Trigonometry

Instructional Focus: Use unit circles and inverse trigonometric functions

	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Use special triangles (F.TF.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Use special triangles to determine the values of sine, cosine, tangent, secant, cosecant, and cotangent for 0, π/6, π/4 and π/3, π/2 and **use the unit circle to express the values of sine, cosine, tangent, secant, cosecant, and cotangent for π–*x*, π+*x*, and 2π–*x* in terms of their values for *x*, where *x* is any real number**	Use special triangles to determine the values of sine, cosine, tangent, **secant, cosecant, and cotangent** for **0**, π/6, π/4, π/3 and **π/2**	Use special triangles to determine the values of **sine, cosine and tangent** for π/6, π/4 and π/3	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Use unit circles to find values (F.TF.4)		Use the unit circle to express any angle, including negative angles and angles involving more than 1 rotation, in terms of its standard position to find **all six** trigonometric functions.	Use the unit circle to express any angle, between 0 and 2π, in terms of its standard position to find ALL 6 trig functions.	Use the unit circle to express any angle, between 0 and 2π, in terms of its standard position to find the **sine, cosine, and tangent functions**.	
Construct Inverse trigono-metric functions (F.TF.6)		**Construct an invertible trigonometric function by restricting the domain so that the function is always increasing or decreasing**	**Identify a domain that will allow construction of the inverse of a trigonometric function, because the function would be always increasing or decreasing**	Given a portion of a trigonometric graph, identify if that part of the graph is invertible	
Use inverse trigono-metric functions (F.TF.7)		Use inverse functions to solve trigonometric equations with restricted and unrestricted domains **and interpret the solutions in context of the situation**	Use inverse functions to solve trigonometric equations with restricted **and unrestricted** domains	Use inverse functions to solve trigonometric equations with **restricted domains**	
Pythagor-ean identity (F.TF.8) Given $\cos\theta = \frac{\sqrt{3}}{2}$		**Prove** the Pythagorean identity $sin^2(\theta) + cos^2(\theta) = 1$ and use it to find $sin(\theta)$, $cos(\theta)$, and $tan(\theta)$	Use the Pythagorean identity $sin^2(\theta) + cos^2(\theta) = 1$ to find $sin(\theta)$, $cos(\theta)$, **and** $tan(\theta)$	Use the Pythagorean identity $sin^2(\theta) + cos^2(\theta) = 1$ to find $sin(\theta)$, $cos(\theta)$, **or** $tan(\theta)$	

F.TF.3 (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π–*x*, π+*x*, and 2π–*x* in terms of their values for *x*, where *x* is any real number.
Functions F.TF.4 (+) Use the unit circle to ~~explain symmetry (odd and even)~~ and periodicity of trigonometric functions.

F.TF.6 (+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

F.TF.7 (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.★

F.TF.8 Prove the Pythagorean identity $sin^2(\theta) + cos^2(\theta) = 1$ and use it to find $sin(\theta)$, $cos(\theta)$,or $tan(\theta)$ given $sin(\theta)$, $cos(\theta)$, or $tan(\theta)$ and the quadrant of the angle.

Trigonometry

Instructional Focus: Graph and transform trigonometric functions

	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Symmetry and periodicity of trigono-metric functions (F.TF.4)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Use the unit circle to explain symmetry (odd and even) of **the six** trigonometric functions. Use the periodicity of the unit circle to explain the repeated cycle of the graphs of **all six** trigonometric functions.	Use the unit circle to explain symmetry (odd and even) of the sine, cosine, **and tangent** functions. Use the periodicity of the unit circle to explain the repeated cycle of the graphs of sine, cosine, **and tangent** functions.	Use the unit circle to explain symmetry (odd and even) of the **sine and cosine** functions. Use the periodicity of the unit circle to explain the repeated cycle of the graphs of **sine and cosine** functions.	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Identify and Find Transfor-mations (F.BF.3)		Identify the effect on a graph by replacing f(x) with **more than two** transformations: $f(x) + k$, $k\,f(x)$, $f(kx)$, $f(x + k)$ for specific positive and negative values of k Given the graph of a function and **more than two** transformations, find the values of the constants and coefficients Given a partial graph, **complete the graph** for both even and odd functions	Identify the effect on a graph by replacing f(x) **with two** transformations: $f(x) + k$, $k\,f(x)$, $f(kx)$, $f(x + k)$ for specific positive and negative values of k Given the graph of a function and **two transformations**, find the values of the constants and coefficients Recognize even and odd functions from graphs **and equations**	Identify the effect on a graph by replacing f(x) with **a single** transformation: $f(x) + k$, $k\,f(x)$, $f(kx)$, $f(x + k)$ for specific positive and negative values of k Given the graph of a function and a **single transformation**, find the value of the constant or coefficient Recognize even and odd functions **from graphs**	
Identify key features of graphs (F.IF.7)		Graph trigonometric functions, and interpret all related key features of a graph **in context of a real world situation**. • asymptotes • period • midline • amplitude	**Graph** trigonometric functions, and identify all related key features of a graph. • asymptotes • period • midline • amplitude	**Given the graph or equation** of trigonometric functions, identify all related key features of a graph. • asymptotes • period • midline • amplitude	

Graphing F.TF.4 (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
F.BF.3 (+) Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. ~~Experiment with cases and illustrate an explanation of the effects on the graph using technology.~~ *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*
F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★
e. (+) Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

Trigonometry

Instructional Focus: Prove and use trigonometric functions

<table>
<tr><th></th><th>4 – Mastery</th><th>3 – Proficient</th><th>2 - Basic</th><th>1 – Below Basic</th><th>0 – No Evidence</th></tr>
<tr><td>Prove and use formulas (F.TF.9)</td><td rowspan="4">Can extend thinking beyond the standard, including tasks that may involve one of the following:

• Designing
• Connecting
• Synthesizing
• Applying
• Justifying
• Critiquing
• Analyzing
• Creating
• Proving</td><td>Prove the addition and subtraction formulas for sine, cosine, and tangent and use the addition and subtraction formulas to solve <u>identities</u></td><td><u>Prove the addition and subtraction formulas for sine, cosine, and tangent</u> and use them to solve numerical problems</td><td>Use the addition, subtraction, and tangent formulas to solve numerical problems</td><td rowspan="3">Little evidence of reasoning or application to solve the problem

Does not meet the criteria in a level 1</td></tr>
<tr><td>Derive area formula (G.SRT.9)</td><td>Explain how to derive the formula: A = 1/2 ab sin(C) for the area of a triangle, and utilize it to find the area of a <u>polygon composed of multiple triangles</u></td><td><u>Explain how to derive the formula: A = 1/2 ab sin(C) for the area of a triangle</u>, and utilize it to find the area of a triangle</td><td>Find the area of any triangle using the formula:
A = 1/2 ab sin(C)</td></tr>
<tr><td>Law of Sines and Cosines (G.SRT.10 and 11)</td><td>Apply the Law of Sines and the Law of Cosines to find unknown measurements in oblique triangles <u>and interpret solutions in context of real-world situations</u></td><td>Apply the Law of Sines <u>and</u> the Law of Cosines to find unknown measurements in oblique triangles</td><td>Apply the Law of Sines <u>or</u> the Law of Cosines to find unknown measurements in oblique triangles</td></tr>
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F.TF.9 (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

G.SRT.9 (+) Derive the formula *A* = 1/2 *ab* sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.

G.SRT.10 (+) Prove the Laws of Sines and Cosines and use them to solve problems.

G.SRT.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).