Vocabulary for Math & Science

for English Language Learners

INTRODUCTION

This document showcases a course developed to supplement the learning objectives taught in core English language skills, providing means of further exposure to academic vocabulary and additional practice with the use of selected terms. The purpose here is simply to provide evidence of my course development and teaching skills, not to market the course materials.

Acknowledgements
Some of the activities included have been adapted from those developed by other instructors in the English Language Program at Purdue University Northwest (formerly Purdue University Calumet). As collaboration and teamwork is considered best practice in our field, I feel it acceptable to include those materials gleaned from others here, showing how I have incorporated and adapted them into this course. I have tried to note this, where applicable.

Note
In the course materials, I have used quite a lot of images from the Internet, which may or may not be copyrighted. I adhere to the Fair Use laws, which enable me to use material for educational purposes (i.e. in the classroom, and not to make a profit). Again, it is not my purpose here to publish my work, only provide a showcase of my teaching ability.

SYLLABUS

English Language Program
Purdue University Calumet
ELP 04500-02 Vocabulary for Math and Science (Elective)

Class Days/Times: Tuesdays & Thursdays, 2:00-3:20pm
Location: CLO 237
Instructor: Heather Torrie, CLO 285 (Office Hours, M-R 12:30-1:30pm), torrieh@pnw.edu (219-989-2648)

Objectives
This is an elective course designed to support the language skills you are learning in your core classes (listening/speaking, reading, and writing). The focus in this course is on learning and practicing vocabulary that is important in mainstream university courses. All PUC students will be required to take some general courses in math and science; therefore, this course will be beneficial for all ELP students. Students will learn vocabulary words relating to math, chemistry, biology, physics, engineering, and computer science. Activities will include watching video-recorded lectures, followed by exercises and projects involving the vocabulary.

In this course, you will do the following:

1. **Expand your vocabulary** by learning the meaning, use, and pronunciation of additional academic terms

Our main goal is to learn new vocabulary that will be helpful to you in academic studies and in your general English study. It is also important to learn how each word is pronounced.

2. **Practice vocabulary learning strategies**:
    a. implying/inferring the meaning of new unknown words

    Some of the practice we will do involves vocabulary-in-context, just like we do in your ELP reading classes. In this case, sometimes it is not necessarily important for you to memorize the word for a quiz, but rather to practice the skill of guessing the meaning of unknown words.

    b. look for definitions and explanations of new terms in lectures and textbooks

    Textbooks and lecture material often explain new terms. You need to use your listening and reading skills to find those definitions and take notes of their meanings.

3. Learning both technical **and non-technical meanings** of academic terms

Many technical words are also used in other situations. In this class, I want you to be aware of how the words we learn are used in non-science ways, as well. For example,

tension = the condition of being stretched tight (technical)

"It is important to have enough tension in the rope in order to hold up the weight."

tension = mental or emotional stress (non-technical)

"There has been a lot of tension at work between the boss and the workers."

Topics
Specific topics we will cover may include:
Math – Geometry, Linear Algebra, Trigonometry, Units of Measurement
Chemistry – Atoms, Molecules, Ions, Chemical Reactions
Biology – Cellular, Molecular, Human
Physics – Basic Forces
Engineering – Materials Science, Design, Engines and Mechanisms

*Note that the goal in this class is to learn and practice the vocabulary in English, so the principles and topics covered may include things you have already learned in high school.

Activities and Assignments
To receive a passing grade in this course, you must achieve a total of 75% or higher in the course. Assignments will be broken down as follows:

a) **(20%) Student-led vocabulary review activity** – You will sign up for one day during the semester which you (and a partner) will lead a 15-minute review game or activity to help practice vocabulary words that we are learning.

b) **(20%) Other Projects/Presentations** – You will complete several in-class projects to help reinforce the vocabulary.

c) **(60%) Vocabulary Quizzes** – There will be three vocabulary quizzes during the semester, based on the vocabulary words we learn. If you score less than 70% on any of these quizzes, you may ask for a make-up assignment.

Tentative Calendar

Week 1	Course Introduction Math Vocabulary
Week 2	Math Vocabulary
Week 3	Math Vocabulary
Week 4	Chemistry Vocabulary
Week 5	Chemistry Vocabulary
Week 5	Chemistry Vocabulary
Week 6	Chemistry Vocabulary
Week 7	Biology Vocabulary
Week 8	Biology Vocabulary
Week 9	Biology Vocabulary
Week 10	Physics Vocabulary
Week 11	Physics Vocabulary
Week 12	Physics Vocabulary
Week 13	Review, Group Projects (Student-led Vocabulary Review Activity)

TARGET VOCABULARY LIST

With the exception of the words highlighted in blue, these vocabulary words all come from the AWL, BEL, and EEWL word lists.

Math
Axis
Balance
Circumference
Coordinate (n)
deep / depth
Degree
Diameter
Dimension
Equation
Height / high
Intercept
Isolate
Length
Mass
Operation
Radius
solution
Solve
Squared
sum
Triangle
Variable
Width / wide

Chemistry
acidity / acid / acidic
brittle
classification / classify
concentration
conductivity / conductive
content
convert
decomposition / decompose
density / dense
diffusion / diffuse
dissolve
ductility / Ductile
emission / emit
equilibrium
Fixed (adj)
Flammability / flammable
form
Gaseous
Inert
insulation / insulate
lack
malleability / malleable
mechanism
molecule / molecular
Particle
Property
ratio
Reactivity / reactive / reactant
relative
set
solubility / soluble
stability / stable / stabilize
state (n)
structure
toxicity / toxic
uniform
uptake
viscosity / viscous
volume
yield

Biology
absorb
bacteria
capacity
circulate
contact
contract
deflate
diffuse
digest
evolve
expel
exposure / expose
filter
germs
host
infection
inflate
microbe
microorganism
microscopic
mild
organism
regulate
replicate
secrete
severe
surface
swallow
tissue
tract
transmission / transmit
virus
waste

Physics
acceleration / accelerate
amplitude / amplify
application / apply
flow
fluctuation / fluctuate
fluid
force
frequency
friction
gravity
inaudible
inertia
kinetic
potential
rate
transform
velocity
vibration / vibrate

Notes on the Target List
114 Total number of words*
18.3% from Basic Engineering List (BEL)
16.2% from AWL
42.3% from EEWL
45.8% unique to this list

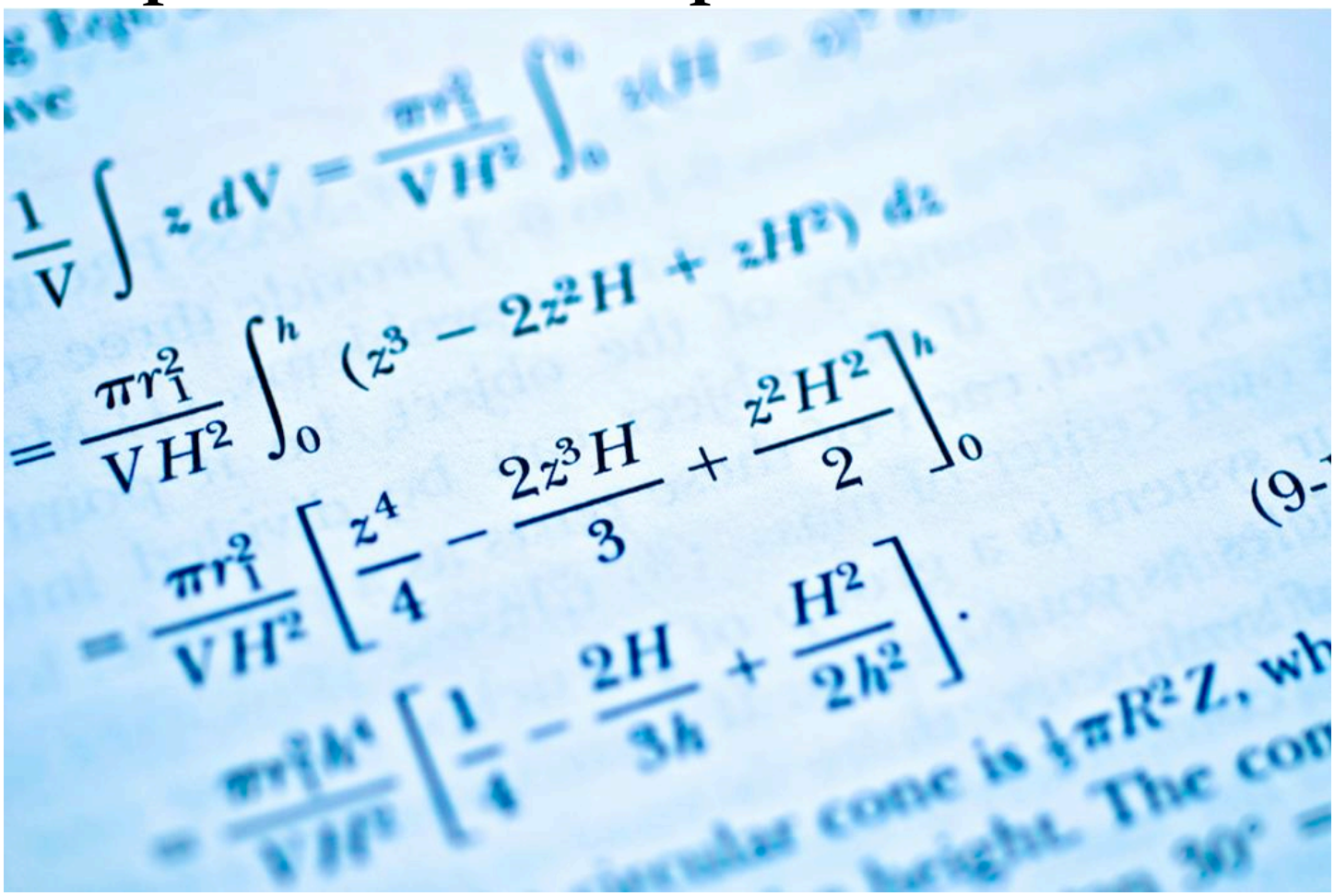
*This list includes some alternate word forms for some of the words because they are stressed particularly in the course.

The vocabulary list for this course was developed by identifying key words from the content material used for each topic.

Hands-on Vocabulary Use Activities

Math	Swimming Pool Design & Presentation
Chemistry	Substance Properties (pH, odor, etc) – household products
	Baking Soda/Vinegar Reactions
	Absorption of Diapers
Biology	Bacteria Cultures (petri dishes)
	Presentation on Human Biological Systems
Physics	Hooke's Law – springs demonstration
	Homemade Flashlights

Sample Material – Topic 1: Math



Warm-up Activity: *Teach pronunciation/word stress of numbers and units; pair activity* (not original)

NUMBERS DICTATION – Student A

1. 2.5 – I have two-point-five gigs of memory.
2. 1/5 – one-fifth of ETIE students start in level two.
3. 1.1029384756– In theory, one could make a calculation that continues infinitely (∞), like 1.1029384756…..
4. 7/8 – About seven-eighths of the population are infected.
5. 3.14159 – Three point one four one five nine is equivalent to PI π.
6. 99.09% - ninety-nine point zero nine percent of Moroccans are Muslim.
7. #16 – Player number sixteen was ejected from the game.
8. 30mm³ – The measurement was exactly 30 millimeters cubed.
9. 67,707 – The population of Hammond is sixty-seven thousand seven hundred and seven this year.
10. $34.90 – The manual costs thirty-four dollars and ninety cents on Ebay.
11. 1986 – Jerry was born on August fifteenth, nineteen eighty-six
12. 12th C – My favorite history is that of the twelfth century

13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____

NUMBERS DICTATION – Student B

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

13. 17% - There is a seventeen percent decline in job growth.
14. 189,648 – In the last years one hundred and eighty-nine thousand six hundred and forty eight civilians have been killed.
15. 2044 – In two thousand and forty-four scientists hope to have cured AIDS.
16. 5^2 – five squared is twenty five.
17. 5:45 – The participants lefts around five-forty-five pm.
18. 1:40 – My next class doesn't start until twenty until two.
19. 3m 11s – He was able to hold his breath for three minutes and eleven seconds
20. .0001 - The margin of error is point zero zero zero one percent.
21. 1/100mm - The increase was only one one hundredth of a millimeter.
22. 7.60695% - It resulted in a seven point six o six nine five reduction.
23. 400/8 = 50 – four hundred divided by eight equals fifty.
24. √100 - The square root of one hundred is ten.

Activity 1: *Practice with vocabulary-in-context and learning new terms as explained in academic lectures and readings* (original activities)

Vocabulary in Context

As we watch the video, pay attention to these terms. Choose the best definition, based on how he explains it.
https://www.khanacademy.org/math/algebra-basics/quadratics-polynomials-topic/Factoring-simple-expressions-core-algebra/v/factoring-and-the-distributive-property-2

1. What is a **binomial**?
    a. An equation with two different terms
    b. An expression that has two numbers
    c. A factor that has two coordinates
    d. An expression that has two properties

2. What does it mean to **factor out** something?
    a. Add it
    b. Divide it out
    c. Subtract it
    d. Think about it

3. What is the **greatest common factor**?
    a. The largest number in the equation
    b. The largest number you can use for your answer
    c. The largest number that you can divide both number by

Now, read the text on NUMBERS, and find the definitions in the reading of each.

1. What is an **integer**?

2. What is a **ratio of integers**?

3. What is a **rational number**?

4. What is an **irrational number**?

5. What is an example of an **imaginary number**?

Types of Numbers

Mathematicians classify numbers into types or number systems. As you learn these various number systems, it's important to remember that numbers can be more than one number type. Or in math geek-speak, number systems can be *subsets* of other number systems. But before we get too complex (pun intended), let's start from the beginning.

When you first learned to count, you started with 1, 2, 3 and kept going until you couldn't remember what came next or grew tired of counting. These positive counting numbers (1, 2, 3, 4, ...) are called **natural numbers**. The ... means the number list continues on infinitely.

If you add the number 0 to the natural numbers, you get the **whole numbers** (0, 1, 2, 3, ...). You also get an example of how a number can be classified as more than one type. For example, the number 2 is both a natural number and a whole number. In fact, all natural numbers are whole numbers, but not all whole numbers are natural numbers. Why? The number 0 is a whole number but not a natural number.

Integers include 0, the natural numbers, and the negatives of the natural numbers: (..., -3, -2, -1, 0, 1, 2, 3, ...). Again, the ... signifies the numbers go on to infinity — this time in both directions. All whole numbers (and therefore, all natural numbers) are integers, but not all integers are whole numbers. Starting to see the pattern here?

You asked about classifying fractions. Fractions are nothing more than ratios of integers. Numbers that can be written as fractions a/b, where a is an integer and b is a natural number, are called **rational numbers**. Remember that even an integer like 5 can be written as a fraction by dividing it by 1: 5/1. So you can see that all integers are rational numbers. Since decimals that end and repeat can be written in this form (0.66... = 2/3), they also are rational numbers.

If a decimal number doesn't repeat or end, it is not rational. It is classified as an irrational number. An irrational number can't be written as a fraction a/b, where a is an integer and b is a natural number. Pi (3.1415...) is a common example of a number that is irrational. **Irrational numbers** and rational numbers are two distinct classifications — a rational number (and integers, whole numbers, or natural numbers) can't be irrational.

Rational numbers and irrational numbers together make up the real numbers. Real numbers

and **imaginary numbers** like i (the square root of –1) together comprise the **complex numbers**.

Now, read the excerpt from a math textbook and answer the questions about the vocabulary. (p. 11 from Elementary Linear Algebra, BookBoon)

1. Find and write the definitions for each of these terms (in some cases, you can copy from the book; in other cases, you'll need to use your own words. For the last two items, draw them.
    a. Set:

    b. Subset:

    c. Integer:

    d. Square parentheses

    e. Round parentheses

Now, read the excerpt from a math textbook and answer the questions about the vocabulary. (p. 11 from Elementary Linear Algebra, BookBoon)

1. Find and write the definitions for each of these terms (in some cases, you can copy from the book; in other cases, you'll need to use your own words. For the last two items, draw them.
    a. Set:

    b. Subset:

    c. Integer:

    d. Square parentheses

    e. Round parentheses

1.1 Sets And Set Notation

A set is just a collection of things called elements. Often these are also referred to as points in calculus. For example $1,2,3,8$ would be a set consisting of the elements 1,2,3, and 8. To indicate that 3 is an element of $1,2,3,8$, it is customary to write $3 \in 1,2,3,8$. $9 \notin 1,2,3,8$ means 9 is not an element of $1,2,3,8$. Sometimes a rule specifies a set. For example you could specify a set as all integers larger than 2. This would be written as $S = x \in \mathbb{Z} : x > 2$. This notation says: the set of all integers, x, such that $x > 2$.

If A and B are sets with the property that every element of A is an element of B, then A is a subset of B. For example, $1,2,3,8$ is a subset of $1,2,3,4,5,8$, in symbols, $1,2,3,8 \subseteq 1,2,3,4,5,8$. It is sometimes said that "A is contained in B" or even "B contains A". The same statement about the two sets may also be written as $1,2,3,4,5,8 \supseteq 1,2,3,8$.

The union of two sets is the set consisting of everything which is an element of at least one of the sets, A or B. As an example of the union of two sets $1,2,3,8 \cup 3,4,7,8 = 1,2,3,4,7,8$ because these numbers are those which are in at least one of the two sets. In general

$$A \cup B \equiv x : x \in A \text{ or } x \in B .$$

Be sure you understand that something which is in both A and B is in the union. It is not an exclusive or.

The intersection of two sets, A and B consists of everything which is in both of the sets. Thus $1,2,3,8 \cap 3,4,7,8 = 3,8$ because 3 and 8 are those elements the two sets have in common. In general,

$$A \cap B \equiv x : x \in A \text{ and } x \in B .$$

The symbol $[a, b]$ where a and b are real numbers, denotes the set of real numbers x, such that $a \leq x \leq b$ and $[a, b)$ denotes the set of real numbers such that $a \leq x < b$. (a, b) consists of the set of real numbers x such that $a < x < b$ and $(a, b]$ indicates the set of numbers x such that $a < x \leq b$. $[a, \infty)$ means the set of all numbers x such that $x \geq a$ and $(-\infty, a]$ means the set of all real numbers which are less than or equal to a. These sorts of sets of real numbers are called intervals. The two points a and b are called endpoints of the interval. Other intervals such as $(-\infty, b)$ are defined by analogy to what was just explained. In general, the curved parenthesis indicates the end point it sits next to is not included while the square parenthesis indicates this end point is included. The reason that there will always be a curved parenthesis next to ∞ or $-\infty$ is that these are not real numbers. Therefore, they cannot be included in any set of real numbers.

Now, look at page 18 (on next page)

1. What is a **theorem**?
    a. Example
    b. Set of equations
    c. General truth that everyone believes

2. What is an **axiom**?
    a. A rule or guideline
    b. A number
    c. A solution
    d. A variable

Look at these adjectives. What is the noun or verb forms of these words?

3. **Additive** identity _____
4. **Associative** law for addition _____
5. **Multiplicative** identity _____
6. **Distributive** law _____

Discuss with your partner how this can help you understand what Theorem 1.4.1 means. Look at each one.

7. What do you think **commutative** law for addition means? What do you think *commutative* means, based on the context?

Theorem 1.4.1 *The complex numbers with multiplication and addition defined as above form a field satisfying all the field axioms. These are the following list of properties.*

1. $x + y = y + x$, *(commutative law for addition)*
2. $x + 0 = x$, *(additive identity).*
3. *For each* $x \in \mathbb{R}$, *there exists* $-x \in \mathbb{R}$ *such that* $x + (-x) = 0$, *(existence of additive inverse).*
4. $(x + y) + z = x + (y + z)$, *(associative law for addition).*
5. $xy = yx$, *(commutative law for multiplication). You could write this as* $x \times y = y \times x$.
6. $(xy) z = x (yz)$, *(associative law for multiplication).*
7. $1x = x$, *(multiplicative identity).*
8. *For each* $x \neq 0$, *there exists* x^{-1} *such that* $xx^{-1} = 1$.*(existence of multiplicative inverse).*
9. $x (y + z) = xy + xz$.*(distributive law).*

Source: Elementary Linear Algebra, BookBoon.com

Activity 2: *Watch a video and find definitions and explanations of terms. Practice showing meaning by giving examples or pictures.*

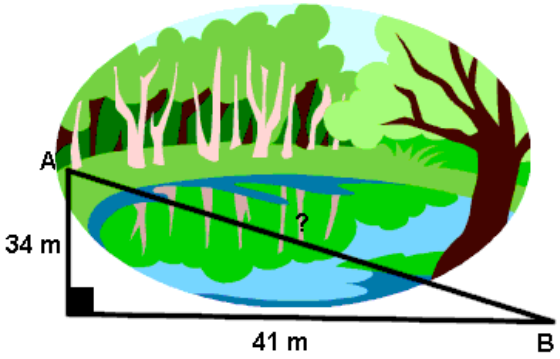
Let's watch the first few minutes of a lecture on geometry.
https://www.khanacademy.org/math/geometry/right_triangles_topic/pyth_theor/v/pythagorean-theorem (First 4:35 minutes)

As we watch the video, pay attention to these vocabulary words and how they are used. What is the part of speech for each one—noun, verb, adjective (is it a true adjective or actually a passive). Then, draw a picture of each to illustrate.

	Part of Speech	Picture
right triangle		
degree		
angle		
squared		
figure out		
formula		

Activity 3: *Pronunciation Practice*

Listen to the dialog. Underline the stressed syllables. Then, read the dialog with a partner. Focus on the pronunciation.



A: Okay, here's a problem for us to solve. Suppose there was a pond that we had to cross. If we walked around the pond, we would have to walk 41 meters across one end, and then 34 meters up the other end. But, if we had a boat, how far would it be to just go directly across the pond?

B: Well, we can apply the Pythagorean Theorem to figure it out, since basically, it's like a right triangle. What's the formula again?

A: a squared plus b squared equals c squared.

B: Right. So, let's see. What's forty-one squared?

A: One thousand, six hundred, eighty-one. And then, thirty-four squared.

B: That's one thousand, one hundred, fifty-six. So, a squared plus b squared is two thousand, eight hundred, thirty-seven.

A: Yeah, and now we need to get the square root of that, which is roughly fifty-three.

B: So, the pond is about fifty-three meters across. Well, it certainly would save us time if we could just boat straight across.

Now, practice talking through the following word problems on the worksheet.

Using the Pythagorean Theorem in Word Problems – WS #2

Solve by drawing a picture, identifying a, b, and c, and applying the Pythagorean Theorem. Don't forget to give your answer with units!

1. Two sides of a right triangle are 8 and 12 in.
    a. Find the missing side if these are the lengths of the legs.

    b. Find the missing side if these are the lengths of a leg and hypotenuse.

2. The foot of a ladder is placed 6 feet from a wall. If the top of the ladder rests 8 feet up on the wall, how long is the ladder?

3. The bottom of a ladder must be placed 3 ft. from a wall. The ladder is 12 feet long. How far above the ground does the ladder touch the wall?

Activity 4: Watch video lectures and notice key vocabulary. Then, use them in doing math activities.

Linear Algebra

Watch the video and pay attention to these terms. When you hear one, circle it on your chart.

https://www.khanacademy.org/math/algebra/solving-linear-equations-and-inequalities

Segments to watch
"How to represent a relationship with a simple equation"
"Solving two-step equations"
"Intro to solving an equation with variables on both sides"

Vocabulary List

Noun	Adjective	Verb
mass		
	balanced	balance
equation	equal	
		solve for *x*
		remove
variable		
operation		

Operations
- addition (+)
- subtraction (-)
- multiplication (x)
- division (/)

add	add 4
plus (+)	4 plus 3
subtract	subtract 2 from 10
minus	10 minus 2
divide	divide 9 **by** 3 divide 3 **into** 9
multiply/multiplied	multiply 4 **by** 3 10 multiplied **by** 3 equals 30

Now, let's practice with some basic operations. Be prepared to explain, using the white board, how to perform each operation.

Solve each equation.

1) $-20 = -4x - 6x$

2) $6 = 1 - 2n + 5$

3) $8x - 2 = -9 + 7x$

4) $a + 5 = -5a + 5$

5) $4m - 4 = 4m$

6) $p - 1 = 5p + 3p - 8$

7) $5p - 14 = 8p + 4$

8) $p - 4 = -9 + p$

Trigonometry/Graphing Coordinates/Functions, etc

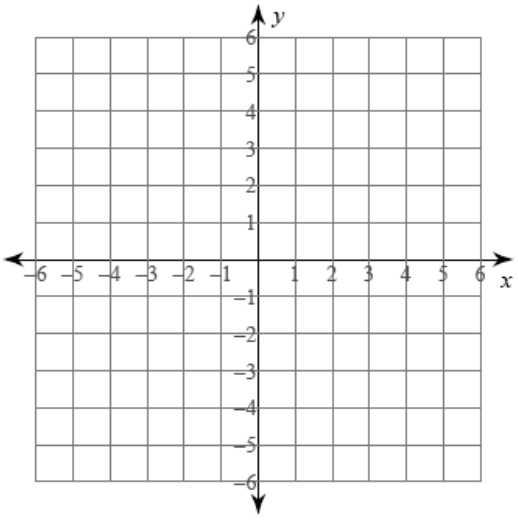
https://www.khanacademy.org/math/algebra-basics/core-algebra-graphing-lines-slope/core-algebra-graphing-intercepts/v/graphing-using-x-and-y-intercepts

Noun	Adjective	Verb
intercept		
axis		
value		
coordinate		
plane		
	corresponding	
		isolate
		cancel out
function (like equation)		
	greater than less than equal to	
slope		
		graph
	inverse	

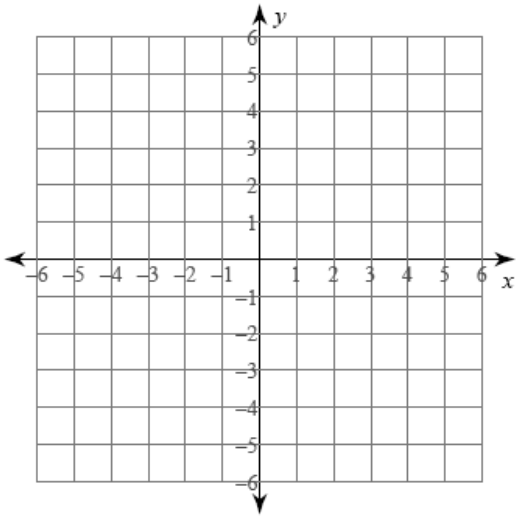
Now, let's practice. Graph the equations on the Math4-3 worksheet. Be prepared to talk through how you solved for x *(which is the slope).*

Sketch the graph of each line.

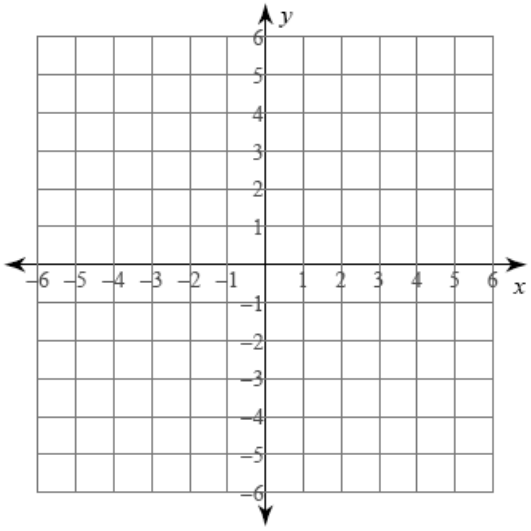
1) $y = \frac{7}{2}x - 2$



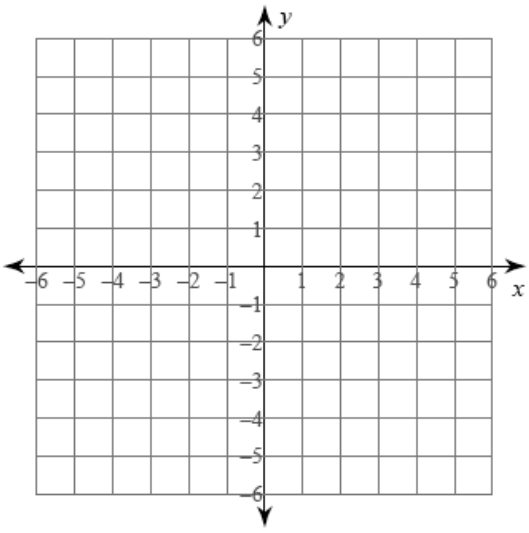
2) $y = -6x + 3$



3) $y = -5$



4) $y = \frac{6}{5}x + 1$



Activity 5: Students look up sample sentences of each word on the Internet, using online dictionaries and corpora.

Vocabulary Log: How to use these words

Use http://sentence.yourdictionary.com/ and http://www.ldoceonline.com/ to find two or three example sentences using each word. Then, record your sentences.

Word	Math-related sentence	Non-math sentence
Variable (n)		
Balance (v)		
Operation (n)		
Distribute (v)		
Intercept (n)		
Intersect (v)		
Axis (n)		
Value (n)		
Coordinate (n)		
Plane (n)		

Corresponding (adj)		
Isolate (v)		
Cancel out (v)		
Function (n)		
Equation (n)		
Slope (n)		
Plot (v)		
Graph (v)		
Inverse (adj)		

English Language Program
Purdue University Calumet
ELP 045-1 Vocabulary for Math and Science Quiz #1

Name: _____ Score: ___ / 26

Part 1 Miscellaneous Items

Use the words below one time each to label the illustrations to the side.

Fill in the chart with the appropriate word forms.

Noun	Adjective
	Long
Height	
	Deep
Width	

Pronunciation: Underline the stressed syllable(s) in the large part of the sentence.

1. The distance to my house is eighty-seven kilometers.
2. When we multiply this number by five, we get four thousand, six hundred, and ninety-two.

Label the pictures below with each term. Draw a line.

Fraction

Horizontal axis

Vertical axis

Coordinate

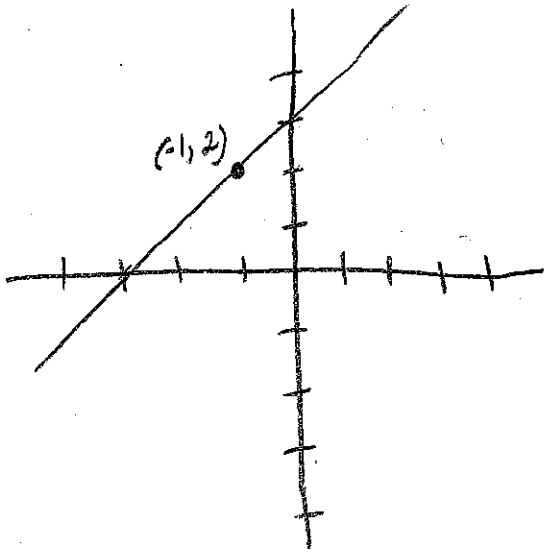
Slope

Intercept

Linear equation

Variable

$2y = \frac{1}{3}x + 1$



Part 2 Multiple Choice

Choose the best answer.

1. In the equation $34x - 3 = 65$, we need to solve for x. First, we should _____ 3 to both sides.
   a. Added by
   b. add
   c. addition
2. Then, we need to _____ 34.
   a. Divide into
   b. Divide by
   c. multiply

3. In the formula for perimeter, $p = 2l + 2w$, an example of a **variable** is ___.
   a. 2
   b. p
   c. l
   d. w
   e. both l and w

4. To solve the equation of $3x^2 = 12$, we need to factor out the 3 from both sides. Now, we have $x^2 = 4$. So, we need to get the _____.
   a. Square of four
   b. Four squared
   c. Root square of four
   d. Square root of four

5. To solve the equation $2(4x + 2) - 3(2x - 1) = 12$, we first need to _____ the variable to get $8x + 4 - 6x + 3 = 12$, or $2x + 7$.
   a. Factor
   b. Distribute
   c. Add

6. A right triangle is one that has a _____.
   a. Degree ninety angle
   b. Angle ninety degree
   c. Ninety degree angle
   d. Right degree angle
7. We can _____ the fraction 12/24 to ½.
   a. Distribute
   b. Reduce
   c. Add
   d. Divide