2 Identifying and Describing Polygons

A Geometry Lesson

Overview

In this lesson, students learn to identify and describe polygons and compare and contrast them with figures that are not polygons.

Prior to the lesson, students are introduced to vocabulary words that they will need to use as they learn about polygons. Students are taught various sentence frames and use the vocabulary introduced to describe everyday objects in the room.

During the geometry lesson, students use the vocabulary and the sentence frames to describe and compare and contrast shapes. They sort cards containing illustrations of shapes into two groups, polygons and nonpolygons. Finally, each student draws a picture of a polygon and describes what he knows about polygons in writing.

Math Goal: Students will identify and describe the features of polygons and figures that are not polygons.

Language Goal: Students will develop the academic language necessary to describe polygons and figures that are not polygons.

Key Vocabulary: closed, connect, curved, intersect, line segment, open, polygon, sides, straight, vertex, and vertices

Materials

- 12 word cards for key vocabulary terms
- 6 sentence strips or pieces of construction paper for sentence frames
- large two-column chart with drawings of figures that are polygons and figures that are not polygons
- *Identifying and Describing Polygons* cards, 1 set of 16 per pair of students (see Blackline Masters)

- envelopes for holding cards, 1 per pair of students
- 1 set of enlarged *Identifying and Describing Polygons* cards
- optional: pocket chart

Sentence Frames That Help Students Describe Polygons and Nonpolygons

Beginning

This is a _____. It is/has_____.
This is not a _____. It is/has_____.

Intermediate

This is a _____ because _____.
This is not a _____ because _____.

Advanced

This shape has _____, _____, and _____.
This shape has _____, _____, and _____; therefore, it is a polygon.

Class Profile

Of the thirty students in Ms. Handel's class, half are native English speakers, and the other half of the class is made up of beginning, intermediate, and advanced English speakers.

From the Classroom

✦ Identifying and Describing Polygons

Minilesson Introducing Academic Language

Christine Sphar greeted the students in Ms. Handel's class and told them that they would be learning about geometry.

"I have some cards with words written on them," she said, "and the first thing we're going to do is learn what the words mean and practice using them in complete sentences." To help make communication comprehensible to the English learners in the class, Christine enunciated her words clearly and spoke at a slightly slower pace than she would normally speak.

To begin, Christine placed the word *curved* into a large pocket chart at the front of the room. As she put the card in the chart, she read the word aloud to the class. To activate students' prior knowledge, she asked if anyone knew what the word *curved* meant.

"It's like folded," Juan said. "It's like wobbly."

"It's like on the letter S, it's curved," Juliana described.

Christine held up a quarter, running her index finger around its curved side and said, "This is curved."

Christine directed the class to say the word *curved* aloud together in a choral voice. Then she asked the students to find something in the room that was curved. Students identified several objects in the room, including a classmate's curly hair, a coiled cord, and the clock. Each time someone found something that was curved, Christine ran her fingers along the object's curves, providing visual clues.

Next, Christine introduced the word *straight* and placed the word card into the pocket chart. She held up a ruler and ran her finger up and down and said, "This is straight." Again, she had the class read the word aloud, asked for the word's meaning, and directed students to find things in the room that were straight.

"The border of the bulletin board has straight and curved lines!" Joan exclaimed.

"That thing that holds the flag is straight," Abraham said.

"The flag holder is straight," Christine said, adding a new word to Abraham's developing vocabulary in English.

Cindy, whose English language skills are further developed than Abraham's, added, "The edge of the desk is straight."

To help all the students make sense of the word *straight*, Christine had them each touch the edge of their desk and say the word aloud together.

Continuing, Christine introduced the word *line segment* by asking the students to each make a line by stretching their arms out in either direction.

"A line goes on forever in both directions," Christine explained. "A line segment is part of a line."

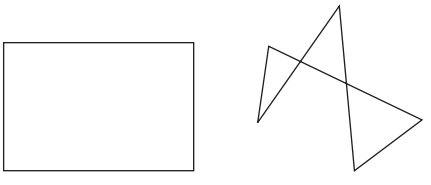
Christine held up a book, illustrating that each side, or line segment, of the book had two end points. Next, she used a yardstick to point out line segments on the ceiling panels, showing students where each line segment began and ended. Then she asked students to find examples of line segments in the room.

Before moving on, Christine pointed out to the students that the word *segment* in English is similar to the word *segmento* in Spanish. Cognates, or words that sound similar and have the same meaning in two languages, can be helpful to English learners if the students' native language is one that shares cognates with English.

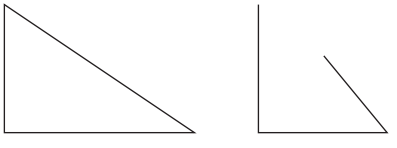
Christine next introduced the word *sides* to the students by drawing different geometric figures on the board (e.g., a square and a triangle) and asking how many sides each figure had. As she pointed to the sides on each shape, Christine introduced the words *vertex* and *vertices*, pointing to the places on the shapes where the sides or line segments connected. Christine used the familiar word *corner* in conjunction with the new word *vertex* to assist the students in their comprehension.

Connect and *intersect* were the next words Christine presented. Once again, she used a strategy called Total Physical Response, asking the students to use both their arms and hands and touch them together to illustrate the word *connect*. She asked students to cross their arms and hands to show the word *intersect*.

In addition, Christine drew figures on the board and asked students to say whether the sides or line segments connected or intersected.



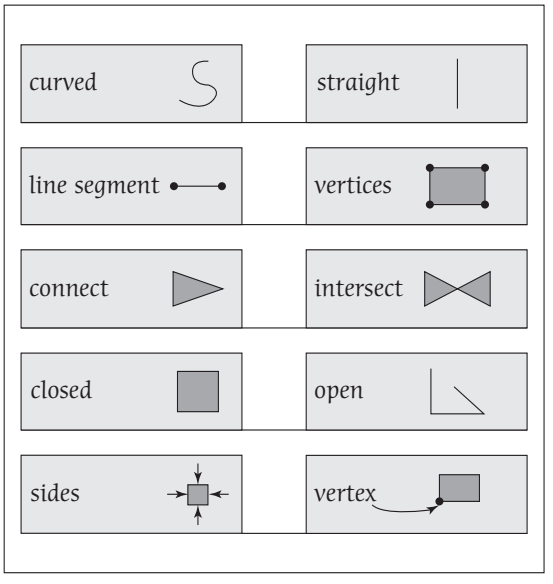
Finally, Christine introduced the words *closed* and *open* in the same manner: drawing figures on the board and asking students to say whether each figure was closed or open.



"If a dog is in a *closed* shape, like a fenced-in yard, he can't get out," Christine said. "But the dog can get out if the shape or figure is

open." Making connections to real-life situations can help English learners make sense of the new words they are learning.

When Christine finished introducing the vocabulary students would need for the upcoming lesson on polygons, the pocket chart at the front of the room was filled with the following word cards, each of which included a small illustration that provided a clue to the word's meaning. These visual clues are important to English learners because they provide support for comprehending vocabulary words.



Introducing Sentence Frames

Learning new vocabulary is not the only language demand that will be placed on students during this lesson. Students will also need to be able to use the vocabulary in complete sentences in English. To help students express their understanding of polygons, Christine introduced several sentence frames intended to support students with varying levels of linguistic competence in English: beginning, intermediate, and advanced.

To prepare for this part of the lesson, Christine had sentence frames written on tag board sentence strips. To begin, she placed the first frame in the pocket chart at the front of the room:

This is a _____. It is/has _____.

Christine started by having the students read aloud the frame, pausing for the blank spaces. Then she modeled for the students how to use the sentence frame. She purposely incorporated the new vocabulary in the pocket chart as well as familiar objects in the classroom.

Pointing to the rim of the clock on the wall, she said, "This is a clock. It is curved."

"Did you notice that I used the vocabulary words in the pocket chart in my sentence?" Christine pointed out.

She modeled another example, pointing to the vent in the wall. "This is a vent. It has four sides." When she was finished with her sentence, she directed the class to repeat it in a choral voice for practice.

Christine then gave the students some think time before practicing the sentence frames with a partner. Think time is crucial, in part because producing language is typically more difficult than comprehending it. Students need time to think about how they'll construct their sentences in English.

After giving students a few seconds to think, Christine directed them to turn to a partner and practice. Following is an exchange between Abraham, who is an intermediate-level English learner, and Joan, who is at an advanced level.

Abraham: This is a table. It is square.

Joan: This is a table. It has four sides.

Here is an exchange between Steph, who is an intermediate-level English learner, and Gina, who is a beginning English speaker.

Steph: This is a book. It has four sides.

Gina: This is a calendar. It has four shapes.

As partners practiced, Christine circulated around the room, monitoring students. As she listened in, she noticed that some students, like Joan, were using the vocabulary in the pocket chart in their sentences, while other students, such as Abraham, were using correct sentences but not including the new vocabulary. And there were a few students, like Gina, who had the right idea, but used some incorrect words, like *shapes* when she meant *sides*.

When the students were finished, Christine called them back to attention and asked Ruth to share her sentence.

"This is a rectangle. It has four squares," Ruth said.

"This is a rectangle. It has four . . . ," Christine repeated, prompting Ruth to use the correct word by pointing to the sides of a rectangle she quickly drew on the board.

Ruth caught on, and repeated, "This is a rectangle. It has four sides."

"Ruth used one of the words in the pocket chart," Christine told the class.

Cindy went next. She pointed to the globe and said, "This is a sphere. It has no sides."

Dan, an advanced English speaker, added, "This is a rectangle. It is a closed shape."

Carmen, a beginning English speaker, said, "This is door."

There was a long pause. Then she added, "It has four . . ."

After another long pause, Carmen looked to the pocket chart for help and found the word she was looking for. "This is a door. It has four sides," she said.

"One more example," Christine urged the class.

"This is a door. It has four angles," Dan said.

Next, Christine placed a new sentence frame in the pocket chart, one that was a bit more difficult than the first. As with the first frame, she directed the class to read it together, pausing for the blank spaces:

This is a _____ *because* _____.

"How is this frame different than the first?" Christine asked the class. "What word did I add?"

"It's almost the same, but you added *because*," Juliana noted.

Christine then modeled the new sentence frame by saying, "This [*pointing to the ceiling panel*] is a rectangle because the opposite sides are the same length."

Christine gave students some think time before practicing the sentence frame with a partner. Partner talk is essential for English learners because it gives all students a chance to practice their English language skills.

Following is an exchange between Amanda, a beginning English speaker who recently immigrated from Mexico, and Julio, an intermediate English speaker.

Julio: This is a triangle because it has three sides and three angles.

Amanda: This is square [*long pause; she looks at pocket chart for a sentence frame and decides to use the first one, which is easier*]. This is square. It has four sides.

Julio: This is an octagon [*pointing to a picture of an octagon on a chart in the room*] because it has eight sides.

After partners had practiced, Christine introduced a third sentence frame. This frame was intended for advanced English speakers, but it could be used by any student in the class. Like the other frames, Christine directed the class to read the frame aloud together:

This shape has _____, _____, and _____.

She then modeled how to use the frame. "OK, I'm going to look at the clock," she said, pointing to it. "This shape has a curve, no vertices, and it is closed."

Christine then held up a piece of paper and asked the students to think about how to describe it using the new frame. She gave students time to think, then called on Abraham.

He began, "This shape has four sides, connect lines . . ." Abraham paused for a long time before Christine jumped in to give him support.

"Connecting lines, and . . . ," she prompted.

Abraham continued, "This shape has four sides, connecting lines, and it's open. I mean it's closed."

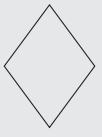
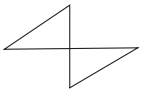
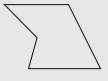
When Abraham finished his sentence, Christine took a picture frame from Ms. Handel's desk and held it up.

"What can you say about this shape?' she asked the class. "Talk with a partner and try to use one of the sentence frames in the pocket chart."

As Christine circulated around the room, she noticed that students were using the sentence frames that were most appropriate for their language level. For example, rather than using the most complex frame that was just introduced, Carmen, a beginning English speaker, chose to use an easier sentence frame. "This is a rectangle because it has four sides," Carmen said to her partner.

Introducing the Lesson

For the polygon lesson, Christine had prepared a piece of paper with a two-column chart on which she had drawn figures that were polygons on one side and figures that were not polygons on the other side:

Polygons	Not polygons
	
	
	
	

After taping the chart to the board and placing the *polygons* word card in the pocket chart, Christine asked the students what they noticed about the figures that were polygons. Before eliciting student ideas, Christine had the students practice saying the word *polygon* several times.

"They're closed," Steph observed.

"They're different shapes," Dan said.

"All the sides are touching," Juliana added.

"What word can we use besides *touching*?" Christine asked, attempting to get the students to use the vocabulary words they'd been introduced to.

"The sides of the polygons are all connected," Julio said.

Christine wrote Julio's sentence on the board and directed the class to read it aloud together. Always thinking of ways to focus on language during a math lesson, Christine asked, "Which adjective describes the sides of the polygon?"

To give the students a clue, Christine held up the word cards *straight* and *curved* from the pocket chart.

"Straight!" the class responded.

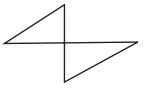
"What do you notice about the figures that are not polygons?" Christine asked.

"The polygons," Amanda began, then she paused and corrected herself, "those ones that are not polygons are open."

"They're open and curved," Cindy said.

"They are not connected," Diana said.

"That shape is intersect," Julio said, as he walked up to the board and pointed to this shape:



"It has intersecting lines," Christine added. She was careful to accept Julio's attempt, yet she also knows that explicitly modeling correct usage can further students' English language development.

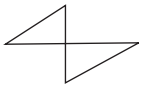
After students had finished making observations about the figures on the chart, Christine added two more sentence frames to the pocket chart:

This is not a _____. It is/has _____.

This is not a _____ because _____.

"You can use these two sentence frames to describe shapes that are not polygons," Christine said. "Who would like to give us some examples using the sentence frames?"

Juliana pointed to the same shape that Julio had pointed to on the two-column chart:



"This is not a polygon. It has intersecting lines," she said. Then, pointing to the same shape, she continued, "This is not a polygon because it has intersecting lines."

"The sentence frames are almost the same," Christine commented.

Then Christine added onto the third sentence frame she had introduced earlier. She wrote on the board:

This shape has _____, _____, and _____; therefore, it is a polygon.

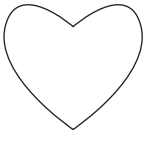
Then she drew a rectangle on the board that looked like this:

"Who can use the new sentence frame to describe this polygon?" Christine asked the class.

Cindy gave it a try. "This shape has four angles, straight sides, and no curved lines; therefore, it is a polygon." Cindy is an example of how students who are advanced English speakers can serve as good models for the rest of the class.

Next, Christine drew figures on the board, one at a time, and asked students to give a thumbs-up if the figure was a polygon and a thumbs-down if it was not a polygon. Asking English learners to participate in this nonverbal fashion is effective because it is nonthreatening, involves everyone at once, and allows students to develop their understanding without having to produce any language.

"What about this one?" Christine asked as she drew this figure on the board:



Most students' thumbs were turned down. Christine asked if anyone could explain why he or she thought the figure wasn't a polygon.

"It is not a polygon. It is curved," Joan said, using the sentence frame on the pocket chart as a support.

"But it's closed," Abraham said, with a confused tone to his voice.

"You're right, Abraham," Christine acknowledged. "Figures that are not polygons can be closed. But if a figure is closed and it has curves, it isn't a polygon, right?"

Students nodded their heads in agreement.

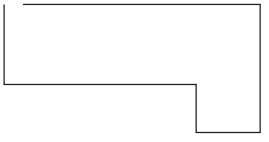
Next, Christine drew this shape on the board:

"What do you think?" Christine asked. "Thumbs up if it's a polygon and thumbs down if it isn't."

When most students had their thumbs up, Christine called on Amy.

"This is a polygon because it has straight lines and it's closed," Amy said.

After Amy finished, Christine drew this figure on the board:



This time, Christine waited for about ten seconds before she called on someone to explain why the shape was not a polygon. Using wait time is crucial for English learners because it gives them time to formulate their ideas. The longer Christine waited, the more hands shot up in the air. Finally, she called on Franco, a beginning English speaker.

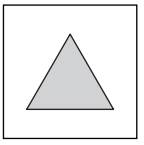
"This is not a polygon. It is open," he said, using one of the most basic sentence frames from the pocket chart.

Sorting Polygons and Nonpolygons

To give students time to identify and describe polygons with a partner, Christine handed out an envelope to each pair of students. Inside each envelope were sixteen cards; on each card there was a figure that was either a polygon or not a polygon. Christine explained to the students that they were to take the cards from the envelope and sort them into two groups—polygons and not polygons—and talk about why each figure belonged in a chosen group. She encouraged students to use the vocabulary and the sentence frames in the pocket chart to help them in their discussions.

Partners immediately got to work, sorting the cards and comparing and contrasting the figures. During a lesson, and especially while students are engaged in partner talk, Christine tries to check in with a variety of students to ask questions that will extend their mathematical thinking and encourage the use of academic language.

Following is an exchange between Christine and two students: Julio, an intermediate English speaker, and his partner, Maria, a beginning English speaker. The two students were looking at a card with a triangle on it and talking about whether it should go in the polygon group or the other group.



Julio: It's a polygon because it is open.

Christine: Are you sure?

Julio: Oh, because it's closed.

Christine: Are you sure? How do you know?

Julio: The line segments touch [*pointing to the vertices on the triangle*].

Christine: What word could we use to say that?

Julio: [*Looking at the pocket chart*] Connect? The line segments connect.

Christine: Maria, show me lines that connect using your arms.

Maria: [*Uses her arms to act out the term* connect] Connect.

Christine: So is the figure a polygon or not?

Maria: It is a polygon. It is closed.

Julio: And it has connecting lines.

When partners had finished sorting the cards, Christine called them back to attention. In her hand she held a set of cards that were enlarged duplicates of the cards that the students had used for sorting. "I'm going to hold up one of the cards and I want you to tell me whether the figure on the card is a polygon or not a polygon and explain why," Christine instructed.

As she held up one card at a time, the students were given one more opportunity to think about the features of polygons and describe their characteristics using the vocabulary and the sentence frames in the pocket chart.