Lesson 1

# Moving in the Plane

## Goals

- Describe (orally and in writing) a rotation of a shape using informal language, e.g., “turn left,” ”quarter turn,” etc.
- Describe (orally and in writing) a translation of a shape using informal language, e.g., “slide,” “move,” “shift,” etc.

## Learning Target

I can describe how a figure moves and turns to get from one position to another.

## Student Learning Goal

Let’s describe ways figures can move in the plane.

## Lesson Narrative

The purpose of this lesson is to introduce students to translations and rotations of plane figures and to have them describe these movements in everyday language. Expect students to use words like “slide” and “turn.” In the next lesson, they will be introduced to the mathematical terms. The term “transformation” is not yet used and will be introduced later in a later lesson.

In all of the lessons in this unit, students should have access to their geometry toolkits, which should contain tracing paper, graph paper, colored pencils, scissors, ruler, protractor, and an index card. For this unit, access to tracing paper and a straight edge are particularly important. Students may not need all (or even any) of these tools to solve a particular problem. However, to make strategic choices about when to use which tools, students need to have opportunities to make those choices. Apps and simulations should supplement rather than replace physical tools.

**Math Community**
This is the first exercise that focuses on the work of building a mathematical community. Students have the opportunity to think about what a mathematical community is and to share their initial thoughts about what it looks like and sounds like to do math together in a community.

### Access for Students with Diverse Abilities

- Representation (Activity 1)

### Access for Multilingual Learners

- MLR2: Collect and Display (Activity 1)

### Instructional Routines

- MLR2: Collect and Display (Activity 1)
- Take Turns
- Which Three Go Together?

### Required Materials

**Materials to Gather**
- Geometry toolkits: Lesson
- Chart paper: Warm-up
- Geometry toolkits: Warm-up
- Sticky notes: Warm-up

**Materials to Copy**
- 6–12 Blank Math Community Chart (1 copy for every 30 students): Warm-up
- Triangle Square Dance Handout (1 copy for every 2 students): Activity 1

### Required Preparation

**Activity 1:**
Make a space for students to place their sticky notes at the end of the *Warm-up*. For example, hang a sheet of chart paper on a wall near the door.

**Lesson:**
Assemble geometry toolkits. It would be best if students had access to these toolkits at all times throughout the unit. Toolkits include tracing paper, graph paper, colored pencils, scissors, ruler, protractor, and an index card to use as a straightedge or to mark right angles. Access to tracing paper is particularly important in this unit. Tracing paper cut to a small-ish size (roughly 5 in by 5 in) is best—commercially available “patty paper” is ideal for this. If using larger sheets of tracing paper, such as 8.5 in by 11 in, cut each sheet into fourths.

## Lesson Timeline

| Warm-up | Activity 1 | Lesson Synthesis | Assessment |
|---|---|---|---|
| 10 min | 25 min | 10 min | 5 min |
| | | | Cool-down |

## Warm-up

# Which Three Go Together: Diagrams

10 min

### Activity Narrative

This is the first *Which Three Go Together* routine in the course. In this routine, students are presented with four items or representations and asked:

"Which three go together? Why do they go together?"

Students are given time to identify a set of three items, explain their rationale, and refine their explanation to be more precise or find additional sets. The reasoning here prompts students to notice common mathematical attributes, look for structure, and attend to precision, which deepens their awareness of connections across representations.

This *Warm-up* prompts students to compare four images. It gives students a reason to use language precisely. It gives the teacher an opportunity to hear how students use terminology and talk about characteristics of the items in comparison to one another.

Before students begin, consider establishing a small, discreet hand signal students can display to indicate they have an answer they can support with reasoning. This signal could be a thumbs up, or students could show the number of fingers that indicate the number of responses they have for the problem. This is a quick way to see if students have had enough time to think about the problem and keeps them from being distracted or rushed by hands being raised around the class.

As students share their responses, listen for important ideas and terminology that will be helpful in upcoming work of the unit, such as reference to angles and their measures.

### Launch

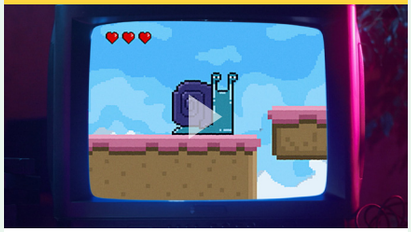
Arrange students in groups of 2–4. Display the images for all to see.

Give students 1 minute of quiet think time and ask them to indicate when they have noticed three images that go together and can explain why.

Next, tell students to share their response with their group and then together find as many sets of three as they can.

**Inspire Math**

**Video Games video**



**Go Online**
Before the lesson, show this video to introduce the real-world connection.

**ilclass.com/l/613740**

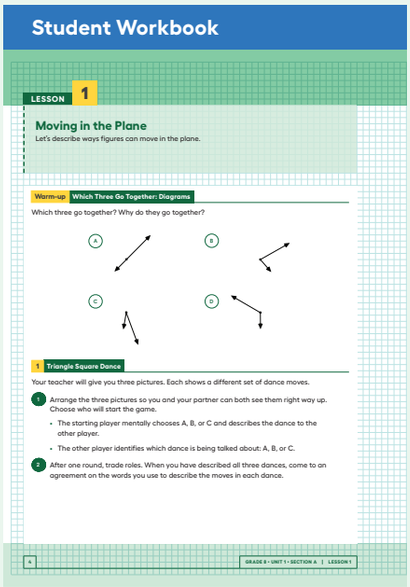
Please log in to the site before using the QR code or URL.

**Instructional Routines**

**Which Three Go Together?**

**ilclass.com/r/10690736**

Please log in to the site before using the QR code or URL.


Student Workbook

LESSON 1

Moving in the Plane

Let's describe ways figures can move in the plane.

Warm-up Which Three Go Together: Diagrams

Which three go together? Why do they go together?

A B C D

1 Triangle Square Dance

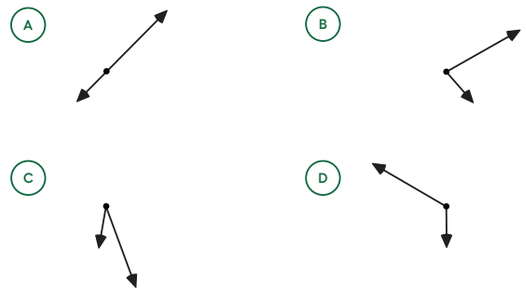
Your teacher will give you three pictures. Each shows a different set of dance moves.

1. Arrange the three pictures so you and your partner can both see them right way up. Choose who will start the game.
   - The starting player mentally chooses A, B, or C and describes the dance to the other player.
   - The other player identifies which dance is being talked about: A, B, or C.
2. After one round, trade roles. When you have described all three dances, come to an agreement on the words you use to describe the moves in each dance.

4 GRADE 8 • UNIT 1 • SECTION A | LESSON 1

## Student Task Statement

Which three go together? Why do they go together?




Sample responses:

A, B, and C go together because:

- The long ray points to the right of the short ray.
- They are not obtuse angles.

A, B, and D go together because:

- They are not acute angles.
- Both rays do not point downward.

A, C, and D go together because:

- They are not right angles.
- The rays do not look like a letter.

B, C, and D go together because:

- It is possible to join points on the rays to make a triangle.
- They do not make a straight line.

## Activity Synthesis

Invite each group to share one reason why a particular set of three go together. Record and display the responses for all to see. After each response, ask the class if they agree or disagree. Since there is no single correct answer to the question of which three go together, attend to students' explanations and ensure the reasons given are correct.

During the discussion, prompt students to explain the meaning of any terminology they use, such as ray, degree, or acute angle. and to clarify their reasoning as needed. Consider asking:

- *"How do you know ... ?"*
- *"What do you mean by ... ?"*
- *"Can you say that in another way?"*

## Math Community

After the *Warm-up,* tell students that today is the start of planning the type of mathematical community they want to be a part of for this school year. The start of this work will take several weeks as the class gets to know one another, reflects on past classroom experiences, and shares their hopes for the year.

Display and read aloud the question

> *"What do you think it should look like and sound like to do math together as a mathematical community?"*

Give students 2 minutes of quiet think time and then 1–2 minutes to share with a partner.

Ask students to record their thoughts on sticky notes and then place the notes on the sheet of chart paper. Thank students for sharing their thoughts and tell them that the sticky notes will be collected into a class chart and used at the start of the next discussion.

After the lesson is complete, review the sticky notes to identify themes. Make a Math Community Chart to display in the classroom. See the blackline master Blank Math Community Chart for one way to set up this chart. Depending on resources and wall space, this may look like a chart paper hung on the wall, a regular sheet of paper to display using a document camera, or a digital version that can be projected. Add the identified themes from the students' sticky notes to the student section of the "Doing Math" column of the chart.

## Activity 1

## Triangle Square Dance

25 min

### Activity Narrative

The purpose of this activity is for students to informally describe moves of figures in the plane. Each possible move results from a translation or rotation, but students are not expected to use this language. In this partner activity, students take turns describing one of 3 possible dances based on a series of plane figures and identifying which dance is being described.

Students are not expected to use precise language yet, but they may agree upon common language and experiment with different ways to describe some moves in the plane as they make sense of the problem.

This is the first time Math Language Routine 2: *Collect and Display* is suggested in this course. In this routine, the teacher circulates and listens to student talk while jotting down words, phrases, drawings, or writing students use. The language collected is displayed visually for the whole class to use throughout the lesson and unit. The purpose of this routine is to capture a variety of students' words and phrases—including especially everyday or social language and non-English—in a display that students can refer to, build on, or make connections with during future discussions, and to increase students' awareness of language used in mathematics conversations.

### Instructional Routines

**MLR2: Collect and Display**

**ilclass.com/r/10690754**

Please log in to the site before using the QR code or URL.

### Instructional Routines

**Take Turns**

**ilclass.com/r/10573524**

Please log in to the site before using the QR code or URL.

### Access for Students with Diverse Abilities (Activity 1, Launch)

**Representation: Access for Perception.**
Display or provide students with a physical copy of the written directions and read them aloud. Check for understanding by inviting students to rephrase directions in their own words. Consider keeping the display of directions visible throughout the activity.

*Supports accessibility for: Language, Memory*

### Access for Multilingual Learners (Activity 1)

**MLR2: Collect and Display**

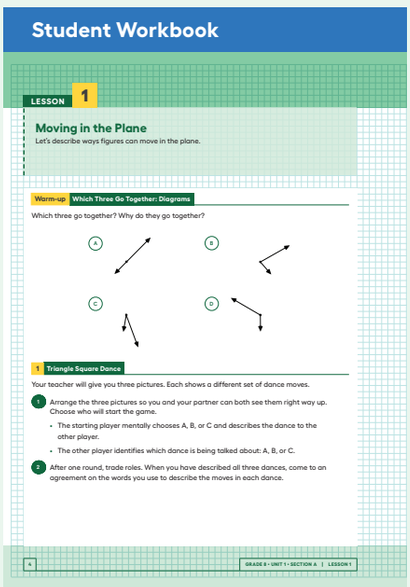
This activity uses the *Collect and Display* math language routine to advance conversing and reading as students clarify, build on, or make connections to mathematical language.

### Building on Student Thinking

Some students may interpret directions like "left" and "right" different from how their partner intended it, depending on whether they are thinking from the point of view of an observer watching the dance or putting themselves in the dance and describing things in terms of the triangle's left, right, up, and down. Watch for miscommunications like this, point out that neither perspective is wrong, and encourage students to be more precise in their language.

Students often confuse or are unsure about the meaning of the terms clockwise and counterclockwise. Discuss with them (and demonstrate, if possible) how the hands on a clock rotate, emphasizing the direction of the rotation. Students may also be unsure of how to describe the amount of rotation. Consider asking a student who expresses angle measures in terms of degrees to explain how they see it.

### Student Workbook


LESSON 1

Moving in the Plane

Let's describe ways figures can move in the plane.

Warm-up Which Three Go Together: Diagrams

Which three go together? Why do they go together?

A B C D

1 Triangle Square Dance

Your teacher will give you three pictures. Each shows a different set of dance moves.

1. Arrange the three pictures so you and your partner can both see them right way up. Choose who will start the game.
   - The starting player mentally chooses A, B, or C and describes the dance to the other player.
   - The other player identifies which dance is being talked about: A, B, or C.
2. After one round, trade roles. When you have described all three dances, come to an agreement on the words you use to describe the moves in each dance.

A GRADE 8 • UNIT 1 • SECTION A | LESSON 1

## Launch

Arrange students in groups of 2, and give a copy of all 3 blackline masters to each group. Tell students that each sheet is an image with 6 frames showing the moves made by the dancing figures. Share the following steps or, if time allows, demonstrate these steps with a student as a partner:

- Place all three sheets so that both students can see the figures.
- One partner picks a dance without revealing which dance they have selected.
- They describe the dance to their partner.
- The other partner identifies which dance is being described.

Use *Collect and Display* to create a shared reference that captures students' developing mathematical language. Collect the language students use to describe movement of the shapes. Display words and phrases such as "flip," "turn," "slide," "translate," "reflect," and "rotate." Arrange the words in two groups, those that describe translations and those that describe rotations (but do not use these terms).

Give students 15 minutes to work in their groups followed by a whole-class discussion.

### Student Task Statement

Your teacher will give you three pictures. Each shows a different set of dance moves.

1. Arrange the three pictures so you and your partner can both see them right way up. Choose who will start the game.
   - The starting player mentally chooses A, B, or C and describes the dance to the other player.
   - The other player identifies which dance is being talked about: A, B, or C.
2. After one round, trade roles. When you have described all three dances, come to an agreement on the words you use to describe the moves in each dance.
3. With your partner, write a description of the moves in each dance.

Sample responses:

A: Move right, turn 90° clockwise, move up, move left, and turn 90° counterclockwise.

B: Slide right, make a quarter turn right, slide left, slide up, and make a quarter turn left.

C: Shift right, spin 90° counterclockwise, shift left, step up, and spin 90° clockwise.

The terms left, right, and up in this answer are from the point of view of an observer watching the dance. Alternatively students might put themselves in the shoes of the triangles and describe things in terms of the triangle's left, right, up, and down.

## Are You Ready for More?

We could think of each dance as a new dance by running it in reverse, starting in the 6th frame and working backwards to the first.

1. Pick a dance and describe one of these reversed dances.

   Sample responses:

   A: Turn 90° clockwise, move right, move down, turn 90° counterclockwise, and move left.

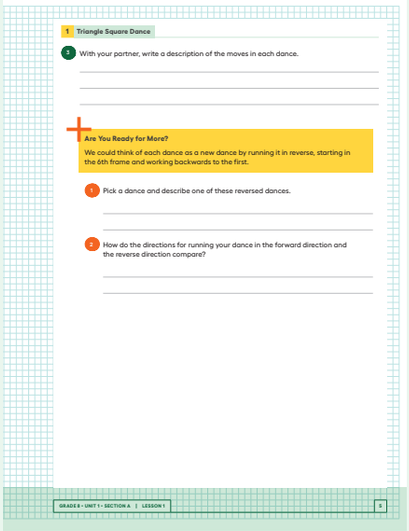
   B: Turn 90° clockwise, move down, move right, turn 90° counterclockwise, and move left.

   C: Turn 90° counterclockwise, move down, move right, turn 90° clockwise, and move left.

2. How do the directions for running your dance in the forward direction and the reverse direction compare?

   The steps are listed in reverse order. "Right" gets replaced by "left" and "clockwise" gets replaced with "counterclockwise," and vice versa.

**Student Workbook**


1 Triangle Square Dance

3 With your partner, write a description of the moves in each dance.

Are You Ready for More?

We could think of each dance as a new dance by running it in reverse, starting in the 6th frame and working backwards to the first.

1 Pick a dance and describe one of these reversed dances.

2 How do the directions for running your dance in the forward direction and the reverse direction compare?

GRADE 8 • UNIT 1 • SECTION A | LESSON 1

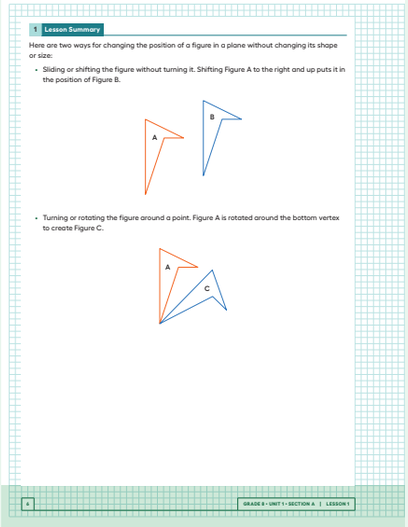
## Activity Synthesis

Direct students' attention to the reference created using *Collect and Display*. Ask students to share their descriptions of the dances. Invite students to borrow language from the display as needed and update the reference to include additional phrases as they respond.

Refer to the groups of words students used that describe rotations and reflections informally. Come to agreement on a word for each type, and discuss what extra words are needed to specify the transformation exactly (for example, move right, turn clockwise 90°).

Consider asking students what they found most challenging about describing the dances. Expected responses include being as precise as possible about the different motions (for example, describing whether the shape is rotating clockwise or counterclockwise). Also consider asking students if they were sometimes able to identify the dance before their partner finished describing *all* of the moves. All three dances begin by moving to the right, but in the second step, Dances A and B rotate 90 degrees clockwise while Dance C rotates 90 degrees counterclockwise. (So if the second move was to rotate 90 degrees counterclockwise, this must be Dance C.) Dances A and B diverge at step 4.

**Student Workbook**


1 Lesson Summary

Here are two ways for changing the position of a figure in a plane without changing its shape or size:

- Sliding or shifting the figure without turning it. Shifting Figure A to the right and up puts it in the position of Figure B.

A B

- Turning or rotating the figure around a point. Figure A is rotated around the bottom vertex to create Figure C.

A C

4 GRADE 8 • UNIT 1 • SECTION A | LESSON 1

## Lesson Synthesis

Display this applet for all to see:

The Geogebra applet 'Triangle Square Dance' is available here: **https://www.geogebra.org/m/AEJZpFYq**

Click "Show Shadows" and advance the slider bar from the initial position to the second position, showing the first move of the dance in A.

Ask students what words they used to describe this move, inviting them to borrow language from the display as needed. Then ask students to describe this move more precisely. How much did it move? How can they describe how far the figure stepped or slid?

> By measuring, such as move 3 inches to the right, or by description, such as move with one square-width between the shapes.

Advance the slider to the next position, so that the rotation is displayed. Ask students what words they used to describe this move, inviting them to borrow language from the display as needed. Then ask students to describe this move more precisely. How much did it turn? How can they describe the direction it turned?

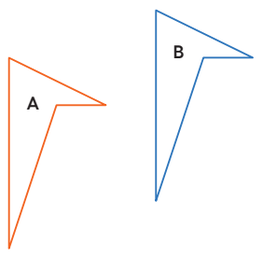
> By using angle measures, like 90 degrees clockwise, or position, like turn so that the triangle is facing right.

Ask students what it would look like if the figure turned 180 degrees. Consider having a student demonstrate turning 180 degrees in either direction and ask the class how they would describe that move.

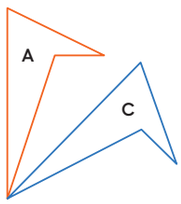
## Lesson Summary

Here are two ways for changing the position of a figure in a plane without changing its shape or size:

- Sliding or shifting the figure without turning it. Shifting Figure A to the right and up puts it in the position of Figure B.




- Turning or rotating the figure around a point. Figure A is rotated around the bottom vertex to create Figure C.



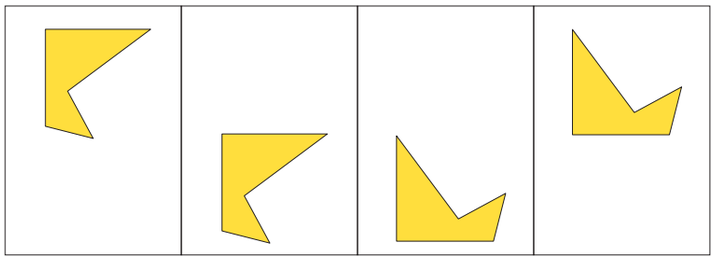
Cool-down

## Frame to Frame

5 min

### Student Task Statement

Here are positions of a shape:




Describe how the shape moves from:

1. Frame 1 to Frame 2.

   slide down

2. Frame 2 to Frame 3.

   turn counterclockwise 90 degrees (or one quarter of a full turn)

3. Frame 3 to Frame 4.

   slide up

### Responding To Student Thinking

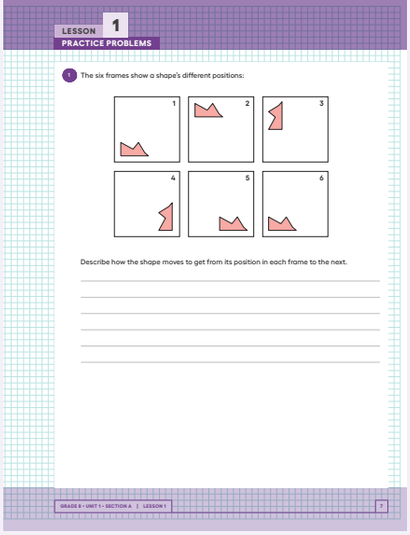
**More Chances**
Students will have more opportunities to understand the mathematical ideas addressed here. There is no need to slow down or add additional work to the next lessons.

Lesson 1

## Practice Problems

3 Problems

Student Workbook


LESSON 1
PRACTICE PROBLEMS

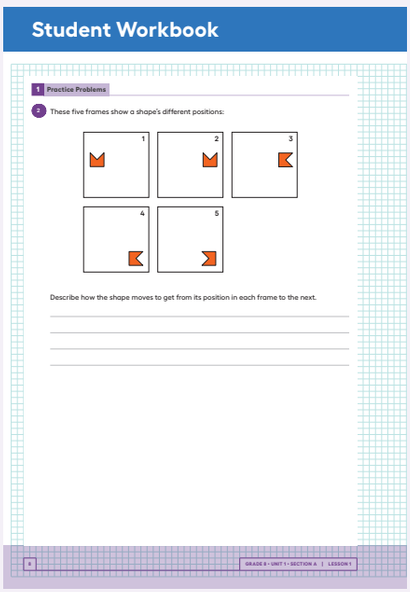
1 The six frames show a shape's different positions:

1 2 3 4 5 6

Describe how the shape moves to get from its position in each frame to the next.

GRADE 8 • UNIT 1 • SECTION A | LESSON 1 7

Student Workbook


1 Practice Problems

2 These five frames show a shape's different positions:

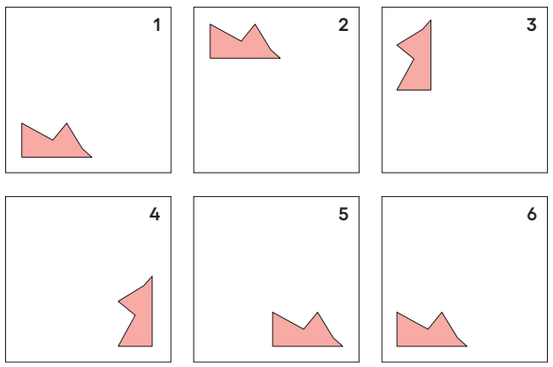
1 2 3 4 5

Describe how the shape moves to get from its position in each frame to the next.

8 GRADE 8 • UNIT 1 • SECTION A | LESSON 1

### Problem 1

The six frames show a shape's different positions:

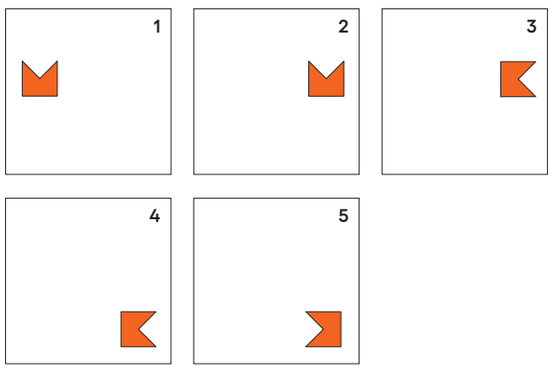



Describe how the shape moves to get from its position in each frame to the next.

Sample response: To get from Position 1 to Position 2, the shape moves up. To get from Position 2 to Position 3, the shape rotates 90 degrees counterclockwise. To get from Position 3 to Position 4, the shape moves down and to the right. To get from Position 4 to Position 5 the shape rotates 90 degrees clockwise. To get from Position 5 to Position 6, the shape moves to the left.

### Problem 2

These five frames show a shape's different positions:

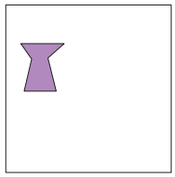



Describe how the shape moves to get from its position in each frame to the next.

Sample response: To get from Position 1 to Position 2, the shape moves to the right. To get from Position 2 to Position 3, the shape rotates 90 degrees clockwise. To get from Position 3 to Position 4, the shape moves down. To get from Position 4 to Position 5, the shape rotates 180 degrees.

## Problem 3

Diego started with this shape.



Diego moves the shape down, turns it 90 degrees clockwise, then moves the shape to the right. Draw the location of the shape after each move.

Student Workbook