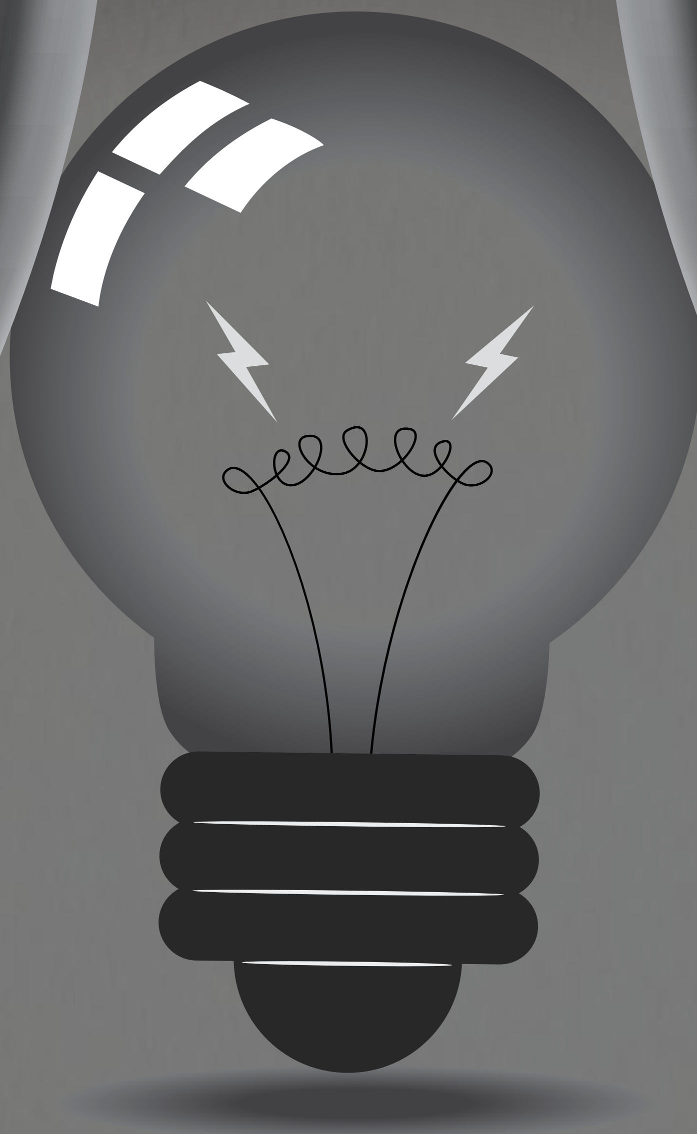
SCIENCE FAIR WARM-UP

» LEARNING THE PRACTICE OF SCIENTISTS «

Grades 7–10

JOHN HAYSOM

NSTA press
National Science Teachers Association



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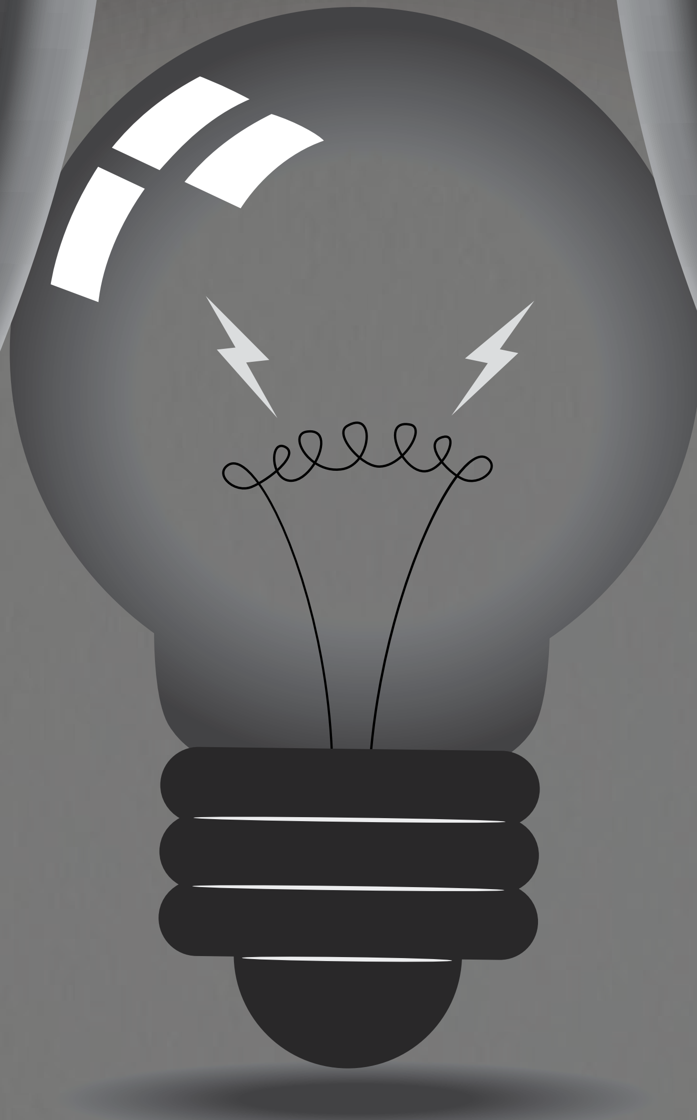

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LET'S GET STARTED! WHICH PROJECT SHOULD WE CHOOSE?
HOW 'BOUT THE ONE ON NAILS?— YOU LIKE WOODWORKING TOO.

I'LL BET THIS NAIL HOLDS BETTER THAN THE LAST ONE.
I'LL MEASURE IT.

Contents

THIS SIMPLE APPARATUS WORKS GREAT!
YES, BUT DOES IT ALWAYS GIVE THE SAME RESULT?

Be Safe!

As you embark on your science fair adventure, some of the steps and activities will be new to you. Keep yourself and your classmates safe by studying this list of safety precautions.

1. Do not touch animals unless instructed to do so by your teacher. Otherwise, you should stick to observing them.
2. Use caution when working with sharp objects such as scissors, razor blades, electrical wire ends, knives, and glass slides. These items can be sharp and may cut or puncture skin.
3. Wear protective gloves and vinyl aprons when handling animals or working with hazardous chemicals.
4. Wear indirectly vented chemical-splash goggles when working with liquids such as hazardous chemicals. When working with solids such as soil, metersticks, and glassware, safety glasses or goggles can be worn.
5. Always wear closed-toe shoes or sneakers in lieu of sandals or flip-flops.
6. Do not eat or drink anything when working in the classroom or laboratory.
7. Wash hands with soap and water after doing activities dealing with hazardous chemicals, soil, biologicals (animals, plants, and so on), or other materials.
8. Use caution when working with clay. Dry or powdered clay contains a hazardous substance called silica. Only work around and clean up wet clay.
9. When twirling objects around the body on a cord or string, make sure fragile materials and other occupants are out of the object's path.
10. Use only non-mercury-type thermometers or electronic temperature sensors.
11. When heating or burning materials or creating flammable vapors, make sure the ventilation system can accommodate the hazard. Otherwise, use a fume hood.
12. Select only pesticide-free soil, which is available commercially for plant labs and activities.
13. Many seeds have been exposed to pesticides and fungicides. Wear gloves and wash hands with soap and water after any activity involving seeds.
14. Never use spirit or alcohol burners or propane torches as heat sources. They are too dangerous.
15. Use caution when working with insects. Some students are allergic to certain insects. Some insects carry harmful bacteria, viruses, and other potential hazards. Wear personal protective equipment, including gloves.
16. Immediately wipe up any liquid spills on the floor—they are slip-and-fall hazards.

Chapter 4:

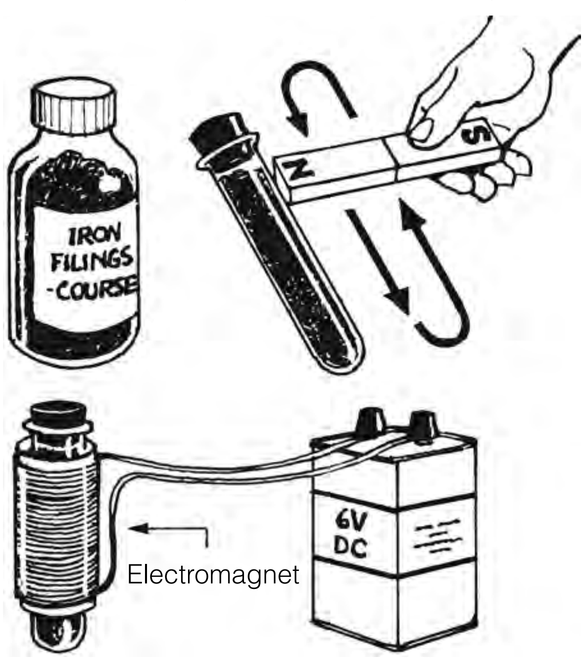
The Numbers Game

**ARE SOME MEASURES BETTER THAN OTHERS?

Which Magnet Is Strongest?

Marie and Monique had read about how you could make magnets by putting iron filings in a test tube and stroking the tube with a regular magnet.

They wanted to make the strongest magnet possible and had various ideas for how to do so. They wondered whether the number of times you stroked the tube made a difference. They wondered whether the size of the filings made a difference. They wondered whether they could magnetize the filings by putting the tube in an electromagnet. They wondered about other possible features. But they were stuck. How were they going to measure the strength of the magnets they made?



Help for Marie and Monique

See what you can do to help Marie and Monique. Here's a good way to start:

1. Obtain two magnets whose strengths are about the same. Mark the magnets A and B. Your task is to find out which magnet is stronger.
2. Devise and perform as many tests as you can. You may find some of the following materials useful: paper clips, plotting compass, nails, string, plastic squares, steel balls, iron filings, a spring balance, elastics, a ruler, washers, and modeling clay.
3. Record your results in a simple chart. First, describe each test in a few words or by drawing a picture. Then record the observations or measurements you make for each of the magnets. Which magnet appears to be stronger?

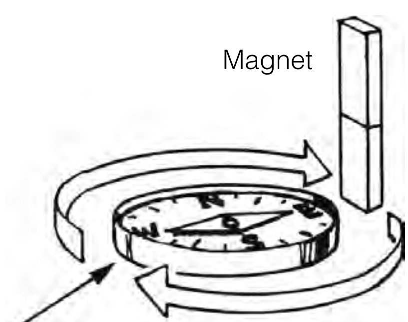
Chapter 4

No wonder Marie and Monique had difficulty. That wasn't so easy, was it? To help you get your thinking straight, try writing them a letter about your experience. Tell them which test you thought was best and try to explain why.

Marie and Monique Talk to a Scientist

Marie and Monique received many ideas for tests, and because they couldn't make up their minds about which test was the best, they decided to ask Dr. Smith at the local research laboratory.

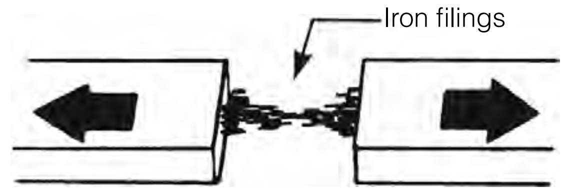
Marie: We tried numerous things to start. We tried picking up iron filings. We tried spinning the compass. We tried pulling a nail off the magnets. But we couldn't decide which magnet was stronger.



Dr. Smith: Those were interesting ideas. But you can't rely on your senses. It often helps to put a number on things. Did you develop any of those ideas?

Monique: Yes! We tried magnetic wrestling with iron filings. You pick up some filings with one magnet and see if the other one can pull them off.

Dr. Smith: That's ingenious! It might help you decide which magnet is stronger. But simple comparisons aren't enough if you've got lots of magnets to test. What else did you try?



Marie: Well, we found that a magnet could hold a whole string of paper clips. We counted how many each magnet held.

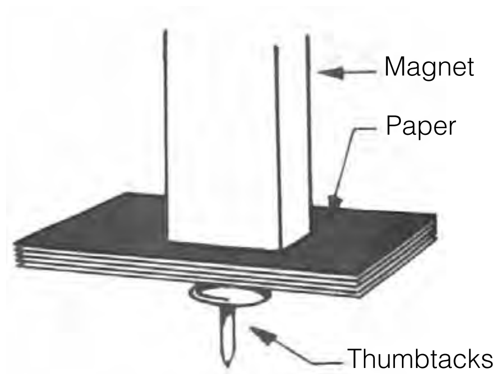
Dr. Smith: Now we're making progress! First, you can measure strength in terms of the number of clips, and second, you can carry out the test on any magnet you make. How did that work?

Marie: Well, when I did it, the red magnet held seven clips and the blue one held five.

Monique: But when I checked it, it was the other way around.

Dr. Smith: Oh! That's a problem, isn't it? You were smart to check it! When scientists measure something, they always check to see if their instrument is reliable. If it is reliable, they will get the same reading each time. Did you try anything else?

Monique: Yes, we tried to measure how many squares of plastic we could slip between the magnet and the thumbtack before the thumbtack fell off.



Marie: They both held the same. Perhaps they were the same strength after all.

Dr. Smith: They were probably very close. Your instrument couldn't detect a difference—it wasn't sensitive enough. Can you think of a way to increase sensitivity?

Marie: How about using thinner plastic?

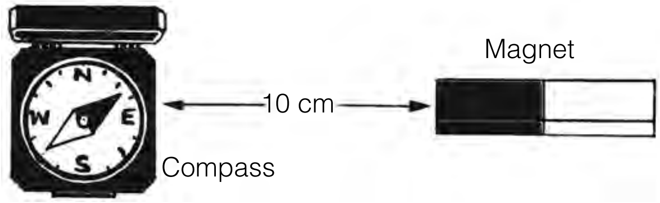
Monique: Or how about paper?

Dr. Smith: Good ideas! They would both be worth trying.

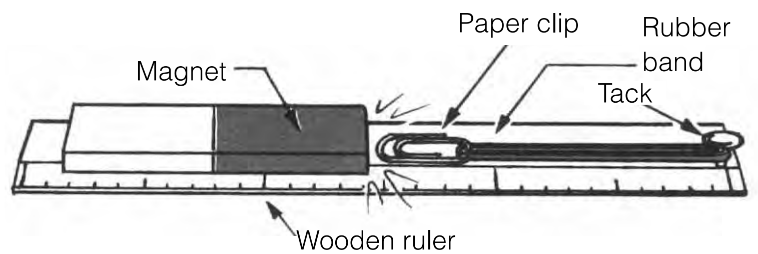
Monique: Do you have any ideas?

Dr. Smith: Well, let me think. Here are a few worth exploring:

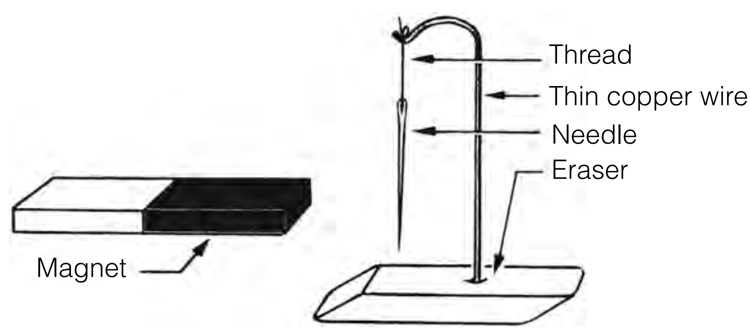
- Get a compass and line it up with north and south. Measure how much the needle is deflected when you place your magnet a set distance away (e.g., 10 cm) along the east-west axis.



- Thread a paper clip on a weak rubber band. Measure the stretch of the rubber band when the magnet and the clip break apart.



- Measure how close you can bring the magnet before the needle starts to move.



Why don't you try these suggestions? You will have to play around a bit to get them to work. Then you will have to test them for reliability and sensitivity.

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Even science fair enthusiasts may dread grappling with these two questions:

1. How can you organize many students doing many different projects at the same time?
2. How can you help students while giving them the freedom of choice and independence of thought that characterize genuine inquiry?

Answer these questions—and face science fairs without fear—with the help of the *Science Fair Warm-Up* series. To save you time, the materials are organized to grow more challenging and encourage independent study as students progress through the grade levels. To help you meet your teaching goals, the series is based on the constructivist view that makes students responsible for their own learning and aligns with national standards and the *Framework for K–12 Science Education*.

This book, for grades 7–10, develops the ideas about practices that students learn in the first book. Students will also find problems that are much more cognitively demanding. In addition to offering original investigations, the book provides problem-solving exercises to help students develop the inquiry skills to carry the projects through.

Science Fair Warm-Up will prepare both you and your students for science fair success. But even if you don't have a science fair in your future, the material can make your students more proficient with scientific research.

"An exciting publication that engages students and fills a need for innovative and conscientious teachers. Students and teachers are likely to encounter real science with the ideas, approaches, and questions the materials encourage." —Robert Yager, Professor Emeritus at the University of Iowa and past president of NSTA

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