Hovercraft Science Fair Project

Project Guidebook

By Aurora Lipper

Table of Contents

How to Use This Book:

Welcome to the world of Supercharged Science! In just a moment, you'll be zooming hovercraft, taking data, and transforming your great ideas into an outstanding science fair project! Whether you're looking to blow away the competition or happy just get a decent grade, you've got the keys to a successful science fair project in your hands right now. The tools you'll find in this manual answer the basic question: **"How can I create a science fair project and enjoy the process?"**

We're going to walk step-by-step through every aspect of creating a science fair project from start to finish, and we'll have fun doing it. All you need to do is follow these instructions, watch the video, and do the steps we've outlined here. We've taken care of the tricky parts and handed you a recipe for success.

Who am I? My name is Aurora, and I am a mechanical engineer, university instructor, airplane pilot, astronomer, and I worked for NASA during high school and college. I have a BS and MS in mechanical engineering, and for the past decade have toured the country getting kids wildly excited about doing *real* science.

What do the kids I teach learn? After a day or two, my students are building working radios from toilet paper tubes, laser light show from tupperware, and real robots from junk. And they're crazy-wild excited about doing it.

One of the problems kids have, however, is taking their idea and fitting it into something acceptable by science fairs or other technical competitions designed to get kids thinking like a real scientist.

Another problem kids often face is applying the scientific method to their science project. Although the scientific method is not the primary method of investigation by industry, it *is* widely used by formal science academia as well as scientific researchers. For most people, it's a real jump to figure out not only how to do a decent project, but also how to go about formulating a scientific question and investigate answers methodically like a real scientist. Presenting the results in a meaningful way via "exhibit board"… well, that's just more of a stretch that most kids aren't really ready for. And from my research, there isn't a whole lot of information available on how to do it by the people who really know how.

This report is designed to show you how to do a cool project, walk you through the steps of theorizing, hypothesizing, experimentation, and iterating toward a conclusion the way a real engineer or scientist does. And we'll also cover communicating your ideas to your audience using a display board *and* the oral presentation using top tips and tricks from real scientists.

For years, Supercharged Science has served as the bridge between the scientific community and the rest of the world. This is yet another step we have taken on to help serve as many families as possible. Thank you for your support and interest… and let's get started!

Materials List

Before we start, you'll need to gather items that may not be around your house right now. Take a minute to take inventory of what you already have and what you'll need.

- Foam meat tray (our materials kit includes one that measures 12" x 8" x 1")
- Foam drinking cup (open end measures 3 ½" diameter, and at least 3" long)
- Foam 'to-go' burger container (ours measures 5" x 5" x 1 ½")
- 3 wooden skewers
- Drinking straw
- Popsicle stick
- Two 3VDC hobby motors (Radio Shack part #273-223 or similar)
- SPST slide switch (Radio Shack part #275-406)
- Two propellers (must press-fit onto motor shaft) *Check your local hobby store.*
- 12" 22-24g hook-up wire (Radio Shack part #278-1224)
- 9V battery clip (Radio Shack part #270-324)
- 9V battery (alkaline is best)
- Camera to document project
- Composition or spiral-bound notebook to take notes
- Display board (the three-panel kind with wings), about 48" wide by 36" tall
- Paper for the printer (and photo paper for printing out your photos from the camera)
- Computer and printer

Create a Science Fair Project in Hovercraft

Before we start diving into experimenting, researching, or even writing about the project, we first need to get a general overview of what the topic is all about. Here's a quick snippet about the science of hovercraft.

Hovercraft are designed to travel over water, land, ice and snow. Also known as Air Cushioned Vehicles (ACV), these craft ride on a smooth cushion of air blasted from the underside and contained under a skirt. Hovercraft are widely used in areas where wheels and treads bog down, such as swamps and damp rainforests.

The first hovercraft was designed for military use in 1915, but was mostly operated over water. In the 1930's, inventors combined simple aircraft principles into their designs to produce the first vehicles that utilized 'ground effect' and could hover on land.

ACVs require at least two engines: one for the lift (hovering action), and the other for forward thrust. The hovering motor pushes air out the bottom, which creates a pocket of higher pressure to acculumulate. As the higher pressure escapes out the bottom, it lifts the vehicle up, creating the 'hovering' effect. Although some hovercraft utilize air ducts to use one engine for both jobs (thrust and hover), most require two or more.

In addition to small vehicles, two hover trains are currently in operation (one in Japan, the other in Austria) since 1985, using an underground cushion of air to reduce track friction and increase speed.

One of the biggest challenges with hovercraft is keeping the vehicle design lightweight but powerful. Hobby motors and batteries are heavy compared with the foam frame, and most hobby motors do not have enough power to lift themselves off the ground by simply adding a propeller. You will be able to overcome this issue using two important design tips: first, by using the motors to generate a pocket of higher air pressure underneath the vehicle, and second: by using a lightweight, high-voltage power source. When designing your vehicle, you'll need to pay close attention to the finer details such as placement of your electrical motors and maintaining proper balance so that your hovercraft doesn't drag a corner and slow itself down.

Your first step: Doing Research. *Why* do you want to do this project? What originally got you interested hovercraft? Is it the idea of floating on air, gliding over any surface? Or do you just like how cool the hovercraft *looks*?

Take a walk to your local library, flip through magazines, and surf online for information you can find about hovercraft. Learn what other people have already figured out before you start re-inventing the wheel!

Flip open your science journal and write down things you've find out. Your journal is just for you, so don't be shy about jotting ideas or interesting tidbits down. Also keep track of which books you found interesting. You'll need these titles later in case you need to refer back for something, and also for your bibliography, which needs to have at least three sources that are not from the internet.

Your next step: Define what it is that you really want to do. In this project, we're going to walk you step by step trough creating a small hovercraft that floats on a smooth floor, made entirely out of hobby store and restaurant 'to-go' parts. Go shopping and get all your equipment together now.

Playing with the experiment: Before you start building the hovercraft, start playing with the motors. Snap on a propeller and hook up the battery and see if you can get your motors to turn. Now add a switch – can you figure out how to switch the motors on and off? (If you're stuck, don't worry… we'll walk you through each step on how to do this later.)

After you've played with the equipment, it's now time to actually build your vehicle. This should take you anywhere between 20 minutes to an hour, depending on how you want to design your vehicle. Go watch the video and learn how to build a hovercraft.

Formulate your Question or Hypothesis: You'll need to nail down ONE question or statement you want to test if it is true. Be careful with this experiment - you can easily have several variables running around and messing up your data if you're not careful. Here are a few possible questions:

- "Which propeller provides the greatest thrust?"
- "Which motor works best for hovering?"
- "Does thruster motor position matter?"
- "What kind of power source gives the best performance?"
- "How much weight can it carry?"
- "How can the hovercraft go over different surfaces more easily?"
- "Where is the best place for passengers?"
- "What is the best skirt design?"

Once you've got your question, you'll need to identify the *variable* and the *control.* For the question: "How much weight can it carry?", your variable is the amount of weight you add, and the control is where you put it.

If you wanted to ask the question: "How can the hovercraft go over different surfaces more easily?", your hypothesis might be: "Increasing the voltage to the motor will enable the hovercraft to move more easily over rougher surfaces."

For testing the skirt design, you could try several different sizes of meat trays and foam bowls, keeping the motors and battery (weight) constant. Your variable is the skirt design, and the control is your power/engine system. Your hypothesis might be: "Increasing the skirt volume will cause the hovercraft to glide higher and thus travel faster."

Taking Data: Sticking with the question "Where is the best place for passengers?", here's how to record data. Grab a sheet of paper, and across the top, write down your background information, such as your name, date, time of day, weather (is it windy?), type and size of motors, floor conditions (carpet, smooth tile, etc.) and anything else you'd need to know if you wanted to repeat this experiment *exactly* the same way on a different day. Include a photograph of your invention also, so you'll see exactly what your project looks like.

Get your paper ready to take data… and write across your paper these column headers, including the things in ( ): (Note – there's a sample data sheet following this section).

- Trial #
- Placement of Weight (cm) – this is your independent variable.
- Time to Travel 4 Meters (seconds) – this is your dependent variable.
- Speed of Vehicle (feet per second) - this is another dependent variable.

Be sure to run your experiment a few times before taking actual data, to be sure you've got everything running smoothly. You'll need to find a flat surface that has enough space for the hovercraft to come up to speed before you start clocking it.

Using chalk, space the *start* and *finish* lines ten feet apart. Place your hovercraft in a spot where it has enough space to reach constant velocity before it hits the start line. (Have someone snap a photo of you getting ready to test, to enter later onto your display board.) Add a fresh battery and flip on the switch. Place a weight (a penny or a stack of pennies) on each corner of the hovercraft at the furthest aft position. Start clocking the time when it passes the start line. Hit the stop button when the vehicle reaches the finish line and write down the time shown on the stopwatch. Record your data on your data sheet.

Run your experiment again and again, moving the weight forward 3cm each time until they weights reach the front end.

Periodically insert a fresh battery to be sure the power supplied by the battery is about the same each time. You can test your batteries with a digital multimeter (Radio Shack #22-810).

Don't forget to take photos as you go along - see if you can get a picture of the vehicle actually crossing the finish line!

Analyze your data. Time to take a hard look at your numbers! You'll need to convert the time measurement to speed before you analyze your data. Simply divide the distance (4 meters) by the number of seconds you recorded to find an average speed in meters per second. Do this calculation for each trial you recorded.

Make yourself a grid (or use graph paper), and plot the *Location of Weight* (in cm) versus the *Vehicle Speed* (in meters per second). In this case, the *Location of Weight* goes on the horizontal axis (independent variable), and *Speed* (dependent variable) goes on the vertical axis.

Using a computer, enter in your data into an Excel spreadsheet and plot a scatter graph. Label your axes and add a title.

Conclusion: So - what did you find out? Where is the best place to add the passengers? Is it what you originally guessed? Science is one of the only fields where people actually *throw a party* when stuff works out differently than they expected! Scientists are investigators, and they get *really* excited when they get to scratch their heads and learn something new.

Hot Tip on Being a Cool Scientist One of the biggest mistakes you can ever make is to fudge your data so it matches what you wanted to have happen. Don't *ever* be tempted to do this… science is based on observational fact. Think of it this way: the laws of the universe are still working, and it's your chance to learn something new!

Recommendations: This is where you need to come up with a few ideas for further experimentation. If someone else was to take your results and data, and wanted to do more with it, what would they do? Here are a few spins on the original experiment:

- Use a larger-volume skirt (foam meat tray)
- Vary the size of the battery pack
- Vary the size of the hover OR thruster motor

Make the display board. Fire up the computer, stick paper in the printer, and print out the stuff you need for your science board. Here are the highlights:

- Catchy Title: This should encompass your basic question (or hypothesis).
- Purpose and Introduction: Why study this topic?
- Results and Analysis (You can use your actual data sheet if it's neat enough, otherwise print one out.)

- Methods & Materials: What did you use and how did you do it? (Print out photos of you and your experiment.)
- Conclusion: One sentence tells all. What did you find out?
- Recommendations: For further study.
- References: Who else has done work like this?

Outline your presentation. People are going to want to see you demonstrate your vehicle, and you'll need to be prepared to answer any questions they have. We'll detail more of this in the later section of this guidebook, but the main idea is to talk about the different sections of your display board in a friendly, knowledgeable way that gets your point across quickly and easily. Test drive your presentation on friends and relatives beforehand and you'll be smoothly polished for the big day.

Sample Data Sheet

Hovercraft Data Log

Name
Date
Time

Floor Conditions
Number/Size of Motors
Vehicle Weight

Trial #	Weight Location	Time to Travel 3m	Vehicle Speed
	(cm)	(seconds)	(meters/second)
1	0		
2	3		
3	6		
4	9		
5	12		
6	15		
7	18		
8	21		
9	24		
10	27		

Create this table yourself using Microsoft Excel. You can download your free copy at this link:

http://www.ability-usa.com/download.php

OR...download your free 60-day trail copy from Microsoft at this link:

http://office.microsoft.com/en-us/excel/default.aspx

Sample Report

In this next section, we've written a sample report for you to look over and use as a guide. Be sure to insert your own words, data, and ideas in addition to charts, photos, and models!

Title of Project

(Your title can be catchy and clever, but make sure it is as descriptively accurate as possible. Center and make your title the LARGEST font on the page.)

by Aurora Lipper

123 Main Street,
Sacramento, CA 10101

Carmel Valley Grade School
6th grade

Table of Contents

Abstract

This is a *summary* of your entire project. Always write this section LAST, as you need to include a brief description of your background research, hypothesis, materials, experiment setup and procedure, results, and conclusions. Keep it short, concise, and less than 250 words.

Here's a sample from Aurora's report:

Where do you put the passengers on a hovercraft? After researching hovering engines, ground effect aerodynamics, and wiring up circuits, I realized I had all the basics for making a hovercraft. But how do we load the people on the hovercraft without compromising the speed of the vehicle?

I hypothesized that best place to put the passengers is near the front. The hovercraft uses two motors, one for hovering and the other for thrust. Using inexpensive hobby motors from Radio Shack, foam containers, and a battery, I created a hovercraft that could hold weights. I ran ten trials varying the position of the weights (increasing in increments of 3cm with each trial) and measured the time to travel four meters using a stopwatch and a smooth floor.

I found that my initial hypothesis was supported by the data, but not in the way I expected. **The hovercraft actually had an ideal "passenger position" range of 9-15cm that yielded the fastest speeds.** (It actually performed about the same for a few trials, instead of having an obvious "peak" performance setting as I originally had hypothesized.)

For further study, I recommend running an experiment to test the various sizes of batteries, and also another experiment to test for the ideal motors to use with this experiment. This experiment was a lot of fun, complete with unexpected results!

Introduction/Research

This is where all your background research goes. When you initially wrote in your science journal, what did you find out? Write down a few paragraphs about interesting things you learned that eventually led up to your main hypothesis (or question).

Here is a sample from Aurora's report:

The first hovercraft was designed for military use in 1915, but was mostly operated over water. In the 1930's, inventors combined simple aircraft principles into their designs to produce the first vehicles that utilized 'ground effect' and could hover on land.

ACVs require at least two engines: one for the lift (hovering action), and the other for forward thrust. The hovering motor pushes air out the bottom, which creates a pocket of higher pressure to accumulate. As the higher pressure escapes out the bottom, it lifts the vehicle up, creating the 'hovering' effect. Although some hovercraft utilize air ducts to use one engine for both jobs (thrust and hover), most require two or more.

In addition to small vehicles, two hover trains are currently in operation (one in Japan, the other in Austria) since 1985, using an underground cushion of air to reduce track friction and increase speed.

One of the biggest challenges with hovercraft is keeping the vehicle design lightweight but powerful. Hobby motors and batteries are heavy compared with the foam frame, and most hobby motors do not have enough power to lift themselves off the ground by simply adding a propeller.

Does it really matter where we put the passengers? If so, does it matter *much*? When the hovercraft moves across the floor, I found that the hovercraft moves at different speeds, depending on where the weights were. After researching hovering engines, ground effect aerodynamics, and wiring up circuits, I realized I had all the basics for making a hovercraft. But how do we load the people on the hovercraft without compromising the speed of the vehicle?

Purpose

Why are you doing this science fair project at all? What got you interested in this topic? How can you use what you learn here in the future? Why is this important to you?

Come up with your own story and ideas about why you're interested in this topic. Write a few sentences to a few paragraphs in this section.

Hypothesis

This is where you write down your speculation about the project – what you think will happen when you run your experiment. Be sure to include *why* you came up with this educated guess. Be sure to write at least two full sentences.

Here's a sample from Aurora's report:

I hypothesized that best place to put the passengers is near the front. The hovercraft uses two motors, one for hovering and the other for thrust. My best guess is that the most air escapes out the front, where the vehicle weight is the lightest, thus having the most ability to carry additional weight.

Materials

What did you use to do your project? Make sure you list *everything* you used, even equipment you measured with (rulers, stopwatch, etc.) If you need specific amounts of materials, make sure you list those, too! Check with your school to see which unit system you should use. (Metric or SI = millimeters, meters, kilograms. English or US = inches, feet, pounds.)

Here's a sample from Aurora's report:

- Foam meat tray (our materials kit includes one that measures 12" x 8" x 1")
- Foam drinking cup (open end measures 3 ½" diameter, and at least 3" long)
- Foam 'to-go' burger container (ours measures 5" x 5" x 1 ½")
- 3 wooden skewers
- Drinking straw
- Popsicle stick
- Two 3VDC hobby motors (Radio Shack part #273-223 or similar)
- SPST slide switch (Radio Shack part #275-406)
- Two propellers (must press-fit onto motor shaft) *Check your local hobby store.*
- 12" 22-24g hook-up wire (Radio Shack part #278-1224)
- 9V battery clip (Radio Shack part #270-324)
- 9V battery (alkaline is best)
- Camera to document project
- Composition or spiral-bound notebook to take notes
- Display board (the three-panel kind with wings), about 48" wide by 36" tall
- Paper for the printer (and photo paper for printing out your photos from the camera)
- Computer and printer

Procedures

This is the place to write a highly detailed description of what you did to perform your experiment. Write this as if you were telling someone else how to do your exact experiment and reproduce the same results you achieved. If you think you're overdoing the detail, you're probably just at the right level. Diagrams, photos, etc. are a great addition (NOT a substitution) to writing your description.

Here's a sample from Aurora's report:

First, I became familiar with the experiment and setup. I connected the motor to the battery and the motor turned! Then I tried to hook up the switch and added the propeller, learning how those all fit together. I then built my vehicle and added the weights.

Once I was comfortable with the setup, I could now focus on my variable (weight location) and how to measure my results (time, distance). I found a very flat tile floor in the school cafeteria and marked off the start and finish lines four meters apart. I made sure to perform this experiment indoors with the doors closed, so weather was not an issue. I used a fresh battery before the first experiment.

I made myself a data logger in my science journal. I placed the vehicle about 2 meters from the start line, to make sure it reached cruising speed before it hit the start line. I also adjusted the vane so it would steer straight. I placed the weights on the vehicle at the back corners for my first trial. Then I flipped the switch and the hovercraft started to gain speed.

When the vehicle passed the start line, I started my timer, stopping it as soon as it reached the finish line. I recorded the time measurement in my data sheet. After the first trial, I chased after the vehicle and set the weights to the next location (increased the position by 3cm forward). I continued this process, increasing the weight position by 3cm for each trial.

Results

This is the data you logged in your Science Journal. Include a chart or graph – whichever suits your data the best, or both if that works for you. Use a scatter or bar graph, label the axes with units, and title the graph with something more descriptive than "Y vs. X or Y as a function of X". On the vertical (y-axis) goes your dependent variable (the one you recorded), and the horizontal (x-axis) holds the independent variable (the one you changed).

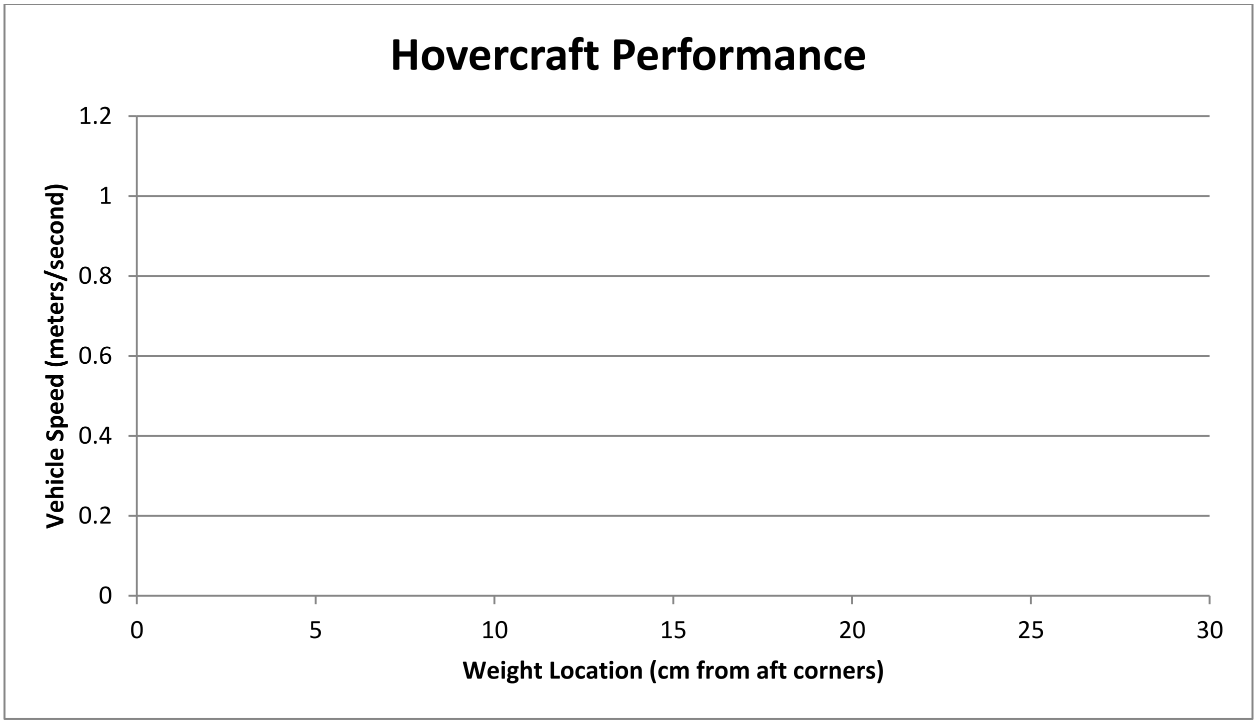
Here is a sample from Aurora's report:

Hovercraft Data Log

Name	*Aurora*	Floor Conditions	*Tile floor*
Date	*Nov. 12, 2009*	Number/Size of Motors	*2 3VDC RS#273-345*
Time	*12:45pm*	Vehicle Weight	*12 oz*

Trial #	Weight Location	Time to Travel 3m	Vehicle Speed
	(cm)	(seconds)	(meters/second)
1	0	8.4	0.36
2	3	7.6	0.39
3	6	7.4	0.41
4	9	7.2	0.42
5	12	8.3	0.36
6	15	8.9	0.34
7	18	9.2	0.33
8	21	10.1	0.30
9	24	10.2	0.29
10	27	10.8	0.28

NOTE: The numbers above are NOT real! Be sure to input your own.


Hovercraft Performance
Vehicle Speed (meters/second)
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
30
Weight Location (cm from aft corners)

Conclusion

Conclusions are the place to state what you found. Compare your results with your initial hypothesis or question – do your results support or not support your hypothesis? Avoid using the words "right", "wrong", and "prove" here. Instead, focus on what problems you ran into as well as why (or why not) your data supported (not supported) your initial hypothesis. Are there any places you may have made mistakes or not done a careful job? How could you improve this for next time? Don't be shy – let everyone know what you learned!

Here's a sample from Aurora's report:

I found that my initial hypothesis was not supported by the data, and not in the way I expected. **The hovercraft actually had an ideal "passenger position" range of 9-15cm that yielded the fastest speeds.** (It actually performed about the same for a few trials, instead of having an obvious "peak" performance setting as I originally had hypothesized.)

For further study, I recommend running an experiment to test the various sizes of batteries, and also another experiment to test for the ideal motors to use with this experiment. This experiment was a lot of fun, complete with unexpected results!

I did not have absolute control over the floor, which was a little bumpy and rough with dust and crumbs here and there, which may have affected the overall speed of the vehicle. Next time, I'd recommend bringing a broom.

Bibliography

Every source of information you collected and used for your project gets listed here. Most of the time, people like to see at least five sources of information listed, with a maximum of two being from the internet. If you're short on sources, don't forget to look through magazines, books, encyclopedias, journals, newsletters… and you can also list personal interviews.

Here's an example from Aurora's report on Rocketry:
(The first four are book references, and the last one is a journal reference.)

Fox, McDonald, Pritchard. Introduction to Fluid Mechanics, Wiley, 2005.

Hickam, Homer. Rocket Boys, Dell Publishing, 1998.

Gurstelle, William. Backyard Ballistics, Chicago Review Press, 2001.

Turner, Martin. Rocket and Spacecraft Propulsion. Springer Praxis Books, 2001.

Eisfeld, Rainer. "The Life of Wernher von Braun." Journal of Military History Vol 70 No. 4. October 2006: 1177-1178.

Acknowledgements

This is your big change to thank anyone and everyone who have helped you with your science fair project. Don't forget about parents, siblings, teachers, helpers, assistants, friends…

Formatting notes for your report: Keep it straight and simple: 12 point font in Times new Roman, margins set at 1" on each side, single or 1.5 spaced, label all pages with a number and total number of pages (see bottom of page for sample), and put standard information in the header or footer on every page in case the report gets mixed up in the shuffle (but if you bind your report, you won't need to worry about this). Create the table of contents at the end of the report, so you can insert the correct page numbers when you're finished.

Add a photo of your experiment in action to the title page for a dynamic front page!

Exhibit Display Board

Your display board holds the key to communicating your science project quickly and efficiently with others. You'll need to find a tri-fold cardboard or foam-core board with three panels or "wings" on both sides. The board, when outstretched, measures three feet high and four feet long.

Your display board contains *all* the different parts of your report (research, abstract, hypothesis, experiment, results, conclusion, etc.), so it's important to write the report *first*. Once you've completed your report, you'll take the best parts of each section and print it out in a format that's easy to read and understand. You'll need to present your information in a way that people can stroll by and not only get hooked into learning more, but can easily figure out what you're trying to explain. Organize the information the way museums do, or even magazines or newspapers.

How to Write for your Display Board Clarity and neatness are your top tips to keep in mind. The only reason for having a board is to communicate your work with the rest of the world. Here are the simple steps you need to know:

Using your computer, create text for your board from your different report sections. You'll need to write text for the title, a purpose statement, an abstract, your hypothesis, the procedure, data and results with charts, graphs, analysis, and your conclusions. And the best part is - it's all in your report! All you need to do is copy the words and paste into a fresh document so you can play with the formatting.

The title of your project stands out at the very top, and can even have its own 'shingle' propped up above the display board. The title should be in Times New Roman or Arial, at least 60 pt font... something strong, bold, and easy to read from across the room. The title has to accurately describe your experiment *and* grab people's attention. Here are some ideas to get you started:

- Hovercraft: Determining the Ideal Power Supply for the Fastest Speed
- ACVs: Studying the Ground Effect of Rough Surfaces
- Wheel-Free Cars: Just Where Should You Place the People without Losing Speed?
- How to Turn Air into Speed: Investigating the Effects of Hovercraft Propeller Design

On the left panel at the top, place your abstract in 16-18 pt font. Underneath, post your purpose, followed by your hypothesis in 24 point font. Your list of materials or background research can go at the bottom section of the left panel. If you're cramped for space, put the purpose in the center of the board under the title.

In the central portion of the board, post your title in large lettering (24-60 pt. font). (You can alternatively make the title on a separate board and attach to the top of the display board… which is *great* if you really want to stand out!) Under the title, write a one-sentence description of what your project is really about in smaller font size (24-48 pt. font) Under the title, you'll need to include highlights from your background research (if you haven't put it on the left panel already) as well as your experimental setup and procedures. Use photos to help describe your process.

The right panel holds your results with prominent graphs and/or charts, and clear and concise conclusions. You can add tips for further study (recommendations) and acknowledgements beneath the conclusions in addition to your name, school, and even a photo of yourself doing your project.

Use white copy paper (*not* glossy, or you'll have a glare problem) and 18 point Times New Roman, Arial, or Verdana font. Although this seems obvious, spell-check and grammar-check each sentence, as sometimes the computer does make mistakes! Cardstock (instead of white copy paper) won't wrinkle in areas of high humidity.

Cut out each description neatly and frame with different colored paper (place a slightly larger piece of paper behind the white paper and glue in place. Trim border after the glue has dried. Use small amounts of white glue or hot glue in the corners of each sheet, or tape together with double-sided sticky tape. Before you glue the framed text descriptions to your board, arrange them in different patterns to find the best one that works for your work. Make sure to test out the position of the titles, photos, and text together before gluing into place!

In addition to words, be sure to post as many photos as is pleasing to the eye and also helps get your point across to an audience. The best photos are of *you* taking real data, doing real science. Keep the pictures clean, neat, and with a matte finish. Photos look great when bordered with different colored paper (stick a slightly larger piece of paper behind the photo for a framing effect). If you want to add a caption, print the caption on a sheet of white paper, cut it out, and place it near the top or bottom edge of the photo, so your audience clearly can tell which photo the caption belongs to. Don't add text directly to your photo (like in Photoshop), as photos are rich in color, and text requires a solid color background for proper reading.

Check over your board as you work and see if your display makes a clear statement of your hypothesis or question, the background (research) behind your experiment, the experimental method itself, and a clear and compelling statement of your results (conclusion). Select the text you write with care, making sure to add in charts, graphics, and photos where you need to in order to get your point across as efficiently as possible. Test drive your board on unsuspecting friends and relatives to see if they can tell you what your project is about by just reading over your display board.

How to Stand Out in a Crowd Ever try to decide on a new brand of cereal? Which box do you choose? All the boxes are competing for your attention… and out of about a hundred, you pick *one*. This is how your board is going to look to the rest of the audience – as just one of the crowd. So, how do you stand out and get noticed?

First, make sure you have a BIG title – something that can be clearly seen from across the room. Use color to add flair without being too gaudy. Pick two colors to be your "color scheme", adding a third for highlights. For example, a black/red/gold theme would look like: a black cardboard display board with text boxes framed with red, and a title bar with a black background with red lettering highlighted with gold (using two sets of "sticky" letters offset from each other). Or a blue/yellow scheme might look like: royal blue foam core display board with textboxes framed with strong yellow. Add color photographs and color charts for depth. Don't forget that the white in your textboxes is going to add to your color scheme, too, so you'll need to balance the color out with a few darker shades as you go along.

It's important to note that while stars, glitter, and sparkles may attract the eye, they may also detract from displaying that you are about 'real science'. Keep a professional look to your display as you play with colors and shades. If you add something to your board, make sure it's there to help the viewer get a better feel for your work.

For a hovercraft exhibit, you can add sparks of electricity up the edges of your display board and around the top of your board in gold or blue. Add your model vehicle at the top of your board as an attention-getter. Have a hovercraft jacked up (so it doesn't zoom away) or hovering in a lipped container, such as a cookie sheet, so people can see your experiment in action.

If you're stuck for ideas, here are a few that you might be able to use for your display board. Be sure to check with your local science fair regulations, to be sure these ideas are allowed on your board:

- Your name and photo of yourself taking data on the display board
- Captions that include the source for every picture or image
- Acknowledgements of people who helped you in the lower right panel
- Your scientific journal or engineer's notebook
- The experimental equipment used to take data and do real science
- Photo album of your progress (captions with each photo)

Oral Presentation

You're now the expert of the Hovercraft Science Experiment… you've researched the topic, thought up a question, formulated a hypothesis, done the experiment, worked through challenges, taken data, finalized your results into conclusions, written the report, and build a display board worthy of a museum exhibit. Now all you need is to prep for the questions people are going to ask. There are two main types of presentations: one for the casual observer, and one for the judges.

The Informal Talk In the first case, you'll need quick and easy answers for the people who stroll by and ask, "What's this about?" The answers to these questions are short and straight-forward – they don't want a highly detailed explanation, just something to appease their curiosity. Remember that people learn new ideas quickly when you can relate it to something they already know or have experience with. And if you can do it elegantly through a story, it will come off as polished and professional.

The Formal Presentation The second talk is the one you'll need to spend time on. This is the place where you need to talk about everything in your report without putting the judges to sleep. Remember, they're hearing from tons of kids all day long. The more interesting you are, the more memorable you'll be.

Tips & Tricks for Presentations: Be sure to include professionalism, clarity, neatness, and 'real-ness' in your presentation of the project. You want to show the judges how you did 'real' science – you had a question you wanted answered, you found out all you could about the topic, you planned a project around a basic question, you observed what happened and figured out a conclusion.

Referring back to your written report, write down the highlights from each section onto an index card. (You should have one card for each section.) What's the most important idea you want the judges to realize in each section? Here's an example:

Research Card: Where do you put the passengers on a hovercraft? After researching hovering engines, ground effect aerodynamics, and wiring up circuits, I realized I had all the basics for making a hovercraft.

Question/Hypothesis Card: But how do we load the people on the hovercraft without compromising the speed of the vehicle? I hypothesized that best place to put the passengers is near the front, where the vehicle weight is at a minimum.

Procedure/Experiment Card: Using inexpensive hobby motors from Radio Shack, foam containers, and a battery, I created a hovercraft that could hold weights. I ran ten trials varying the position of the weights (increasing in increments of 3cm with each trial) and measured the time to travel four meters using a stopwatch and a smooth floor.

Results/Conclusion Card: I found that my initial hypothesis was not supported by the data, and not in the way I expected. **The hovercraft actually had an ideal "passenger position" range of 9-15cm that yielded the fastest speeds.** (It actually performed about the same for a few trials, instead of having an obvious "peak" performance setting as I originally had hypothesized.)

Recommendations Card: For further study, I recommend running an experiment to test the various sizes of batteries, and also another experiment to test for the ideal motors to use with this experiment. This experiment was a lot of fun, complete with unexpected results!

Acknowledgements Card: I want to express my thanks to mom for saving me lots of foam pieces to transform into new hovercraft designs, for my teacher who encourages me to go further than I really think I can go, for my sister for helping chase down the vehicle when it escaped, and for dad for his help building the vehicle model that actually went straighter.

Putting it all together… Did you notice how the content of the cards were already in your report, in the abstract section? The written report is such a vital piece to your science fair project, and by writing it first, it makes the rest of the work a lot easier. You can do the tougher pieces (like the oral presentation) later because you took care of the report upstream.

As you practice your oral presentation, try to get your notes down to only one index card. Shuffling through papers onstage detracts from your clean, professional look. While you don't need to memorize exactly what you're going to say, you certainly can speak with confidence because you've done every step of this project yourself.

You're done! Congratulations!! Be sure to take lots of photos, and send us one! We'd love to see what you've done and how you've done it. If you have any suggestions, comments, or feedback, let us know! We're a small company staffed entirely human beings, and we're happy to help you strive higher!