

Steps to the Scientific Method

Name: _____ Date: _____

Your teacher has just announced that there's going to be a science fair this year, and that your project needs to follow the scientific method—the step-by-step process that scientists follow when they perform an experiment. Where should you begin? Step One: Don't panic! Step Two: Check out the cheat sheet below. It outlines the scientific method.



1. Make an observation. Then, propose a research question based on your observation.

A good science-fair project question is testable and measurable. For example: *Which brand of bubble gum keeps its flavor longest?* You can test this by chewing different brands of gum and measuring how long the flavor lasts for each brand. The best questions are usually ones that you have a genuine interest in answering.

2. Identify the variables.

A science-fair project involves *variables*, or things that change or could be changed. There are two types of variables: independent and dependent variables. An *independent variable* is one that you change on purpose. For instance, if you were experimenting to find out which brand of gum keeps its flavor longest, you may choose to test three different brands of bubble gum. The *dependent variable*, or the factor that responds to a change in the independent variable, would be the amount of time that the flavor lasts.

You'll also want to identify your *constants*, or things that will stay unchanged. For instance, you might test only bubble gum that is sugar free. And to make sure that the amount of gum you test is equal each time, you might choose to test only sticks of gum—not gumballs.

3. Research your topic to learn more about it.

Research comes in many forms. You can research a topic by going to the library, performing Internet research, interviewing a scientist, or even speaking with experts at museums, zoos, hospitals, and so on. For our example, you might interview a spokesperson or scientist from a bubble-gum company.

4. Develop a hypothesis, or a possible answer to your question.

Your *hypothesis* should be based on your research. It is important to remember that it is okay if your hypothesis turns out to be wrong. You can learn a lot from any hypothesis—whether it is right or wrong. Your science-fair project will help you test your hypothesis.

5. Design an experiment that will help you answer your research question.

Come up with an experiment *procedure*. This list of steps should be detailed enough so that anyone could read it and repeat the experiment exactly as you performed it.

You will want to run several trials. That means that you'll want to repeat your experiment several times. The more times you repeat the experiment, the more reliable your results will be.

Record your experiment results in a journal. The more notes you take, the easier it will be to type up your report (more on that later). Also, take photos to document your work as you go.

6. Draw conclusions from your results and type up a report that explains your project, results, and conclusions.

The report should be typed and include neat and colorful charts and graphs.

Sample Project One: Stretch Test

Name: _____ Date: _____

Below is an example of a science project from start to finish.
You can use this as your guide as you work on your own project.

Project Topic: *How a Person's Flexibility Changes Throughout a Workout*

Project Title: *Stretch Test*

1. My Question

The question I plan to answer with my experiment is: *Are people able to stretch farther before or after hanging in a forward bend?*

2. My Purpose

Rewrite your question to complete the following sentence. The purpose of my experiment is to: *find out when people are most flexible—at the start or end of a workout.*

3. My Variables

My independent variable, or the one thing I plan to change, is: *the total length of time spent hanging in a forward bend before giving a stretch test.*

My dependent variable, or the change I will measure, is: *the distance that people stretch.*

My controlled variables, or the things I will keep the same, are: *people will perform the same stretch test. I will make sure that the room temperature stays constant throughout the workout because people's muscles loosen up in warmer temperatures. I will have people perform the stretch test three days in a row, always at the same time of the day.*

4. My Research

Go to the library, perform Internet research, or interview an expert to gather information about your topic. Keep notes on your findings:

It is best to do light stretching before a workout and a more thorough stretching routine after a workout. Stretching your muscles when they're cold increases your risk of pulled muscles. Source: Mayo Clinic staff, Stretching: Focus on flexibility, The Mayo Clinic, <http://www.mayoclinic.com/health/stretching/HQ01447>



Sample Project One: Stretch Test

(continued)

5. My Hypothesis

A *hypothesis* is a possible answer to a research question. Reread your question in Step 1. Based on my research, my hypothesis is:

The longer a person works out before stretching, the farther the person will be able to stretch.

6. My Procedure

Materials:

- ruler
- masking tape
- clock
- pencil
- paper

Procedure Steps:

1. Place a ruler on the floor.
2. Use masking tape to tape the ruler to the floor.
3. Ask a person to sit on the floor with his or her legs straight out in front and heels lined up with the ruler's 5-inch mark. Have the person separate his or her heels by 12 inches.
4. Have the person lean forward, arms stretched straight out in front as far as he or she can reach.
5. When he or she can't stretch forward comfortably any more, have the person put his or her fingertips down on the ruler. Record this distance (measure from the 0-inch mark).
6. Have the person stand up and hang in a forward bend for one minute.
7. Repeat Steps 3 through 5.
8. Have the person stand up and hang in a forward bend for another minute.
9. Repeat Steps 3 through 5 once more.
10. Repeat the experiment with the same person for three days in a row. Perform the experiment at the same time each day.

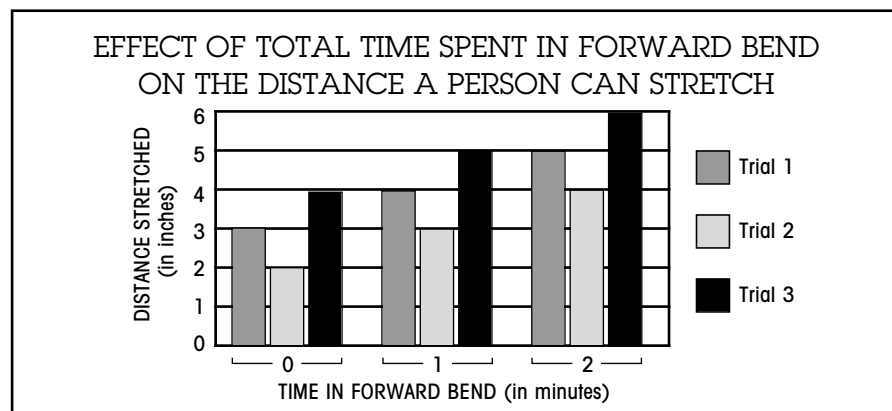
Sample Project One: Stretch Test

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7. My Data

Independent Variable: Total length of time in forward bend	Dependent Variable: Distance stretched (in inches)			
	Trial 1	Trial 2	Trial 3	Average
0 minute	3 inches	2 inches	4 inches	3 inches
1 minute	4 inches	3 inches	5 inches	4 inches
2 minutes	5 inches	4 inches	6 inches	5 inches

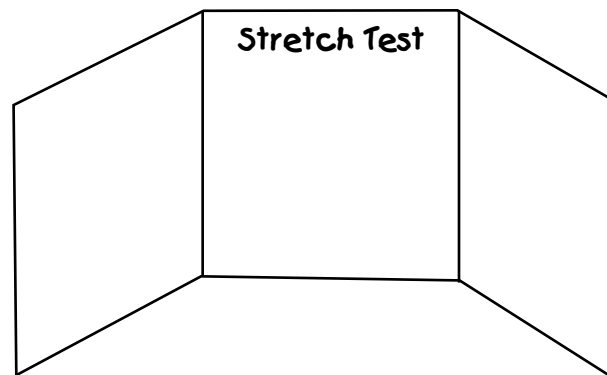
8. Graph of My Data



9. My Conclusions

Based on my results, I conclude that my hypothesis was correct. The longer a person works out before stretching, the farther the person will be able to stretch. I would like to see how other forms of workout affect the distance a person can stretch. For instance, would doing jumping jacks help a person stretch farther?

10. A Sketch of My Display



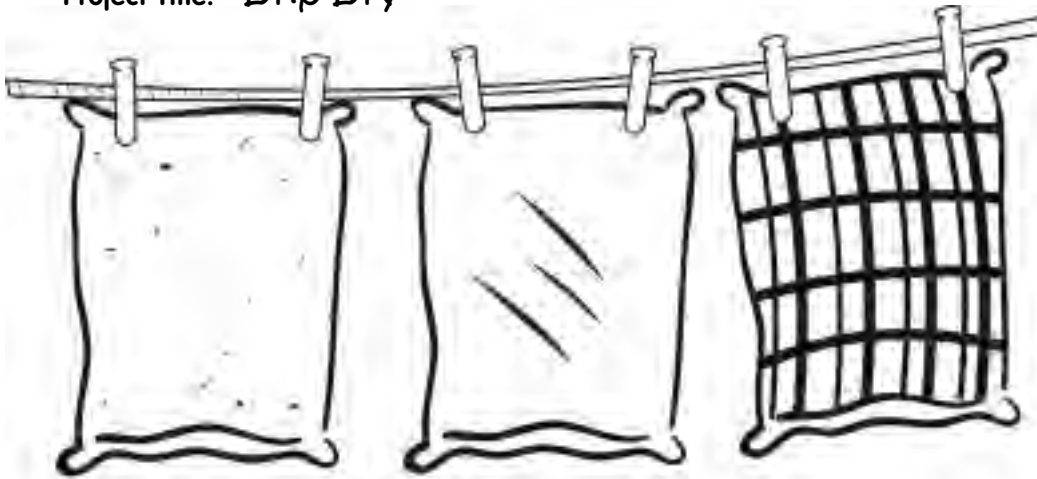
Sample Project Two: Drip Dry

Name: _____ Date: _____

Below is an example of a science project from start to finish.
You can use this as your guide as you work on your own project.

Project Topic: *How Fabric Type Affects
a Cloth's Drying Time*

Project Title: *Drip Dry*



1. My Question

The question I plan to answer with my experiment is:
How does the type of fabric—flannel, cotton, or satin—affect how long a cloth takes to dry?

2. My Purpose

Rewrite your question to complete the following sentence. The purpose of my experiment is to:
find out if different materials dry more quickly than others.

3. My Variables

My independent variable, or the one thing I plan to change, is:
the cloth's material.

My dependent variable, or the change I will measure, is: *the time it takes for a wet cloth to dry.*

My controlled variables, or the things I will keep the same, are:
the cloth's size and shape. I have decided to always use a standard-size pillowcase and soak each pillowcase in water for the same amount of time. I will keep the water's temperature constant. I will place all pillowcases in the same location to dry.

Sample Project Two: Drip Dry

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4. My Research

Go to the library, perform Internet research, or interview an expert to gather information about your topic. Keep notes on your findings.

I interviewed two experts in fabrics: the owner of my local dry cleaner, who said that satin is a very fast-drying material, and a fashion designer, who said the same thing.

5. My Hypothesis

A *hypothesis* is a possible answer to a research question. Reread your question in Step 1. Based on my research, my hypothesis is:

satin pillowcases will dry faster than flannel or cotton pillowcases.

Cotton pillowcases will dry the slowest.

6. My Procedure

Materials:

standard-size satin pillowcase
standard-size cotton pillowcase
standard-size flannel pillowcase
washtub
cold water
bathroom scale
drying rack
bathtub
clock
pencil
paper

Procedure Steps:

1. Weigh each pillowcase and record its dry weight.
2. Fill the washtub completely with cold water.
3. Place all three pillowcases in the water.
4. Leave the pillowcases in the water for 1 hour to soak.
5. While the pillowcases are soaking, set up the drying rack in the bathtub.
6. After allowing the pillowcases to soak for 1 hour, remove them from the water and weigh each one again. Record each pillowcase's wet weight.
7. Hang each pillowcase on a top bar of the drying rack.
8. Close the shower curtain to keep any stray breezes from hitting the towels.
9. Allow the pillowcases to line dry.
10. Weigh each pillowcase every 2 hours.
11. The first pillowcase to reach its dry weight from step 1 is the fastest drying.
12. Continue to let the remaining pillowcases dry. Continue weighing them every 2 hours until all three have reached their dry weight from step 1.

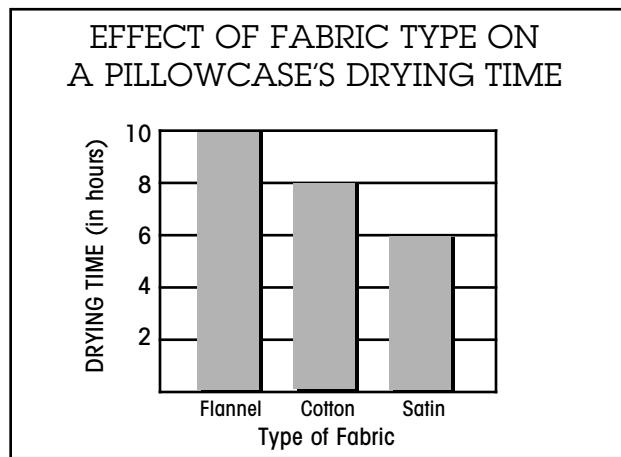
Sample Project Two: Drip Dry

(continued)

7. My Data

Independent Variable: Pillowcase fabric	Dry Weight (in pounds)	Wet Weight (in pounds)	Hour 2 (in pounds)	Hour 4 (in pounds)	Hour 6 (in pounds)	Hour 8 (in pounds)	Hour 10 (in pounds)
Flannel	.4	.8	.8	.7	.6	.5	.4
Cotton	.3	.7	.6	.5	.4	.3	.3
Satin	.2	.6	.5	.3	.2	.2	.2

8. Graph of My Data



9. My Conclusions

Based on my results, I conclude that the first half of my hypothesis was correct but the second half was wrong. A satin pillowcase dries faster than cotton or flannel pillowcases. But I also hypothesized that a cotton pillowcase would take the longest to dry. My data shows that the flannel pillowcase took the longest time to dry. If I could do this experiment again, I would use a more sensitive scale. Then I could get more accurate results.

10. My Display

