Chapter One: Measurement

- **1.1 Measurements**

- **1.2 Time and Distance**

- **1.3 Converting Measurements**

- **1.4 Working with Measurements**

Section 1.3 Learning Goals

- Apply the decimal point rule to convert between metric quantities.

- Use dimensional analysis to convert English and SI measurements.

- Determine the number of significant digits in measurements.

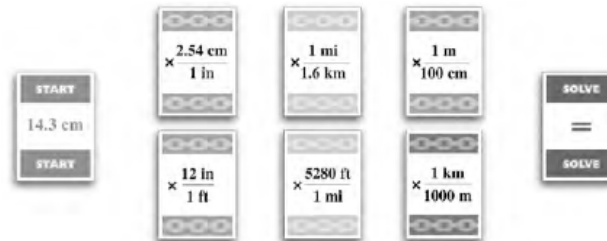**Investigation 1C**

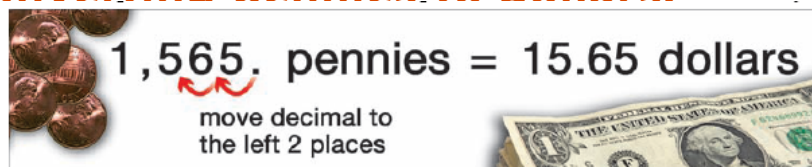# Conversion Chains

- **Key Question:**

How can you use unit canceling to solve conversion problems?

1.3 Converting units

- To convert 1,565 pennies to the dollar amount, you divide 1,565 by 100 (since there are 100 pennies in a dollar).

- Converting SI units is just as easy as converting pennies to dollars.

1,565. pennies = 15.65 dollars

move decimal to
the left 2 places

Solving Problems

- **Convert 655 mm to m**
1. **Looking for:**
   - …the distance in meters
2. **Given:**
   - …distance = 655 millimeters
3. **Relationships:**
   - Ex. There are 1000 millimeters in 1 meter
4. **Solution:**

655 mm = .655 meters

Solving Problems

Convert 142 km to m

1. **Looking for:**
   - …the distance in meters
2. **Given:**
   - …distance = 142 kilometers
3. **Relationships:**
   - Ex. There are ? meters in 1 kilometer?
4. **Solution:**
   - Use the conversion tool.

kilo	hecto	deca	meter gram liter	deci	centi	milli
1000	100	10		0.1	0.01	0.001

+ − x ÷ **Solving Problems**

Convert 754,000 cm to km

1. **Looking for:**
   - ...the distance in kilometers
2. **Given:**
   - ...distance = 754,000 centimeters
3. **Relationships:**
   - Ex. There are ? cm in 1 m?
   - There are ? m in 1 km?
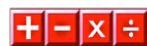4. **Solution:**
   - Use the conversion tool.

kilo	hecto	deca	**meter** **gram** **liter**	deci	centi	milli
1000	100	10		0.1	0.01	0.001

Converting SI Units

kilo	hecto	deca	**meter** **gram** **liter**	deci	centi	milli
1000	100	10		0.1	0.01	0.001

1.3 Converting units

- A conversion factor is a ratio that has the value of one.
- This method of converting units is called dimensional analysis.
- To do the conversion you multiply 4.5 feet by a conversion factor.

Solving Problems

Convert 4.5 ft to cm

1. **Looking for:**
   - You are asked for the distance in cm
2. **Given:**
   - You are given the distance in ft.
3. **Relationships:**
   - Ex. There are ? cm in 1 ft?   30.48 cm = 1 ft
4. **Solution:**

$$4.5 \text{ feet} \times \left(\frac{30.48 \text{ cm}}{1 \text{ foot}}\right) = 137 \text{ cm}$$

1.3 Converting units

$$\frac{2.54 \text{ cm}}{1 \text{ in}} \qquad \frac{1.609 \text{ km}}{1 \text{ mi}}$$

$$\frac{30.48 \text{ cm}}{1 \text{ foot}} \qquad \frac{39.37 \text{ in}}{1 \text{ m}}$$

- **Use the correct conversion factor to convert:**
  - **175 yds. to m.**
  - **2.50 in. to mm.**

Solve first Look later

a. 160 m
b. 63.5 mm

1.3 Working with Measurements
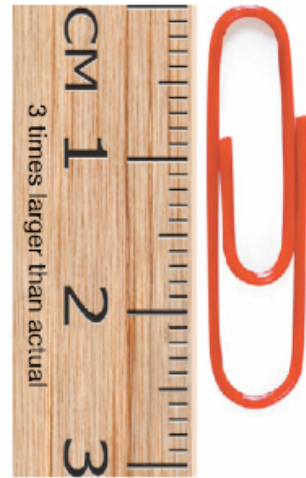
- In the real world it is impossible for everyone to arrive at the exact same true measurement as everyone else.

Find the length of the object in centimeters. How many digits does your answer have?

1.3 Uncertainty in measurements

- **The best answer for the length of the paper clip is 2.65 cm.**

- **To a scientist this number means "between 2.60 and 2.70 cm."**

- **The last digit, 5, representing the smallest amount, is uncertain.**

1.3 Significant digits

- **Significant digits** **are the meaningful digits in a measured quantity.**
- **The third digit tells someone the object is about halfway between 2.60 and 2.70 cm long.**
- **Therefore, we say there are three significant digits in this length measurement.**

1.3 Which digits are significant?

Digits that are always significant:
1. Non-zero digits.
2. Zeroes between two significant digits.
3. All final zeroes to the right of a decimal point.

Digits that are never significant:
1. Leading zeroes to the right of a decimal point. (0.002 cm has only one significant digit.)
2. Final zeroes in a number that does not have a decimal point.

Solve It!

What is area of 8.5 in. x 11.0 in. paper?

1. **Looking for:**
   - …area of the paper
2. **Given:**
   - … width = 8.5 in; length = 11.0 in
3. **Relationship:**
   - Area = W x L
4. **Solution:**
   - 8.5 in x 11.0 in = 93.5 in^2

 # Sig. fig = two = 94 in^2

Chapter One: Measurement

- **1.1 Measurements**

- **1.2 Time and Distance**

- **1.3 Converting Measurements**

- **1.4 Working with Measurements**

Section 1.4 Learning Goals

- Use graphs to create a visual representation of data.

- Analyze trends on a graph.

- Explain the difference between a direct relationship and an inverse relationship.

Thickness of Aluminum Foil

- **Key Question:**

  What is the thickness of aluminum foil?
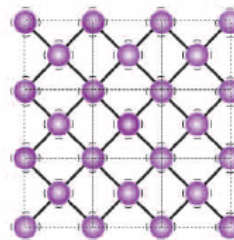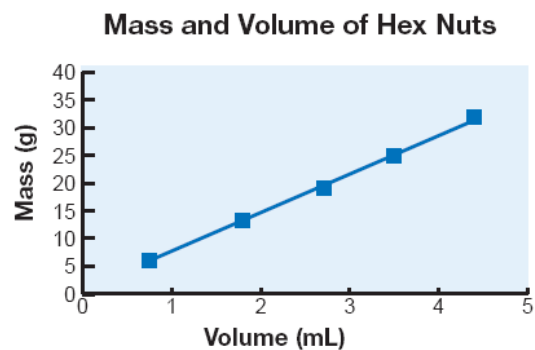
1.4 Measurement and Graphing

- A bar graph compares data grouped by a name or category.

B. Bar Graph

Distance from Home to Places Visited Weekly
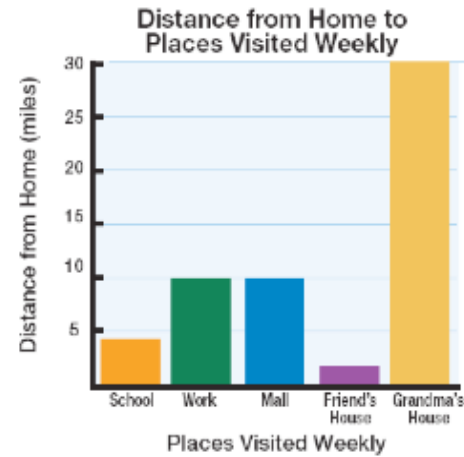
1.4 Measurement and Graphing

C. Pie Graph

% Time used in 24 hours

Eating
2 hours (8.3 %)

Other
2.5 hours (10.5 %)

Studying
2.5 hours (10.4 %)

After school
activities
2 hours (8.3 %)

Sleep
8 hours (33 %)

School
7 hours (29.2%)
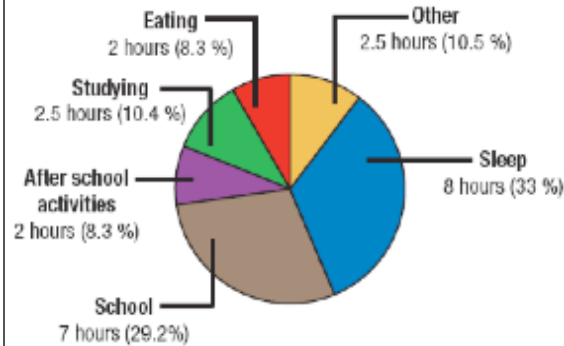
- A pie graph shows the amount each part makes of up of the whole (100%).

1.4 Measurement and Graphing

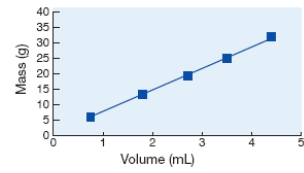- A "connect-the-dots" line graph is often used to show trends in data over time.
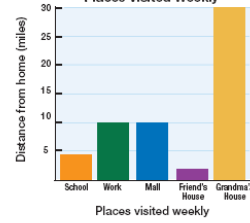
D. Line Graph
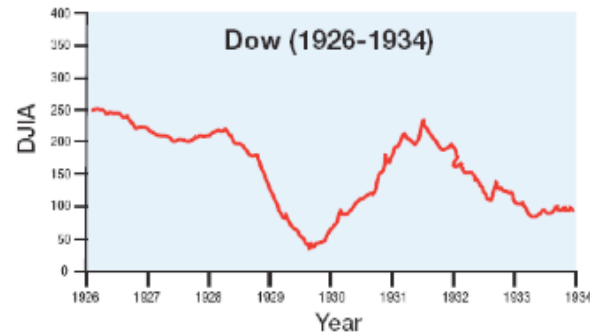
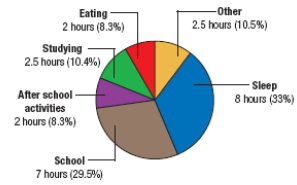# Types of Graphs

A. Scatterplot

Mass and Volume of Hex Nuts

B. Bar Graph
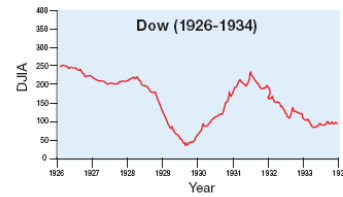
Distance from Home to Places Visited Weekly

C. Pie Graph

% Time Used in 24 Hours

- Eating — 2 hours (8.3%)
- Studying — 2.5 hours (10.4%)
- After school activities — 2 hours (8.3%)
- School — 7 hours (29.5%)
- Other — 2.5 hours (10.5%)
- Sleep — 8 hours (33%)

D. Line Graph

Dow (1926-1934)

1.4 Making a scatterplot or XY

- Scatterplots show how a change in one variable influences another variable.

- The independent variable is the variable you believe might influence another variable.

- The dependent variable is the variable that you hope will change as a result of the experiment.

1.4 Making a scatterplot or XY

- Pressure is critical to safe diving.

- How does an increase in depth affect the pressure?

- What sort of graph would best show the relationship between pressure and depth?

Depth (m) (x-axis)	Pressure (atm) (y-axis)
0	1.0
5	1.5
10	2.0
15	2.5
20	3.0
25	3.5
30	4.0
35	4.5
40	5.0

1.4 Making a scatterplot or XY

1. **Choose x and y-axis**
   - Depth is the independent variable = x axis
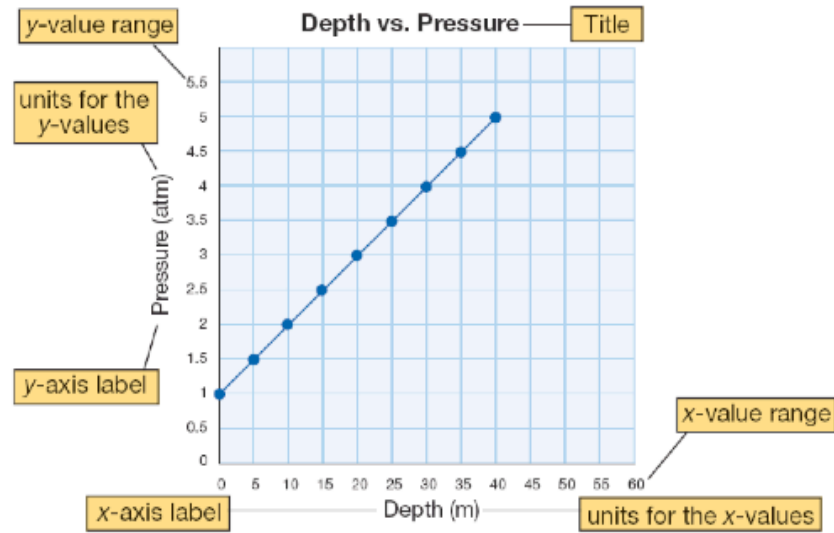   - Pressure is the dependent variable = y axis
2. **Make a scale**
   - Calculate the value per box
   - Most graphs use ones, twos, fives or tens
3. **Plot your data**
4. **Create a title**
* **Exception- when time is a variable**

Making a Scatterplot or XY Graph

Depth vs. Pressure — Title

y-value range

units for the y-values

y-axis label

x-value range

x-axis label

units for the x-values

Pressure (atm)

Depth (m)

1.4 MIXES TUCS

- **M:** maximize your graph

- **IX:** Independent variable on x-axis

- **ES:** Equally spaced scale increments

- **T:** Title (includes axis names)

- **U:** Units and labels on both axes
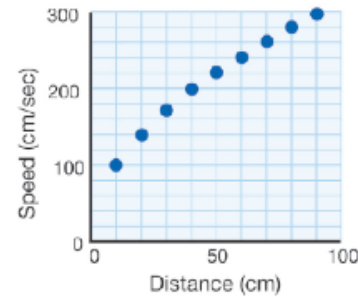
- **CS:** Continuous smooth curve connects data

1.4 Identifying graph relationships

- **In a direct relationship, when one variable increases, so does the other.**

The distance and speed variables show a direct relationship.

Strong Relationship Between Variables

Distance (cm)	Speed (cm/s)
10	99
20	140
30	171
40	198
50	221
60	242
70	262
80	280
90	297

1.4 Identifying graph relationships

No Relationship Between Variables

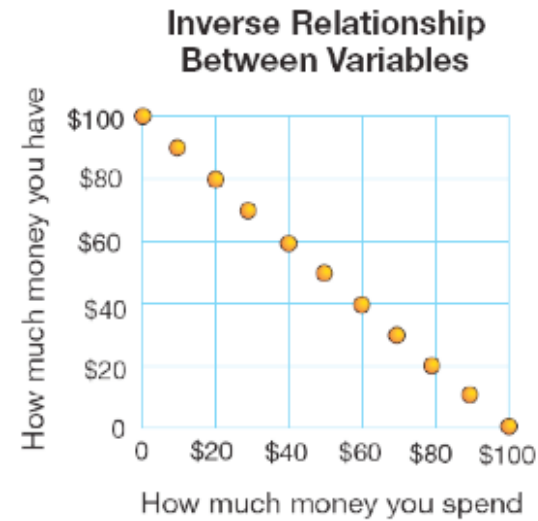| # of groups	Last 2 digits
10	06
15	05
19	15
6	22
22	09
9	11
26	13
12	14
11	19
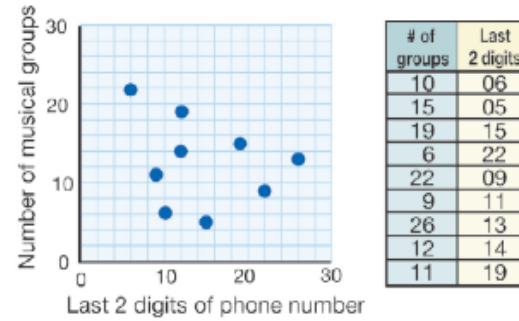
No pattern appears.

- When there is no relationship the graph looks like a collection of dots.
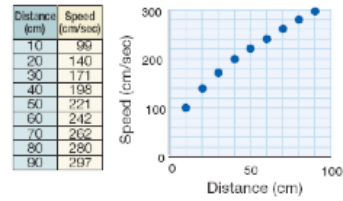
1.4 Identifying graph relationships

- In an inverse relationship, when one variable increases, the other decreases.

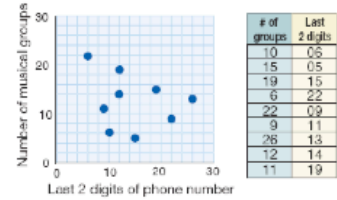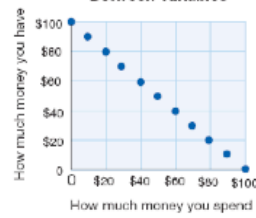Inverse Relationship Between Variables

Relationships Between Variables

Strong Relationship Between Variables

Distance (cm)	Speed (cm/sec)
10	99
20	140
30	171
40	198
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No Relationship Between Variables

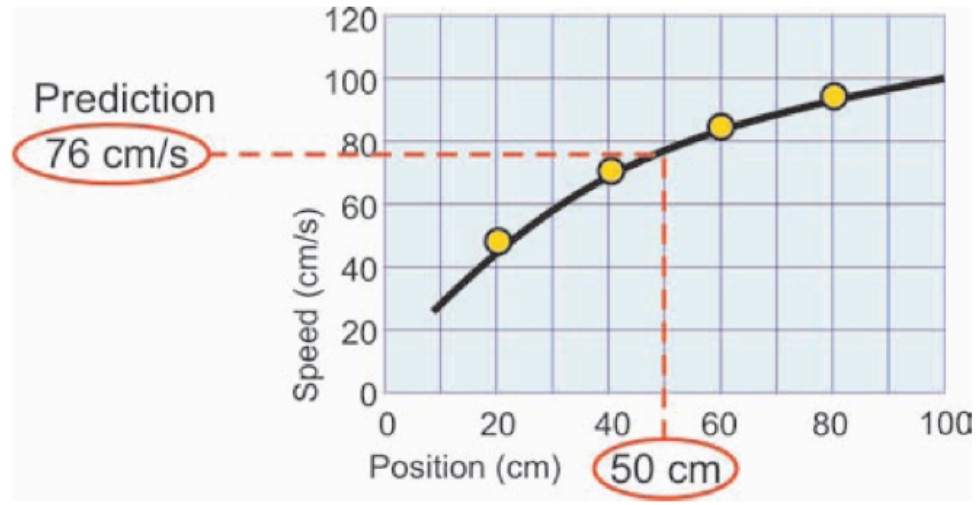| # of groups	Last 2 digits
10	06
15	05
19	15
6	22
22	09
9	11
26	13
12	14
11	19

Inverse Relationship Between Variables

1.4 Reading a graph

Nanotechnology

- **What if biological nanomachines could seek out a broken part of a cell and fix it? How can a nanomachine mimic nature's ability to heal?**

- **These are the cutting-edge questions that nanomedicine scientists are trying to answer.**