Science Fair Project Steps

Choose a Project Idea

A key step in the Science Fair process is to choose a science fair project idea. Jump start the idea flow by having young scientists consider what interests them—and this is the really important part—in the form of a testable question.

A good testable question sets up the investigation. Then it's time to choose the details. The table below shows how testable questions could be addressed in an investigation. Any of the variables could be chosen as the changed or "independent" variable.

Conduct Background Research

Once students have a testable question, it is important to do some background research. What do scientists think they already know about the topic? What are the processes involved and how do they work? Background research can be gathered first hand from primary sources such as interviews with a teacher, scientist at a local university, or other person with specialized knowledge. Or students can use secondary sources such as books, magazines, journals, newspapers, online documents, or literature from non-profit organizations. Don't forget to make a record of any resource used so that credit can be given in a bibliography.

Gathering Background Research

- Helps students gain in depth knowledge about the topic and processes they will be observing during the investigation.
- Sparks ideas about different variables to test when setting up the investigation.
- Provides the basis for predicting what will happen in the investigation when making a hypothesis.
- Provides the understanding needed to interpret and explain the results to others –especially a science fair judge!

Compose a Hypothesis

After gathering background research, students will be better prepared to formulate a hypothesis. More than a random guess, a hypothesis is a testable statement based on background knowledge, research, or scientific reason. A hypothesis states the anticipated cause and effect that may be observed during the investigation. Consider the following hypothesis:

If ice is placed in a Styrofoam container, it will take longer to melt than if placed in a plastic or glass container. I think this is true because my research shows that a lot of people purchase Styrofoam coolers to keep drinks cool.

The time it takes for ice to melt (dependent variable) depends on the type of container used (independent variable.). A hypothesis shows the relationship among variables in the investigation and often (but not always) uses the words if and then.

"The important thing about a hypothesis is not its initial accuracy. For instance, looking at the last example, students are likely to determine that the materials used or the shape of those materials will also impact an object's ability to sink or float. For students who worry that their hypothesis does not match their experimental results, parents and teachers should emphasize the idea that all hypotheses are valuable regardless of their truth if they lead to fruitful investigations." (Benchmarks for Science Literacy, 2003)

Design Experiment

Once students formulate a hypothesis for their investigation, they must design a procedure to test it. A well-designed investigation contains procedures that take into account all of the factors that could impact the results of the investigation. These factors are called variables.

NOTE: at elementary level, you may wish to begin by using the phrases "What is changed," "What stays the same," and "What is measured." Once students are comfortable with these ideas and that of controlling the experiment, the term variable can be introduced. Young students can often get hung up on the differences among the terms, which can hamper the investigation.

There are three types of variables to consider when designing the investigation procedure.

- The independent variable is the one variable the investigator chooses to change.
- Controlled variables are variables that are kept the same each time.
- The dependent variable is the variable that changes as a result of /or in response to the independent variable.

Having students talk through the investigation will help them to clarify the different variables involved in the experimental design. What factors will change? What factors will stay the same? The challenge is for students to create what is called a "fair test." In a fair test, only one factor or variable is changed at one time so that the investigator can determine if the changed factor has an impact on the end results.

One of the easiest ways to help students understand the concept of a fair test is to give them an example that is NOT a fair test. For instance, suppose the problem is to determine which stain remover is best at removing stains. It would not be fair to test one stain remover on a well set grass stain while testing the other stain remover on fabric only lightly soiled with dirt—a much easier stain to remove. A well designed procedure avoids such unfair comparisons.

Another hands-on way to introduce a fair test is to ask students, "Who can make the best paper airplane?" Once two students are selected to compete, hand one a large piece of construction paper and the other a piece of regular copy paper. Students will immediately note that this is "unfair." If we want the test to be fair, only the paper airplane design can be different. Everything else, including how hard the airplane is tossed, must be the same.

Collect Data

Carrying out the investigation involves data collection. There are two types of data that may be collected—quantitative data and qualitative data.

Quantitative Data

1. Uses numbers to describe the amount of something.
2. Involves tools such as rulers, timers, graduated cylinders, etc.
3. Uses standard metric units (For instance, meters and centimeters for length, grams for mass, and degrees Celsius for volume.
4. May involve the use of a scale such as in the example below.

Qualitative Data

- Uses words to describe the data
- Describes physical properties such as how something looks, feels, smells, tastes, or sounds.

As data is collected it can be organized into lists and tables. Organizing data will be helpful for identifying relationships later when making an analysis. Encourage students to make use of technology such as spreadsheets to organize their data.

Analyze Data & Draw Conclusion

After students have collected their data the next step is to analyze it. The goal of data analysis is to determine if there is a relationship between the independent and dependent variables. In student terms, this is called "looking for patterns in the data." Did the change I made have an effect that can be measured?

Recording data on a table or chart makes it much easier to observe relationships and trends.

You can use these questions to help guide students in analyzing their data:

- What can be learned from looking at the data?
- How does the data relate to the student's original hypothesis?
- Did what you changed (independent variable) cause changes in the results (dependent variable)?

After analyzing the data, students will be able to answer these questions as they draw some conclusions. Encourage students not to change their hypothesis if it does not match their findings. The accuracy of a hypothesis is NOT what constitutes a successful science fair investigation. Rather, Science Fair judges will want to see that the conclusions stated match the data that was collected.

Application of the Results: Students may want to include an application as part of their conclusion. For example, after investigating the effectiveness of different stain removers, a student might conclude that vinegar is just as effective at removing stains as are some commercial stain removers. As a result, the student might recommend that people use vinegar as a stain remover since it may be the more eco-friendly product.

In short, conclusions are written to answer the original testable question proposed at the beginning of the investigation. They also explain how the student used science process to develop an accurate answer.