

Lesson 4-4A

Action Fractions
Math+CT

Polygon Partners (Unplugged)

Math Connections: Children describe polygons to practice identifying defining characteristics of shapes.

CS Connections: Children practice writing a complete set of instructions in advance, prior to having a partner follow them. They work together to debug their instructions, noting how outcomes improve as they make instructions more specific, precise, and complete.

► Before You Begin

Prepare shape cards for distribution. You will need at least one shape card per child plus some extras in case they request a new shape. When distributing, take care not to give the same shape to multiple children in a group.

Decide how you and children will represent shapes in small groups and on display for the whole class – using physical geoboards, dot paper, or an online geoboard. When children participate in your demonstrations, plan whether they will draw on the board or use your computer.

Prepare enough index cards and geoboards or dot paper to distribute to children. You may wish to have children put their dot paper on clipboards or use rulers when drawing their shapes.

Common Core State Standards

- Reason with shapes and their attributes.

Computational Thinking

- **SEQUENCE:** Precision and completeness are important when writing instructions in advance.
- **DEBUGGING:** Iterative refinement can help fix errors.

1 Warm Up 5 min

Materials

Following Directions

Children recall an earlier lesson on following directions exactly.

“I Can ...” Statements

Children read the explicit Math and CS goals.

2 Focus 20–30 min

Drawing Polygons

Children follow given instructions to draw polygons.

Geoboard Dot Paper; online interactive geoboard (optional for demonstration)

Polygon Partners

Children practice creating, following, and improving directions in partnerships.

Shape Cards; *Geoboard Dot Paper*; index cards; rulers (optional)

“I Can ...” statements

- *I can identify attributes of polygons.*
- *I can draw polygons based on instructions.*
- *I can use math language to write instructions that a friend can follow to create a polygon.*
- *I can give and receive feedback to improve directions to create a polygon.*

Anticipated Barriers

- Children may have difficulty describing the irregular shapes/polygons.
- Children may struggle with describing the length of a diagonal side of a shape in their instructions.
- Children may struggle with verbally describing aspects of the instructions which helped them accurately complete the drawing, and what made it more difficult.

Student Options

Consider these options for adapting the lesson to your students’ preferences:

- Some children may prefer to use actual geoboards instead of geoboard paper.
- Children may have preferences as to with whom they work best as a partner.

"I Can ..." statements

- I can identify attributes of polygons.
- I can draw polygons based on instructions.
- I can use math language to write instructions that a friend can follow to create a polygon.
- I can give and receive feedback to improve directions to create a polygon.

Academic Language Development

If you do not have an anchor chart of the the academic language (e.g., parallel lines, right angle, intersecting vertices), utilize examples and non-examples to build or reinforce this language.

Geoboard Dot Paper

Geoboard Dot Paper

NAME _____ DATE _____ TIME _____

①

②

③

④

⑤

⑥

TA31

1 Warm Up

5 min

► Following Directions

Remind children of their experience in Lesson 1-12A: *Brownie Bites*, where you acted like a computer – following given instructions exactly, without assuming any information that might seem obvious. Tell children that today they will get their chance to act like a computer when following instructions exactly as written.

► I Can ...

Display the "I Can ..." statements and remind children that these statements express the goals for today's lesson and can give them clues about what to expect. Carefully read each statement and ask them to use their thumbs to show how true they feel each statement is for them right now.

2 Focus

20–30 min

► Drawing Polygons

WHOLE CLASS | SMALL GROUP | PARTNER | INDEPENDENT

Provide each child with Geoboard Dot Paper (*Math Masters*, page TA31). Tell children that today they will be drawing polygons based on a description or instructions they will receive. As needed, quickly review polygons that the children are familiar with (e.g., *Point to a right triangle in the classroom. Point to a right angle in the classroom.*). When children are ready, give a general description of a polygon and ask them to draw the polygon you described.

Suggested descriptions:

- A triangle with a right angle
- A triangle with two equal-length sides

Lead a whole-class discussion noting that all children did not come up with the same shape based on your description(s). Ask: *Is a general description enough to get everyone to draw the same shape? What changes could I make if I wanted everyone to draw the exact same shape?* **Sample answers:** **Tell where to start and stop. Tell which corner is the right angle. Tell how long the sides are.** As needed, guide the discussion toward the idea of adding more details (or specifics) about what the shape should look like and how to draw it. Ask: *What word did we use to describe instructions that are specific, detailed, or exact?* **precise**

Now tell children that instead of just giving a description, you will write instructions for a specific polygon for them to draw, without using its name. Write down or display these instructions on the board. Make sure these directions remain available to the children throughout the activity.

- Start at the top row of dots.
- Draw a vertical line 4 units long.
- Draw a second line at a right angle to the first, 3 units long.
- Draw a line back to the starting point.

The various shapes that children might draw based on these directions are shown in the margin. Ask children to hold up the shape they have drawn and give its name. **a right triangle** Ask: *Did everyone come up with the exact same shape? no Why did some children draw one shape and some children draw another? Sample answer: Some children drew the second side to the left, others to the right. How you could I improve these instructions to make sure that everybody draws the same shape? How could I make them more precise? Sample answers: Say exactly where to start the first line (e.g. top middle). Say in which direction the perpendicular line should go. Say whether to start the perpendicular line at the top or bottom of the first line.*

Edit the original written instructions with children’s suggestions.

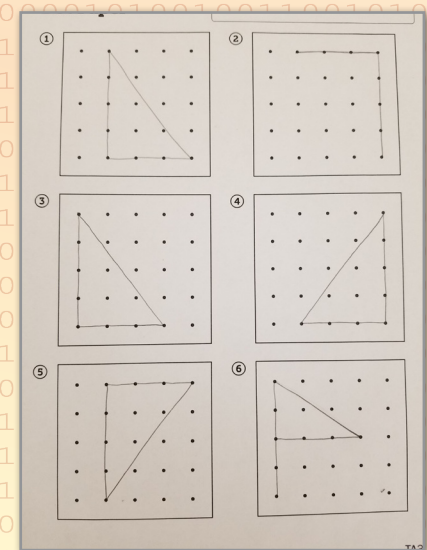
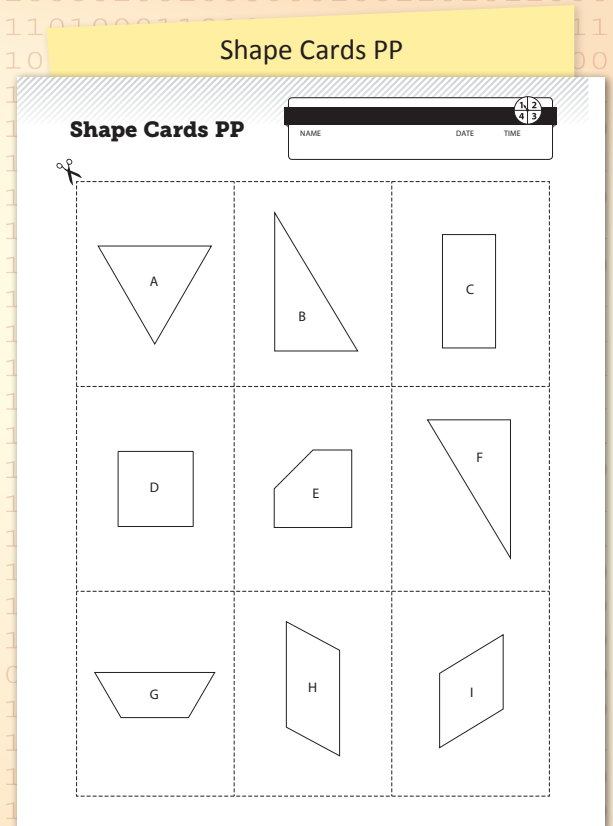
Next, hold up a quadrilateral shape (or draw one on the board) and ask children to think of precise instructions they could write so that they and their classmates would create exactly the same drawing without using the name of the shape to describe it. You may wish to use an online interactive geoboard, or draw over a projected section of dot paper. Use a shape with at least one pair of parallel sides or a shape with two or more equal-length sides. Record children’s instructions on the board and discuss ways they could be made more precise. Keep improving them until the class is satisfied that they are sufficiently specific and complete.

► Polygon Partners

WHOLE CLASS SMALL GROUP PARTNER INDEPENDENT

Distribute one Shape Card to each child. Tell children not to show their shape to anyone else. Have children first draw the shape on one of the grids on the Geoboard Dot Paper, then write directions for a partner on an index card, so that the partner could accurately draw the shape using the written directions. Have partners swap index cards and draw the shape following the directions they receive.

As you circulate and observe, watch for examples of ambiguous instructions, where children need to interpret beyond exactly what is written. You may wish to use some of these examples in your later class discussions. As needed, reinforce today’s “I Can ...” statements. Then, have partners compare their drawings and see how close they are to the original shapes and discuss how they could improve the precision and completeness of each of their instructions to make the shapes match more closely. Partners can work together to improve the instructions for each of their shapes, then swap these new instructions with another pair of children, to see if their improved instructions yield more accurate results.



NOTE Watch for children giving verbal instructions instead of written ones. The written aspect of this is important as verbal instructions lend themselves more to in-the-moment revisions.

NOTE You may wish to have children in groups of 3, with two children working together to come up with written instructions for the third to draw. The drawing partner should sit away from the writing partners, so s/he cannot hear their discussion about the shape.

NOTE This activity can be done again on other occasions, using other goals. Children may even enjoy pairing up and taking turns instructing and being the “computer” once they become used to interpreting instructions without any inferences.

“I Can ...” statements

- I can identify attributes of polygons.
- I can draw polygons based on instructions.
- I can use math language to write instructions that a friend can follow to create a polygon.
- I can give and receive feedback to improve directions to create a polygon.

After children have had some time to work, have volunteers share examples of when their partners drew a different shape than what they intended. Ask: *What information did you need to add to the directions to help make them clearer?* **Sample answer:** I had to say how long the sides were. *Why do you think you forgot to put that in your directions to start?* **Sample answer:** I already knew how long the sides were, so I didn’t really think about writing it down. Point out that children’s partners did not have any information about the shapes other than what was in the instructions, so children had to be careful to specify everything they wanted their partners to do. Explain that children will have to do the same thing when they work with computers. Computers don’t know what programmers are trying to do, so they must be given very specific and precise instructions.

Finally, ask for another volunteer to read their instructions aloud for you to follow. Deliberately do something that the instruction allows, but would not lead to a shape on the shape cards, such as drawing a curved line instead of a straight line. Point out that even though children’s partners did not know which specific shape they were to draw, they did know some information about the shapes that they probably used when following the instructions, such as that the shapes have straight sides. Explain that writing precise instructions for a computer might be even more challenging than for a partner, because computers don’t bring any knowledge to a task, but humans do.

► Wrap Up

WHOLE CLASS | SMALL GROUP | PARTNER | INDEPENDENT

Lead a whole-class discussion about what aspects of the instructions helped children accurately complete the drawing(s), and what made it more difficult, with an emphasis on how computers narrowly interpret instructions. *Sample discussion questions:*

- What is an example of an instruction that was difficult to understand? **Answers vary.**
- What changes did you make to your first set of instructions? **Answers vary.**
- How did watching your partner try to draw the shape help you give better instructions the second time? **Answers vary.**
- What is a suggestion that you would give someone who is trying to do this activity? **Answers vary.**
- Do you think that a computer might be able to draw the shape based on your instructions? **Answers vary.**
- Are there any words or phrases in the instructions that you think a computer would not understand what to do? **Answers vary.**

Now “I Can ...” Review today’s “I Can ...” statements and ask children to use their thumbs to show their opinion of each statement. Consider using these suggested prompts for Think-Pair-Share.

- When did you accomplish this “I can ...” statement? **Answers vary.**
- Which “I can ...” statement did you use the most today? **Answers vary.**