Construct polygons based on angle measures and side lengths.

**Prerequisite Skills/Concepts**
- Draw a triangle when given side lengths and angle measures.
- Know the properties of triangles, squares, rectangles, and parallelograms.

**Expectations**
- classify and construct polygons and angles
- sort and classify quadrilaterals by geometric properties related to symmetry, angles, and sides, through investigation using a variety of tools (e.g., geoboard, dynamic geometry software) and strategies (e.g., using charts, using Venn diagrams)
- construct polygons using a variety of tools, given angle and side measurements

**Assessment for Feedback**

<table>
<thead>
<tr>
<th>Students will</th>
<th>What You Will See Students Doing…</th>
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</thead>
<tbody>
<tr>
<td>• construct appropriate angles given the angle measures</td>
<td>• Students will use a protractor to construct any angle when given the angle measure.</td>
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<tr>
<td>• construct appropriate side lengths given their measurements</td>
<td>• Students will use a ruler to construct sides of the correct length placed appropriately in relationship to any angle.</td>
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<tr>
<td>• construct a polygon when given its angle measures and side lengths</td>
<td>• Students will construct any polygon when given its angles and side lengths.</td>
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<table>
<thead>
<tr>
<th>If Students Misunderstand</th>
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<tbody>
<tr>
<td>• Students may need assistance reading the protractor’s gradations in order to identify the correct placement of an angle, especially an obtuse angle.</td>
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<tr>
<td>• Students will need to be guided in order to measure the side lengths of each arm of any angle being constructed.</td>
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<tr>
<td>• Review the steps involved in the construction of a polygon with students who have difficulty: a) construct an angle and its two side lengths, b) construct angles at the end of each side and new side lengths from them as needed, c) repeat b) as needed, d) construct and intersect the last two sides, and e) check for accuracy.</td>
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**Preparation and Planning**

<table>
<thead>
<tr>
<th>Pacing</th>
<th>5–10 min Introduction</th>
<th>20–25 min Teaching and Learning</th>
<th>15–25 min Consolidation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
<td>• ruler (1/pair)</td>
<td>• protractor (1/pair)</td>
<td></td>
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<tr>
<td>Masters</td>
<td>• Optional: Chapter 7 Mental Math p. 59</td>
<td>• Assessment: Communication Rubric, Masters Booklet p. 11</td>
<td></td>
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<tr>
<td>Workbook</td>
<td>p. 66</td>
<td></td>
<td></td>
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<tr>
<td>Vocabulary/Symbols</td>
<td>construct, draw, kite</td>
<td></td>
<td></td>
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<tr>
<td>Key Assessment of Learning Question</td>
<td>Question 4, Application of Learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematical Processes</td>
<td>Selecting Tools and Strategies; Reasoning and Proving</td>
<td></td>
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</table>

**Meeting Individual Needs**

**Extra Challenge**
- Have students explore the minimum amount of detail that they need to give about a particular polygon in order ensure that it will always be drawn the same way. They should question what details they should include and why they have chosen them. For example, in order to construct a triangle, would three angles alone be sufficient, or three side lengths? Should they give information about angle measures in a square or not? Have them experiment with different polygons.
- Have students exchange their details with a partner who will test them to see if the same polygon results.

**Extra Support**
- Have students practise constructing different acute and obtuse angles with a protractor.
- Have students then practise drawing line segments of given lengths and constructing angles of given measures at both ends of the line segments.
- Ask students to now follow the sequence in Rebecca’s Diagram to construct the parallelogram by 1) drawing the first line segment, 2) constructing the angles at each of its ends, and 3) measuring and drawing the remaining side lengths to finish.
Lesson 4: Constructing Polygons

Introduction (Whole Class)  5–10 min

Begin the lesson by drawing a large obtuse scalene triangle on the chalkboard. Engage students in a discussion about what kind of polygon this is, and the information they would have to give someone located at a distance about it in order to have that person reconstruct it accurately.

Sample Discourse

“How would you describe this polygon?”
• It is a triangle with an obtuse angle.
• It is also a scalene triangle, because none of its sides are the same length.

“What information would you give about this triangle to someone located far away so they could redraw it accurately?”
• I would measure its side lengths and provide the person with this information.
• I would measure its angles and provide the person with this information.
• I would also say that the polygon was a triangle.
• I would also say what kind of tools and materials the person would need, and the steps they should take.

Tell students that, in this lesson, they will construct polygons given specific and sometimes missing information, and also do so to scale in order to fit available space.

Teaching and Learning (Whole Class/Pairs)  20–25 min

Ask students to turn to Student Book page 218. As a class, read about the props needed for the school play, the central question, and Rebecca's scaled diagram. Read through the steps that Rebecca has followed and then ask students to form into pairs. Distribute rulers and protractors as needed, then have the pairs follow each of Rebecca's steps to complete Prompt A and use their protractors to measure the angles for Prompt B. Ask them to then follow Rebecca's steps again to complete Prompt C. Remind students that the symbols on the kite's side lengths in Prompt C indicate equal lengths.

Reflecting

Have students reflect on the sequence of the steps they used to construct the polygons, and why that sequence was important in order to ensure that the resultant polygons would satisfy the given angle measures and side lengths.

Sample Discourse

1. • I would start by drawing a side whose length I know. Then I would construct one angle at one end of this length and measure and draw its second arm as another side of the parallelogram. Now I would go back to the other end of the first length, construct the second angle, and measure and draw its second arm to be the same length as the second side. This will form the third side. Then I can draw the fourth side across the tips of the two remaining end points to finish the parallelogram.
• I would draw the length of one side first, and then an angle at one of its ends. I would measure and draw the second arm of this angle as the second side of the parallelogram. At the end of this length, I would construct another angle and measure and draw a third side of the parallelogram. Now I could just join the last ends.

2. • I started out by drawing a line segment 8 cm long. At the end of this length, I constructed a 60° angle and made its other arm 8 cm long as well because the shape is a kite. Then I constructed a 95° angle on the other end of the first 8 cm line segment, and measured and drew this angle's other arm to be 5 cm. Lastly, I joined the two remaining ends to make the kite. This order makes sense because it's how Rebecca did it, and I was able to use all the given information.
Consolidation 15–25 min

Checking (Whole Class)

For intervention strategies, refer to Meeting Individual Needs and the Assessment for Feedback chart.

3. Students may initially find this question more difficult than the previous two due to the unequal side lengths of the polygon and the fact that two adjacent side lengths are not given. Prompt struggling students to begin with the parts of the quadrilateral that they know the most about (e.g., the 110° angle and the lengths of the two known sides). Then they can go to the end points of these arms, construct the two known angles there, and extend their arms until they cross.

After students have completed the quadrilateral, ask them to compare their drawings and say whether more than one quadrilateral could be constructed from the information. They should conclude that this is not possible, as the two arms that extend from the known angles always meet in the same place, and, thus, retain their same individual lengths.

Practising (Individual)

5. Remind students that a rhombus is a parallelogram with equal sides.

6. Remind students that, according to the definition of a parallelogram, its opposite angles should be equal.
**Assessment of Learning**—What to Look for in Student Work…

**Assessment Strategy:** Written Answer

**Application of Learning**

**Key Assessment Question 4**
- Draw these polygons.
  a) parallelogram  b) parallelogram  c) regular pentagon

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<thead>
<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td></td>
<td>• demonstrates limited ability to apply mathematical knowledge and skills in familiar contexts (e.g., has difficulty constructing polygons based on side lengths and angle measures)</td>
<td>• demonstrates some ability to apply mathematical knowledge and skills in familiar contexts (e.g., demonstrates some ability to construct polygons based on side lengths and angle measures)</td>
<td>• demonstrates considerable ability to apply mathematical knowledge and skills in familiar contexts (e.g., constructs polygons based on side lengths and angle measures)</td>
<td>• demonstrates sophisticated ability to apply mathematical knowledge and skills in familiar contexts (e.g., demonstrates sophisticated ability to construct polygons based on side lengths and angle measures)</td>
</tr>
</tbody>
</table>

**Extra Practice and Extension**
- You might assign any of the questions related to this lesson, which are cross-referenced in the chart below.

| Curious Math | Student Book p. 221, Questions 1, 2, & 3 |
| Skills Bank | Student Book p. 226, Questions 4 & 5 |
| Problem Bank | Student Book p. 228, Question 2 |
| Chapter Review | Student Book p. 231, Questions 5 & 6 |
| Workbook | p. 66, all questions |
| Nelson Web Site | Visit [www.mathK8.nelson.com](http://www.mathK8.nelson.com) and follow the links to Nelson Mathematics 6, Chapter 7. |

**Math Background**

The ability to visualize and construct polygons accurately according to specific angle measures and side lengths and to draw scaled diagrams remains an important skill in drafting, mechanical and civil engineering, and architectural design, in spite of the fact that computer technology has now made it possible for many drawings to be done using software. Most on-the-spot drawing revisions are still done by hand.

Knowing the definitions of polygons and their properties also makes it possible to identify the existence of measurement or recording errors before construction and, thus, gain efficiencies in time as well as save energy and money—all of which impact productivity and the bottom line. However, once it has been determined that an error in measurement has occurred, there is still the problem of deciding what the exact nature of that error is. Could the error have been an angle measurement or a side measurement? Could there be more than one error? Was a polygon incorrectly identified? It is not always possible to determine exact errors purely through deduction, although a theory can be developed that may make their eventual discovery easier. Regardless, measurements will still need to be checked.

**At Home**
- Have students find polygons on furniture, curtains, or resilient flooring, measure their angles and side lengths, and then draw scaled diagrams of each shape.

**Optional:** Chapter 7

**Mental Math p. 59**

**Assessment:**

Communication Rubric, Masters Booklet p. 11