Monday, August 19, 2019

Welcome to Investigative Science with Mr. Fireng

SKEPTIC VADER

FINDS YOUR LACK OF EMPIRICAL EVIDENCE DISTURBING
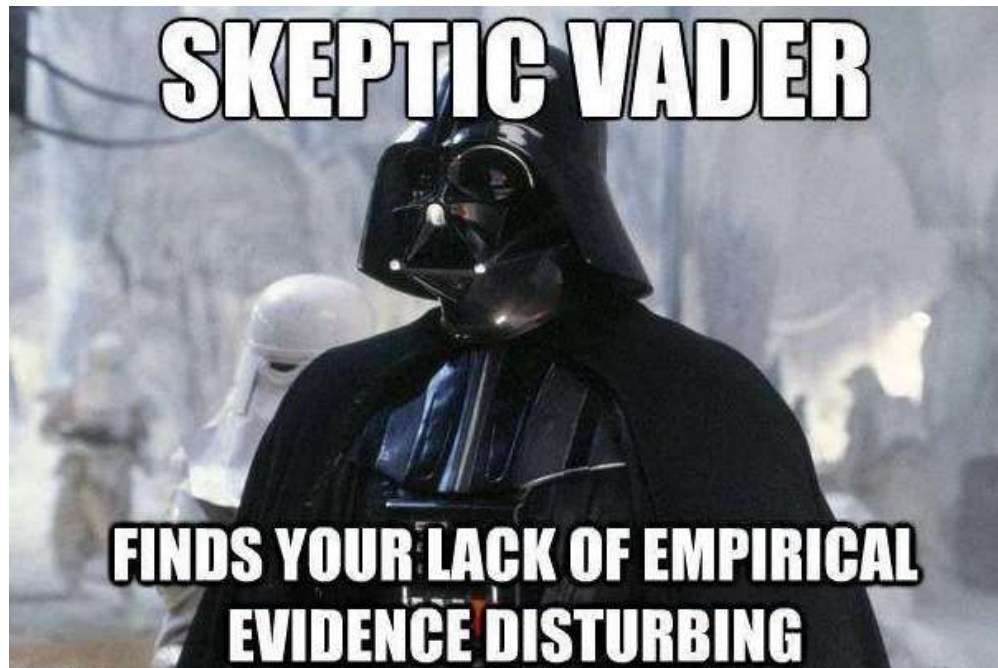
1. Get out your stampsheet
2. Get out your homework
3. Write tomorrow's homework in agenda
4. START WORKING QUIETLY

Investigative Science

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

What is dimensional analysis?

What is a conversion factor?

Steps for dimensional analysis

1.
2.
3.
4.

Example:

Dimensional analysis

Write all Cues!!

4
Design, complete, valid conclusion

3
Design & complete

2
Know steps, follow directions

1
Know the steps

Summary:

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
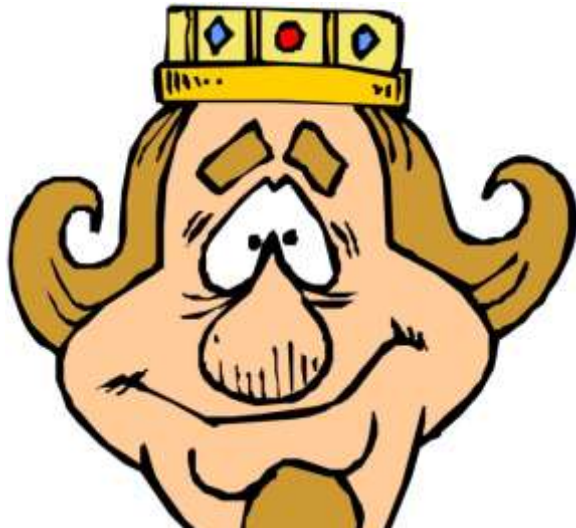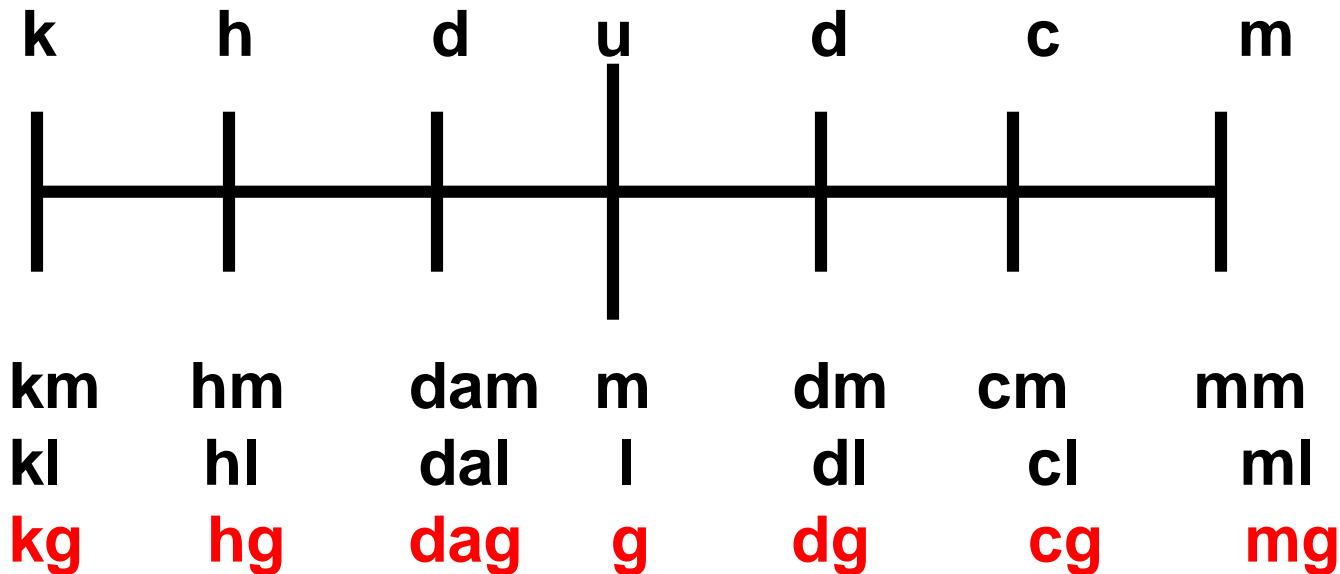Know steps, follow directions

1
Know the steps

Investigative Science

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

Review

Metric prefixes

The Metric System Prefixes

Prefix	Label	Decimal Value	Scientific	Colloquial
yocto	y	0.000 000 000 000 000 000 000 001	10^{-24}	septillionth
zepto	z	0.000 000 000 000 000 000 001	10^{-21}	sextillionth
atto	a	0.000 000 000 000 000 001	10^{-18}	quintillionth
femto	f	0.000 000 000 000 001	10^{-15}	quadrillionth
pico	p	0.000 000 000 001	10^{-12}	trillionth
nano	n	0.000 000 001	10^{-9}	billionth
micro	μ	0.000 001	10^{-6}	millionth
milli	m	0.001	10^{-3}	thousandth
centi	c	0.01	10^{-2}	hundredth
deci	d	0.1	10^{-1}	tenth
---	---	1	10^{0}	one
deka	da	10	10^{1}	ten
hecto	h	100	10^{2}	hundred
kilo	k	1 000	10^{3}	thousand
mega	M	1 000 000	10^{6}	million
giga	G	1 000 000 000	10^{9}	billion
tera	T	1 000 000 000 000	10^{12}	trillion
peta	P	1 000 000 000 000 000	10^{15}	quadrillion
exa	E	1 000 000 000 000 000 000	10^{18}	quintillion
zetta	Z	1 000 000 000 000 000 000 000	10^{21}	sextillion
yotta	Y	1 000 000 000 000 000 000 000 000	10^{24}	septillion

4
Evaluate based on A&P

3
Distinguish A&P in data

2
Importance of A&P

1
Define A&P

Investigative Science

Review

Metric prefixes

Kilo means thousand **(1000)**

Hecto means hundred **(100)**

Deca means ten **(10)**

Deci means one-tenth **(1/10)**

Centi means one-hundredth **(1/100)**

Milli means one-thousandth **(1/1000)**

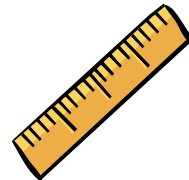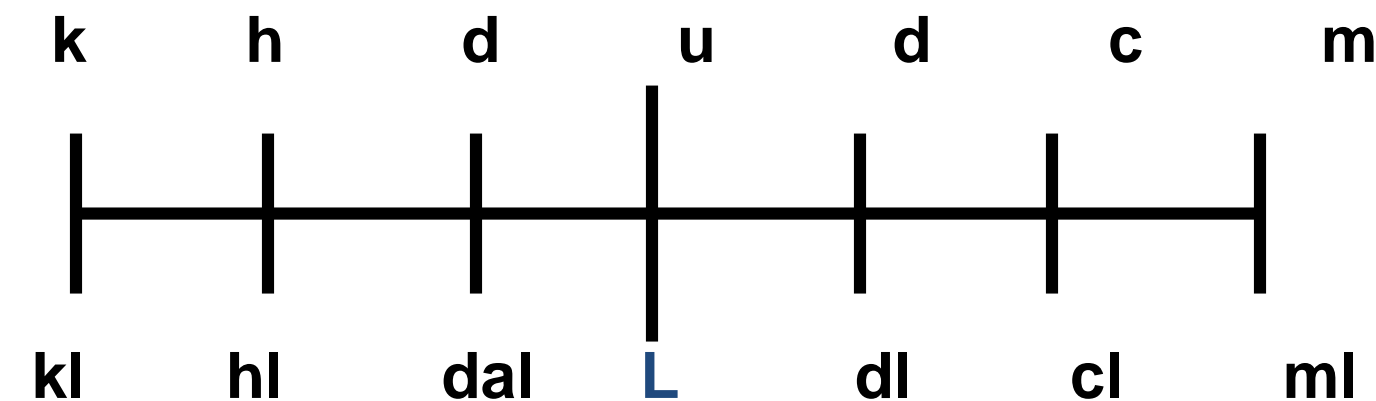| 4 Evaluate based on A&P |
| --- |
| 3 Distinguish A&P in data |
| 2 Importance of A&P |
| 1 Define A&P |

Investigative Science

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

Review

Pneumonic device to memorize prefixes

King Henry Died Unexpectedly Drinking Chocolate Milk

Memorize this!

Investigative Science

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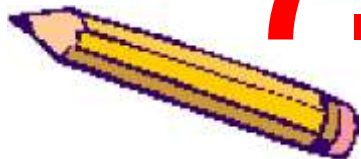
Review

Do: Let's add the gram line:

k   h   d   u   d   c   m

km   hm   dam   m   dm   cm   mm
kl   hl   dal   l   dl   cl   ml
kg   hg   dag   g   dg   cg   mg

Investigative Science

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

Review

Example #2:

2. Move to new unit, counting jumps and noticing the direction of the jump!

k   h   d   u   d   c   m

kl   hl   dal   L   dl   cl   ml

7.25 L = .00725 kL

Three jumps to the left!

Investigative Science

What if you need to Convert Between Different Units that are not metric?

- How many seconds are in a day?

- How many inches are in a centimeter?

- If you are going 50 miles per hour, how many meters per second are you traveling?

- To answer these questions you need to change (<u>convert</u>) from one unit to another.
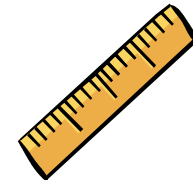
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Evaluate based on A&P
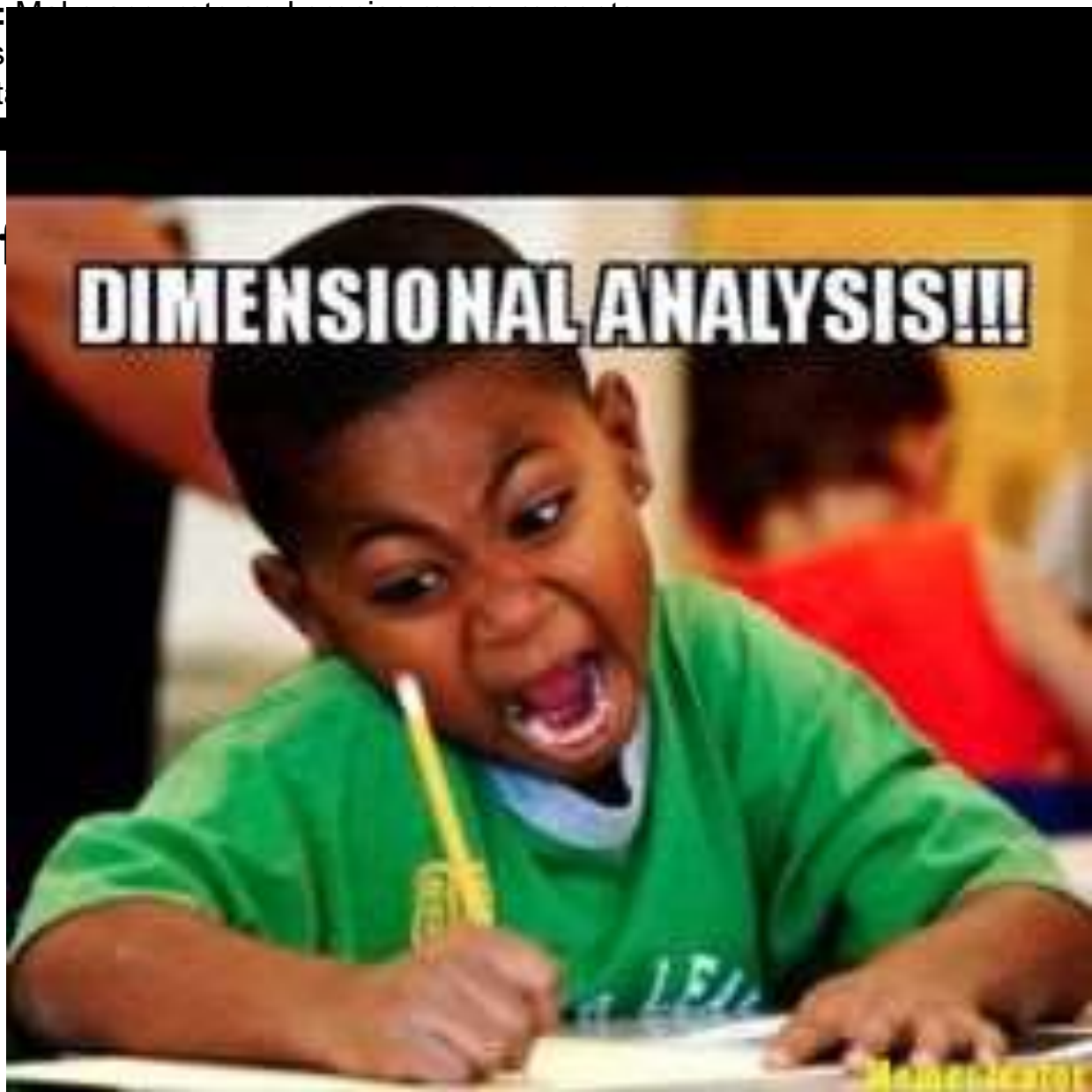
3
Distinguish A&P in data

2
Importance of A&P

1
Define A&P

Investigative Science

Learning goal: ~~Make~~ ~~learn~~
using proper s~~
organizing dat~~

4
Evaluate based on A&P

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Define A&P

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

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

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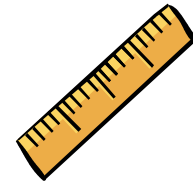Evaluate based on A&P

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Distinguish A&P in data

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Define A&P

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

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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

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

4
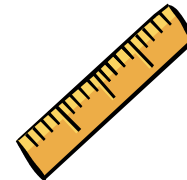Evaluate based on A&P

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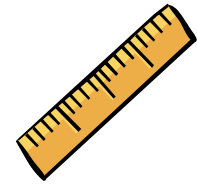
Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

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

$$°F = 1.8 °C + 32$$

$$°C = \frac{°F - 32}{1.8}$$

$$K = °C + 273$$

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Conversion Factors

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

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

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

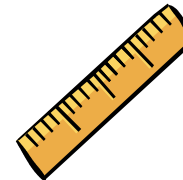| 4 Evaluate based on A&P |
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Learning goal: Make accurate and precise measurements using proper significant figures when collecting and organizing data.

Steps for dimensional analysis

Example Problem #1

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

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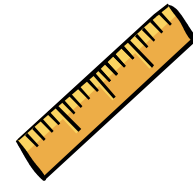Evaluate based on A&P

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Investigative Science

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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 ad a "X".

What units you have----->   What units you want

inches -----> feet

$$\frac{60 \ inches}{1} \qquad X$$

Investigative Science

*1 inch = 2.54 centimeters   1 foot = 12 inches   *1 pound = 454 grams
*1 liter = 1.06 quarts   1 yard = 3 feet   1 hour = 60 minutes
*1 calorie = 4.18 joules   1 mile = 5,280 feet   1 minute = 60 seconds
*1 atm = 101.3 kilopascals   1 mile = 1,760 yards   1 gallon = 4 quarts
        1 pound = 16 ounces   1 quart = 2 pints

$$°F = 1.8\,°C + 32 \qquad °C = \frac{°F - 32}{1.8} \qquad K = °C + 273$$

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

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

$$\frac{12\,inches}{1\,foot} \qquad or \qquad \frac{1\,foot}{12\,inches}$$

Use this one..

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 measurement using proper significant figures when collecting and organizing data.

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Steps for dimensional analysis

Example Problem #1 How many feet are in 60 inches?
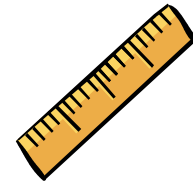
Step 3: Set up the problem:

Unit you have   X   conversion factor = units you want.

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

Evaluate based on A&P

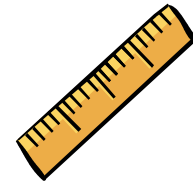**3** Distinguish A&P in data

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Investigative Science

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

Steps for dimensional analysis

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

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

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

What units you have x $\left[\dfrac{\underline{\textbf{What units you want}}}{\text{What units you have}} \right]$ = **What units you want**

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

Steps for dimensional analysis

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

Step 4: Cancel the units and solve the problem!

Now you have the unit you want..

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

(Mathematically all you do is: 60 x 1 ÷ 12 = 5)

4
Evaluate based on A&P

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Distinguish A&P in data

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Importance of A&P

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Define A&P

Investigative Science

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

Steps for dimensional analysis

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

Step 1:   inches → feet

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

Investigative Science

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

*1 inch = 2.54 centimeters
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Steps for dimensional analysis

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

Step 2: **Use this one!**

Step 1: inches → feet

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

$$\frac{60\ inches}{1}$$

- Evaluate based on A&P

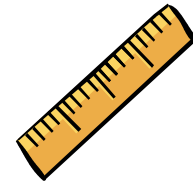**3** Distinguish A&P in data

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Investigative Science

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

Steps for dimensional analysis

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

Step 1: inches → feet

Step 2: **Use this one!**

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

Step 3: $\dfrac{60\ inches}{1}$ x $\dfrac{1\,foot}{12\,inches}$ = feet

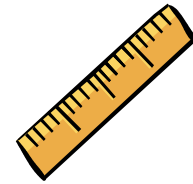| 4 |
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Investigative Science

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

Steps for dimensional analysis

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

Step 1: inches → feet

Step 2: **Use this one!** $\dfrac{1\,foot}{12\,inches}$

Step 3: $\dfrac{60\ inches}{1}$ x $\dfrac{1\,foot}{12\,inches}$ = feet

Step 4: $\dfrac{60\ \cancel{inches}}{1}$ x $\dfrac{1\,foot}{12\,\cancel{inches}}$ = 5 feet

(60 x 1 ÷ 12 = 5)

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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.

Example Problem #1 (cont)

- The previous problem can also be written to look like this:

- 60 inches | 1 foot | = 5 feet
  12 inches

- This format is more visually integrated, more bridge like, and is more appropriate for working with factors. In this format, the horizontal bar means "divide," and the vertical bars mean "multiply".

What is 3.45 pounds expressed in grams?

$$3.45 \text{ pounds} \times \frac{453.6 \text{ grams}}{1 \text{ pound}} = 1{,}560 \text{ grams}$$