and other materials are attached to the display board.

- 2) **Models, materials, devices and samples** that relate to the science fair project experiment may be shown in front of the display unit. **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.

- 3) The following **information from the written report** should be on the display unit in a NEAT and CONCISE manner:
 - **First name (only)** of students and their grade
 - **Purpose:** The problem stated in the form of a question. (This is also the **title** of your project.)
 - **Hypothesis:** An educated guess of how the experiment will turn out, worded in terms of the independent and dependent variables.
 - **Procedure & Materials List:** A summary of the procedure that was followed, including summary of materials used.
 - **Results:** The data collected, as part of the experiment, should be displayed in tables, charts, and/or graphs. Photographs, diagrams, and drawings that describe what was done and what was learned may be included.

- **Discussion:** The student should discuss what was learned from the data collected. Did the data support their hypothesis? What did the student learn during and after their investigation? How might they change their experimental procedure next time?
- **Conclusion:** A statement that summarizes the investigation and addresses the original purpose. It should include 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 report 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, graphs and data tables. An example report is provided 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.

Gather information from at least three different books, magazines or websites. No bibliography is required.

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: Design the experiment.

Design an experiment that looks at the effect of change in the independent variable on the dependent variable. It is important that only one independent variable be changed at a time and that only one dependent variable is measured at a time. Determine in what increment the independent variable will change and how to measure the results of the change on the dependent variable. Appropriate units should be used on all measurements. The project report should include a detailed procedure and materials list, so that it is clear to others how to do the experiment.

Worksheet 5: Conduct the experiment and keep records.

Conduct the experiment. Record the data collected and what you observed during the experiment. Also, record any errors that may have occurred during the experiment.

Worksheet 6: Analyze the results.

Analyze the data that you collect, looking for patterns and trying to draw a conclusion. 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: Develop 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 1: State the Problem in the Form of a Question

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

Variables are conditions of the experiment that are either kept the same, changed or are the measure of 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 3: Develop 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: Design 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 **the** 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.
- Describes 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 the experiment.

Worksheet 5: Conduct the Experiment and Keep 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.

Dependent variable _____

Independent variable _____	Trial 1	Trial 2	Average
control			

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

Worksheet 6: Analyze the Results

After all of the data has been collected, look for a pattern in the data and try to formulate a conclusion. Draw a graph in the space below, using the values for the independent variable and the dependent variable.

- 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: Develop a Conclusion

Using your data, graphs and observations, develop a conclusion that addresses the hypothesis. The conclusion represents what you actually learned by conducting the experiment. Also, provide suggestions for how you would do the experiment differently next time and a statement of the importance of the experiment.

1. Using your experimental data, graphs and your observations, was your hypothesis correct? NO YES

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?

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

Salt is put on icy roads to melt the ice. Addition of salt to water will affect both the temperature at which water freezes and boils. Salt water will boil at a higher temperature than pure water.

3. Develop a hypothesis

If the amount of table salt added to water increases, then the boiling temperature of the water will increase.

4. Design 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.
- List the Procedure:
 - i) 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.
 - ii) Measure out 1 tablespoon of table salt using the measuring spoon. Record the amount of salt with units in data table.
 - iii) 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 in °C in the data table.

iv) Repeat the procedure above using first 2 tablespoons and then 3 tablespoons of salt.

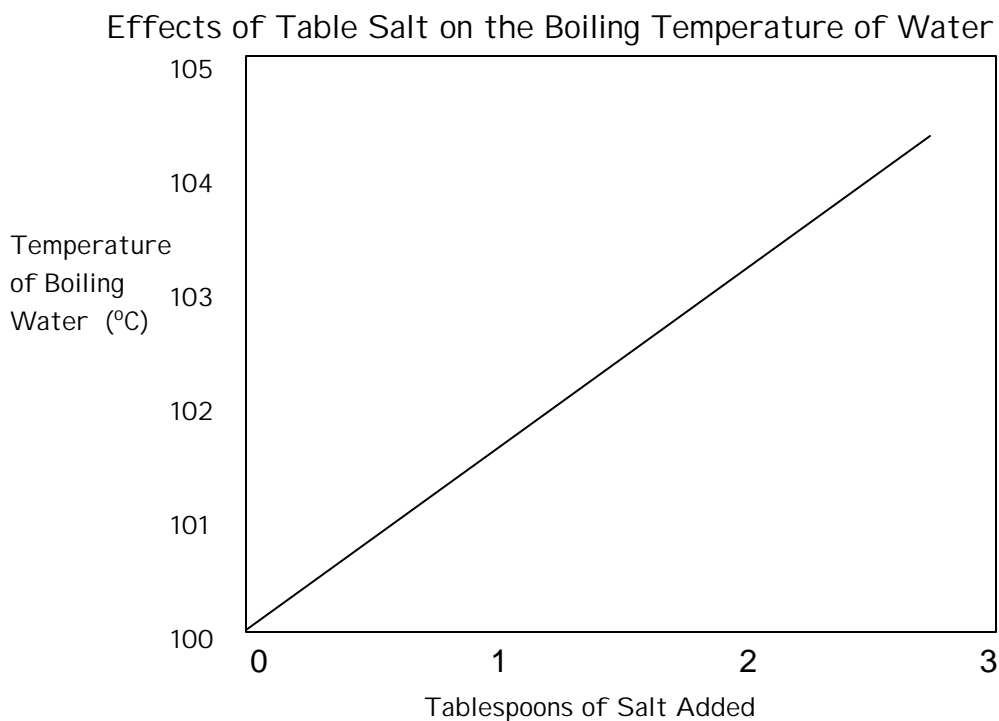
5. Conduct the experiment and keep records

Temperature of boiling water in °C

Amount of salt in tablespoons	Trial 1	Trial 2	Average Temperature
Control 0 tablespoons	100°C	100°C	100°C
1 tablespoons	101°C	103°C	102°C
2 tablespoons	103°C	103°C	103°C
3 tablespoons	104°C	106°C	105°C

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 tablespoon of salt before adding it to the water.

6. Analyze the results



7. Develop 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 too hot.

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

From this experiment, I discovered that the addition of salt to water changes its boiling point. This is why 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 more quickly. 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.

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Thursday, March 14, 2002

Memorial Union Ballroom

Michigan Technological University, Houghton, MI

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). Two judges will score each project independently of each other. Judges will be volunteers from Michigan Technological University and other educators from the community. The judges will determine whether the project meets all the requirements listed in the Student Planning Guide. Students should be available next to their project during their scheduled interview time. The students' interview with each judge will be part of the total score for their project. Projects will receive a composite score from the two judges. Parents should pick up their children after the judging time is over.

WHAT THE JUDGES WILL BE LOOKING FOR

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

Scientific Thought

- Does the project have a title, problem to be investigated and hypothesis clearly stated?
- Does the project represent sincere 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 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 creativity by the student?
- Are the display unit and 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, be sure to give the name, 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 _____

WESTERN UPPER PENINSULA SCIENCE FAIR

Thursday, March 14, 2002
Memorial Union Ballroom at Michigan Technological University, Houghton, MI

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 _____