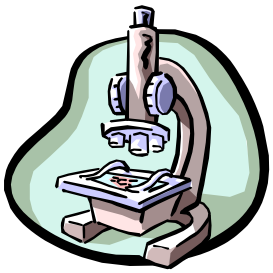
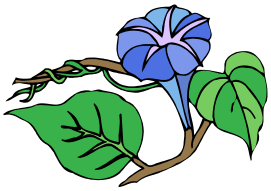
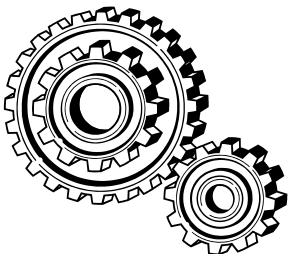
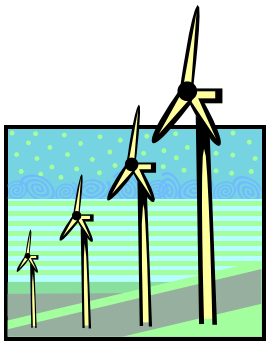
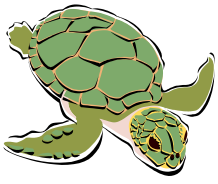
RUBE GOLDBERG DEVICE PROJECT

6TH – 8TH GRADE

Science Fair

Student Information Packet

long beach unified school district

SECONDARY

SCIENCE FAIR

STUDENT INFORMATION PACKET

Revised 2009, 2011

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SCIENCE FAIR
STUDENT INFORMATION PACKET
INTRODUCTION

You are surrounded by science. Everything uses some form of science to make it work. Even the chair you sit on was made by a person using tools to build it based on knowledge of science and technology. How did they know what shape to make the saw and how sharp the teeth needed to be to cut wood? How did they know to make one saw for wood and a different one for metal? Why does the wood-cutting saw have larger teeth than the metal-cutting saw?

Science is asking questions and finding answers. A science project, simply put, is the process of asking a question about something you are interested in, for which you don't already know the answer, and then hypothesizing (best-guessing) what the answer might be, researching for information on that topic, experimenting, inventing, surveying, etc., analyzing your results, and coming to a conclusion!

The purpose of a science fair is to provide a focus for you, the student, to apply skills and concepts you have learned in science as well as in math, reading, writing, and technology. It gives you a place to use these skills creatively in your own way.

What your accomplishment will mean for you:

- ★ Developing self-reliance
- ★ Gaining self-confidence
- ★ Acquiring organizational skills
- ★ Knowing what the scientific method is and how it can help you.
- ★ Having your work viewed and recognized by your school and community

Everything you need to know about doing a great science project is inside this packet. You'll be discussing the contents in class. Approximately every two weeks between now and your school science fair, your teacher will give you a **Student Timeline for Science Fair Project** sheet to check your science project's progress. The timeline sheet is designed to keep you on target, and keep your teacher and parents informed so that they can help you if needed

You must keep this packet, timeline sheets, letters home to parents, and all other information in a separate folder. Your science fair folder should be kept at home unless your teacher asks you to bring it to school.

You will find the science fair to be an exciting and rewarding experience. Let's make this year's fair the best ever!

Helpful Hints for Students

- Start EARLY; don't wait until the last two weeks before it is due.
- Plan it out. It will be much more fun if you spread the time out over several days per week or several weekends, and you won't have to race to get it done!

  It might look like this:

  Week 1 – Decide on your PROBLEM – what you want to solve.

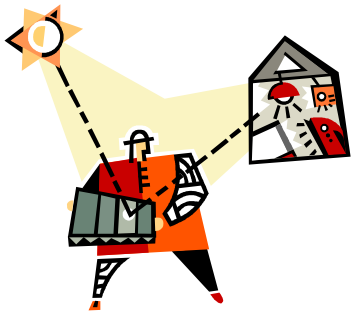
  Week 2 – Conduct your preliminary research by reading books about your topic, visiting libraries, universities, making contact with other sources, and checking out web sites.

  Week 3 – Work the "steps" of your project.

  Week 4 – Think about the results and make your charts or graphs.

  Week 5 – Write your report.

  Week 6 – Make your display.
- The goal is that you learn to use "the scientific method" or "the engineering design process" through direct experience.
- Check with your parent or teacher if you want to use a web site for research. Not all web sites give correct information. *Remember:*
  - Anyone can create a web site; this does not mean its information is correct!
  - Make sure the web site is run by a large, recognized group such as a college or organization.
  - DOT "org", "gov" or "edu" are generally trustworthy for accuracy of content.
- What is an acceptable science fair project?
  - Something that answers a question to which you do not know the answer
  - Something you can figure out yourself
  - Something you can change somehow, add another variable, and then predict the outcome. That's an experiment!
- What is NOT an acceptable science fair project?
  - Reproducing results found on the web is *not* an experiment; it's a reproduction.
  - A demonstration is not an experiment (i.e., volcano).



RUBE GOLDBERG DEVICE

DESIGNING A SCIENCE FAIR PROJECT

USING ENERGY TRANSFERS

For 6th, 7th and 8th Grades ONLY

This type of science project allows you the unique opportunity to design and create a set of at least 8 energy transfers using at least 4 different types of energy to accomplish a realistic task in the style of the great cartoonist, Rube Goldberg.

I. TASK

Choose a realistic task to accomplish (pushing in a chair, turning off your alarm, turning the page of a book, etc.). Write a few sentences explaining the task and why you chose it.

II. RESEARCH / BIOBLIOGRAPHY

You will write a report on the types of energy and how energy is transferred and converted from one type to another. You must use **at least 3 sources from several types of information resources** (books, encyclopedias, internet, etc.). Include a bibliography with sources cited.

III. PRELIMINARY DESIGN

Design a set of at least **8 energy transfers per person** that uses **at least 4 types of energy** (see list on next page) to accomplish the task. Create labeled drawings of the device and all energy transfers. Keep all drafts to include in your written report, to show your thinking process and the experimentation process.

IV. OBSTACLES

Observe, analyze, and record the obstacles that occurred during the design and construction of the device and what was done to overcome them.

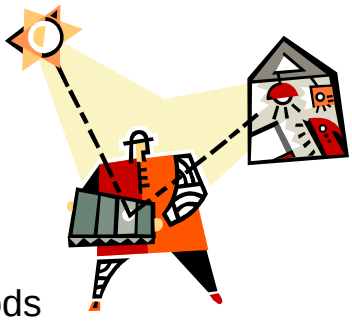
V. FINAL DESIGN WITH KEY

Create a final drawing in **ink** that clearly displays your device with all of its energy transfers and types of energy. Along with the final drawing, include a **key** to each energy transfer and the type of energy.

VI. DEVICE OPERATION

Build the device and run it, correcting any problems so that it accomplishes the task. You must document your device *successfully accomplishing your task* in video, DVD, or detailed, step-by-step photographs. You should **narrate**, from start to finish, the transfers of energy from object to object. **Please check with your teacher to make sure that the video/DVD is in a format that can be viewed in the classroom.**

ENERGY FORMS
TO USE IN
RUBE GOLDBERG DEVICE
PROJECTS



Potential Energy (Stored) Forms

- ❑ Gravitational.....in height
- ❑ Chemical.....in the bonds of fuels/foods
- ❑ Elastic .....in stretched or compressed objecs
- ❑ Magnetic .....in magnetized objects
- ❑ Nuclear.....in the nucleus of atoms

Active Energy Forms

- ❑ Mechanical (Kinetic)....moving objects
- ❑ Electrical .....moving charges
- ❑ Thermal.....moving atoms/molecules
- ❑ Electromagnetic .....moving photons

SECONDARY RUBE GOLDBERG DEVICE
WRITTEN REPORT CONTENT

6th - 8th Grade

Scientists always report their research and experiments so that others may benefit from this new knowledge. Some research is reported through published papers while other work is presented at conventions, on TV, or through the Internet. *Your* research will be presented through your written report, a project display, and an oral presentation.

❑ ABSTRACT

The abstract is a concise summary of your whole project. Others can read the abstract if they do not have time to read your full report. The abstract must *not* be more than one page long. It includes your task, research, design, and conclusion. You will write the abstract *after* your report is complete.

❑ TITLE PAGE

The title page belongs *after* the abstract. The project title must be centered on the page. See the **Written Report Format** sheet for information that needs to be in lower right corner.

❑ PURPOSE

In one short paragraph, tell why you did your project on the topic you chose.

❑ ACKNOWLEDGEMENTS

On one page, say "thank you" to all the people who helped you with your project. Include any family members, teachers, or experts who assisted you with information, materials, or equipment, or participated in some way in your project.

❑ TABLE OF CONTENTS

Divide your Table of Contents into sections as indicated on the **Written Report Format.** Put the actual page numbers at the bottom of each page *after* you have finished the final copy of your report.

❑ TASK

Write a few sentences explaining the task and why you chose it. Be specific.
Your page numbering begins here.

❑ RESEARCH / BIBLIOGRAPHY

This section is a summary in essay form of information you gathered on the types of energy and how energy is transferred and converted from one type to another, explaining how these energy sources are used in your device. You must use at least 3 sources from several types of information resources (books, encyclopedias, internet, magazines, interviews, etc.). Include any previous research on your topic. Include a bibliography with sources cited. See **Written Report Format for Citing Scientific Research Sources.**

WRITTEN REPORT CONTENT continued:

❑ PRELIMINARY DESIGN

Be very specific in listing the energy transfers (8 per person) and the four types of energy you used to accomplish your task. Include your labeled drawings of the device and all energy transfers, along with all of your drafts.

❑ OBSTACLES

Each member of the group will write their **own** paragraph describing the obstacles that occurred during the design and construction of the device and what was done to overcome them.

❑ FINAL DESIGN WITH KEY

This is your final drawing **in ink** that clearly displays your device with all of its energy transfers and types of energy. Include a **key** to each energy transfer and the type of energy.

❑ REFLECTION

Each member of the group will write their **own** reflection on the project, based on the reflection questions and their experience with this project. Use your drawings and notes to help you reflect and answer the following questions.

- What has been the most rewarding part of this project?
- Was the device similar to the way you originally envisioned it? How was it different than you expected?
- What were your thoughts/feelings about this project? Was it challenging, motivating, frustrating, energizing or...? Why?
- Is engineering (designing and building things) a field you could see yourself pursuing as a career? Why or why not?

Rewrite your paper several times to correct errors.
Have someone you trust proofread your report before you make the final copy.

BOXED *topics are part of the rubric criteria for judging. The other parts are used only for grading the written report by the teacher.*

SECONDARY RUBE GOLDBERG DEVICE
WRITTEN REPORT FORMAT

Each line with a box (❑) in front of it begins a new page in the report.

❑ Abstract

❑ Title page

Title *in middle of page*

In lower right-hand comer:
Last Name, First Name
Grade ___
Period ___
Teacher Name
School Name
Date (include year)

❑ Purpose

❑ Acknowledgements

❑ Table of Contents (with page numbers)

❑ Task (page numbering starts here)

❑ Research / Bibliography

❑ Preliminary Design

❑ Obstacles

❑ Final Design with Key

❑ Reflection

OTHER POINTS TO REMEMBER:

- ✓ Type or write on one side of paper.
- ✓ Do not put pages in plastic.
- ✓ Make two copies of your original report: Original to teacher, one copy you keep, second copy to use on display board (if you wish).
- ✓ Put report in a store-bought folder with three brads or rings.
- ✓ Put name, subject, period, date, and teacher's name on front of the folder in *upper right-hand corner.*

1. **The ORIGINAL report goes inside the report pocket on the display board.**
2. **A COPY should be kept at home or on the computer.**

WRITTEN REPORT FORMAT FOR CITING SCIENTIFIC RESEARCH SOURCES

(When used within the report)

Citations are similar to footnotes in English or history papers but are much easier to include. Citations are included only in the Preliminary Research. Scientific citations are placed *within* the paper itself, not at the bottom of the page. Citations are placed *at the end* of a sentence or paragraph that contains the information you gathered from another source.

Rule 1: Cite all sources that refer to information on your species, experiment, or study site.

Rule 2: Cite all sources that back up your conclusions.

Rule 3: Cite anything that brings in a fact not directly taken from your own personal observations or experiment.

Rule 4: When in doubt, cite!

EXAMPLES OF PROPER CITING

(author, date)

White sharks are known to be maneaters (Halstead, 1954). They are the only shark that regularly preys on marine mammals for food. Some scientists believe that great whites attack humans by mistake: the silhouette of a surfer paddling on a surfboard may be mistaken for a seal sunning on the surface (Ellis, ed., 1987).

(editor, date)

VARIATIONS IN SCIENTIFIC CITATIONS

One Author	Example	*(last name only, date)* (Bronowski, 1973)
Two Authors	Example	*(both last names only, date)* (Walker and Maben, 1980)
Three or More Authors	Example:	*(all last names only, date)* (Cochran, Wiles, and Kephart, 1975)
No Authors	Example:	*(abbreviated title, date)* (Insects of Guam, 1942)
Only an Editor	Example:	*(last name only, abbreviation for editor, date)* (Ellis, ed., 1987)
Citing an Expert You Have Spoken to or Corresponded with	Example:	*(last name, "personal communications")* (Collins, pers. commun.)

WRITTEN REPORT FORMAT FOR SOURCES / BIBLIOGRAPHY

Entries in a Sources / Bibliography section of a report are alphabetized by the last name of the author and the date is placed directly afterwards. An entry for which the author is unknown, such as a newspaper article or an unsigned review, is alphabetized by the first word of the title, excluding the articles *A*, *An*, and *The.* Always double-space and *indent the second and succeeding lines of each reference.* Do not number your references and if you have two or more references by the same author, alphabetize them starting with the most recently written paper.

Books

One Author

(last name) (initial) (date) (title) (city) (publisher)
Bronowski, J. 1973. The Ascent of Man. Boston: Little & Brown, Inc. 376 pp.
(total # of pages only)

By Editor

(editor)
Ellis, R. (ed.) 1987. Sharks. New York: Wiley, 256 pp.

2 Authors, Local Agency

Walker, R. G., and A. Maben. 1980. The Feeding Ecology of Bats.
Guam Div. Aquatic & Wildlife Resources. Mangilao, Guam. 44 pp.
(agency) (city) (country) (total # of pages)

Magazines and Scientific Journal Articles

3 Authors, Journal Article

(last name, first initial, then first initial, last names) (date) (title)
Cochran, J. A., Wiles, G. *and* D. Kephart 1975. "Money, Banking, and the Economy". Fortune 34 (4): 47-55.
(vol.) (no.) (exact pages)

No Author, Scientific Bulletin

"Insects of Guam". 1942. Bernice P. Bishop Museum, Honolulu Bull. 17.
(title) (date) (publisher) (bulletin # only)

Newspapers

Basic Entry

(author) (exact day) (title)
Kristof, Nicholas D. 3 Jan. 1985: "Oil Futures Plunge on OPEC Doubt."
New York Times, Dl3.
(publisher) (section #)

Encyclopedia, Dictionary, Atlas

Article Within Encyclopedia

(author) (date) (title) (specific pages within)
Halstead, B. 1954. "Poisonous & Dangerous Marine Animals". Pp. 105-115 in Encyclopedia Britannica Vol. 93 (C. Brown, ed.), New York: Academic Press.
(encyclopedia) (volume) (editor) (city) (publisher)

Dictionary Entry

"Advertisement." Webster's Third International Dictionary. (Because the number of the edition appears in the title, the date is not necessary.)

Atlas Entry

"Hidden Face of the Moon." Times Atlas of the World. 1981 ed.

Nonprint Sources

Video / Film

(director) (date) (title) (actors)
Shatner, William, dir. 1989. Star Trek V: The Final Frontier. With William Shatner, Leonard Nimoy, and DeForest Kelley. Paramount Studios, Hollywood.
(studio) (city)

Computer Materials

Computer Software

(title) (date) (version) (publisher) (city) (format)
SimEarth. l990. Version 2.0. Sunburst Software, Green Valley, CA. CD or DVD

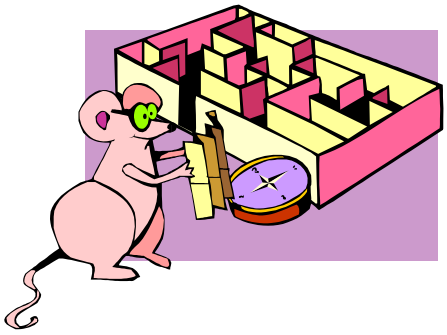
Web Sites

(title) (date) (source)
"How to Produce Award-winning Science Projects". 2005. Nat. Assoc. of Biology Teachers Bulletin Board, NABT.edu.
(Internet address)

Citing "personal communications" with an Expert

(in person, on the phone, in letters or on the Internet)

(full name and title) (date interviewed)
Collins, Dr. Charles 2009. Prof. of Biology, Calif. State Univ., Long Beach, CA
(address of work or home)



RUBE GOLDBERG DEVICE DISPLAY INFORMATION

BACKBOARD MATERIALS

The backboard must be sturdy and stand by itself on a table. Foam core-board and cardboard are the best materials. If you need to cut through the sides of your core-board to make "wings", do not cut all the way through.

COLORS

If you need to paint your backboard, enamel paint works best. Do not use water-based paint. Contact paper may also be used. Use a minimum of three contrasting colors on your board.

LETTERING

Your title and subtitles may be computer-generated or cut from construction paper. Do not freehand the letters. The title letters should be 3-4 inches high. The subtitle letters should be 1-2 inches high. The subtitles, which are mandatory on the display board, are: **Task, Preliminary Design, Final Design, and Obstacles**. All items on the display must be glued to the board. Do not use pins, tacks, staples, or tape.

DRAWINGS, PHOTOS AND GRAPHS

Drawings and photos are most useful on the display. **Preliminary Design** should be drawn in pencil. **Final Design with Key** should be in ink. Drawings should be in color and outlined in thin black felt tip pen **and labeled using keys**.

If you have a camera, you should photograph your **project's** progress. **Photos of your group working on the device** are encouraged. All photos must be titled.

DISPLAY DIMENSIONS

1. When backboard (display portion) is flat, it should be 48 inches wide.
2. Side panels ("wings") should be l2 to l8 inches.*
3. Height should be no more than 48 inches.

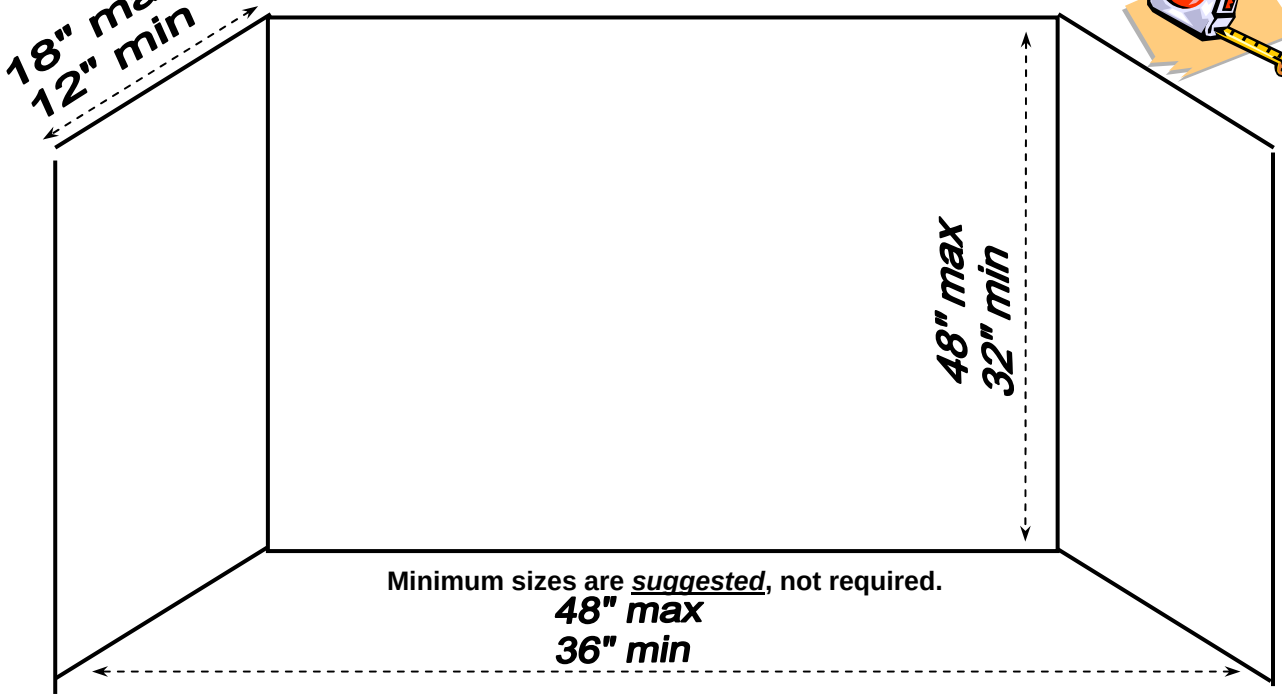
REPORT POCKET

There must be a "pocket" on the display to hold your report.

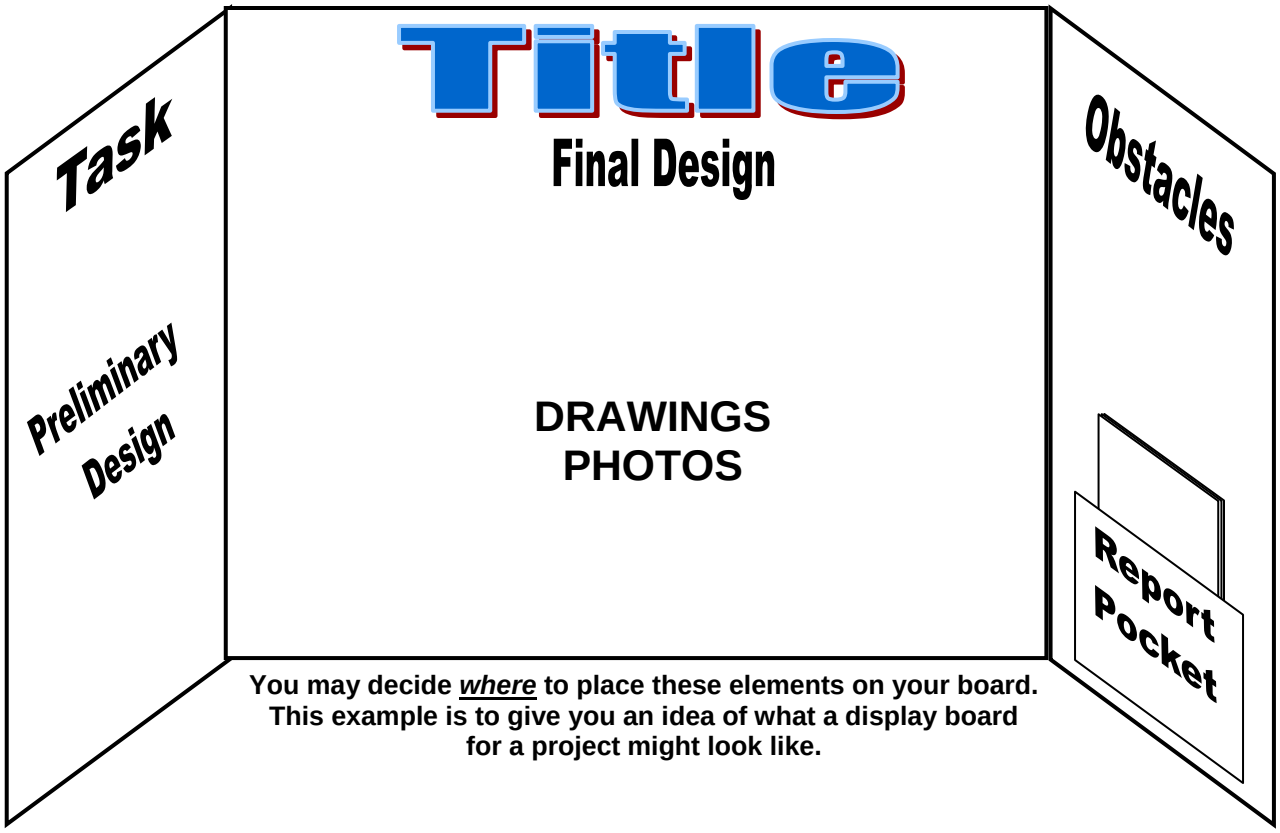
When you have decided what you are going to put on the backboard (display), lay the unglued display on the floor and look at it carefully. Have family and friends look at it and ask their opinions. Then, you should glue everything into place. Examples of displays will be shown and discussed in class.

DISPLAY SIZE & SET-UP

FOR SCHOOL SITE AND LBUSD SCIENCE FAIRS



Minimum sizes are *suggested*, not required.



You may decide *where* to place these elements on your board. This example is to give you an idea of what a display board for a project might look like.

RUBE GOLDBERG DEVICE

DISPLAY LABELS

TASK

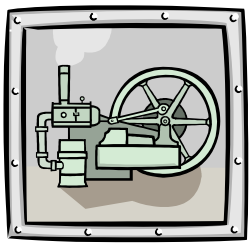
PRELIMINARY DESIGN

FINAL DESIGN

OBSTACLES

REPORT

DISPLAY ITEMS



Part of your display should include something that represents the project and should be placed in front of or on the display board. Depending on the type of project you do, the display items may or may not be the focus of the display.

If you cannot decide what to use to represent your project, brainstorm with family, friends, and classmates. Keep in mind that the items you choose will set the tone for your display and must be approved.

No part of your display may pose a safety hazard. *Do not include harmful chemicals, bacterial cultures, sharp objects, or any source of heat or flames.* No live or preserved animals are allowed at the LBUSD district-level science fair, at the Los Angeles County Fair, or at the California State Fair.

Some examples of display items are listed below:

- **Equipment or materials** you have built or used as part of your project or experiment (i.e., an incubator, variously shaped kites, a solar oven, a microscope with slides, etc.)
- **Models**
- **Artistic representations** of your topic (i.e., a large paper maché nose for an odor project, toothpick bridges for a physics project, or a collage of leaves for a plant project)
- **Samples or specimens**
- **Simulated items** such as photos, video, and audio taken while working on your project or during your experiment. (Keep in mind that use of extension cords requires special permission.)

There are endless possibilities. Be creative! Put on your thinking cap!

Science Fair Rube Goldberg Device (6th - 8th Grade)

Rubric for School Site Science Fair

	Attempted **1 point**	Proficient **3 points**	Advanced Proficient **5 points**
Task	The device performs a simple task that has no practical value.	The device performs a simple task some people would find practical.	The device performs a task that is moderately complicated, or that many people would find practical.
Research	Cites two or fewer sources of information about energy, or uses the wrong format, or uses only one type of information resource. Makes little or no connection to the actual energy transformations of the device.	Cites three or more sources of information about energy in the correct format, using at least two types of information resources. Makes a general connection to the types of energy transformations of the device in the student's own words.	Cites four or more sources of information about energy, in the correct format, using at least three types of information resources. Makes clear and well-elaborated connections to each energy transformations of the device in the student's own words.
Preliminary Design	Diagram and notes show limited progress toward making a working device, or have fewer than eight energy transfers, or use only two or three types of energy.	Diagram and notes show a proposed device with at least eight energy transfers using four types of energy.	Diagram and notes show a proposed device with at least ten energy transfers using five or more types of energy.
Obstacles x2 *(double points)*	Fails to analyze obstacles related to the practical design, construction, and stable function of the invention (i.e., may list obstacles that refer only to shopping for materials or cosmetic issues).	Provides adequate analysis of the obstacles related to the practical design, construction, and stable function of the device.	Demonstrates in-depth analysis of the obstacles related to the practical design, construction, and stable function of the device.
Final Design with Key x2 *(double points)*	Drawing is not rendered in ink, or is unclear or incomplete in showing the operating pieces and structural supports. Or, the labels and explanations for the energy transfers are significantly flawed.	Drawing is made in ink. It reasonably represents the operating pieces and the necessary structural supports. Energy transfers are labeled and explained with minor omissions or mistakes.	Drawing is made in ink. It clearly shows each operating piece and the necessary structural supports. All energy transfers are well labeled and explained.
Reflection	Student fails to describe both challenges and rewards of the project, or omits or makes unclear applications to personal strengths and possible career goals.	Student describes some challenges and rewards of the project, making applications to personal strengths and possible career goals.	Student clearly describes challenges and rewards of the project, making numerous applications to personal strengths and possible career goals.
Device Operation x2 *(double points)*	Live device (or video recording) does not demonstrate complete operation without a break and without assistance after starting the device. Student narrates, from start to finish, the transfers of energy from object to object, but has significant omissions or inaccuracies.	Live device (or video recording) shows complete operation without a break and without assistance after starting the device. Student narrates, from start to finish, the transfers of energy from object to object with minor omissions or inaccuracies.	Live device (or video recording) proves complete and reproducible operation without a break and without assistance after starting the device. Student narrates, from start to finish, the transfers of energy from object to object without omissions or inaccuracies.

(Projects will receive between 10 and 50 points when all rubric criteria have been addressed.)