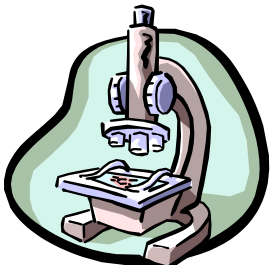
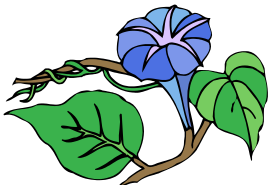
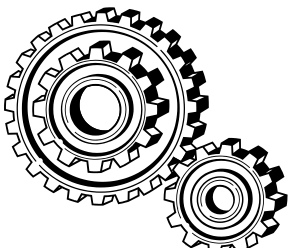
Reverse Engineering PROJECT

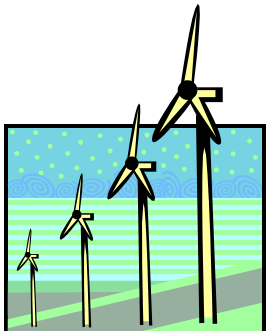
3rd and 4th GRADE

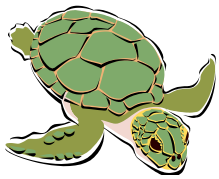
Student Information Packet











long beach unified school district

ELEMENTARY

SCIENCE FAIR

STUDENT INFORMATION PACKET

Revised 2009, 2011, 2015

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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. The chair you sit on was made by some person. All the tools used to build it are because of knowledge from science and technology. Someone had to know what shape to make the saw and how sharp the teeth are to cut wood, right? How did they know to make one saw for wood and a different one for metal? Why does the wood saw have big teeth and the metal saw have small teeth?

Science is asking questions and finding answers. A science project, simply put, is the process of asking a question you have about something you are interested in, hypothesizing (best-guessing) what the answer might be, researching for information on that topic, experimenting, inventing, collecting or doing in-depth research, analyzing your results, and coming to a conclusion!

What your accomplishment will mean for you:

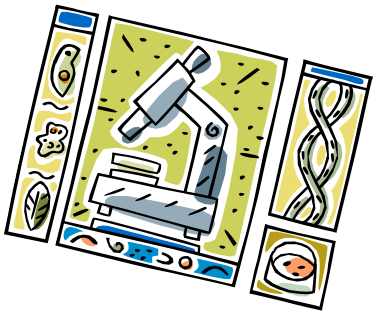
- ★ Gaining self confidence
- ★ Proving you can do it
- ★ Learning new things
- ★ Being recognized by your school and community
- ★ Knowing what the scientific method is and how it can help you.

Everything you need to know about doing a great science project is inside this packet. You'll be discussing the contents with your teacher and also your parents. 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 project's progress. The timeline sheet is designed to keep you, your parents and your teacher on target.

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 – Collect and read information about your topic.

  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.

- Check with your parent or teacher if you want to use a web site for research. Not all web sites give correct information.
- This is to be a fun process. "Success" is a completed project where you had fun and learned a lot.
- Enjoy the fun!

REVERSE ENGINEERING

CREATING A SCIENCE FAIR REVERSE ENGINEERING PROJECT USING AN ENGINEERING ANALYSIS PROCESS

For Grades 3 - 5 ONLY

Nearly everything we use, work with, or wear is engineered. Someone had to think of how to design that object to solve a particular problem. Anyone can be an engineer! An engineer is someone who uses knowledge of science and math, and their own creativity to design objects or processes (inventions) to solve problems. Sometimes, they also take things apart to study how they were designed by other engineers.

I. PURPOSE AND ACKNOWLEDGEMENTS

Explain why you want to know how this device works and why you chose certain people to help you.

II. PRODUCT RESEARCH

Research information about how the device was originally invented and revised over time.

III. DEVICE DETAILS

Describe the device in detail and all the ways it is meant to be used.

IV. PART/SUBASSEMBLY DESCRIPTION & EXPLANATION

Organize and label all of the subassemblies and parts. Describe how each component functions in the device.

V. MATERIALS AND CONNECTIONS

Explain how the parts are connected to each other and what materials they are made of.

VI. PROFESSIONS INVOLVED IN DESIGN AND MANUFACTURE

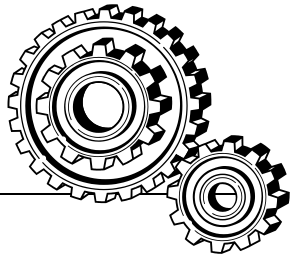
Research and explain the roles of the different types of professionals needed to design and make this device.

VII. REFLECTION AND PRINCIPLES

Explain what you learned, including how concepts from science and engineering were included in the device.

For ideas on devices you might want to investigate, see the **Reverse Engineering** Guidelines on the last page of this packet (page 18).

ELEMENTARY Reverse Engineering
WRITTEN REPORT CONTENT



3rd - 5th Grades

❋ TITLE PAGE

See **Written Report Format** *on next page.*

❋ PURPOSE & ACKNOWLEDGEMENTS

In three sentences or less, tell why you did your science project on the topic you chose. Also, 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

List each of the following sections and the page numbers for each. Type the page number at the bottom of each page after you have finished the final copy of your report.

❋ PRODUCT RESEARCH

Your page numbering begins here.

This section is a summary of the information you collected about the origin and development of the device you are studying. Use notes from books, journals, the Internet, magazines, visits to stores, and interviews with experts.

❋ DEVICE DETAILS

Describe the device and the ways it is used. Be specific.

❋ PART / SUBASSEMBLY DESCRIPTION

Describe and diagram all of the subassemblies and parts that make up your device. Explain how each component contributes to the function of the device. Remember to include features that are specifically designed for safety purposes.

❋ MATERIALS & CONNECTIONS

Having made careful observations as the device is taken apart, describe and diagram how the different parts fit together. Explain how and why the connections between parts are designed as they are.

❋ PROFESSIONALS INVOLVED

Mechanical engineers, electrical engineers, chemical/materials engineers, software engineers, scientists, and artists are often involved in design of devices. Research the professionals involved in making your device. Explain why each one was needed.

❋ REFLECTION & PRINCIPLES

Reflect on what you have learned through this project. Be sure to note specific science and engineering principles applied by the device.

❋ SOURCES / BIBLIOGRAPHY

List all books, articles, pamphlets, and other communications or sources that you used for writing your research section. You must have at least three sources, only one of which may be an encyclopedia. Interviews with experts in your field of study are encouraged.

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

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

ELEMENTARY Reverse Engineering
WRITTEN REPORT FORMAT

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

❑ Title Page

Title
in middle of page

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

❑ Purpose and Acknowledgements

❑ Table of Contents (with page numbers)

❑ Product Research (page numbering starts here)

❑ Device Details

❑ Part / Subassembly
Description & Explanation

❑ Materials & Connections

❑ Professional Involved in
Design & Manufacture

❑ Reflection & Principles

❑ Sources / Bibliography

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.**

ELEMENTARY Reverse Engineering WRITTEN REPORT FORMAT FOR SOURCES / BIBLIOGRAPHY

Entries in a bibliography are alphabetized by the last name of the author or the first word of the title. 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.*

Books

Basic Form — Bronowski, Jacob. The Ascent of Man. Boston: Little & Brown, 1973.

Two Authors — March, James G., and Herbert A. Simon. Organizations. New York: Wiley, 1958.

Magazines

Weekly — Tuchman, Barbara W. "The Decline of Quality." New York Times Magazine, 2 Nov. 1980: 38-57.

Monthly — Brown, Norman O. "Apocalypse: The Place of Mystery in the Life of the Mind." Harper's. May 1961: 27-35.

Newspapers

Basic Entry — Kristof, Nicholas D. "Oil Futures Plunge on OPEC Doubt." New York Times, 3 Jan. 1985: Dl3.

Reference Works

Encyclopedia Entry, Unsigned

"Huygens, Christiaan." Encyclopedia Britannica. 13th ed.

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

Redford, Robert, dir. Ordinary People. With Mary Tyler Moore and Donald Sutherland. Paramount, 1980.

Computer Materials

Computer Software

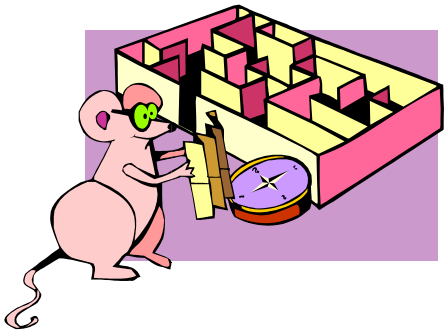
Visispell: Fut.heuristix. Version 1.00. Computer software. San Jose: Visicorp, 1983. Disk.

Web Sites

Corte, Corrinne. "Why Are British Sailors Called Limeys?" *Ask A Biologist*. Arizona State University. http://ls.la.asu.edu/askabiologist/research/scurvy/index.html (8 Mar. 2001)

Interview

Persons name (last name first), position or work title, place of interview, date of interview.



ELEMENTARY Reverse Engineering

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: **Purpose & Acknowledgements**, **Product Research**, **Device Details**, **Part/Subassembly Description and Explanation**, **Materials and Connections**, **Professionals Involved in Design and Manufacture**, **and Reflection and Principles**. All items on the display must be glued to the board. Do not use pins, tacks, staples, or tape.

DIAGRAMS, PHOTOS, AND GRAPHS

Drawings and photos are most useful on the display. Drawings should be drawn in pencil first and then retraced. Drawings should be in color and outlined in thin black felt tip pen. All graphs and charts must have explanatory titles. Graph axes must be labeled.

If you have a camera, you should photograph your invention in progress. A photo of you with your invention is 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.

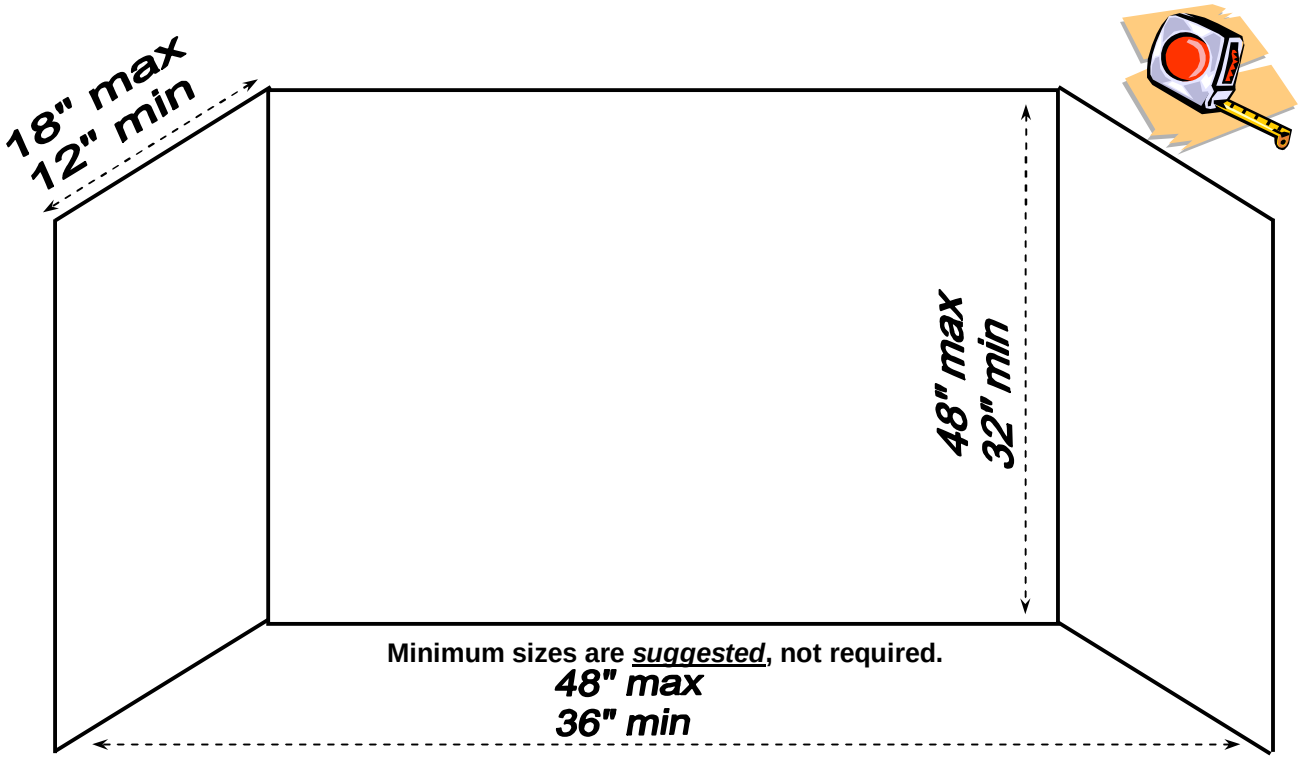
REPORT POCKET

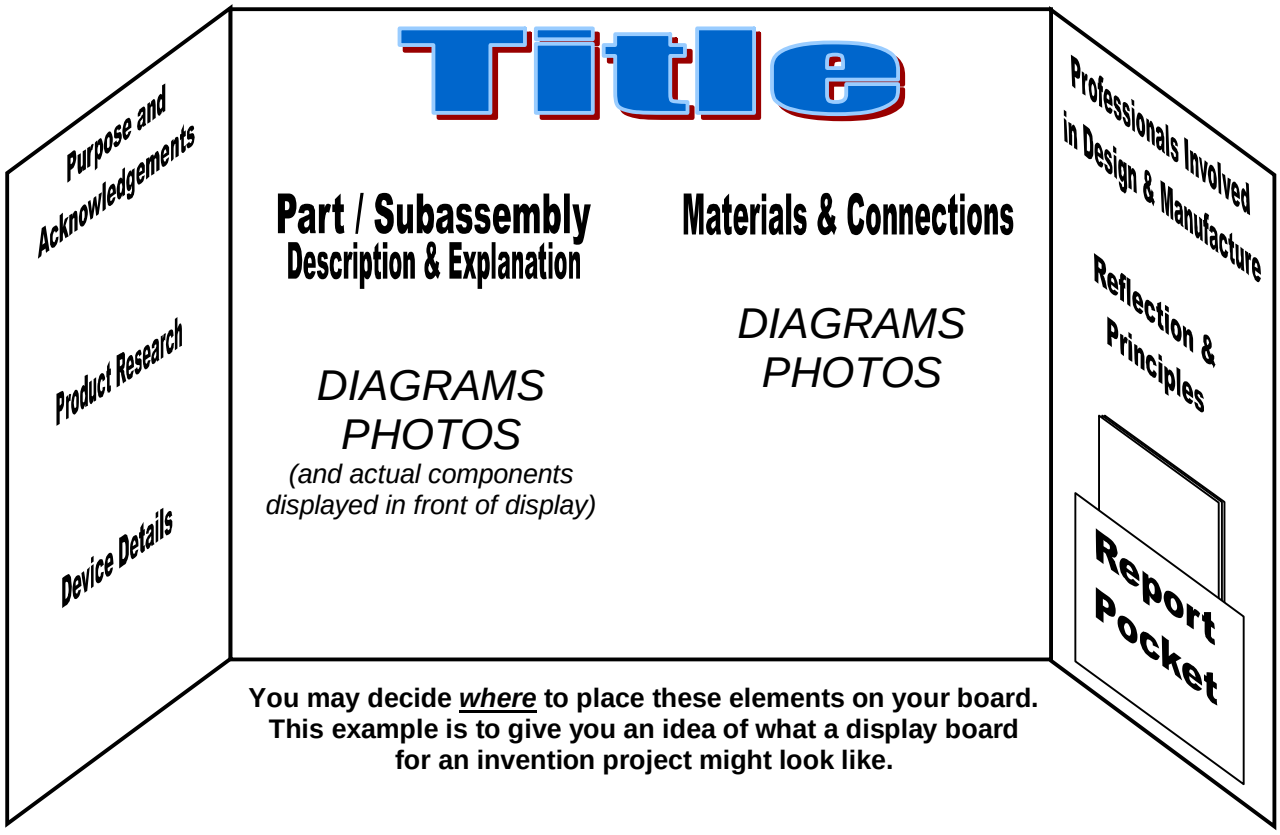
There must be a "pocket" on the display to hold your report.

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





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 an invention project might look like.

DISPLAY LABELS

PURPOSE and ACKNOWLEDGEMENTS

PRODUCT RESEARCH

DEVICE DETAILS

PART / SUBASSEMBLY

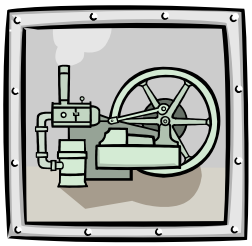
DESCRIPTION & EXPLANATION

MATERIALS and CONNECTIONS

PROFESSIONALS INVOLVED IN DESIGN & MANUFACTURE

REFLECTION and PRINCIPLES

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 require special permission.)

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

Science Fair **Reverse Engineering** (3rd and 4th Grades)

Rubric for School Site Science Fair

	Attempted **1**	Proficient **3**	Advanced Proficient **5**
Purpose & Acknowledgements	Is unclear about their purpose for reverse engineering this device. Acknowledgements do not address the relevant skills of those who helped.	Describes the general purpose for reverse engineering this device. Acknowledges and thanks people that contributed to understanding the device and addresses some relevant skills and interests of each contributor.	Provides a clear presentation of the student's purpose for reverse engineering this device. Acknowledges and thanks each person that contributed to understanding the device and clearly explains relevant skills and interests of each contributor.
Product Research	Presents findings from only one source or cites sources that may not be reliable. Or, provides little information about the origin and development of the device over time.	Presents findings from two or more reputable sources and provides some information about the origin and development of the device over time.	Presents detailed findings from three or more reputable sources and clearly explains the origin and development of the device over time.
Device Details	Identifying information about the device may be incomplete, or description of the basic operation and purpose of the device is vague or incomplete.	Provides identifying information about the device and describes the basic operation and purpose of the device.	Provides thorough identifying information about the device. Clearly describes the operation and purpose of the device, including all multiple functions.
Part / Subassembly Description & Explanation ***(Double Points)*** (x2)	Labels and details are too limited to give the reader an understanding of each part of the device. Explains of the function or operation of a few parts or neglects to mention how they relate to the device as a whole. Does not consider what would happen if certain parts were altered or missing or explanation is not clear.	Provides labels and enough details to give the reader an adequate understanding of each part of the device. Explains of the function or operation of most parts and how they relate to the device as a whole. Considers what would happen if certain parts were altered or missing.	Provides all labels and details needed to give the reader a clear understanding of each part of the device. Gives a clear explanation of the function or operation of each part and how it relates to the device as a whole. Carefully considers what would happen if each part was altered or missing.
Materials and Connections	Recorded observations describing the types of materials are used in each part are incomplete or unclear. Attempts to explain how each part fits into the device, but labeled diagrams/photographs and explanations are unclear about how each part is connected to the device. Or, neglects to explain ***why*** certain materials were used in each part.	Writes observations describing the types of materials are used in each part. Briefly explains how each part fits into the device. Provides labeled diagrams/photographs and adequate explanations to demonstrate how each part is connected to the device. Explains ***why*** certain materials were used in each part.	Writes clear, scientific observations describing what types of materials are used in each part. Demonstrates in-depth analysis of how each part fits into the device. Provides clearly labeled diagrams/photographs and precise explanations demonstrating how each part is connected to the device. Explains ***why*** certain materials were used in each part.
Professionals Involved in Design & Manufacture ***(Double Points)*** (x2)	Identifies some professions, but the connection to the design and manufacture the device is unclear.	Identifies some professions required to design and manufacture the device. Explains some specific ways that people (such as engineers, artists, scientists, etc.) have contributed to the device.	Identifies the various professions required to design and build the device. Explains several specific ways that people (such as engineers, artists, scientists, etc.) have contributed to the device.
Reflection & Principles	Explanation of new things learned about the device through the reverse engineering process is vague or missing. Connections of the device design to scientific and engineering principles are unclear or missing.	Explains new things learned about the device through the reverse engineering process. Makes general connections of the device design to one or few scientific and engineering principles.	Explains new things learned about the device through the reverse engineering process. Connects the device design to various and specific scientific and engineering principles.
Visual Quality of Display	Project has limited eye appeal or is not easily readable at approximately two feet distance. The project has limited organization, or contains confusing visuals, or contains major language or spelling errors.	Project is appealing and readable at approximately 2 feet distance. It is organized and clear, uses understandable visuals and/or models, and contains few language and spelling errors.	Project is appealing and neat, and is readable at approximately 2 feet distance. It is well organized and clear, makes striking use of inventive or amusing visuals and/or models, and uses language and spelling flawlessly.

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

Class grade should also include how well timelines were met and elements of the written report not found on the display board:
Title Page, Acknowledgements, Table of Contents, and Sources/Bibliography

Science Fair **Reverse Engineering** (3rd and 4th Grades)

Targets for an Excellent Science Fair Project

	Advanced Proficient 5	"TRANSLATED"
Purpose & Acknowledgements	Provides a clear presentation of the student's purpose for reverse engineering this device. Acknowledges and thanks each person that contributed to understanding the device and clearly explains relevant skills and interests of each contributor.	Explain why you are interested in how this device works. Give reasons for why you asked certain people to help you.
Product Research	Presents detailed findings from three or more reputable sources and clearly explains the origin and development of the device over time.	Research thoroughly how this device was invented and how it has developed. Connect this to your purpose.
Device Details	Provides thorough identifying information about the device. Clearly describes the operation and purpose of the device, including all multiple functions.	Describe the device and all the ways it is used.
Part / Subassembly Description & Explanation ***(Double Points)*** (x2)	Provides all labels and details needed to give the reader a clear understanding of each part of the device. Gives a clear explanation of the function or operation of each part and how it relates to the device as a whole. Carefully considers what would happen if each part was altered or missing.	Organize and label all parts of your device for display. Explain each part's name/description. Describe how each part works or is used in the device.
Materials and Connections	Writes clear, scientific observations describing what types of materials are used in each part. Demonstrates in-depth analysis of how each part fits into the device. Provides clearly labeled diagrams/photographs and precise explanations demonstrating how each part is connected to the device. Explains ***why*** certain materials were used in each part.	Observe what each part is made of and explain why the material makes sense. Describe how each part is attached to the device. Use pictures, diagrams, and words to make it really clear.
Professionals Involved in Design & Manufacture ***(Double Points)*** (x2)	Identifies the various professions required to design and build the device. Explains several specific ways that people (such as engineers, artists, scientists, etc.) have contributed to the device.	Identify the various engineers, scientists, and artists needed to design and produce the device. Explain why each one was needed.
Reflection & Principles	Explains new things learned about the device through the reverse engineering process. Connects the device design to various and specific scientific and engineering principles.	Explain new learning. Point out science and engineering concepts the design takes advantage of.
Visual Quality of Display	Project is appealing and neat, and is readable at approximately 2 feet distance. It is well organized and clear, makes striking use of inventive or amusing visuals and/or models, and uses language and spelling flawlessly.	Make your project fun to look at with pictures and colors. Use large, clear lettering. Check grammar and spelling.

Reverse Engineering

Guidelines for Grades 3rd and 4th

Select ONE device with 3 to 10 component parts to analyze.

- Get permission from your parent or legal guardian to take apart or analyze this device. (Recognize that this may be a one-way process. Not every device needs to be taken apart, but if it does the device may not go back together well!)
- Get approval from your teacher for the device.
- Have your parent or guardian sign the **Project Permission Form** and return it with your teacher.
- Types of devices you might consider:

Kitchen:	can opener, cheese slicer, egg slicer, peeler, thermos, paper towel dispenser, scale, drawer, etc.
Office:	pen, stapler, hole punch, pencil sharpener, binder, tape dispenser, etc.
Bathroom:	floss container, shower head, sink drain, lip balm tube, rugs, towel bar, toilet paper holder, etc.
Garage:	pliers, clamp, tape measure, vice, paint brush, caulking gun, broom, shelves, etc.
Other:	shoe, spray bottle, reading glasses, sun glasses, hat, belt, toy, container, lamp, blinds, etc.

Note: Try to select a device that is neither too simple nor too complicated for you.

Product Research

- Find a minimum of 3 resources providing information about the type of device you are going to disassemble.
- Describe the origin of your device (or type of device) and how it has developed over time.
- Explain why you have chosen to reverse engineer this device.

Device Details

- Record the following basic information about your device:
  - Name of the device
  - Model/brand of the device
  - Year of manufacture
- Explain how the device works. (What is the purpose of the device? Exactly how does the device do that? Does the device have more than one function?)

Disassembly and Analysis

- Before you begin to disassemble your device, make sure to take several pictures from different angles.
- Plan how you disassemble the device, consider these points:
  1. How will you organize and store the parts. Consider using re-sealable sandwich bags to keep the parts sorted and labeled.
  2. Include an index card or small slip of paper in the re-sealable sandwich bag to write the name and function of each part.
  3. Take photos to record the disassembly process.
  4. Complete a table recording the following information for each part or subassembly:

Part #	**Name/Description** of Part or Subassembly	**Explanation of Function or Operation**	**Material** (color, characteristics, physical state: s, l, or g)	**How Part is Connected**	**Types of Professionals Needed to Design/Manufacture**
1					

- If you have difficulty identifying the parts of your device, try looking online for manuals and diagrams. You may also want to consult a professional, if necessary. Once you identify each part, you should be able to find its function.

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CURRICULUM, INSTRUCTION & PROFESSIONAL DEVELOPMENT
Science Curriculum Office ■ Teacher Resource Center, Room 7 ■ 1299 E. 32nd Street ■ Signal Hill, CA 90755
(562) 997-8000 Ext. 2963 ■ FAX: (562) 426-8448

Reverse Engineering

Project Permission Form

We are pleased that you are interested in investigating the inner workings of a device to learn how and why people design the things we use daily. We want to make sure that your experience is a positive and safe one. To that end, please read and sign this form so that we are assured that your investigation will be properly supervised and safely pursued.

Student Name(s) (PRINT): _____

Device to be investigated: _____ **School:** _____

Only disassemble devices with the permission of your teacher and parent/guardian, recognizing that disassembly may result in the device no longer being able to function.

Safety issues to consider:

- Be very careful to protect eyes, hands, etc., when disassembling a device, particularly if a casing or part needs to be broken.
- Use sharp tools and work with sharp device parts only under adult supervision.
- Research the composition of any fluid, crystal, or powdered chemicals to be aware of any potential hazards.
- Do not puncture or open any components containing pressurized liquids or gases. If in doubt, do not open.

Electrical devices:

- Never disassemble an electrical device that is plugged in or has been plugged within the last 30 minutes.
- Do not disassemble devices containing large capacitors or materials considered hazardous waste, including microwave ovens, computers, televisions, refrigerators, and air conditioners.
- Do not disassemble thermostats, or any fluorescent light bulb or compact fluorescent light bulb (CFL), as they contain small amounts of mercury.
- Do not disassemble any electrical motors or electrical components of a device manufactured before 1979 as many of them contain capacitors with polychlorinated biphenyls (PCBs) which were banned in 1979.
- When disposing of devices or their components, make sure you follow local regulations regarding electronic waste.

PARENT PERMISSION

By signing below, you are affirming that you have read the precautions mentioned above and agreeing to support and, as necessary, supervise this project.

Any questions regarding this Reverse Engineering process should be referred to Eric Brundin, LBUSD Science Curriculum Leader, (562)997-8000, extension 2963 or EBrundin@lbschools.net.

PERMISSION FOR PARTICIPANT – ***Requires signature of parent or legal guardian.***

Signature of Parent/Guardian: _____ Date: _____

Publication Authorized:
Pamela Seki, Assistant Superintendent
Office of Curriculum, Instruction, and Professional Development 04/15