Teacher, Parent, and Student's Guide to

SCIENCE FAIR BASICS

Introducing the process behind the competition.

This booklet contains a set of lesson plans and student activities intended to facilitate the process of Science & Engineering Fair competition. It has been prepared to offer help to those just beginning the experience of Science Fairs, primarily elementary or middle school teachers and students, but may prove helpful to students in high school who have never before participated.

The current official Georgia Science & Engineering Rule book should be used alongside these lessons. If the Rule Book is unavailable, a complete set of rules, forms, and ideas, as well as, an interactive version of these lessons is on the web site at www.uga.edu/oasp .

If these lessons will be used for classroom instruction, it is recommended that each student maintain a tabbed folder to receive each exercise as it is presented. Each page is intended as a single lesson. The facing page includes helpful teacher/sponsor instruction information, hints, and practices. Individuals can follow the lessons at home with some help from parents or sponsor.

Science & Engineering Fair rules

All rules and regulations used by the Georgia Science & Engineering Fair are the same as those used by the International Fair. Any local or regional fairs that are affiliated with the State Fair must also follow the same rules.

The complete set of rules, forms, ideas, and methods is available on the web site at no cost: **www.uga.edu/oasp**

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INTRODUCTION

Time-Table for Project Completion

If lessons are started at the beginning of the school year and followed each week, the student should be able to finish the entire research project by mid-year. This is ideal timing for entry into local and regional competition, which usually start in January or early February. The State Fair is in April.

Start	Parent Meeting
Week 1	Wonder
Week 1-2	Research
Week 3	Question
Week 3	Define
Week 4	Predict/Set Goals
Week 5	Plan
Week 6-8	Experiment
Week 8	Organize, Analyze, Synthesize
Week 9	Summarize
Week 10-11	Report
Week 12	Double Check, Share, and Evaluate

Learning objectives

Learning objectives are included with each exercise in this section. The specific goals used are:

1. **Research Skills**: Students will use world-wide information, connectivity to specialists through various resources, and utilization of a wealth of ideas for preparation of and synthesis into a unique science project.
2. **Logical and Creative Problem-solving**: Students will learn to solve problems logically and to use creative and or alternate solutions to situations encountered during the research project phases.
3. **Critical Thinking**: The students will identify and clarify research issues by following a line of reasoning; judging statements, conclusions, and observations of others before applying information and techniques to own research project.
4. **Communication Skills**: Students will communicate information, ideas, problems, and solutions of the independent research project through verbal, written and visual means.
5. **Self-direction Skills**: Students will use computer skills, graphics skills, determination, goal setting, and organization for information gathering, analysis, synthesis, and evaluation during the Science Fair process.
6. **Creative Thinking Skills**: Students will use techniques such as brainstorming to generate ideas for unique and/or original research-based directions.

The Wheel of Science

Especially for young students, the use of the Wheel of Science will help break down the Science Fair process so they can better organize their progress. The names on the wheel correspond to each lesson or group of lessons in this section. As a student completes a step, the pointer is moved to the next numbered section on the wheel. A classroom teacher may wish to enlarge and display one wheel to show the classroom's progress.

PARENTS

Parent Meeting

It is vital to involve parents in the process from the very beginning. If projects will be done at school, the teacher should schedule a parent meeting at the start of school. At this meeting, discussion can include:

- the parent's role and responsibilities
- the student responsibilities and performance expectations
- science fair rules and forms, signatures and dates
- the learning objectives
- materials needed

Parent's Role and Responsibilities.

< transportation, motivation, and guidance outside of the classroom

< help for the instructor and other students in the classroom

< Forms must be filled out and guidelines adhered (Like it or not, rules are part of the scientific process and help to teach the student discipline and responsibility, as well as science safety.)

< Many Science & Engineering projects are completed outside of the classroom. Some projects will be entirely performed away from school. In these cases, the parent or other adults must take on additional roles:

Adult Sponsor
Qualified Scientist
Designated Supervisor
Animal Care Specialist
(See pages 33-34 of the Rule book for details)

At the meeting, teachers should have the following GSEF forms available to introduce parents to the rules and regulations of the Science & Engineering Fair: (Get a complete set of forms and rules at: **www.uga.edu/oasp**)

Quick Reference Guide
Approval Form (1B), obtain parent and student signatures and dates, collect and file away.

Have the following forms available for discussion, but these can not be completed yet:

Official Abstract Form
Checklist for Adult Sponsor Form (1), send home if parent or another adult at home will be the student's sponsor
Research Plan (1A) or (1A) Team Projects

PARENTS AND TEACHERS WARNING!
The richness is not in winning, the richness is in doing.

STUDENTS

Student responsibilities and performance expectations.

Feedback and guidance should be given to students at each step along the way. If project is done at school, much communication needs to go to parents. Parents and students need to know what has to come to school, when each part will be due, what the student does at home and what at school, what materials parents need to supply, etc.

Students are directly responsible for:

- the completion of all lesson papers, forms, log books, and work in and outside of the classroom
- remembering to bring folders and log books to class on the designated science fair lesson days
- may be responsible for providing the materials they will need for their experiments
- choosing a project, question or problem in which they are genuinely interested.

Lesson 1 WONDER TEACHERS/SPONSORS INSTRUCTIONS

Learning Objectives: Creative Thinking Skills, Self-direction Skills

PREPARATION

You should have available resources for science and engineering project ideas such as books, encyclopedias, Internet access, lists of science questions or ideas.

Make sure EACH student has the following:

- Tabbed and pocketed folder to hold lesson pages or notebook
- Copy of Lesson 1 page and the Wheel of Science for each student, cardboard, glue, scissors, brad (**or** a single enlarged Wheel of Science for the class)
- A bound (glued or stitched) log book, labeled with name and other information needed.
- Ink pen and scratch paper

INTRODUCTION

Scientists wonder. What makes the sky blue? What happens to the water in a puddle when it is in the sun? Which paper towel works the best? How do bees find flowers? How much weight will this bridge hold?

Curiosity is the finest quality a scientist can have. **Combine curiosity, creative thinking, and careful experimenting, and you have the science process.**

Today we will begin our curiosity adventure with a project for the Science & Engineering Fair.

A. The best ideas come from their own heads, but books and web sites are available to help if needed. On our web site **www.uga.edu/oasp/gsef/sources.html** are listed hundreds of ideas. Links to other web sites and a list of helpful books is also available there. People are a great source as well. Doctors, professors, landscape professionals, business people, dentists, etc., can be contacted for ideas.

B. Have students brainstorm everything they like, are interested in, or are curious about. Have students limit the ideas to one or two words to simplify writing and to keep the ideas flowing. Share within the class some of these ideas.

C. Have students complete the rest of the exercise. Some may be reluctant to select only one idea. Tell them they can return to this page if their first selection doesn't work out. Scientist must focus their work on small areas or single ideas in order to explore it thoroughly; one idea at a time.

D. Have young students construct the **Wheel of Science** (or introduce enlarged classroom Wheel). Older students may want to use a checklist.

Lesson 1

WONDER

Your first step for the Science & Engineering Fair is to pick your topic. Ideas can come from hobbies, interests, problems needing solutions. Many ideas are available through books and web sites, but the BEST ideas come from your own head.

A. Brainstorm all of your interests here. Think of activities or things that interest you or maybe something you've always wondered about. Use simple one-word ideas like plants, worms, cars, sports, fishing.....

B. Circle 3 of the ideas above that you like BEST.

C. Now look very carefully at your 3 choices. Which ONE do you already know something about AND really CARE about?
Underline that word.
Can't decide? Keep brainstorming. It will come to you.

D. Your underlined word is the start to your project. From now on we'll call it your TOPIC. Now we can begin.

The Wheel of Science
Make a copy Wheel of Science found in the back of this booklet. Paste it onto cardboard and cut it out. Use a brad to attach the pointer. This is your guide to a great project. Use it at home or school to keep track of your progress.

Lesson 1 WONDER TEACHERS/SPONSORS INSTRUCTIONS *continued*

Learning Objectives: Creative Thinking Skills, Self-direction Skills

E. Introduce the Log Book. Read through the list of what belongs in the log book and how students should maintain information in it. *RULE BOOK REFERENCE PAGE 19.*

The log book can go home to share with parents, but must come back to the classroom whenever science fair lessons begin again.

If some students were unable to decide on a topic during this session, insist that they have one by the next class. Make sure they know where to go for ideas.

AT HOME

Allow students to begin writing in the log book like a journal. They should write about the things they did today and the topic idea they will be exploring for the project. Make sure they use a pen and that they date the top of each page.

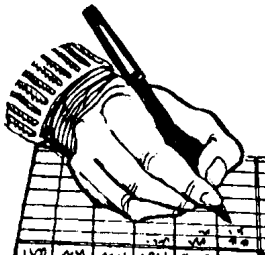
Have them talk about their idea with parent. Encourage them to explore web sites on the topic and to bring in books on the subject. Tell them to put any activity they do for science fair in their log book.

Your Log Book

Your log book should contain accurate and detailed notes of everything you do for your research project. Good notes will show you are consistent and thorough. It will also help you when you write your ABSTRACT, RESEARCH PAPER, and DISPLAY.

1. A log book is a notebook that must be bound with stitching or glue so that the pages are not removable.

2. Your log book should be written in ink only. Do not use pencil or printouts from a computer (except graphs and charts).



3. Put your name and school on the front of your log book.

4. Include notes on readings and bibliographic information.

5. Include your thoughts, ideas, and trials.

6. Include your raw data (all of the measurements you collect during your experimental trials).

7. Staple in copies of graphs or charts.

8. Attach photos and label them.

9. Date every entry and enter each science activity you do.

10. Do not try to make your log book neat. It should be readable, but you may cross out information you don't want as you work. Never remove pages from your log.

Write about your topic in your log book. Write all of your thoughts, ideas, what you know already about your topic.
Remember to date the page.

You can start looking up information about your topic. Web sites and reference books are a good start. If you can, contact someone who works with anything to do with your topic. This is a great source of information and a possible way to work with an expert.

Add any information you gather into your log book.

Lesson 2 RESEARCH TEACHER/SPONSOR INSTRUCTIONS

Learning Objectives: Research Skills, Critical Thinking, Communication Skills, Self-direction Skills

PREPARATION

- Students should have books, copy of Lesson 2 page, web site print outs, brochures from companies, or other information gathered and LOG BOOKS
- Teacher may have publications, research materials, and books available during class

INTRODUCTION

By now, students should have a good concept of what topic they wish to investigate. Next their task is to find out what is already known about the topic they have chosen. The aim behind independent research and the Science & Engineering Fair is to create NEW knowledge. Therefore, encourage students to seek areas of study with little or no information about it. By reading books, web sites, and other informative publications, the student is better able to discover the areas that need:

a. Clarification
b. More supporting data
c. Investigation on related topics
d. Problem solving
e. Narrower or broader focus

This lesson will probably take all week, for some students even longer. Expect at least 3 references sited for each topic. Young students may need help with scientific writings, but children's versions of many topics are available at the local library and on the web. This is a good time to encourage the use of a Thesaurus and a Dictionary.

A. The list of categories in the Rule Book may help students to identify key words or study areas for library/Internet research. Have each student try to identify the category which best describes his/her topic.

B. Spend time discussing your preferred bibliographic style for references.

C. Allow students time to look through reference material and to make notes in log books.

D. Discuss research and organizational steps they must take this week. You may wish to introduce outlining and notebook organization before students begin.

E. Discuss the rules governing the areas of research that require special forms and supervision.

Lesson 2
RESEARCH

Study everything known about your topic

1. Go to the library, record the topic information gathered and bibliographic information into your log book.

2. Talk to professionals in the field, take notes and record phone numbers, etc. into your log book.

3. Write to companies for information or visit their web sites. Web sites are especially good places to find building specs and equipment information.

4. Be on the lookout for areas of the topic that are not well understood. This may lead to NEW information with your research.

Organizing your Information:

5. Organize everything you have learned about your topic with an outline. Put your notes, papers, and information into a notebook with section labels.

6. Narrow down your information by focusing on a particular idea. This can help you define your question and help identify the procedure for testing.

Next Steps:

7. Think about where you will work. Science & Engineering Fair Rules limit what work can be done at home. (See the Rule Book for details)

8. Arrange for your work place and the person who will supervise you. Some projects require a Qualified Scientist. Others need a Designated Supervisor. Some projects are OK to do at home with a parent as supervisor. As you plan, keep this in mind.
(See the Rule Book or www.uga.edu/oasp for details)

These research areas have specific rules and forms, and require approval from a school science safety committee called the SRC/IRB.

- 3 human subjects
- 3 non-human vertebrates
- 3 pathogenic agents
- 3 controlled substances
- 3 recombinant DNA
- 3 human or animal tissue
- 3 hazardous materials or devises

If you think your project will deal with one or more of these, do not begin with your experiment. You should continue to define, question, plan, and prepare then get approved.

Lesson 3 DEFINE TEACHER/SPONSOR INSTRUCTIONS

Learning Objectives: Critical Thinking, Logical and Creative Problem-solving, Creative Thinking

PREPARATION

RULE BOOK REFERENCE PAGES 15 AND 30.

- Overhead transparencies as needed
- Students should have copy of Lesson 3 page, log books and scratch paper.

INTRODUCTION

This lesson will help students define the process they will take to develop their investigations. Students will learn if they are doing an engineering project or a science-based project. The process for investigation is slightly different for each type of project.

A. Read top part of lesson with students.

B. If a student is still unsure where his/her topic fits, they may need to narrow the topic to a simpler level.

What is a good engineering project? Generally these are in the categories of Engineering, Mathematics, Physics, or Computer Science. Here are a few key words for topics to help generate engineering needs or problems to solve: golf club, ditch digger, computer program, pitching machine, egg carton, water power generator

Some engineering ideas may have to be tested using human subjects, others could be tested with full scale models or samples, some are mathematical equations or computer programs.

C. Have students add this information to log books and share with sponsor and/or parent.

Lesson 3

DEFINE

Science or Engineering?

For the Science & Engineering Fair you can conduct a *Science* investigation or an *Engineering* investigation. The process is slightly different for each:

Science Process:

- Define the Problem
- Find a Purpose
- Write a Hypothesis
- Develop a Procedure
- Analyze Results
- Draw a Conclusion

Engineering Process:

- Define the Problem
- Find a Goal
- Develop design criteria
- Build and test prototype
- Analyze Results
- Draw a Conclusion

You may already know if you have a Science Investigation or an Engineering Investigation. Science Investigations create new knowledge about how things live, operate, or exist. Engineering projects generally involve construction or design of an idea or new product.

A. Do I have a Science Investigation Topic?

Answer these questions if you think you have a Science topic

- What MATERIALS are readily available for conducting experiments on _____ ? (Your topic)
- How does _____ ACT?
- How can you CHANGE the set of materials to affect the action?
- How can you MEASURE or describe the response of _____ to the change?

B. Do I have an Engineering Investigation Topic?

Answer each of these if you think you have an Engineering topic:

- What is the need you are meeting or the problem you want to solve using _____? (Your topic)
- What MATERIALS / EQUIPMENT are readily available for the design and testing of _____ ?
- What construction or testing standards will you set?
- How can you MEASURE the success of the design of _____?

Add this information to your log book.

Lesson 4 QUESTION TEACHER/SPONSOR INSTRUCTIONS

Learning Objectives: Logical and Creative Problem-solving, Critical Thinking, Self-direction Skills, Creative Thinking Skills

PREPARATION

• Teacher can prepare overhead transparencies of questions.

• Students should have copy of Lesson 4 page, books, web site print outs, brochures from companies, or other information about topic available. They should also have their log books.

INTRODUCTION

Today students should be ready to form a research question. Forming a question is the easiest and most direct way to begin investigating a topic. By asking a question, all work should then be directed toward finding an answer.

Here students will learn to form a question which can be answered using experimental research. The question should contain a topic, a variable the student is changing, and the measurement of the change.

A. Use a transparency to demonstrate and work through examples.

1.Comparison/Choice Questions use a set of similar items and compare the action between them. Use the topic, a variable that is changed, and a measurable observation. Remind students to change only one variable (material or condition) at a time.

Example: WHICH PAPER TOWEL SOAKS UP WATER THE FASTEST?

What is the topic? PAPER TOWELS

What variable changes? DIFFERENT PAPER TOWELS

What can be measured? SOAKING UP TIME

2. Yes or No Questions get yes or no answers but still have variables and measurement. Use the topic, a variable that is changed, and a measurable observation.

Example: DOES YOUR HEARTBEAT CHANGE WITH DIFFERENT KINDS OF MUSIC?

What is the topic? EFFECTS ON HEARTBEAT

What variable changes? MUSIC TYPES

What can be measured? HEARTBEAT CHANGES

B. Have students begin writing their own questions on scratch paper. These can be checked by you and the best rewritten into the log book.

Lesson 4

QUESTION

Coming up with a question to ask

Science & Engineering Projects usually start with a question. There are two types of questions that work well to help design your project:

1. Comparison/Choice Questions use a set of similar items and compare the action between them. Use a topic, a variable that is changed, and a measurable observation. Remember to change only one variable at a time.

Example: WHICH PAPER TOWEL SOAKS UP WATER THE FASTEST?
What is the topic?
What variable changes?
What can be measured?

2. Yes or No Questions get yes or no answers but still have variables and measurement. Use the topic, a variable that is changed, and a measurable observation.

Example: CAN A PERSON TELL SOUND DIRECTION WHEN BLINDFOLDED?
What is the topic?
What variable changes?
What can be measured?

Here are some other questions to try. Find the topic, the variable that is changed, and a measurable observation.

Which brand of soap makes the most suds?

In which type of liquid do plants grow best?

Which model car design will be the fastest?

B. Below or on scratch paper try to form your own question. Remember you need your TOPIC, CHANGEABLE VARIABLE, and MEASURABLE OBSERVATION.

Students should evaluate their questions using the ones on the student page opposite.

Sometimes learning about the categories helps to generate ideas and questions. Here is a list of Categories used at the State Fair. Local and Regional Fairs may combine categories if there are insufficient entries in one or more.

1) **Behavioral and Social Sciences** - Human and animal behavior, social and community relationships--psychology, sociology, anthropology, archaeology, ethology, ethnology, linguistics, learning, perception, urban problems, reading problems, public opinion surveys, educational testing, etc.
2) **Biochemistry -** Chemistry of life processes--molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, hormones, etc.
3) **Botany** - Study of plant life--agriculture, agronomy, horticulture, forestry, plant taxonomy, plant physiology, plant pathology, plant genetics, hydroponics, algae, etc.
4) **Chemistry** - Study of nature and composition of matter and laws governing it--physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, materials, plastics, fuels, pesticides, metallurgy, soil chemistry, etc.
5) **Computer Science** - Study and development of computer software and hardware and associated logical devices.
6) **Earth and Space Sciences** - Geology, mineralogy, physiography, oceanography, meteorology, climatology, astronomy, geology, speleology, seismology, geography, etc.
7) **Engineering** - Technology; projects that directly apply scientific principles to manufacturing and practical uses--civil, mechanical, aeronautical, chemical, electrical, photographic, sound, automotive, marine, heating and refrigerating, transportation, environmental engineering, etc.
8) **Environmental Sciences** - Study of pollution (air, water, and land) sources and their control; ecology.
9) **Gerontology** - Study of the aging process in living organisms.
10) **Mathematics** - Development of formal logical systems or various numerical and algebraic computations, and the application of these principles--calculus, geometry, abstract algebra, number theory, statistics, complex analysis, probability.
11) **Medicine and Health** - Study of diseases and health of humans and animals--dentistry, pharmacology, pathology, ophthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, etc.
12) **Microbiology** - Biology of microorganisms--bacteriology, virology, protozoology, fungi, bacterial genetics, yeast, etc.
13) **Physics** - Theories, principles, and laws governing energy and the effect of energy on matter--solid state, optics, acoustics, particle, nuclear, atomic, plasma, superconductivity, fluid and gas dynamics, thermodynamics, semiconductors, magnetism, quantum mechanics, biophysics, etc.
14) **Zoology** - Study of animals--animal genetics, ornithology, ichthyology, herpetology, entomology, animal ecology, paleontology, cellular physiology, circadian rhythms, animal husbandry, cytology, histology, animal physiology, invertebrate neurophysiology, studies of invertebrates, etc.
15) **Team Projects -** All disciplines--multi disciplinary or interdisciplinary. Team projects will be judged by judges assigned to the category selected. Study conducted by two or three students in any discipline.

C. Do I have a good question?

After you write your question, ask yourself:

1. Can it be answered through experimentation or investigation?

Example:

Question 1 - What is the temperature on Venus?

Question 2 - Which color gets warmest in sunlight?

Which question can be answered through experimenting? Which question can be answered by looking up the information in a resource book?

2. Is my question suitable for a Science or Engineering project?

a. Does it interest me?

b. Do I know a little about it?

c. Would it involve measuring?

d. Are equipment/supplies readily available to me?

e. Is it useful to find out about?

3. Are the materials workable and obtainable?

4. If I am doing a Science project, are there variables I can change?

Are there conditions that should stay the same? Can I think of a control?

5. If I am doing an Engineering project, can I design and build a prototype to test?

Will it be too expensive to redesign and test again?

Let's Recap:

1. What is your question?

2. Why is this important to find out?

3. What materials will you need to answer your question?

4. Will you follow the Science process or the Engineering process for your investigation?

Lesson 5 PREDICT/SET GOAL TEACHER/SPONSOR INSTRUCTIONS

Learning Objectives: Logical and Creative Problem-solving, Critical Thinking,
Self-direction Skills, Creative Thinking Skills

PREPARATION

Teacher prepares overhead transparencies as needed

Students should have copy of Lesson 5 Part 1, books, web site print outs, brochures from companies, or other information about topic available. They should also have their log books.

INTRODUCTION

The first part introduces the rules and standards of an hypothesis. Science Investigations begin with an hypothesis. Engineering projects use design criteria and a goal. The second part of this lesson discusses design criteria and setting a goal.

Hypotheses are mainly written to aid the researcher in setting a goal and keeping to premise of the idea. The Hypothesis should include question information, materials and conditions, outcome expected, and reason for the expected outcome.

PART 1 Hypotheses

A. Most hypotheses are written as an If/Then statement so that it is clear what process, materials, and outcome is expected.

Develop your hypothesis. Read though the points with the students.

Let's try this: Read through the example and have students answer the questions about June's hypothesis.

Here is another example:

If I build several model automobiles of the same material and size but with different size wheels, then _____

B. To begin, students need the information they completed previously:

question
materials
reason behind idea

Have students write hypotheses on scratch paper before writing the one hypothesis selected into log book. This way you can check to make sure that it contains:

question information
materials and conditions
hints of the process
outcome expected
reason for the expected outcome

This is a VERY important step in the Scientific process and should not be rushed. Students must form a clear and easily followed hypothesis in order to design experimentation.

Lesson 5

PREDICT

Part 1 Hypothesis Writing for Science Projects

For a science project you will use all of your knowledge and study information about the topic to predict the answer to the question you are asking. This is called an **hypothesis**.

Developing your Hypothesis.

1. Make your hypothesis an IF/THEN statement to show exactly what you are testing and what you expect to find.
2. Make your hypothesis a TESTABLE statement. At the end of your experiments you want to be able to say, "My hypothesis was supported."
3. NEVER change your hypothesis after experimenting. Remember, it is just an educated guess. The reason for an hypothesis is to remind you of the goal of your investigation. It forces you to think and plan before you begin.
4. You hypothesis should include the reasoning behind your prediction. Support your point of view with expert information.

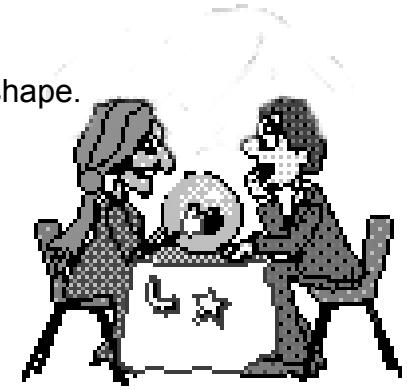
Let's try this:

Here is June Bug's hypothesis:

If I place lettuce seedlings under various colored lights, then I believe the seedlings under the RED light will grow the tallest. I believe this is true because I read that the wavelength of red light is better absorbed by the green chlorophyll in the plant leaf.

Does this hypothesis meet the standards above?
What was June Bug's question?
What materials and conditions does she need to test her hypothesis?
What steps should she take to test her hypothesis?
What could June use as a control?
How did June support her prediction?

Now you can see June's experimental plan is taking shape.



Your turn to write an hypothesis.

1. Look back at your question.
2. Get out your list of materials and conditions.
3. Think carefully about how you will proceed.
4. What do you expect to happen?
5. Why do you think that will happen?

Practice several hypotheses on scratch paper. Check with your sponsor, then write your hypothesis into your log book and date it.

Lesson 5 PREDICT/SET A GOAL TEACHER/SPONSOR INSTRUCTIONS

Learning Objectives: Logical and Creative Problem-solving, Critical Thinking, Self-direction Skills, Creative Thinking Skills

PREPARATION

- Teacher prepares overhead transparencies as needed.
- Students should have copy of Lesson 5 Part 2, books, web site print outs, brochures from companies, or other information about topic available. They should also have their log books.

INTRODUCTION

This page introduces the process of developing design criteria and goal setting for Engineering project completion.

PART 2 Setting a Goal

Let's try this: Read through the example and have students answer the questions about Billy Bass' problem. (Brainstorm)

- **Problem** (TESTING FLYING DISTANCES OF PAPER AIRPLANES)
- **Goal** (TO MAKE A PAPER AIRPLANE THAT FLIES THE GREATEST DISTANCE)
- **Criteria for building and testing** (1. ALL AIRPLANES MUST BE MADE FROM THE SAME PAPER, 2. ALL AIRPLANES WILL VARY IN SIZE BUT NOT SHAPE; 3. ALL AIRPLANES WI LL BE THROWN WITH THE SAME MOTION AND THRUST (could this be an idea for engineering a throwing machine?), 4. TEST INSIDE TO AVOID WIND, ETC.)
- **How will it be tested** (1. MAKE AIRPLANES OF DIFFERENT SIZES, BUT SAME SHAPE, 2. STAND ON SAME LINE IN GYM FOR EACH TEST, ETC.)

Here are other examples:

What distances can different golf balls travel?
What is the effect of materials on sound waves?
Do video games affect reflexes?
How is the speed of a boat affected by its shape?

B. To begin, students need the information they completed previously:

- problem or question
- materials
- reason behind idea

Have each student develop the goal and criteria of the research on scratch paper. Check for:

- question or problem information
- materials and conditions criteria
- Testing criteria
- goal or outcome expected

This is a VERY important step in the Scientific/Engineering process and should not be rushed. Students must form a clear and easily followed goal in order to design experimentation.

Lesson 5

Set A Goal

Part 2 Design Criteria and Goal Setting for Engineering Projects

Engineering projects do not usually need an hypothesis. Engineers try to create new things and test out new ideas. They start with a goal and come up with the design and testing criteria to meet the goal.

Goals are what you want to accomplish with your project. A goal is the end product and the answer to your question.

Criteria are the guidelines, standards, and requirements you decide upon to control the design and testing in a fair and equal way.

Here is an example:

Billy Bass wants to test paper airplanes for distance flying.

1) What problem is Billy trying to solve?

2) What do you think his engineering **goal** should be?

3) What **criteria** should Billy Bass set up for building his planes?

4) What **criteria** should Billy Bass set up for testing his planes?

5) How will Billy Bass **test** his paper airplanes to see if they meet the goal?

Try setting your goal and developing your criteria here:

- What is the **problem or need** or your **question**?
- What engineering **goal** do you have in mind? What is it you want to accomplish?
- What **criteria** will you use for the materials and conditions of your idea?
- What **criteria** will you use for the testing of your idea?
- Using your criteria, what **steps** will you use to meet your goal?

Now your next steps should be much clearer. Write your answers to these questions into your log book.

Lesson 6 PLAN TEACHER/SPONSOR INSTRUCTIONS

Learning Objectives: Research Skills, Logical and Creative Problem-solving, Critical Thinking, Communication Skills, Self-direction Skills, Creative Thinking Skills

PREPARATION

RULE BOOK REFERENCE PAGES 27-29 AND 33-38.

- Copies of Research Plan Form (1A) or (1A Team) for each project. Any additional form that may be needed for the SRC/IRB committee approval.
- Teacher prepares overhead transparencies as needed.
- Students should have copy of Lesson 6, their log books and papers.

INTRODUCTION

The Research Plan is the information about the student's project that is presented to the Adult Sponsor and (if necessary) to the Scientific Review Committee BEFORE any experimentation takes place. The Plan is reviewed and evaluated for the following:

evidence of library search
compliance with rules and laws governing human and animal research
use of accepted research techniques
logical process to solve problem or answer question safety

A. Students will use the notes and previous lessons to write about each item listed into their log books. Remind them to use pen. Help them to make clear, concise statements using research-based support for each entry. This process may take a while, as the whole plan must be worked out and procedure written.

B. Students should bring to class a typed version of this Research Plan. If the student is able to complete and save the plan on a computer, the text will be ready to use for the Abstract, the Report, and the Display!

C. Pass out Research Plan Form (1A or 1A Team). Students may complete this form neatly and in ink or they may take it home for adult help.

Students should leave question #5 blank until actual experimentation begins. Those projects requiring approval from the SRC/IRB committee must wait until approval is given.

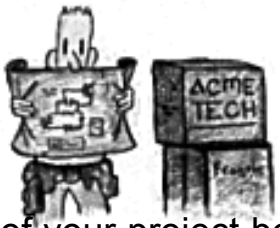
AT HOME

Students may need to complete this process at home, especially for those with complicated procedures. Make sure each student completes and returns **Form 1A** and attaches a typed version of the Research Plan to it. They must also have obtained signatures and dates on **Form (1B)**.

Lesson 6

PLAN

Writing out the Project Plan



The Project Plan is the complete written organization of your project before you do it. You will give this plan to your sponsor. Your plan will go to the SRC/IRB committee if your project has anything to do with these subjects:

- human subjects
- animals
- pathogens
- controlled substances
- recombinant DNA
- human or animal tissue
- hazardous materials or devices

Here's what your plan should contain:

PROBLEM Tell the reader the question you are asking or the problem you will try to solve.

PURPOSE The purpose states the usefulness of the study. It tells why the project will be done.

HYPOTHESIS (for Science Projects) The hypothesis is your educated guess about the outcome of your investigation.

GOAL (for Engineering Projects) Tell exactly what you want to accomplish with your project.

DESIGN AND TESTING CRITERIA (For Engineering Projects)
Write the specific standards you will set to meet your goal.

PROCEDURES Describe in detail the method you will use to get your data and observations. Use photographs or drawings of equipment to describe your experiment further. Include a precise description of the testing and control groups and apparatus to be constructed or modified.

BIBLIOGRAPHY Include at least 3 books, articles, web sites, telephone conversations, etc.

When you have this all written out, enter it into your log book. Then type it on a computer, save it and print it out.

Your sponsor should give you **Research Plan Form (1A)**. Attach your plan to this and complete the information on the form. Do not complete the date for the beginning of experimentation yet.

You should also have the form called **Approval Form (1B)**. This must be signed by you, a parent, and your sponsor and dated at the top before you begin to experiment. Each individual and team member must complete their own copy of this form.

Please check with your sponsor for other required forms.

(All forms are available on the web site at www.uga.edu/oasp)

Lesson 7 EXPERIMENT TEACHER/SPONSOR INSTRUCTIONS

Learning Objectives: Research Skills, Logical and Creative Problem-solving, Critical Thinking, Communication Skills, Self-direction Skills, Creative Thinking Skills

PREPARATION

RULE BOOK REFERENCE PAGES 35-38.

- Students should have a copy of Lesson 7, their log books and papers
- Students may need to bring experimental materials and equipment

INTRODUCTION

This is the moment the students have waited for. Now they can finally begin experimentation or testing. Some students have already begun, especially if plants had to be grown, materials ordered, and apparatus built. Students whose projects did not require SRC/IRB pre-approval could begin experimentation much earlier than this point as long as sponsor approved project. If they are not prepared to do experimentation in class, this will be an opportunity for them to catch up on the log book entries, background reading, typing/computer work, etc.

A. Review each of the points listed . Students can complete worksheet as you review.

- **Project Plan** must not be significantly changed as they work on their data collection because this was the plan that was approved by the sponsor or SRC/IRB committee. Any changes must be re-approved.
- **Log Book.** Students should by now be used to writing in the log book. Use the book as a record keeper for measurements, observations, and collected data.
- **Sample Size**. Judges pay attention to the number of subjects/samples in each experimental group. When this data is placed in a graph or chart, the results are clearer and more believable with more test samples.
- **Repetitions.** Experiments should be repeated several times to collect enough data to average and to show that the method used is valid and producing true results.
- **Controls.** Each Science experiment needs a control. This is the sample group that is not experimented upon so that it can be used for comparison to the experimental groups. A control is not always appropriate for an Engineering project.
- **Variables.** Remind students to change only one variable per experiment.
- **Exact Procedure**. Measurement, weight, timing, etc. must be recordable and repeatable and believable.

Lesson 7

EXPERIMENT

Finally!

You are now ready to begin your plan:

- Follow your project plan carefully**.** Do not change it unless you get permission to do so. Remember it has been approved**.**

- Keep detailed log book notes in ink of every experiment, measurement, and observation you do. Be sure to include things that don't work as well as the ones that do. You will use all of this information later, so take good notes.

- Keep your procedure controlled and exact. Think about what you are doing and how you might explain to someone else how to do it exactly the same to get the same results.

- Remember to include the following in your experiment:

  Control Group This is the set of test items that are treated as in a parallel experiment except for omission of the procedure or agent under test and which is used as a standard of comparison in judging effects. (Usually only for Science Projects)

  Experimental Groups The is the set of test items that undergo the various manipulation of variables.

  Large Sample Size Use at least 5 test items per experimental group. The greater the number used, the better.

  Repetition Repeat your trials many times to collect enough data to average and to demonstrate the validity of your method.

  Test, Redesign, and Test Again (for Engineering Projects)
  You want your prototype to be successful and to meet your goal.

Add your Experimental Start and Finish dates to
Research Plan Form (1A) or for teams (1A) Team Projects.

Lesson 8 ORGANIZE, ANALYZE, AND SYNTHESIZE TEACHER/SPONSOR INSTRUCTIONS

Learning Objectives: Research Skills, Logical and Creative Problem-solving, Critical Thinking, Communication Skills, Self-direction Skills, Creative Thinking Skills.

PREPARATION

- Students should have a copy of Lesson 8, their log books and papers
- Students will need centimeter rulers, calculators
- Make an overhead transparency of the chart
- Student access to computers with graphing/charting software, and word processing

INTRODUCTION

Even if all students are not yet ready to analyze their data and organize it into useful and meaningful graphics, the class will benefit from learning how to use the software and techniques. They will learn how to look at raw data and synthesize it into averages or trends so that the results of their tests are more understandable.

A big part of Science & Engineering Fair participation is the art of communication. Graphs, charts, and clear, simple language are necessary tools. The objective of this synthesis is to distill the data and information gathered into a science story, one which tells the beginning, middle, and end of the student's project. The clearer and more concise this information is, the better the story can be told and understood.

A. Students can use June Bug's experiment with plants under colored lights to help them understand the process. Show students the raw data from June Bug's log book.

What does this chart show? What does *seedling height (cm)* mean?

How many days did June Bug record data? Why is there a gap after 3 days?

How many samples were in each of June Bug's experimental groups?

When did June Bug first see growth?

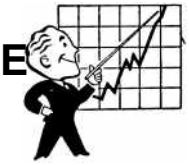
B. Help the students to find patterns and to come up with explanations for the trends they see.

C. Help students to find the average per day, per light color, per seedling. This is the information that will be used to synthesize the raw data into charts and graphs for display and discussion.

Lesson 8

ORGANIZE, ANALYZE, AND SYNTHESIZE

What does it all mean?



Do you remember June Bug's experiment under colored lights? Here is the raw data she wrote into her log book.

Colored Lights	WHITE					RED					BLUE					GREEN				
seedling height (cm) DAY 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DAY 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DAY 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DAY 6	.5	.5	.5	0	.5	0	.5	.5	0	.5	.5	.5	0	0	.5	.5	.5	.5	.5	.5
DAY 9	1	1	1	0	1	.5	1	1	0	1	1	1	0	0	1	1	1	0	1	1
DAY 12	2	2	2	.5	2	1	2	2	0	2	1	1	0	0	1	1	1	0	1	1
DAY 15	3	3	3	1	3	1	2	2	0	2	1	1	0	0	1	1	1	0	1	1
DAY 18	4	4	4	2	4	2	3	2	0	3	2	2	0	0	2	0	0	0	1	1
DAY 21	6	6	6	4	5	2	3	2	0	3	0	0	0	0	2	0	0	0	0	0

From the information on this chart, what did June Bug do?

Can you find a pattern of growth from this data?

Find the average grow for each color of light. Find the average growth per seedling.

You do not want to display all of this raw data on your display board. It is too confusing and unorganized. You want to use averages and make graphs and charts to tell big picture of the information you collected and to show trends with the data.

Engineers will use the averages of the raw data to show the success of their design.

A chart like this belongs in your notebook along with other supporting information. A copy of it can also be taped into your log book.

Lesson 8 ORGANIZE, ANALYZE, AND SYNTHESIZE
TEACHER/SPONSOR INSTRUCTIONS *continued*

D. You may be able to demonstrate the use of a computer graphing program in your classroom. Many students may be able to use their home computers to generate graphs.

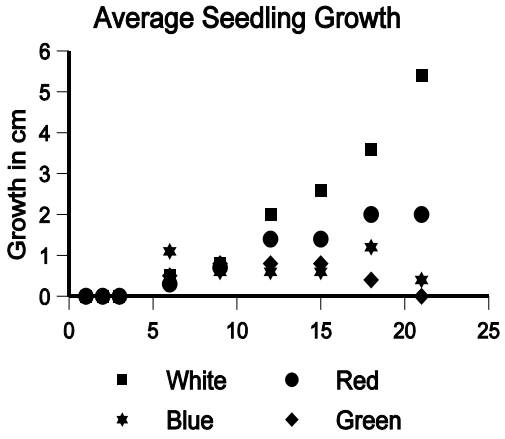
- Discuss the way the averages look using different types of graphs–pie, line, bar.
- Demonstrate axis labeling and titles, discuss the importance of these, discuss size of lettering, etc for display
- Some data is better represented in a simplified chart than with a graph

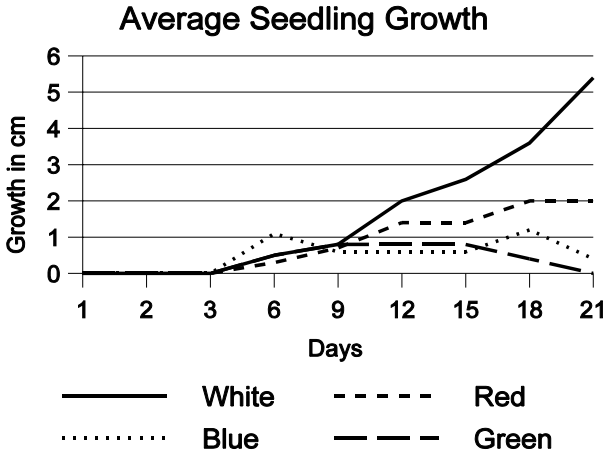
E. Have students practice these steps using their own data. Students should ask themselves if the graphs show the results in support of the hypothesis or goal.

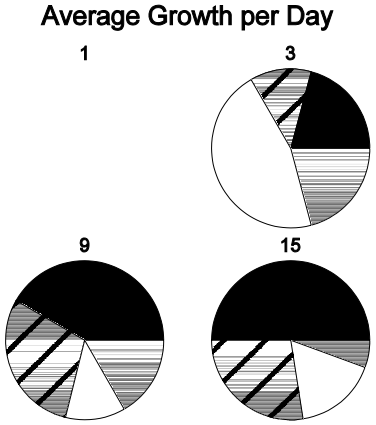
F. After students have generated their graphs, one small copy should be taped into the log book. The graphs will be printed larger for the report and display.

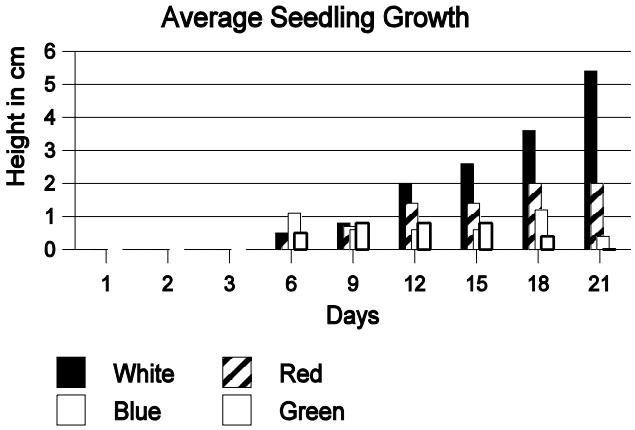
AT HOME

Have students complete graphs of the data and answer questions.









June Bug's hypothesis stated:

"If I place lettuce seedlings under various colored lights, then I believe the seedlings under the red light will grow the tallest."

1. Which chart helps us to see if the hypothesis was supported?

2. Find the averages of your data and make graphs and charts.

3. Remember to label carefully and completely so that your graphs can be understood without explanation from you.

4. Do your graphs or charts show the results the way you stated in your hypothesis or goal statement? Try different types of graphs to show the data in different ways.

5. Print a copy of the graphs and tape into your logbook. You can make larger print outs for your report and display board.

6. Did your experiment support your hypothesis or meet your goal? Should you go back and do more trials?

7. In your log book, talk about your data and how it related to your question, purpose, hypothesis, and goal. Include any problems and what you might do next.

Lesson 9 SUMMARIZE TEACHER/SPONSOR INSTRUCTIONS

Learning Objectives: Research Skills, Logical and Creative Problem-solving, Critical Thinking, Communication Skills, Self-direction Skills, Creative Thinking Skills.

PREPARATION

RULE BOOK REFERENCE PAGE 21.

Copies of the Official Abstract for each student project

Printouts of each student's Research Plan

Students should have copy of Lesson 9, their log books and papers

Access to computers word processing

Make an overhead transparency of the Official Abstract

INTRODUCTION

An abstract is the summary of the entire project in 250 words or less. The students have already written most of the information needed for the abstract in their Research Plan. **The Plan** contained everything except:

- a Title
- a short summary of Results
- Conclusions

A. Abstracts are written in full sentences and should not contain subtitles. Make the Abstract a narrative about the project using 250 words or less.

B. Abstract Rules:

- Abstracts must be typed or printed from a computer
- Use the Official Abstract Form only
- Limited to 250 words or less

C. Students can practice writing concise, accurate abstracts, using the information in their log books and project plans.

Lesson 9

SUMMARIZE

Writing an Abstract

For your Science & Engineering Project you must write an abstract on the official Abstract Form. An abstract is a short summary of your complete project. It is limited to **250 words** or less.

Writing your abstract.

Most of the information has already been written into your log book and project plan. Your job will be to make it much shorter and write it in narrative form, like telling a science story.

You should include:

TITLE Keep the title brief and descriptive. Think of someone reading just the title and having a very good idea of what your project is all about.

PROBLEM Look at the copy of the Research Plan. Can you make a short sentence or 2 saying the same thing?

PURPOSE Again, look at the copy of the Research Plan. Can you make a short sentence or 2 saying the same thing?

HYPOTHESIS OR GOAL Do not re-word hypotheses or goal. You should use it just the way you wrote it in Research Plan.

DESIGN AND TESTING CRITERIA For Engineering projects, include a brief description of your criteria.

PROCEDURES You do not need to list the materials in an abstract. Keep procedures less specific than in the Research Plan. Some details may be necessary in order to explain the process best.

RESULTS Make this a short summary of results, using medians, means, and modes

CONCLUSIONS Tell what the results mean and whether or not the hypothesis was supported or the goal met.

Rules for Abstracts

• Abstracts must be typed or printed from a computer

• Use the Official Abstract Form only

• Limited to 250 words or less

• The abstract must be present on or in front of your display. It can not be in any other form than on the **Official Abstract Form**. Do not cut it out or label it in any other way.

• The abstract is limited to the square on the form. Do not include cover sheets, graphics, or pictures.

Lesson 10 REPORT TEACHER/SPONSOR INSTRUCTIONS

Learning Objectives: Research Skills, Logical and Creative Problem-solving, Critical Thinking, Communication Skills, Self-direction Skills, Creative Thinking Skills.

PREPARATION

RULE BOOK REFERENCE PAGE 20.

- Printouts of each student's Research Plan and Abstract
- Students should have copy of Lesson 10, their log books and papers
- Access to computers word processing

INTRODUCTION

The Report is a fully written, complete document of the student's research. It takes all of the information contained in the Research Plan and Abstract and expands it to tell a more detailed version of the same science story.

A. Students should spend time writing the report and typing it on the computer. Use full sentences and a narrative style. Each section can be subtitled. This will become the framework for the text of the display.

B. Graphs should be printing in duplicate, and doubles of photographs should be made. These extras will be used on the display board.

C. Students will put the Report in a notebook with copies of the completed and necessary forms. The original forms should be kept in a file at home or school.

Lesson 10

REPORT

A full and complete explanation of your science story

For your Science & Engineering Project you will write a report about your total experience. Most of this is already written!
Just add a few more explanations to your abstract and include graphs, charts, and photos. Check your sentence structure and spelling and you are practically done.

Contents of the Report:

Title Page - include project title, name, address, school and grade.

Table of Contents - number each section and list here

Introduction - use background information, purpose of study, problem, question, design and testing criteria, and goal or hypothesis.

Materials & Procedures - write detailed lists and step-by-step process of research and testing, include design and testing criteria.

Photographs, drawings, plans -include equipment, procedures, apparatus, location, results.

Results - present in tables and graphs and explain in words, do not use raw data, discuss problems or errors that may have happened

Conclusions - summarize results, tell whether or not data supported hypothesis or met goal

Acknowledgments/Credits - thank those that helped: mentors, parents, teachers, etc.

Bibliography - list the reference material used in alphabetical order: books, web sites, papers, journal articles, and communication with experts

Type your report on the computer and print out a nice copy.
Put the copy in a notebook along with completed necessary forms and any other written material you want the judges to see.

Lesson 11 DOUBLE CHECK TEACHER/SPONSOR INSTRUCTIONS

PREPARATION

RULE BOOK REFERENCE PAGE 19.

- Student Notebook containing Report and all completed forms
- Students should have copy of Lesson 11 and their log books
- Access to computers word processing

INTRODUCTION

This is a last minute check for forms and individual parts needed to compete in the Science & Engineering Fair.

A. Help students find and organize all parts needed.

B. If time permits, have students complete the top portion of the Science Project Evaluation. This form can be used for teacher evaluation and grades, as well as a way for student to self-evaluate their product and performance.

Lesson 11

DOUBLE CHECK

Don't forget a thing!

Check below to make sure you have everything you will need before you make your display.

You should have:

- **Log Book** everything up-to-date, graphs, charts, dates
- **Notebook** with
  - T Scientific Research Paper
  - T Graphs and charts
  - T Photographs

  And Forms:
  - T Abstract on Official Form
  - T Sponsor Checklist Form (1)
  - T Research Plan (1A) or Team (1A)
  - T Approval Form (1B)

Other Forms you may need:

A. If you worked in a research lab (other than school)
Form (1C) and Form (2)

B. If you worked with human subjects
Form (4A) and possibly Form (4B)

C. If you worked with pathogenic agents or controlled substances
Form (2) or Form (3)

D. If you worked with vertebrate animals
Form (5) and
Form (2) or Form (3)

E. If you worked with animal or human tissue
Form (6)

F. If you worked with hazardous substances or devices
Form (3)

Put everything in order in your notebook. Use tabs to organize. Make a nice cover for the outside.

Lesson 12 SHARE TEACHER/SPONSOR INSTRUCTIONS

Learning Objectives: Research Skills, Logical and Creative Problem-solving, Critical Thinking, Communication Skills, Self-direction Skills, Creative Thinking Skills.

PREPARATION

RULE BOOK REFERENCE PAGES 22-24 AND 31-33.

- Student Notebook containing Report and all completed forms
- Students should have copy of Lesson 12 and their log books
- Access to computer word processing and printer
- Colored paper, display boards, paper cutter, and other construction materials, such as spray adhesive, scissors, foam core pieces, glue, etc.

INTRODUCTION

Now students will prepare to share their projects with judges, teachers, parents, and peers. The projects are shared using tri-fold display boards made of cardboard, wood, or foam-core.

The text and other display items used on the board are usually printed out onto white or light colored paper. Then sprayed with adhesive and mounted onto colorful construction paper. Foam core can also be used to mount the text, graphics, and photos.

The title can be attached separately to the top of the board or integrated into the main part. All wording should be kept to the minimum using bulleted text and many graphics and photographs to tell the science story.

The display boards must sit on a table and be no larger than **30 inches deep x 48 inches wide x 78 inches tall.**

(Students in grades 9-12 only may choose to build a floor model for display. See Rule Book for details)

A. Students are **not allowed** to display certain things on the board or table. Go over this list in the Rule Book with them.

B. Students should use fonts with simple, straight text in black. Their boards will be read from 2-3 feet away. If the board is very tall larger text should be used especially toward the top. Here is the **suggested minimum** size of text for each printed part:

Title: 100 point, but not so large it overwhelms the project
Subtitles: 72 point
Body text: 24 point, but not larger than 36 point
Graphs/Charts: 18 point, certain areas might be labeled smaller
Legends: 14 point

Lesson 12

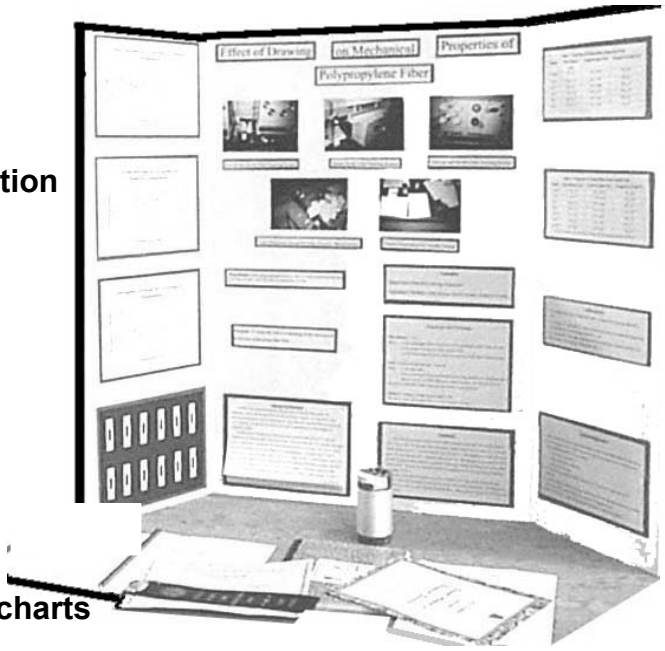
SHARE

Putting together your display board

CONGRATULATIONS! You are almost done!

One of the most important acts of doing a Science & Engineering Projects is sharing the information you have discovered with others.

At the Fair we share using a display board. The board can be made from cardboard, wood, or foam core. It should be folded or hinged to make 3 parts so that it can sit on a table.



Your display should include:

Title

Background Information and question

Purpose of project

Hypothesis or Goal

Materials and Methods

Design and Testing Criteria (for engineering projects)

Results

Conclusions

Photos, illustrations, graphs, and charts

Your display should **SHOW and TELL**. Make it visual, colorful, easy to follow, and informative.

- **Keep it simple.** Use a large colorful title and subtitles. Use bullets instead of paragraphs to discuss your project under each subtitle.
- **Use photos.** You must have written permission from any individuals other than yourself in photos used on the display. Have someone take photos of you during experimentation. Take pictures of your results, too.
- **Be organized.** Your display should be logically presented and easy to read. Follow the path of Scientific Method or Engineering Method from left to right, top to bottom.
- **Have a Good Title.** Simply and accurately represent your research. Use the same title on all your forms.
- **Easy to Read.** Your font size should be readable from at least 3 feet away. Your title should be in large letters, but not overwhelm the board. Your subtitles should stand out and be easy to find.
- **Follow the Rules.** Your display is restricted by certain size, safety rules and what can be displayed. Please read the Rule Book for details. Display all required and completed forms in your project notebook on the table in front of your display.

Lesson 12 SHARE TEACHER/SPONSOR INSTRUCTIONS *continued*

C. When the displays are complete, students should practice **informally** presenting their science in front of the class. Start them out with “Tell us about your project”. Teacher and peers should ask questions about the science or engineering processes used.

D. Remind students of when and where the local fair will be held. Make sure everyone takes home a reminder and that parents and administrators are invited. Help them obtain any application forms or necessary information they may need.
The Georgia Science & Engineering Fair charges an entrance fee per student participating. Check with your director to see if this is required at your local and regional fairs.

Give everyone a big HURRAY for participating! Think of how far they have come and how much they have learned.

Practice for the Judging

The Judging at a Science & Engineering Fair is usually done by professionals in the field, teachers, and professors. The style of questioning is informal and personal.

Usually 1 or 2 judges will come to you after they have read your display board. They want to talk to you about your project. They want to find out how important this project is to you. They also want to know if you learned anything new and if you did it yourself.

Some of the questions judges might ask:

- Where did you get your idea?
- What will you do next?
- Why did you do _____?
- Why did you choose this project?
- Who helped you?
- What was the hardest thing to do?
- What did you learn?
- Were you surprised by anything?

Practice in front of your class, with your sponsor, or at home. Have them ask difficult questions about your research so that you will be prepared for the judges.

Find out about your first fair from your sponsor. Be on time and well dressed.

Bring the following to the Fair:

- Finished Display Board
- Notebook with completed forms and Project Report
- Log Book

Good Luck!

My Science & Engineering Fair Evaluation

Name _____ Date _____

My project taught me

_____
_____
_____
_____

The hardest thing to do on my project was

_____
_____
_____
_____

I enjoyed most

_____
_____
_____
_____
_____

I could have improved on

_____
_____
_____
_____
_____

Next year I think I will

_____
_____
_____
_____
_____
_____

Student Name _____ Date _____

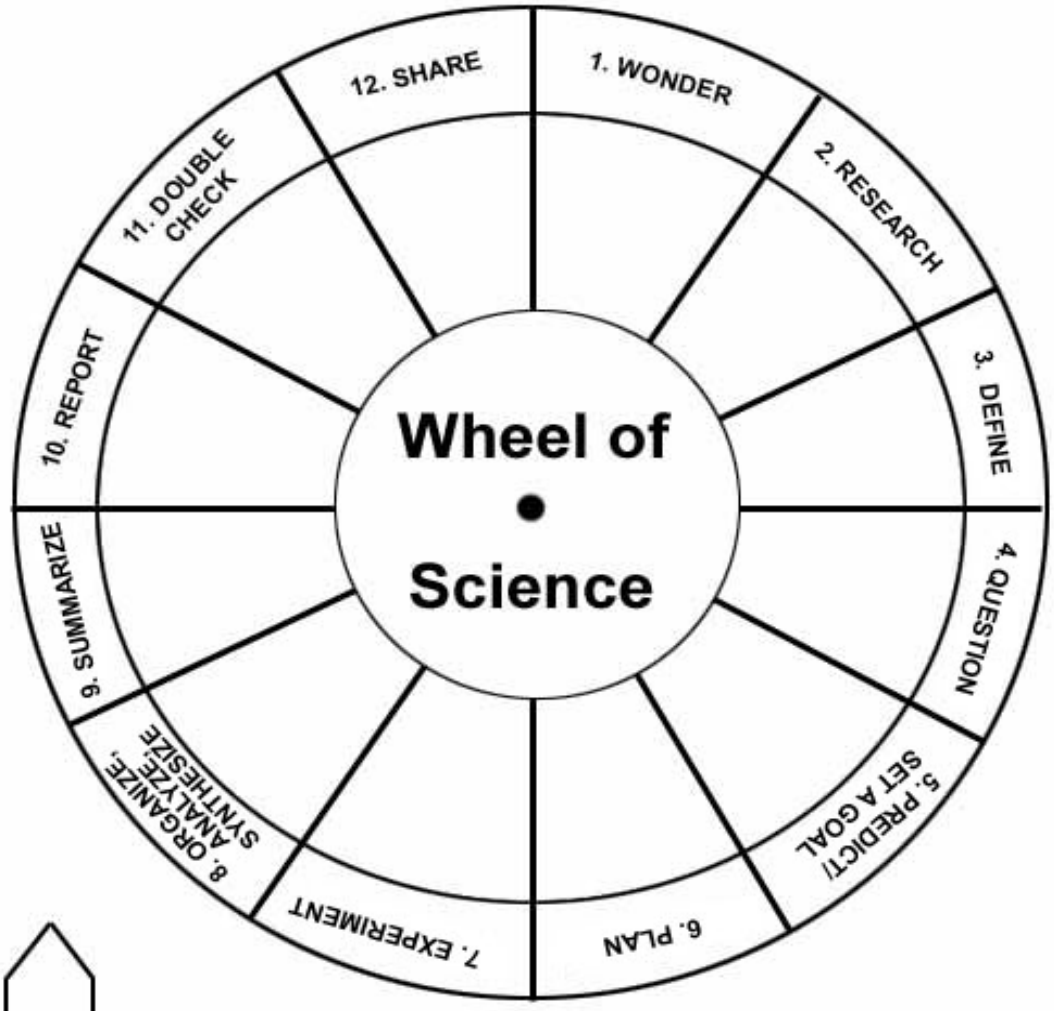
Project Title _____

Teacher Evaluation of Project

- ☐ Log book _____
- ☐ Notebook _____
- ☐ Abstract on Official Abstract Form_____
- ☐ Sponsor Checklist Form (1), signed and complete_____
- ☐ Research Plan (1A), signed and complete _____
    - ☐ Approval Form (1B), signed and complete
    - ☐ Any additional forms the project may require
    - ☐ Research Report with graphs and charts
- ☐ Visual Display _____
    - ☐ Attractive
    - ☐ Informative
- ☐ Communication about project_____

Comments overall

Use this Wheel of Science to help you follow each step along the way to a Science Fair project.



Paste this wheel and pointer onto a piece of poster board. Cut them out and attach the pointer to the middle of the wheel with a brad.