Financial Sponsors of West Michigan Science Challenge

The Science Challenge Steering Committee wishes to acknowledge and thank the following individuals, organizations and businesses for their generous support for this student program:

Brickley Delong PLC

Nina Brown-George Nielson Award

Gary and Paula Doig

GENTEX Corportation

Gerber Foundation

Grand Valley State University - Annis Water Resources Institute

Marsha Green - GreenDoor Education, LLC

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Ottawa Area Intermediate School District

Thomas W. O'Bryan

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John and Mary Ann Seelman

Gregg Zulauf - EduSci, LLC

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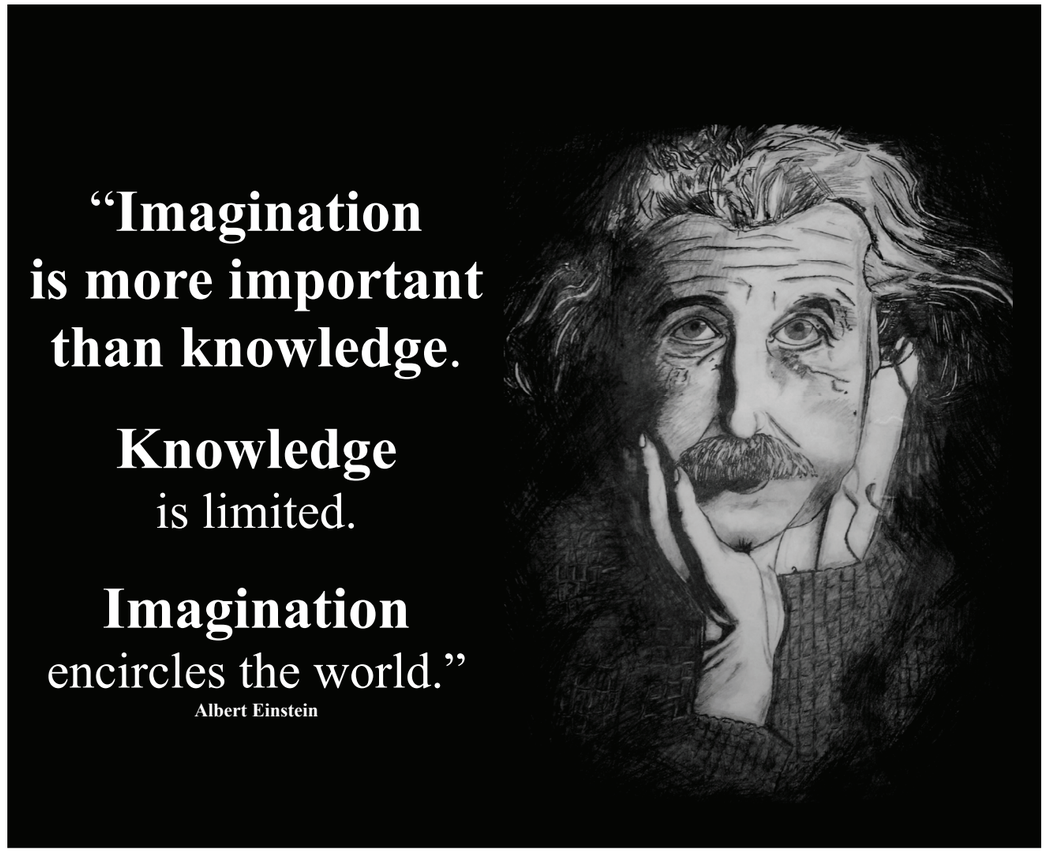
community foundation Muskegon County For good. For ever.

Muskegon Community College

West Michigan *SCIENCE CHALLENGE* *2009*

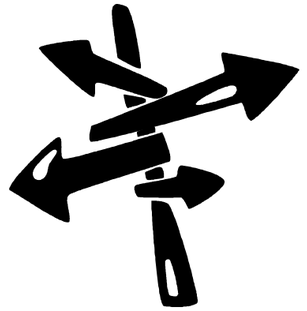


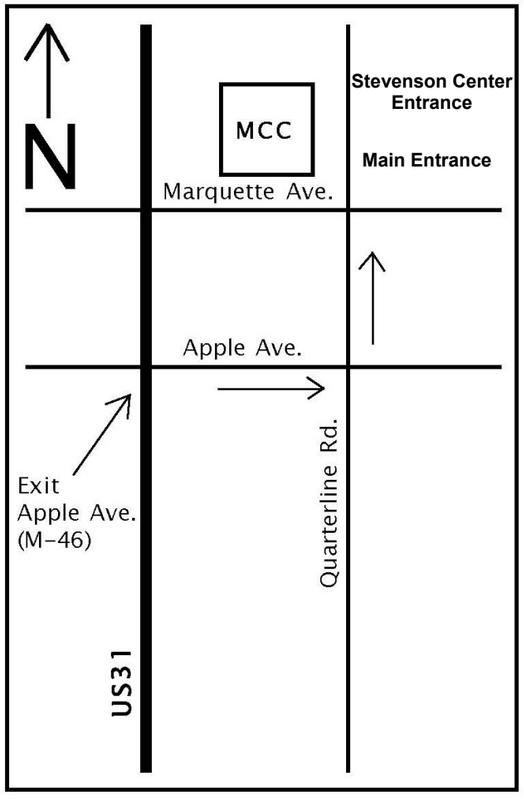
Science Challenge engages students with creative problem solving in the areas of science, mathematics, and engineering. Science Challenge is supported by donations from education, business, industry and civic groups in the West Michigan area.

Guidebook on the web:
http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

WMSC 2008

Directions to Muskegon Community College





From the East:
Take I-96 West to Muskegon
Take exit 1-B and follow US-31 North

Take Apple Avenue exit. Exit east on Apple Avenue and continue to Quarterline Road. There is a traffic signal at Quarterline Road. Turn left (north) on Quarterline. The next traffic signal is at Marquette. Muskegon Community College is located on the northwest corner of Marquette Avenue and Quarterline Road. At Marquette and Quarterline turn left. Entrance to MCC is on your right.

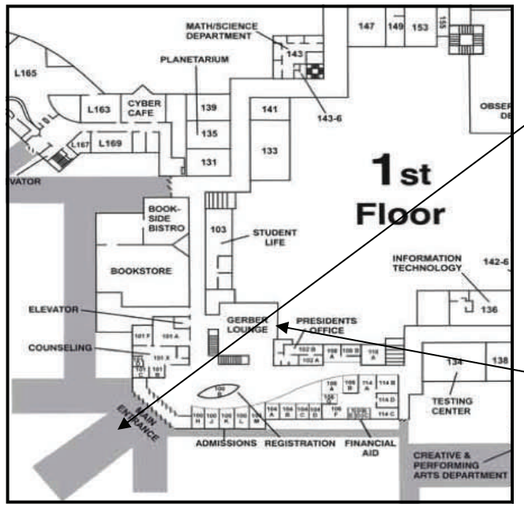
From the North:
Take US-31 South to Muskegon

Take Apple Avenue exit. Exit east on Apple Avenue and continue to Quarterline Road. There is a traffic signal at Quarterline Road. Turn left (north) on Quarterline. The next traffic signal is at Marquette. Muskegon Community College is located on the northwest corner of Marquette Avenue and Quarterline Road. At Marquette and Quarterline turn left. Entrance to MCC is on your right.

From the South:
Take US-31 North to Muskegon

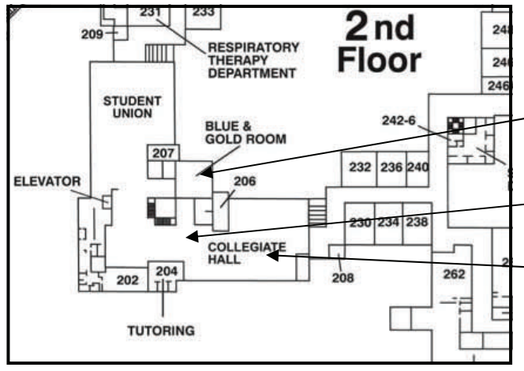
Take Apple Avenue exit. Exit east on Apple Avenue and continue to Quarterline Road. There is a traffic signal at Quarterline Road. Turn left (north) on Quarterline. The next traffic signal is at Marquette. Muskegon Community College is located on the northwest corner of Marquette Avenue and Quarterline Road. At Marquette and Quarterline turn left. Entrance to MCC is on your right.

Muskegon Community College



Main Entrance-Science Challenge

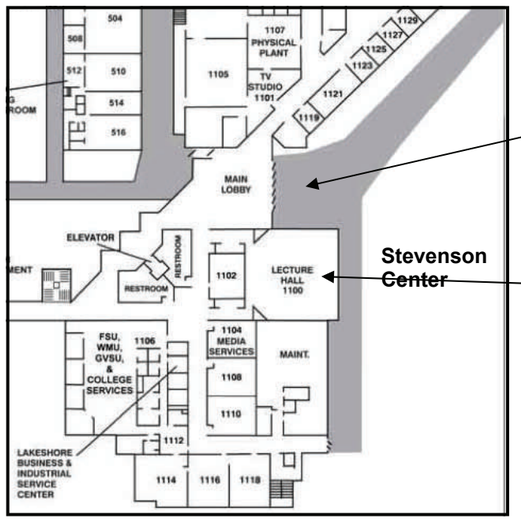
Gerber Lounge-Waiting Area Parents & Students



Blue & Gold Room Judges' Area

Student Registration

Collegiate Hall-Student Projects



Entrance to Stevenson Center

Stevenson Center

Awards Ceremony Room 1100 March 23, 2009 6:00 PM

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Dear Participating Teachers, Adult Sponsors, and Parents:

West Michigan Science Challenge has been a part of this community for twenty-six years. Few student programs can claim such a long and successful history. This longevity is a tribute to the work of the students and teachers in our area and the dedication of the judges and the WMSC Steering Committee. This program would not be possible without the continued support of the Muskegon Area Intermediate School District, Muskegon Community College, and the numerous corporate, service, and individual financial donations received from those listed on the back page of this Guidebook.

WMSC is a regional science fair affiliated with national and international student science fairs. Aligning Science Challenge with state and international fairs has increased the number of opportunities for students to participate in other research events. This past year, eight students were invited to participate in the Society for Science and the Public Middle School Program (formerly Discovery Channel Young Scientists Challenge).

The steering committee has developed many examples and models for students to use on the WMSC website. The judges' scoring rubric is available for students and teachers Also included, are links to other websites with helpful science fair and Science Challenge information.

http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

The WMSC Steering Committee is dedicated to the continued improvement of student science in the classroom and the West Michigan Science Challenge. We welcome your input.

Best wishes for a successful year in science!

West Michigan Science Challenge Steering Committee
Marsha Green, Chairperson
West Michigan Science Challenge
mgreen@muskegonisd.org

MAISD Regional Mathematics & Science Center

West Michigan Science Challenge is a program of the
MAISD Regional Mathematics and Science Center
231-767-7318

"Advancing high quality, innovative teaching and higher student academic performance in mathematics and science."

Required Cover Sheet Format for Project Report (Staple Only)

See Website:
http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

(Sample)

Statement of Problem: Does the height of an incline affect the speed of an object?

Category: Physical Science
Grade: 6
Name: Ima Scientist
School: Investigation Middle School

Total points will be reduced by up to two points for cover sheets missing information.

West Michigan Science Challenge Abstract Form for Grades 5-12

Use this form **only**. Please type on the word processor in 12 point font. Include in Research Paper. Available on the website:
http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

Please summarize your information so your abstract will fit on one page!

Title of Project: MOLDY OLDIES

Problem: (question) Is mold growth affected by different colors of light?
Hypothesis: If mold is subjected to different colors of light, then the purple light will have the smallest amount of growth and the red light will have the greatest amount of growth.

Procedures: Briefly summarize the steps used to conduct this project. Give the main points and general plan of what was done in paragraph form.

I put the same amount and type of bread in identical individual Petri dishes and misted them with the same amount of water. I placed the 5 dishes under five colors of cellophane and placed them in a room with exactly the same conditions. The only variable was the color of the cellophane. My control is the dish covered with clear cellophane. I observed the mold growth for 14 days. I then repeated this procedure two more times.

Results: Briefly describe what was found by doing this project. Explain how the results support or disprove your hypothesis in paragraph form. Do not give tables of data.

I found that the green colored light had the least effect on the mold growth and therefore, the greatest amount of mold grew under green light. None of the other colors produced any mold growth. The same results happened in each of my three trials. This did not support my hypothesis.

Acknowledgements: Use only names of people who helped with this project and how they helped with this project. Do not list schools, industry, institutions, or universities. (This is not a bibliography.)

Mrs. Margaret Johnson - 5th grade teacher - guided my study
Jenny Linde - mother - typed my report

Total points may be reduced by up to five points for Abstracts missing information, using an incorrect form, or being over one page in length.

West Michigan Science Challenge 2009

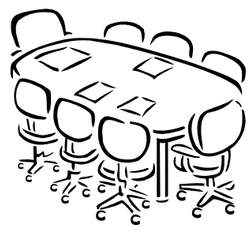
is a student program of the

MAISD Regional Mathematics and Science Center

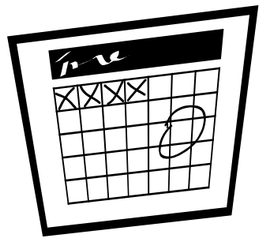
Science Challenge Chairperson
Marsha A. Green
1001 Wesley Avenue
Muskegon, MI 49442
Phone: 231-767-7318
Fax: 231-773-0505
mgreen@muskegonisd.org

www.muskegonisd.org/departments/math-science/studentpgms/science-challenge/

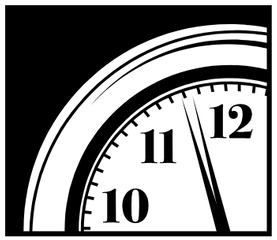
Steering Committee Members:



Gary Doig
Kris Gale
Paula Halloran
Laura Holwerda
Jessica O'Donnell
Diane Krasnewich
Dave Krebs
Dawn Kohn
Laurie Perham
Bill Dinklemann
John Seelman
Mary Ann Seelman
George Strabel
Gregg Zulauf



Important Dates



Activity	Date	Time	Location
Science Challenge Applications Due	Thursday, March 5, 2009	**MUST be received by** March 5, 2009	MAISD Regional Math & Science Center
Mail in **5 Copies** of Project Report	Thursday, March 5, 2009	**MUST be received by** March 5, 2009	MAISD Regional Math & Science Center
Set Up Projects	Thursday, March 19, 2009	12:00-3:00 p.m.	Collegiate Hall Muskegon Community College (MCC)
Judges View Projects No students or parents	Thursday, March 19, 2009	3:00-4:00 p.m.	Collegiate Hall MCC
Judges' Interviews (Students Only)	Thursday, March 19, 2009	4:00-6:00 p.m. (approximately)	Collegiate Hall MCC
Public Open House & Special Award Judging	Thursday, March 19, 2009	6:00-7:00 p.m. (approximately)	Collegiate Hall MCC
Student Projects-Cleared from MCC	Thursday, March 19, 2009	7:00-7:30 p.m.	Collegiate Hall MCC
Award Winners PostedOn Website	Friday, March 20, 2009	After 3:00 p.m.	See web address Page 2
Awards Ceremony	Monday, March 23, 2009	6:00-7:00 p.m.	MCC-Stevenson Higher Ed Center Room 1100
Michigan High School Symposium	TBD	By Invitation Only	Grand Valley State University-Eberhard Center

Requirements for Successful Science Challenge Projects

7. Results: divided into three areas (See pg. 14)
   - ☐ Data Tables - Trials and averages-mean, median, mode (Chi Square or t Test)
   - ☐ Graphs - Only the important averages of data.
   - ☐ Written Results - Discuss the data and graphs in words. What do they mean?
8. Conclusions (See pg.14)
   - ☐ Was your hypothesis supported or not supported by your data?
   - ☐ How did you come to this conclusion? Refer to tables and graphs
   - ☐ Compare your results to others' work or commonly held beliefs.
   - ☐ Discuss problems or errors you may have had during the investigation.
   - ☐ Make suggestions for changes or solutions to the above problems.
   - ☐ Who would benefit from seeing the results of this project and why?
   - ☐ How could this project be continued or expanded?
9. Bibliography/References (See correct format on website.)
   - ☐ Document any materials, ideas or discussions used that are not your own.
   - ☐ Credit anyone who assisted you in anyway.

Oral Summary

- ☐ Prepare a 2-3 minute summary of the most important parts of the project to present to judges and others.
- ☐ Introduce yourself-shake hands.
- ☐ Speak slowly and clearly.
- ☐ Look at the person to whom you are speaking
- ☐ Be serious-NO GUM.

Backboards should: (Sample layouts available on the website)

- ☐ Attract attention plus inform
- ☐ Be clear, concise, neat, and organized
- ☐ Use headings which stand out and different colors to back printed material
- ☐ Use charts, graphs, pictures, photographs, and/or drawings
- ☐ Have all spelling checked
- ☐ Follow all rules for size (see page 6)
- ☐ White cardboard display boards are available for purchase at the MAISD Regional Mathematics & Science Center for $2.00 (Minimum of 5 boards. Large quantities available)

Backboard Information

- ☐ Title-attention grabber
- ☐ Problem-clear question
- ☐ Procedures-brief outline
- ☐ Hypothesis-the original hypothesis
- ☐ Results-written summary plus **summarize** graphs, charts, and drawings, etc.
- ☐ Conclusion-written summary

Display Items

- ☐ Nothing fragile or expensive
- ☐ Use photographs or a simulation if necessary
- ☐ MCC and WMSC take no responsibility for lost or damaged property
- ☐ Follow safety and display procedures (See page 7)
- ☐ Bring an extension cord (25 feet) if needed for electricity (110 volts)
- ☐ LOG BOOK
- ☐ REPORT

Checklist for Student Planning

General Requirements	Date Started	Date Completed
1. Project Log		
2. Abstract-using Template (p. 25)		
3. Research Paper-typed with correct Cover Sheet (p. 26) - 9 different sections		
4. Display with Backboard		
5. Oral Summary		

Requirements for a Successful Science Challenge Project

Project Log should include: (See Page 10 in Teacher's section for more details)

- ☐ Keep in a spiral or other bound notebook-bring to display on Science Challenge Day
- ☐ Number the pages
- ☐ Project title and your name on the first page
- ☐ Second page-table of contents-do this last
- ☐ Keep records and notes of: interviews, videos, magazines, websites
- ☐ Diagrams of designs of special tools or models used in project
- ☐ Date and time of all work
- ☐ Notes on all experiments
- ☐ Work for math calculations plus correct units
- ☐ No erased errors-put a line through them
- ☐ Never tear out a page or recopy-Project Logs are not always pretty!

Abstract (See Page 10, Page 25 for a sample, or go to the website)

- ☐ An Abstract is a **summary** of your project.
- ☐ It will be one of the last items to be completed.
- ☐ There is a writeable form on the website to use.
- ☐ Follow the form **exactly**. Only the **one** page form is allowed.
- ☐ It is required as part of the project report

Research Paper (Items **must** be in this order) (Make 5 copies **but keep the original**). Use a minimum of size 12 font with an easily readable font such as "Times New Roman" or "Arial".

1. Cover Sheet - Follow the form exactly as it appears. Example on page 26.
2. Abstract (see above)
3. Table of Contents - Include a page number for the beginning of each section.
4. Introduction - 4 parts:
   - ☐ Problem statement - Is the problem a testable question? (See page 8 for clarification)
   - ☐ Research information - Research about the Independent and Dependent Variables to be studied in this project. This is the main body of the introduction.
   - ☐ Reasons for research - Why is this project important?
   - ☐ Hypothesis - *(*See page 12 for clarification)
5. Materials List (See website for examples and page 13)
   - ☐ Name of material, size or description
   - ☐ Number used
   - ☐ Uses for the material
6. Methodology (Procedures)
   - ☐ Detailed listing of the methods used to collect data or observations
   - ☐ Define Independent and Dependent variables, constants and controls (See Pg. 12)
   - ☐ Include photographs or drawings of self-designed equipment
   - ☐ Be very detailed with information

Detailed Schedule for Science Challenge

12:00-3:00 p.m. - Registration and project set-up. Some students come during their lunchtime to set up and register. They then return to their school. Others (usually from greater distances) come in later (2:00) and stay at the college. In other cases, parents come in to register and set-up for the student. All set-up and registration **must be completed** by 3:00 p.m. Students are not required to be with their projects until 4:00 p.m.

3:00-4:00 p.m. - The judges view projects. There are **no students or parents** allowed by the projects at this time. Students who are staying at MCC may wait in the Gerber Lounge by the main entrance.

4:00-6:00 p.m. - Judges interview students at their projects. Judges may interview as a team or separately. It is important for the students to remain at their projects during this time, as judges may return to a project after the initial interview. In addition, pictures and videos are taken during this time. **No other people are allowed in the judging areas**. Students are free to read, work on homework, etc. during the times they are not being judged. Parents may wait and view general judging of projects in the Gerber Lounge.

6:00-7:00 p.m. - Public viewing of projects. This is a very important time. Parents, friends, relatives, the public, and sponsors get their first and only look at **all** the projects. **During this time, the committee and selected judges are also looking at projects for special awards.** Students are asked to stay with their projects and explain their work to viewers.

7:00-7:30 p.m. - All projects/materials **must** be cleared from the college. Science Challenge and MCC are not responsible for abandoned projects.

Science Challenge Website

The official Science Challenge website includes additional information regarding Science Challenge. Found on the web will be examples of display boards and rubrics for further clarification of scoring. It will also be the site of award announcements on the Friday following the fair. Website address:

http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

Available on the WMSC website:

- **Rubrics-used to score by judges**
- **Log book sample and templates**
- **Graphing sample**
- **Abstract-writeable form**
- **Abstract samples**
- **Title Page template**
- **Scientific Method explanations**
- **Alignment to Michigan Content Expectations**
- **Individual and Team registration forms-writeable**
- **Backboard Display samples**
- **Student written examples**
- **Bibliography examples**
- **Math analysis examples**

What is West Michigan Science Challenge?

Science Challenge is an opportunity for 5th through 12th grade students and student teams to develop science experiments during the school year and submit them for judging and exhibition. Using methods employed by scientists, students demonstrate creative inquiry and problem solving skills.

Who May Enter?

Students in Muskegon, Oceana, Ottawa or Newaygo Counties enrolled in grades five through twelve are eligible to enter. Students may enter a project individually or as a member of a team. **Teams may consist of only two (2) students.** The contest is divided into four grade divisions: grades 5-6, 7-8, 9-10, and 11-12. A student may enter only **one** project.

Each school building is limited to one (1) project per 20 students per grade **or** three (3) projects per grade, whichever is **greater**. To determine the number of projects eligible per building, simply total the number of students **in that grade in your building** and **divide by 20**. Repeat this calculation for each building. For example: to determine the number of 5th grade projects eligible, divide the total number of 5th graders in your building by 20 (68 fifth graders ÷ 20 = 3.4 (rounded to) = 3 fifth grade projects). Similarly, 78 sixth graders ÷ 20 = 3.9 (rounded to) = 4 sixth grade projects. In the above examples, three (3) fifth grade projects and four (4) sixth grade projects are eligible for Science Challenge. **The above formula is to be used for all grade levels 5-12**. Please be accurate, as these numbers will be verified. (Exceptions may be considered for unusual circumstances)

Adult Sponsors

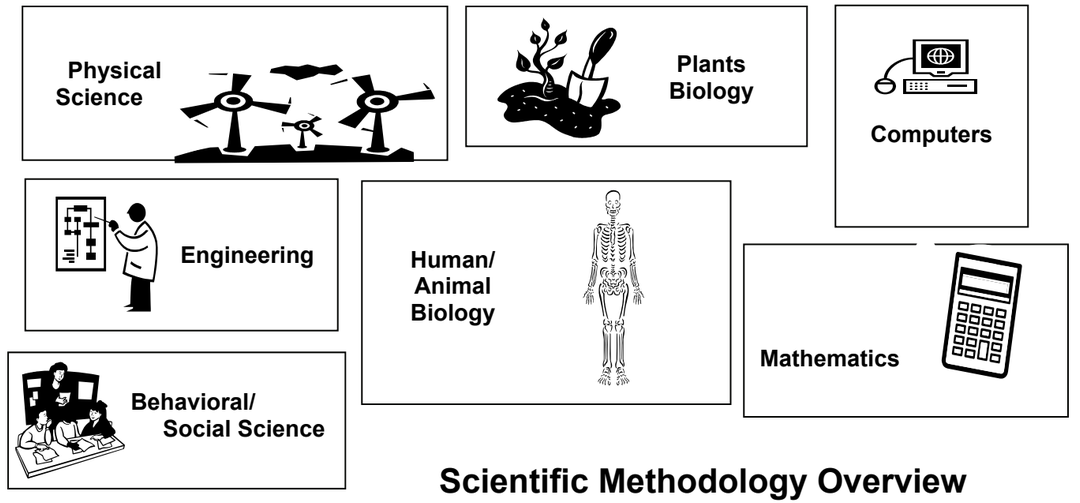
Students **must** have an adult sponsor. An adult sponsor may be a teacher, parent, university instructor, or scientist in whose lab the student is working. This person must have a solid science, math, computer, or engineering background and should have close contact with the student during the course of the project. The adult sponsor is ultimately responsible for the student conducting the research, as well as the human subjects or animals used for research. The adult sponsor must be familiar with the regulations that govern potentially dangerous research as it applies to a specific project. For more information regarding these issues use this website:
http://www.sciserv.org/isef/primer/rules_regulations.asp

Before beginning a science fair project, as an adult sponsor, have students fill out any form necessary for the following research areas:

1. Vertebrate animals-non human
2. Dangerous or illegal substances
3. Human subjects
4. Controlled substances
5. Recombinant DNA
6. Hazardous substances or devices
7. Microorganism
8. Pathogenic agents
9. Human or animal tissue

What Kinds of Projects

As a student, you need to choose a project in an area of science that interests you.
The project you choose must fit into one of the following categories:



Scientific Methodology Overview

The scientific method is a way to ask and answer scientific questions by making observations and doing experiments.

The steps of the scientific method are to:

- Ask a Question
- Do Background Research
- Construct a Hypothesis
- Test the Hypothesis by Doing an Experiment*
- Analyze Data and Draw a Conclusion
- Communicate Results

*It is important for your experiment to be a fair test. A "fair test" occurs when the experimenter only changes one variable at a time while keeping all other conditions constant.

Understanding How Science Works

Some non-scientific questions can be rewritten as questions that can be investigated scientifically. For example, the question “Which battery is best?” is **non-scientific** because “best” cannot be measured. However, the question could be rewritten to focus on a measurable quality of a battery, such as how long a battery works.

More information about project choices may be found in the teachers’ section on page 9.
The WMSC Steering Committee and its judges may reclassify any project.
Questions? mgreen@muskegonisd.org

Why Participate in West Michigan Science Challenge? What's In It For You?

All Participants Will Receive:

- Cool West Michigan Science Challenge T-Shirts
- West Michigan Science Challenge Certificate-mailed to schools
- West Michigan Science Challenge Bumper Sticker

Individual Place Winners in Each Category/Grade Level Will Receive:

- First Place - $200 Savings Bond and large place ribbon
- Second Place - $100 Savings Bond and large place ribbon
- Third Place - $50 Savings Bond and large place ribbon
- Honorable Mention - Place ribbon

Each Team Place Winners in Each Category/Grade Level Will Receive:

- First Place - $100 Savings Bond and large place ribbon for each team member
- Second Place - $50 Savings Bond and large place ribbon for each team member
- Third Place - $15 and large place ribbon for each team member
- Honorable Mention - Place ribbon for each team member

Gerber Foundation Awards:

- Grade 12 - $500 Savings Bond
- Grade 11 - $400 Savings Bond
- Grade 10 - $300 Savings Bond
- Grade 9 - $200 Savings Bond

Society for Science and the Public Middle School Program for Grades 5-8:
If you are nominated for the SSPMSP by the WMSC Steering Committee, you may choose to fill out a booklet about you and your science project and send it in to DCYSC. Eight 2008 WMSC students were nominated by WMSC.

Other Awards:
Several people, organizations, and businesses present awards to projects that best fit their interests. This may include project(s) that do not win a place award. These awards may be a bond, plaque, trophy or other awards. Projects qualifying for special awards may be judged again during the public viewing from 6:00-7:00 p.m.

Award Ceremony:
WMSC Award Ceremony is held at Muskegon Community College's Stevenson Center for Higher Education on Monday, March 23, at 6:00 PM. Please plan on attending! The public is also invited.

Students:
You are competing against a standard of excellence. This means the judges may award one, none, or several place awards. More than one project may receive a place award. This also means judges may decide no project deserves an award. **The decision of the judges is final.**

West Michigan Science Challenge
Rules and Regulations

1. Display must be durable with all parts firmly attached. No attachment to walls or tables will be allowed.
2. Display must not exceed maximum size requirements. Table Displays-4 ft wide x 2 ft deep x 6 ft tall. Floor Displays-4 ft wide x 2 ft deep x 9 ft tall.
3. All display limitations must be followed (see Display and Safety Regulations page 7).
4. Every student must have an adult sponsor: (e.g. teacher, administrator, or science professional-see page 5).
5. No project may use consumable alcohol, tobacco, or illegally obtained narcotics.
6. Only one exhibit will be allowed per student. Projects in the Team Category must be limited to two students. A registered team project **cannot** be converted to an individual project. **Both members of the team** must be available for judging interviews. (Points will be divided in half for the interview and display portion of the scoring if only one team member is present.)
7. All experimental work must be done by the student. Adults may supply materials, advice, consultation, and typing help.
8. The Science Fair Steering Committee reserves the right of refusal of an exhibit which it deems unsafe or unsuitable for public exhibition.
9. The project may have begun at any time from January 2008 to March 2009. A previously investigated topic may continue under investigation, but data previously displayed must be treated as "research". New data must be generated, displayed, and conclusions drawn based on new data.
10. **Projects must adhere to all Federal, State, and Local laws.** Rules regarding Human Subjects, Recombinant DNA, Controlled Substances, Hazardous Substances or Devices, Non-Human Vertebrate Animals, Human and Animal Tissue, and Pathogenic Agents can be found at: **http://www.sciserv.org/isef/primer/rules_regulations.asp**
11. All students entered must be in 5th-12th grade and attend a school or home school in Muskegon, Oceana, Newaygo, or Ottawa County at the time of the fair. Schools are limited in the number of projects they may enter (See "Who May Enter?" page 5). Numbers are monitored and schools will be penalized for not adhering to these rules.
12. Plagiarism will result in disqualification. All material (including Internet) must be cited.
13. Projects may be disqualified for not following any of the above rules and regulations.

West Michigan Science Challenge
Display and Safety Regulations

Unacceptable for Display:

1. Living organisms
2. Taxidermy specimens or parts
3. Preserved vertebrate or invertebrate animals
4. Human/animal parts or body fluids (e.g., blood, urine) Exceptions: teeth, hair, nails, dried animal bones, histological dry mount sections, and wet mount tissue slides
5. Waste samples
6. Laboratory chemicals
7. Poisons, drugs, controlled substances, hazardous substances or devices (i.e., fire arms, weapons, ammunition, reloading devices)
8. Dry ice or other sublimating solids
9. Sharp items (i.e., syringes, needles, pipettes, knives)
10. Flames or highly flammable materials
11. Empty tanks that previously contained combustible liquids or gases, UNLESS purged with carbon dioxide
12. Batteries with open top cells
13. Awards, medals, business cards, flags, etc.
14. Photographs or other visual presentations depicting vertebrate animals in other-than-normal conditions (i.e., surgical techniques, dissections, necropsies, or other lab techniques)
15. Active Internet or e-mail connections
16. Glass or glass products

Acceptable for Display Only:
(Cannot be operated)

1. Projects with unshielded belts, pulley, chains, and moving parts with tension or pinch points
2. Class III or IV lasers
3. Any device requiring voltage over 110 volts

Acceptable for Display & Operations:
(with restrictions)

1. Class II lasers:
    a. Must be student operated
    b. Posted sign must read **"Laser Radiation: Do Not Stare into Beam"**
    c. Must have protective housing that prevents access to beam
    d. Must be disconnected when not in use
2. Large vacuum tubes or dangerous ray generating devices must be properly secured.
3. Pressurized tanks that contained non-combustibles may be allowed if properly secured.
4. Any apparatus producing temperatures that will cause physical burns must be adequately insulated.
5. High-voltage equipment must be shielded with a grounded metal box or cage to prevent accidental contact.
6. High-voltage wiring, switches, and metal parts must have adequate insulation and overload safety factors, and must be inaccessible to others.
7. Electric circuits for 110-volt AC must have a 25-foot cord. The cord must have sufficient load carrying capacity and approved by Underwriters Laboratories.
8. Electrical connections must be soldered or made with approved connectors. Connecting wires must be insulated.
9. Bare wire and exposed knife switches may be used only in circuits of 12 volts or less; otherwise, standard switches are required.

Please consult the following website for help with rules of display and use:
http://www.sciserv.org/isef/primer/rules_regulations.asp

Student Section of the West Michigan Science Challenge Guidebook

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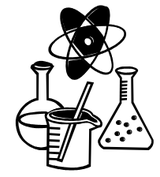
Dear Student Scientists,

West Michigan Science Challenge welcomes you to an exciting way of doing science-the way real scientists work-developing science experiments! Plus, this experiment can be about an area of science that really interests you.

There are rules which teachers, parents and others will help you follow. This project will also require a lot of work and take many weeks to finish. But, in the end, you will have accomplished a scientific experiment to proudly display to others. This could be just the beginning of something great. Are YOU ready for Science Challenge?



Sincerely,
West Michigan Science Challenge Steering Committee
Marsha Green, Chairperson
mgreen@muskegonisd.org

Schedule for Science Challenge Day-March 19

12:00-3:00 p.m. - Registration and project set-up. The student (or a parent or teacher) must register and have the project set-up **by 3:00 p.m**. All set-up and registration must be completed by 3:00 p.m. Students are not required to be with their projects until 4:00 p.m.

3:00-4:00 p.m. - The judges view projects only. There are **no students or parents** allowed in the room with projects at this time. Students who are staying at MCC may wait in Gerber Lounge.

4:00-6:00 p.m. - Judges interview students at their projects. Judges may interview as a team or separately. It is important students remain at their projects during this time as judges may return to a project after the initial interview. In addition, pictures and videos are taken during this time. **No other people are allowed in the judging areas**. Students may read, work on homework, etc. during the times they are not judged.

6:00-7:00 p.m. - Public viewing of projects. This is a very important time. Parents, friends, relatives, judges, the public, and sponsors get their first and only look at **all** the projects. **During this time, the committee and selected judges are also looking at projects for special awards.** Students are asked to stay with their projects and explain their work to viewers.

7:00-7:30 p.m. - All projects/materials must be cleared from the college. **Science Challenge and MCC are not responsible for abandoned projects.**

What are the Benefits?

Educational Benefits:

- Students Participate in “Real World Science”
- Students Talk with Actual Scientists and Professionals from Scientific Fields
- Students Can Network with Other Students
- Content Aligned to Michigan Content Expectations (See WMSC website)
- High School Students may Present Research to College Instructors
- Integration of Subjects-Students Form Connections Between Different Subjects

Individual Place Winners Will Receive:*

- First Place - $200 Savings Bond and Place Ribbon
- Second Place - $100 Savings Bond and Place Ribbon
- Third Place - $50 Savings Bond and Place Ribbon
- Honorable Mention - Place Ribbon

Team Projects Will Receive:*

- First Place - $50 Savings Bond and Place Ribbon for each Team Member
- Second Place - $25 Savings Bond and Place Ribbon for each Team Member
- Third Place - $15 and Place Ribbon for each Team Member
- Honorable Mention - Place Ribbon for each Team Member

Gerber High School Awards:

- Grade 12 - $500 Savings Bond
- Grade 11 - $400 Savings Bond
- Grade 10 - $300 Savings Bond
- Grade 9 - $200 Savings Bond

Society for Science And The Public Middle School Program (SSPMSP)
Award-winning projects in grades 5-8 may be nominated by the WMSC Steering Committee. The SSPMSP Students may submit an entry booklet by the June deadline. Information will be given to nominees. This is a nationwide science competition. WMSC has had semi-finalists each year and a finalist in 2007.

Teacher/School Awards:
The teacher or sponsor of a first-place team or individual project will be recognized with a $100 grant for the purchase of classroom science materials.

Sponsor Awards:
Several professional organizations and individuals will present awards to projects (individual or team) that best represent a specific area of interest. These awards are in addition to the place awards and may consist of bonds, plaques or other awards.

Michigan Science Symposium:
High school students may be asked to present their projects at Grand Valley State University. College instructors from all over Michigan are invited to attend.

All Participants Will Receive:
West Michigan Science Challenge T-Shirt & West Michigan Science Challenge Certificate, and WMSC bumper sticker.

Students should recognize that they are competing against a standard of excellence. Therefore, multiple awards or a limited number of awards may be given in any category. For example, if more than one project deserves a "first" ranking, more than one award will be presented. On the other hand, judges may determine that no project in a given category* deserves a "first" ranking. **The decision of the judges will be final.

Scientific Methodology Overview

The scientific method is a way to ask and answer scientific questions by making observations and doing experiments.

The steps of the scientific method are to:

Ask a Question

- Ask a Question
- Do Background Research
- Construct a Hypothesis
- Test the Hypothesis by Doing an Experiment*****
- Analyze Data and Draw a Conclusion
- Communicate Results

*****It is important for your experiment to be a fair test. A "fair test" occurs when the experimenter only changes one variable at a time while keeping all other conditions constant.

The Scientific Method and The Engineering Process

This is comparison and contrast between The Scientific Method and The Engineering Process. Students designing a new prototype should use the engineering process. There is a scoring rubric for each of these on the WMSC website:
http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

The Scientific Method	The Engineering Process
State the problem as a question	Define a need
Do background research	Do background research
Form hypothesis, identify variables	Establish design criteria
Design experiment, establish procedure	Prepare preliminary designs
Test hypothesis by doing an experiment	Build and test a prototype
Analyze results & draw conclusions	Test & redesign as necessary
Present results	Present results

Clarification of Problem Statement

The problem should be stated as a testable question that does not have a yes or no answer (nor does it include the word “best”). The answer to the question has results, which are able to be graphed. If the answer to the question is known because it is obvious, a new problem statement (question) is needed. Example: Does the height of a bean plant determine how many beans the plant will produce? What is the effect of the (independent variable) on the (dependent variable)? See website for more examples:

http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

What Types of Projects May Be Submitted?

Projects must be entered in one of five categories listed below. Both Teacher or Adult Sponsor and student should agree on the primary emphasis of the project. Science Challenge officials reserve the right to reclassify projects.

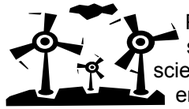
1. Plant (Non-Animal) Biology

Projects based upon investigations and experiments utilizing plant/non-animal subjects. Investigations may be in, but not limited to: terrestrial and aquatic plants, ecology, biochemistry, disease, pesticides, molds, lichens, pollution, plant physiology, photosynthesis, organic breakdown, recycling of nutrients, plant bacteria, and biological waste products.

2. Human/Animal Biology

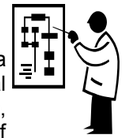
Projects based upon investigations and experiments that affect the biological measurements of humans and other animals. Investigations may be in, but not limited to: anatomy, physiology, biochemistry, disease, yeasts, human/animal bacteria, and nutrition.

3. Physical Science



Projects based upon investigations and experiments dealing with physics, chemistry, or earth science. Investigations may be in, but not limited to: astronomy, mechanics, optics, material science, thermodynamics, electricity, pollution, minerals, and principles of solar energy, wind energy conversion, fossil fuels, and light.

4. Engineering/Computers/Mathematics



a. **Engineering** projects require students to design and build (or construct) a product that solves a unique problem. These projects directly apply scientific principles to manufacturing and practical uses-civil, mechanical, aeronautical, chemical, electrical, photographic, sound, automotive, marine, heating and refrigerating, transportation, or environmental engineering. While many of these areas appear in the Physical Science area, the distinction is engineering projects involve the **design** and **building** of a new product, which solves a problem. (Kits are not allowed.)

b. **Computer** projects may be in the form of computer hardware or software enhancements, and software development.

c. **Math** projects may include the development of various mathematical algorithms, models and expressions, theorems and original proofs as well as the application of these principles in the areas of calculus, geometry, abstract algebra, number theory, statistics, and complex analysis or probability.

5. Behavioral/Social Sciences

Projects based upon investigations and experiments that affect the **behavior** of humans or animals (both individuals and groups) in the following areas: social and community relationships, psychology, sociology, anthropology, archeology, linguistics, learning, urban problems, and educational testing.

Understanding How Science Works

Students need an understanding about the nature of science. Students must learn to distinguish between a scientific question that can be tested or investigated and questions that are not scientific. Some non-scientific questions can be reframed as questions that can be investigated scientifically. For example, the question "Which battery is best?" is non-scientific because "best" cannot be measured. However, the question could be rewritten to focus on a measurable quality of batteries, such as length of a battery's working life.

Help in Classifying a Project

The Science Challenge Steering Committee and its judging staff reserve the right to reclassify any project. If there is a question about project classification, please email Marsha Green at mgreen@muskegonisd.org.

Individual Entry Blank On Page 17

Team
Project Entry Blank

Due No Later Than March 5, 2009!

No Entries Will Be Accepted After March 5, 2009

Please Print

Mail to: Science Challenge 2009, c/o MAISD Regional Mathematics and Science Center, 1001 Wesley Avenue, Muskegon, MI 49442. Send with **five** copies of the student report.

Team Member 1 Name: _____ (Last / First / Middle)

Team Member 2 Name: _____ (Last / First / Middle)

Team Member 1 Home Address: _____ (Street / City / Zip)

Team Member 2 Home Address: _____ (Street / City / Zip)

Team Member 1 Home Phone: _____

Team Member 2 Home Phone: _____

School: _____ Address: _____

City: _____ Zip: _____ School Phone: _____ School Fax: _____

Grade: _____ Science Teacher: _____

Category of Entry: (circle one)

Plant Biology *Human/Animal Biology* *Physical Science* *Engineering* *Math* *Computers* *Behavior/Social Science*

Project Problem Statement (question): _____

Electricity Needed? Yes *or* No **Display Will Set On:** Floor *or* Table

Team Member 1 - Shirt Size (adult): Small ____ Medium ____ Large _____ Extra Large ____ Extra-Extra Large ____

Team Member 2 - Shirt Size (adult): Small ____ Medium ____ Large _____ Extra Large ____ Extra-Extra Large ____

We hereby certify that we **have a copy of** the entire 2009 GUIDEBOOK and our project is the result of our own efforts and was not prepared for us by other persons or organizations. We agree to abide by all rules and regulations or be subject to disqualification. We will not hold the Science Challenge organization, Muskegon Community College, or the Muskegon Area Intermediate School District liable for loss, damage, or theft to my exhibit while in their possession. Photos of registrants and/or projects may be used by Science Challenge for educational and/or advertising purposes. Students needing a guidebook should email mgreen@muskegonisd.org or download from Science Challenge website: **http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/**

Team Member 1 Student Signature: _____ (required) Date

Team Member 2 Student Signature: _____ (required) Date

Team Member 1 Parent Signature: _____ (required) Date

Team Member 2 Parent Signature: _____ (required) Date

Team Member 1 Parent Name (Please Print): _____

Team Member 2 Parent Name (Please Print): _____

Teacher Signature: _____ (or Adult Sponsor) (required) Date

Teacher Email Address: _____ (or Adult Sponsor) (required)

Do not sign unless all information above is completely accurate, and you have read your own copy of the 2009 WMSC Guidebook.

Team Entry Blank
On Page 18

Individual
Project Entry Blank

Due No Later Than March 5, 2009

No Entries Will Be Accepted After March 5, 2009

Please Print

Mail to: Science Challenge 2009, c/o MAISD Regional Mathematics and Science Center, 1001 Wesley Avenue, Muskegon, MI 49442. Send with **five** copies of the student report.

Name: _____
Last First Middle

Home Address: _____ City: _____ Zip: _____

Home Phone: _____ Parent/Guardian: _____

Grade: _____ Science Teacher: _____

School: _____ Address: _____

City: _____ Zip: _____ School Phone: _____ School Fax: _____

Category of Entry: (circle one)

Plant Biology *Human/Animal Biology* *Physical Science* *Engineering* *Math* *Computers* *Behavior/Social Science*

Project Problem Statement (question): _____

Electricity Needed? Yes *or* No **Display Will Set On:** Floor *or* Table

Shirt Size (adult): Small ____ Medium ____ Large _____ Extra Large ____ Extra-Extra Large ____

Student Signature: _____ Date: _____

I hereby certify that I **have a copy of** the entire 2009 GUIDEBOOK and my project is the result of my own efforts and was not prepared for me by other persons or organizations. I agree to abide by all rules and regulations or be subject to disqualification. I will not hold the Science Challenge organization, Muskegon Community College, or the Muskegon Area Intermediate School District liable for loss, damage, or theft to my exhibit while in their possession. Photos of registrants and/or projects may be used by Science Challenge for educational and/or advertising purposes. Students needing a guidebook should email mgreen@muskegonisd.org or download from Science Challenge website: **http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/.**

_____
Parent Signature (required) Date

_____
Teacher or Adult Sponsor Signature (required) Date

_____
Teacher or Adult Sponsor Email Address (required)

Do not sign unless all information above is completely accurate, and you have read your own copy of the 2009 WMSC Guidebook.

Successful Science Challenge Projects

Project Log: The Log (notebook) is a **dated** "diary" of all student work. Notes should be accurate and detailed. Good notes show consistency and thoroughness to the judges. All data must be included as well as drawings and designs. The log will help when writing the research paper. Logs should **not** be recopied. **Logs must be displayed with project.**

There is a template for the log book on the Science Challenge Web Site:
http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

Recommendations for keeping the Project Log:

- The Project Log should be kept in a spiral or other bound notebook.
- Number the pages of the log.
- Put the project title and student's name on the first page of the log.
- Reserve the second page of the log for a table of contents. This can be completed as work is done on the project.
- The Project Log should include records of any of these activities in which the student participates:
  - Name, date, time, and location of anyone interviewed.
  - Names of any videos, television shows, magazines, books, or websites viewed or read while researching the project. Use these notes later to write the bibliography for the written report.
  - If a special tool or model is made by the student for the project, include any designs or drawings.
- When making observations or collecting data, write down the date and time.
- Show all the work for any calculations done. Include the proper units. Do **not** erase errors. Put a line through them and start again. Project Logs are not always pretty!
- Never tear a page out of the Project Log. Do not recopy the Log. The Log is scored on what it contains, not how it looks.

Abstract: After finishing research and experimentation, students are required to write a **one page** abstract using the template on page 25. It is available in a writeable format on the Science Challenge site:
http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

An Abstract is a summary, not a complete report. Abstracts must include the following:

1. **Problem** (question) and **hypothesis** of the experiment
2. **Summary of procedure** or methods used
3. **Summary of results** (no graphs, tables etc.)
4. **Acknowledgments**

The abstract must be included with the research paper. (See Abstract Form Page 25)

Attention: If a required section of the research paper is intentionally omitted, please state what was omitted and why it was omitted.

The Research Paper Must Contain These Parts In This Order:

(Examples of student papers are on the West Michigan Science Challenge website.)

a. **Cover Sheet** - The front cover of the report must look like the cover sheet on page 26. Staple a cover sheet to the top of each copy of the report. **Do not use paper clips, notebooks, folders, or plastic report covers of any kind.**

b. **Abstract** - A one page summary (using template on page 26) of the paper. Problem, hypothesis, methodology (procedures), results, and acknowledgments are included. The template is also available in a writeable format on the West Michigan Science Challenge website: **http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/**

c. **Table of Contents** - Include a page number for the beginning of each section.

d. **Introduction** - The introduction should be written separated into four parts:
(1) Problem statement - Is the problem a testable question? (See page 8 for clarification)
(2) Research information - Research about the Independent and Dependent Variables to be studied in this project. This is the main body of the introduction.
(3) Reasons for research - Why is this project important?
(4) Hypothesis - (See page 12 for clarification)

e. **Materials List** - Include everything used in the experiment, the number used, and use. (See page 13)

f. **Methodology (procedures)** - Describe in detail the methods used to collect data or make observations. This is where to define the Independent and Dependent Variables, controls, and constants. (See page 12 for clarification). The procedures should be detailed enough that someone would be able to repeat the experiment from the information in your paper. Include photographs or drawings of self-designed equipment.

g. **Results** - Results should be divided into three areas:
(1) ***Data Table(s)*** - should include all trial results as well as **mean, median, and mode***.
(2) ***Graph(s)*** - illustrate the important **averages** of data. Template available on website*.
(3) ***Written results*** - Discuss your data table(s) and graph(s). This section is a written account of the results*.
*Additional statistical tests may also be appropriate such as the ***Chi squared*** test or the ***t Test*** for more advanced students.

h. **Conclusion** - This is the most important part of the paper. Be thorough. Was the hypothesis supported or not supported by the results? Discuss how the conclusion was made and refer to tables and graphs. Compare the results with published data, commonly held beliefs, and/or expected results. Discuss problems encountered. Make suggestions for solutions or changes that need to be made. Who would benefit from these results and why? Also, discuss ways to expand on this project or other related research, which could be done.

i. **Bibliography (references)** - Using the correct style, include any documentation that is not your own. Credit all those who assisted in any way: printed references, interviews, films, Internet, use of loaned equipment, etc**. Look for specific examples on the WMSC website.** http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

Judging Science Challenge

Judges are qualified volunteers from business, industry, and professionals related to the project categories. Two to four judges will interview each contestant. Judges may judge individually or in groups. Judges graciously volunteer a considerable amount of time adjudicating this event.

Judges attend a pre-fair meeting during which any new or changed aspects of the fair are updated. Judges also practice using the scoring system with a rubric. The rubrics are available on the website:

http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

Each judge receives a copy of the students' Project Report at the pre-fair meeting. Judges will give preliminary scores to the Project Report before the fair. The Interview and Display portions of the scoring sheet will be scored on the day of the fair as well as modifications of previous scores.

WMSC Steering Committee believes that with training, scoring reliability is increased. However, some judges score consistently higher or lower than other judges. WMSC uses a computer program, which adjusts scores based upon judges' scoring tendencies. Through this process, judging is as accurate as possible. Therefore, **all judging scores are final**.

Judges Scoring Rubric

Here are two sections of the Scoring Rubric used by judges to evaluate student written reports in the areas of physical science, plant biology, human/animal biology, behavioral/social science and computers. These examples are for the Problem (stated as a question) and Research. Separate Scoring Rubrics are available for engineering and math. These are also on the WMSC website. (See above)

Problem (project question)	**Characteristics** Stated as a testable question Relates specifically to the effect of one variable upon another No obvious answer	**Comments**	**0-5 Points** Three areas – 5 points Two areas – 3 points One area – 1 point **Score** _____
Research	**Characteristics** Relates to the problem statement Any direct quotes or paraphrased materials are cited Cites adequate research	**Comments**	**0-5 Points** Three areas – 5 points Two areas – 3 points One area – 1 point **Score** _____

What are the Criteria for Judging Student Projects?

*Look for clarifying rubrics on the Science Challenge website:
http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

Official Judging Form For:

Engineering Technology
Computer Technology
Math Technology

Project Report

A) ***Problem:*** Define a need or problem, challenging solution, effect of one variable upon another (5)

B) ***Research*****:** Relates to problem or need, cites adequate research, quotes or paraphrased materials cited (5)

C) ***Project Design:*** Procedures clearly stated and align with problem statement, well thought out and efficient (10)

D) ***The Product:*** *Neat and organized, practical use of materials and techniques, attention to product details* (10)

E) ***RE-design of the Product:*** *Create the redesign, test the redesign, alternative solutions clearly written* (10)

F) ***Testing Results:*** *Prediction for changing variables, measured results are quantitative, alternative designs based on predictions/ results* (10)

G) ***Style:*** Grammar, spelling, punctuation; paper organization, easy to read (5)

K) ***Bibliography:*** Credit for print and electronic material, acknowledgement of contacts and mentors, correct style (5)

Display

I) ***Project Log:*** Organized and complete, original, accurate, all parts included, legible/ handwritten (10)

J) ***Visuals:*** Communicates intent and accomplishments, neatly done with correct spelling, grammar, organization, pictures (5)

Interview

K) ***Knowledge of Project:*** Command of subject through summary of experimental design, results & conclusions, sincere answers, discusses errors (10)

L) ***Oral Presentation:*** Introduces self, organized, clear, enthusiastic, easily heard, eye contact (5)

Total Points **(90)**

****Penalty Points (Abstract –5 or Title Page –2)** (-7)

Final Score ☐

All students must submit the required cover page and abstract using the correct forms. These two requirements have no point value unless they are omitted or incomplete.

✓ One-two points will be deducted for a missing/incomplete cover page.
✓ One-five points will be deducted for a missing/incomplete abstract
These points will be subtracted from the project total.

Official Judging Form For:

Behavioral/Social Sciences
Human/Animal Biology
Plant Biology, Physical Science

Project Report

A) ***Problem:*** Testable question, no obvious answer, relates the effect of one variable upon another (5)

B) ***Research*****:** Relates to problem question, cites direct quotes or paraphrased material, adequate research (5)

C) ***Hypothesis***: Sufficient research, relates to problem question, predicts how changing the independent variable changes the dependent variable (5)

D) ***Methodology:*** Procedures produce necessary data, clearly written, appropriate instrumentation, materials list, project could be replicated (5)

E) ***Experimental Design:*** All variables, controls, constants clearly defined and used correctly, repeated trials (10)

F) ***Data Collection:*** Graphable. quantitative, accurate collections, data from all trials (5)

G) ***Data Presentation:*** Graphs/tables titled & labeled, intervals scaled correctly, neat & easy to read (5)

H) ***Data Analysis:*** Describes & analyzes data mathematically, connects data to hypothesis, error analysis (5)

I) ***Conclusion:*** Supported by data, limitations recognized, recommendations for improvement (5)

J) ***Style:*** Grammar, spelling, punctuation; paper organization, easy to read (5)

K) ***Bibliography:*** Credit for print and electronic material/contact with professionals recognized, correct style (5)

Display

L) ***Project Log:*** Organized and complete, original, accurate, all parts included, legible/handwritten (10)

M) ***Visuals:*** Communicates intent and accomplishments, neatly done with correct spelling, grammar, organization, pictures (5)

Interview

N) ***Knowledge of Project:*** Command of subject through summary of experimental design, results & conclusions, sincere answers, discusses errors (10)

O) ***Oral Presentation:*** Introduces self, organized, clear, enthusiastic, easily heard, eye contact (5)

Total Points **(90)**

****Penalty Points (Abstract –5 or Title Page –2)** (-7)

Final Score ☐

Scientific Methodology

Clarification of Independent Variable, Dependent Variable, Control, and Constants

An Independent Variable is the part of an experiment that the investigator changes on purpose. In a simple experiment, there is only one independent variable. Sometimes this variable is called the manipulated variable.

A Dependent Variable is the variable that responds in an experiment. The dependent variable is the reaction or response to the independent variable or change made in the experiment. The dependent variable is the measured response. It may be a measurement using quantitative data-length, mass, time, volume, height etc., or qualitative data-color, appearance, behavior, or observations.

A Control is used as a standard of comparison. A control is important because it is used to detect "hidden" variables that are varying when they should not. In some experiments the control is called a "no treatment" control. The experimenter does nothing to one of the samples. In some experiments, all trials receive a treatment. The experimenter must select one of the levels of the independent variable being tested as the control.

Constants are variables that *might* affect an experiment but are kept from doing so. Constants are all the factors that are kept the same so they are prevented from affecting the outcome of the experiment.

For examples of variables, dependent variables, controls and constants and graph set-ups see the website:
http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

Clarification of Hypothesis

The West Michigan Science Challenge Steering Committee requests that students phrase their hypothesis as an "if-then" statement. A hypothesis is a prediction of the effect the independent variable will have on the dependent variable. A simple hypothesis may be written as an "if-then" statement such as, "If soils contain a high percentage of clay (independent variable), then percolating rainwater will be more acidic" (dependent variable).

Other examples worded differently are: The longer or farther an object falls through the air (independent variable), the faster it will fall (dependent variable) or, As the diameter of a car's tires increases, the maximum speed of the car decreases.

Materials List

Material	Quantity or Amount	Use

Specific examples are available on the WMSC website:

http://www.muskegonisd.org/departments/mathscience/studentpgms/science-challenge/

Key Elements of the Experimental Methodology (Procedures)

- Describe all experimental and control groups
- List everything which must be completed in the experiment by steps or numbering
- Include how the independent variable will change and how the change will be measured
- Explain how to measure the resulting change in the dependent variable or variables
- Explain how the controlled variables will be maintained at a constant value
- Specify how many times the experiment will be repeated.
- A good experimental procedure allows someone else to duplicate the experiment exactly!

Conducting the Experiment

- Set up **Project Log** (see page 10)
- Organize data collection table
- Collect all needed materials
- Consider safety-eye protection, gloves, long hair, fire extinguisher
- Follow, step by step, the procedure written for the experiment
- Record any changes made in the procedure
- Be as accurate as possible when taking measurements
- Take pictures for the display board during experimentation

Data Analysis and Graphs

Review all data collected from the experiment. Make sure it is complete and that enough trials were conducted. There must be enough data to prove that your hypothesis is correct or incorrect. This is called raw data. The next step is to summarize the raw data. The average for the trials might also be calculated. Percentages, ratios, or error significance may be useful for some experiments. Verify that all math calculations are correct.

One way to display data is to use graphs to summarize the data. There are many types of graphs:

- Bar graph
- Line graph
- Scatter Plot
- Box and Whiskers
- Time-series
- Pie graph
- Stem and Leaf

Graphing Hints

The Independent variable is usually placed on the x-axis and the dependent variable is placed on the y-axis. (See graph sample on website)

Label the axes of the graph and include units of measurement.

A Legend is necessary if there is more than one set of data shown on the graph.

A Title representing the topic of the graph is required.

The graph must use the correct scale (low and high values on the axes) and use consistent increment values.

Data must be plotted clearly and accurately.

Conclusions

Conclusions summarize how the results support or oppose the original hypothesis. Use a short summary of a few sentences to support the conclusions. Use key facts from background research to explain the results.

State whether the results support or oppose the hypothesis. (Engineering projects will state whether design criteria were met.) If the hypothesis is proven false, explain what factors did not go as expected. Use these findings to construct a new Hypothesis and what that experimentation would look like. (Science fair judges do not subtract points for unproven hypothesis; what is important is to show them how much has been learned.)

Explaining the relationship between the independent and dependent variable may be stated here. Also, discuss the success and effectiveness of the procedures. Suggest possible changes in the experimental design of the project if it was redone. Recommend areas for further study.