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UNM GK-12 Optics & Photonics Fellow Program, 2005 [Version 1.0]
Introduction

**Student Research EXPO (SRE)**

The traditional “Science Fair” has been transformed into a “Student Research EXPO” in order to extend the activities of inquiry, exploration, discovery, experimentation and hands-on learning to all subjects, not just science. The SRE will be composed of up to a half year long research project where students will learn how to apply elements of the scientific method towards increasing their understanding of a chosen subject matter. It is desirable to encourage cross-disciplinary efforts to show the important links between subjects. For example, writing a good abstract or report is equal in importance to developing a strong research question/problem. Or, presenting or communicating a conclusion is equally important as the structuring of the project to acquire the data/information that proves or rejects a hypothesis. Overall, the goal is to provide an effective approach for synchronizing the entire West Mesa Cluster so that students can follow a standardized process and structured method to build on terminology, skills and competencies as they progress from K to 12 levels.

**Vision**

- To increase the ability and motivation for both students and teachers to explore and gain understanding of various subject matter using the scientific method
- To become a model for how a cluster-wide Student Research EXPO can be successfully across elementary, middle and high schools

**Mission**

- To meet and/or exceed the education standards in ALL subject areas (such as math, science, reading and writing) by focusing on the creation and implementation of a Student Research EXPO across K-12

**Goals of the Student Research EXPO**

**Student Goals**

1. To learn a formal method/process to carry out a successful student research project
   a. To understand and apply elements of the scientific method towards any subject matter
   b. To connect concepts across activities, classes and/or curriculum
2. Increase the parental/family support network for academic activities
3. To earn prizes for succeeding
   a. Prizes can include cash, computers, certificates
   b. Can include a variety of aspects such as creativity, effort and/or research
4. To gain exposure to industry professionals
   a. Can include advising, judging and/or career days
   b. Can include a field trip to local university and/or museums
5. To prepare for the Intel International Science and Engineering Fair (ISEF)

**Teacher Goals**

1. To learn a formal method/process for leading a successful Student Research EXPO that is standardized within the resident school and all other K-12 levels in the West Mesa Cluster
2. To meet and/or exceed the New Mexico education standards by:
a. Gaining easy access to information and activities
   b. Gaining training and handbook that describes how to integrate concepts and activities
3. To gain visibility by the local/regional media on progress and success
4. To prepare for the Intel International Science and Engineering Fair (ISEF)
Student Research EXPO (SRE) Champion

The SRE Champion will be instrumental in the overall success of the SRE effort. There will be one SRE Champion chosen per school. It is a prestigious leadership and high visibility position that will require commitment towards maintaining effective meetings, time management and constructive diplomacy. This individual(s) will serve as the lead coordinator for the SRE Committee and will collaborate with the GK12 Fellow to perform all activities related towards completing the SRE in an appropriate fashion.

The specific role/function of the SRE Champion is to:

• Recruit the SRE Committee; it should include
  o A variety of teacher representation at each grade level
  o Any motivated and responsible parents that can commit time & effort
  o Principal or Assistant Principal
• Facilitate the SRE Committee; this should include
  o Presenting (with the GK12 Fellow) the initial SRE vision and mission to the school
  o Set-up periodic meetings (locations, times, agendas, etc) throughout the SRE effort; recommend to start off with meeting a minimum of 1x/week then decrease as each level ramps up in momentum/process
  o Document a listing of concerns/issues/progress
• Serve as the Point of Contact for the School; collaborate with GK12 Fellow to
  o Implement SRE handbook
  o Harness resources for the SRE
  o Meet w/ external organizations on an “as-needed” basis
  o Coordinate efforts with the Student Research EXPO (SRE) Champion at each school
Getting Started

1. If you have a GK12 Fellow assigned to your school and have not done so already, meet with him/her to discuss goals and expectations of the GK12 program at your school. West Mesa cluster schools who do not have a Fellow assigned should contact the GK-12 Project Manager to arrange for a consulting Fellow who can assist with the SRE.

2. Set up a specific meeting with the school Principal (and the GK12 Fellow) to brief him/her on the vision/mission. The goal is to obtain the administration’s formal support and commitment for the SRE.

3. The next major milestone is to recruit a solid volunteer base of teachers (at least one from each grade level) and identify some motivated parents (at least one from each grade level) to be on a Student Research EXPO Committee. This committee will be the go-to team that facilitates the organization, development and deployment of the school-wide effort. They should also plan on inviting the school Principal to at least one monthly meeting to brief him/her on progress.

4. With the committee’s help, establish a project timeline that will be distributed to all teachers and students (a sample is provided).

5. Schedule the Gym (or similar) for the school-wide SRE and a room for the judges to meet.

6. Schedule school awards ceremony; most likely right after the judging on the same day of SRE.

7. Meet with a representative from each grade level and explain that the committee is there as a resource and to help on deciding on the overall format and structure of the SRE.

8. If needed, make sure that the GK12 Fellow provides you with the current information (rules, standards, format, etc) from the International Science and Engineering EXPO.

9. Select a date when the Student Research EXPO will be introduced.
   a. Decide if participation will be mandatory and/or voluntary.

10. Decide how teachers can encourage and motivate students to participate.

11. For the actual SRE, design a rotation schedule for student tours of the entire Student Research EXPO. Schedule student, parent, and teacher monitors to be on duty while the student body is viewing projects.

12. Decide what, if any, prizes will be offered such as certificates, cash or computers.
   a. This can be for various non-traditional categories such as “most creative” or “best effort”.

13. Schedule a time for classes, parents and community to view the projects.

14. Be sure you will have access to enough tables for exhibits.

15. Request volunteers and provide a list of possible duties.

16. Request mentors to help students with projects.

17. Request prize donations.
Preparing for the EXPO

Cultivate Teacher Involvement
1. Distribute SRE handbooks to teachers.
2. Provide a timeline of important project dates, after-school work sessions and the actual Student Research EXPO date.

Provide an Overview of the Rules To Participants
1. Explain the teacher’s role in presenting student research EXPO concepts
2. Explain the parent’s role in the child’s project.

Project Display Checklist
Students should start planning their displays as soon as they begin their projects. Some of the items that should be on display are:
1. Pictures taken during the experiment
2. Data notebook or background research notebook
3. Any equipment or material used in the experiment (that is not excluded by rules)
4. Abstract
5. Title (as a header at the top of the display board)
6. Hypothesis
7. Procedure
8. Results
9. Conclusions
10. Applications
11. Charts, graphs, tables, or other visual aids
12. Statistics, where appropriate

Other Display Tips
• Arrange your table to fit the space available.
• Allow plenty of space between the rows so students, parents, and judges can pass through easily.
• Cover your tables with thin vinyl or butcher paper in school colors.

Remind students that they are an important part of their displays, too. They are representing their school to the public and should be dressed appropriately, should not chew gum or listen to music, and should respect other students and judges. Also, be sure they are prepared (practiced) to describe their projects to a judge in a clear, succinct presentation.

Recruit and Prepare Judges
1. Recruit judges at least a month prior to the EXPO.
2. Send out a recruiting letter, distribute and follow up by phone or email. An Example is found on page 47.
   a. Local volunteer agencies
   b. Industry community affairs offices
   c. Medical offices, hospitals
d. Local High School

e. Local college science departments

3. Call judges to remind them of their commitment a few days before the EXPO.

**Scoring and Judging Criteria**

1. A scoring rubric that provides judges with a way to assign a point total for each project has been included and can be found in the appendix on page 51. Please use this form to insure uniformity across the cluster.

2. Supply your judges with your scoring rubric prior to the EXPO to allow them time to become familiar and to ask questions as needed.

3. Review judging criteria with your judges the day of the EXPO. Note: If possible, have each project judged by two or three judges (and average score). This will be helpful if there are any issues regarding a project.

**Arrange for Ribbons and Awards**

1. Order ribbons and certificates for students (You may be able to create the certificates with a word processor). Allow 4 to 6 weeks for delivery.

2. Decide if anyone will receive medals and order them.

3. If prizes are donated, decide how they will be awarded.

4. Present prizes at school awards ceremony.

**One Week Prior to the EXPO**

Finalize volunteer assignments

1. Gym/Cafeteria set-up

2. Student check-in - collection of student display form

3. Help students to set up projects

4. Safety monitor

5. Provide refreshments for the judges

6. Gym clean-up

7. Create student display form: name, type of project, and project number.

8. Create judging assignments.

**Day of the EXPO**

1. Meet with the judges to review judging criteria and judging assignments.

2. Tabulate scores from judges.

3. Decide on school winners. It’s nice to announce the same day.

4. Make a list of the 5 finalists in each grade level who will move onto the next EXPO (cluster, district), complete the finalist form and forward as necessary.

**After the EXPO**

1. Students pick up projects.

2. Volunteers clean up display area and return tables.

3. Write thank you notes to judges and volunteers.

4. Congratulate all who participated on a job well done!
5. Meet with student research EXPO committee to discuss the EXPO process; what went well, what needs to change.
6. Recruit students with superior projects to present at science classes, to encourage participation next year. Let them help spread the word.
7. Ask classroom teachers to encourage their students to start new projects over the summer.

**Letter to Parents**

Examples of two letters that you can use to get Parental involvement are included in the appendix starting on page 43.
### EXPO Day Schedule

**Schedule of Activities**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 a.m. – 8:30 a.m.</td>
<td>Project Setup</td>
</tr>
<tr>
<td>7:30 a.m. – 8:00 a.m.</td>
<td>Judges’ Reception</td>
</tr>
<tr>
<td>8:00 a.m. – 9:00 a.m.</td>
<td>Judges’ Orientation</td>
</tr>
<tr>
<td>7:00 a.m. – 9:00 a.m.</td>
<td>Safety and Violations Inspection</td>
</tr>
<tr>
<td>8:45 a.m.</td>
<td>Judging floor cleared (everyone other than students, task force and assigned volunteers must leave)</td>
</tr>
<tr>
<td>9:00 a.m. – 11:30 a.m.</td>
<td>Projects Judging</td>
</tr>
<tr>
<td>11:30 a.m. – 12:00 p.m.</td>
<td>Lunch</td>
</tr>
<tr>
<td>12:00 p.m. – 12:30 p.m.</td>
<td>Awards Presentation</td>
</tr>
<tr>
<td>12:30 p.m. – 1:00 p.m.</td>
<td>All Projects Breakdown</td>
</tr>
</tbody>
</table>
**Finalist Form**

1. Student Name ________________________________  
   (last, first, middle - as you would like to see it appear on your certificate)
2. Partner 1 ___________________ Partner 2 __________________
3. Home Phone Number ___________________
4. Grade ___________
5. Project Title ____________________________________________
6. Sponsor/Teacher ___________________________________________
7. Sponsor/Teacher's Email Address ______________________________
   School ___________________________
8. School Phone Number _______________
   School Address
   _________________________________
   _______________________________
Teacher Guidelines
This EXPO guideline is written to assist the teacher in carrying out a Student Research EXPO program with their students.
The time required from the introduction of the Student Research EXPO Project to the class until the Student Research EXPO day can be decided by the classroom teacher. A minimum of four weeks is suggested (for lower elementary grades). This time is for finding a project, research, experiment, and writing up the results and putting a display board together.

Pacing Calendar

Student Research EXPO-4 Week Schedule

<table>
<thead>
<tr>
<th>Date of Student Research EXPO</th>
<th>Date to begin project (4 weeks before)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Scheduled Completion Date</td>
</tr>
<tr>
<td>Date</td>
<td>Actual Completion Date</td>
</tr>
</tbody>
</table>

Scheduled Weekly Events

**Week 1**
- Choose a topic or problem to investigate
- Start a journal for notes and research
- Begin primary research: Write for information from scientist, businesses, and government agencies.
- Begin secondary research: Search printed sources (books, journals, magazines, and newspapers) and electronic sources (Internet and software)

**Week 2**
- Decide how to set up your investigation or experiment, including the procedure and necessary materials
- From your initial research, write your hypothesis
- Continue your research using the resources you found
- Interview experts for more information
- Complete initial research. Set up outline for written report
- Start your experiment or demonstration collection Record observations in your journal
- Begin collecting or buying materials for your display

**Week 3**
- Work on first draft of written report
- Continue to record observations from your experiment
- Write down or sketch preliminary designs for you display
- Start assembling display unit
- Begin designing signs, labels, charts, and graphs
- Write text for background display and plan its layout

**Week 4**
- Write second draft of your report
- Continue to record observations from experiment
- Take any photographs you need
- Complete your experiment, analyze observations and write up your results
- Write, type, and proofread final draft
- Have photographs developed and enlarged
- Type explanations and mount them on your display
Finish constructing your display, including graphs, charts, and visual aids
# Student Research EXPO-6 Week Schedule

<table>
<thead>
<tr>
<th>Scheduled Weekly Events</th>
<th>Scheduled Completion Date</th>
<th>Actual Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choose a topic or problem to investigate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start a journal for notes and research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Begin <em>primary research</em>: Write for information from scientist, businesses, and government agencies.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Begin <em>secondary research</em>: Search printed sources (books, journals, magazines, and newspapers) and electronic sources (Internet and software)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change your topic or problem if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decide how to set up your investigation or experiment, including the procedure and necessary materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>From your initial research, write your hypothesis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continue your research using the resources you found</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interview experts for more information</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete initial research. Set up outline for written report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start your experiment or demonstration collection. Record observations in your journal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Begin collecting or buying materials for your display</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work on first draft of written report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continue to record observations from your experiment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write down or sketch preliminary designs for your display</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 5</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write second draft of your report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start assembling display unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Begin designing signs, labels, charts, and graphs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write text for background display and plan its layout</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continue to record observations from experiment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Take any photographs you need</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Week 6</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete your experiment, analyze observations and write up your results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write, type, and proofread final draft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have photographs developed and enlarged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type explanations and mount them on your display</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finish constructing your display, including graphs, charts, and visual aids</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Student Research EXPO-8 Week Schedule

<table>
<thead>
<tr>
<th>Date of Student Research EXPO</th>
<th>Date to begin project (8 weeks before)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scheduled Completion Date</td>
</tr>
</tbody>
</table>

## Scheduled Weekly Events

### Week 1 and 2
- Choose a topic or problem to investigate
- Start a journal for notes and research
- Begin primary research: Write for information from scientist, businesses, and government agencies.
- Begin secondary research: Search printed sources (books, journals, magazines, and newspapers) and electronic sources (Internet and software)

### Week 3
- Change your topic or problem if necessary
- Decide how to set up your investigation or experiment, including the procedure and necessary materials
- From you initial research, write your hypothesis
- Continue your research using the resources you found
- Interview experts for more information

### Week 4
- Complete initial research. Set up outline for written report
- Start your experiment or demonstration collection Record observations in you journal
- Begin collecting or buying materials for your display

### Week 5
- Work on first draft of written report
- Continue to record observations from your experiment
- Write down or sketch preliminary designs for your display

### Week 6
- Write second draft of your report
- Start assembling display unit
- Begin designing signs, labels, charts, and graphs
- Write text for background display and plan its layout
- Continue to record observations from experiment
- Take any photographs you need

### Week 7 and 8
- Complete your experiment, analyze observations and write up your results
- Write, type, and proofread final draft
- Have photographs developed and enlarged
- Type explanations and mount them on your display
- Finish constructing your display, including graphs, charts, and visual aids
- Peer Review, in-class with completed project
- Make necessary changes
**Research Categories**
The research categories are the different academic disciplines that students can choose from to do their projects on.

**Elementary School Level**
- Life Science
- Earth and Space Science
- Physical Science
- Environmental Science

**Middle & High School**
- Behavioral and Social Sciences
- Biochemistry
- Botany
- Chemistry
- Computer Science
- Earth Science
- Space Sciences
- Engineering
- Environmental Science
- Mathematics
- Medicine and Health
- Microbiology
- Physics
- Zoology
- Team
The Scientific Method

The scientific method and its terminology is explained in this section. The scientific method is the method or procedure that students follow to perform their science fair project.

Basic Vocabulary:
1. Scientific Method
2. Purpose or question
3. Research
4. Hypothesis
5. Experiment
6. Results
7. Conclusion
8. Show board

1. Scientific Method. A process or procedure scientists use to discover new facts or to form new theories. The scientific method is composed the following steps; the purpose or question to answer, research, hypothesis, experiment, results, and the conclusion.

2. Purpose or Question. This is the start of a Student Research EXPO project. The student decides on a question of interest, that they want to answer. Picking a topic for research is probably the most difficult part of a project. Other ideas for finding a project are listed in the Student Guidelines section.
   One method to select a question to answer is for the teacher to lead the class in a brainstorming session. Encourage participation by the students in the brainstorming session and let one idea lead to another without any criticism of ideas.
   Another possibility is to use Student Research EXPO project idea books or use the list of web links that are listed in this handbook.
   Discuss the ideas for projects and how they can be made into a question that can be answered through an experiment. Discuss the feasibility of the proposed project. Is it safe? Is there time to complete the project? Does it fit into cost constraints? Is the material required to do the project readily available?

3. Research. In this phase the students perform research to gather information related to the question they want to answer. The research can be conducted in a library, on the internet, or by asking questions of people who are a topic expert. Gathering this information concerning the student’s question topic will not only be a way of learning, but should give enough background information to lead to a project hypothesis.

4. Hypothesis. The hypothesis is a statement of the student’s prediction of the answer to the question they want to answer with their experiment. The hypothesis is a student’s guess resulting from or based on the research they performed on what the outcome of their experiment will be.

5. Test the hypothesis by experiment. After the hypothesis is formed, an experiment can be designed to test the hypothesis. A description of the procedure the student expects to follow should be written. This procedure should include a list of materials, the experimental procedure, and a list of variables. Safety considerations should be stated. Each project should be reviewed for safety. While conducting the
experiment, data should be taken that will later serve to support or reject the hypothesis. A good way to take and keep data is to use a data log or journal that includes notes, drawings, measurements, tables, graphs, etc.

6. Results. In this step the data from the experiment are analyzed and placed into a form that leads to interpretation of the data. This data form would include graphs, and or tables. The data will also be included on the show board that will be displayed during the Student Research EXPO for judging.

7. Conclusion. The conclusion should include an interpretation of the data collected relating it to the hypothesis. A statement should be made based on the data results as to whether the hypothesis was correct or incorrect. A recommendation for further study and improvements in the experiment should be made.

8. Show Board. The display board is for students to display their project results. Examples of show boards are shown in the student section.

High school level student research projects can participate in the International Science and Engineering EXPO (ISEF). If this is the case, then from the projects’ inception, steps should be taken so the project and required paperwork are filled out and sent in on time to the ISEF. Abstracts for the ISEF can be submitted at their web site which is listed below. To qualify for the ISEF, a research project has to be awarded enough points at the Regional Science EXPO. Middle school projects that score high enough can compete in the Regional Science EXPO. Paperwork to compete in the Regional must be sent in on time.

An example procedure with the goal of going to the ISEF is the following.

1. Start a project notebook. (ISEF judges require a notebook.) The notebook is for storing and recording everything relating to a research project.
2. Choose a research topic. Ideas for doing this were presented above with more ideas in the student section.
3. Research the topic. Look in professional journals, in the library, or perform a web search.
4. Write out a hypothesis and problem statement.
5. Find a topic knowledge expert.
6. Define the experimental design to support a hypothesis and complete required Regional and ISEF forms. Forms can be obtained online:
   (Regional Forms) http://www.unm.edu/~scifair/
7. Submit final experimental design for approval.
8. Take data and analyze.
9. Decide on your presentation design. Develop the show board to meet ISEF guidelines and rules.
Rubric for the teacher

Elementary, Middle & High School

This rubric for grading the research project can be adapted as needed for the elementary, middle, or high school.

<table>
<thead>
<tr>
<th>Scientific Thought</th>
<th>Individual</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Possible</td>
<td>Score</td>
</tr>
<tr>
<td>Has the student followed the scientific method?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem/Question</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Hypothesis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Methods &amp; Data</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Conclusion</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>What were the methods used to solve the problem? Were they followed?</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Are the variables recognizable and clearly defined?</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>If controls were necessary, does the student/team recognize their need and were they used correctly?</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Is there enough data to support conclusions?</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Does the student/team understand their project's tie to related research?</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>30</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Creative Ability</th>
<th>Individual</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Possible</td>
<td>Score</td>
</tr>
<tr>
<td>Does the project show creative ability and originality in:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The question asked?</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Approach to solving the problem?</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>The analysis of the data?</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>The interpretation of the data?</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Is the display creative and pleasing to look at?</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>30</strong></td>
<td></td>
</tr>
</tbody>
</table>

*This does not mean that the entire project must be original, but credit should be given to what the student has contributed. Collections and models can be considered creative only when used to support an investigation or to help answer a question in some original way. Assembling a kit cannot be considered creative unless some unusual approach or design was used. For Engineering, a clear distinction between gadgeteering and a genuine contribution should be made.*

<table>
<thead>
<tr>
<th>Teamwork (team projects only)</th>
<th>Possible Points</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are the tasks and contributions of each member clearly outlined?</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Was each team member fully involved with the project, and is each one familiar with all aspects?</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Does the final work reflect the coordinated efforts of all team members?</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>16</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Thoroughness

<table>
<thead>
<tr>
<th></th>
<th>Individual</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the project carry out its original purpose to completion?</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Are the conclusions based on a single experiment or on replication?</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Are the project notes complete?</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Is the student/team aware of other approaches or theories?</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>How much time did the student/team spend on the project?</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Is the student/team familiar with scientific literature in the studied fields?</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total Points**

<table>
<thead>
<tr>
<th>Individual</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>12</td>
</tr>
</tbody>
</table>

### Skill

<table>
<thead>
<tr>
<th></th>
<th>Individual</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the student/team have the skills required to do the necessary work? Ex: Laboratory, computation, observational, design skills</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Is the student/team able to respond to oral questioning? (Nervousness is Okay!)</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Is written material prepared by the student/team and reflects their understanding?</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Was assistance received? (By all means, we hope the student received some help. However, the project should reflect their work.)</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total Points**

<table>
<thead>
<tr>
<th>Individual</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>12</td>
</tr>
</tbody>
</table>

### Clarity

<table>
<thead>
<tr>
<th></th>
<th>Individual</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can the student/team explain the purpose, procedure, and conclusion of their project?</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Are the important phrases of the project presented in an orderly manner?</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>How clearly are the data and results presented?</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>How well does the project display itself?</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total Points**

<table>
<thead>
<tr>
<th>Individual</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>
Student guidelines

Students should be given a copy of the grading rubric their teacher will be using.

The scientific method and terminology:

The scientific method is explained next. It is the steps or procedure you will follow to answer the question you are trying to answer. The steps are explained below in the order that they should be performed.

1. Scientific Method
2. Purpose or question
3. Research
4. Hypothesis
5. Experiment
6. Results
7. Conclusion
8. Show board

1. Scientific Method. A process of procedure scientists use to discover new facts or to form new theories. The scientific method is composed the following steps; the purpose or question to answer, research, hypothesis, experiment, results, and the conclusion.

2. Purpose or Question. This is the start of a Student Research EXPO project. The student decides on a question of interest, that they want to answer. Picking a topic for research is probably the most difficult part of a project. Other ideas for finding a project are listed in the Student Guidelines section.
   One method of deciding a question to answer is for the teacher to lead the class in a brainstorming session. Encourage participation by the students in the brainstorming session and let one idea lead to another without any criticism of ideas.
   Another possibility is to use Student Research EXPO project idea books or use the list of web links that are listed in this handbook.
   Discuss the ideas for projects and how they can be made into a question to answer with an experiment.
   Discuss the feasibility of the proposed project. Is it safe, is there time to complete the project, does it fit into cost constraints, and is the material required to do the project readily available.

3. Research. In this phase the students perform research to gather information related to the question they want to answer. The research can be conducted in a library, on the internet, or by asking questions of people who are a topic expert. Gathering this information concerning the student’s question topic will not only be a way of learning, but should give enough background information to lead to a project hypothesis.

4. Hypothesis. The hypothesis is a statement of the student’s prediction of the answer to the question they want to answer with their experiment. The hypothesis is a student’s guess resulting from or based on the research they performed on what the outcome of their experiment will be.

5. Test hypothesis the experiment. After the hypothesis is formed, an experiment can be designed to test the hypothesis. A description of the procedure the student expects to follow should be written. This procedure
should include a list of materials, the experimental procedure, and a list of variables. Safety considerations should be stated. Each project should be reviewed for safety. While conducting the experiment, data should be taken that will later serve to support the hypothesis. A good way to take and keep data is to use a data log or journal that includes notes, drawings, measurements, tables, graphs, etc.

6. Results. In this step the data from the experiment is analyzed and placed into a form that leads to interpretation of the data. This data form would include graphs, and or tables. The data will also be included on the show board that will be displayed during the Student Research EXPO for judging. A conclusion should include interpretation of the data taken and analysis of the data relating it to the hypothesis.

7. Conclusion. The conclusion should include an interpretation of the data taken relating it to the hypothesis. A statement should be made based on the data results as to whether the hypothesis was correct or incorrect. A recommendation for further study and improvements in the experiment should be made.

8. Show Board. A display board for students to display their results. Examples of show boards are shown this section.
Procedure to pick a project

More ideas on deciding on a research project.
1. What are you interested in? Think of three of your most favorite interests. How could you use one of these for a research project?
2. What hobbies do you enjoy? Pick three of your most favorite hobbies. Can one of these be made into a research project?
3. Have you decided on a career? Research this career choice for a possible project.
4. Use one of the web links listed in the appendix on page 35 for help on finding and doing a research project. A very good link is www.sciencebuddies.org. It even has a topic selection wizard.
5. Get help from your teacher.
Guidelines for Literature research

Grade level targeted: To be grade scalable by class room teacher. The research you perform will serve to provide information to prove your hypothesis statement. Of course, at the end of the day, the research might disprove your hypothesis. As the research is performed think about how an experiment can be designed with the information you are finding to prove your hypothesis.

Literature research possibilities:

1. A library. At your school, a public library, or a university library. You can look for trade magazines and professional journals. Next, you can look for published papers.
2. Another place to look is to do an internet search.
3. Look in past and present newspaper articles.

The idea is to do as much research and learn as much about your topic as possible to design a good experiment.
Display layout (display board)
The following are two examples of a show board

A logical flow to the show board, when judges look at it, is, start at the top then move to the left side and down. Then, they move across the center of the board to the right top and down.
## Project Display Rubric

**Final Score:**  /25  **Name:**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display meets' physical &amp;</td>
<td>Project display needed a number of changes to meet guidelines set</td>
<td>Project display needed little</td>
<td>Project display needed no changes to meet guidelines set out by</td>
<td>Project display needed no</td>
<td>changes to meet guidelines set out by teacher</td>
</tr>
<tr>
<td>safety criteria</td>
<td>out by teacher</td>
<td>change to meet guidelines set</td>
<td>teacher</td>
<td>changes to meet guidelines</td>
<td>set out by teacher</td>
</tr>
<tr>
<td></td>
<td></td>
<td>out by guidelines set out by</td>
<td></td>
<td>set out by guidelines set</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>teacher</td>
<td></td>
<td>out by teacher</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Appeal</td>
<td>Project is cluttered and difficult to follow</td>
<td>Project is easy to follow,</td>
<td>Project is uses design elements to assist viewer in following</td>
<td>Project is uses design</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>with little visual interest</td>
<td>information</td>
<td>elements to assist viewer in</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>following information</td>
<td></td>
</tr>
<tr>
<td>Information Components</td>
<td>Project displays only some components, sequence is not logical</td>
<td>Project displays most required</td>
<td>Project displays most required components, in a logical sequence</td>
<td>Project displays all</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>components</td>
<td></td>
<td>information components,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>in a logical sequence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demonstration Items</td>
<td>Project has no or irrelevant demonstration items</td>
<td>Project has relevant</td>
<td>Project has relevant demonstration items that are an integral</td>
<td>Project has relevant</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>demonstration items, but are</td>
<td>part of the presentation</td>
<td>demonstration items that are</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>not integrated into</td>
<td></td>
<td>an integral part of the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>presentation</td>
<td></td>
<td>presentation</td>
<td></td>
</tr>
<tr>
<td>Laboratory Journal &amp; Report</td>
<td>Only one of these items is present</td>
<td></td>
<td>Both of these items are present</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Timeline for the student**

It is a good idea to divide the time allotted for doing the project from beginning to the final day of the science EXPO into thirds. Probably the beginning of the project will be defined by your teacher. The following is an example project timeline to follow:

<table>
<thead>
<tr>
<th>Due Date</th>
<th>Date completed</th>
<th>Project Task</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>First week: topic selection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Literature research</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Literature research</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Literature research. Write problem statement and hypothesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complete rough draft of experimental design</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complete experimental design. Complete any required Student Research EXPO paperwork</td>
</tr>
<tr>
<td></td>
<td></td>
<td>End of 1&lt;sup&gt;st&lt;/sup&gt; third of project time:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Get approval of paperwork</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Obtain materials required for the experiment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start experiment and collect data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continue collecting data from experiments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start analyzing data: tables, graphs, statistics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>End of 2&lt;sup&gt;nd&lt;/sup&gt; third of project time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>State results and conclusion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Write first draft of abstract</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start show board: Title, Question, Hypothesis, Background, materials, procedure, bibliography</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continue work on show board: data, tables, graphs, results, conclusion, further study, final draft of abstract</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In class peer review with completed show board</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Compete in Student Research EXPO</strong></td>
</tr>
</tbody>
</table>
Example of student research EXPO projects

For grades 4-5
As an example of using an internet link for research project help the following project was found using one of the links listed in this handbook: www.super-science-fair-projects.com. This is a comprehensive site for help with research projects. It contains supplies, magazines, books, and additional links for project help. Sometimes it is a little difficult to follow because the help is sometimes listed as a ‘clue’. It has material to help for no charge and some, like an e-book you can download for project help for $9.95. A project example for 4th grade was the following:

EXPERIMENTAL SCIENCE PROJECTS:
The Effect of Salt on the Boiling Temperature of Water
This is my son Cole's 4th grade science project. It was done by following the steps in Experimental Science Projects: An Introductory Level Guide. With his permission, I have edited and reformatted it for use as an example.

 INITIAL OBSERVATION
Cooking instructions tell you to add salt to water before boiling it.

 PROJECT TITLE
The Effect of Salt on the Boiling Temperature of Water

 PURPOSE OF THE PROJECT
To find out how table salt affects the boiling temperature of water.

HYPOTHESIS
Adding table salt to boiling water will cause the water to boil at a higher temperature.

MATERIALS AND EQUIPMENT
Table Salt
Distilled Water
2 Quart Cooking Pot
Pint measuring cup
Teaspoon and tablespoon measuring spoons
Thermometer
Stirring spoon

EXPERIMENTAL PROCEDURE
1. Boil one quart of distilled water on a stove.
2. Measure the temperature of the boiling water. Record the highest temperature reading. This is the control to compare with.
3. Measure out table salt using a kitchen measuring spoon. Level the spoonful.
4. Add the measured salt to the boiling water and stir.
5. Measure the temperature of the boiling water with the salt in it. Record the highest temperature reading.
6. Repeat for other amounts of salt.

**DATA**

**Data Obtained:** 2/25/95, Mankato, MN

<table>
<thead>
<tr>
<th>Amount of boiling water</th>
<th>2 Cups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature of boiling water (Control)</td>
<td>212.9° F</td>
</tr>
<tr>
<td>Amount of table salt added to boiling water: Run #1</td>
<td>1 Tbl.</td>
</tr>
<tr>
<td>Temperature of boiling water after adding salt: Run #1</td>
<td>215.6° F</td>
</tr>
<tr>
<td>Additional amount of table salt added to boiling water: Run #2</td>
<td>1 Tbl.</td>
</tr>
<tr>
<td>Temperature of boiling water after adding salt: Run #2</td>
<td>218.3° F</td>
</tr>
</tbody>
</table>

**EXPERIMENTAL OBSERVATIONS**

When the salt was added to boiling water it bubbled up more, and then stopped boiling. Shortly afterwards, it boiled again.

If the thermometer extends beyond the outside of the pot it reads a higher temperature. Heat from the stove burner makes the thermometer read higher. Keep the thermometer over the pot when making temperature measurements.

**CALCULATIONS**

- Total amount of table salt added for Run #1: 0 + 1 = 1 Tbl.
- Total amount of table salt added for Run #2: 1 + 1 = 2 Tbl.

**RESULTS**

<table>
<thead>
<tr>
<th>Temperature of boiling water (Control)</th>
<th>212.9° F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of table salt added to boiling water: Run #1</td>
<td>1 Tbl.</td>
</tr>
<tr>
<td>Temperature of boiling water after adding salt: Run #1</td>
<td>215.6° F</td>
</tr>
<tr>
<td>Total amount of table salt added to boiling water: Run #2</td>
<td>2 Tbl.</td>
</tr>
<tr>
<td>Temperature of boiling water after adding salt: Run #2</td>
<td>218.3° F</td>
</tr>
</tbody>
</table>

Amount of Table Salt Added Versus Water Boiling Temperature
CONCLUSIONS
Is the hypothesis correct?
Yes. Adding table salt to water causes the water to boil at a higher temperature.

Problems with doing the experiments.
The temperature readings were hard to make. Gloves had to be worn to keep my hands from getting too hot.
Had to be careful that the stove heat was not hitting the thermometer.

Other things learned.
Be careful when adding salt to boiling water. It makes the water boil vigorously for a second or two.

RELATED QUESTIONS
Why do you think cooking instructions tell you to add salt when boiling water?
When the water is hotter, you can cook food faster. Salt also makes the food taste better.

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**Experimental Science Project: An Introductory Level Guide**

**Experimental Science Project: An Intermediate Level Guide**

David Morano, Assoc. Professor
Mankato State University
27 May 1995
dmorano@vax1.mankato.msus.edu
**For grades 6-8**

The example for middle school was taken from the internet link: [www.sciencebuddies.org](http://www.sciencebuddies.org)

This is another comprehensive project help link. The ‘Topic Selection Wizard’ was used to find a project. First, the Wizard takes you to a survey to complete to help find a project topic. Next, the Wizard asks more questions to narrow down the project ‘question’. Then the Wizard gives background research tips and general project ‘how to’.

In following this procedure using the Wizard and purposely having an ‘interest’ in nature the research topic found came under the general heading of Plant Biology. The project was listed for 7th grade. A list of possible projects was given for Plant Biology, one of which was, “Size vs. Depth: The Relationship between the Size of a Seed and Its Ideal Planting Depth.”

Most of this help site projects were for middle school.
Resources for the Student Research EXPO

The goals are to create incentives for the entire process of participating in the SRE and reward both the students and teachers who have put time, effort and brainpower into successfully completing the projects. In order gain resources for the SRE, you should collaborate with the GK12 Fellow to leverage the UNM to contact potential media, judges and sponsors (listed below).

From the Community

Possible Sources/Contacts for Judges
UNM – GK12 Program: Fellows, staff and administration
Sandia National Labs:
Air Force Research Labs:
Hispanic Engineering and Science Organization:
Members of professional science and engineering organizations such as SPIE, IEEE, and OSA.

Possible Sources/Contacts for Sponsors
UNM – GK12 Program:
Sandia National Labs:
Air Force Research Labs:
Intel Corporation:
Resource Web links

Guide for students and teachers, parents guide, teachers resource
www.super-science-fair-projects.com

Educational resources searchable by grade, subject, and museum
www.smithsonianeducation.org

Contains various types of science projects and activities organized by difficulty
www.exploratorium.edu/science_explorer/index.html
www.halcyon.com/sciclub/kidproj1.html

Contains a video which describes the steps and importance of the scientific method
www.scifair.org/ideas/index.shtml
www.brainpop.com/science/scientificinquiry/scientificmethod

Links to glossaries from different scientific areas
www.eurekalert.org/links.php

Answers to science questions
www.madsci.org

NSTA science store - resources for science educators 1-800-277-5300 www.nsta.org
http://store.nsta.org

PBS show showing kids doing their own science inquiries
www.dragonflytv.org

Science ideas
www.topscience.org

Science insights videos
www.sciencevideos.com/default.htm
Show board supplies
www.showboard.com

The following link has comprehensive Student Research EXPO help for the teacher and student, including a topic selection wizard.
Science Buddies
www.sciencebuddies.org

Link to the ISEF site:
www.sciserv.org/isef/
The ISEF also has a magazine.
The following link is constructed and maintained by the UNM GK-12 Fellows. It includes lesson plans for grades K-12.
University of New Mexico – GK12 Program
http://gk12.unm.edu
**Media contacts**

- The Daily Lobo
- The Albuquerque Journal
- The Albuquerque Tribune
- KASA-TV, Channel 2 (Fox)
- KOB-TV, Channel 4 (NBC)
- KNME-TV, Channel 5 (PBS)
- KOAT-TV, Channel 7 (ABC)
- KRQE-TV, Channel 13 (CBS)
- KRQS-FM (105.1)
- KUNM-FM (89.9)
- KBTK-AM (1310)
- KKOB-AM (770)
- KANW-FM (89.1)
- KNKT-FM (107.1)
- KFLQ-FM (91.5)
- KZRR-FM (94.1)
- KBQI-FM (107.9)
- KPEK-FM (100.3)
### Appendix

#### Check lists

**Teachers**

**DUE DATES FOR EXPERIMENT AND BACKGROUND RESEARCH PAPER**

| COMPONENTS                        | 
|-----------------------------------|-------|
| BRAINSTORM PROJECT IDEAS          |       |
| List of topics that interest you  | September |
| Select topic / question to investigate | September |
| RESEARCH                          |       |
| List of resources (source cards)  | October |
| Notecards (with citation source on each) | October |
| Outline (include notecards)       | October |
| EXPERIMENT                        |       |
| Description of experimental plan  | November |
| Purpose, hypothesis, variables    | November |
| Materials And Procedure           | November |
| Complete Experiment / Data Gathering | December |
| ROUGH DRAFT                       |       |
| Experiment: purpose, hypothesis, material & procedure, observations (data tables & graphs), data analysis and conclusion | December |
| Backgound Research Paper         |       |
| (Include List of literature cited in paper) | December |
| FINAL PROJECT                     |       |
| Completed Student Research EXPO Report | January |
| Displayboards Completed           | January |
| Oral Presentation                 | January |
| STUDENT RESEARCH EXPO             |       |
|                                   | February |
| REGIONAL SCIENCE EXPO             |       |
|                                   | TBD |

Extensions may be granted after a discussion with your Student Research EXPO coordinating teacher.
**Students**
The following is a checklist that Elementary Schools can give students to help them complete the tasks needed for the student research EXPO in a timely manner.

<table>
<thead>
<tr>
<th>ELEMANTARY SCHOOL PROJECT DUE DATES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st Week</strong></td>
</tr>
<tr>
<td>Introduction to Student Research EXPO</td>
</tr>
<tr>
<td>Handout letter to parents.</td>
</tr>
<tr>
<td>Handout a list of possible topics.</td>
</tr>
<tr>
<td>Discuss and pick Student Research EXPO topic.</td>
</tr>
<tr>
<td>Start journal and begin research</td>
</tr>
<tr>
<td><strong>2nd Week</strong></td>
</tr>
<tr>
<td>Discuss the Scientific Method and terminology.</td>
</tr>
<tr>
<td>Write an abstract and hypothesis.</td>
</tr>
<tr>
<td>Continue Research.</td>
</tr>
<tr>
<td><strong>3rd Week</strong></td>
</tr>
<tr>
<td>Complete initial Research.</td>
</tr>
<tr>
<td>Start Experiment.</td>
</tr>
<tr>
<td>Discuss display layout.</td>
</tr>
<tr>
<td><strong>4th Week</strong></td>
</tr>
<tr>
<td>First Draft of report.</td>
</tr>
<tr>
<td>Continue writing observations from experiment.</td>
</tr>
<tr>
<td>Sketch display design layout.</td>
</tr>
<tr>
<td><strong>5th Week</strong></td>
</tr>
<tr>
<td>Start assembling part of display layout</td>
</tr>
<tr>
<td>Continue writing observations from experiment.</td>
</tr>
<tr>
<td><strong>6th Week</strong></td>
</tr>
<tr>
<td>Finish experiment</td>
</tr>
<tr>
<td>Do analysis of observation, and write-up conclusion.</td>
</tr>
<tr>
<td>Complete display</td>
</tr>
<tr>
<td>Practice for day of EXPO and judging.</td>
</tr>
</tbody>
</table>
The following is a checklist that Middle and High Schools can give students to help them complete the tasks needed for the student research EXPO in a timely manner.

<table>
<thead>
<tr>
<th>HIGH SCHOOL PROJECT DUE DATES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st Week</strong></td>
</tr>
<tr>
<td>Day 1</td>
</tr>
<tr>
<td><strong>1st Week</strong></td>
</tr>
<tr>
<td>Day 2/3</td>
</tr>
<tr>
<td><strong>2nd Week</strong></td>
</tr>
<tr>
<td>Day 10</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>4th Week</strong></td>
</tr>
<tr>
<td>Day 24</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>4th Week to 6th Week</strong></td>
</tr>
<tr>
<td>Day 24 to Day 40</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>5th Week</strong></td>
</tr>
<tr>
<td>Day 31</td>
</tr>
<tr>
<td><strong>7th Week</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

*Take PICTURES (NO FACES) of experiment for DISPLAY*
<table>
<thead>
<tr>
<th>Day 41</th>
<th>CHECK. At this time, include a brief summary of what you have done so far and how it is working. I will be checking your work to see if you need to revise your plan. Meanwhile, <strong>KEEP WORKING!</strong></th>
</tr>
</thead>
</table>
| 7th Week to 10th Week Day 42 to Day 58 | Continue experiments, recording in **Notebook**, as described in the four steps outlined on the first page and handout for the **Notebook**.  
- Start **Scientific Paper** (see handout for details)  
- Start **Building Display** (see handout for details) |
| 10th Week Day 59 | **Notebooks DUE** for 2nd CHECK |
| 11th Week Day 66 | **Scientific Papers DUE** for CHECK |
| 11th Week to 12th Week Day 63 to Day 75 | Make any revisions as necessary. Prepare **Notebooks** _________ and **Scientific Papers** for review.  
- Revise **Scientific Paper**  
- Continue working on **Display** |
| 13th Week Day 76 | **Notebooks DUE** (FINAL DRAFT) |
| 13th Week Day 80 | **Scientific Papers DUE** (FINAL DRAFT) |
| 13th Week Day 77 to Day 82 | Teacher review of **Notebooks** and **Scientific Papers**  
- Finish **Display** |
<p>| 14th Week Day 85 | <strong>Displays DUE</strong> |
| 14th Week Day 83 to Day 89 | Revise <strong>Scientific Paper</strong>, if needed |
| 15th Week Day 90 | <strong>ALL Notebooks, Scientific Papers, andDisplays must be submitted for Judging and Open House</strong> |
| 15th Week Day 91 | Prepare Project for <strong>FINAL DISPLAY for JUDGING</strong> and <strong>OPEN HOUSE</strong> |</p>
<table>
<thead>
<tr>
<th>15th Week Day 92</th>
<th>JUDGING AFTER SCHOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>15th Week Day 93</td>
<td>OPEN HOUSE</td>
</tr>
<tr>
<td></td>
<td>STUDENT RESEARCH EXPO PROJECTS ON DISPLAY</td>
</tr>
</tbody>
</table>
Letter to parents

Recruiting Letters
The following are two letters that you can use to get Parental involvement. This is an important part of any student research EXPO. You might wish to adapt these letter to alert parents of the upcoming EXPO. (For information on how parents can help their children in the student research EXPO process, see the section Parents-Get Involved.)

First example of a letter to the parents

Date:

Dear Students and Parents:

Your child has been invited to take part in a student research EXPO, an exciting event that encourages students to think like young scientists. During the next few weeks your child will be designing a science project that uses the scientific method to solve a problem. We hope you agree that the educational benefits are numerous, as students develop skills in writing, oral presentation, creative thinking, and problem solving.

Each student will be given instructions and handouts during class for the various steps of his or her project. Most of the work will be completed at home, and students will receive a monthly calendar noting due dates for each part of the project. For suggestions on helping your child through this process — from choosing a topic to the final report—see the Web site "Parents — Get Involved" at http://discoveryschool.com/sciencefaircentral/scifairstudio/parents.html.

I ask that you encourage your child and monitor his or her progress along the way. Your support is key to a successful project, but please do not allow your involvement to extend any further in order to assure equity and promote student learning! It is important that your child wrestle with problems and try to solve them. Guide your child whenever and wherever you can, but let the final project reflect your child's individual effort and design. Also, keep in mind that a successful project can be completed for under $10.

Please let me know if you'd like more information on creating a successful student research EXPO project. If you have any questions, do not hesitate to contact me. I look forward to watching your child enjoy this unique opportunity for scientific discovery!

Sincerely,
Second example of a letter to the parents

Date:

Dear Students and Parents:

It’s time to start work on our school’s Student Research EXPO! Enclosed is a schedule outlining due dates and important information regarding your child’s project. Ample time has been scheduled and work has been spread out, so students can complete the work at a comfortable pace.

This is a **major** project and will represent a **significant portion** of your child’s grade for the next grading period(s). The primary objective of this project is to have students approach a problem scientifically. This includes:

6. Asking questions and forming hypotheses  
7. Creating experiments to test those hypotheses  
8. Organizing data and drawing conclusions  
9. Writing about scientific research

The project must be **experimental** in nature as opposed to research oriented. In other words, students must do a test, survey, or experiment to determine the answer to their question instead of just looking it up in a book. We encourage students to pick topics that they are genuinely interested in, since they will be working on these projects for the next several months. Topics must also be “**original**” - something students do not already know.

Students will be working in small groups of **three**. Each group member will be responsible for contributing equally to the project and keep up with the research. To encourage all group members to share equally in the work, grades will be given **individually** based on one of the specific tasks each student selects. The three tasks are outlined as follows:

1. **Notebook:** This person is in charge of entering data into the project notebook on a regular basis.

2. **Scientific Paper:** The Scientific Paper chronicles how the project evolved, how the research was done, the results, and conclusion. This paper must be typed or word processed.

3. **Display:** This person will be responsible for organizing the display. This includes taking pictures or making sketches of the experimental process, gathering materials, building, and setting up the display for presentation and judging.

In order to do well on these individual tasks, all group members must be engaged in the project from the beginning and not wait until the last minute. Please note on the schedule, **Notebooks** are due for 1st Check on __________. At this time, each student will also be required to turn in 1/2 page paragraph summarizing the progress of the group’s research.

Project guidelines state that all work must be done by the students; however, assistance may be provided by teachers, parents, etc. It is very difficult to work alone without the exchange of ideas, so we encourage you to brainstorm with your child on different ideas and possible topics your child may want to pursue. Students have been given lists of Student Research EXPO Categories and Guidelines and Project Ideas. Please take a moment to review these with your child in order to generate topic ideas. Student Research EXPO Proposals are due on __________.
Please keep in mind that our school’s Student Research EXPO is the first step to participating in the County Student Research EXPO. Students who complete a First, Second, or Third Place Student Research EXPO Project for our school’s Student Research EXPO will be considered for participation in the County Student Research EXPO.

I am looking forward to working with you to make this a valuable learning experience for your child. I appreciate your support on this important project. As acknowledgement and part of your child’s homework, please sign, date, and return the bottom portion of this letter by ______________________.

Sincerely,
Homework Assignment DUE _______________________

I have reviewed the Science EXPO information and calendar with my child, ____________________, (Printed Name of Child) and we understand the requirements for a successful Science EXPO Project.

_____________________________
(Parent Signature/Date)

_____________________________
(Student Signature/Date)

Science EXPO Groups

For your project, you will be able to select your own groups; no more than 3 in a group. Each group member will be responsible to contribute equally to the project and keep up with the research. In order to ensure all group members contribute to the project, your individual grade will be based on one of the following tasks:

1. One person will be in charge of entering data into the Notebook (details will be given shortly). This does not mean others in the group do not contribute to the research involved in compiling the notebook. This person should have the following qualities:
   - Be able to write regularly - 10 minutes per day
   - Keeps a regular schedule and sticks to it
   - Have access to the experiment in order to make daily entries

2. One person will be in charge of the Scientific Paper. This paper will chronicle how the project came to be, how the research was done, the results, and conclusions (details to come later). This person should have the following qualities:
   - Have access to a computer
   - Have good writing skills
   - Have a good understanding of what the research entailed

3. One person will be in charge of putting the display together. This means if any sketches, photographs, need to be made of the experimental process, this person does it. This person is also responsible to put the display together according to Science EXPO guidelines (more on that later). This person should have the following qualities:
   - Have access to a camera (if necessary)
   - Have an artistic flair to make display understandable and interesting
Judges
An example of a letter to the Judges

Date:

Dear Sir or Madam:

We would like to invite you to take part in a student research EXPO, an exciting event that encourages students to think like young scientists. We hope you agree that the educational benefits are numerous, as students develop skills in writing, oral presentation, creative thinking, and problem solving. It would be of great appreciation if you could volunteer some of your time as a judge for our student research EXPO.

I am looking forward to working with you to make this a valuable learning experience for our children. I appreciate your support on this important project. As an acceptance for this vital role in our student research EXPO, please fill out, sign, date, and return the bottom portion of this letter by __________________________.

Please be sure to submit your complete name, full mailing address, at least one phone number where you can be reached and most important, if available, your e-mail address. You must provide your first choice of category (discipline).

Sincerely,

Prefix: _____ First Name: ___________
Middle Name: ___________
Last Name: Postfix: ______________

NOTE: Please enter address where correspondence can be sent most easily.
Address 1: _______________
Address 2: _______________
Address 3: _______________
City: _____________________, NM Postal Code:________

Home Phone: __________ Work Phone: ________

E-mail: ____________________

Employer: __________________
Job Title: __________________
Years Professional Experience: _____
Previous Judging Experience: ____
Primary Category in which you qualify to judge: (mark most appropriate category)
___ Behavioral Science, ___ Biochemistry, ___ Botany, ___ Chemistry, ___ Computer Science,
___ Earth Science, ___ Engineering, ___ Environmental Science, ___ Mathematics,
___ Medicine and Health Science, ___ Microbiology, ___ Physics, ___ Space Science, ___ Zoology

Please identify any additional categories that you would feel qualified to judge:
________________________________________________________________________

Diet: ___Normal; ___Kosher; ___Vegetarian; ___Vegan (Strict Vegetarian)

Parking Needed: ___ (No/Yes)

If you require special assistance (ADA), please indicate below:
________________________________________________________________________

I hereby acknowledge that by submitting this application, I agree to serve as a judge for the Student Research Expo. I also agree to conduct myself ethically and responsibly at all times during the Expo. To that end, I agree to notify the Host Judging Coordinator immediately if I become aware of any circumstance, including personal familiarity with a student Finalist, which would potentially compromise my ability to evaluate all finalists' projects without bias or prejudice.

Full Name: ________________  Signature: _____________________  Date: _______
Sponsors
An example of a letter to the Sponsors

Date:

Dear Sir or Madam:

We would like to invite you to take part in a student research EXPO, an exciting event that encourages students to think like young scientists. We hope you agree that the educational benefits are numerous, as students develop skills in writing, oral presentation, creative thinking, and problem solving. It would be of great appreciation if you could become a sponsor for our student research EXPO.

WHY DONATE/SPONSOR?
• Make a positive impact on a large number of students in our schools.
• Support and encourage students interested in science, technology, engineering, & math!
• Get great visibility for your organization! You’ll be recognized in our print materials, and on signage at the Fair itself. You can even have a booth set up during the Fair!
• We work very hard to make an student research EXPO coordinated and produced in a highly professional manner and that our student exhibitors as well as their teachers have an awesome experience before, during, and after the fair!
• Make a difference, encourage excellence, and motivate the scientists, engineers, doctors, nurses, mathematicians, teachers, etc. of the future!

Student Research EXPO offer awesome opportunities for students to delve into the worlds of science, technology, engineering, and math. Many of them come away from their science fair experiences committed to pursuing careers in science, engineering, healthcare, technology, math, etc. You and/or your organization can be part of this amazing program! Come join our Student Research EXPO family...we’d love to have you!

CATEGORY SPONSORSHIP
You or your organization can sponsor one of the 14 science fair competition categories! Category Sponsors receive benefits that include free advertising and, signage during the fair, opportunity to present the category awards, etc. The 14 categories for our student research EXPO are: Behavioral Science, Biochemistry, Botany, Chemistry, Computer Science, Earth Science, Engineering, Environmental Science, Mathematics, Medicine and Heath Science, Microbiology, Physics, Space Science, and Zoology

GENERAL DONATION
Unrestricted funds are critical to the successful operation of and Student Research EXPO and help us pay for unsponsored expenses such as temporary employees during the fair, paper, office supplies, awards, postage, etc. Donations for unrestricted funds are gratefully accepted in any amount

IN-KIND DONATIONS
In-Kind Donations are a wonderful way to help support the Student Research EXPO, especially if your organization is low on funds, but really wants to help out. In-Kind
Donations can be just about anything...paper, supplies, wish-list items, printing, mailings...you name it!

VOLUNTEERS & JUDGES
We ALWAYS need more volunteers and judges who can work during the Student Research EXPO! Potential judges should contact us for a form that can be filled out and submitted. It is a quick and painless experience! We appreciate any gentle arm-twisting you can do to help us recruit judges!

Please call, or e-mail us with any questions you may have. I am looking forward to working with you to make this a valuable learning experience for our children. I appreciate your support on this important project. As an acceptance for this vital role in our student research EXPO, please fill out, sign, date, and return the bottom portion of this letter by ________________________.

Sincerely,

________________________________________

Donor Name: ________________

NOTE: Please enter address where correspondence can be sent most easily.
Address 1: ________________
Address 2: ________________
Address 3: ________________
City: _____________________, NM Postal Code: ______

Contact Phone: ______

Contact E-mail: ________________

Donation Type:
____ Category Sponsorship; for the following Category/Categories: _____________________
____ General Donation
____ In-Kind Donation

Donation of: ________________________________

I hereby acknowledge that by submitting this application, I agree to serve as a sponsor for the Student Research Expo. I also agree to fulfill the obligations that I listed in this application.

Donor Full Name: ________________ Signature: _____________________ Date: ______
## Judging Rubric

### Scientific Thought

<table>
<thead>
<tr>
<th></th>
<th>Individual Possible</th>
<th>Individual Score</th>
<th>Team Possible</th>
<th>Team Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has the student followed the scientific method?</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Problem/Question</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Hypothesis</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Methods &amp; Data</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Conclusion</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>What were the methods used to solve the problem? Were they followed?</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the variables recognizable and clearly defined?</td>
<td>5</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>If controls were necessary, does the student/team recognize their need and were they used correctly?</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there enough data to support conclusions?</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the student/team understand their project's tie to related research?</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>30</strong></td>
<td></td>
<td><strong>25</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Creative Ability

<table>
<thead>
<tr>
<th>Does the project show creative ability and originality in:</th>
<th>Individual Possible</th>
<th>Individual Score</th>
<th>Team Possible</th>
<th>Team Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>The question asked?</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Approach to solving the problem?</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>The analysis of the data?</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>The interpretation of the data?</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Is the display creative and pleasing to look at?</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>30</strong></td>
<td></td>
<td><strong>25</strong></td>
<td></td>
</tr>
</tbody>
</table>

*This does not mean that the entire project must be original, but credit should be given to what the student has contributed. Collections and models can be considered creative only when used to support an investigation or to help answer a question in some original way. Assembling a kit cannot be considered creative unless some unusual approach or design was used. For Engineering, a clear distinction between gadgeteering and a genuine contribution should be made.*

### Teamwork (team projects only)

<table>
<thead>
<tr>
<th>Possible Points</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are the tasks and contributions of each member clearly outlined?</td>
<td>5</td>
</tr>
<tr>
<td>Was each team member fully involved with the project, and is each one familiar with all aspects?</td>
<td>6</td>
</tr>
<tr>
<td>Does the final work reflect the coordinated efforts of all team members?</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>
### Thoroughness

<table>
<thead>
<tr>
<th></th>
<th>Individual</th>
<th></th>
<th>Team.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Possible</td>
<td>Score</td>
<td>Possible</td>
<td>Score</td>
</tr>
<tr>
<td>Does the project carry out its original purpose to completion?</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the conclusions based on a single experiment or on replication?</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the project notes complete?</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the student/team aware of other approaches or theories?</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much time did the student/team spend on the project?</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the student/team familiar with scientific literature in the studied fields?</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>15</strong></td>
<td><strong>12</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Skill

<table>
<thead>
<tr>
<th></th>
<th>Individual</th>
<th></th>
<th>Team</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Possible</td>
<td>Score</td>
<td>Possible</td>
<td>Score</td>
</tr>
<tr>
<td>Does the student/team have the skills required to do the necessary work? Ex: Laboratory, computation, observational, design skills</td>
<td>3</td>
<td>2</td>
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<tr>
<td>Is the student/team able to respond to oral questioning? (Nervousness is Okay!)</td>
<td>6</td>
<td>5</td>
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<tr>
<td>Is written material prepared by the student/team and reflects their understanding?</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Was assistance received? (By all means, we hope the student received some help. However, the project should reflect their work.)</td>
<td>3</td>
<td>2</td>
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<tr>
<td><strong>Total Points</strong></td>
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<td><strong>12</strong></td>
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### Clarity

<table>
<thead>
<tr>
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<th>Team</th>
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</tr>
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<td></td>
<td>Possible</td>
<td>Score</td>
<td>Possible</td>
<td>Score</td>
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<tr>
<td>Can the student/team explain the purpose, procedure, and conclusion of their project?</td>
<td>4</td>
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<tr>
<td>Are the important phrases of the project presented in an orderly manner?</td>
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<tr>
<td>How clearly are the data and results presented?</td>
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<td>2</td>
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<tr>
<td>How well does the project display itself?</td>
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<td><strong>Total Points</strong></td>
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</table>
Glossary

Physical Science Glossary

**Acceleration** - the rate at which the velocity of an object changes

**Acid** - a chemical substance that reacts with metals to release hydrogen

**Atom** - a tiny particle of matter consisting of a nucleus that contains protons and neutrons and electrons

**Atomic Number** - the number of protons in the nucleus of an atom which identifies the kind of atom

**Boiling** - the process in which particles of a liquid change to gas, travel to the surface of the liquid, and pass into the air

**Catalyst** - a substance that speeds up chemical reactions, but is not changed by the reaction

**Celsius** - a temperature scale used in the metric system in which water freezes at 0 degrees and boils at 100 degrees

**Chemical Change** - a change in which atoms and molecules form or break chemical bonds

**Chemical Equation** - a description of a chemical reaction using symbols and formulas

**Chemical Property** - a property that describes the behavior of a substance when it reacts with other substances

**Chemical Reaction** - a change that produces one of more new substances

**Chemical Symbol** - the shorthand way of writing the name of an element

**Chemistry** - the study of matter

**Coefficient** - a number that tells how many molecules of a substance are needed or produced in a reaction

**Compound** - a substance made up of two or more elements

**Conductor** - a material that transmits or carries electricity

**Conservation of Energy** - the principle that energy cannot be made or destroyed, but only changed in form, and that the total energy in a physical system cannot be increased or diminished

**Crystal** - a solidified form of a substance in which the atoms of molecules are arranged in a definite pattern

**Density** - the ratio of the mass of an object to its volume

**Direct Current** - electric current that moves from negative to positive current and amplitude does not vary with respect to time

**Electron** - a negatively charged atomic particle

**Fahrenheit** - the temperature scale in which the freezing point of water is 32 degrees and the boiling point of water is 212 degrees

**Fulcrum** - the point on which a lever is supported

**Galvanometer** - a tool used for measuring very small electrical currents

**Gas** - the form of matter that has no definite shape or volume

**Gravity** - the force of attraction between objects and the earth

**Heterogeneous Mixture** - a mixture in which the composition is not the same throughout

**Inertia** - the property of matter to resist changes in motion

**Insoluble** - that which cannot be dissolved

**Ion** - an electrically charged atom which has lost or gained one or more electrons in a chemical reaction

**Liquid** - the form of matter that has a definite volume but no definite shape

**Luminous Objects** - objects that give off their own light

**Mass** - the amount of matter in an object

**Matter** - anything that has mass and takes up space

**Mixture** - a substance containing two or more ingredients which are not in fixed proportions, do not lose their individual characteristics of the element or compound
Molecule-the smallest particle of an element or compound that can exist in the free state and still retain the characteristics of the element or compound
Negative Charge-the charge of an atom having an excess of (negative) electrons
Neutral-neither positively nor negatively charged; neither acidic nor basic
Neutron-a neutral atomic particle
Non-electrolyte-a substance that will not make water conduct electricity
Nucleus-the center of an atom which contains protons and neutrons
Oxidation-the union of a substance with oxygen; the process of increasing the positive capacity of an element of the negative capacity of an element to combine with another to form molecules; the process of removing electrons form atoms or ions
Physical Change-a change in which chemical bonds are not formed or broken and no new substance is produced
Physical Property-a property that distinguishes one type of matter from another and can be observed without changing the identity of the substance
Physics-the study of different forms of energy
Positive Charge-the charge of an atom having an excess of (positive) protons
Precipitate-an undissolved solid that usually sinks to the bottom of a mixture
Property-a quality that describes or characterizes an object
Proton-a positively charged particle found in the nucleus of an atom
Pure Substance-a substance that contains only one kind of material, has definite properties, and is the same throughout
Refraction-the bending of light as it passes form one medium to another
Suspension-a cloudy mixture of two or more substances that settles on standing

Earth & Space Science Glossary

Abrasion-the wearing away of rocks by rubbing and scraping
Absolute Magnitude-the measure of a star’s actual brightness
Abyss-ocean depths of 2000-6000 meters
Air Mass-a body of air that has the same properties as the region over which it develops
Anemometer-an instrument used to measure wind speed
Apparent Motion-the motion of an object relative to the position of its observer
Aquifers-permeable rocks container water
Arid Climate-a climate in which the plants receive much less rainfall than they require
Asteroids-numerous small planets with orbits between Mars and Jupiter
Astronomy-the study of the stars, planets, and other heavenly bodies
Atmosphere-the gaseous mass that surrounds any star or planet
Axis-an imaginary line around which something spins
Barometer-an instrument used to measure air pressure
Bedrock-the solid rock found under soil
Comet-a heavenly body consisting of rocks and gases that orbits the sun
Conglomerate-sedimentary rock made of pebbles and gravel cemented together by clay
Convection Current-the movement of material within a fluid caused by uneven temperature
Crust-the outermost layer of Earth, extending to a depth of about 35 km
Density Currents-currents of water that move up and down in the ocean
Diurnal-an event occurring once a day; usually referring to tides
Drag—a force of friction that resists the movement of a body through a fluid medium
Elevation—the distance of a point above or below sea level
Full moon—moon phase occurring when Earth is between the sun and the moon, with the sun shining on the moon so that it is visible from Earth
Galaxy—a large grouping of millions of stars
Gemstones—a mineral or petrified substance that can be used as a gem when cut and polished
Geologic Time Scale—a history of the earth based on observations of rocks and fossils
Geyser—a spring form which boiling water and steam shoot into the air at intervals
Glacier—a moving river of ice and snow
Gravity—the force of attraction that exists between all objects in the universe
Hydrosphere—all of the water on the face of the earth
Igneous Rock—rock formed from the cooling of hot, molten magma
Latitude—distance, measured in degrees, north or south of the equator
Longitude—distance, measured in degrees, east or west of the prime meridian
Lunar Eclipse—the partial or total blocking of the moon when the earth comes directly between the sun and the moon
Magma—liquid or molten rock deep inside the earth
Mantle—the thick layer of the earth between the crust and the core
Meridian—imaginary lines running from the North Pole to the South Pole
Meteor—the flash of light that occurs when a meteoroid is heated by its entry into the earth’s atmosphere (a shooting star)
Meteorite—the part of a meteoroid that passes through the atmosphere and falls to earth
Mineral—any of the small, solid bodies that travel through outer space and are seen as meteors when they enter earth’s atmosphere
Mountain—a raised part of the earth’s surface with an elevation of at least 600 meters higher than the surrounding land
Neap Tides—low tides that occur when the sun, Earth, and moon form a right angle
New Moon—phase of the moon in which the side of the moon facing Earth is dark
Orbit—the path of one object in freefall around another object in space
Penumbra—a partial shadow formed during an eclipse
Period—a subdivision of a geologic era
Phases—any of the recurring stages of changes in the appearance of the moon or planet
Plateau—a large, flat area with an elevation that differs little from the surrounding area
Planet—an object in space that reflects light form a nearby star around which it revolves
Plates—rigid blocks of Earth’s crust and upper mantle
Plate Tectonics—a theory that explains movements of continents and changes in Earth’s crust caused by internal forces
Precipitation—the falling of water or ice formed by condensation
Prehistoric—before recorded history
Richter Scale—a means for measuring the magnitude of earthquakes
Sandstone—sedimentary rock made of sand
Satellite—a small planet that revolves around a larger one; a man-made object put into orbit around some heavenly body
Schist—a metamorphic rock containing parallel layers of flaky minerals
Sedimentary Rocks—rocks formed by the cementing together of materials
Seismograph—an instrument that measures movements in the earth’s crust
Shale—sedimentary rock made of mud and clay that splits easily into thin layers
Sill—igneous rock that has solidified between and parallel to the layers of rock in the earth’s crust
Slate—a metamorphic rock that is made form shale and that breaks in flat sheets
Solar Eclipse—an eclipse that occurs when Earth is in the moon’s shadow
Spring Tides—tides that occur when the sun, moon, and Earth align
Stratosphere—the second layer of the atmosphere which extends six to fifteen miles above the earth’s surface and where the temperature is fairly constant
Stratus Clouds—clouds that extend in long, low, gray layers
Sunspot—a temporarily cooler area of the sun that appears as a dark spot
Telescope—an instrument which makes distant objects appear closer and larger
Umbra—an inner, complete shadow formed during an eclipse
Weathering—the process by which surface rocks and other materials are broken down by wind, water, and ice
Wind—movements of air parallel to the Earth’s surface

Life Science Glossary

Adaptation—a change in structure, function, or form that helps an organism adjust to its environment
Amphibians—the class of vertebrates, including frogs, toads, and salamanders, that begins life in the water as tadpoles with gills and later develops lungs
Angiosperms—a class of plants which includes the flowering plants and which is characterized by having seeds enclosed in ovaries
Antennae—a pair of movable, jointed sense organs on the heads of insects and other related organisms that are used for taste, touch and smell
Arachnids—the class of arthropods, including spiders and scorpions, which have four pairs of legs, no antennae, and which breathe through lung-like sacs or breathing tubes
Arthropoda—the phylum of invertebrate animals with jointed legs and a segmented body such as insects, crustaceans, arachnids etc.
Benedict’s Solution—a blue liquid that is used to test sugar
Biochemistry—the branch of chemistry that deals with plants and animals and their life processes
Biome—an extensive community of plants and animals whose makeup is determined by coil and climate
Botany—the study of plants
Bulb—an underground plant structure which has roots and which consists of a short stem covered with scales (as in onions and tulips)
Camouflage—body coloring that protects an organism
Carbohydrate—any of certain nutrients made of sugar or starch
Carbon Dioxide—a colorless, odorless gas that is used by green plants in photosynthesis and which is given off by all living things in respiration
Chlorophyll—the chemical in chloroplast of plant cells that is needed for photosynthesis
Chloroplast—the chemical in chloroplasm in cells of green plants that contains chlorophyll (photosynthesis takes place in the chloroplasts)
Chordata—the phylum of animals with an internal skeleton
Chromosomes—microscopic, rod-shaped bodies, which carry the genes that convey hereditary characteristics and which are consistent in number for each species
Coelenterata—the phylum of animals with central cavity and tentacles
Commensalism—a relationship where one organism lives on another without harming it
Crustaceans—the class of arthropods, including lobster, crab, and shrimp, which live in the water, breathe through gills, and have a hard outer shell and jointed appendages.

DNA—(deoxyribonucleic acid) the acid in chromosomes that carries genetic information.

Echinodermata—the phylum of marine animals with a water vascular system and usually a hard, spiny skeleton and radial body (starfish, sea urchins etc.)

Ecology—the study of the relationship between plants, animal, and their environment.

Ecosystem—a system consisting of a community of animals, plants, and bacteria and its interrelated physical and chemical environment.

Environment—the part of the biosphere surrounding a particular organism.

Fertilization—the joining of nuclei of the male and female reproductive cells.

Food Chain—the path of food energy from one organism to another is an ecosystem.

Fungi—a kingdom of plant-like organisms that are parasites on living organisms or feed upon dead organic material and which lack true roots, chlorophyll, stems, and leaves, and reproduce by spores.

Gymnosperms—a large class of seed plants which have the ovules borne on open scales (cones), and which lack vessels in the woody tissue (trees: pines, spruces, cedars etc.).

Habitat—the type of environment suitable for an organism; native environment.

Heredity—the passing on of traits from parents to offspring by means of genes in the chromosomes.

Inherited Traits—traits that are passed on from parents to offspring.

Larva—the free-living, immature form of any animal that changes structurally when it becomes an adult (the second stage of insect development).

Mammal—a warm-blooded vertebrate that produces milk to feed its young.

Minerals—certain elements essential to the proper functioning of living organisms.

Mollusca—the phylum of invertebrates characterized by a soft, unsegmented body (often closed in a shell) and which usually has gills and a foot (oysters, snails, clams, etc.).

Molting—a process by which an animal sheds its outer covering.

Nocturnal Animal—an animal active mainly at night.

Nucleus—the central mass of protoplasm present in most plant and animal cells that contains the hereditary material and controls the life functions of the cell.

Nutrient—a chemical substance found in foods which is necessary for the growth and development of an organism.

Offspring—a new organism produced by a living thing.

Organ—a group of specialized tissues that work together or perform a special function.

Organism—a living thing.

Parasite—an organism that lives on or in the body of another organism form which it derives sustenance or protection without benefiting the host and often causing harm.

Photosynthesis—the process in which green plants use the sun’s energy to produce food.

Pollen—the yellow, powder-like male reproductive cells formed in the anther of the stamen of a flower.

Pollination—the movement of pollen from stamen to upper top of the pistil of a flower.

Porifera—phylum of chambered animals (sponges) that live in water.

Protein—any of a large class of nitrogenous substance consisting of a complex union of amino acids and containing carbon, hydrogen, nitrogen, oxygen, and sulfur; proteins are essential for the building and repairing of protoplasm in animals.

Protists—Kingdom of simple organisms, mostly one-celled; most do not make own food.

Prototoplasm—the essential living material of all animal and plant cells.

Protozoa—the phylum of mostly microscopic animals made up of a single cell or group of identical cells and living mainly in water (many are parasites).

Reptiles—cold-blooded animals with scales; live mostly on land and breathe air.
Sepals— the green leaf-like structures that surround the bottom of flowers
Vertebrates— animals with backbones
Vitamins— organic substances essential for the regulation of the metabolism and normal growth and functioning of the body
Zoology— the study of animals
Zygote— a cell formed by fertilization