

M155: Right Triangle Trigonometry

[Illustrative Mathematics– Geometry Unit 4: Right Triangle Trigonometry](#)

Notes for improving overall alignment:

- Opportunities for students to engage in pair or group work are an integral part of this curricular design, and special considerations will need to be taken into account if working outside of a traditional classroom setting to give students opportunities to **engage in social activities (LP2)**.
- Leverage the structure of the curriculum to give space for students to **have agency in their learning (LP4)**. This can be accomplished by learning about students' interests and lived experiences, then tailoring curricular prompts to reflect those experiences and interests. Use the curriculum's mathematical learning arcs to structure opportunities and check for progress toward attainment of *Content and Practice Expectations*.
- Leverage the structure of the curriculum and embedded instructional routines to give students space to **view mathematics as a human endeavor across centuries (LP5)**. This can be done by positioning students as authors of important mathematical ideas, where their thinking is at the center of discussion and exploration, as well as by giving time to reflect on progress and personal growth.
- Opportunities for students to **employ technology as a tool for problem-solving and understanding (LP7)** are available throughout the unit, particularly the use of calculators when using ratios and using trigonometric functions for solving missing side lengths and angles of right triangles.
- Consider adding in supplemental activities to support 155.c.ii with contextual practice problems from the curriculum.

Learning Principles

Engage with cognitively demanding tasks in heterogeneous settings (LP 1). Students should be given opportunities to grapple with multistep, non-routine tasks that promote mathematical rigor. These experiences should be differentiated so that all students

engage in appropriate challenges—for example, through tasks with multiple entry points and solution pathways. These experiences should continue to integrate knowledge and skills developed in grades 6-8 at the level of sophistication of high school mathematics.

Engage in social activities (LP 2). Students should have opportunities to work independently and to communicate with one another about mathematics by engaging in collective and collaborative learning activities. Explaining and having opportunities to revise one’s thinking has excellent value in solidifying one’s knowledge.

Build conceptual understanding through reasoning (LP 3). Students should be given the opportunity to reason, justify, and problem solve with critical thinking, reading, writing, speaking, and listening. Through reasoning and work with multiple representations, students learn why procedures work and build a conceptual understanding of key mathematical ideas.

Have agency in their learning (LP 4). Students should be able to choose tasks and learning experiences that align with their interests and aspirations. All students have rich and varied experiences and home lives. Learning mathematics should bring students’ identities and interests to the fore and build on the strengths that they bring to the learning space.

View mathematics as a human endeavor across centuries (LP 5). Students should understand that mathematical ideas emanated over time from civilizations around the world and have opportunities to explore these contributions to mathematics. Students should develop an appreciation of mathematics as a human endeavor: one in which they feel a sense of belonging, where they see themselves as mathematicians, and one that offers opportunities to broaden their ideas about what mathematics is, how it is used, and who it is for.

See mathematics as relevant (LP 6). Students should engage with mathematics in ways that authentically involve real-world situations. Problem-solving contexts should allow students to perceive mathematics as a tool for addressing the questions that arise in everyday life, as well as the ways it can model our world and address global economic, social, and environmental challenges. Students should also engage with mathematics in ways that connect to academic disciplines and future careers by doing the mathematics used by artists, designers, engineers, and other professionals.

Employ technology as a tool for problem-solving and understanding (LP 7). Research indicates that technology is a powerful tool for learning deeper mathematics by improving calculation efficiency and enabling more sophisticated analysis. Students should learn to use technology, with emphasis put on widely used tools and software, such as calculators and spreadsheets, to make sense of models. Technology use should not be limited to supporting “doing mathematics,” but should also be used as a tool for displaying and communicating results to appropriate audiences.

Content and Practice Expectations

Content and Practice Expectations	Indicators Choose an artifact where you...
155.a: Use similarity to explain the meaning of trigonometric ratios.	i. measure side lengths and angles of multiple triangles and describe patterns you see.
	ii. explain why trigonometric ratios remain the same for different-sized right triangles.
155.b: Explain and use the relationship between the sine and cosine of complementary angles.	i. illustrate the relationship between the sine and cosine of complementary angles.
	ii. use the relationship between the sine and cosine of complementary angles to solve problems.
155.c: Use trigonometric ratios to solve right triangles in applied problems.	i. use trigonometric ratios to find unknown side lengths in problems.
	ii. use trigonometric ratios to find unknown angles in problems.

Unit Overview

	<u>L1</u>	<u>L2</u>	<u>L3</u>	<u>L4</u>	<u>L5</u>	<u>L6</u>	<u>L7</u>	<u>L8</u>	<u>L9</u>	<u>L10</u>	<u>L11</u>	<u>MT</u>
155.a.i	X	X	X	X	X							X
155.a.ii				X	X							
155.b.i								X				
155.b.ii								X		X		
155.c.i					X	X	X		X	X	X	X
155.c.ii									X	X		X

Guidance for Lesson Priority

Unit.Lesson	Priority D - Delete M - Modify K - Keep	Content and Practice Expectations (CPE)	Learning Principles (LP)	Additional Lesson Information
4.1	K	155.a.i	LP5, LP6	Context: Ramps for wheelchairs, ramps for schools Math focus: Angles and ratios of right triangles
4.2	M Combine Lesson 4.2 and Lesson 4.3.	155.a.i	LP3	Context: Purely mathematical Math focus: 45-45-right triangle as half a square
4.3	M Combine Lesson 4.2 and Lesson 4.3.	155.a.i	LP3	Context: Purely mathematical Math focus: 30-60-right triangle as half an equilateral triangle
4.4	K	155.a.i 155.a.ii	LP1, LP3, LP5	Context: Purely mathematical Math focus: Connect angle measures with ratios of side lengths of right triangles
4.5	K	155.a.i 155.a.ii 155.c.i	LP3	Context: Rocket launch (warm-up) Math focus: Using ratios in right

Unit.Lesson	Priority D - Delete M - Modify K - Keep	Content and Practice Expectations (CPE)	Learning Principles (LP)	Additional Lesson Information
				triangles to solve missing side lengths and introduction of Pythagorean triples
4.6	K	155.c.i	LP2, LP3	Context: Purely mathematical Math focus: Formal introduction of trigonometric ratios by name and continued solving triangles
4.7	K	155.c.i	LP2, LP3, LP5, LP6	Context: Height of Burj Khalifa and City Hall in Philadelphia Math focus: Using trigonometric ratios to solve missing side lengths in context
4.8	K	155.b.i 155.b.ii	LP1, LP2, LP3	Context: Purely mathematical Math focus: Relationship between sine and cosine of complementary angles
4.9	K	155.c.i 155.c.ii	LP3, LP5, LP6	Context: Safe angles of a leaning ladder Math focus: Using trigonometric

Unit.Lesson	Priority D - Delete M - Modify K - Keep	Content and Practice Expectations (CPE)	Learning Principles (LP)	Additional Lesson Information
				ratios to solve unknown angles of right angles
4.10	K	155.b.ii 155.c.i 155.c.ii	LP1, LP3	Context: Airplane's angle of descent Math focus: Solving problems using trigonometry
4.11	K	155.c.i	LP1, LP3, LP5	Context: Purely mathematical Math focus: Generalizing a formula for the perimeter of a polygon inscribed in a circle
Modeling Task- <u>So Many Flags</u>	M Consider having students construct a replica of the flag they select on GeoGebra or Desmos-Geometry.	155.a.i 155.c.i 155.c.ii	LP1, LP3, LP4, LP5, LP6, LP7	Context: Flag of Nepal, parade with flags Math focus: Constructions, using Pythagorean theorem and right triangle trigonometry to solve for side lengths and angles of a flag of their choice