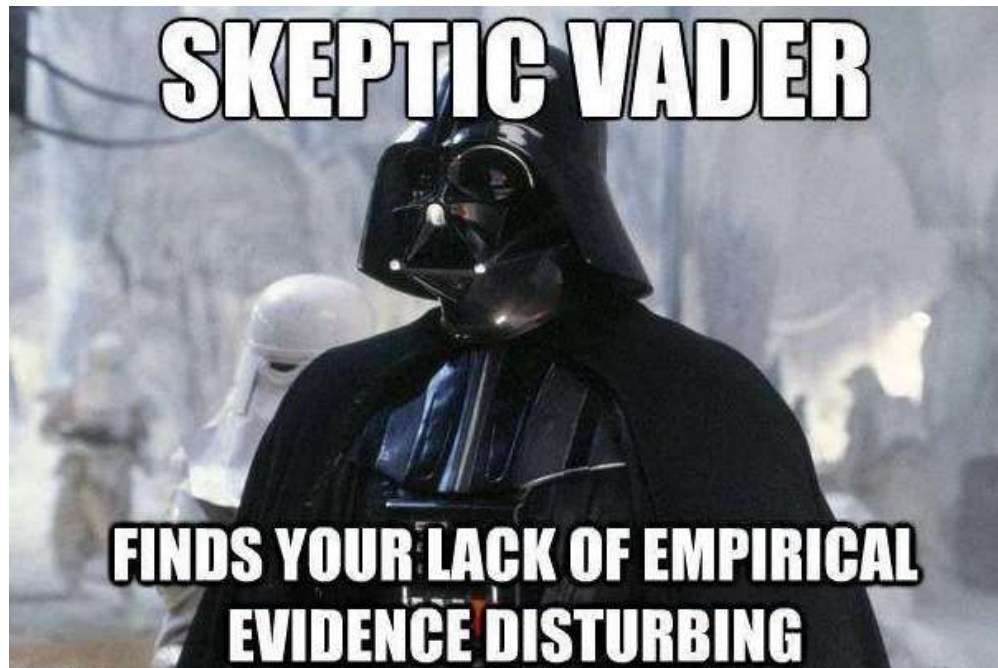


Friday, August 23, 2019

**Welcome to Investigative Science
with Mr. Fireng**



1. Get out your stampsheet
2. Get out your homework
3. Write tomorrow's homework in agenda
4. START WORKING QUIETLY

Investigative Science



Learning goal: Properly apply all steps in the scientific method when problem solving.

Learning goal: Properly apply all steps in the scientific method when problem solving.

Learning scale:

1	2	3	4
Name the steps	Name the steps and follow directions in an investigation	Can design and conduct an investigation leading to a conclusion	Design and carry out an investigation leading to a valid and rational conclusion

Student's self-evaluation: Complete at home or at the end of class, use the **4-3-2-1** Learning scale (two to three sentences).



4 Design, complete, valid conclusion
3 Design & complete
2 Know steps, follow directions
1 Know the steps

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Multi Step Dimensional Analysis

Write all Cues!!



What is Multi Step Dimensional Analysis?

4 steps of multi-step dimensional analysis

1.

2.

3.

4.

EXAMPLE:

Summary

4

Design, complete, valid conclusion

3

Design & complete

2

Know steps, follow directions

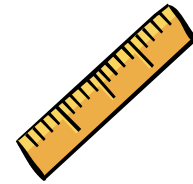
1

Know the steps

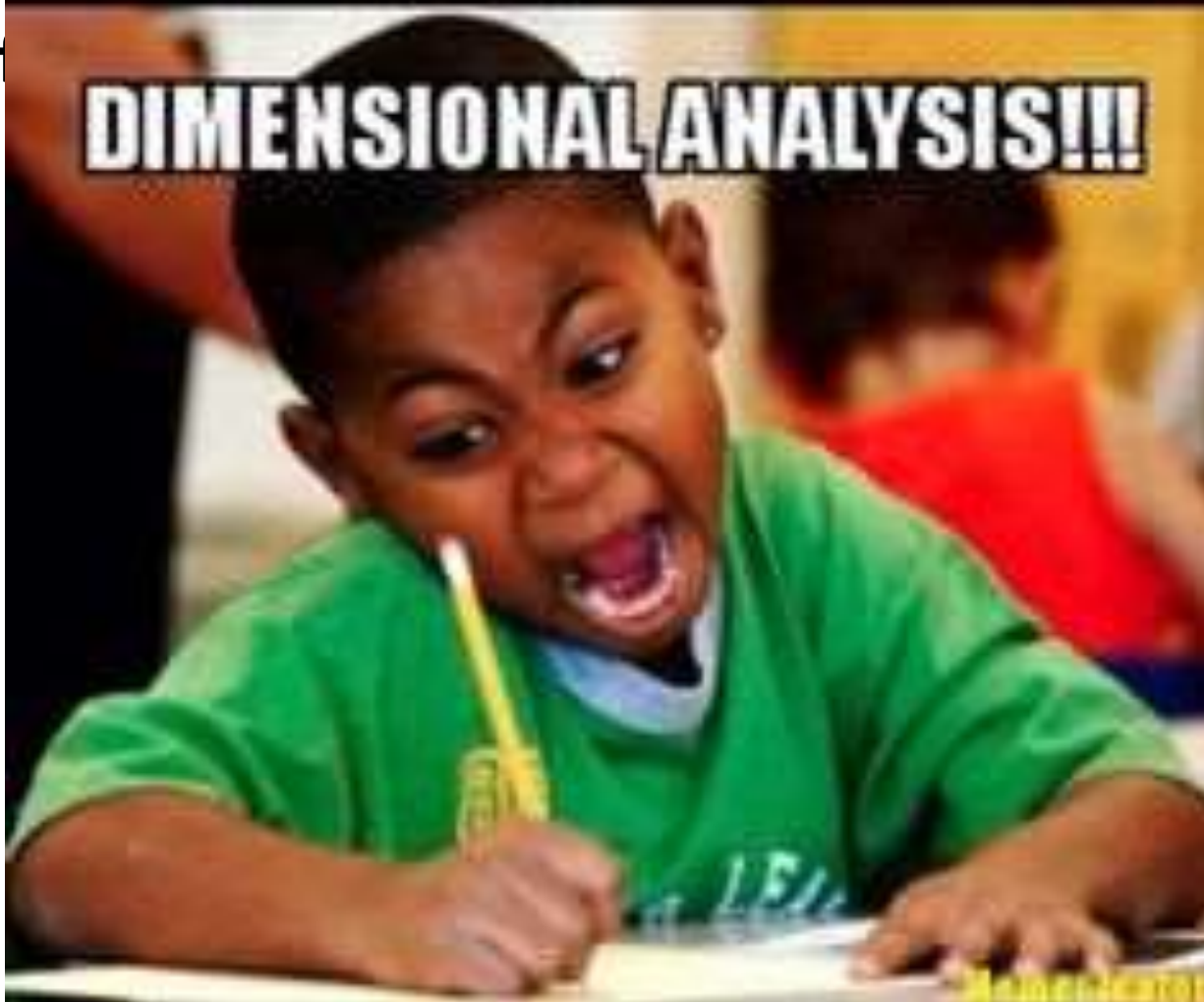
Investigative Science

Learning goal: Making a model using proper scientific methods and organizing data

Review



What is



Units

4 Evaluate based on A&P
3 Distinguish A&P in data
2 Importance of A&P
1 Define A&P

Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Review



Dimensional Analysis

- Whenever you have to convert a physical measurement from one dimensional unit to another, **dimensional analysis** is the method used.

Dimensional analysis is a method to convert one different type of unit to another

4

Evaluate based on A&P

3

Distinguish A&P in data

2

Importance of A&P

1

Define A&P

Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Review



Dimensional Analysis

- How does dimensional analysis work?
- It will involve some easy math (Multiplication & Division)
- In order to perform any conversion, you need a **conversion factor**. any two terms that describe the **same or equivalent** “amounts” of what we are interested in.
For example, we know that:
1 inch = 2.54 centimeters
1 dozen = 12

4

Evaluate
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A&P

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Distinguish
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data

2

Importance
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Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Review



Conversion Factors

- So, conversion factors are nothing more than equalities or ratios that equal to each other. In “math-talk” they are equal to one.
- In mathematics, the expression to the left of the equal sign is equal to the expression to the right. They are equal expressions.
- For Example
12 inches = 1 foot
Written as an “equality” or “ratio” it looks like

$$\frac{12 \text{ inches}}{1 \text{ foot}} = 1 \quad \text{or} \quad \frac{1 \text{ foot}}{12 \text{ inches}} = 1$$

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Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Review



Conversion Factors

*1 inch = 2.54 centimeters

*1 liter = 1.06 quarts

*1 calorie = 4.18 joules

*1 atm = 101.3 kilopascals

1 foot = 12 inches

1 yard = 3 feet

1 mile = 5,280 feet

1 mile = 1,760 yards

1 pound = 16 ounces

*1 pound = 454 grams

1 hour = 60 minutes

1 minute = 60 seconds

1 gallon = 4 quarts

1 quart = 2 pints

$$^{\circ}\text{F} = 1.8^{\circ}\text{C} + 32$$

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

$$\text{K} = ^{\circ}\text{C} + 273$$

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Review



Conversion Factors

- *Conversion Factors* look a lot like fractions, but they are **not**! They are “ratios”

$$\frac{12 \text{ inches}}{1 \text{ foot}} \quad \text{or} \quad \frac{1 \text{ foot}}{12 \text{ inches}} \quad \text{Either one is correct}$$

- But! The critical thing to note is that *the units behave like numbers do when you multiply fractions.* That is, the inches (or foot) on top and the inches (or foot) on the bottom can cancel out. Just like in algebra,

$$\frac{12 \cancel{\text{ inches}}}{1 \text{ foot}} \quad \text{or} \quad \frac{1 \text{ foot}}{12 \cancel{\text{ inches}}}$$

4

Evaluate based on A&P

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Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Review



Steps for dimensional analysis

Example Problem #1

- How many feet are in 60 inches? Solve using dimensional analysis.

4

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Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Review



Steps for dimensional analysis

Example **Problem #1** How many feet are in 60 inches?

Step 1: Read the problem and find out what unit you are in, and what unit you want to get to, then write what you have below it. Put a 1 below it and a “X”.

What units you have-----→ What units you want


inches -----→ feet

$$\frac{60 \text{ inches}}{1} \quad \times$$

4	Evaluate based on A&P
3	Distinguish A&P in data
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Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.


*1 inch = 2.54 centimeters 1 foot = 12 inches 1 pound = 454 grams
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= 101.3 kPa 1 quart = 2 pints
F = 1.8 C + 32 °C = (F - 32) / 1.8 K = °C + 273

Review

Steps for dimensional analysis

Example Problem #1 How many feet are in 60 inches?

Step 2: Find the “conversion factor”, put the unit you have on the bottom.

Inches → feet

$$\frac{12 \text{ inches}}{1 \text{ foot}}$$

or


$$\frac{1 \text{ foot}}{12 \text{ inches}}$$

Use this one..

Evaluate based on A&P	3
Distinguish A&P in data	2
Importance of A&P	1
Define A&P	1

Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.


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°F = 1.8 °C + 32 °C = (°F - 32) / 1.8 K = °C + 273

Review

Steps for dimensional analysis

Example Problem #1 How many feet are in 60 inches?

Step 3: Set up the problem, unit you have X conversion factor = units you want.

$$\frac{60 \text{ inches}}{1} \times \frac{1 \text{ foot}}{12 \text{ inches}} = \text{feet}$$

Evaluate based on A&P	3
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Investigative Science

Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Review



Steps for dimensional analysis

Example Problem #1 How many feet are in 60 inches?

Step 4: Cancel the units and solve the problem!

Now you have the unit you want..

$$\frac{\cancel{60 \text{ inches}}}{1} \times \frac{1 \text{ foot}}{\cancel{12 \text{ inches}}} = 5 \text{ feet}$$

(Mathematically all you do is: $60 \times 1 \div 12 = 5$)

4

Evaluate based on A&P

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Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Multi-step Dimensional Analysis

Dimensional Analysis where you will have to perform multiple conversions.

Example: How old are you in seconds?

Multi-steps..

Years -> Months -> Days -> Hours -> Seconds!!!

4

Evaluate based on A&P

3

Distinguish A&P in data

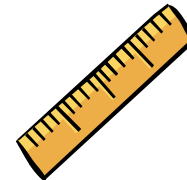
2

Importance of A&P

1

Define A&P

Investigative Science



Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 10 feet?

Step 1: Read the problem and find out what unit you are in, and what unit you want to get to. This time leave space in between. Write what you have below it. Put a 1 below it and a “X”.

What units you have →

Feet →

What units you want

Centimeters

$$\frac{10 \text{ feet}}{1} \times$$

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What units you have →

Feet →

What units you want

Centimeters

$\frac{10 \text{ feet}}{1}$

X

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$$\text{K} = ^{\circ}\text{C} + 273$$

Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 10 feet?

Step 2: Find the “conversion factor **S”, that will get you to the units you want. Write in the missing units.**

Feet → inches → *Centimeters*

$$\frac{10 \text{ feet}}{1} \times$$

Evaluate based on A&P
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Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 60 inches?

Step 3 : Write in “conversion factors” one at a time, put the unit you have on the bottom. Cancel as you go.

Feet → inches → *Centimeters*

$$\frac{\cancel{10 \text{ feet}}}{1} \times \frac{12 \text{ inches}}{\cancel{1 \text{ foot}}}$$

Evaluate based on A&P

3

Distinguish A&P in data

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$$\frac{\cancel{10 \text{ feet}}}{1} \times \frac{\cancel{12 \text{ inches}}}{\cancel{1 \text{ foot}}} \times \frac{2.54 \text{ cm}}{\cancel{1 \text{ inches}}}$$

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Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 60 inches?

Step 4: Cancel the units and solve the problem!

Feet → inches → *Centimeters*

$$10 \times 12 \div 1 \times 2.54 \div 1 = 270 \text{ cm}$$

$$\frac{\cancel{10 \text{ feet}}}{1} \times \frac{\cancel{12 \text{ inches}}}{\cancel{1 \text{ foot}}} \times \frac{2.54 \text{ cm}}{\cancel{1 \text{ inches}}} = 270 \text{ cm}$$

Evaluate
based on
A&P

3

Distinguish
A&P in
data

2

Importance
of A&P

1

Define
A&P

...making your make accurate and precise measurements using proper significant figures when collecting and organizing data.

Multi-step Dimensional Analysis

Example Problem: **How many centimeters are in 10 feet?**

Step 1: Read the problem and find out what unit you are in, and what unit you want to get to. This time leave space in between. Write what you have below it. Put a 1 below it and a "X".

What units you have →

Feet →

10 feet
1

X

What units you want

Centimeters

4	Evaluate based on A&P
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Learning goal: make accurate and precise measurements using proper significant figures when collecting and organizing data.

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$$\text{K} = ^{\circ}\text{C} + 273$$

Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 10 feet?

Step 2: Find the “conversion factor **S”, that will get you to the units you want. Write in the missing units.**

Feet → **inches** → *Centimeters*

$$\frac{10 \text{ feet}}{1} \times$$

Evaluate based on A&P	3
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Step 3 : Write in “conversion factors” one at a time, put the unit you have on the bottom. Cancel as you go.

Feet → inches → *Centimeters*

$$\frac{\cancel{10 \text{ feet}}}{1} \times \frac{12 \text{ inches}}{\cancel{1 \text{ foot}}}$$

Evaluate based on A&P

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Multi-step Dimensional Analysis

Example Problem: How many centimeters are in 60 inches?

Step 4: Cancel the units and solve the problem!

Feet → inches → *Centimeters*

$$10 \times 12 \div 1 \times 2.25 \div 1 = 270 \text{ cm}$$

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Evaluate based on A&P
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Problem set up:

$$\frac{5 \text{ frumious Bandersnatches}}{1} \times \frac{1 \text{ tulgey wood}}{1 \text{ frumious Bandersnatches}} \times \frac{20 \text{ tumtum trees}}{1 \text{ tulgey wood}} \times \frac{2 \text{ Jubjub birds}}{200 \text{ tumtum trees}} \times \frac{1 \text{ slithy tove}}{5 \text{ Jubjub birds}} \times \frac{2 \text{ borogoves}}{5 \text{ slithy toves}} \times \frac{200 \text{ mome raths}}{1 \text{ borogove}} \times \frac{1 \text{ Jabberwock}}{2 \text{ mome raths}}$$

Cancellation of Units (Color coded for cancelling units)

$$\frac{5 \text{ frumious Bandersnatches}}{1} \times \frac{1 \text{ tulgey wood}}{1 \text{ frumious Bandersnatches}} \times \frac{20 \text{ tumtum trees}}{1 \text{ tulgey wood}} \times \frac{2 \text{ Jubjub birds}}{200 \text{ tumtum trees}} \times \frac{1 \text{ slithy tove}}{5 \text{ Jubjub birds}} \times \frac{2 \text{ borogoves}}{5 \text{ slithy toves}} \times \frac{200 \text{ mome raths}}{1 \text{ borogove}} \times \frac{1 \text{ Jabberwock}}{2 \text{ mome raths}}$$

The units all cancel until all you are left with are Jabberwocks! Now just do the math and you end up with 8 Jabberwocks!