# Core Content

| Cluster Title: Extend the domain of trigonometric functions using the unit circle. |
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| **Standard F.TF.1:** Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. |
| **Concepts and Skills to Master** |
| <ul><li>Define a radian as the length of the arc on the unit circle subtended by the angle.</li><li>Locate radian measures on the unit circle.</li></ul> |

# Supports for Teachers

| Critical Background Knowledge |
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| **Academic Vocabulary** |
| radian, unit circle, subtended, central angle |

| Suggested Instructional Strategies | Resources |
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| <ul><li>Tie to Secondary II.G.C.5. Define radian measure of an angle as the constant of proportionality between the length of an arc intercepted by the angle and the radius.</li><li>Locate points on the unit circle corresponding to angles commonly used in trigonometry.</li><li>Explore how the radian measure of an angle does not change even when the size of the circle changes.</li><li>Use the special right triangles to help student develop fluency in reproducing the unit circle from memory.</li></ul> | <ul><li>"Experiencing Radians" from *Mathematics Teacher,* Vol. 92, No. 6, September 1999.</li></ul> |

| Sample Formative Assessment Tasks | |
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| **Skill-Based Task:**<br><br>Draw the angle whose measure is 2 radians. | **Problem Task:**<br><br>How many radians can you fit around a circle with a diameter of 10 inches? How does this compare to the number of radians you can fit around a circle with a diameter of 5 inches? |

III.3.F.TF.1

# Core Content

| Cluster Title: Extend the domain of trigonometric functions using the unit circle. |
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| **Standard F.TF.2:** Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle. |
| **Concepts and Skills to Master** |
| <ul><li>Find the measure of an angle, given a coordinate on the unit circle and given an angle, find the corresponding coordinates on the unit circle.</li><li>Be able to explain how the use of positive and negative rotations can be used to obtain the domain of the sine and cosine functions.</li><li>Use co-terminal and reference angles to find values for trigonometric functions.</li><li>Recognize that the coordinates of any point on the unit circle may be defined as (cos θ, sin θ).</li><li>Use the angles and corresponding coordinates on the unit circle to create the graphs of the sine and cosine functions.</li></ul> |

# Supports for Teachers

| Critical Background Knowledge |
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| <ul><li>Understanding radian measure (III.3.F.TF.1)</li><li>Defining trigonometric ratios—Secondary II (G.SRT.6)</li></ul> |
| **Academic Vocabulary** |
| co-terminal angles, reference angle |

| Suggested Instructional Strategies | Resources |
|---|---|
| <ul><li>Tie measures in special right triangles to values on the unit circle and use those values to generate a relationship between the angles and the corresponding locations on the unit circle.</li><li>Use the values on a unit circle to generate the graphs of the sine and cosine functions on the coordinate plane.</li></ul> | <ul><li>*Illuminations: Graphs from the Unit Circle*</li></ul> |
| **Sample Formative Assessment Tasks** | |

| Skill-Based Task | Problem Task: |
|---|---|
| Use the unit circle to find cos(-7π/3). | Find 5 solutions to sin($x$) = .5. (Teacher note: The goal of this conversation is to generate infinite solutions.) |

III.3.F.TF.2

## Core Content

| **Cluster Title: Extend the domain of trigonometric functions using the unit circle.** |
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| **Standard F.TF.3:** Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, 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. |
| **Concepts and Skills to Master** |
| <ul><li>Use similarity to determine the side measures of 30°–60°–90° and 45°–45°–90° triangles.</li><li>Find the values of sine, cosine, and tangent in the special right triangles using degree and radian measures.</li><li>Understand and use reference angles on the unit circle.</li></ul> |

## Supports for Teachers

| **Critical Background Knowledge** |
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| <ul><li>Understanding that trigonometric ratios are defined by acute angles in similar triangles (II.G.SRT.6)</li><li>Using trigonometric ratios and the Pythagorean Theorem to solve right triangles (II.G.SRT.8)</li></ul> |
| **Academic Vocabulary** |
| domain, reference angle, angle of rotation, co-terminal, initial side, terminal side, sine, cosine, tangent |

| **Suggested Instructional Strategies** | **Resources** |
| --- | --- |
| <ul><li>Divide a unit circle into fractional parts to create the radian values in the unit circle. Begin with halves, then quarters, then thirds, then sixths to illustrate equivalencies. Tie these values to the special right triangles to build the values in the unit circle.</li></ul> | |

| **Sample Formative Assessment Tasks** | |
| --- | --- |
| **Skill-Based Task:**<br>Find the value of *t* that corresponds to the given function values.<br>cos (*t*)= -($\sqrt{2}$)/2 ; *t* in QII<br>tan *t* = $\sqrt{3}$; *t* in QIII | **Problem Task:**<br>Explain how the points ($\sqrt{3}$/2, ½) and (-1/2, -$\sqrt{3}$/2) on the unit circle are related in terms of their reference angles. |

III.3.F.TF.3