NAME_____

Pythagoras's Theorem can take us into some very interesting places…it's the passport to a country called 'Trigonometry." First, tho, let's get comfortable with the theorem by doing a bit of practice:

1. Write the Pythagorean Theorem right here:

2. What kind of triangles do we use it for?

3. Now, use it calculate the hypotenuse for the following triangles. **Remember, the last step is to find the <u>SQUARE ROOT</u> of the sum of the two sides squared!**

   <u>Triangle A</u> side a = 3, side b = 4 Hyp =

   Triangle B side a = 6, side b = 8 Hyp =

   Triangle C side a = 9, side b = 12 Hyp =

4. Using the Pythagorean Theorem in real life:
   Go outside and measure the height of the handicapped ramp, and how far it reaches on the ground. Then calculate the actual length of the handicapped ramp without measuring it. Show your calculations below:

It is 90 feet from base to base on a baseball diamond. The angle between the bases is 90 degrees. Draw the baseball diamond below.

How far does a third baseman have to throw the ball to first base? Show how you calculate the distance of the throw:

5. Look again at your answers to question 3. I want you to create a **fraction** for each triangle by placing the length of side b of the triangle over the hypotenuse.

   Fraction for triangle A (side b/hyp): _____

   Fraction for triangle B (side b/hyp): _____

   Fraction for triangle C (side b/hyp): _____

6. Now - divide each fraction to create a decimal:

   A:

   B:

   C:

6. Next, draw each triangle on your graph paper, using one square as one unit. What do you notice about the three triangles?

Now do these three triangles:

1. Calculate the hypoteneuse for these three triangles:
   Triangle D base = 2, height = 4 Hyp =
   Triangle E base = 4, height = 8 Hyp =
   Triangle F base = 6, height = 12 Hyp =

2. Create a fraction for each triangle by placing the height over the hypotenuse.
   D

   E

   F

3. divide the fraction to create a decimal for each ratio.

4. draw each triangle on your graph paper, using one square as one unit.

5. what do you notice about **these** three triangles?

Draw four more triangles:

Triangle **Hortense** – with a ratio of 3/8 for the height and the hypotenuse

Triangle **Ida** - with a ratio of 3/7

Triangle **Julius** - with a ratio 4/ 11

Triangle **Roscoe** – with a ratio of 6/7

Label each with their names, and the decimal version of the ratio

SO –

If I give you a decimal, you could, in theory, create a triangle for which that decimal is the ratio of **height** to **hypotenuse**, right? Let's try it:

Triangle **Bertha** has this decimal -- 0.6. What is her ratio? Now draw Bertha on the graph paper.

Now – using the protractor, measure the angle across from the right angle, and write it on the angle, as I show you on the board.

And fill in this table with the data from the five triangles

Name of Tri	Hypot length	Height length	Ratio	Decimal	Angle
Hortense					
Ida					
Julius					
Roscoe					
Bertha			0.6		

Pythagorean Theorem – Revisited

As you know, Pythagoras didn't really say "A squared plus B squared equals C squared"

He really said: **"The square of the length of the hypotenuse equals the sum of the squares of the other two sides."**

Or – (Hyp)^2 = A^2 + B^2

So – if you know the length of A and of B – you can square them and add the squares together and get the square of the hypotenuse.

A = 7, B= 9 H=

But, what if you know the length of the hypotenuse and one other side? Can you figure out the length of the last side?

A= 6, H= 11 B = or…

B= 12, H= 15 A=

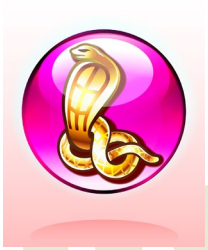
You have to use a bit of simple algebra to do this……..if you know what the **hypotenuse** is and what side '**b**' is, you can find side '**a**' this way:

h^2 = a^2 + b^2

then h^2 – b^2 = a^2 + b^2 – b^2

so h^2 – b^2 = a^2

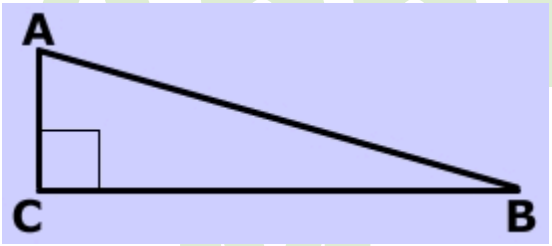
Remember – it's the square of the hypotenuse which equals the sum of the squares of the other two sides!!



FIERY CIRCLES AND SNAKES!!!!

Now let's do that human thing and create some names:

The long side of the triangle – across from the right angle – as you know, we call the HYPOTENUSE – which is only a useful word because it is so weird it is hard to forget! Line AB is the hypotenuse.



The angle ABC (the angle with its 'vertex' at B) is important!!

It decides the length of the hypotenuse, and pretty much everything else about the triangle. **We need a symbol for the angle ABC**. Pythagoras, and his fellow Greeks had their own alphabet. Here are some of the letters.

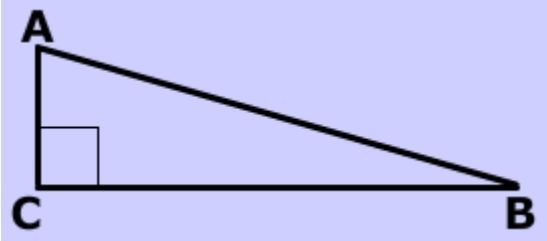
Αα	Alpha	**Νν**	Nu
Ββ	Beta	**Ξξ**	Xi
Γγ	Gamma	**Οο**	Omicron
Δδ	Delta	**Ππ**	Pi
Εε	Epsilon	**Ρρ**	Rho
Ζζ	Zeta	**Σσς**	Sigma
Ηη	Eta	**Ττ**	Tau
Θθ	**Theta**	**Υυ**	Upsilon
Ιι	Iota	**Φφ**	Phi
Κκ	Kappa	**Χχ**	Chi
Λλ	Lambda	**Ψψ**	Psi
Μμ	Mu	**Ωω**	Omega

In geometry, people generally use the Greek letter "**theta**" as the symbol for the angle. See if you can find it above.

So – let's finish our naming task…

The long side is called the **HYPOTENUSE**
The side across from theta is called the **SIDE OPPOSITE**
The side next to the right angle is called the **SIDE ADJACENT**
(adjacent means 'next to,' as in "my gall bladder is adjacent to my liver")
The angle across from the right angle (angle ABC) is called **THETA**

Please write the names of the three sides and the angle on the correct parts of the triangle below



Some questions for you to think through and answer:

1. Draw a triangle where the angle theta (angle ABC) is as big as you possibly can make it. What is the **biggest angle** (in degrees) that theta could be?

2. If theta is as big as possible, how does the length of the **side opposite** compare to the length of the **hypoteneuse**?

3. For this triangle, what is the approximate value of the fraction **side opposite/hypoteneuse** (O/H)?

4. Draw a triangle where the angle theta is as small as can be. What is the **smallest** the angle theta can be?

5. What happens to the fraction **side opposite/hypoteneuse** (O/H) when theta gets really small?

In trigonometry (the "measurement of triangles"), the ratios (fractions) of sides is important. And each ratio has its own peculiar name!

They are **'sine'**, **'cosine,'** and **'tangent.'**

For the angle THETA, the ratio of opposite/hypotenuse is called the **SINE** of theta.

OK – NOW TO REVEAL THE 'SECRET CODE'….I HOPE YOU ARE READY  …

SOH stands for **S**ine (is the) **O**pposite/**H**ypotenuse

CAH stands for **C**osine (is the) _____

TOA stands for **T**angent (is the) _____

Today, you are going to do some graphing and some calculations

What happens to the sine of theta changes as theta goes from 0 to 180 degrees?

1. Create a graph and put Theta on the X axis. Mark off theta in 15 degree amounts, from 0 to 180 degrees.

2. Put sine theta on the Y axis, using units of .05. Remember – what is the MAXIMUM that sine Theta can be? That is how high your Y axis needs to go.

3. Now – do you remember what sine theta is when theta is 0 degrees? What about when theta is 90 degrees? You can mark these on your graph.

4. Then draw triangles for theta as 15 degrees, 30 degrees, 45 degrees, etc. DRAW ACCURATELY – then use the triangles to calculate the value of the sine for each theta.

5. Now graph the sine for each theta on your graph.

Remember: SOH CAH TOA?

6. Figure out the missing sides of the following triangles:

Luigi: Side adjacent: 8 cm hyp = _____

Side opp: 5 cm

****

Mario: Side adjacent: 11 cm side opp = _____

Hypot 14 cm

7. Figure out theta for each (you'll have to draw them and measure theta w/a protractor)

8. Create a little table that lists the following for Mario and Luigi:

Name, theta, sine, cosine, and tangent

It's time for....Cosines!!!!

Let's look at the relationship between sine and cosine...

SOH tells us that the sine of theta is: _____

CAH tells us that the cosine of theta is: _____

So, when you draw a bunch of right triangles with different thetas, what happens to side opposite as side adjacent gets longer? Describe it here:

_____

What happens to side adjacent as side opposite gets longer? Describe it here:

So, now I want you to take out the graph you made of sine theta against theta,

And calculate the COSINES for the angles, and then graph them (in a different color) on the first graph...

(**HOWEVER – IF YOU SHOW ME THE CALCULATIONS FOR THETA = 0, THETA = 30, THETA = 45 AND THETA = 90, I'LL GIVE YOU A CALCULATOR TO DO ALL THE REST!**)