

## Tips for refining an idea for a science fair project

1. Try things out before committing to an idea
2. Know **what** and **how** to measure
3. Generate targeted questions to guide the research (instead of just looking up facts that aren't necessarily relevant)
4. Create and revise models to help design the right experiment and interpret/explain the results. The models help you explain what you think is going on.

Example 1:

A third grade student asked 'How long does it take various liquids to freeze?'. In one weekend session he went home and discovered that the time to freeze olive oil < water < salt water < juice < vodka (didn't freeze). After some conversations, he acknowledged that he didn't really know how these liquids were different. With coaching from his mentor he developed a simple model of water vs. salt water. He revised his question to 'How does the concentration of salt affect the time it takes for the liquid to freeze'. This was a successful and scientifically valid project.

Example 2:

A sixth grade student asked 'How do my filtration systems at home affect pH?'. One weekend early in the process she spent an hour running various liquids through her filters at home (Brita, backpacking filter) and discovered that the pH never changed. She and her mentor sketched out a brief model together to explain her results (i.e. pH = concentration of hydrogen ions ... which are really small ... which don't get trapped in the filter). She revised her question to read 'How do my filtration systems affect the concentration of food coloring?'. Though her final project had challenges (measuring concentration of food coloring is tricky), it was a successful project, and she could apply her developing model to it.

Example 3:

A third grade student was interested in water shooting out of pipes. He had a wild idea about building a contraption from PVC pipes that he could use to reroute water. Without a clear question in mind, he spent a weekend session putting pipe parts together and shooting his hose through them. After talking through his preliminary experiences, he settled on the question "How does the location of a bend in a pipe affect the time for water to flow through it?". Though he didn't include a lot of details in his model because he wasn't able to really say what was going on in the pipe to cause the difference in his measurements, he learned a lot about turbulence with a sound experimental design:

