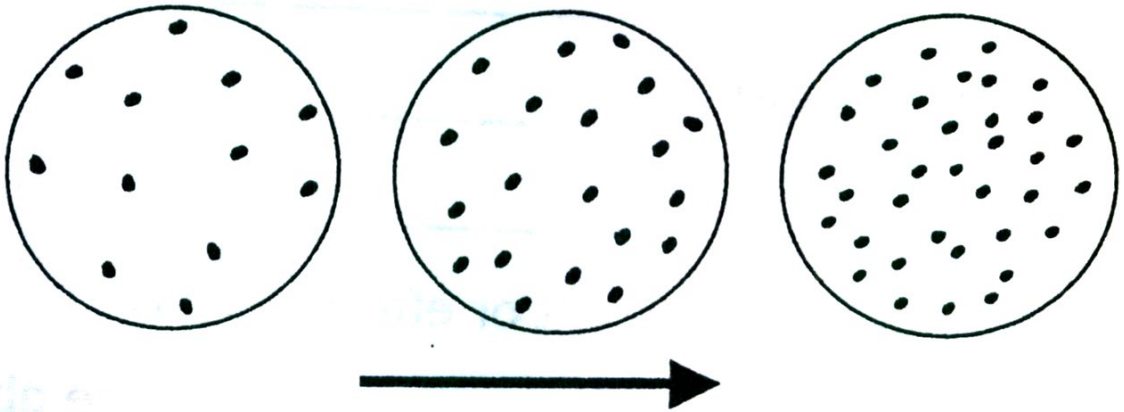
G. Density

The concentration of matter in an object; the ratio of mass per unit volume

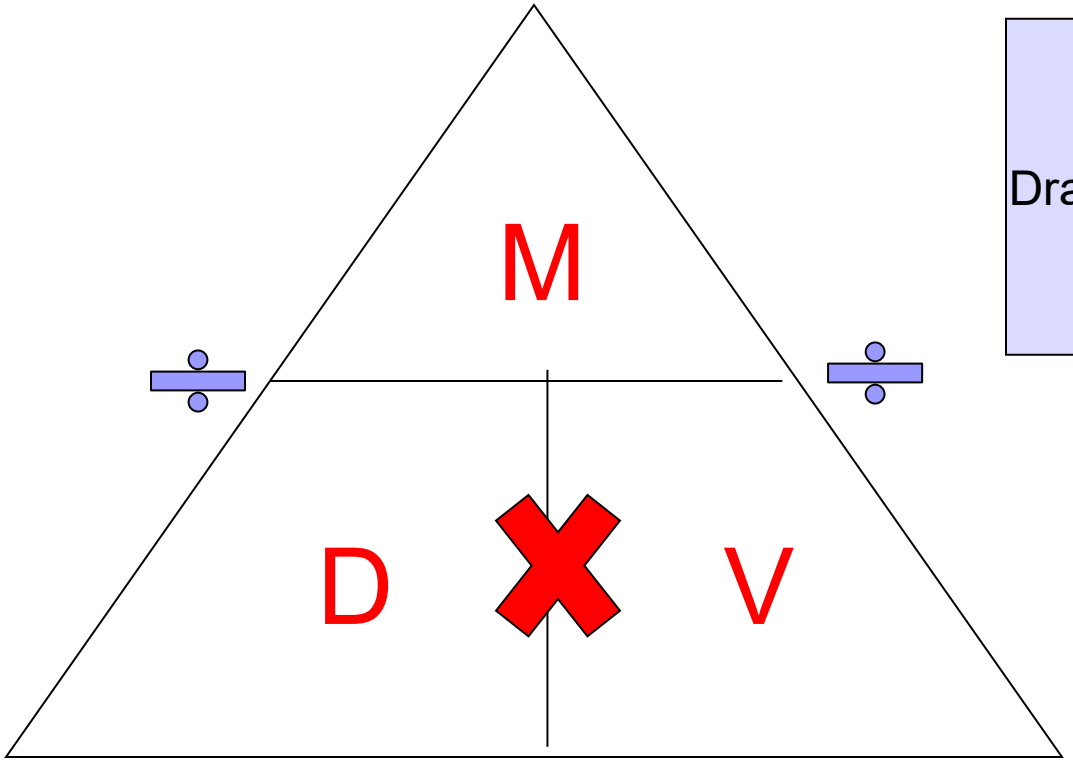


How does concentration of matter change from circle 1 → 3?

Increases; as you go to the right there is a higher concentration of dots, which means it is more dense!

1. Formula:

$$\text{Density} = \frac{\text{MASS}}{\text{VOLUME}}$$



Draw the division signs in your notes

Not in notes!

A handy little way of dealing with the 'density equation',

$$D = \frac{M}{V}$$

Just put M over V and divide. No problem.

But what if you're given D and M and asked to solve for V? What If you're given D and V and asked to solve for M? What now?

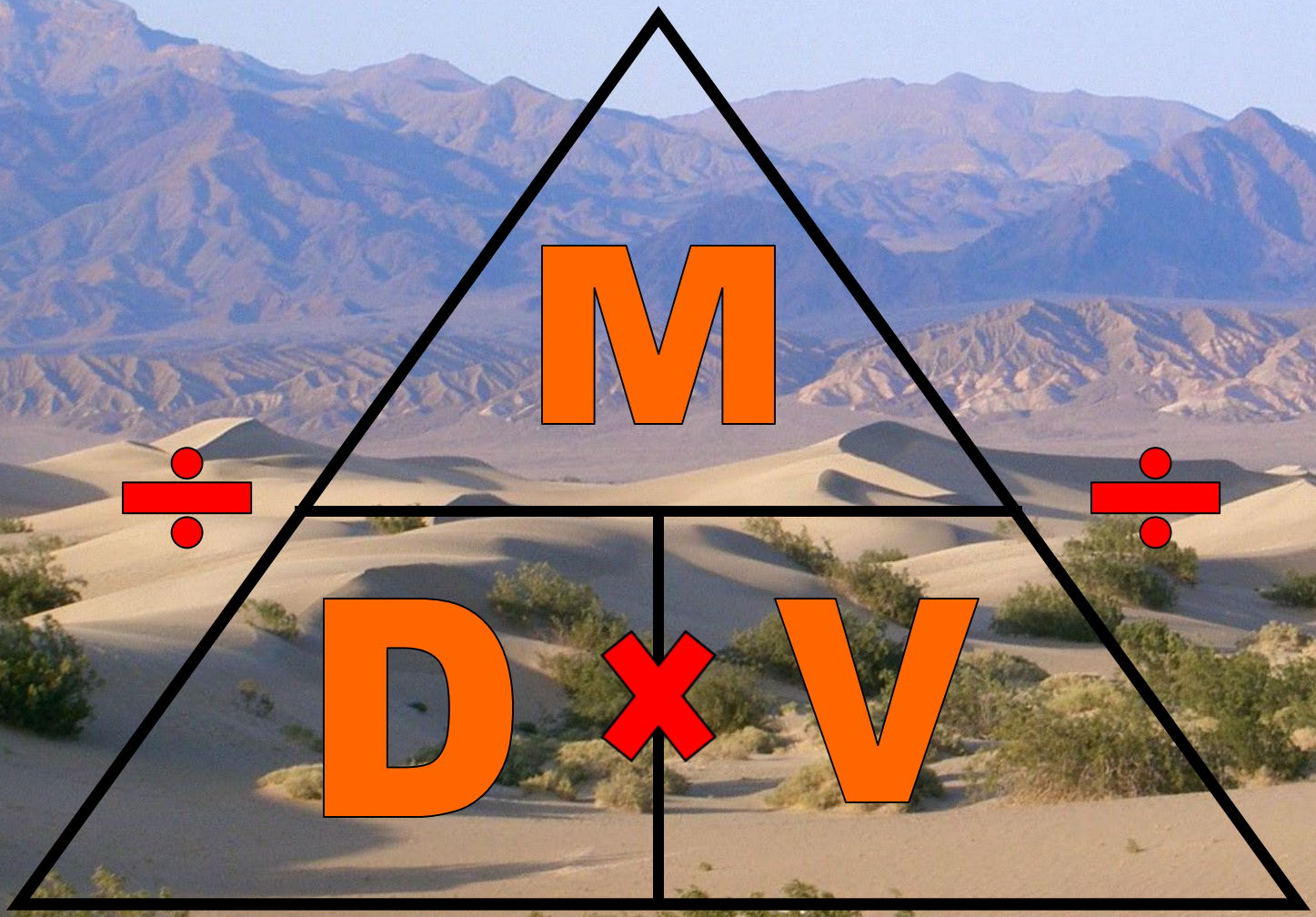
EASY! Just remember "Mountains over Deserts and Valleys"


Mountains up here and ….
Deserts and valleys down here.

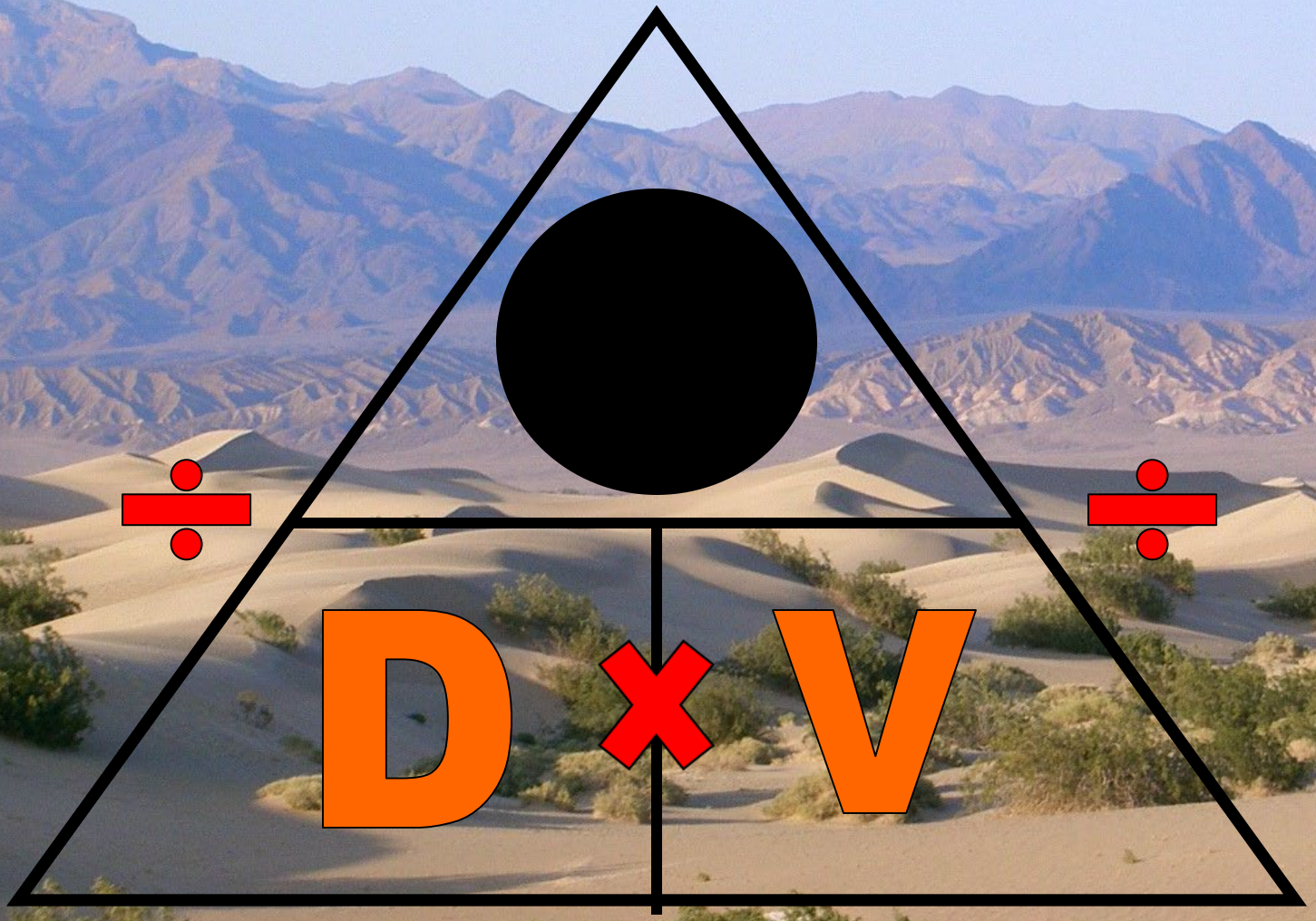
Now draw a triangle……

And draw these lines

Insert M for mountains, D for deserts and V for valleys

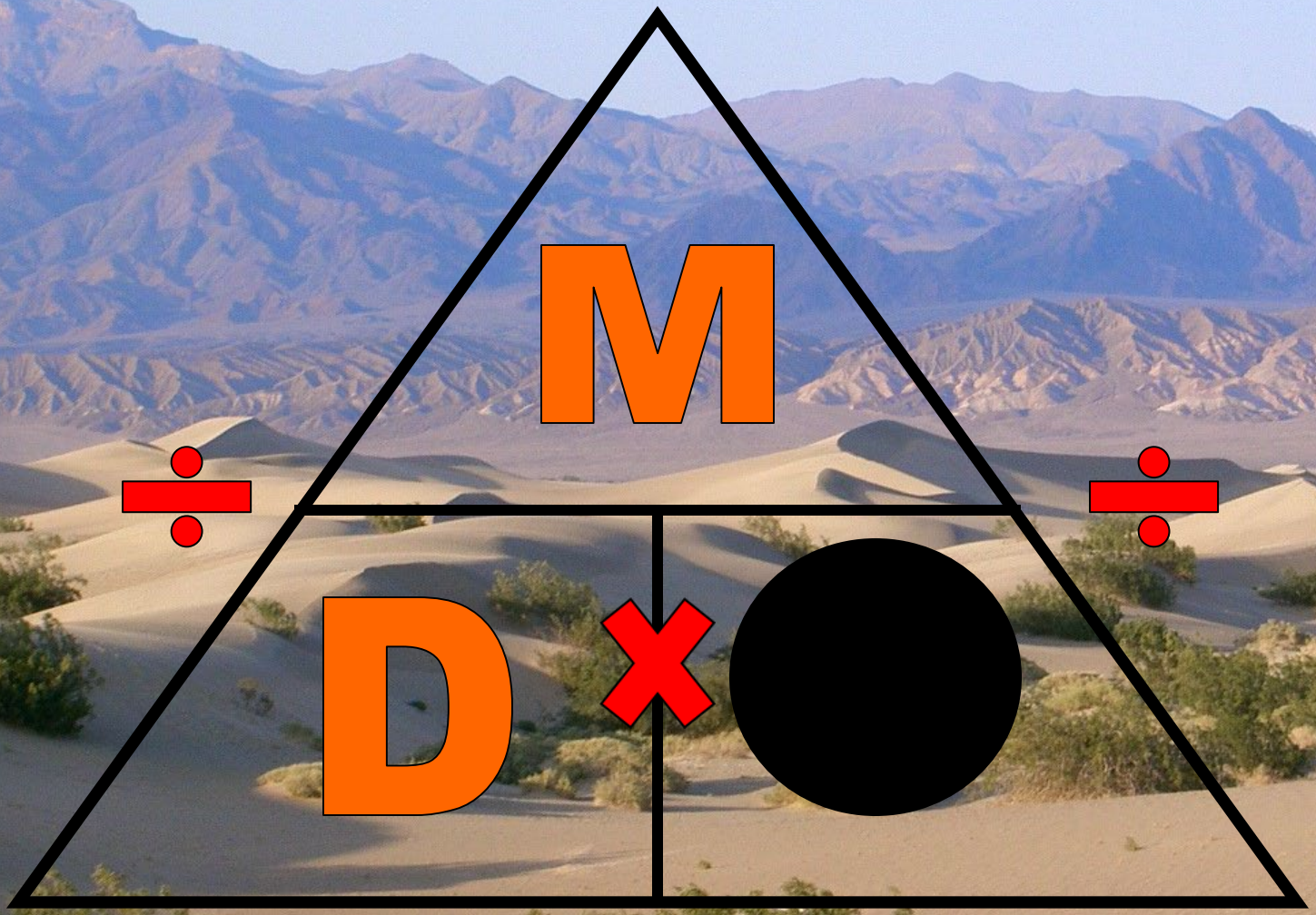


All you have to do is COVER whichever term you want to solve for.
For instance, if you need to solve for mass, just cover the ‘M’.
You’re left with DV so M = DV

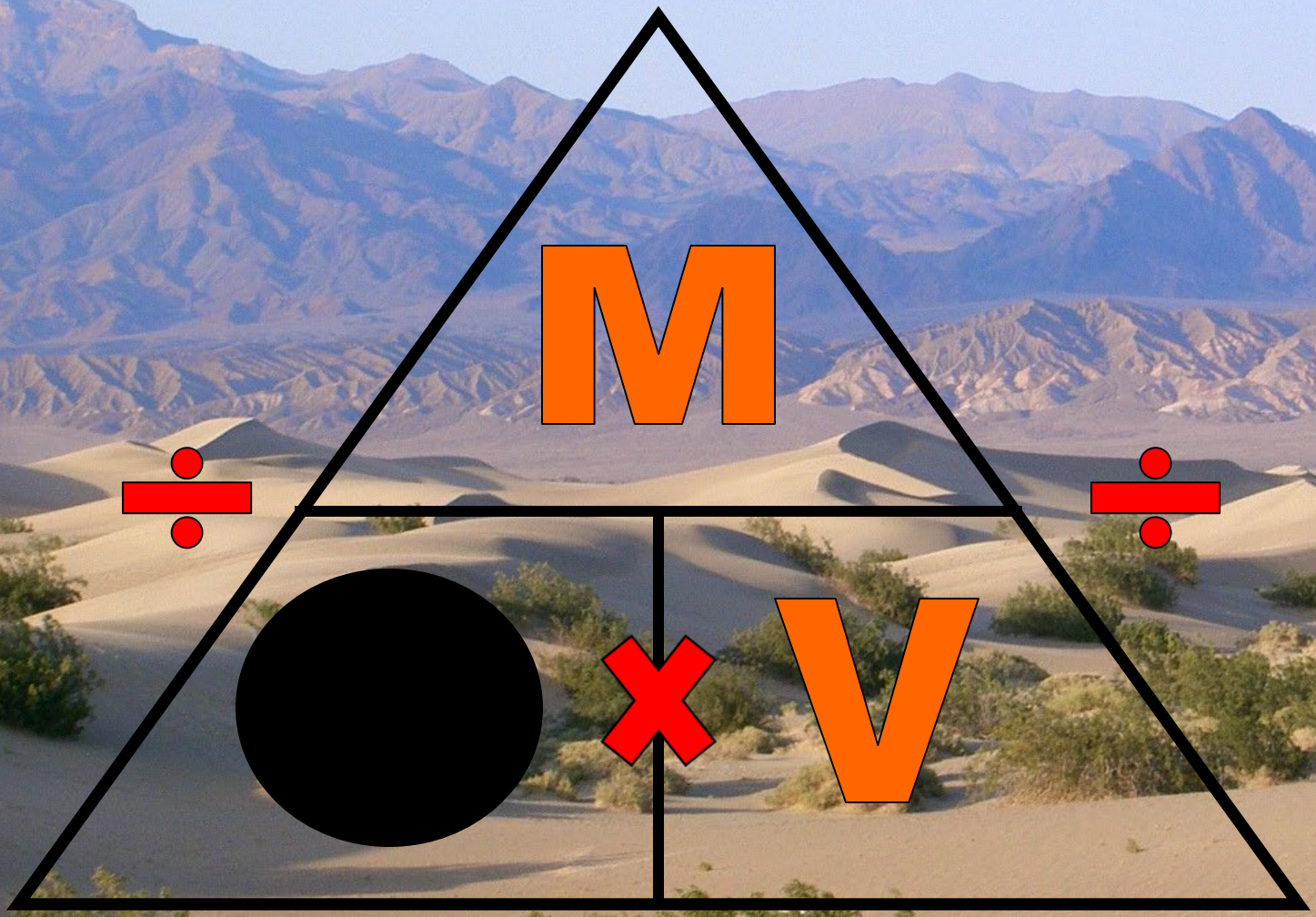


To solve for volume, just cover the “V”.

That leaves M/D so V = M ÷ D



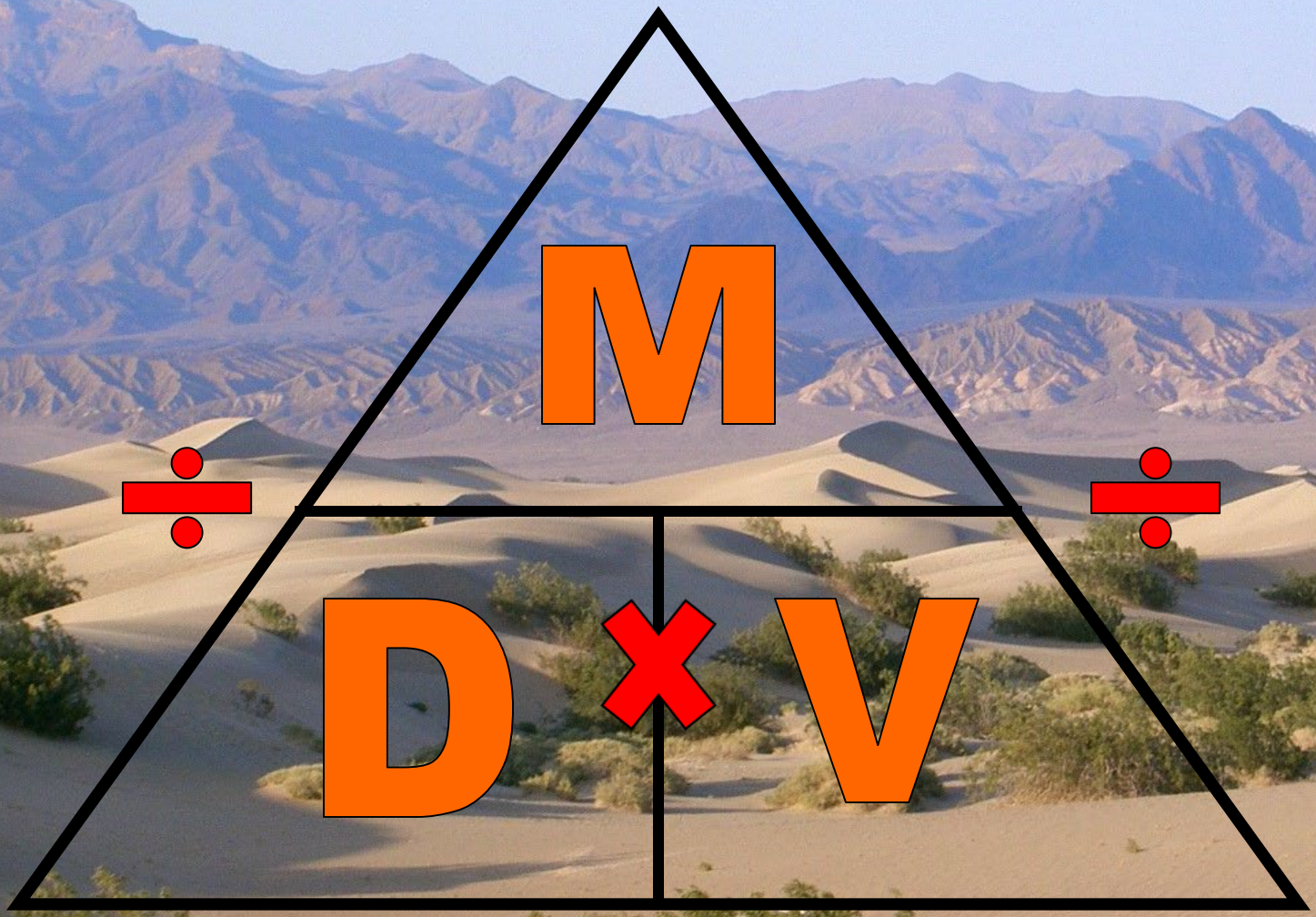
And of course density, ‘D’ equals M ÷ V



So just remember……

Mountains over deserts and valleys

And then check your math…….twice!



- 2. Instruments

p. 7

  - a. Density of a liquid

graduated cylinder +

To find volume…

  - b. Density of a solid

ruler + triple beam balance/scale

To find volume… To find mass…

- 3. Units for Density (what units do we use for mass? For volume?) Just combine them!

a) g/cm^3

b) g/mL

4a. Individual Practice:

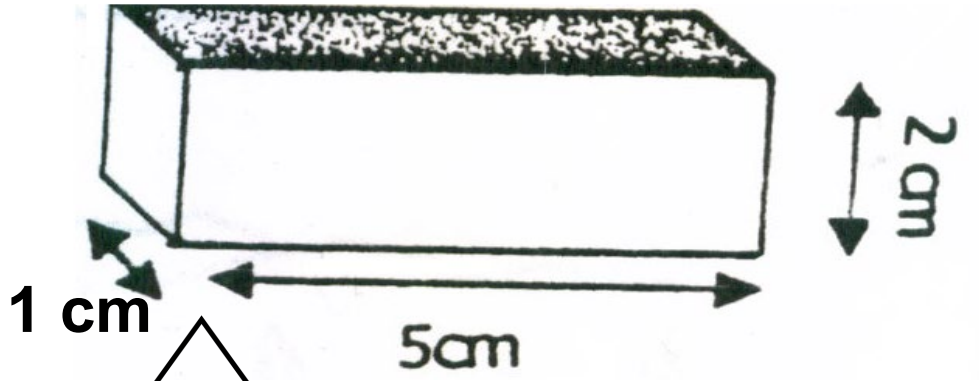
a. The dimensions of a rectangular solid object is given as illustrated below. Given that this object has a mass of 150 grams, determine the density of the object. (Not drawn to scale)

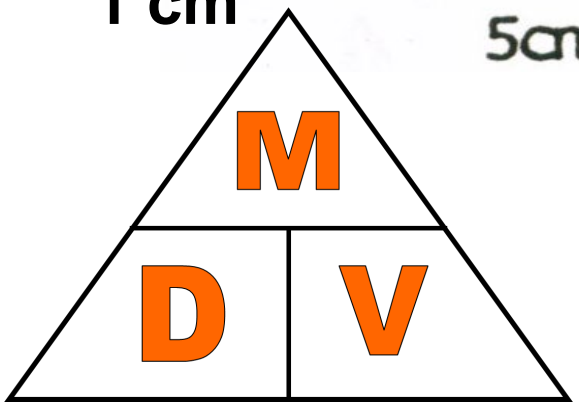
Show Work:

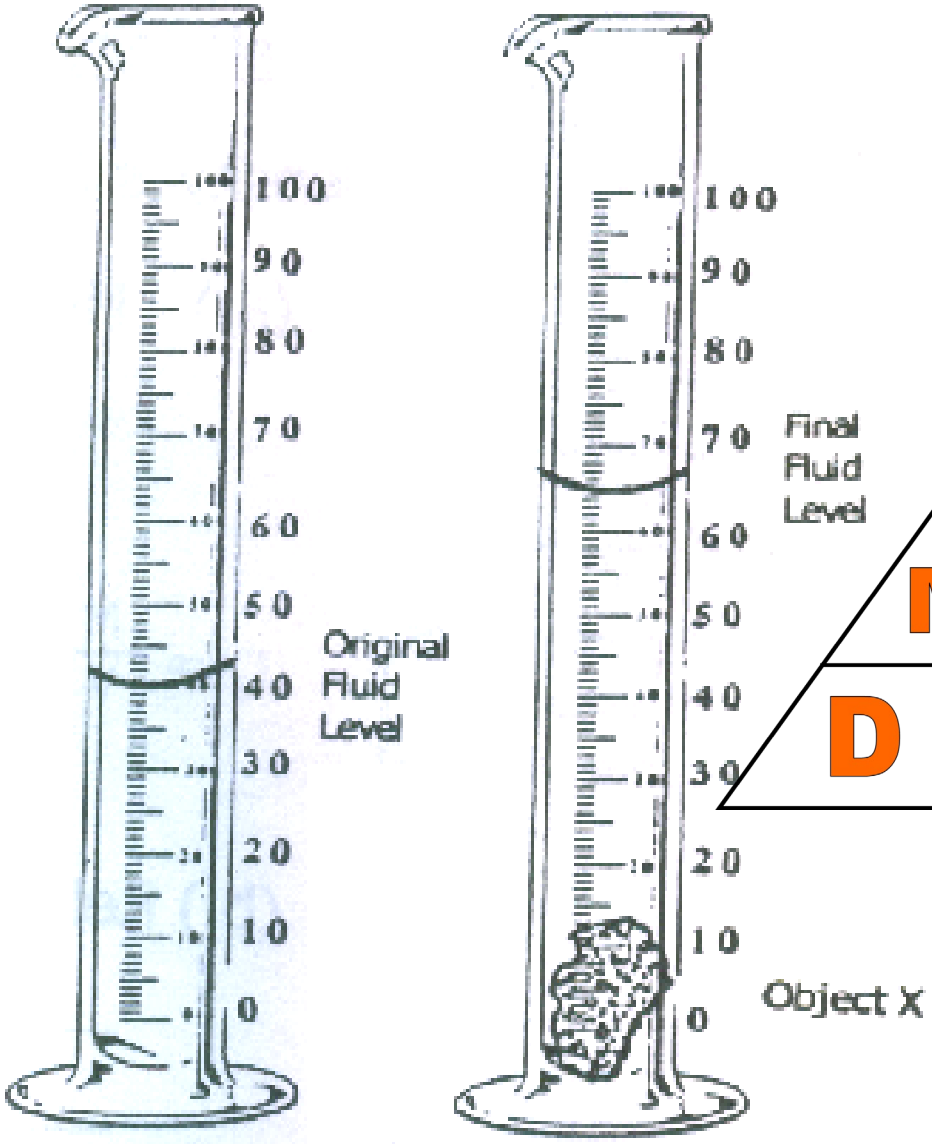
D = m/v

D= 150 g/ 10cm^3

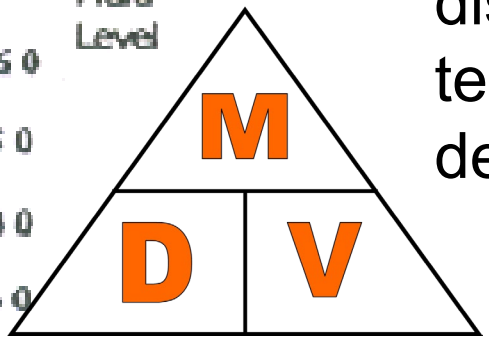
D= 15 g/cm^3







- b. In your notes, solve this problem.
  - Object “x” has a mass of 80 grams.
  - Use the water displacement technique to find the density of object x.



3.2 g/ mL

Mass = 80 g

Volume = 65mL – 40mL = 25mL

Density = 80g/ 25 mL = 3.2 g/mL

- c. Object "Y" is a perfect cube. The density of Y is 5.5 g/cm^3.

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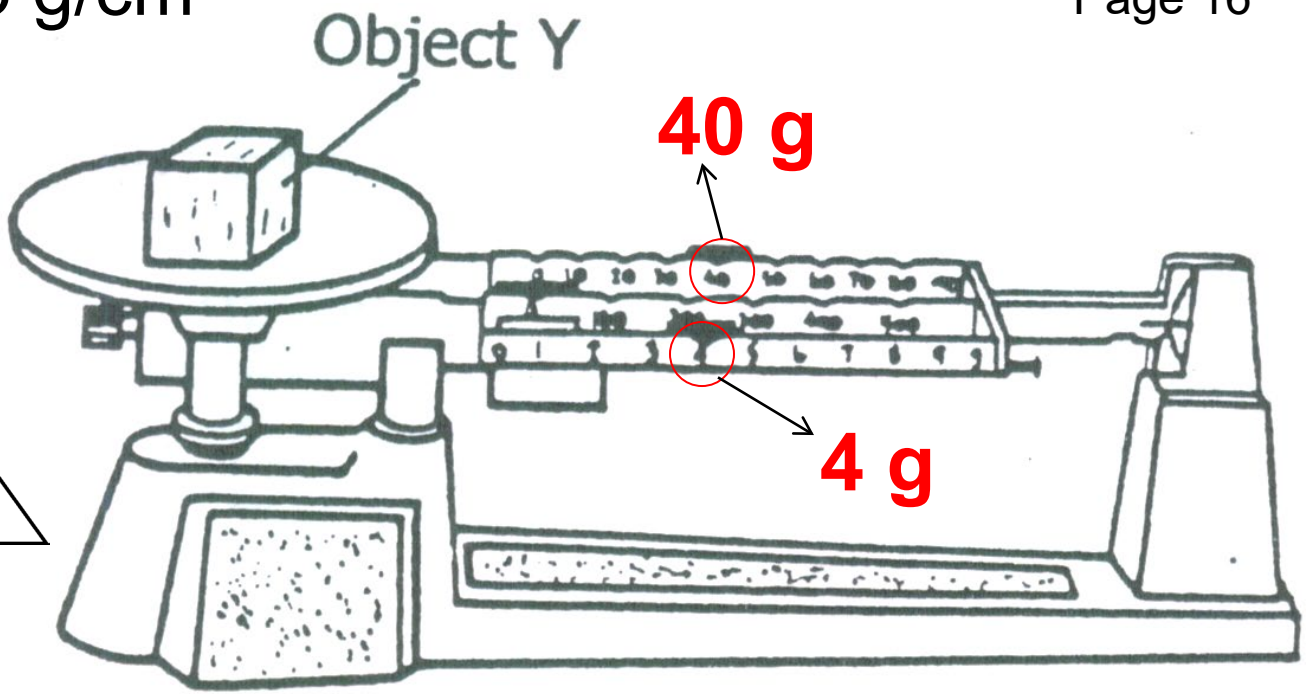
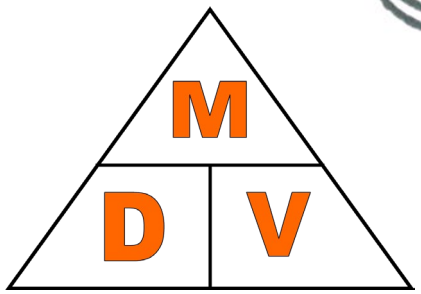




1. What is the mass of object Y? **44 g**
2. Calculate the volume of object Y? **8 cm^3**
3. Since object Y is a perfect cube, determine the length of each side of that cube. **2 cm**

Page 13

Liquid Layers

- If you pour together liquids that don't mix and have different densities, they will form liquid layers.
- The liquid with the highest density will be on the bottom.
- The liquid with the lowest density will be on the top.

Liquid Layers

- Check out this picture Which layer has the highest density? green
- Which layer has the lowest density? beige
- Imagine that the liquids have the following densities:
  - $10 g/cm^3$. $3 g/cm^3$.
  - $6 g/cm^3$. $5 g/cm^3$.
- Which number would go with which layer?

Choose different size pots to fill a container in the least number of pours.


INSTRUCTIONS
By only pouring liquid from the large container to the small, and some times emptying and refilling the containers, you must find from 1 quart to 8 quarts. Each time either of the containers has a volume you need, drag it onto the correct number on the right.
1
2
3
4
5
6
7
8
PLAY GAME

Another Classroom Example
Galileo Thermometer

http://www.4physics.com/phy_demo/Galileo_thermometer/galileo-thermometer-a.html

Explain how a Galileo Thermometer works….

More or less…. Complete each phrase

Write the one on the left In your do, now!

- As the clear liquid heats up, it expands, becomes **less** dense than the liquid in the balls, causing the balls to rise!

- As the clear liquid cools, it contracts, becomes **more** dense than the liquid in the balls, causing the balls to sink!

Drawing Comparisons

- List some similarities and differences of the two cans below.

vs.

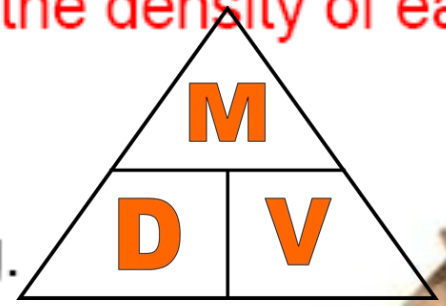
Hypothesize why this happens?

Coke (355 mL)	Diet Coke (355 mL)
Water=355g	Water=355g
Sugar= 39 g	Sugar= 0g
Nutra Sweet= 0 g	Nutra Sweet= .1 g
TOTAL MASS:	TOTAL MASS:

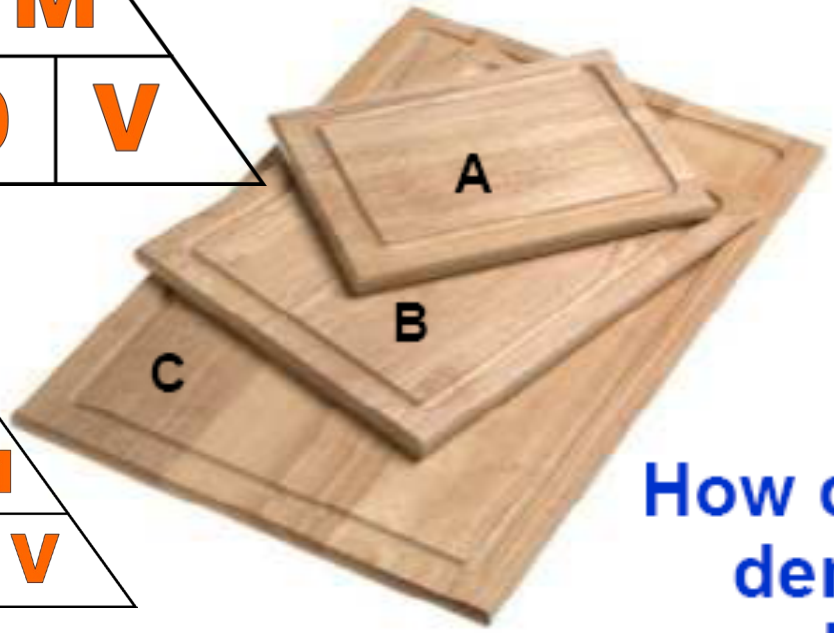
H. Density Relationships

Not in notes come to board use fill in the triangle & use calc!

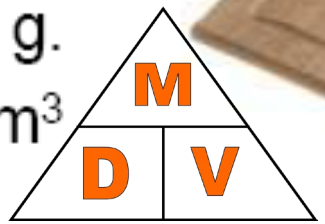
- **1. Density in Relation to Size**
  - Calculate the density of each piece of maple wood



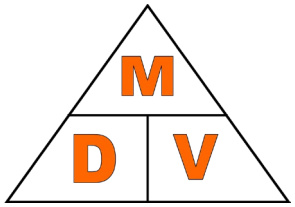
- A→ mass of 5 g.
  volume: 1cm^3



- B→ mass of 10 g.
  volume: 2cm^3



- C→ mass of 20 g
  volume: 4cm^3



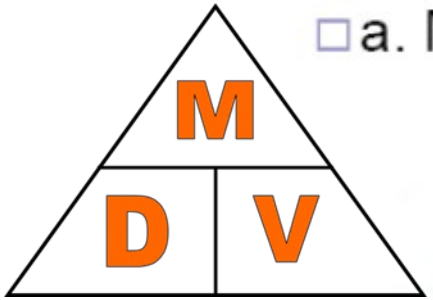
How does the density of each size of wood compare?

Size does not matter!

H. Density Relationships

1. Density in Relation to Size

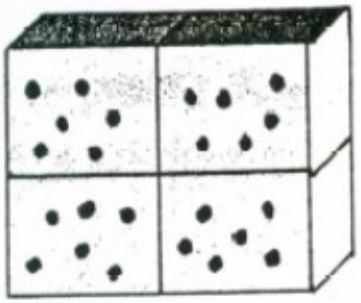
a. Model Problem



Total mass: **6**

Total volume: **1**

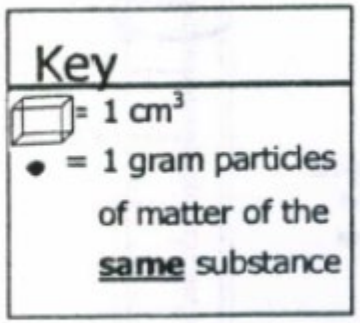
Density: **6 g/cm3**

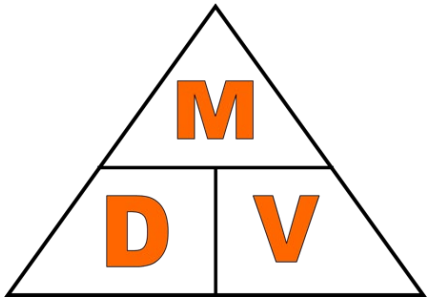


Total mass: **24**

Total volume: **4**

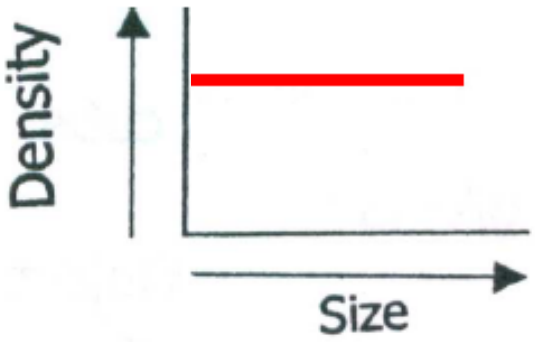
Density: **6**





- Relationship…

The size of an object does not determine (effect) Its density



Two different volumes of gold will have the same exact density.

D=19.3 g/cm^3

D=19.3 g/cm^3

H. Density Relationships

2. Density in Relation to Temperature

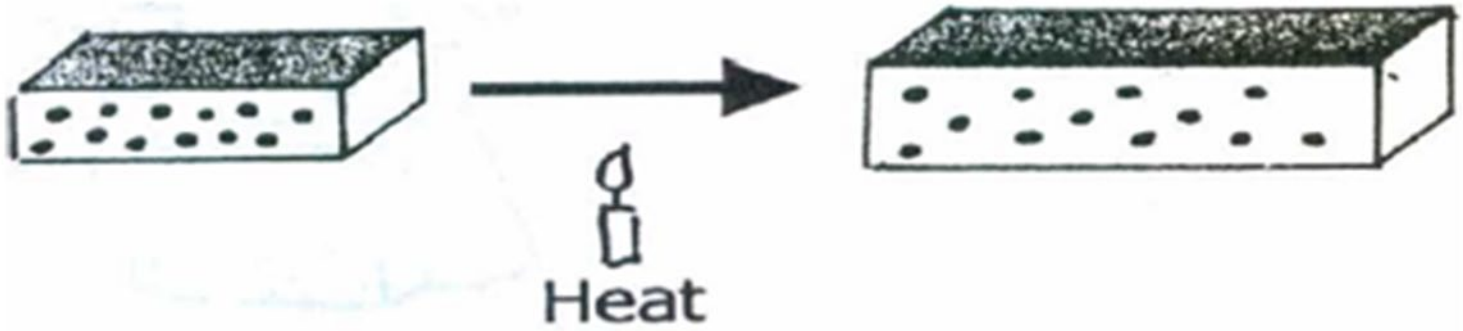
Click picture below to view video…

How does temperature seem to affect density?

2. Density in Relation to Temperature

Key
• = particle of matter/1 gram

- h Model Problem

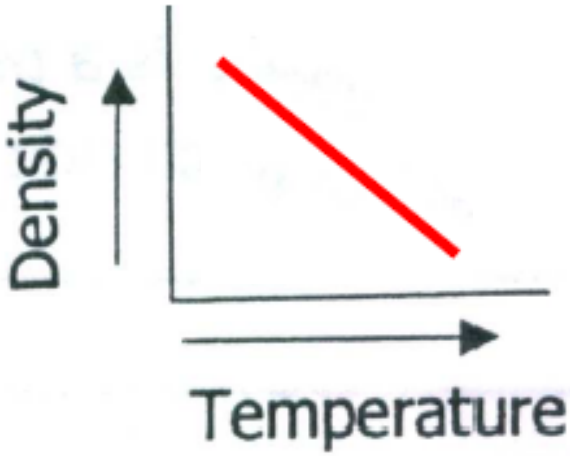


1. volume- increases (expands/liquid rises) (↑)
2. mass- remains the same (just more spread out)
3. density- Decreases (↓)

Relationship…

i **as temperature increases, density decreases**

How would we draw the line on this graph?

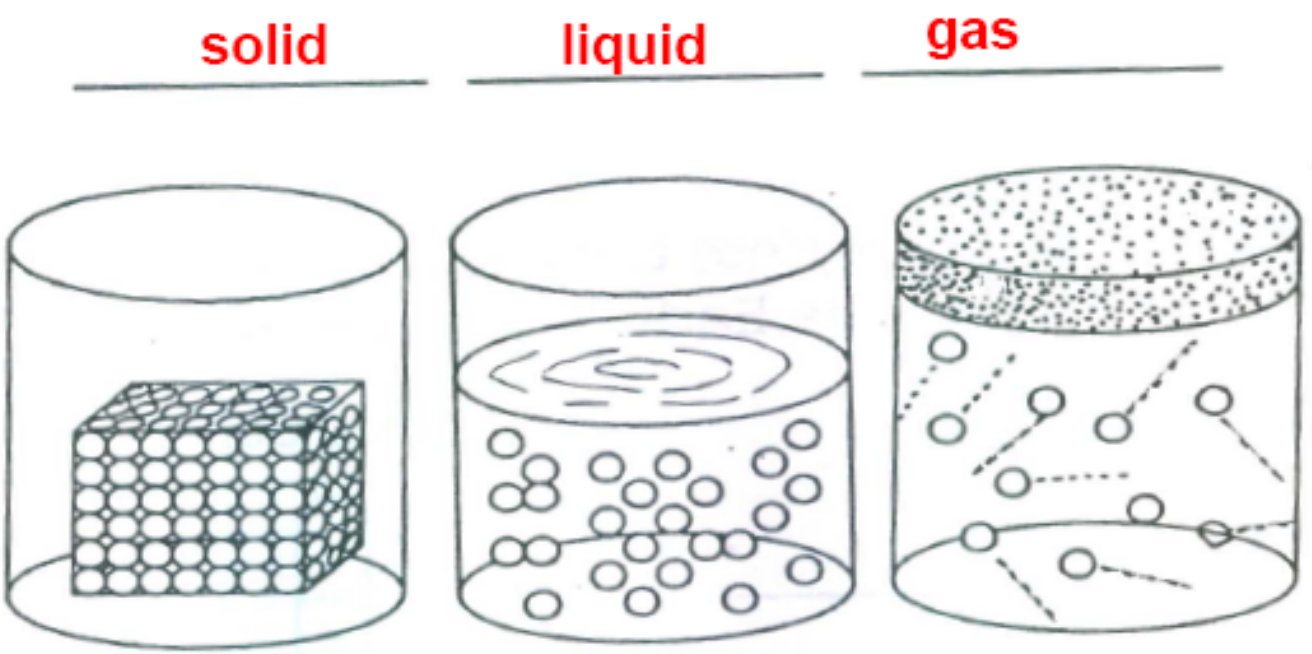


Another temperature vs. density experiment that you can try at home!

http://www.teachersdomain.org/resource/phy03.sci.phys.descwrld.zhot/

3. Density in Relation to State of Matter

- a. Determine which glass resembles the properties of a a substance at solid, liquid, and gas state.



b) Density decreases as a substance goes from solid→ gas

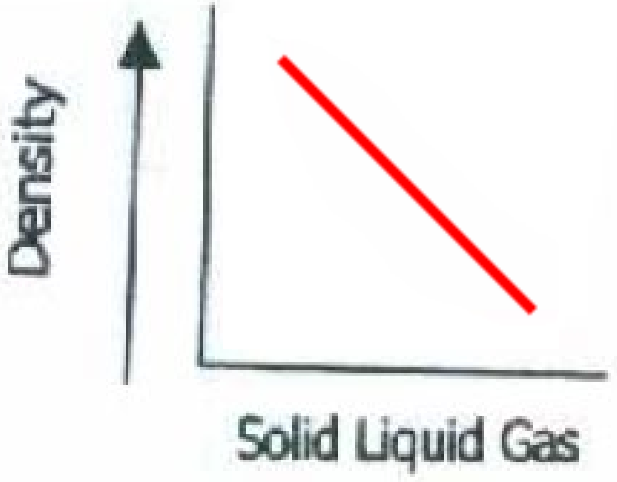
c. *Water has a maximum density as a liquid!

(This is the one exception to all materials)

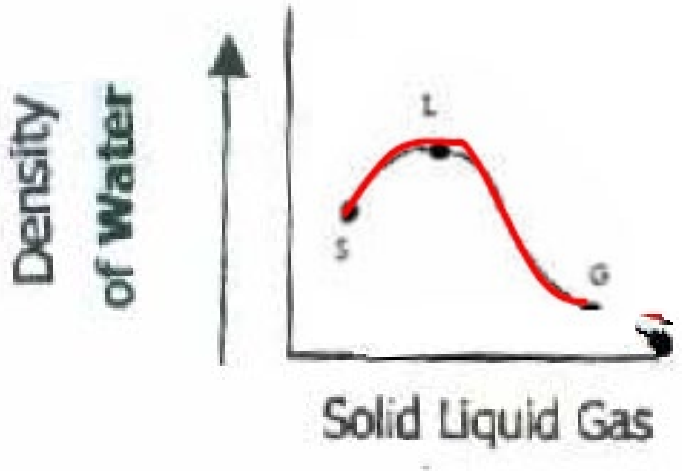
***the density of water is 1.0g/mL or 1.0g/cm3 **

d. In your notes, draw an appropriate graph according to what you have just learned.

(1)

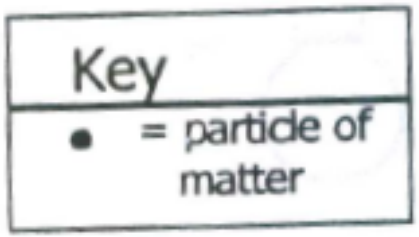


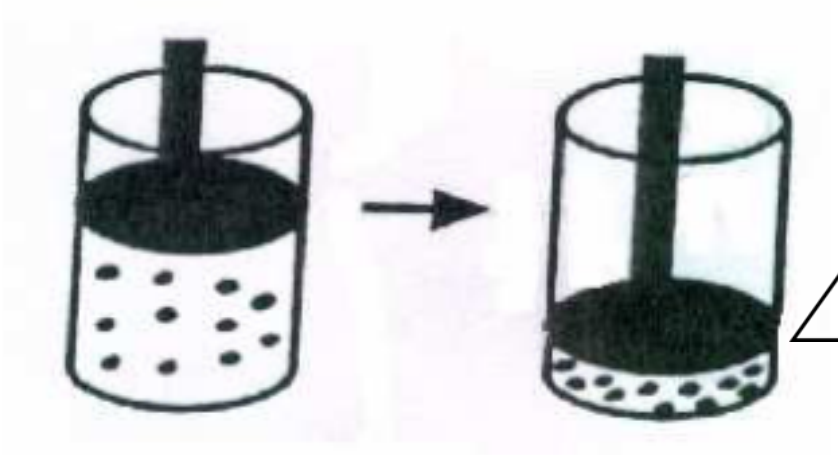
(2)

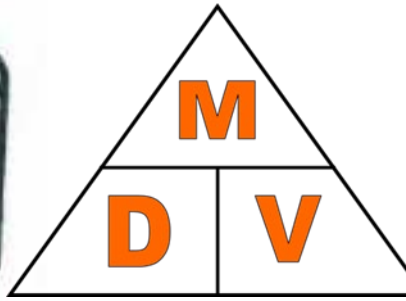


4. Density in Relation to Pressure (on a gas)

- a. Model Problem



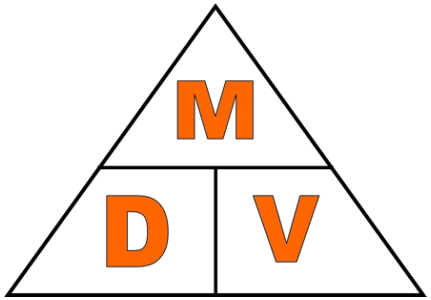




- 1. volume- decreases
  2. mass- remains the same
  3. density- Increases

Ex: $10g/20cm^3 = .5$

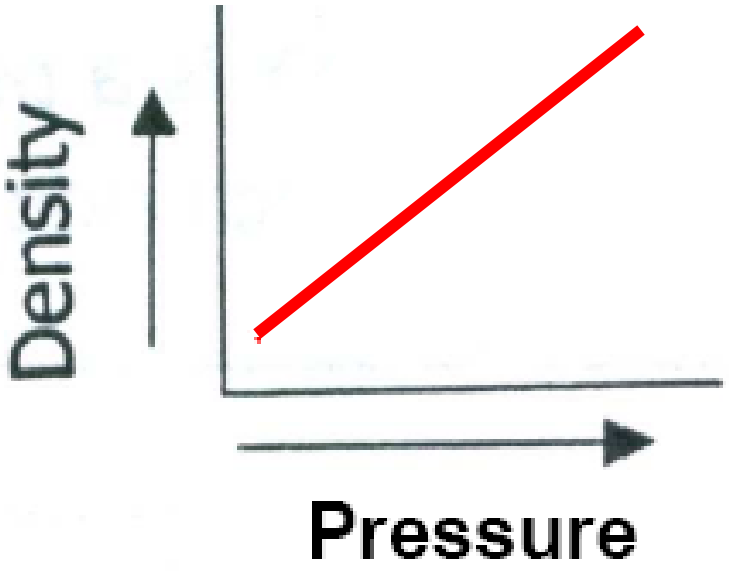
$10g/10cm^3 = 1$ (higher)



Relationship…

- b. as pressure increases, density increases

- c. pressure vs. density graph



Closure Video- Review of Density

http://www.teachersdomain.org/asset/phy03_vid_zoil/

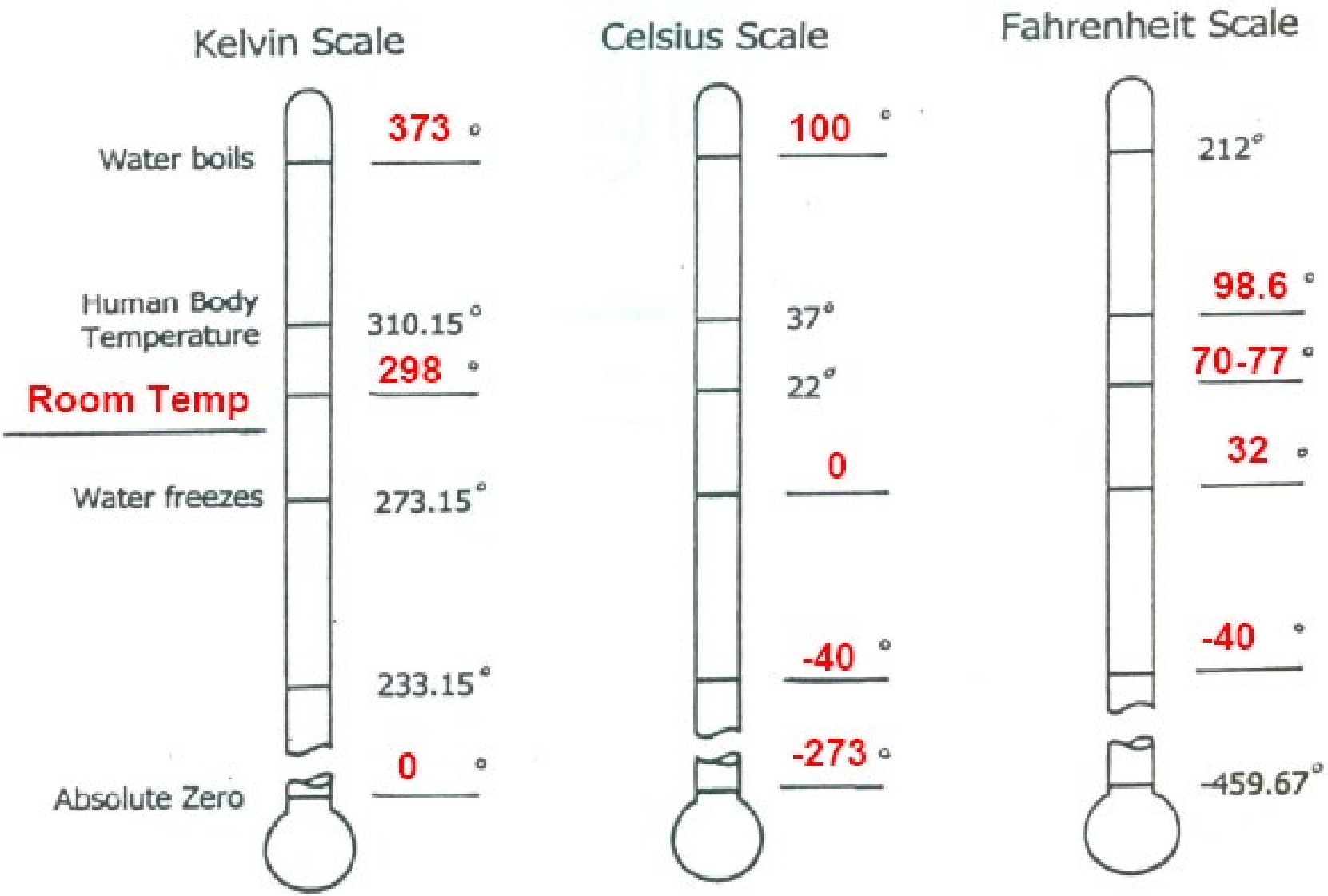
The Big Mix

- Temperature conversions
- % error
- rate of change
- scientific notation
- cyclic/non cyclic events
- graphical relationships

Mrs. Soto

I. Temperature- the average kinetic energy of a material → (energy in motion)

- 1. **instrument-** thermometer
- 2. **Units-** degrees (°)
  - a. Fahrenheit
  - b. Celsius
  - c. Kelvin


Kelvin Scale
Water boils
373 °
Human Body Temperature
310.15°
298 °
Room Temp
Water freezes
273.15°
233.15°
0 °
Absolute Zero
Celsius Scale
100 °
37°
22°
0
-40 °
-273 °
Fahrenheit Scale
212°
98.6 °
70-77 °
32 °
-40 °
-459.67°

Temperature Conversion Formulas

$$^{o}K = {}^{o}C + 273.15$$

$$^{o}C = \frac{^{o}F - 32}{1.8}$$

$$^{o}F = 1.8\,(^{o}C) + 32$$

- Turn to the last page of your notes!

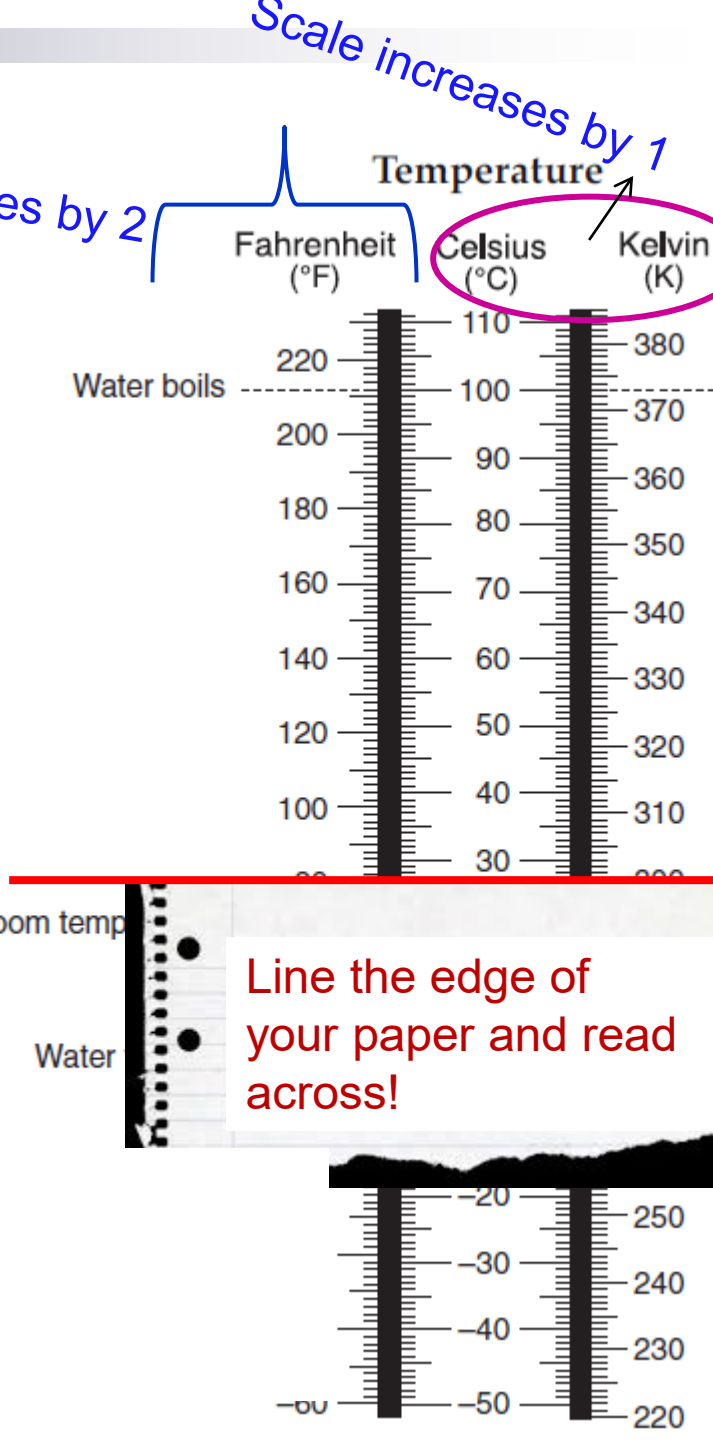
What does the Fahrenheit scale increase by???

What does the Celsius scale increase by???

Practice

What does the scale Kelvin scale increase by???

- 27 ° C = 80 °F
- 100 °F= 38
- 89 °C= 362 °K



Percent Deviation

- Determining the accuracy of data collected
- Instruments
- Observations
- A measure of how much you messed up your calculations

$$\% \text{ deviation} = \frac{\text{diff. between meas.\& accepted val.}}{\text{Accepted value}} \times 100\%$$

Key Terms

Accepted Value:

- Real Value
- True Value
- Actual Value

Measured Value:

Students Value
Experimental Value
Determined Value

$$\% \text{ deviation} = \frac{\text{diff. between meas.\& accepted val.}}{\text{Accepted value}} \times 100\%$$

Know Your Fractions!!!

Numerator → 1

(put in calculator first!) ———

Denominator → 2

(put in calculator second!)

Percent Deviation

- What is the percent deviation of Joe's Rocks and Minerals exam from the class average? Joe's grade was an 80 and the class average was a 70.

$$\% \text{ deviation} = \frac{\text{diff. between meas \& accepted val}}{\text{Accepted value}} \times 100\%$$

80-70 =10

$$\frac{10}{80} = .125 \times 100\% = 012.5$$

% Error Examples:

- 1. A student measures the length of a room to be 4.64 meters. The actual length of the room is 5.80 meters. What is the students percent error?

a. 6.0 %

b. 8.0%

c. 14.0%

d. 20.0%

$$\%\ \text{deviation} = \frac{\text{diff. between meas \& accepted val}}{\text{Accepted value}} \times 100\%$$

- 2. You measure the density of rock "x" to be .8 g/cm^3. Rock "x" has a known density of 1.1 g/cm^3.What is your percent error?

$$\% \text{ deviation} = \frac{\text{diff. between meas \& accepted val}}{\text{Accepted value}} \times 100\%$$

27.3%

Rate of Change

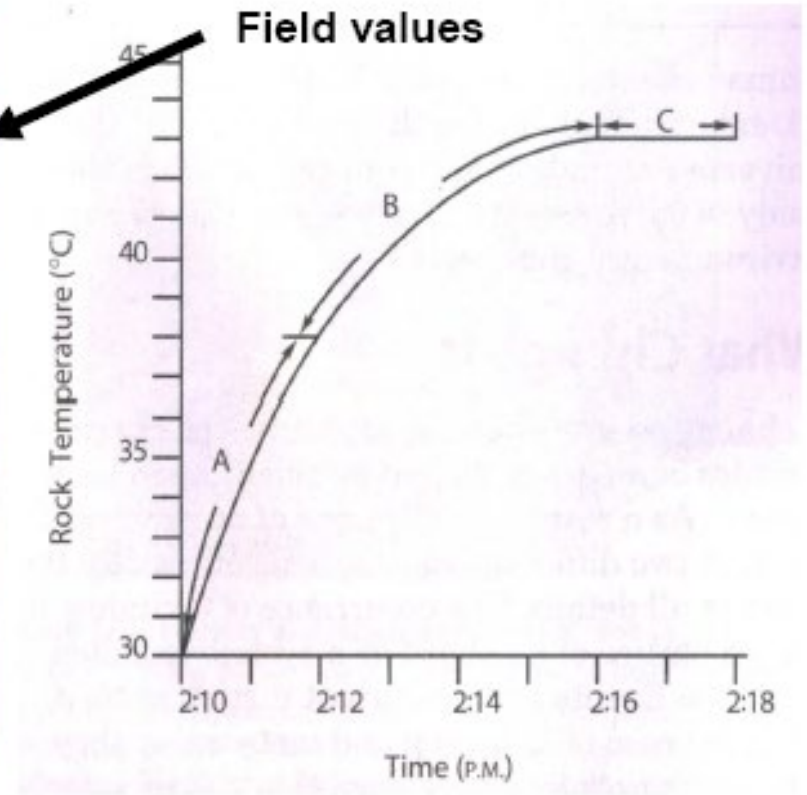
- Change can be described as the occurrence of an event. Events may be almost instantaneous, as in the case of lightning and meteors, or they may occur over long periods of time, as in changes in sea level or elevation of mountains.

$$\text{Rate of Change} = \frac{\text{change in "field" value}}{\text{change in time}}$$

Example:

Based on the data below, what is the rate of change in rock temperature from 2:10 PM to 2:13 PM?

Time (P.M.)	Rock Temperature (°C)
2:10	30
2:11	33
2:12	38
2:13	40
2:14	41
2:15	42
2:16	43
2:17	43
2:18	43



Answer: 3.3 °C/hr

- 2. Refer to the following data table. At approximately what rate did the temperature rise inside the green house between 8:00 AM and 10:00AM?

  a. 1.0ºC/hr

  b. 2.0ºC/hr

  c. 0.5ºC/hr

  d. 12.0ºC/hr

Answer: A

Time Average	Greenhouse Temperature
6:00 AM	13°C
8:00 AM	14 °C
10:00 AM	16 °C
12:00 noon	20 °C

Scientific Notation

- Rules: (coefficients must be between 1 and 9)
  - 1. if your coefficient is raised to a positive #, move the decimal to the right.
    - Ex: $5.14 \times 10^{5} = 514000.0$
    - Ex: $5.61 \times 10^{1} = 56.1$
  - 2. if your coefficient is raised to a negative #, move your decimal to the left.
    - Ex: $5.62 \times 10^{-2} = .0562$
    - Ex: $5.765 \times 10^{-4} = .0005765$

Converting Real Numbers → Scientific Notation

*If your number is larger than 1 → positive exponent

*If your number is a decimal than → negative exponent

- Ex: .000345 = 3.45×10^{-4}
- Ex: 24,327 = 2.4327×10^{4}

- Ex: 0.0078 = 7.8×10^{-3}
- Ex: 750,000 = 7.5×10^{5}

Cyclic vs. Non-Cyclic Events

- A non-cyclic event is an un-predictable and non repeating one
  - Ex: earthquakes, volcanic eruptions, snow storms
- A cyclic event is an event that is predictable and repeatable
  - Ex: sunrise/sunset, phases of the moon, tides, yearly temperatures

Graphical Relationships

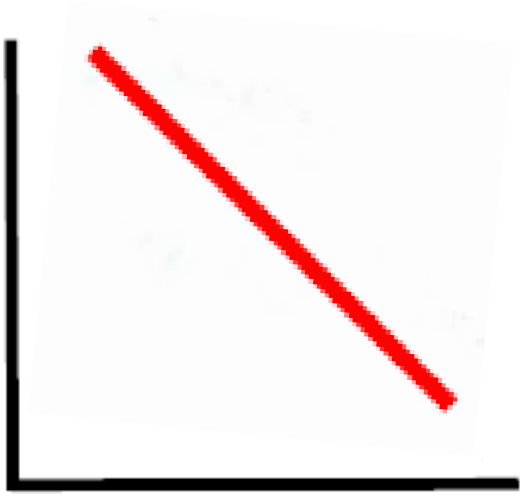
Direct Relationship

As one variable increases, the other increases.

Graphical Relationships

Inverse Relationship

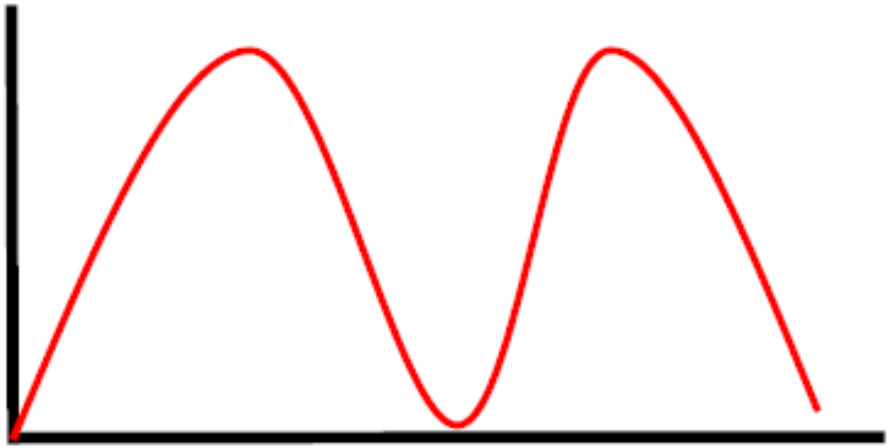
As one variable increases, the other decreases



Graphical Relationships

Cyclic Relationship

As one variable increases, the other Changes in a predictable way



Graphical Relationships

No Relationship

As one variable increases, the other _____