**Lab: Law of Sines/Cosines Lab: *(Instructor Version)***

*This lab is a discovery lab and should be done prior to presenting the formulas during lecture.*

**Motivation:** To not just see and memorize formulas, but understand the geometry supporting the Law of Sines and the Law of Cosines.

**Objectives:** Students will be able to verify the Law of Sines and derive the Law of Cosines.

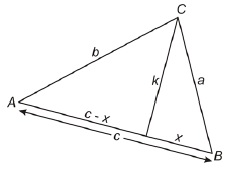
**Materials Needed:**

Protractor, Ruler, Paper,Pencil

**Activity 1: Law of Sines**

*This activity should take 20-30 minutes. Your students will use the straight edge of their protractor to draw a triangle and answer the following questions. ( All triangles should be different so that students can see that the Law of Sines is true for all triangles.)*

1. What are the measures of each of the angles?
2. What are the lengths of each of the sides?
3. Calculate the following ratios: , , and .
4. Based on your calculations in 3., can you draw any conclusions? *(Think, pair, share is a good activity to use for this question.)*
5. Will your conclusions work with any triangle? Why or why not? *(Think, pair, share is a good activity to use for this question.)*

**Activity 2: Law of Cosines**

*This activity should take about 30-40 minutes.*

*You should lead your students through the drawing of the triangle and inform your students that their triangles should look different than the person next to them.*

Draw triangle . From vertex , draw an altitude (height of the triangle) of length . Separate side into segments and . *(Question you can pose to your class: Why can the segments be represented in this way?)*

*Students will follow the steps below to derive the Law of Cosines. Good steps to use the think, pair, share activity will have a TPS label on them.*

1. The altitude separates into two right triangles. What are the triangles?
2. *TPS:* Use the Pythagorean Theorem to write two equations, one relating and , and another relating and .
3. *TPS:* Notice that both equations contain . Why is this so?
4. Solve each equation for .
5. Since both of the equations in Question 4 are equal to , we can set them equal to each other. *(Question you can pose to the class: Why is this true?)*
6. Set the equation equal to each other to form a new equation. But notice now that the equation you just formed involves . However, is not a side of . As a result we will attempt to rewrite the newly found equation so that it does not include . Begin by expanding the equation and combining like terms then solve the equation for .
7. The resulting equation in Question 6 still includes . To eliminate from the equation we need to substitute an equivalent expressions for . Try finding a relationship between and that we can substitute into the equation. *(Question to pose to your students:* *Why should we use ?)*
8. Use the relationship from Question 6 and solve for . *(Question to pose to your students: Why should we solve for ?)*
9. Substitute the equivalent expression for into the equation from Question 6. This equation is called the **Law of Cosines**.
10. Using this same method, two more equations could be written for and . Without going through the whole process again, write two other forms of the law of cosines for .

**Part 3:**

*This activity would be great using the think, pair, share technique and should take about 10-15 minutes.*

1. What could the Law of Sines and the Law of Cosines be used for?
2. Can you think of a type of problem where the Law of Sines would be used over the Law of Cosines and vice versa.