# Science and Engineering Fair

## Student and Parent Booklet

Washington County School District
*revised January 16 - Jessica Jones

# PURPOSE of this booklet:

For parents, science and engineering projects are often just another intrusion into an already too hectic life. Even the simplest project consumes considerable amounts of *precious* free time. These projects, however, are one of those school assignments where parent assistance is not only allowed, but also encouraged (maybe even expected). **The key word is HELP, not DO!** You feel obligated to help, if only to demonstrate your dedication to your child's education. And you probably wouldn't mind if you saw clear-cut objectives such as "What, specifically, is my child expected to achieve?" Instead of answering these questions, instruction that is sometimes provided may be murky and difficult to read.

Of course, parent-assisted projects often become parent-dominated projects. It's really annoying to attend the science fair and discover the projects on display are often obviously NOT the work of a school-age child. Instead, the fair may tend to become a competition among parents. This is NOT the intent of the fair.

This booklet is intended to help parents understand what they NEED to do to help their child complete a successful project. The project may not rival those achieved by an overabundance of parental assistance, but it will attain its purpose.

<u>Rules have been defined to help reward student work with minimal parent help.</u> We all want the same thing: your child's success and a fair learning opportunity! Not every child can win first place, but every child who participates IS successful!

# WHY do science and engineering projects?

Almost daily some favored snack is identified as "cancer-causing", or some detested vegetable is labeled "cancer-fighting". Scientists make these determinations by experimentation. Scientific research is often cited in newspapers and then contradicted. Why? Because even the simplest experiment can become complex and the experiment's validity shadowed by doubt. This explains much of the controversy surrounding "scientific facts", and an important lesson to learn from our own experiments.

At the same time there are many complex problems in today's society that require an object to help solve the problem.  Imagine where we would be if crafty engineers didn't design cell phones, printers, airplanes, or even the wheel!  Engineering design takes the scientific processes, and allows the students to create something that can be demonstrated for others.  It is real-world problem solving at its finest.

Although a student's science or engineering fair project is going to be far simpler than a professional engineer/scientist's, it still follows the same basic procedure called the Scientific Method or the Engineering Design Process.  This booklet will cover both in detail later on. Finally, properly done, science and engineering projects provide a rare opportunity for students to combine a number of academic skills to produce an end product.

# Science Project (Experimental Design)

## **<u>What science projects *ARE*:</u>**

Science projects should involve students in an experiment where the result can be guessed at but isn't known for sure. This experiment should solve a problem. This is actually an advantage over the demonstration projects. The best part of a science fair project is that *if something unexpected occurs with an experiment, or it doesn't turn out the way you had hoped, the project doesn't need to be trashed*! In fact, some of the best projects were the ones with the most unexpected results because the student learned far more that he or she would have if the experiment ended the way they had been expecting it to. It is completely *acceptable* in an experiment for the conclusion to contradict the hypothesis.

To conduct a proper experiment for the District Science and Engineering Fair, you **<u>MUST</u>** follow the Scientific Method. The Scientific Method requires:

- PURPOSE / QUESTION
- HYPOTHESIS
- PROCEDURE
- DATA / OBSERVATIONS
- RESULTS
- CONCLUSIONS
- SUMMARY
- BIBLIOGRAPHY

**PURPOSE / QUESTION**

The question should be very simply stated. What is the scientific experiment all about? What are you trying to prove or disprove? What is the reason you are doing the experiment? With the battery-operated bunny, the question is "Which battery lasts longer, Duracell or Eveready?" If you choose diapers for the experiment, the question is "Which diaper lasts longer, Luvs or Pampers?"

**HYPOTHESIS**

The hypothesis is also very simply stated. This is your "educated guess". It is YOUR expected outcome of the experiment. Example: You've always liked the Luvs brand of diapers and you've always encouraged everybody to use them. Now you are going to prove to any doubters out there that Luvs are better than Pampers. Your hypothesis is "Luvs diapers absorb more liquid than Pampers." Remember: it is okay if your result is different from your hypothesis.

**PROCEDURE**

This procedure is the instruction process to complete the experiment. You may write this out in step-by-step instruction format or in paragraph form. Make sure to be as detailed as possible as your experiment needs to "stand alone", which means somebody who has never heard of your experiment should be able to do it themselves because of your description. This would be a great place to include supplies used to perform your experiment.

**DATA / OBSERVATIONS**

Data and observations can include notes, errors found while experimenting, or **anything** that you watched and observed while doing the experiment.

**RESULTS**

Results are the specific results of the experiment. This is a GREAT place to include charts and graphs. If Duracell batteries lasted longer than the Eveready batteries, the results of the experiment would be: "The Duracell batteries continued to power the toy 22 minutes longer than the Eveready batteries."

**CONCLUSION**

The conclusion relates back to your hypothesis. You will make reference to your hypothesis. Were you wrong or right? Why do you think you were wrong or right? To go along with the battery results, the conclusion example would be: "From my experiment, I determined that my hypothesis was correct (or incorrect). Duracell batteries last longer than Eveready."

**SUMMARY**

Each project is required to have a summary. The summary is the final bit of exhausting work, and yet it is among the most important tasks your child undertakes. Your child has to write the most important information accumulated during the entire science project. It's important because this is about all the judges have time to read. They will look at the display, interview the child and read the summary. Make sure the summary includes: the question/purpose, the hypothesis, why you chose this experiment, the data/observations, the results and conclusion, and what you learned. Keep it short and simple.

**BIBLIOGRAPHY**

This provides a "thank you list" to books you used as references or people and stores that helped you with supplies.

# What science or experimental projects are *NOT*:

Too often, science projects are equated with science demonstrations. It's cute to see that vinegar and baking soda together cause a reaction and if the reaction occurs in a mock-up volcano, it's a rather distinctive demonstration. But that's all it is; a demonstration! No new information was discovered.

**Science fair demonstrations ARE NOT accepted** at any School Science Fair or at the District Science Fair. It isn't a science *experiment* and if your child chooses to do a demonstration, it will harm your child's score.

**Some popular science demonstrations include:** showing how clouds form, showing how electricity is conducted, showing how caterpillars become butterflies, showing how a volcano erupts, etc. *These are not acceptable for the purpose of the science fair.* Models and collections also hurt a child's chances of winning. They do NOT follow the Scientific Method. They cannot be experimented upon. They involve much money, time, and research if they are done well. Quite frankly, they stand NO chance of winning.

# Experiment Ideas

Commercials are a gold mine for ideas for simple experiments. Does Joy dishwashing liquid last longer than the leading bargain brand? Does Tide really clean better than its competitors? You can use these commercials for inspiration. For example, does the battery that propels silly bunnies across endless commercials really last longer? If you're a cynic, you say no. If you're taken by the ads, you say yes. If you're a budding scientist, you say, "Let's do an experiment!"

Ideas are all over, but the near at hand are the best. After all, **science is expected to improve our daily lives.** By applying science to problems in our lives, it can do just that. ***Remember:*** Choose a topic that you are familiar with, one you may be studying this year or have studied in previous years… OR… choose a topic that you are highly interested in.

**Other Ideas:**

- *Have a spot in the garden where nothing grows? Try a couple of different plants.*
- *Do you think you may be over-watering the lawn? Take a patch of out-of-the-way grass. Water it carefully with different amounts of water. What are the results?*
- *Which type of house plant will do better under a skylight? In a kitchen window? In a dark corner?*
- *Does an aluminum bat hit a ball farther than a wooden bat?*
- *Does saccharine attract ants like sugar does?*
- *Which diaper is really more absorbent?*

**Before you decide on a science experiment, brainstorm a long list.** Get silly about it! Write them down. Discuss these with your child. Then decide.

# Engineering Project (Engineering Design)

Just like the science fair experiment, and engineering design project should be a learning activity. You are going to figure out a real-world problem that you may have, and you are going to design a solution for it. Your solution should be created mostly by you as a student, but because of the hands-on nature of building, parent supervision is always a great idea. Remember: The design and idea should be all yours! You should be creating something NEW or redesigning something in a completely new way in order to solve a problem. The problem can be very simple, like a device that makes coiling your garden hose go faster, or more complicated like designing a new type of garden hose that coils up on its own. Both solve a problem with the garden hose, in a new and unique way.

This is the time for a demonstration. You are going to create an invention prototype that can be used to demonstrate the solution to your problem. Your prototype should work, and should be safe. When engineers design a solution, they always want to make sure that it will not harm anyone who uses it. If it is not safe, it doesn't solve a problem, it creates a new one.

Engineers also work like scientists. They do not always get it right the first time. In fact, sometimes they have to try over and over again to get the result they want. And sometimes by trying things, they discover a totally different and better idea for solving the same problem! If that happens to you, it is okay, because that is built in to the Engineering Design process.

Your Engineering Fair project will be required to follow the Engineering Design Process (just like the experiment does), and it must be clearly displayed on your board.

**The Engineering Design Process goes as follows:**

- **Ask**
- **Imagine**
- **Plan**
- **Create**
- **Improve**
- **Recreate (if needed)**
- **Conclusion/Summary**
- **Bibliography**

## Ask:

This is the part of the design that should always come first. This is where you find something that needs to be made better. You need to solve a problem by creating and design for it. This is where you ask the question, "What am I trying to solve or fix?" Thomas Edison created many designs and he ended up with many inventions, one of which is the lightbulb.

## Imagine:

During this part you should use your imagination to figure out all the ways you could solve your problem. You should be asking questions and trying to answer them. This is the time to be creative and start figuring things out.

## Plan:

Choose the best solution from all your ideas. You should choose the idea that will be the easiest to accomplish, but is also interesting, and creative. You want your prototype to work, but you also want it to be attractive to the judges. At this point it would be a great idea to draw a diagram of what your prototype will be. Save that diagram! Your judges will want to see it displayed on your board to show your work.

## Create:

This is the step where things get really fun! You get to actually make your prototype! Try to keep it small, simple, and interesting, but also try your very best to get it to work. The goal is a working prototype, but sometimes things don't go to plan. In that case, make sure to document your design and tell the judges why you think it did not work. If your prototype is too big, then please take pictures or video of it working, but remember showing a prototype is much more powerful than telling about one.

## Improve:

During this step you see what you can do to make it better. Is there a better solution all together? What changes did you make? This step is actually done throughout the process. Any time you make a change to make it better, you are doing the improve step. Make sure to tell the judges what you liked about your prototype, and how well it worked or did not work. It is also okay if your prototype worked out perfectly the first try. It is super uncommon for that to happen, but it is a possibility.

## Conclusion/Summary:

what did you learn from this? Tell us all about the new discoveries that you made during this fun process. Make sure to let us know all the things you researched in order to be successful with your project.

## Bibliography:

Just like in the experimental design. This is where you are going to cite all of your sources. Thanks those extra helpers who gave you a hand, and make sure you give credit where credit is due.

# What an engineering project is NOT:

Just like with a science fair project, an engineering fair project is not a demonstration. This is tricky because you are demonstrating things, but it must be an ORIGINAL design of your OWN creation. Looking up an hovercraft on the internet is not the same as designing a better version of a scooter, or figuring out a new device to help save water. The judges will mark your score down if you simply make a project that you saw on YouTube, or out in the world. You need to be the creator of the design, and you need to be the builder. It is acceptable to improve an existing design, but the work must be all yours.

## KEEP IT SIMPLE!

Science projects can become complex, so keep the experiment simple! This is actually very important to the Scientific Method. **Remember this: The simpler the experiment, the less likely that some unknown variable caused the result.** It's like starting a homeowner's project: you replace the drapes and the carpet suddenly looks awful; you replace the carpet and the tiling looks out of place; you replace the tiling…. Etc. So, if you start simple, hopefully the experiment will stay manageable.

What is simple? Using a battery example, choose two types of batteries – not every battery on the market. Which lasts longer, Duracell or Eveready? For detergent, the same thing applies: Which cleans better, Tide or Bold? If the experiment involves plants, choose two types of plants. What grows better in damp soil, marigolds or periwinkles?

## A FEW FINAL WORDS

**Please make sure you have read the rules very carefully!!!** Many have changed and it is important that you know of the changes before starting. You will be judged by grade level band (k-1, 2-3, 4-5). Remember that you **MUST** have a project that follows the Scientific Method or uses Engineering Design.