

# M154: Coordinate Geometry

## [Illustrative Mathematics–Geometry Unit 6: Coordinate Geometry](#)

### 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 opportunities to use the embedded math language 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.

### 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...
154.a: Translate between the geometric description and the equation for a conic section, specifically of a circle and parabola.	i. explain how the Pythagorean theorem can be used to derive the equation of a circle.
	ii. write the equation for a parabola using the focus and directrix.
154.b: Use coordinates to prove simple geometric theorems algebraically.	i. use the distance formula to find the distance between two points on a coordinate plane.
	ii. use coordinates along with the slope formula, distance formula, and/or midpoint formula to prove simple geometric theorems algebraically.
	iii. use coordinates to prove that a quadrilateral is, or is not, a specific quadrilateral.
154.c: Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems.	i. classify lines or segments as parallel, perpendicular, or neither.
	ii. write the equation of a line parallel or perpendicular to a given line and passing through a given point.
	iii. solve problems involving equations of parallel and perpendicular lines.
154.d: Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	i. use the midpoint formula, the section formula, and the distance formula to find the partition point of a given directed line segment.
	ii. use dilations to find the coordinates of a point that divides a directed line segment in a given ratio.

Content and Practice Expectations	Indicators Choose an artifact where you...
154.e: Use coordinates to compute perimeters of polygons and areas of triangles and rectangles (e.g., using the distance formula).	i. use coordinates to compute perimeters of polygons and the areas of triangles and quadrilaterals.
	ii. decompose complex figures whose vertices can be located on a coordinate plane into simple shapes to determine perimeter and/or area.

## Unit Overview

	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	MT
154.a.i				X	X	+												
154.a.ii							X	X										
154.b.i				X			X	X										
154.b.ii				X			X	X							X	X	X	
154.b.iii														X				
154.c.i										X	X	X						X
154.c.ii										X	X	X	X					X
154.c.iii										X	X	X	X					X
154.d.i															X	X		
154.d.ii															X			

154.e.i																			X
154.e.ii																			X

Note: Columns in gray indicate a recommendation to delete the lesson

- + This lesson supports work at the level of the Content and Practice Expectation, yet not at the indicator level.

## Guidance for Lesson Priority

Unit.Lesson	Priority D - Delete M - Modify K - Keep	Content and Practice Expectations (CPE)	Learning Principles (LP)	Additional Lesson Information
6.1	D No connection to CPEs, but may be helpful for establishing a foundational understanding of rigid transformations on the coordinate plane.			<b>Context:</b> Purely mathematical  <b>Math focus:</b> Rigid transformations, congruence, finding length on the coordinate plane
6.2	D No connection to CPEs, but may be helpful for establishing a foundational understanding of transformations as functions on the coordinate plane.			<b>Context:</b> Purely mathematical  <b>Math focus:</b> Rigid transformations and dilations on the coordinate plane
6.3	D No connection to CPEs, but may be helpful for building a lens to analyze transformations that produce congruent			<b>Context:</b> Purely mathematical  <b>Math focus:</b> Writing rules for transformations on the coordinate plane; comparing figures as congruent or similar

Unit.Lesson	Priority D - Delete M - Modify K - Keep	Content and Practice Expectations (CPE)	Learning Principles (LP)	Additional Lesson Information
	and similar figures.			
6.4	K	154.a.i 154.b.i 154.b.ii	LP1, LP3	<b>Context:</b> Purely mathematical  <b>Math focus:</b> Deriving the equation of a circle on coordinate plane; using the Pythagorean theorem to find the distance between two points
6.5	M Focus on Activity 5.3 to solidify an understanding of the equation of a circle. Other activities could be useful for solidifying an understanding of the connection between the distributive property and perfect square trinomials.	154.a.i	LP1	<b>Context:</b> Purely mathematical  <b>Math focus:</b> Continued development of understanding for the equation for a circle by looking at perfect square trinomials
6.6	M Use work on Activity 6.2 and Activity 6.3 to connect the structure of the equation of a circle	154.a	LP3	<b>Context:</b> Purely mathematical  <b>Math focus:</b> Finding the center and radius of a circle by completing the square

Unit.Lesson	Priority D - Delete M - Modify K - Keep	Content and Practice Expectations (CPE)	Learning Principles (LP)	Additional Lesson Information
	to the graph on the coordinate plane. This lesson will support work to CPE 154.a with that emphasis. No direct connection to indicators associated with 154.a.			
6.7	K	154.a.ii 154.b.i 154.b.ii	LP1, LP7	<b>Context:</b> Purely mathematical  <b>Math focus:</b> Transition from circles to parabolas; understanding the focus and directrix; identifying an equation for a parabola
6.8	K	154.a.ii 154.b.i 154.b.ii	LP1, LP2, LP6, LP7	<b>Context:</b> Purely mathematical  <b>Math focus:</b> Writing an equation to represent a parabola using distance between a point and a directrix
6.9	D No connection to CPEs, yet may be helpful to bolster an understanding of point-slope form for an			<b>Context:</b> Purely mathematical  <b>Math focus:</b> Moving from circles/parabolas to lines; analyzing slope; writing equations in point-slope form

Unit.Lesson	Priority D - Delete M - Modify K - Keep	Content and Practice Expectations (CPE)	Learning Principles (LP)	Additional Lesson Information
	equation.			
6.10	K	154.c.i 154.c.ii 154.b.iii	LP1, LP3, LP7	<b>Context:</b> Purely mathematical <b>Math focus:</b> Proving parallel lines
6.11	K	154.c.i 154.c.ii 154.c.iii	LP1, LP3, LP7	<b>Context:</b> Purely mathematical <b>Math focus:</b> Using transformations to show perpendicular lines; working with perpendicular lines and equations
6.12	K	154.c.i 154.c.ii 154.c.iii	LP2, LP4	<b>Context:</b> Purely mathematical <b>Math focus:</b> Using an understanding of parallel and perpendicular lines to write equations; solving problems involving parallel and perpendicular lines
6.13	M Emphasize Activity 13.3 if needed to continue an understanding of parallel/perpendicular lines going through a certain point. If not needed, consider	154.c.ii 154.c.iii	LP3	<b>Context:</b> Purely mathematical <b>Math focus:</b> Writing equations for parallel/perpendicular lines that intersect a circle

Unit.Lesson	Priority D - Delete M - Modify K - Keep	Content and Practice Expectations (CPE)	Learning Principles (LP)	Additional Lesson Information
	deleting this lesson.			
6.14	K	154.b.iii 154.e.i	LP2, LP4	<b>Context:</b> Purely mathematical  <b>Math focus:</b> Finding measurements of quadrilaterals on the coordinate plane; using slope to prove right angles are made by perpendicular lines
6.15	M Emphasize Activity 15.3 question 4 in order to focus on indicator 154.d.ii.	154.b.ii 154.d.i 154.d.ii	LP1, LP3, LP6	<b>Context:</b> Purely mathematical  <b>Math focus:</b> Finding a partitioning point; creating lines/shapes with given ratios
6.16	K	154.b.ii 154.d.i	LP1, LP2, LP4	<b>Context:</b> Purely mathematical  <b>Math focus:</b> Creating medians using midpoints; proving intersection at the centroid
6.17	K	154.b.ii 154.c.i 154.c.ii 154.c.iii	LP1, LP3	<b>Context:</b> Purely mathematical  <b>Math focus:</b> Using midpoint/slope to understand altitudes, medians, and perpendicular bisectors of triangles on coordinate plane

Unit.Lesson	Priority D - Delete M - Modify K - Keep	Content and Practice Expectations (CPE)	Learning Principles (LP)	Additional Lesson Information
Modeling Task- <a href="#">A New Town</a>	M Have students do research similar to what <a href="#">urban and regional planners</a> do to learn about zoning and building codes, environmental regulations, and other issues that need to be considered when planning for use of land. Consider having students use software like GeoGebra or Desmos- Geometry to design their town to engage with additional CPEs.	154.e.i 154.e.ii	LP1, LP2, LP3, LP4, LP6	<b>Context:</b> Students will design a town  <b>Math focus:</b> Computing area/perimeter of polygons