

# Geometric Properties

## Vocabulary

concurrent  
centroid  
collinear  
chord

## Curriculum Expectations

### Analytic Geometry

#### *Using Analytic Geometry to Verify Geometric Properties*

By the end of this chapter, students will

**AG3.01** determine, through investigation (e.g., using dynamic geometry software, by paper folding), some characteristics and properties of geometric figures (e.g., medians in a triangle, similar figures constructed on the sides of a right triangle);

**AG3.02** verify, using algebraic techniques and analytic geometry, some characteristics of geometric figures (e.g., verify that two lines are perpendicular, given the coordinates of two points on each line; verify, by determining side length, that a triangle is equilateral, given the coordinates of the vertices);

**AG3.03** plan and implement a multi-step strategy that uses analytic geometry and algebraic techniques to verify a geometric property (e.g., given the coordinates of the vertices of a triangle, verify that the line segment joining the midpoints of two sides of the triangle is parallel to the third side and half its length, and check using dynamic geometry software; given the coordinates of the vertices of a rectangle, verify that the diagonals of the rectangle bisect each other).

## Chapter Problem

The Chapter Problem involving the golden ratio is introduced in the Chapter 3 Opener. Have students do an Internet search to find one example of the golden ratio or a historical fact concerning this special ratio. Students can go to [www.mcgrawhill.ca/links/principles10](http://www.mcgrawhill.ca/links/principles10) and follow the links to find sites of interest.

Have students complete the Chapter Problem revisits that occur throughout the chapter. These questions are designed to help students move toward the Chapter 3 Problem Wrap-Up on page 153.

Alternatively, only assign the Chapter Problem when students have completed the chapter. The Chapter Problem is a summative assessment.

## Chapter 3 Planning Chart

Section Suggested Timing	Student Text Pages	Teacher's Resource Blackline Masters	Assessment	Tools
<b>Chapter 3 Opener</b> • 10 min	106–107			
<b>Get Ready</b> • 10–60 min	108–109	<ul style="list-style-type: none"> <li>• G–1 Grid Paper</li> <li>• G–3 Coordinate Grids</li> <li>• BLM 3–1 Get Ready</li> </ul>	<ul style="list-style-type: none"> <li>• BLM 3–2 Get Ready Self-Assessment Checklist</li> </ul>	<b>Tools</b> <ul style="list-style-type: none"> <li>• grid paper</li> </ul>
<b>3.1 Investigate Properties of Triangles</b> • 70–90 min	110–116	<ul style="list-style-type: none"> <li>• T–4 <i>The Geometer's Sketchpad</i>® 3</li> <li>• T–5 <i>The Geometer's Sketchpad</i>® 4</li> <li>• BLM 3–3 Section 3.1 Practice Master</li> </ul>	<ul style="list-style-type: none"> <li>• A–10 Observation General Scoring Rubric</li> </ul>	<b>Tools</b> <ul style="list-style-type: none"> <li>• ruler</li> <li>• cardboard</li> <li>• scissors</li> <li>• compasses</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• <i>The Geometer's Sketchpad</i>®</li> <li>• computer</li> <li>• Cabri® Jr.</li> <li>• graphing calculator</li> </ul>
<b>3.2 Verify Properties of Triangles</b> • 40–70 min	117–127	<ul style="list-style-type: none"> <li>• G–1 Grid Paper</li> <li>• G–2 Placemat</li> <li>• T–4 <i>The Geometer's Sketchpad</i>® 3</li> <li>• T–5 <i>The Geometer's Sketchpad</i>® 4</li> <li>• BLM 3–4 Section 3.2 Practice Master</li> </ul>	<ul style="list-style-type: none"> <li>• BLM 3–5 Section 3.2 Achievement Check Rubric</li> </ul>	<b>Tools</b> <ul style="list-style-type: none"> <li>• grid paper</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• <i>The Geometer's Sketchpad</i>®</li> <li>• computer</li> <li>• Cabri® Jr.</li> <li>• graphing calculator</li> <li>• Internet access</li> </ul>
<b>3.3 Investigate Properties of Quadrilaterals</b> • 60–75 min	128–136	<ul style="list-style-type: none"> <li>• G–1 Grid Paper</li> <li>• G–4 Protractor</li> <li>• T–4 <i>The Geometer's Sketchpad</i>® 3</li> <li>• T–5 <i>The Geometer's Sketchpad</i>® 4</li> <li>• BLM 3–6 Section 3.3 Practice Master</li> </ul>	<ul style="list-style-type: none"> <li>• BLM 3–7 Section 3.3 Achievement Check Rubric</li> <li>• A–10 Observation General Scoring Rubric</li> <li>• A–22 Report Checklist</li> </ul>	<b>Tools</b> <ul style="list-style-type: none"> <li>• grid paper</li> <li>• ruler</li> <li>• compasses</li> <li>• protractor</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• <i>The Geometer's Sketchpad</i>®</li> <li>• computer</li> <li>• Cabri® Jr.</li> <li>• graphing calculator</li> <li>• Internet access</li> </ul>
<b>3.4 Verify Properties of Quadrilaterals</b> • 40–70 min	137–144	<ul style="list-style-type: none"> <li>• G–1 Grid Paper</li> <li>• G–2 Placemat</li> <li>• T–4 <i>The Geometer's Sketchpad</i>® 3</li> <li>• T–5 <i>The Geometer's Sketchpad</i>® 4</li> <li>• BLM 3–8 Section 3.4 Practice Master</li> </ul>		<b>Tools</b> <ul style="list-style-type: none"> <li>• grid paper</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• <i>The Geometer's Sketchpad</i>®</li> <li>• computer</li> <li>• Cabri® Jr.</li> <li>• graphing calculator</li> </ul>
<b>3.5 Properties of Circles</b> • 60–75 min	145–151	<ul style="list-style-type: none"> <li>• G–1 Grid Paper</li> <li>• T–4 <i>The Geometer's Sketchpad</i>® 3</li> <li>• T–5 <i>The Geometer's Sketchpad</i>® 4</li> <li>• BLM 3–9 Section 3.5 Practice Master</li> </ul>	<ul style="list-style-type: none"> <li>• A–7 Thinking General Scoring Rubric</li> </ul>	<b>Tools</b> <ul style="list-style-type: none"> <li>• circular object, such as a juice can</li> <li>• compasses</li> <li>• ruler</li> <li>• grid paper</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• <i>The Geometer's Sketchpad</i>®</li> <li>• computer</li> <li>• Cabri® Jr.</li> <li>• graphing calculator</li> </ul>

Section Suggested Timing	Student Text Pages	Teacher's Resource Blackline Masters	Assessment	Tools
<b>Chapter 3 Review</b> • 60–75 min	152–153	<ul style="list-style-type: none"> <li>• G–1 Grid Paper</li> <li>• G–4 Protractor</li> <li>• T–4 <i>The Geometer's Sketchpad</i>® 3</li> <li>• T–5 <i>The Geometer's Sketchpad</i>® 4</li> <li>• BLM 3–10 Chapter 3 Review</li> </ul>		<b>Tools</b> <ul style="list-style-type: none"> <li>• grid paper</li> <li>• protractor</li> <li>• compasses</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• <i>The Geometer's Sketchpad</i>®</li> <li>• computer</li> <li>• Cabri® Jr.</li> <li>• graphing calculator</li> </ul>
<b>Chapter 3 Problem Wrap-Up</b> • 70–140 min	153		• BLM 3–11 Chapter 3 Problem Wrap-Up Rubric	<b>Tools</b> <ul style="list-style-type: none"> <li>• ruler</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• Internet access</li> </ul>
<b>Chapter 3 Practice Test</b> • 45–70 min	154–155	<ul style="list-style-type: none"> <li>• G–1 Grid Paper</li> <li>• G–4 Protractor</li> <li>• T–4 <i>The Geometer's Sketchpad</i>® 3</li> <li>• T–5 <i>The Geometer's Sketchpad</i>® 4</li> </ul>	<ul style="list-style-type: none"> <li>• BLM 3–12 Chapter 3 Practice Test</li> <li>• BLM 3–13 Chapter 3 Test</li> <li>• BLM 3–14 Chapter 3 Practice Test Achievement Check Rubric</li> </ul>	<b>Tools</b> <ul style="list-style-type: none"> <li>• grid paper</li> <li>• protractor</li> <li>• compasses</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• <i>The Geometer's Sketchpad</i>®</li> <li>• computer</li> <li>• Cabri® Jr.</li> <li>• graphing calculator</li> </ul>
<b>Chapters 1 to 3 Review</b> • 70 min	156–157	<ul style="list-style-type: none"> <li>• G–1 Grid Paper</li> <li>• G–3 Coordinate Grids</li> <li>• T–4 <i>The Geometer's Sketchpad</i>® 3</li> <li>• T–5 <i>The Geometer's Sketchpad</i>® 4</li> </ul>	<ul style="list-style-type: none"> <li>• A–14 Self-Assessment Recording Sheet</li> <li>• A–15 Self-Assessment Checklist</li> </ul>	<b>Tools</b> <ul style="list-style-type: none"> <li>• grid paper</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• <i>The Geometer's Sketchpad</i>®</li> <li>• computer</li> <li>• Cabri® Jr.</li> <li>• graphing calculator</li> </ul>
<b>Task: Multiple Midpoints</b> • 25–35 min	158	<ul style="list-style-type: none"> <li>• G–1 Grid Paper</li> <li>• T–4 <i>The Geometer's Sketchpad</i>® 3</li> <li>• T–5 <i>The Geometer's Sketchpad</i>® 4</li> </ul>	• BLM 3–15 Task: Multiple Midpoints Rubric	<b>Tools</b> <ul style="list-style-type: none"> <li>• grid paper</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• <i>The Geometer's Sketchpad</i>®</li> <li>• computer</li> <li>• Cabri® Jr.</li> <li>• graphing calculator</li> </ul>
<b>Task: A Site for the New Hospital</b> • 70 min	158	<ul style="list-style-type: none"> <li>• G–1 Grid Paper</li> <li>• T–4 <i>The Geometer's Sketchpad</i>® 3</li> <li>• T–5 <i>The Geometer's Sketchpad</i>® 4</li> </ul>	• BLM 3–16 Task: A Site for the New Hospital Rubric	<b>Tools</b> <ul style="list-style-type: none"> <li>• grid paper</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• <i>The Geometer's Sketchpad</i>®</li> <li>• computer</li> </ul>
<b>Task: Pythagoras Park</b> • 70 min	159	<ul style="list-style-type: none"> <li>• G–1 Grid Paper</li> <li>• T–4 <i>The Geometer's Sketchpad</i>® 3</li> <li>• T–5 <i>The Geometer's Sketchpad</i>® 4</li> <li>• BLM 3–18 BLM Answers</li> </ul>	• BLM 3–17 Task: Pythagoras Park Rubric	<b>Tools</b> <ul style="list-style-type: none"> <li>• grid paper</li> <li>• protractor</li> <li>• compasses</li> <li>• ruler</li> </ul> <b>Technology Tools</b> <ul style="list-style-type: none"> <li>• <i>The Geometer's Sketchpad</i>®</li> <li>• computer</li> </ul>

## Chapter 3 Blackline Masters Checklist

	BLM	Title	Purpose
<b>Get Ready</b>			
	G-1	Grid Paper	Student Support
	G-3	Coordinate Grids	Student Support
	BLM 3-1	Get Ready	Practice
	BLM 3-2	Get Ready Self-Assessment Checklist	Student Self-Assessment
<b>3.1 Investigate Properties of Triangles</b>			
	T-4	<i>The Geometer's Sketchpad</i> ® 3	Technology
	T-5	<i>The Geometer's Sketchpad</i> ® 4	Technology
	BLM 3-3	Section 3.1 Practice Master	Practice
	A-10	Observation General Scoring Rubric	Assessment
<b>3.2 Verify Properties of Triangles</b>			
	G-1	Grid Paper	Student Support
	G-2	Placemat	Student Support
	T-4	<i>The Geometer's Sketchpad</i> ® 3	Technology
	T-5	<i>The Geometer's Sketchpad</i> ® 4	Technology
	BLM 3-4	Section 3.2 Practice Master	Practice
	BLM 3-5	Section 3.2 Achievement Check Rubric	Assessment
<b>3.3 Investigate Properties of Quadrilaterals</b>			
	G-1	Grid Paper	Student Support
	G-4	Protractor	Student Support
	T-4	<i>The Geometer's Sketchpad</i> ® 3	Technology
	T-5	<i>The Geometer's Sketchpad</i> ® 4	Technology
	BLM 3-6	Section 3.3 Practice Master	Practice
	BLM 3-7	Section 3.3 Achievement Check Rubric	Assessment
	A-10	Observation General Scoring Rubric	Assessment
	A-22	Report Checklist	Assessment
<b>3.4 Verify Properties of Quadrilaterals</b>			
	G-1	Grid Paper	Student Support
	G-2	Placemat	Student Support
	T-4	<i>The Geometer's Sketchpad</i> ® 3	Technology
	T-5	<i>The Geometer's Sketchpad</i> ® 4	Technology
	BLM 3-8	Section 3.4 Practice Master	Practice

	BLM	Title	Purpose
<b>3.5 Properties of Circles</b>			
	G-1	Grid Paper	Student Support
	T-4	<i>The Geometer's Sketchpad</i> ® 3	Technology
	T-5	<i>The Geometer's Sketchpad</i> ® 4	Technology
	BLM 3-9	Section 3.5 Practice Master	Practice
	A-7	Thinking General Scoring Rubric	Assessment
<b>Chapter 3 Review</b>			
	G-1	Grid Paper	Student Support
	G-4	Protractor	Student Support
	T-4	<i>The Geometer's Sketchpad</i> ® 3	Technology
	T-5	<i>The Geometer's Sketchpad</i> ® 4	Technology
	BLM 3-10	Chapter 3 Review	Practice
<b>Chapter 3 Problem Wrap-Up</b>			
	BLM 3-11	Chapter 3 Problem Wrap-Up Rubric	Summative Assessment
<b>Chapter 3 Practice Test</b>			
	G-1	Grid Paper	Student Support
	G-4	Protractor	Student Support
	T-4	<i>The Geometer's Sketchpad</i> ® 3	Technology
	T-5	<i>The Geometer's Sketchpad</i> ® 4	Technology
	BLM 3-12	Chapter 3 Practice Test	Diagnostic Assessment
	BLM 3-13	Chapter 3 Test	Summative Assessment
	BLM 3-14	Chapter 3 Practice Test Achievement Check Rubric	Assessment
<b>Chapters 1 to 3 Review</b>			
	G-1	Grid Paper	Student Support
	G-3	Coordinate Grids	Student Support
	T-4	<i>The Geometer's Sketchpad</i> ® 3	Technology
	T-5	<i>The Geometer's Sketchpad</i> ® 4	Technology
	A-14	Self-Assessment Recording Sheet	Student Self-Assessment
	A-15	Self-Assessment Checklist	Student Self-Assessment
<b>Task: Multiple Midpoints</b>			
	G-1	Grid Paper	Student Support
	T-4	<i>The Geometer's Sketchpad</i> ® 3	Technology
	T-5	<i>The Geometer's Sketchpad</i> ® 4	Technology
	BLM 3-15	Task: Multiple Midpoints Rubric	Assessment

	BLM	Title	Purpose
<b>Task: A Site for the New Hospital</b>			
	G-1	Grid Paper	Student Support
	T-4	<i>The Geometer's Sketchpad</i> ® 3	Technology
	T-5	<i>The Geometer's Sketchpad</i> ® 4	Technology
	BLM 3-16	Task: A Site for the New Hospital Rubric	Assessment
<b>Task: Pythagoras Park</b>			
	G-1	Grid Paper	Student Support
	T-4	<i>The Geometer's Sketchpad</i> ® 3	Technology
	T-5	<i>The Geometer's Sketchpad</i> ® 4	Technology
	BLM 3-17	Task: Pythagoras Park Rubric	Assessment
	BLM 3-18	BLM Answers	Answers

# Get Ready

## Student Text Pages

108–109

## Suggested Timing

10–60 min

## Tools

- grid paper

## Related Resources

- G–1 Grid Paper
- G–3 Coordinate Grids
- BLM 3–1 Get Ready
- BLM 3–2 Get Ready Self-Assessment Checklist

## TI-Navigator™

Go to [www.mcgrawhill.ca/books/principles10](http://www.mcgrawhill.ca/books/principles10) and follow the links to the file for this section.

## Common Errors

- Some students may confuse the formulas for length and midpoint and have trouble remembering when to add the coordinates and when to subtract them.
- R<sub>x</sub>** Remind students that the coordinates of the midpoint are an “average” of the coordinates of the endpoints. This should help them realize that adding the coordinates and dividing by two is necessary. In contrast, when calculating length, the rise and the run are included in the formula, so subtracting the coordinates is necessary. Have students write the formula each time they calculate a length or a midpoint to reinforce their skills.

## Accommodations

**Gifted and Enrichment**—Challenge students to investigate the point(s) of intersection of lines and parabolas.

**Visual**—Let students use graphing calculators to determine the point of intersection of two lines.

**Spatial**—Provide students with photocopies of the triangles in questions 5 and 6. Let them use calculators to determine the missing angles.

**Memory**—Encourage students to use colour-coding for the  $x$ - and  $y$ -values when substituting into the formulas for the midpoint of a line segment and the slope of a line segment.

## Teaching Suggestions

- The Get Ready reviews material from Chapter 2 (Length and Midpoint of a Line Segment) and from Chapter 1 (Intersection of Lines). These two sections should be completed by students who had difficulties in the first two chapters, but may not be necessary for other students.
- The other two sections, Sum of the Angles in a Triangle and Types of Quadrilaterals, review geometric properties that will be useful in this chapter.
- Students might work in pairs or small groups on the appropriate Get Ready material.
- Use **BLM 3–1 Get Ready** for remediation or extra practice.

## Assessment

Assess student readiness to proceed by informal observation as students are working on the exercises. A formal test would be inappropriate since this material is not part of the grade 10 curriculum for this chapter. Student self-assessment is also an effective technique; students can place a check mark beside topics in the Get Ready for which they feel confident of having the necessary skills. Use **BLM 3–2 Get Ready Self-Assessment Checklist** as a self-assessment for students. Remedial action can be taken in small groups or with a whole class skill review.