

Studies in Trigonometry

MS-3215

Common Core Standards

7.RP: Ratios & Proportional Relationships

7.RP.A.1

Standard Text: Compute unit rates associated with ratios of fractions.

How This Relates to Trigonometry: Strengthening proportional reasoning sets the stage for understanding trigonometric ratios (which compare side lengths in right triangles).

7.RP.A.2

Standard Text: Recognize and represent proportional relationships between quantities.

How This Relates to Trigonometry: The concept of proportional relationships is foundational. In trigonometry, sine, cosine, and tangent are constant ratios for given angles, a direct extension of proportional thinking.

7.G: Geometry

7.G.A.1

Standard Text: Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

How This Relates to Trigonometry: Working with scale drawings reinforces the idea that shapes can be similar (same angles, proportional sides). This parallels how right triangles of different sizes share the same trigonometric ratios for corresponding angles.

7.G.B.5

Standard Text: Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.

How This Relates to Trigonometry: Complementary angles are especially important in trigonometry, where the sine of one angle equals the cosine of its complement. Recognizing angle relationships at this level paves the way for more advanced angle-based reasoning later.

8.G: Geometry**8.G.B.6**

Standard Text: Explain a proof of the Pythagorean Theorem and its converse.

How This Relates to Trigonometry: The Pythagorean Theorem is the underlying relationship in right triangles, forming the core basis for defining trigonometric ratios.

8.G.B.7

Standard Text: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles.

How This Relates to Trigonometry: As students repeatedly solve for missing side lengths, they build the understanding that side lengths have consistent relationships—eventually leading to defining sine, cosine, and tangent in high school.

8.G.B.8

Standard Text: Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

How This Relates to Trigonometry: This work with right triangles in the coordinate plane is a precursor to defining trigonometric functions on the unit circle in high school.

NGSS Middle School Physical Science (MS-PS)

If your project incorporates physical contexts (e.g., measuring heights, distances, or slopes), you can cross-reference NGSS performance expectations related to motion and forces that use ratios and proportional relationships.

ISTE Standards (for Digital Tools Integration)

If students use technology to explore or visualize geometric concepts (interactive geometry software, simulations), they meet ISTE standards on creativity, innovation, and computational thinking.

NCTM Process Standards

Concepts such as problem-solving, reasoning, and making connections in geometry align with broader NCTM standards, reinforcing how proportional reasoning in Grades 7–8 leads directly into trigonometry in high school.

Pathway to High School Trigonometry and Beyond

Building a Bridge to SRT (Similarity, Right Triangles, and Trigonometry) Standards: The 7th- and 8th-grade focus on ratio, similarity, and right triangles directly prepares students for HSG.SRT.C.6–8 in high school (sine, cosine, tangent definitions and applications).

Extension Activities: Simple scale drawing or Pythagorean Theorem projects at the middle school level can be extended by introducing angle measures or simple applications of trigonometric ratios, providing a preview to high school geometry.

High School: Geometry – Similarity, Right Triangles, and Trigonometry (HSG.SRT)**HSG.SRT.C.6**

Standard Text: Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

How the Project Meets It: Activities that derive the sine, cosine, and tangent ratios from similar right triangles help students see that those ratios depend on angles rather than specific triangle sizes.

HSG.SRT.C.7

Standard Text: Explain and use the relationship between the sine and cosine of complementary angles.

How the Project Meets It: Lessons or problem sets typically include exercises where students explore how sine of one acute angle equals the cosine of its complement, reinforcing understanding through numeric and geometric examples.

HSG.SRT.C.8

Standard Text: Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

How the Project Meets It: Students apply sine, cosine, and tangent to determine unknown sides or angles in real-world scenarios (e.g., height of a building, angle of elevation). Such tasks emphasize problem-solving skills and the practical utility of trigonometry.

High School: Functions – Trigonometric Functions (HSF.TF)

While trigonometric functions are often introduced in Geometry under right triangles, they appear again in the Functions conceptual category (HSF.TF). Depending on the scope of the project, it may align with:

HSF.TF.A.1–3 (defining and interpreting trigonometric functions on the unit circle, extending beyond acute angles).

HSF.TF.B.5 (modeling periodic phenomena with trigonometric functions, if the project extends to sinusoidal modeling or wave forms).

If the Trigonometric Ratios project focuses purely on right triangles, it primarily covers HSG.SRT, but a more advanced extension that uses the unit circle or periodic modeling would meet these additional Function standards.

Other Possible Cross-Referenced Standards

Next Generation Science Standards (NGSS)

Application in Physics or Engineering: NGSS often intersects with trigonometry in areas like wave properties (HS-PS4), analyzing forces on inclined planes (HS-PS2), or simple harmonic motion. Projects that include real-world physics problems (e.g., using sine and cosine to model wave displacement) can align to these performance expectations.

International Society for Technology in Education (ISTE) Standards

When Technology Tools Are Integrated: If the project uses digital tools (graphing software, simulations, or programming) to visualize or explore trigonometric functions, it can align with ISTE standards focusing on creative problem-solving and computational thinking.

National Council of Teachers of Mathematics (NCTM) Standards

Connections and Problem Solving: Trigonometry units featuring conceptual understanding, problem-solving, and reasoning connect well with NCTM's high school geometry standards (e.g., analyzing characteristics/properties of geometric shapes, making mathematical connections).

How These Standards Can Lead to Additional Standards

Advanced Function Concepts: Once students are comfortable with right-triangle definitions, they can move on to unit-circle definitions (HSF.TF.A.2) and modeling periodic phenomena (HSF.TF.B.5).

Precalculus and Beyond: Mastery of basic trig ratios sets the stage for more advanced courses—covering laws of sines and cosines (often in Precalculus) and ultimately complex numbers and Euler's formula in more advanced math.

STEM Integration: Projects highlighting real-world applications of trigonometry (in physics, engineering, architecture) can align with NGSS engineering standards (focusing on defining problems and designing solutions) and can introduce or deepen connections to other STEM fields.