Scientific Method Notes

• What is Physical Science?
  1. Physics
  2. Chemistry
  3. Astronomy

• Science = Latin for ______________________________
• Method = Greek for __________
• Science + Method = “______________________________ _______”

Step #1:
• Use 5 senses
  1. 
  2. 
  3. 
  4. 
  5. 

Step #2:
• What are trying to figure out/ is reason for doing the experiment?

Step #3:
• Hypo = _____________(Greek)
• Thesis = _____________ (Greek)
• What you think the answer will be based on prior knowledge/experimentation.
  •
  •
  •
• It may be __________________ or __________________________
**Format:** If __________________, then _______________ because......
(justification statement)

**Justification Statement** - The __________________________or
_____________________________(s) you have had that justify your reasoning
behind your prediction about what will happen.

**Step #4:**
- _________________Hypothesis
- Carry out or conduct an ___________________

*Good Experiment
  1.-
  2.-
  3.-

**Step #5:**
- Data = _________________
- Compare it with the _________________

**Step #6:**
- _________________ or _________________your hypothesis using the _____________
in your **Conclusion Statement**.

**Step #7:**

**Measurement & Metric Conversion**

*SI = International System of Measurement (Metric System)-

Why do scientists use the metric system? Compare data & Communicate easier

3 Basic Measurements
1. Grams =
2. Meter =
3. Liter =
Measure a liquid from the bottom of the meniscus (bottom of the curve of the water).

EX.

Graduated Cylinder—used to measure volume

Pg. ___ of Agenda = Metric Conversion Chart

<table>
<thead>
<tr>
<th>King</th>
<th>Henry</th>
<th>Died</th>
<th>Grams</th>
<th>Meters</th>
<th>Liters</th>
<th>Drinking</th>
<th>Chocolate</th>
<th>Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>H</td>
<td>Da</td>
<td>G</td>
<td>M</td>
<td>L</td>
<td>D</td>
<td>C</td>
<td>M</td>
</tr>
<tr>
<td>Kilo</td>
<td>Hecto</td>
<td>Deka</td>
<td>G</td>
<td>M</td>
<td>L</td>
<td>Deci</td>
<td>Centi</td>
<td>Milli</td>
</tr>
<tr>
<td>1,000</td>
<td>100</td>
<td>10</td>
<td>1</td>
<td>.1</td>
<td>.01</td>
<td>.001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How to Convert to a Larger unit
From a smaller unit?

- Move the decimal the same number of places the unit is from place over to the left
  the smaller unit
EX.

How to Convert to a Smaller unit
from a larger unit?

- Move the decimal place over to the right the same number of places
  the smaller unit is over from the larger unit
EX.
Volume = x x

How do I convert from L to m$^3$ to get the volume of an irregular solid? Or mL to cm$^3$?

What is the SI unit for Weight?

What is the difference between mass and weight?

Mass is the amount of _______ or stuff that something is made of & Weight is mass plus _______ pulling on it

Ex.

Density Formula = /volume =

Units Kg/m$^3$ or g/cm$^3$

How is knowing the density of an object helpful?

-You can predict whether it will float or sink in a liquid

Which one will sink? float?

Pg. 25 fig.14 Ex. Water & Ice

Variables & Graphs

*What is a VARIABLE?

*In an experiment there are 2 types of variables
  1.
  2.

 1. INDEPENDENT VARIABLE

-This is the variable we can ______________ in an experiment.
-Independent variables are ________________/_________ you start following your procedures
-On a Data Table this variable is on the _________ side.
-On a Graph it’s on the _________ axis
Examples of Independent variables:

- Time- every 30 seconds, every day, etc.
- Distance-every 0.5 meters, every 10.0 cm
- Amount-add 2.0 grams each trial

- Your book calls the independent variable the ____________ variable, because we manipulate or set it to our specifications
- The scientific community calls it the_________ variable

2. **DEPENDENT VARIABLE**

*This is the variable we _______________ or _______________ ahead of time in an experiment.
- ___________ during the experiment
* On a ____________this variable is on the __________ side.
* On a __________ it goes on the ______-axis

Example of a Dependent variable: **Temperature**

<table>
<thead>
<tr>
<th>Temperatures In NY City</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

*Your book calls the Dependent Variable the____________________ variable.

*The scientific community calls it the _________variable.
Controlled Experiment
- ________ variable is changing or being tested
- Sometimes a control trial or group is used for _________________ with experimental data

GRAPHING
- A Graph is a __________ or __________ that shows the relationship between changing things. It displays the relationship between __________ or __________.
- 3 Main Types of Graphs
  1. __________ 2. __________ 3. __________

7 Rules For Graphing
- **RULE # 1.** Always draw neat lines with a __________.
- **RULE # 2.** Make your graph is at least __________ to __________ page in size.
- **RULE # 3.** __________ (goes across the bottom of your graph) & __________ (the line that goes up & down on the left side of your graph)

Rule#4. ________ three places on your graph descriptively.
  1. __________
  2. __________ (with __________ in parentheses)
  3. __________ (with __________ in parentheses)

Ex. WHAT DOES YOUR GRAPH SHOW US?

2. Title the x-axis with the __________ variable

3. Title the y-axis with the __________ variable

**RULE #5.** Number the x and y axis with a regular numerical Sequence or Pattern to space out your data and fill the entire graph starting with Zero at the corner.

Ex: 1 2 3 4, 1 3 5, 2 4 6 8, 5 10 15 20 25,
0.5 1.0 1.5 2.0 2.5, 0.1 0.2 0.3 0.4 0.5,
0.25 0.5 0.75 1.0 1.25 1.5 1.75 2.0
RULE #6. Number the x and y axes on the lines (draw them) of the graph, not between the lines.
EX. (see the example graphs made in class)

RULE #7. If your graph shows more than one trial of data, or has more than 1 line,

-A key can be different colors, different lines, or patterns etc...

EX.

<table>
<thead>
<tr>
<th>Graph Rubric 12 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>• No Ruler=No Points!!!!!!</td>
</tr>
<tr>
<td>• Title for the Graph=+1</td>
</tr>
<tr>
<td>• “y” is place at the top of the y-axis =+1</td>
</tr>
<tr>
<td>• y-axis titled with units in parentheses=+1</td>
</tr>
<tr>
<td>• y-axis has a regular numerical sequence with lines next to each number=+1</td>
</tr>
<tr>
<td>• “x” is place at the end of the x-axis=+1</td>
</tr>
<tr>
<td>• x-axis titled with units in parentheses=+1</td>
</tr>
<tr>
<td>• x-axis has a regular numerical sequence with evenly spaced lines next to each number or bars even in width with categories listed below each one=+2</td>
</tr>
<tr>
<td>• Zero is at the corner of the graph=+1</td>
</tr>
<tr>
<td>• Data points plotted and connected with a Line or Bars are made to the height of the data &amp; filled in with different patterns or colors =+1</td>
</tr>
<tr>
<td>• If there is more than one trial of data, make a color or pattern key. =+2</td>
</tr>
</tbody>
</table>
Slope - How steep the line is on a ______ graph - Amount of ______ of the y-axis variable (Dep.) for every x-axis variable (IND.)

What does it mean when the slope is steep? * Change happens quick

Not steep/shallow? * Change is slower/gradual

Units for Slope = Dep. Unit / Ind. Unit EX

Formula Slope = \( \frac{\text{Rise}}{\text{Run}} \)

How do I show the work for calculations? formula = work with units = answer with units

**Ex.** Pg. 30 fig. 23
1. Slope of line between 10 min and 40 min.

**Ex.** Pg. 30 Math Analysis #1-4 (do not copy)
1.
2.
3.
4.
**Significant Figures**

Physical Sciences

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**What is a significant figure?**

- There are 2 kinds of numbers:
  - Exact: the amount of money in your account. Known with certainty.

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**What is a significant figure?**

- Approximate: weight, height—anything MEASURED. No measurement is perfect.

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**When to use Significant figures**

- When a measurement is recorded it should be to the place value of the accuracy of the instrument you measure with.

---

**When to use Significant figures**

- If you measured the width of a paper with your ruler you might record 21.7cm.
  
  To a mathematician 21.70, or 21.700 is the same.

---

**But, to a scientist 21.7cm and 21.70cm is NOT the same**

- 21.700cm to a scientist means the measurement is accurate to within one thousandth of a cm.

---

**But, to a scientist 21.7cm and 21.70cm is NOT the same**

- If you used an ordinary ruler, the smallest marking is the mm, so your measurement has to be recorded as 21.7cm.

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**How do I know how many Sig Figs?**

- Rule: All digits are significant starting with the first non-zero digit on the left.

---

**Exception to rule:** In whole numbers that end in zero, the zeros at the end are not significant if the instrument is not accurate to that place value.
### How many sig figs?
- 7
- 40
- 0.5
- 0.00003
- 7,000,000

### How many sig figs here?
- 1.2
- 2100
- 56.76
- 4.00
- 0.0792
- 7,083,000,000

### How do I know how many Sig Figs?
- **2nd Exception to rule:** If zeros are sandwiched between non-zero digits,

### How do I know how many Sig Figs?
- **3rd Exception to rule:** If zeros are at the end of a number that has a decimal, the zeros are significant.

### How do I know how many Sig Figs?
- 3401
- 2100
- 2100.0
- 500
- 0.00412
- 8,000,050,000

### How many sig figs here?

### What about calculations with sig figs?
- **Rule:** When adding or subtracting measured numbers, the accuracy of the answer is restricted to the place value of the least accurate measurement.
- 2.45cm + 1.2cm = 3.65cm in math class
- In science class we round to 2 sig figs: 3.7cm
- 7.432cm + 2cm = 9.432 \( \rightarrow \) 9cm

### Add/Subtract examples
- 56.328cm – 3.31cm = 53.018 \( \rightarrow \) 53.02cm
- 5g – 1.043g = 3.957 \( \rightarrow \) 4g
**Multiplication and Division**

*Rule:* When **multiplying or dividing**, the answer will be to the least amount of sig figs

<table>
<thead>
<tr>
<th>A couple of examples</th>
<th>A couple of examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>56.78 cm x 2.45 cm = 139.111 ( \rightarrow ) 4sf x 3 sf = 3sf ( \rightarrow ) 139cm²</td>
<td>50g</td>
</tr>
<tr>
<td>75.8 cm x 9.6 cm = ?</td>
<td>730cm³</td>
</tr>
<tr>
<td>3sf x 2sf = 2sf</td>
<td>3445g/70 = ?</td>
</tr>
</tbody>
</table>

**A-49.21g**

70 is not a measurement

<table>
<thead>
<tr>
<th>More Examples .....</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
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<tr>
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<tr>
<td>0.001</td>
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<tr>
<td>0.0100</td>
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</table>