# Cloverly Science Fair 2019
## *How to Make an Awesome Project*

Hello Excellent Engineers and Super Scientists!

We are excited that you are making a project for this year's Cloverly Science Fair! We are all really looking forward to seeing what you have created. We want to make sure that your project is the best that it can be, so please read all the advice in this document.

Be sure to tell your adult helper (parent, grandparent, or caregiver) about these important dates:

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| Friday, May 10 | 5:00pm | Sign-up forms should be turned in to school or submitted online (see bottom of this page for links) |
| Monday, May 20 | 7:30am-5:00pm | Drop off your projects at the Cloverly gym |
| Monday, May 20 | 6:30pm-8:00pm | THE SCIENCE FAIR! Many people will come look at your project poster and talk about your research, and then there will be an awards ceremony. |

**General Guidelines:**

- All students in grades K through 5 may participate, and everyone will receive a medal and a certificate.
- Team projects (up to 4 students) are permitted, and team members may be in different grades. Please only submit one registration form per project.
- No projects involving experiments on live animals will be allowed. Observations of wild or domesticated animals are fine, but no experiments that affect the health or happiness of the animal are permitted.
- To enroll your project, please fill out this online form : http://bit.ly/csf-2019 or send in the printed registration form that came home in Friday Folders.

# The Three-Step Plan

Your Science Fair Project will follow three main steps:

1. Pick an interesting project topic or scientific question that you will try to answer.
2. Do experiments or research to learn about your topic and answer your question.
3. Make a poster to explain your project and answers to everybody else.

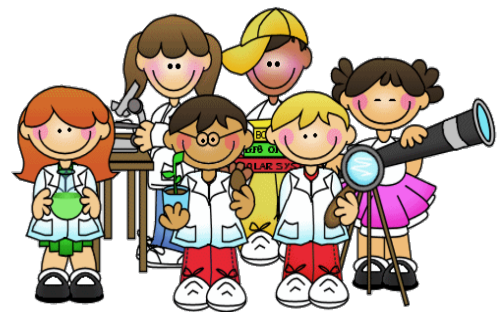
Let's look at each of these steps in more detail.

# 1. Choosing a Project Topic or Question

The very first step is to find something that really interests you about the world around you. It might be something nearby, like those bugs that live in your backyard, or it might be super far away, like black holes in a distant galaxy.

Next, decide what sort of project you want to do:

- **Experimental** : using the scientific method to answer a specific question
- **Research** : collecting information from books and the Internet and summarizing what you've learned
- **Engineering, Construction, or Design** : building a structure or device using good engineering principles
- **Demonstrations, Models, and Collections** : for instance, a rock collection or a model of a cell



We encourage all students to undertake an Experimental or Engineering project, since these types of projects are closest to "real science" (using the Scientific Method) or "real engineering". A Research project is a good option for any grade level – it's more like a book report than an experiment. Younger students may prefer to do a Demonstration, Model, or Collection, but they are welcome to do any of the other types. And keep in mind that some projects might be a combination of two or more categories, which is fine.

So what is this "Scientific Method" that we mentioned? **The Scientific Method** is the process that scientists use to figure out how the world works. The websites listed below do a good job of explaining the idea. There isn't a single official description of the Scientific Method, so you will notice that different descriptions have different numbers of steps, but they all address the same basic principles.

http://www.sciencekids.co.nz/projects/thescientificmethod.html
http://www.ducksters.com/science/scientificmethod.php
http://www.sciencebob.com/sciencefair/scientificmethod.php
http://www.biology4kids.com/files/studies_scimethod.html

One of the most important parts of the Scientific Method is that you are trying **to answer a specific question** by doing an experiment. If you plan to do an Experimental project, make sure that you have a clear idea of what that question is! For both Experimental and Research projects, try to be very specific. Science fair research topics are often too general, such as research reports on "Insects" or "The Solar System". Projects like "Ant Species of Maryland" or "The Moons of Jupiter" would be a lot more interesting and focused. For an experimental project, go ahead and get really specific, like "Food preferences of black ants vs red ants in the Paint Branch watershed".

Below are some online resources for Science Fair project ideas. Please do *not* just copy one of these project ideas. Use these examples for inspiration, but you should make the project into your own unique creation as much as possible. For instance, study bugs that live in that big tree in your backyard or investigate the dynamics (physics of motion) or statistics of your favorite sport.

http://www.education.com/science-fair/elementary-school/

http://www.sciencebuddies.org/science-fair-projects/science_project_ideas.php

Finally, Lora Holt has made a nice comprehensive but kid-friendly guide to selecting a project, doing the experiments, and putting together the presentation. Not all of the details are relevant to the Cloverly Science Fair, but it's still a great resource.

Elementary Science Fair Planning Guide by Lora Holt

## 2. Do experiments, do research, or build your project

It's important to start early and work on your project consistently. Doing the entire project and preparing your presentation on the weekend before the Fair probably won't turn out well. Real scientific research and engineering development always involves mistakes, adjustments to your procedure, and do-overs, so give yourself plenty of time to work out any problems.

If you are doing an **Experimental project**, you will need to do some experiments! That seems obvious, but choosing the right experiment is actually one of the hardest parts of a project. You need to be clever about planning the experiment so that the result will help you answer your main question. Try to guess what the possible outcomes are, and what each outcome means for the answer to your question. Also see the FAQ answer about "control experiments" on page 7 for some guidance. Don't be discouraged if the experiment doesn't work the first time – just figure out what went wrong, fix it, and try it again.

For a **Research project**, be sure to use several different sources. Just copying some information from one book or one Wikipedia article isn't going to teach you very much. Try to synthesize (combine together) information from a bunch of different places. If you find that different sources disagree with each other, that's a good thing! It shows that scientific knowledge is always evolving, and that different scientists can come to different conclusions. See if you can figure out which resource is more likely to be correct, or why people came to different conclusions. (Were they looking at different data? Are they biased towards a certain conclusion?)

For an **Engineering project**, you can just build something cool, but your project will be even better if you include a little bit of an experiment. For instance, you could build two similar bridges out of toothpicks, but use mostly triangle shapes in one bridge structure and mostly square shapes in the other bridge structure. Then see which bridge can hold up more weight before it collapses.

Similarly, for a **Collection or Model project**, see if you can develop a hypothesis even if you're not doing a full experiment. As an example, if you want to show off your collection of snail shells, you might notice that the larger shells tend to be more colorful. Why would that be?

## 3. Make a great poster presentation

Communication is an important part of the scientific process. You may have discovered or invented something amazing, but if you don't take the time to explain it to other scientists/engineers and the general public, then it's like it was never discovered at all. The following tips will help you make a great poster and prepare you to talk to the many visitors who will visit your poster.

- A tri-panel poster board (like the picture to the right) is the best way to present your project and results. You can buy them at Staples, Office Depot, or Amazon. All science fair projects will be set up on the tables in the gym, so the **posters need to be able to stand up on their own**. You should *not* plan on attaching your poster to a wall.


- Focus on the most important parts of your project. You don't have to explain every single step in your research project or experiment.
- Organize your information like a newspaper so that your audience can quickly follow the thread of your experiment by reading from top to bottom in the leftmost column, then the middle column, then the rightmost column. The traditional sections include (1) the abstract or overview, (2) the question that you're trying to answer, (3) the hypothesis, (4) the variables, (5) the results, (6) your conclusions, and (7) a bibliography listing the resources that you used. You don't have to follow this sequence exactly, but it's a good guideline.
- Your poster must include a **nice big title** (to catch people's attention) **and your name**.
- Clarity and neatness count! Your project poster should be organized clearly, with neat printed handwriting or computer-printed text. A visitor should be able to read your project explanation from several feet away (without leaning in and squinting). It should only take a visitor a few minutes to read through the entire presentation, so try not to include lots and lots of detail. Anyone reading your presentation should get a basic understanding of what question you were trying to answer, how you did your experiment or research to answer that question, and what your conclusions were. If they want to know more, they will ask!
- If you're doing an experiment, making a graph to display your numerical measurements is highly recommended. See the last question in the FAQ on page 8 for more details.
- A picture is worth a thousand words! Use photos or diagrams to show your experimental setup or illustrate your hypothesis. But don't put text on top of photographs or images – that can be very difficult to read.

# Frequently Asked Questions

Have a question about the Science Fair? Read through this document, including the list below, to see if your question has already been answered. If not, please contact Science Fair Coordinator Brad Behr at bradfordbehr@gmail.com.

***Q***: Can my parents or other adults help me with my project?

***A***: Adults can certainly help out, as long as you (the student) do most of the work and take most of the responsibility for the project. You can use their assistance and guidance for deciding on the project, doing the experiments or research, and creating your presentation, but it should be *your* project, not theirs. All the writing on the poster should be yours (although adults can help type it out).

If there is any part of your project that involves any safety issue, be sure to get parental help and supervision. **Safety is the top priority for any science fair activity**. This includes using knives or sharp scissors, building anything large or heavy, working with any chemicals (vinegar and baking soda, ammonia, etc), objects moving fast or flying through the air, or anything else that might be dangerous.

***Q***: Can I build a baking-soda-and-vinegar volcano?

***A***: The erupting volcano is a very traditional science fair project, but frankly, it's *not* a very good one. Simply building a model volcano and making it erupt doesn't teach you anything about real volcanoes or the scientific method. If you absolutely must build a volcano, try to include a hypothesis or measurement aspect to the project, like "What combination of vinegar and baking soda makes the biggest eruption?" or "Do all types of vinegar work the same?"

***Q***: Will the Science Fair judges evaluate my project?

***A***: Cloverly parents and staff will come to visit your poster and talk about your project, but we will not be judging projects this year. Every project will receive an award in one of three categories:

- "Splendid Science", for those projects which used the Scientific Method to answer a specific hypothesis (question) with an experiment, data, analysis, and a conclusion.
- "Incredible Innovation", for those projects which created something clever and original using good engineering principles.
- "Quality Communication", for those projects that stand out for having a well-organized and easily understood poster, clear explanations, and good use of diagrams, photos, and graphs.

***Q***: Do I have to use a computer to make the text and graphics for my poster?

***A***: No, it's not required, but it does make it easier. If you have access to a word processor, it's a good way to make the text parts of your poster — but neatly handwritten text is just fine too. (Typewriter printing tends to be too small to read easily from a distance, so that's not recommended.) Similarly, graphs and drawings can be done by hand, as long as they are neat and clear. A well-organized handwritten project presentation will be more interesting and understandable to your audience than something sloppy and disorganized from a computer, no matter how cool the computer fonts look.

***Q***: Can I use graphics and other materials from books, magazines, and the Internet?

***A***: Yes, as long as you include proper citations of anything that you got from someone or somewhere else. This means **giving credit where credit is due**, and listing the name of the person, organization, book, or website where you got it. For instance, if you download and a photo of Saturn from a NASA website, be sure to write "Image credit: NASA from http://saturn.jpl.nasa.gov/" next to the image. If you want to quote somebody else's words, include their name in parentheses after the quote.

If you take someone else's pictures or words and pretend that they are yours, it's called plagiarism, and that's **really, really bad**. If grown-up scientists steal or fake their research results, they get kicked out of science permanently.

***Q***: Should I set up a demonstration of my experiment or construction project at the Science Fair? How much room will I have?

***A***: If the main part of your project was building something — for instance, a toothpick bridge, a model of a cell, a simulated dinosaur fossil dig — then definitely bring it and set it up for the science fair. You will have a tabletop area (approximately 3½ feet x 1½ feet) for your project presentation. If you absolutely need a larger area, let the Science Fair Coordinator know ahead of time.

If you are doing a live demonstration, then certainly bring everything you need to the fair. Please keep in mind that you can't take up the whole aisle with your demo equipment, and remember: **SAFETY FIRST**. If things are going to be flying through the air, or if there is a risk of making a slippery or sticky mess on the floor, let us know in advance and we will set up your display in a corner of the cafeteria.

If your project was primarily an experiment, then you do not have to bring your actual experiment equipment. Pictures of the experiment will probably be better instead. For example, if you grew a bunch of houseplants under different amounts of light, there is no need to bring all the plants to school — just put photos of the plants on your poster.

If you're unsure about your particular situation, feel free to contact the Science Fair Coordinator for guidance.

***Q***: Is there an online resource that can help me choose a project?

***A***: There are many websites which list ideas for science fair projects. Two of our favorites are:

http://www.education.com/science-fair/elementary-school/
http://www.sciencebuddies.org/science-fair-projects/science_project_ideas.php

Please do not just copy one of these project ideas. Use these examples for inspiration, but make the project into your own unique creation as much as possible. For instance, study bugs that live in that big tree in *your* backyard, or investigate the dynamics (physics of motion) and statistics of *your* favorite sport.

***Q***: What is the scientific process and how do I apply it to my project?

***A***: The Scientific Method is the way that scientists use to figure out how the world works. The websites listed below do a good job of explaining the idea. There isn't a single official description of the Scientific Method, so you will notice that different descriptions have different numbers of steps, but they are all addressing the same fundamental principle.

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http://www.ducksters.com/science/scientificmethod.php
http://www.sciencebob.com/sciencefair/scientificmethod.php
http://www.biology4kids.com/files/studies_scimethod.html

Your science fair project should try to answer a very specific question about your topic, such as "What sort of soil do petunias grow best in?" or "What shape of wooden block moves through the air easiest?" or "Does the weight of a pendulum change the speed that it swings back and forth?" The evaluators at the Cloverly Science Fair will probably ask you what question your experiments were trying to answer, so make sure you know!

***Q***: Why is the scientific process so important?

***A***: The Scientific Method is important for many reasons, but three of the biggest reasons are:

- The world is a complicated place, so by creating a controlled experiment where only one thing changes at a time, it's much easier to figure out what's going on.
- Following the scientific method reduces the chance that the scientist's previous expectations or assumptions will influence the results.
- Describing your procedure and results to other scientists gives them a chance to understand what you did, possibly catch any errors or suggest improvements, and repeat the experiment to confirm the results. A scientific "discovery" is not considered valid until other researchers have done the same experiment (or similar experiments) and gotten the same results.

***Q***: What is a control treatment? And why is it important?

***A***: In many experiments, you will change one variable and see how things change as a result. But you won't know the effect of the change unless you compare it to something else. A control is the part of the experiment that serves as a reference point, where you don't change anything.

Here's a simple example. You're trying to figure out if plants grow faster if they are watered with tomato juice instead of water. You will need at least two plants: one to be watered with tomato juice (that's the experiment), and one to be watered with water (that's the control). The control plant tells you what growth rate is normal for that kind of plant, and the difference in growth rate between the control plant and the experiment plant tells you what the effect of the tomato juice is.

***Q***: Do I have to analyze my data? If so, how?

***A***: Data never speaks for itself — the scientist (that's you!) needs to analyze and interpret the data to draw conclusions. Often this requires some statistical calculations, for instance to figure out if a small difference in height between two bean plants is significant or just random chance. If you need help with this part of your project, please contact the Science Fair Coordinator.

***Q***: How do I display my data? Bar graphs? Box plots?

***A***: Graphs are a great way to show the numerical results from your experiments. It's a lot easier for people to look at the shape of a graph and understand what's going on than it is to read through a bunch of numbers. Different types of graphs are good for different types of data. You will most likely want to use one of the following types of graphs:

- Line graphs are for "continuous data", where the x axis (the horizontal direction) is some quantity like time or temperature or voltage.
- Bar graphs are better when you are comparing different categories or groups, like "elm trees" versus "maple trees" versus "pine trees".
- Scatter plots use a single dot for each sample. This is a good way to show the raw data, since it shows how much multiple samples agree with each other. You can also draw a horizontal line to show the average value of those points. For instance, if you are growing twelve bean plants for your project, you might measure the height of each plant every week. Your graph can have zones for Week 1, Week 2, etc. and within each zone you can put a point representing the height of each plant.

The National Center for Education Statistics has a nice online tutorial at

https://nces.ed.gov/nceskids/help/user_guide/graph/whentouse.asp