Lesson 2.10

Prime and Composite Numbers

Overview

During this lesson, students will use their knowledge of prime numbers, between 2 and 10, to determine if a number more than 10 but less than 100 is a prime or non-prime (composite) number. Students will integrate and exhibit learning by building a SAM system which verifies if a number is prime or non-prime (composite).

Key Information

Level 2: (Ages 8-10) US Grades 3 or 4 Time: 45/90 minutes

Lesson consists of...	
Warm-Up	5 mins
Mini-lesson	14 mins
Worked Example	7 mins
Challenge 1	7 mins
Challenge 1 - Debug	5 mins
Challenge 2	7 mins
Tidy Up / Exit Ticket	4 mins

Learning Objectives

As a result of this lesson, students will be able to

- ➜ Identify whether a number is a prime or non-prime number
- ➜ Create a clear definition of prime number and non-prime number
- ➜ Design a system to identify if a number is a non-prime
- ➜ Debug systems when errors arise

Lesson Topics

Math

- ➜ Determine whether a given whole number in the range 1-100 is prime or non-prime

Computing

- ➜ Counters, outputs, debugging

Design and Technology

- ➜ Generate, develop, model and communicate ideas through talking, drawing and mock-ups

English Language Arts

- ➜ Engage effectively in a range of collaborative discussions.
- ➜ Report on a topic or text, tell a story, or recount an experience in an organized manner

Materials required

- ➜ SAM Labs Kit
- ➜ Student Workbook
- ➜ Counting blocks
- ➜ Calculators
- ➜ Number tiles (2 - 10) 1 set per table

Prime and Composite Numbers

Warm Up — 5 minutes

What are the prime and non-prime numbers between 0 and 10?

Objective: Identify what the prime numbers are, and, as a result, the non-prime numbers between 2 and 10.

Procedures: *"Today we are going to organize numbers into two categories and identify how we know."*

- Students will be asked to organize the numbers tiles from 2 to 10 into two categories.
- Students have freedom to choose how to categorize numbers, explaining why they chose the method they did.
- Record suggestions on a display so that everyone's thoughts can be seen.
- If all of the groups suggest even / odd, as a way to categorize, then suggest a organizing the numbers as multiples. For example, these numbers are multiples of 3, these others are not.
- If primes and non-primes are not suggested as a way of organizing, which is fairly likely, display the numbers organized in that way and ask students to discuss what system might have been used.

Link forward: Link to students sorting numbers that are greater than 10

Mini-lesson — 10 minutes

Use the primes you know to find the primes you don't

Objective: To use the multiples of prime numbers between 2 and 10 to discover if a number more than 10 is a prime or a non-prime (composite).

Procedures:

- At a table of 4, students opt to find factors between 11-100 of one of these numbers: 2, 3, 5 or 7.
- Students should:
    - Find all factors of the number they've selected
    - If the number has only two factors, 1 and itself, then it is prime.
    - If the number has more than two factors, then it is non-prime.
- Have counting blocks ready to support counting at this time, particularly for 7s.
- Once students have completed their task, make sure that all members of the group check their work, calculators could be used at this point.
- Ask one volunteer to start counting from 11. Students should indicate if the number read is prime or non-prime (composite), according to their selected number. Students could raise hand, say, "got it," knock on the desk, etc.
- If students miss one, teach into how they can find out whether a number is a prime or non-prime. (8 minutes)

At the end of the mini-lesson, students can match or define keywords in their workbooks. (2 minutes)

Keywords

- Prime
- non-prime
- Multiple
- Divisibility
- Rule

Let's Discuss: *Are there more prime or non-prime numbers overall? In your workbook or with a partner, record or discuss how you can use math to identify a prime and non-prime (composite) number.*

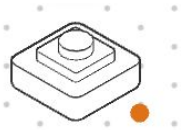
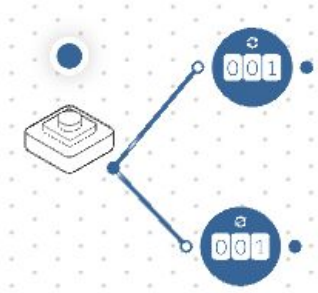
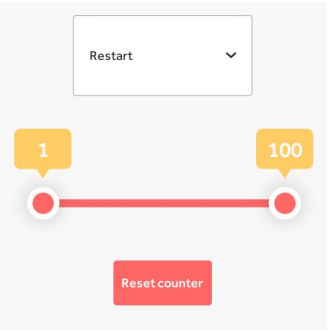
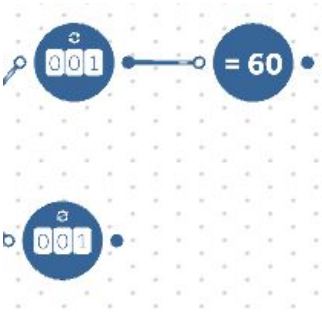
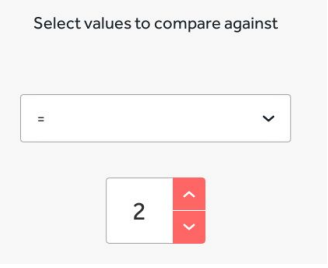
Link forward: What numbers would we need to use to check for prime numbers within 200?

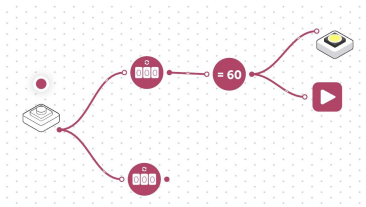
Prime and Composite Numbers

Worked Example

7 minutes

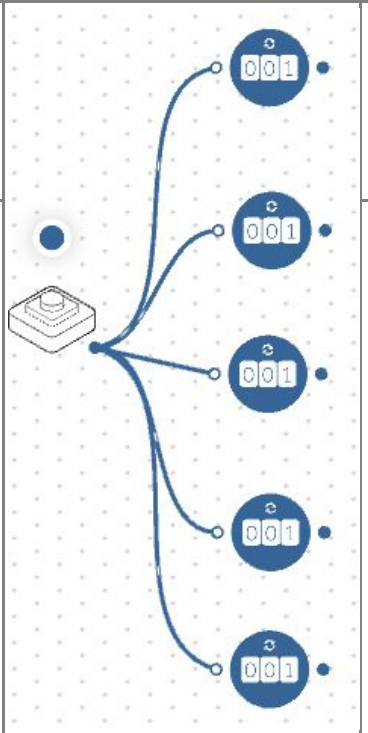
Design a SAM system to check for even numbers.

Instructions	Workspace	Notes for Teachers
Step 1. Turn on and pair: • A Button/Virtual Button block Add it to the workspace.		*The Button will be the control for the counter you will add.*
Step 2. Drag two Counters onto the workspace. Connect them to the Button.		*Now, as you click the Button, both the first and second Counter will increase.*
Step 3. Click the settings icon for the first Counter to go from '1 - 2'. Set the second counter from '1 - 100'.		*The first counter will be used to determine even numbers and the second will be used to keep track of how many times the Button is clicked in total.*
Step 4. Drag a Compare block onto the workspace and connect it to the first Counter.		*You will want to keep track of that top Counter and do something when it reaches a certain number.*
Step 5. Set the Compare block to be = to 2.		*In this example, 2 is the multiple being counted. Each time it is reached, something will happen.*

Step 6. Add a Sound Player block to the workspace and connect it to the first Counter.		*This will alert the student every time a multiple of 2 is reached.*
Step 7. Click the settings of the Sound Player block. Choose Note and 'Do'.		*This sound is quick, fairly quiet and will be built upon later in this lesson.*
Step 8. Turn on and pair: • RGB LED block Connect it to the Compare block. Choose a color through the settings.		*This also also alert the students. Some may be more receptive to seeing than hearing.*

Challenge 1 — 7 minutes

Include prime numbers less than 10.

Instructions	Workspace	Notes for Teachers
Step 1. Add 3 more Counter blocks. Connect them to the Button. Arrange it so that the Counter block set to 1 - 100 is at the bottom of the workspace.		*This will allow you to count with a number of prime numbers at the same time.*
Step 2. Enter a range of '1 - 3', '1 - 5' and '1 - 7' for each of the other Counters.		*It is vital that all of the counters start at 1. This could be something to debug. The reason each counter starts at 1 is because the system would consider 0 to 3, for example, a count of 4 and it needs to be a count of 3.*

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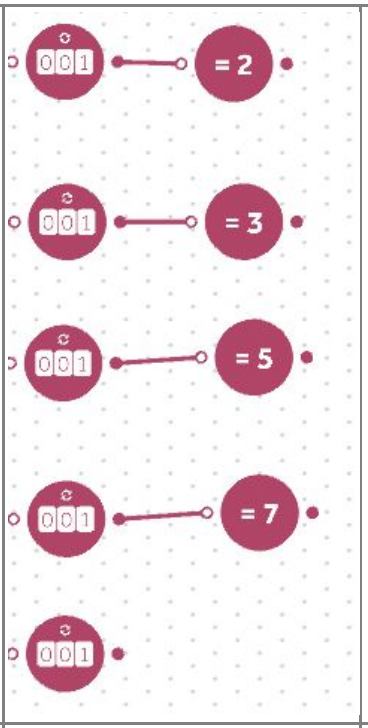
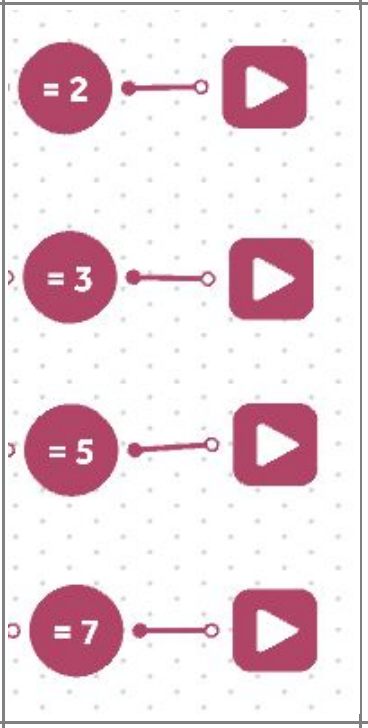
Step 3. Add three more Compare blocks. Connect them to each of the new Counter blocks. Set each of the Compare blocks to = ‘3, 5 and 7’, depending on the Counter to which they are connected.		*This will keep track of all of the multiples of 2, 3, 5 and 7 at the same time.*
Step 4. Add a Sound Player block to each Compare block.		*This will have a sound play each time a multiple of 2, 3, 5 or 7 is reached..*
Step 5. Set the Sound Player blocks to Note and ‘Mi’ for 3, ‘Sol’ for 5 and ‘La’ for 7.		*This will allow for one note sometimes, two notes at others and 3 notes a few times. 4 notes will not play at the same time because the first number to have the factors 2, 3, 5 and 7 is 210 and this system only goes to 100.*

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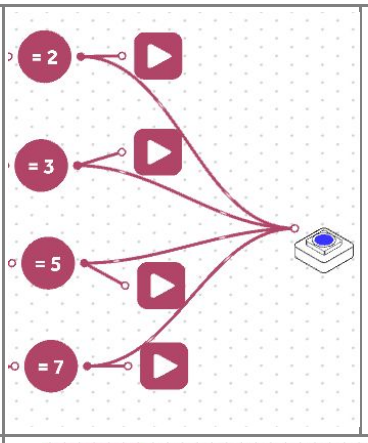
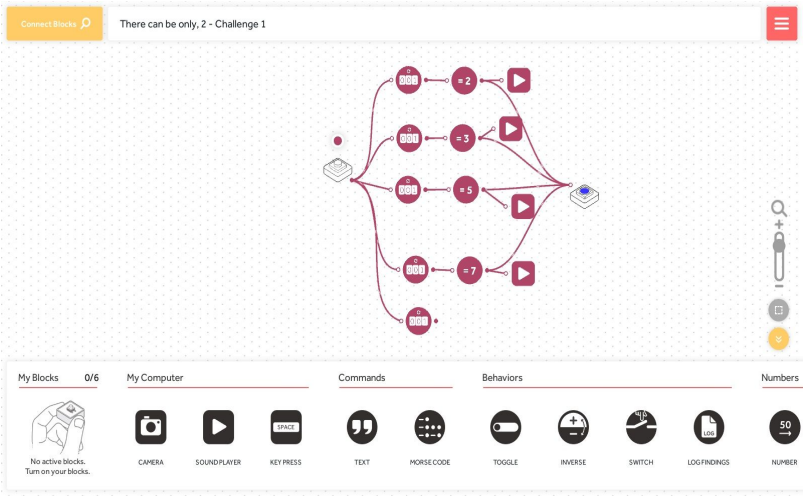
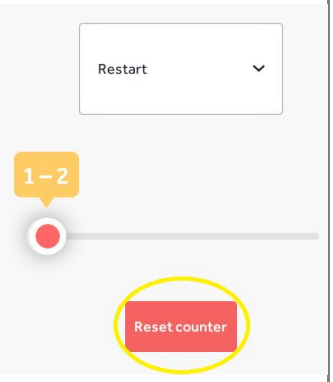
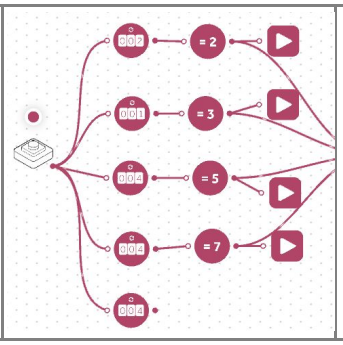
Step 6. Connect all of the Sound Player blocks to the RGB LED. Test it by checking if you hear the correct tone for 2, 3, 5 and 7.		*As with the worked example, some students may respond better to light than sound.*
Example of full system.		

Checks for understanding: *What is a prime number? What is a non-prime number?*

Challenge 1 - Debug it — 5 minutes

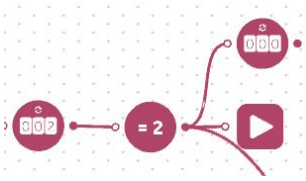
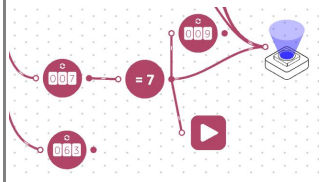
Why might some Counters not make sense with big Counter? Why might some sounds never play?

Instructions	Workspace	Notes for Teachers
Step 1. Be sure to reset your Counters after the worked example.		*If the Counter is not reset when the students move from the Worked Example to Challenge one, the count will not be correct for any of the numbers.*

Step 2. Check your connections.		*There are a lot of connections here. If one is missing, or connected to the wrong block, you will not get the intended result.*

Challenge 2 — 7 minutes

Return the factor pair when the bottom Counter displays a non-prime number.

Instructions	Workspace	Notes for Teachers
Step 1. • Drag 4 new Counter blocks onto the workspace used in challenge 1, there will now be 9 Counter blocks in total. • Connect each new Counter block to each of the Compare blocks. Set the counter for '0 - 100'.		*This new Counter needs to start at 0 as the first time this block is true it will become 1.*
Step 2. Test the workspace to see if the numbers, identified as prime in the student workbooks, are prime in the workspace. Examples might be 29, 37, 61, etc.		*In this instance, I am checking to see if 63 is prime. It isn't, it is a non-prime. A factor pair is 7 and 9.*

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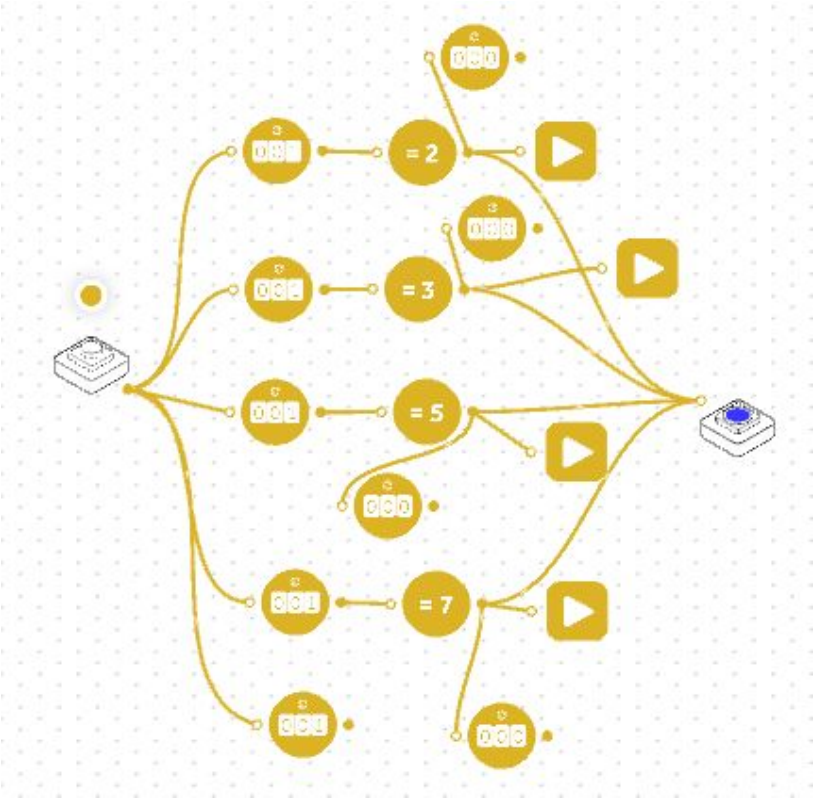
Example of the full system.	

Extension Ideas:

- **Computing**:
  - Can you think of a way to make the workspace less busy?
  - Could you think of another way to indicate if a number is prime or non-prime?
- **Math:**
  - What do you think it means when the number is great, like 64 or 81, but only 1 number lights up as a factor?

Checks for understanding: *What does it mean if the sound does not change? Why might two or three notes play at the same time?*

Tidy Up / Exit Ticket — 4 minutes

Reinforcing the learning objectives of the lesson, students can reflect on key takeaways by completing and submitting an exit ticket.