Math Chat

Math Connections: Students use formulas for the area and perimeter of rectangles.
CS Connections: Students use variables in a program for the first time. They use variables to store data (input) and use operators to make and display calculations (output).

▶ **Before You Begin**
This lesson uses two Scratch projects. The first is for teacher demonstration only. For the student exploration, make sure that students start with the correct Scratch project.

▶ **Vocabulary**
input • output

Computational Thinking
- **VARIABLES:** Many programs accept user input.
- **VARIABLES:** Variables can hold user input.

1 Warm Up   5 min
Materials

Chatting about Math
Students chat with their teacher about a calculation.

"I Can ..." Statements
Students read the explicit Math and CS goals.

2 Focus   45–50 min

Variables and Formulas
Students learn to make calculations in Scratch and think about a program's input and output.

Computers Compute Numbers project; *Math Masters* page TA20

Math Chat
Students explore how variables are used in a computer program.

Math Chat TIPP&SEE journal page; *Variables - Math Chat* project

"I Can ..." statements

- *I can find the area and perimeter of a rectangle.*
- *I can create a program to calculate the area and perimeter of a rectangle.*
- *I can use variables in a Scratch project.*
- *I can store inputs, such as numbers, to use later in a program.*
- *I can use the "set" block to assign values to variables.*
- *I can use variables to change the output of a program.*
- *I can find and fix a calculation error in a program.*

Anticipated Barriers

- Students may confuse the formulas for area and perimeter.
- Differentiating between inputs and outputs may not be clear for students.
- The notion of assignment of a value to a variable may not be clear for students.
- Understanding the components of the "set variable" blocks may be challenging without more direct instruction.
- The relationship between variables and nested blocks inside of variables may be tricky for some students.

Student Options

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

- Some students may need a calculator for the calculations.

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- I can create a program to calculate the area and perimeter of a rectangle.
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- I can use variables to change the output of a program.
- I can find and fix a calculation error in a program.

SS: *Computers Compute Numbers*

1 Warm Up — 5 min

▶ Chatting About Math

Ask a volunteer to come to the front of the room to have a "math chat" with you. Whisper in the volunteer's ear that he or she should ask you to find the area of a 5 x 7 rectangle. When the student asks, deliberately give an incorrect answer, such as 30 square units. Ask: *Did I calculate the correct area?* No. Ask students to provide the correct answer and explain how they know it is correct. 35 square units, because 5 times 7 is 35. Point out that you made a mistake in your calculation, but that is ok. Explain that one of the things that computers do very well is to perform calculations on which people might make little mistakes. In fact, that is why computers were first invented. The name computer comes from computing the answer to a math problem.

▶ I Can …

Display the "I Can …" statements and remind students 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 — 45–50 min

▶ Variables and Formulas

| WHOLE CLASS | SMALL GROUP | PARTNER | INDEPENDENT |

Remind students that they have used a formula to calculate area. Ask:

- *What is the formula to calculate the area of a rectangle?*
  Area = length * width
- *Think about the variables that were in your programs when you played Robot Boxes. Can we think about any of the parts of this formula as variables? Why or why not?* Yes. Length, width, and Area could be variables because they stand for values that can change for different rectangles.
- *Why is it useful to know a formula?* If we have a length and width and want to calculate the area, the formula tells us how to do it.

Tell students that variables and formulas are useful in computer programs, too. Have them imagine that they want a computer to calculate the area of a rectangle that is 5 inches wide and 7 inches long. Ask: *What does the computer need to do to calculate the area?* Multiply the length times the width or 5 * 7.

Open the *Computers Compute Numbers* teacher demonstration project and work with students to create Scratch code that multiplies the length and width. (Open https://scratch.mit.edu/projects/238759009/)
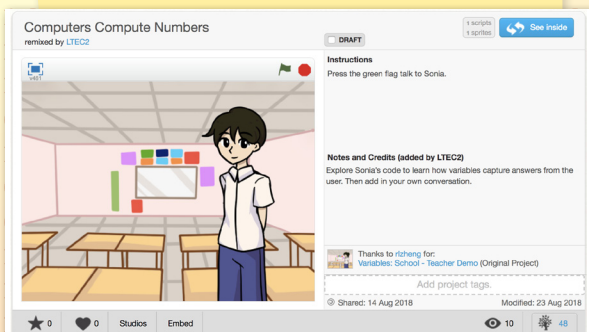
Ask: *We created a program that finds the area of a 5 x 7 rectangle. What do I need to do to ask the computer to compute the area of an 8 x 10 rectangle?* Change the program so 8 and 10 are in the multiplication block. *What if I want the computer to calculate the area of a 6 x 9 rectangle?* Change the program again. (*See margin for Starting and Solution Code.*)

Point out that a program that must be changed for every different rectangle is not very useful. It would be much more useful to create a program that could calculate the area of any rectangle. Tell students that today, they will create a program that can:

1. receive any width and length,

2. perform the area calculation, and

3. display the result.

Help students to connect this idea to their work with function machines and in/out tables from previous grades. Display a blank function machine and in/out table. (*See the Teaching Master in the margin for an example.*) They can think of the computer as a kind of function machine in this case. The user of the student's computer program will supply the length and width of the rectangle; those will be the *in* numbers. The computer will use those numbers to compute the area, using the area formula as its *rule*. Ask: *What will be the* out *number?* The area. That is what the computer will display. Explain that computer scientists use the word **input** to describe the *in* numbers for a program, and the word **output** to describe the *out* numbers. In the student program, sliders are used to change the inputs.

▶ Math Chat

WHOLE CLASS	SMALL GROUP	**PARTNER**	**INDEPENDENT**

Ask: *What does it mean to have a chat with someone?* You talk to them. You say something and the other person says something back. Tell students that they can think of using a program that uses input and output as chatting with a computer. Ask another volunteer to come up for another math chat to demonstrate how the program will work. Whisper to this volunteer to ask you to calculate the area of a rectangle. When the student asks, respond by asking for the dimensions of the rectangle. Wait for the student to provide dimensions, and then respond with the area. For example, this "math chat" might happen as follows:

• Student: Please calculate the area of a rectangle.
• Teacher: *What are the dimensions of the rectangle you want to know the area of?*
• Student: 8 by 6.
• Teacher: *The area is 48 square units!*

Ask: *What information was the input in our chat?* The dimensions—length and width, 8 by 6 *What was the output in the chat?* "The area is 48 square units!"

Explain that students will create a program like this math chat, but they will be chatting with the computer instead of you! As needed, have students have similar chats with a partner before moving on to the exploration.

Starting Code:

Solution Code
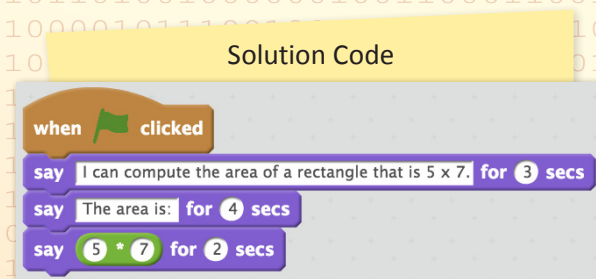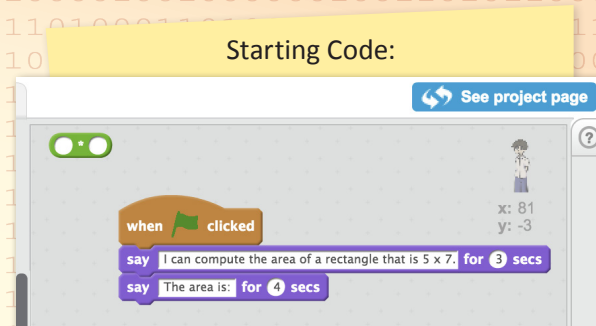
Math Masters, p. TA20

"What's My Rule?" Tables

TIPP&SEE Math Chat

NAME

Lesson 2-2B
SCRATCH ID   DATE   TIME

Objective: I can explore how to use variables to chat with the computer.
Scratch Link: Variables - Math Chat (https://scratch.mit.edu/projects/239362753/)

Start with **TIPP&SEE!**   Get a **TIPP** from the Project Page.
Read carefully: **Title**   **Instructions**   **Purpose**
Play the project and fill in your *input* to the computer and the computer's *output* to you.

① Fill in your input for length and width.

length   width

② Fill in the computer's output.

The area is:_____

③ Write a number sentence for the area: _____

④ Fill in the correct output.

The area is:_____

⑤ Was the computer's output correct?   YES   NO

SEE Inside.

Answer each question by looking at Sonia's `when this sprite clicked` script.

⑥ Circle the block that does a calculation:

`length + width`   `say join The area is: area for 4 secs`

⑦ Circle the block that places the calculated area into the **area** variable:

`set area to length + width`   `say join The area is: area for 4 secs`

⑧ Circle the block that displays the area in the output:

`set area to length + width`   `say join The area is: area for 4 secs`

• *I can find the area and perimeter of a rectangle.*

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• *I can use variables in a Scratch project.*

• *I can store inputs, such as numbers, to use later in a program.*

• *I can use the "set" block to assign values to variables.*

• *I can use variables to change the output of a program.*

• *I can find and fix a calculation error in a program.*

Distribute and display the *Math Chat* TIPP&SEE journal page and remind students of the TIPP&SEE strategy. Direct them to the *Variables - Math Chat* starter project. Have students complete the page to explore how the variables are used in computer programs. First, they fix the calculation — it starts out as an addition rather than multiplication. They then add blocks to calculate perimeter.
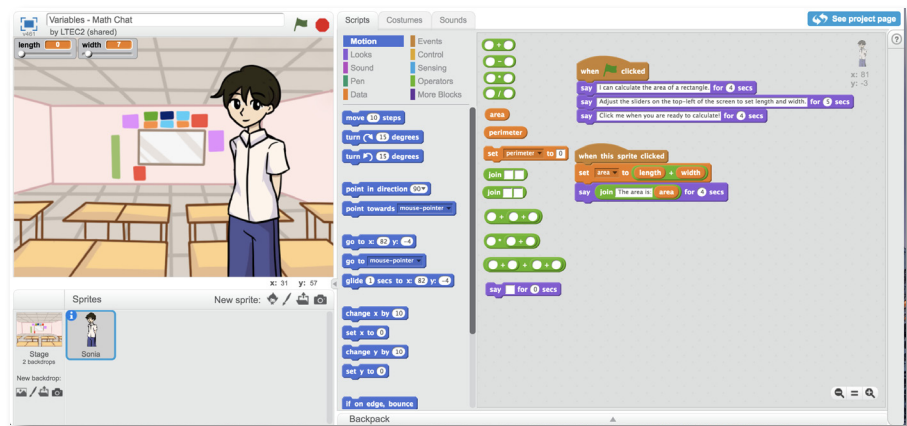
If students have trouble nesting blocks, demonstrate zooming in and waiting for the white box to light up before letting go. (*See margin.*)
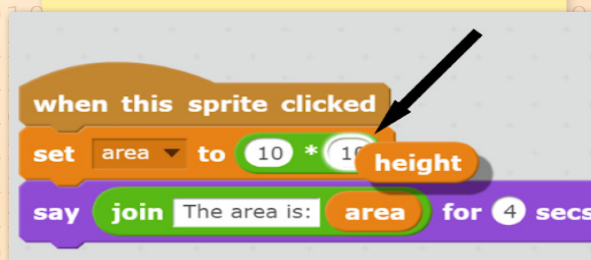
▶ Wrap Up

WHOLE CLASS	SMALL GROUP	PARTNER	INDEPENDENT

When students have had sufficient time to finish their programs, bring them together to discuss today's experience. Ask:

- *How did the computer use variables?* to store the numbers or values the users input so it could make a calculation and display the answer
- *What does the "set" block do?* place a value into a variable
- *How and when did we change the value in each variable?* The sliders control the values in length and width, so they change if we move the sliders and run the program again. We set the value of area to a calculation using the values in length and width, so that would also change when the "set" block runs.
- *What did you change to fix the calculation error in the project?* Sample answer: I swapped the green addition block for a multiplication block.
- *What did you notice about the new blocks you used in today's project?* Sample answers: Many blocks were oval. The variables were orange. The computation blocks were bright green.
- *What combination of blocks did you use for the perimeter calculation?* Answers vary.
- *How did using variables help with the perimeter calculation?* We used the variable blocks again to do another calculation instead of having to do another set of input.
- *How did these blocks combine or fit together?* Sample answer: The operator blocks could fit or nest inside of each other to make a compound expression.

Now "I Can ..."   Review today's "I Can ..." statements and ask children to use their thumbs to show their opinion of each statement.