In Science we must...

Make careful observations!

It's Practice Time!
Scientific Method Overview
The Seven Steps of the Scientific Method

1. **State the Problem**: What is it that you are trying to solve? This should be in the form of a question.

2. **Gather Information**: Research your question. Find out as much information as you can on your question.

3. **Form a Hypothesis**: Take a guess at the solution to the problem.

4. **Run your Experiment**: Test your hypothesis. Run an experiment to see if your hypothesis is correct. This should include step by step procedures for completing the experiment.

5. **Record and Analyze Data**: Write down your results from your experiment in an organized fashion.

6. **Draw Conclusion**: Based on your results, was your hypothesis correct or incorrect. How do you know? What is your proof?

7. **Repeat Your Work**: Repeat your work to make sure you were correct.
Practice Time
The Seven Steps of the Scientific Method

Draw Conclusion
Research your question. Find out as much information as you can on your question.

State the Problem
Write down your results from your experiment in an organized fashion.

Repeat Your Work
What is it that you are trying to solve? This should be in the form of a question.

Do the experiment over

Record and Analyze Data
Test your hypothesis. Run an experiment to see if your hypothesis is correct. This should include step by step procedures for completing the experiment.

Gather Information
Take a guess at the solution to the problem.

Form a Hypothesis
Based on your results, was your hypothesis correct or incorrect. How do you know? What is your proof?

Run your Experiment
The Seven Steps of the Scientific Method

1. **State the Problem:** Does mass affect how fast an object will fall when dropped?

2. **Gather Information:** Research mass, rate of acceleration,.....

3. **Form a Hypothesis:**

4. **Run your Experiment:**
   1. Gather materials to test: cannonball vs. lead weight, anvil vs. orange, and watermelon vs. billard ball
   2. Calculate the mass of each object and record.
   3. Go to a tall building, like the Leaning Tower of Pisa.
   4. Drop each set of items from the top of the Tower.
   5. Record your observations.

Interactive Scientific Method

5. **Record and Analyze Data:**

<table>
<thead>
<tr>
<th>Object</th>
<th>Mass</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. **Draw Conclusion:**

7. **Repeat Your Work:** Repeat to see if your information and results were correct. Did you make any mistakes? Did you get the same results?
**Control:** The items in an experiment that stay the same. In the Leaning Tower demonstration the constants would be the height of the drop, the dropper, the weather,......

**Variable:** The one item in an experiment that changes or is different. In the Leaning Tower demonstration the variable was the mass of the object being dropped.

In order to determine the effect that a variable has on an experiment, you can only have one thing that changes or is different. Otherwise, you do not know what caused the effect.
Paper Towel Lab

I. State the Problem:

II. Gather Information:

III. Form a hypothesis

IV. Perform the experiment:
1. Gather your materials: paper towel, ruler, pen/marker, beaker filled with water, chart to record data
2. Measure 2cm from the corner of the paper towel and mark it. Label each paper towel
3. Dip the marked paper towel in the beaker of water and hold it exactly on the mark for 30 seconds
4. Remove the towel from the water and quickly mark where the water “crept” to on the paper towel.
5. Measure the new mark
6. Record the measurement on the chart
7. Repeat steps 2-6 with the other two brands of paper towel

V. Record and Analyze Data

<table>
<thead>
<tr>
<th>Brand of paper towel</th>
<th>Measurement in cm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
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</tr>
</tbody>
</table>

VI. Draw a conclusion:

VII. Repeat your work
Metric System: Mass, Volume, and Density

**Mass:** The amount of substance an object is made of. It is measured using a triple beam balance. The basic unit of measurement is the gram.

**Volume:** The amount of space a substance takes up. For a liquid it is measured by a graduated cylinder. For a solid, you must use the formula: \( \text{Volume} = L \times W \times H \). The basic unit of measurement is the liter.

**Length:** How long an object is. It is measured by a meter stick or a metric ruler. The basic unit of measurement is the meter.
<table>
<thead>
<tr>
<th>Tool</th>
<th>Measurement</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>Length</td>
<td>Liters</td>
</tr>
<tr>
<td>Meters</td>
<td>Meter stick</td>
<td>Mass</td>
</tr>
<tr>
<td>Graduated Cylinder</td>
<td>Grams</td>
<td>Triple Beam Balance</td>
</tr>
</tbody>
</table>
Metric Units
The metric system has prefix modifiers that are multiples of 10.

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Symbol</th>
<th>Factor Number</th>
<th>Factor Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kilo</td>
<td>k</td>
<td>1,000</td>
<td>Thousand</td>
</tr>
<tr>
<td>Hecto</td>
<td>h</td>
<td>100</td>
<td>Hundred</td>
</tr>
<tr>
<td>Deca</td>
<td>da</td>
<td>10</td>
<td>Ten</td>
</tr>
<tr>
<td>Deci</td>
<td>d</td>
<td>0.1</td>
<td>Tenth</td>
</tr>
<tr>
<td>Centi</td>
<td>c</td>
<td>0.01</td>
<td>Hundredth</td>
</tr>
<tr>
<td>Milli</td>
<td>m</td>
<td>0.001</td>
<td>Thousandth</td>
</tr>
</tbody>
</table>

Kangaroos Hopping Down Mountains During Christmas Morning Lakes Glaciers

Reading centimeters
1. Write down your "kangaroo" scale

2. You will decide what unit you are changing FROM and what unit you are changing TO

3. Start at your original units and count over to the new units.
   **This will be the number of places you will move the decimal in your answer.

   EXAMPLES: 32 kilograms = _______ grams
   You want to change FROM kilograms TO grams. Use diagram and count over, starting at kilograms to grams.
   
   K H D ( grams) D C M
   (start) 1-> 2-> 3
   **(3 places to the right)
   4. Move your decimal the same number of times we moved on our "kangaroo" scale. Move it in the same direction.

   given info 3 places to the "right"

   32 kilograms = 32.000 = 32000
   32 kilograms = 32000 grams

   Practice: 50 centimeters = _______ meters
   You want to change FROM centimeters TO meters. Use diagram and count over, starting at centimeters to meters

   K H D ( meters) D C M
   2 < 1< start
   **(2 places to the left)
   Now we use this information (3 places to the "left") and apply to the given information - 50 centimeters.

   given info 2 places to the "left"

   50 centimeters = 50 = .5
   50 centimeters = .5 meters
Practice: 14.6 hectograms = _______________ milligrams
You want to change FROM hectogram TO milligrams.

Practice: 354 kilometers = _______________ meters

Practice: 86 dag = _______________ dg

Practice: 14 cm = _______________ hm
Write the equivalents.

1) 18 m = _____ cm
2) 167 mm = _____ m
3) 500 kg = _____ g
4) 23 dm = _____ hm
5) 1,589 dl = _____ dm
6) 700 ml = _____ l
7) 5 cm = _____ mm
8) 35.45 mg = _____ hg
9) 0.5 l = _____ kl
10) 130 dag = _____ kg

Create your own conversion.

11) _____ _____ = _____ _____
    # Unit   # Unit
Metric Ruler

Centimeter

Decimeter

Milimeter

10mm = 1cm
10cm = 1dm
**Let's try together...**

Reading centimeters

<table>
<thead>
<tr>
<th>Line</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.6 centimeters</td>
</tr>
<tr>
<td></td>
<td>2.1 centimeters</td>
</tr>
<tr>
<td></td>
<td>9 millimeters</td>
</tr>
<tr>
<td></td>
<td>5 centimeters</td>
</tr>
</tbody>
</table>
Find an item in the room that is close to the target length. Write the item in the first column. Then, write down the items actual measurement and write it in the third column. Write the difference between the target length and the actual length.

<table>
<thead>
<tr>
<th>Item</th>
<th>Target Measurement</th>
<th>Actual Measurement</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>34 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6dm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5 dam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>83 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2 dm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.8 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.7 dm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>923 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Triple Beam Balance

Tutorial Triple Beam Balance
How to Read a Triple Beam Balance

1. Make sure that the Triple Beam Balance (TBB) is zeroed before you try to find the mass of any object. The "pointer" should line up with the white line.

2. Place the object on the pan of the balance.

3. Begin by moving the largest weight until the pan pops up. Slide the weight back one spot.

4. Move the middle weight until the pan pops up. Slide this weight back one spot.

5. Move the smallest weight until the pointer lines up with the white line.

6. Add the three weights together to find the total mass of the object.
Let's try reading a Triple Beam Balance together...

http://www.ohaus.com/products/education/weblab/TBBread.html
Reading a graduated cylinder
How to Read a Graduated Cylinder

1. Determine what each line on the graduated cylinder stands for. (1 mL, 5 mL, 10 mL).

2. Read the graduated cylinder at eye level. Make sure it is on a flat surface.

3. Read the level of the water at the bottom of the "bubble". This is known as the meniscus.

(Use the zip file)
To find the volume of a solid use the following formula:

$$\text{Volume} = \text{Length} \times \text{Width} \times \text{Height}$$

$$V = L \times W \times H$$
Let's solve the following volume examples:

1. $V = \text{length} \times \text{width} \times \text{height}$
   
   - Length: 10 cm
   - Width: 8 cm
   - Height: 5 cm

   $V = 10 \times 8 \times 5 = 400$ cm$^3$

2. $V = \text{length} \times \text{width} \times \text{height}$
   
   - Length: 12 cm
   - Width: 5 cm
   - Height: 8 cm

   $V = 12 \times 5 \times 8 = 480$ cm$^3$
The Microscope

http://www.brainpop.com/technology/scienceandindustry/microscopes/
MICROSCOPE TERMS

1. eyepiece - houses a lens that magnifies 10x. It is where you look into the microscope.

2. body tube - holds the eyepiece, connects the eyepiece and the objective lens.

3. nosepiece - allows you to revolve, or change the objective lenses.

4. low power objective lens - magnifies objects a small amount - 4x.

5. high power objective lens - magnifies objects in large amounts - 40x and 10x.

6. stage - where you set your slide to view it.

7. stage clips - clips on the stage hold slide in place.

8. base - legs that support the entire microscope.

9. light source - may be a mirror or light bulb.

10. diaphragm - dial that allows you to adjust the amount of light entering the microscope.

11. coarse adjustment - knob that moves the stage in large amounts to focus.

12. fine adjustment - knob that moves the stage in small amounts to focus.

13. arm - supports the upper part of the microscope.

14. stage moves the top part if needed.

15. total magnification: multiply eyepiece (10x) by the objective lens (4x or 10x or 40x).
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    the amount of light entering the microscop

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to focus

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to focus

13. arm - supports the upper part of

14. stage moves the up part if needed

15. total magnification: multiply eyepiece (10x)
    by high power lenses (4x or 10x or 40x)
16. field of view - what you see when you look into the microscope

17. compound microscope - the microscope we use in school has several different lenses.
let's Review the parts of the microscope

http://davesolon.com/scopetrain/scopeRO.swf
How to use a microscope

http://davesolon.com/scopetrain/interactive.html

Step 1.
Carry the **microscope** with two hands. Keep one hand underneath the **microscope** and the other on the arm. The biggest reason **microscopes** break is not because they wear out, but because they are dropped.

**Step 2.**
Never touch any **lens** with your fingers. This leaves oil which is hard to clean and particles which may damage the **lens**. If a lens needs cleaning, use **lens tissue**, a **lens cloth** or a **lens pen** and be gentle. Do not use your shirt or a towel.

**Step 3.**
Learn the **parts** of your **microscope**.

**Step 4.**
Prepare a **slide**. If you are using prepared **slides**, skip this step for now, but come back later. You will need to learn how to prepare a slide.

**Step 5.**
Place the **slide** on the **stage** of the **microscope**, and secure with the **stage clips**.
Step 6.
Rotate the objectives on the nosepiece of the microscope until the shortest objective is over the slide and make sure the objective clicks into place. The shortest objective is LOW power. ALWAYS START WITH THE LOW POWER OBJECTIVE!
Memorize this. Low power lens gives the widest field of view and makes it easier to find the specimen when you look through the microscope.

Step 7.
Set the light control. Rotate the diaphragm until one of the large holes is centered under the slide. Start with plenty of light, but once you have focused and found your specimen in the field of view, start reducing light until you see the most amount of detail. The brightest setting is typically not the best for contrast and detail. Use only as much light as you need.

Step 8.
Focus slowly. It is easy to focus right past the correct focus point if you are going too fast. If your microscope has two controls, use the coarse adjustment for low and medium power and fine tine with the fine focus knob as needed. MOVE THE SLIDE IN THE OPPOSITE DIRECTION YOU WANT YOUR SPECIMEN TO GO. When you want the specimen to move to the right, move the slide to the left. When you want the specimen to move up, move the slide down.

Step 9.
Now for more magnification (power). Rotate the objective that has the medium length over the slide and be sure it clicks into place. Refocus, but slowly. Move the slide slowly back and forth if you cannot see anything. If you get lost and lose the specimen, go back to low power, center the slide and try again. It may take several tries to find a specimen, but this is normal.

Step 10.
If you managed medium power and have the specimen focused and in the field of view you can try high power. Once again, center a specimen in the field of view and slowly and carefully rotate the longest tube objective (high power) until it clicks into place. It will barely clear the slide, so be careful. The next rule is very important. DO NOT USE COARSE FOCUS ON HIGH POWER! If your microscope has both fine and coarse focus, use only fine focus at high power. Why? The objective is very close to the slide, now. If you use coarse focus, you can, on many microscopes jam the objective down onto the slide and break the slide.
Attachments

- Interactive Scientific Method - Dropping Objects
- Testing Variables
- Interactive Triple Beam Balance
- Interactive Graduated Cylinder
- Reading centimeters
- Metric System: Mass, Volume, and Length