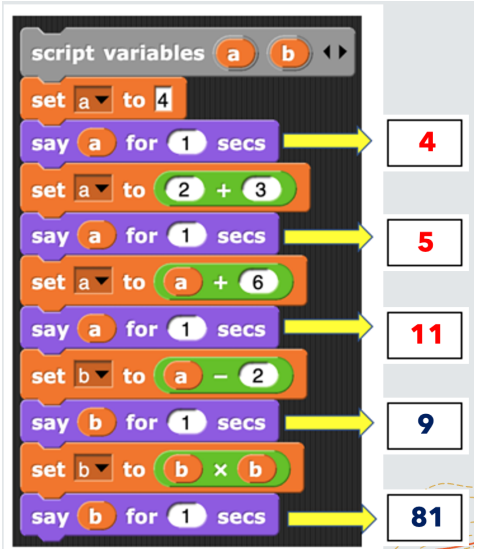
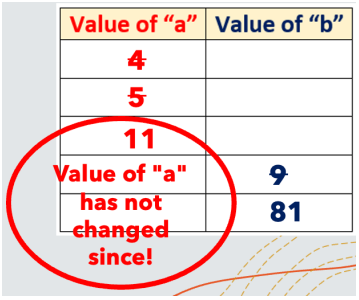
Student Audience: 10th grade, Intro to Computer Science

AIM:	How can we trace the values of variables as each line of code is executed?
LEARNING OBJECTIVES/SWBAT:	**CS LEARNING STANDARDS**
• Determine the result of code segments by tracing variable values during execution • Create art with loops and variables • Use test cases, hand tracing, and adding extra output statements to find and correct errors in code	• **9-12.CT.1** Create a simple digital model that makes predictions of outcomes. • **9-12.CT.9** Systematically test and refine programs using a range of test cases, based on anticipating common errors and user behavior. • **9-12.CT.10** Collaboratively design and develop a program or computational artifact for a specific audience and create documentation outlining implementation features to inform collaborators and users.
PREREQUISITE KNOWLEDGE	
• Algorithms run sequentially and lines of code run one at a time • Structure and control flow of conditionals and iterative structures • Expectations of driver-navigator pair programming model • Understanding of rubber duck debugging	

AGENDA	**QUESTIONS/CFUs/MISUNDERSTANDINGS**
INTRO (5 MINS) Students will trace the values of two variables and predict program output. 	**Doesn't the program just say what a and b are?** Yes, when the program is told to "say a for 1 second," the sprite says the value stored in the variable. Notice the sequencing of the blocks – a and b are reassigned values throughout the program's execution. **Why doesn't the program say 10 the third time the sprite says the value of a?** When variables are reassigned values, they "forget" what they used to be. They can only hold one value at a time. Although a is initialized (given an initial value of) as 4, it gets a new value: 2+3, or 5. The righthand side of the expression is evaluated first – a is 5, and 5+6 is 11. So a gets a value of 11 for the third say block. **What if we added a "say a" block at the end of the script?** It will say the value of a at the end of the program. Since a is not reassigned in value, the sprite will say 11.
MINI-LESSON (10 MINS) Introduce a trace table to students. It acts as a record keeper ("history of values") of different variables.	**What is a variable?** A variable is like a box that can only hold one value at a time – the value can be of any type (integer, String, etc.).

<table>
<tr>
<td> 

As a class, trace the value of variables through two more scripts – one in which one variable gets assigned the value of another, and one in a loop.</td>
<td>When you give a value a name, you can refer to it without knowing exactly what the value is.

In the example:
<pre>a ← 3
b ← a
a ← 4
DISPLAY(b)</pre>
, why is the value of b 3 and not 4?
When you assign a value to a variable, the variable holds the value and not where it came from. When b ← a, b is assigned the value of a at that moment in time, 3. When a is reassigned a value of 4, b does not change in value.</td>
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<td>LAB ACTIVITY (27 MINS)
Students will work on the lab using a pair programming model. In the lab, they will continue to trace code as values of variables are reassigned and enter loops.

Teacher will circulate and observe student progress as formative assessment.

When students are “stuck,” student groups may:
Utilize hints embedded in lab document
Trace the value of counter in a trace table (maybe only for the first few iterations…)
Rubber duck debugging 🐥
Consult a neighboring pair
Change the values of inputs. Predict how the program output will change, and verify your hypothesis in Snap!
Students will swap driver and navigator roles when directed in the lab.</td>
<td>Students will use an indicator (putting a cup above their station or putting a tally mark on the whiteboard) to demonstrate they have completed Q6. (Students can move on if they are up to that point.)

When most student groups have a solution to Q7, ask student groups for volunteers of their algorithm that uses a loop to display “2, 4, 6…14.” The teacher will do this as a class (either on projector or with student screens locked and showing teacher’s station) – student pairs will navigate, and teacher will drive as we build solutions together.

Provide opportunities for feedback on student solutions.</td>
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LOG OUT (3 MINS) Discuss with your partner what work is left to be done, and whether you want to collaborate on the rest of it. If not, split up the remaining work fairly.	Encourage students to write down their agreed upon assignments, or set reminders on their phones.
HOMEWORK: Complete any outstanding parts of the lab and checkpoint.	