

# Lesson 2-2A

Action Fractions  
Math+CT

# Introducing Variables: Robot Boxes (unplugged)

**Math Connections:** Students find the area or perimeter of a rectangle by applying formulas.  
**CS Connections:** Students are introduced to variables.

## ► Before You Begin

Option 1: Do this activity in Lesson 2-2: The Area Formula for Rectangles, instead of the Focus activity *Playing Rugs and Fences* or the Practice activity *Playing Spin-and-Round*.  
Option 2: Play this game as a stand-alone activity.

Because this activity can fit into an existing lesson, “I Can...” statements are not formally discussed. However, we provide “I Can ...” statements below if you wish to use this routine with this lesson.

## Computational Thinking

- **VARIABLES:** Variables hold data.
- **VARIABLES:** Variables have types related to the kind of data they hold and the operations available on that data.

## 2

## Focus

25–35 min

## Materials

### Playing *Robot Boxes*

**Game** Students practice applying formulas for area and perimeter and are introduced to variables, their types, and use in computer programs.

*Robot Boxes* game directions; *Robot Boxes* cards; *Robot Boxes* Record Sheet; *Robot Boxes* CALCULATOR, ROBOT, and FILLER instructions sheets; index cards; number cards

## “I Can ...” statements

- *I can find the area and perimeter of a rectangle.*
- *I can walk to model a rectangle when I know the length and width.*
- *I can adjust the output based on a change to the variables.*

## Anticipated Barriers

- Students may think that variables can hold multiple values at one time.
- Students may struggle with finding the area and perimeter without a visual picture of the rectangle.

## Student Options

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

- Students may prefer to see visual directions (both written in student-friendly language and pictorial) in addition to the oral directions.
- Some students may wish to watch the game being played several times before they are ready to play.
- Some students may wish to see a visual model of the rectangle created by the robot to help them accurately interpret and apply the formulas for area and perimeter. Provide grid paper to draw a model of the rectangle the robot creates.
- Providing length and width values larger than nine may provide an additional extension for some students.

## Robot Boxes Game Directions

### Robot Boxes

<b>Materials</b>	<input type="checkbox"/> 6 boxes with labels or 3 printed Robot Boxes sheets <b>message</b> ; <b>length</b> ; <b>width</b> ; <b>myAction</b> ; <b>measure</b> ; <b>answer</b> <input type="checkbox"/> index cards and pencils <input type="checkbox"/> 1 set of Robot Boxes cards <input type="checkbox"/> 1 Robot Boxes Record Sheet <input type="checkbox"/> 1 Robot Boxes: CALCULATOR Program Sheet <input type="checkbox"/> 1 Robot Boxes: ROBOT Program Sheet <input type="checkbox"/> 1 Robot Boxes: FILLER Instructions Sheet <input type="checkbox"/> number cards 1–9
<b>Players</b>	3
<b>Skill</b>	Finding the area and perimeter of rectangles by applying formulas; Following the instructions in a program, substituting values where needed
<b>Object of the Game</b>	To get the Robot to perform a silly rectangle dance.

#### Directions:

1. Players take turns. One player is the "Robot," one is the "Calculator," and one is the "Filler."
2. Players follow the instructions on their sheet.
3. FILLER instructions:
  - a. Get the Robot Boxes: FILLER Instruction sheet.
  - b. Place the six boxes where the Robot and Calculator can both see them.
  - c. Think of a funny message and silly action you want the Robot to do.
  - d. Follow your instructions to fill the boxes.
4. ROBOT instructions:
  - a. Get the Robot Boxes: ROBOT Program Sheet and read the program to yourself.
  - b. Wait for the Filler to place cards in the boxes.
  - c. Start your program, using the contents of the boxes to control your actions. For example, if the **length** box has 3 in it, move 3 steps.
5. CALCULATOR instructions:
  - a. Get the Robot Boxes: CALCULATOR Program Sheet, the Robot Boxes Record Sheet, and one index card.
  - b. Wait for the Filler to place cards in five of the boxes.
  - c. Start your program, using the contents of the **measure**, **length**, and **width** boxes. Use the record sheet to help you calculate the Area or Perimeter.
6. When the Robot is finished executing its program, empty the boxes, shuffle the cards, switch roles, and play again!

## 2 Focus 25–35 min

### ▶ Playing Robot Boxes

WHOLE CLASS   SMALL GROUP   PARTNER   INDEPENDENT

Students play *Robot Boxes* to practice applying formulas for finding the areas and perimeters of rectangles and to learn about **variables**, their types, and use in computer programs. Review the rules on the *Robot Boxes* Game Directions. Read the Instructions and Program sheets with the class and play a couple of rounds. One example program is given below. Select volunteers to help you play the other roles as needed. Model both how to use the formulas to calculate area and perimeter and how to use the Area and Perimeter cards to determine whether players should calculate the area or perimeter. Record a couple of rounds on the *Robot Boxes* Record Sheet so students can see how to use the formulas and the table.

Carefully explain to students how to read and execute the program(s) and use the boxes at the appropriate times. Whenever a student sees the underlined box name (e.g., width), they should use the value in that box. Divide students into groups of three and provide them time to play several rounds of the game. Each student should have the opportunity to be the filler, the calculator, and the robot.

## Robot Boxes

### Robot Boxes

#### ROBOT Program Sheet

1. Here is your program. Read it to yourself.
  - a. Say **message**;
  - b. Move **length** steps;
  - c. Say "I am **length** units long!"
  - d. Turn right;
  - e. Move **width** steps;
  - f. Say "I am **width** units wide!"
  - g. Turn right;
  - h. Move **length** steps;
  - i. Turn right;
  - j. Move **width** steps;
  - k. Do **myaction**;
  - l. Wait for Calculator to fill **answer** box.
  - m. Say "**measure** is **answer**"
2. Wait for Filler to place cards in the boxes.
3. Start your program, using the contents of the boxes to control your actions. For example, if the card in the **length** box has 3 in it, move 3 steps.

```
message = "I am a robot and I love rectangles."
length = 3
width = 4
myAction = Jump!
measure = Area
answer = 12
```

#### ROBOT Program

1. Say "I am a robot and I love rectangles.";
2. Move 3 steps;
3. Say "I am 3 units long!"
4. Turn right;
5. Move 4 steps;
6. Say "I am 4 units wide!"
7. Turn right;
8. Move 3 steps;
9. Turn right;
10. Move 4 steps;
11. Do **Jump!**;
12. Wait for Calculator to fill **answer** box.
13. Say "Area is 12"

<b>message</b> 	<b>length</b> 
<b>width</b> 	<b>myAction</b> 
<b>measure</b> 	<b>answer</b> 

### Observe

- Which students are correctly distinguishing area and perimeter?
- Some students may need extra help remembering out how to use the values in the boxes at the appropriate times.
- Watch for students using different strategies for getting values from the boxes. Some may try to memorize all the values on the cards at the beginning. Encourage them to only look at the card in a box when they get to that step in their program.
- After several rounds, you may wish to invite each group to perform their best silly robot program for the class.

**Robot Boxes Record Sheet**

Perimeter formulas:  $p = l + l + w + w$   $p = (2 * l) + (2 * w)$   $p = 2 * (l + w)$   
 Area formula:  $A = l * w$

Length	Width	Circle A (area) or p (perimeter)	Equation	<u>measure</u>
		A or p		
		A or p		
		A or p		
		A or p		
		A or p		

**Discuss**

- Why does the Robot need the cards in the boxes? The robot has a program, but it doesn't say what to say, what action to do, or how many steps to move.
- Did the Robot do the same thing each time? No. The program can run a different time, and will do different things, if the values on the cards are different. Same program, but different results depending on values in the boxes.
- What would happen if we swapped what is in the message box with what is in the length box? The robot would be confused because the instruction "Move message steps" would not make sense.

**Wrap Up**

WHOLE CLASS	SMALL GROUP	PARTNER	INDEPENDENT
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**Summarize** Explain to the class that **message**, **length**, **width**, **myAction**, **measure**, and **answer** are called **variables**.

- A **variable** holds a value that can change. Variables are used in the program as placeholders, and they hold the values that are assigned to them by the computer running the program.
- A variable can hold a number, some text, or other types of values. For example, we have a variable holding an action-command: **myAction**.
- Variables can be used to make programs more general, so that they can do more than one thing, or do things in different ways.
- Variables can also be helpful when we want to use the same value multiple times in a program.

Choose one of the program variables. Draw a box on the board labeled with the given variable. List the different values that the variable held while students were playing their games. For example, **message**: "Rectangles rock," "I love rectangles," etc. Do not write these down as a list in the box, instead--for each new value, erase or cross out the old value to reinforce the idea that the variable holds only one value.

Ask students to think about how variables could store information about things in the real world. For example, information about a car could be stored in variables describing color, make, or speed. A person could be described using variables for age, height, weight, or hair color.

**Robot Boxes**

**Robot Boxes**

**FILLER Instructions Sheet**

- Place the boxes where Robot and Calculator can both see them.
- Take two index cards, shuffle the number cards, then fill the boxes as follows:
  - message**: Write a message (for the robot to say) on an index card. e.g. "I am a robot and I love rectangles."
  - length**: Choose a number card.
  - width**: Choose a number card.
  - myAction**: Write an action on an index card. e.g. Jump, Bow, Clap, Spin, etc.
  - measure**: Choose an Area or Perimeter card.
  - answer**: Leave this box empty for Calculator to fill.
- Have fun watching Robot dance!

**Robot Boxes**

**Robot Boxes**

**CALCULATOR Program Sheet**

- Get the Robot Boxes Record Sheet and one index card.
- Here is your program. Read it to yourself.
  - If (**measure** is Area), then
    - Multiply **length** times **width**.
    - Write the result on the index card.
    - Place card in **answer** box.
  - If (**measure** is Perimeter), then
    - Add **length + length + width + width**.
    - Write the result on the index card.
    - Place card in **answer** box.
- Wait for Filler to place cards in the boxes.
- Start your program.
 

Use the recording sheet to help you calculate the Area or Perimeter.