Starting a Science Project

Most Science Fair or Expo projects explore a scientific question by conducting an investigation or solving a problem through design and invention. This guide will help you get started with the basics.

1. Ask a testable question

A testable question is one that you can take action on. For example the question, which lubricants make a model car roll farthest? You can take action on this question by testing different lubricants on the wheels of a model car. You also need to evaluate if you have the resources to conduct a test. Do you have the materials you need? Do you have the time?

The Testable Question Flow Chart can help you determine if your question is testable.

Check the STEM Expo Rules and Guidelines at www.MWVSTEMExpo.com and email MWVSTEMExpo@gmail.com with any questions about your project idea.

2. Think about what you already know about your subject.

Make a list of what you already know, ask more questions, read up to learn more about your subject, ask an expert, watch videos, go to a museum.

3. Design and conduct an investigation to answer your question

Think about what you will need to do to set up your test? What **variable** will you change? How will you measure and record your results? How will you know if any change has occurred? Be sure you plan a way to measure and record your results.

4. Make a Hypothesis

A **hypothesis** is an explanation of how or why something happens. For your experiment, your hypothesis should try to explain your predicted outcome based on what you understand at the moment. A hypothesis may or may not be correct.

5. Collect, record and analyze your data

Take good notes and measurements. Review your notes and data and consider what happened in your experiment? What patterns or trends do you notice? Was your hypothesis correct? Did you answer your question, or do you need to go back to the drawing board? What new questions do you have?

6. Draw conclusions

Tell what you learned and observed. Did your results match your hypothesis? Can you explain what happened?

7. Share your results

Communicate what you learned – Make your STEM Expo display. Describe the process and what you learned. Be sure to include brief descriptions of each step mentioned above.

Definitions and Resources

Fair Test - is a test or experiment where one factor or variable is changed and all other conditions remain the same.

Variable - is the factor that you change.

- Independent Variable is the factor that you change. For example, using different lubricants to see how they affect how far a toy car rolls.
- Dependent Variable is the factor that is measured. For example, the distance the car rolls for each lubricant tested. This variable depends on the independent variable, i.e. the lubricant used.

When designing your experiment and presentation for the STEM Expo, use the Judging Rubrics to help ensure you include all the required parts. Judging Rubrics can be found online at www.mwvstemexpo.com.

For more information on conducting investigations and the steps of the Scientific Method visit Sciencebuddies.org:

https://tinyurl.com/2h7nhkeb

Online video resources:

1. Project ideas and research:
www.tinyurl.com/5xt28xyt

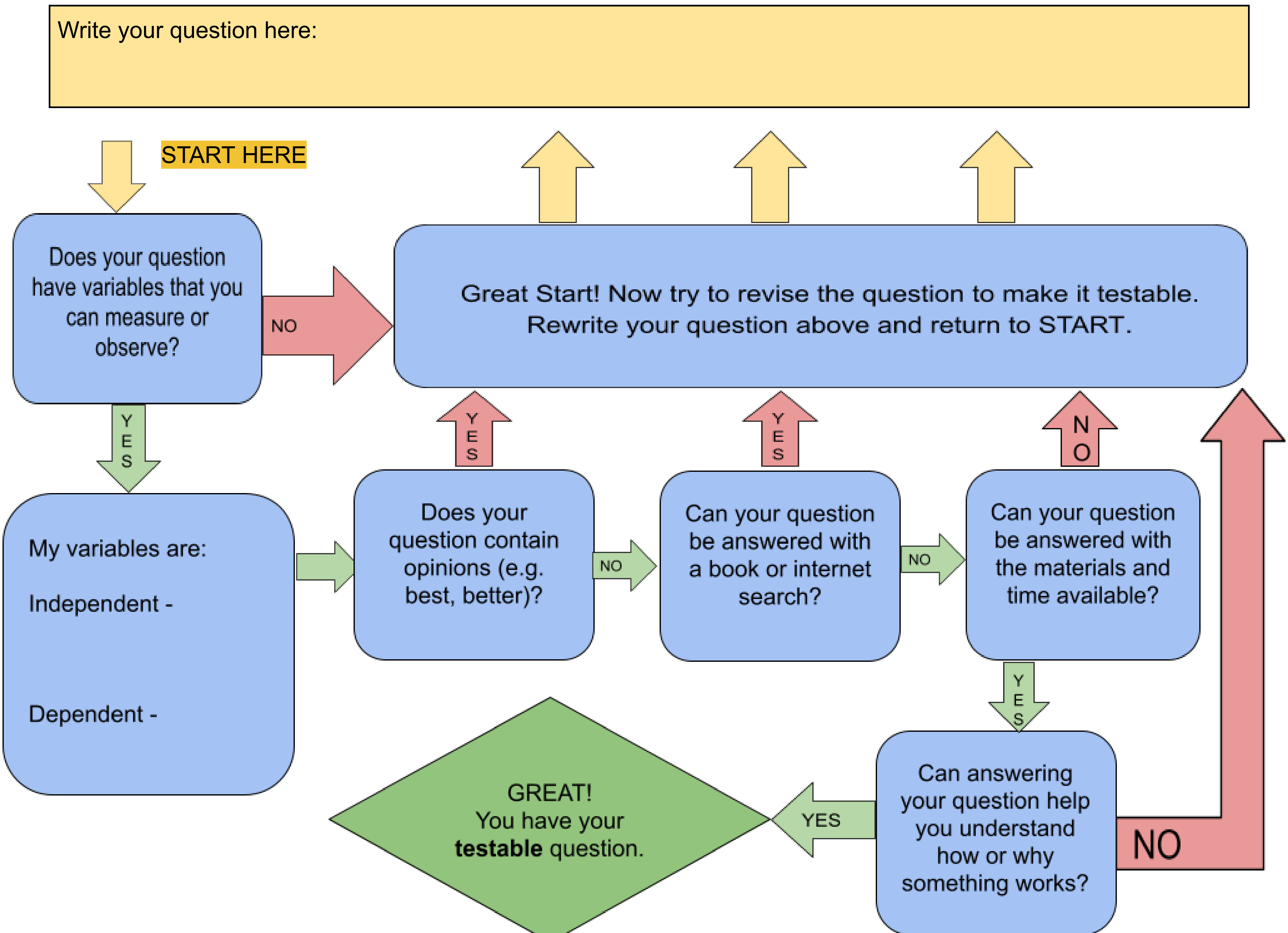
2. Asking a testable question:
www.tinyurl.com/yc6fmcj2

3. Design and Conduct your experiment:
www.tinyurl.com/ys5w44ph

4. Examine Your Results:
www.tinyurl.com/3sd356dv

5. Communicate your experiment and results:
www.tinyurl.com/2p9xmd86

Testable Scientific Question Flowchart



Experiment Example

I am curious about how plants grow and what factors affect how well they grow.

Ask a testable question:
Ask questions about plants and how they grow. Then edit your question to make it specific and testable.

a) Why do the same kinds of plants sometimes grow big and sometimes grow smaller? (not testable)
b) If plants have more room to grow will they grow better?
c) How does crowding affect plant growth?
d) How does the number of tomato plants in a pot affect their growth? (testable)

Conduct background research:
I know that all plants need room to grow. I can read about plants in gardening books, I can ask a Master Gardener or someone at a nursery about plants.

Design a Fair Test:
I could plant different amounts of tomato seeds in different containers and measure their growth over several weeks. I will plant 1, 5, 10, 15, and 20 tomato seeds in 4-inch containers filled with potting soil. The pots will sit in a window and receive equal amounts of water. I will measure plant height, timing, and size of flower blossoms.

Make a Hypothesis:
I think the pots with fewer seeds in each pot will grow better.

Collect and analyze your data:
Measurement of average height of tomato plants in inches

	1 seed	**5 seeds**	**10 seeds**	**15 seeds**	**20 seeds**
1 week	1	1.5	1	1	1
2 weeks	3	3	3	2.75	2.5
3 weeks	7	6	5	4	3.5
4 weeks	10	10	7.5	5.5	4.25
5 weeks	15	14	10	8	5.5

I noticed the plants in the pots with fewer seeds grew taller and were much greener. The 1 seed/pot plants grew the tallest but the 5 seed/pot plants were almost as tall. The 1 seed and 5 seed/pot plants also formed flower buds but did not blossom. I think they would have blossomed in another week or so. The 10, 15 and 20 seed pots did not form flower buds.

Draw Conclusions:
Tomato plants in pots with fewer seeds in them grew taller. The plants in 1 seed pots grew 15 inches in 5 weeks with the plants in the 5 seed pots growing 14 inches. When I took the soil and roots out of the pots, I noticed that the 1 seed and 5 seed plant roots were bigger and the 20 seed plants roots were tiny. I think the bigger the roots are the bigger the plant can grow.

The Engineering Design Process
How to Build a Better Mousetrap

The engineering design process is a process for designing and testing solutions for a problem. Typically a problem is defined can be solved by designing a product or system and/or refining its design. The old idiom to “build a better mousetrap” aptly describes the engineering design process. If one wants to build a better mousetrap, you need to mess about with ideas and materials to come up with a new design solution for the problem of building a better mousetrap. It involves creative thinking, problem-solving, critical thinking, and analysis.

Find more information on the Engineering Design Process
Visit at Sciencebuddies.org:

www.tinyurl.com/msu2vp3f

1. Define a Problem – What’s the problem here? Why is it a problem? How does it affect me or others? How can I fix it? *Planting seeds by hand into seed trays is too slow and cumbersome. How can I speed up the process and make it more efficient?*

2. Consider your current knowledge, research similar problems and brainstorm possible solutions to your problem - Ask, what do I already know? Where can I learn more about my subject? What resources do I have? Can I design or build something to fix the problem? What will happen if…? *I know there are different kinds of hand seeders and vacuum seeders. How do they work? Can I make a jig to collect and evenly space my seeds?*

3. Explore Possibilities (Build A Prototype) - Mess around with materials to develop a solution to your problem and keep records of your efforts. Try working with different materials and designs. Test to see what works best. Ask, what happened? What parts of the design work? What parts of the design don’t work? Does my design solve the problem or do I need to go back to the drawing board. *What kinds of materials do I have or can I get? What if I use two foam trays with holes slightly larger than my seeds in the top tray that line up with the cells in my seed tray and offset similar holes in the bottom tray. That way I could shake seeds into the holes of the top tray and slide the bottom tray to line up the holes and drop the seeds into the cells when they’re lined up.*

4. Modify the design based on prototype test results and continue to test it - Ask, what have I observed? What could I change? What new questions do I have? Look at my notes. *My trays worked pretty well but the holes in the tray must be only slightly larger than the seeds or else too many seeds will drop into the cells. I would need different trays for different-sized seeds.*

5. Finalize designs - Record your observations and make drawings and a model of your final design. Analyze and draw conclusions about your final design. Consider what worked and what didn’t. Ask, what new questions do I have?

6. Share your results - Communicate what you learned – Make your STEM Expo display. Describe the whole process and be sure to include your initial problem, solution and research. Describe your problem-solving process. Tell how you tested your designs, measured your results, and describe your analysis and conclusions. See the Judging Rubrics online at www.mwvstemexpo.com

Adapted from Sneider, Cary I, and Brenninkmeyer, Julie (2007). “Achieving Technical Literacy at the Secondary Level: A Case Study from Massachusetts.” Professional Development for Engineering and Technology.