Name _____

Graphing Review

Save this for the entire year!

Introduction

Line graphs compare two variables. Each variable is plotted along an axis. A line graph has a vertical axis and a horizontal axis. For example, if you wanted to graph the height of a ball after you have thrown it, you would put time along the horizontal, or x-axis, and height along the vertical, or y-axis.

Line graphs are important in science for several reasons such as:

- showing specific values of data. If one variable is known, the other can be determined.
- showing trends and relationships in data clearly. They visibly depict how one variable is affected by the other as it increases or decreases.
- allowing the viewer to make predictions within recorded data, called **interpolation**, and to make predictions about data not yet recorded, called **extrapolation**.

Interpolation vs. Extrapolation

Determine which of the examples below is interpolation and which is extrapolation. Explain why.

1. The value of Sarah's car in 2004 was $17,500. _____
2. The value of Sarah's car in 2008 was $1,900. _____

How to Construct a Line Graph:

1. Identify the Variables & Label the Axes
   a. **Independent Variable** – factor that is varied in an experiment and specifically controlled by the experimenter
      i. Label along the x-axis (horizontal) – include units
      ii. Typically found on the left side of a data table
   b. **Dependent Variable** – factor that is measured in an experiment and will change as a result of the independent variable
      i. Label along the y-axis (vertical) – include units
      ii. Typically found on the right side of a data table

Independent vs. Dependent Variable Practice

- A student wanted to observe how changing the temperature of the aquarium water would affect the breathing rate of his goldfish.
  - What is the independent variable? _____
  - What is the dependent variable? _____
- A student wanted to determine how tall corn would grow if different types of fertilizer were used.
  - What is the independent variable? _____
  - What is the dependent variable? _____

2. Determine the Graph Scale
   a. Determine the magnitude (numeric value) of each variable
   b. Establish a scale that best fits the range of each variable
   c. Spread the graph to use the MOST available space (use at least ¾ of the graph)
   d. Be consistent throughout each axes' scale
3. Plot the data points
   a. Plot each data value on the graph with a dot
   b. If multiple sets of data are being plotted, use different colored lines and include a key

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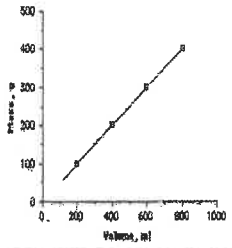
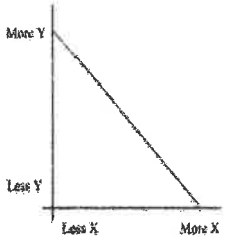
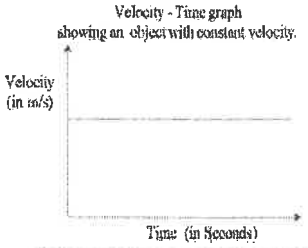
4. Draw the Graph
    a. DO NOT connect the dots unless specifically told to do so
    b. . Draw one of the following types of graphs:
        i. Best fit Straight Line



DIRECT RELATIONSHIP
-Both variables increase together

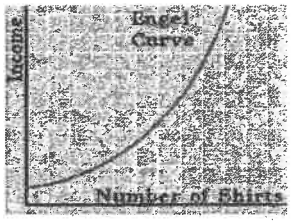


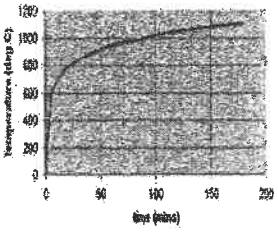
INDIRECT RELATIONSHIP
-As one variable increases, the other decreases



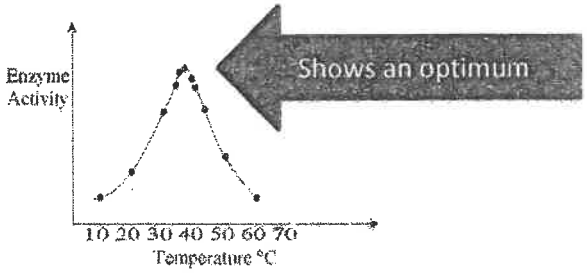
CONSTANT RELATIONSHIP
-Change in one variable has no effect on the other

        ii. Best fit Curved Line





        iii. Best fit Peak Line



5. Title the Graph
    a. Titles are used to clearly portray what the graph is about so be specific.
    b. Titles are typically written as "Y-axis variable" vs. "X-axis variable" and are written at the top of the graph.

Example: Think back to the goldfish experiment. The appropriate title for that graph would be The Breathing Rate of Goldfish vs. The Temperature of Water.

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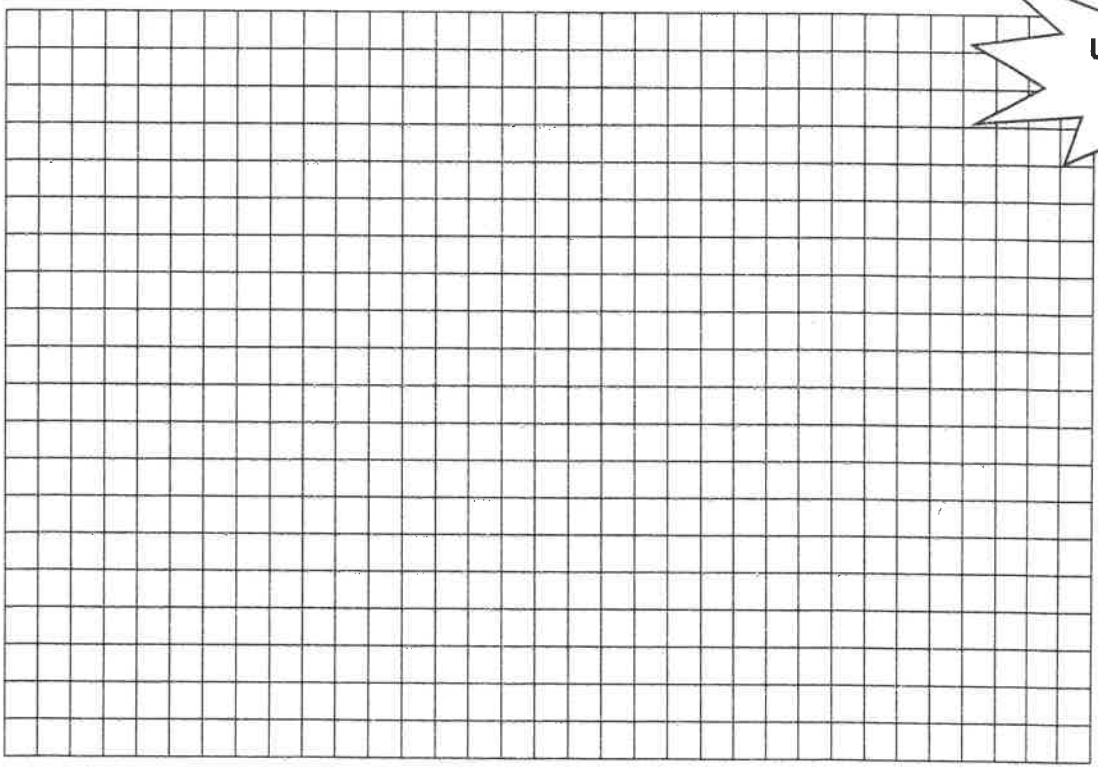
Graphing Practice

Practice Problem #1

Background: The thickness of the annual rings indicates what type of environmental situation was occurring the time of the tree's development. A thin ring usually indicates a rough period of development such as lack of water, forest fires, or insect infestation. On the other hand, a thick ring means a prosperous period of development. Use the information from the data table below to create a proper scientific graph and to answer the corresponding questions.

Age of Trees (in years)	Average Thickness of Annual Rings in Forest A (millimeters)	Average Thickness of Annual Rings in Forest B (millimeters)
10	20	24
20	24	28
30	30	35
35	34	38
50	41	45
60	46	51

1. What is the dependent variable? _____
2. What is the independent variable? _____
3. What was the average thickness of annual rings for 40 year old trees in Forest A? _____
4. What is it called when you make predictions within given data, such as made in question #3? _____
5. What was the mean thickness of annual rings for all trees found in Forest B? _____
6. Based on the data shown, what can be concluded about the comparative health of Forest A & B? _____
   _____
7. What type of relationship (constant, direct, or indirect) exists between the age of trees and the average thickness of the tree's rings? Explain. _____
   _____



Name _____

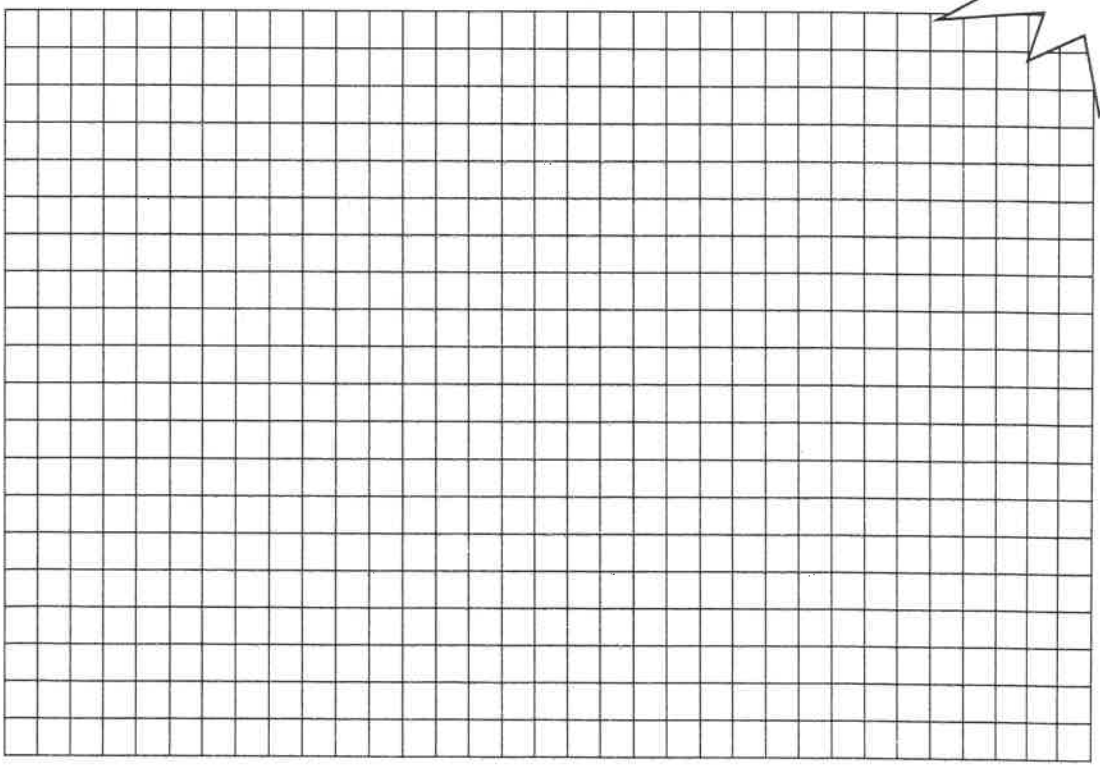
Practice Problem #2

Background: Clams were placed into various temperatures of water. Use the information in the data table below in order to create a proper scientific graph and to answer the corresponding questions.

Water Temperature (°C)	Number of Developing Clams
15	72
20	92
25	120
30	140
35	99
40	72
45	36
50	0

1. What is the dependent variable? _____
2. What is the independent variable? _____
3. What is the optimum temperature for clam development? _____
4. What is the mean number of clams per sample? _____
5. Approximately how many clams would be developing in 10 degree Celsius water? _____
6. What is it called when you make predictions about data not yet recorded, such as the prediction we made in question number 5? _____

Use PENCIL to make graph!



Name _____

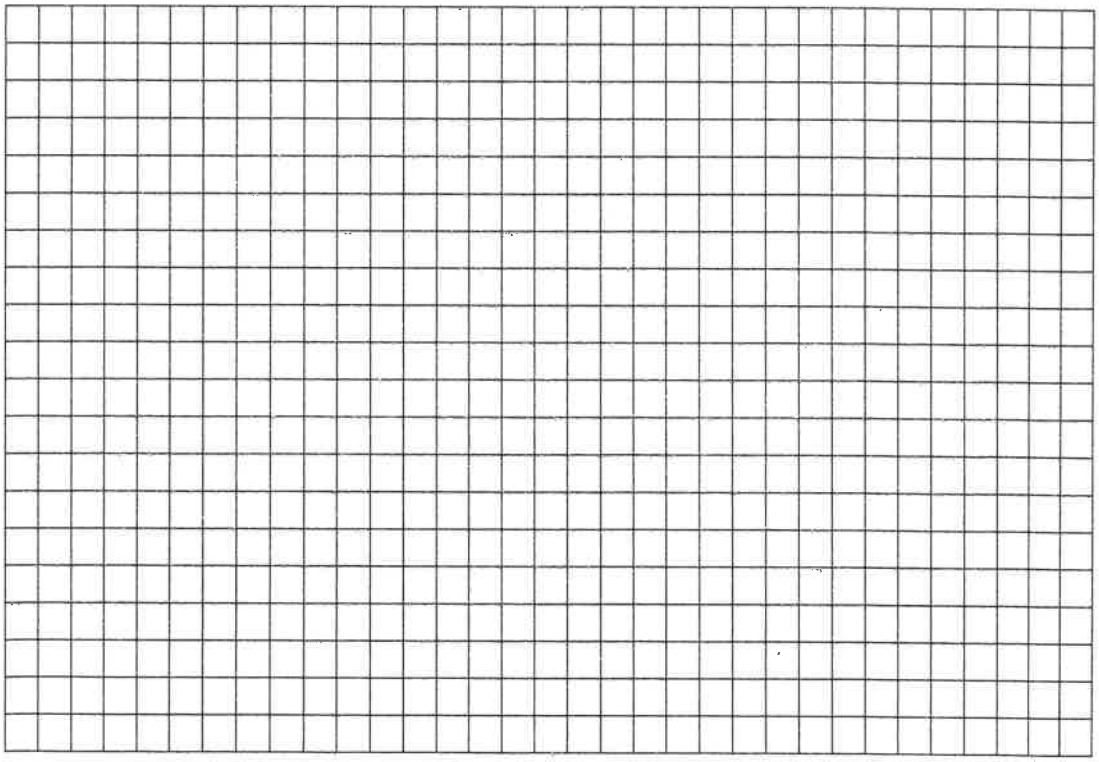
Practice Problem #3

Background: Natalie sets out to run 15 kilometers. Every 30 minutes she checked her pedometer to determine how far she had run. Use the data below to create a proper scientific graph and to answer the corresponding questions.

Time (minutes)	Total Distance (km)
0	0
30	6.8
60	10.1
90	12
120	13.3
150	15

1. What is the dependent variable? _____
2. What is the independent variable? _____
3. How many kilometers had Natalie run after 40 minutes? _____
4. What was Natalie's average speed (in kilometers per hour) over the course of her run? _____
   Use the formula Speed = Distance / Time

Use PENCIL to make graph!



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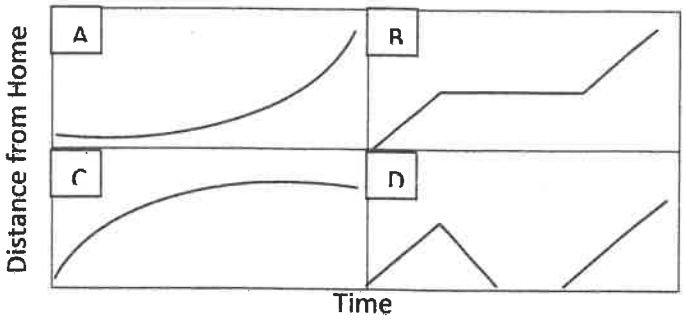
Practice #4

Background: Match each story on the left with the graph it represents on the right. Each graph compares the distance a car is from home compared to time.

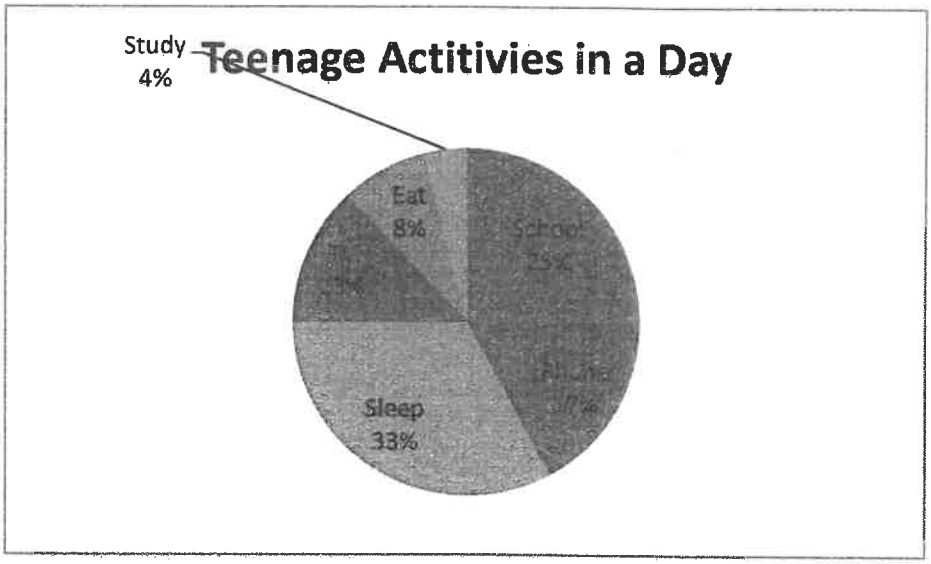
____1. I had just left home when I realized I had forgotten my books, so I went back to pick them up.
____2. The battery on my electric car started to run down.
____3. Things went fine until I had a flat tire.
____4. I started out calmly, but sped up when I realized I was going to be late.



Practice Problem #5

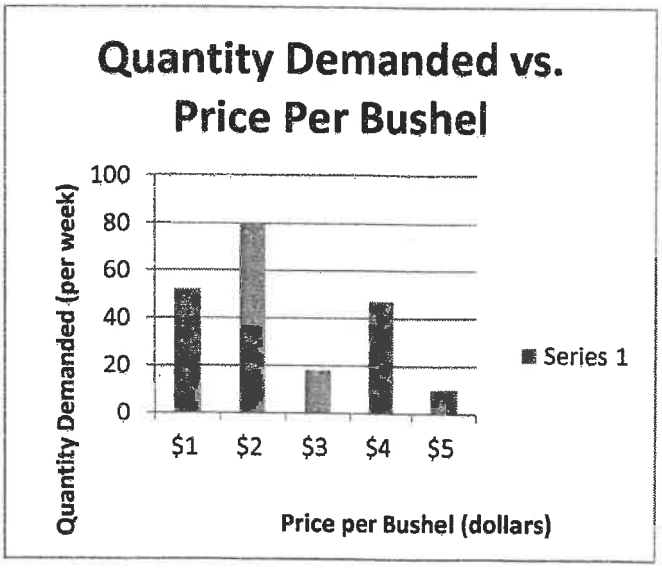
Background: The pie chart shows the approximate percentages teenagers spend doing various activities in a day. Use the information in the pie chart to answer the questions below.

1. What percent of the day is spent watching TV? _____
2. How many hours are spent sleeping? _____
3. What activity takes up the least amount of time? _____
4. What activity takes up a quarter of the day? _____
5. What two activities take up 50% of the day? _____
6. What two activities take up 25% of the day? _____



Practice Problem #6

1. What is the dependent variable? _____
   _____
2. Does the price per bushel always increase with demand?
   _____
3. What is the quantity demanded when the price is $5 per bushel? _____
4. What is the price per bushel when the quantity demanded is 80? _____



Conversions and Dimensional Analysis

Conversions are needed to convert one unit of measure into another equivalent unit of measure. Ratios, sometimes called conversion factors, are fractions that denote the correlation between the given unit and the desired unit. Dimensional analysis can be used to solve any conversion problem and allows problems to be easily checked for possible errors. This handout focuses on the most common conversions: metric, chemical, and multi-step.

Metric Conversions

A base unit is the basis of measurement in the sciences. The most commonly used base units are liters (L) for liquids, grams (g) for mass, and meters (m) for distance. Metric base units can be converted to other useful quantities by adding a prefix (see the common metric conversions table below). The base unit does not have a prefix, and these prefixes are not used in any other measuring system.

Multiplication Factor	Prefix	Symbol
$1{,}000{,}000{,}000 = 10^{9}$	giga	G
$1{,}000{,}000 = 10^{6}$	mega	M
$1{,}000 = 10^{3}$	kilo	k
$100 = 10^{2}$	hecto	h
$1 = 1$		
$0.01 = 10^{-2}$	centi	c
$0.001 = 10^{-3}$	milli	m
$0.000001 = 10^{-6}$	micro	μ
$0.000000001 = 10^{-9}$	nano	n

Example 1: How many meters are in 350 kilometers?

Step1: Identify the relationship between the given unit and the desired unit.

$$1\ km = 10^3 m = 1{,}000\ m$$

Step 2: Set up the ratios that show the relationship between the given and the desired unit.

$$\frac{1\ km}{1{,}000\ m} \text{ or } \frac{1{,}000\ m}{1\ km}$$

Step 3: Multiply the given number by the appropriate ratio. Remember that the desired unit is on the top of the ratio, and the given unit is cancelled out.

$$350\ \cancel{km} \times \frac{1{,}000\ m}{1\ \cancel{km}} = 350{,}000\ m$$

Example 2: How many meters are in 57 millimeters?

Step 1: Identify the relationship between the given unit and the desired unit.

$$1\ mm = 10^{-3} m = 0.001\ m$$

Step 2: Set up the ratios that show the relationship between the given and the desired unit.

$$\frac{1\ mm}{0.001\ m} \text{ or } \frac{0.001\ m}{1\ mm}$$

Step 3: Multiply the given number by the appropriate ratio. Remember that the desired unit is on the top of the ratio, and the given unit is cancelled out.

$$57\ \cancel{mm} \times \frac{0.001\ m}{1\ \cancel{mm}} = 0.057\ m$$

Practice Problem # 7

Convert the following units to the new units specified. Make sure to show your work and set up the problems usinf the examples as a guide.

A. Convert 2.73 kilograms into grams. _____g

B. Convert 37 grams of sodium into milligrams. _____mg

C. Convery 7.2 decameters into meters. _____m

D. Convert 54.67 meters into nanometers._____nm