PROJECT CREATION MANUAL

Updated January 2021 for Virtual Fair. If you find errors in the manual, please email webmaster@wwsef.ca

Introduction

An amazing variety of projects are brought to the science fair each year. The ideas for the projects come from everyday life, from something done in school, from a television program or web site.

The intent of this manual is to guide you through the steps of your project, regardless of the topic, and whether you're doing an experiment, an innovation or a study.

Be aware of the rules and regulations in the http://wwsef.ca/exhibitor.html.

Those pertaining to safety and ethics apply to projects at a school science fair too.

FIRST STEPS IN DOING A PROJECT

Finding a Topic

A project has parts: First, learn something you don't yet know; and then second, show and teach what you learned. Somebody may already know what you're about to find out, but many science fair projects develop new knowledge.

For an Experiment: What don't you know about something? Do you think you can find out safely? Can you afford to find out? Do you have the tools you need? Can you create a good question to guide your project? For example, you might like popcorn. A bad question would be "What popcorn is best?" That's not helpful, as 'best' is too general (subjective) and doesn't suggest what you can measure. Experiments have to produce reliable measurements of something.

A better question might be, "What's the moisture content of popcorn?" and even better, "How does the moisture content of popcorn affect popping?"

For an Innovation: Is there a device, a contraption or process you think would be useful? What would it do? Do you have the tools to develop a model? For example, many cooking recipes require the cook to stir a pot constantly for several minutes to avoid something sticking to the bottom. Is there some way a device could do that while the cook is doing something else nearby?

For a Study: Is there some way to use what's already known to do find out something new? For example, the colour of sunrises and sunsets can be used to make short-term weather forecasts. Does the reverse hold true? If you know the weather forecast, can you predict the colour of a sunrise or sunset?

Background Research

Whether your project will be an Experiment, Innovation or Study, start with finding out more about the topic from several sources. Teachers and parents can help you find information. You might need a mentor as a guide – someone you know or can find. The internet has both reliable and inaccurate information on it, so be careful. In your notebook, record every source for your information, as well as what you find out.

<u>You're seeking information such as:</u>
What principles are involved with your topic?
What basic information is needed to understand your question?
To what extent has your topic already been developed?
Does your topic relate to other areas of science or engineering?
Does your project have practical applications?
For example:
1. You might find why popcorn pops, and at the same time how cereal manufacturers puff wheat and oats. Are the processes similar?
2. What sorts of recipes require constant stirring? Ask a chef in a restaurant, or cooking instructor at a college, or community program or chef school? Is there an ingredient more likely to scorch?
3. Why isn't the sky coloured the same all day? At high latitudes, when the sky is low in sky all the time, does the sky appear in sunset colours? Why isn't it always the same?

Review the Rules

Before starting your project, read over the rules and regulations, and review your intention with your teacher or an adult who is familiar with those rules and regulations. You need to know if your project can be done safely and ethically. The Project and Exhibitor Information page has our rules and regulations in the Exhibitor Manual as well as the necessary Risk Forms.
All projects with animals must be approved by our Ethics Officer (and our Animal Care Committee) before you begin.
All Low-Risk projects with humans must be approved by your teacher or an adult supervisor before you begin.
All Significant Risk projects must be approved by our Ethics Officer (mailto:ethics@wwsef.ca) before you begin.

See the Ethics Flow Chart in the Exhibitor Manual to help guide you through any ethics considerations.
For example:

1. The popcorn project is likely to involve heat that could cause serious and painful burns. What safety measures will you have in place?
2. The pot-stirring project may involve electrical devices that may pose a risk of shock or short circuit sparking.
3. The sunset project may have a safety concern, avoiding direct observation of the sun. However, observing the sky colour would not pose a risk.

CONDUCTING an EXPERIMENT

(following the popcorn example)

1. Write your question or purpose. Does it reveal what you're going to measure? The popping of popcorn is dependent on heating moisture in the kernel to produce steam pressure. What is the minimum moisture content for popping?

2. Write your Hypothesis. This is your informed guess of what you think you'll learn. As moisture content decreases, time to pop will increase, and the success rate of popping will decrease.
3. Plan your procedure. Write down the steps in order. List all the materials you'll need. Note which variables you'll control, and what it is you'll be measuring. Prepare the place where you'll record your data. Assemble your equipment and materials. Check with your supervisor. Count out and weigh batches of 100 kernels. Pop one batch, weigh the popped kernels. The difference in mass would be the mass of water that turned to steam to pop the kernels. Then, dry a batch for a period of time in a low oven. Weigh it again to determine moisture lost through drying. Then pop and weigh it. Repeat with as many batches as you can, varying the amount of time each is dried in the oven before popping. If you're inclined, you can go the other way, trying to increase the moisture content.

4. Keep a Project Notebook. Record all of your observation, including accidents, surprises and problems you encountered. You might sketch out a graph for your display, or note variations in your measurements. This is the place for raw data, ideas for your display, observations you hadn't intended as part of your data. (smell of the popcorn, size of the popped kernels). This could lead to further research or may help you explain your results. If you prepared before your experiment you might have charts of numbers and then you could do calculations. For example, Mass of 100 kernels, 40 grams; mass of 100 popped kernels 20 grams; moisture level at popping (40-20)/40 = 50%. Time to pop 3 minutes 45 seconds. Kernels oven dried 15 minutes: original mass 40 grams, mass 38 grams, mass popped 20 grams; moisture level (38-20)/40= 45%. Time to pop 4 minutes, etc.

5. Results are never wrong. Do your results support your hypothesis? If they do not, don't despair! Disproving your hypothesis is as good as proving it. It shows that you learned something. As the moisture level of the popcorn was reduced through oven drying, the time to pop increased.

6. Analyze your data and make a Conclusion. What does it mean? What can you conclude from your experiment? Other researchers should be able to reach the same conclusion by following your described research procedure. The conclusion should include additional background information, any sources of error that may have been present, and possible practical applications for the results. Ideas for further research are described in this section. There is an optimum moisture level for popcorn. When the popcorn moisture level was reduced, popping time increased and the size of the popped kernels was reduced. Below 30% moisture content, popping did not occur at all. Attempts to increase the moisture level were unsuccessful. Perhaps the kernels would decompose if they were too moist.

DEVELOPING an INNOVATION

(following the pot-stirring device)

1. Write your purpose. While cooking it is often an advantage to gently keep the pot stirring. A device to do this would allow a cook to 'set it and forget it'.

2. Write the Design Criteria. The device should fit securely on pots of various diameters. The stirrers should be adjustable to accommodate pots of different depths. The stirrers should have various speeds, and be able to be set for specific time periods, perhaps with an indicator that time has expired. Power might come from either a battery source or household AC.

3. Outline the procedure. What will you work on first, second etc. Draw labelled sketches of possible innovations. Consider the contraption or process in parts – i.e. base, stirrer mount, timer, power source.

4. Does something similar already exist? Laboratories use automatic stirrers, some with hot plates. Could these be made suitable for kitchen use? Stand mixers can do the stirring – but do any of them provide heat?

5. Keep a record of what you work on – research sources, attempts at components. Take photographs of any attempts. Can you can devise a rig that will hold a hand mixer safely over a pot on a stove. Timers exist for controlling household lights. Is there one that would control the mixer for a set number of minutes?

6. Every time you try your innovation, record the results, analyze the success/failure, and consider any adjustments. Take photographs/videos if appropriate.

7. The results of your attempts may lead you to adjust your procedure, over and over until you've gone as far as you can.

8. Write your conclusion and make any recommendation(s). A professional kitchen would benefit from a combination cooking/stirring appliance. A household kitchen, however, should stick with a manual stirring method due to cost and risks of unobserved scorching.

CARRYING OUT a STUDY

(following the sky colour question)

A study searches out information already available and attempts to put it together to answer a question. For example, many of Albert Einstein's discoveries were studies. When Kepler figured out the orbits of planets, he was using data from observations made by Tycho Brae.

When carrying out a study, the researcher doesn't control the variables, but makes careful observations and tries to explain phenomena. Observing traffic in a traffic circle is a study; signaling or not while using a traffic circle is an experiment.

1. Write a brief description of the problem or question. While the sky colours of sunrises and sunsets can be used to predict weather in the short term, can a weather forecast be used to predict sky colour at sunrise or sunset?

2. Write your prediction. "A weather forecast does predict sky colour". OR "A weather forecast doesn't predict sky colour".

3. Find evidence on the question. Use books, Internet sources and mentors to gather evidence. In what ways does the weather influence the sky colour in the two situations? Has anyone tested the reverse? Why does "Red at night – sailor's delight" hold true? Does it always? What about "Red sky in the morning – sailor take warning"? Are they the same phenomenon?

4. Make observations. You'd need to make observations over an extended period of time. When a weather forecast is for rain, is the morning sky always red? When the forecast is for fair weather, is the sunset always red? Are there are other factors?

5. Write a conclusion. After you've gathered enough information or supporting data that you are confident you can answer the question reliably, write a conclusion. In the conclusion, recall the supporting evidence for, or

against, your original idea.

"After observing 15 sunrises and 30 sunsets, and correlating those observations with weather forecasts, it is apparent that a weather forecast is not a reliable predictor of sky colour at sunrise or sunset. I conclude this because ……"

DISPLAYING YOUR PROJECT

This is the part of your project where you now show and teach what you've learned.
The WWSEF science fair has rules about the maximum size of your display. School fair display sizes may be different. For a virtual fair this may not be necessary, but it is a good way of organizing your project.

Building a Backboard:

Before you begin, please refer to the rules governing your display at the Fair. The Exhibitor Manual will help you.

Projects, which do not follow the rules, have to be disqualified.

Science fair projects need freestanding backboards made of sturdy material such as masonite/MDF, pegboard, plywood or corrugated plastic sheets, although strong corrugated cardboard seems to work.

If you use plywood, masonite, or pegboard, a coat of paint helps improve the backboard's appearance.

It's also important that it be sturdy with all parts securely fastened.

Try to design a display that is easily and quickly set up.

Organizing your Information:

1. Remember, people read left to right, top to bottom, so organize your display in a sequence that leads the audience through your project.

2. Choose a font that's easy to read – nothing fancy.

3. Use bold or capitalized headings to guide the reader – Purpose and Background, Hypothesis or Design

Criteria or Thesis, Observations, Conclusions, etc.

4. A neat and organized display is more informative.

5. Photographs or models can help explain what you did.

6. Use colours to make your display attractive, and use contrast to make headings stand out.

7. Consider making ‘frames’ around individual pages to set them off from the background – either with coloured paper behind them, or with a ruler and marker.

8. Animals and chemicals should never be put on display. The names of any person who was a subject in your project should never be revealed to anyone.

9. A title for your display can attract visitors and outline the topic you explored. It should be brief, and sometimes have fun with word play. (Too Pooped to Pop, I Dried and Dried, The Big Stir, Lend Me a Hand, Why is the Sky Red? Predicting Sky Colour)