Lesson
8-7A
Action Fractions
Math+CT

Fraction Number-Line Mysteries

Math Connections: Children locate fractions on a number line, including equivalent fractions with different denominators.
CS Connections: Children plan and implement a Scratch project that sequences timed speech, sprite motion, and background changes.

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Computational Thinking
- **DECOMPOSITION:** Problem decomposition is a useful early step in problem solving.
- **DEBUGGING:** Iterative refinement can help fix errors.

1 Warm Up 5–10 min

	Materials	
Number-Line Squeeze Children review how clues can help them guess a mystery fraction.	*Student Reference Book*, p. 245 (optional)	3.NF.3d
"I Can ..." Statements Children read the explicit math and CS goals.		

2 Focus 35–40 min

A Fraction Mystery Children examine features of Fraction Number-Line mysteries.	*Fraction Number-Line Mystery - Teacher* project, *Fraction Number-Line Mysteries* journal page; *Brainstorming Sheet*	3.NF.2, 3.NF.2a, 3.NF.3, 3.NF.3a, 3.NF.3b, 3.NF.3d
Storyboarding a Fraction Mystery Children plan how they will animate their Fraction Number-Line Mysteries in Scratch.	*Fraction Number-Line Mystery - Teacher* project, example *Storyboard Organizer*, *Storyboard Organizer* pages	3.NF.2, 3.NF.2a, 3.NF.3, 3.NF.3a, 3.NF.3b, 3.NF.3d
Creating in Scratch Children program their Fraction Number-Line Mysteries in Scratch.	*Fraction Number-Line Mysteries - Student* project	

"I Can ..." statements

- *I can locate and name fractions on a number line, including equivalent fractions with different denominators.*
- *I can decompose or break a problem into smaller parts.*
- *I can use the hide/show, go to, and wait blocks in Scratch as part of my program.*
- *I can use a storyboard organizer to plan my project.*

Anticipated Barriers

- Some students may need support around identifying and locating equivalent fractions that do not match the number of equal parts on the number line, e.g. three-sixths on a segment partitioned into fourths.

Student Options

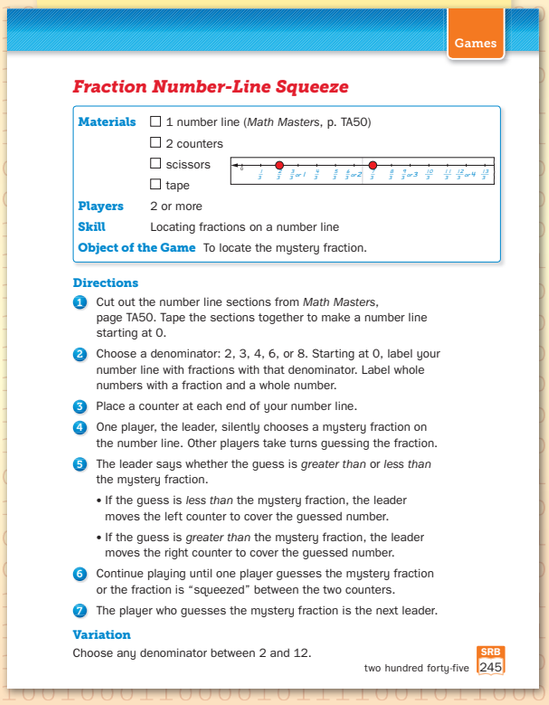
Consider these options for adapting the lesson to your students' preferences:

- Some students may wish to work on the journal page activities individually rather than in partnerships.

"I Can ..." statements

- *I can locate and name fractions on a number line, including equivalent fractions with different denominators.*
- *I can decompose or break a problem into smaller parts.*
- *I can use the hide/show, go to, and wait blocks in Scratch as part of my program.*
- *I can use a storyboard organizer to plan my project.*

Fraction Number-Line Squeeze, SRB p. 245



Games

Fraction Number-Line Squeeze

Materials ☐ 1 number line (*Math Masters*, p. TA50)
☐ 2 counters
☐ scissors
☐ tape

Players 2 or more

Skill Locating fractions on a number line

Object of the Game To locate the mystery fraction.

Directions

1. Cut out the number line sections from *Math Masters*, page TA50. Tape the sections together to make a number line starting at 0.
2. Choose a denominator: 2, 3, 4, 6, or 8. Starting at 0, label your number line with fractions with that denominator. Label whole numbers with a fraction and a whole number.
3. Place a counter at each end of your number line.
4. One player, the leader, silently chooses a mystery fraction on the number line. Other players take turns guessing the fraction.
5. The leader says whether the guess is *greater than* or *less than* the mystery fraction.
   - If the guess is *less than* the mystery fraction, the leader moves the left counter to cover the guessed number.
   - If the guess is *greater than* the mystery fraction, the leader moves the right counter to cover the guessed number.
6. Continue playing until one player guesses the mystery fraction or the fraction is "squeezed" between the two counters.
7. The player who guesses the mystery fraction is the next leader.

Variation

Choose any denominator between 2 and 12.

two hundred forty-five SRB 245

1 Warm Up 5–10 min

Number-Line Squeeze

Remind children of playing *Fraction Number-Line Squeeze*. (See margin for directions.) As needed, play a round or two with children. Ask:

- *How does each guess help you to figure out the mystery fraction?*
  Sample answer: Each guess tells me more about the fraction, because when the counters move closer together, there are fewer possible answers.
- *What kinds of other clues might help you guess the mystery fraction?*
  Sample answers: the denominator, the numerator

I Can ...

Display the "I Can ..." statements and remind children 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.

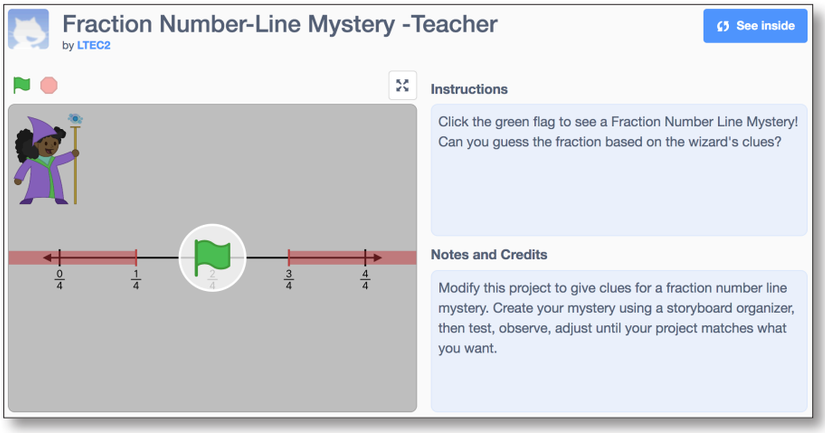
2 Focus 35–40 min

A Fraction Mystery

WHOLE CLASS | SMALL GROUP | PARTNER | INDEPENDENT

Tell children that today they will be using Scratch to create a Fraction Number-Line Mystery game for a friend. They will write clues to help their friend figure out a specific fraction, similar to *Fraction Number-Line Squeeze*. First they will look at an example Scratch project, then they will Remix and Modify a project for their own Fraction Number-Line Mystery.

Open today's example project: Fraction Number-Line Mystery - Teacher (https://scratch.mit.edu/projects/302071264/) and go over the project page with the class using TIPP.



After you Play the project, lead a short discussion about what children

notice. Point out that the project first gave some background information for the mystery, then gave the clues, then the answer. Note that the number line changed after each additional clue. On the board, write these three headings (Background Information, Clues, and Answer). Ask:

- *What background information was given?* Sample answer: The fraction is a number between 0 and 1 on a number line with 4 equal parts.
- *How many other clues did you notice? What were they?* Sample answer: two: I am greater than $\frac{1}{4}$. I am less than $\frac{3}{4}$.
- *What was the mystery fraction?* The fraction is $\frac{2}{4}$

Write children's responses under the headings on the board. This is the format the children will follow on their Brainstorming sheets. Ask: Did you notice a pattern in the order the clues were presented? Sample answer: The clues started out general and became more specific. There were many possible answers after the beginning clues, but only one answer after the last clue.

In partnerships, have children complete the first Fraction Number-Line Mysteries journal page by drawing on the number line to match the given clues for the three examples. As needed, briefly ask children to share their answers to the discussion questions.

Next have each partnership use the Brainstorming Sheet to start planning their own mystery, modeled after the examples. They must choose a fraction between 0 and 1 and use thirds, fourths, sixths, and eighths. They will think of background information and two or three clues. As children work, circulate and help them think of clues as needed. Encourage children to use at least one equivalent fraction in their clues.

After most partners have finished brainstorming, choose a few pairs to read their mysteries to the class. Allow the class to guess the answer. It may help to have teams draw their mystery on the board as they read it.

Storyboarding a Fraction Mystery

WHOLE CLASS | SMALL GROUP | PARTNER | INDEPENDENT

Remind children that sometimes it is helpful to plan a project using a Storyboard Organizer before creating the project in Scratch. Explain that storyboard organizers can be helpful for breaking down a larger project or problem into smaller parts. Display the Example Storyboard Organizer and run the Fraction Number-Line Mystery -Teacher project again. (https://scratch.mit.edu/projects/302071264/)

Fraction Number-Line Mysteries

NAME

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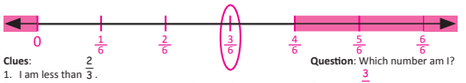
SCRATCH ID DATE TIME

Fraction Number-Line Mysteries

For each mystery, complete the number-line drawing and fill in the blank based on the clues.

Mystery 1

Background: I am a number between 0 and 1 on a number line with 6 equal parts.



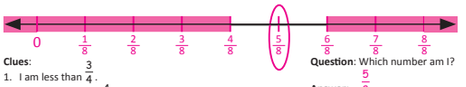
Clues:
1. I am less than $\frac{2}{3}$.
2. My numerator is an odd number greater than 1.

Question: Which number am I?

Answer: $\frac{3}{6}$

Mystery 2

Background: I am a number between 0 and 1 on a number line with 8 equal parts.



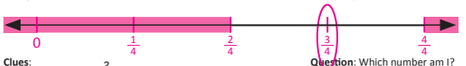
Clues:
1. I am less than $\frac{3}{4}$.
2. I am greater than $\frac{4}{8}$.

Question: Which number am I?

Answer: $\frac{5}{8}$

Mystery 3

Background: I am a number between 0 and 1 on a number line with 4 equal parts.



Clues:
1. I am greater than $\frac{2}{4}$.
2. I am less than $\frac{4}{4}$.

Question: Which number am I?

Answer: $\frac{3}{4}$

Talk with your partner about the patterns in all three Mysteries:
1. What information helps you draw tick marks to partition the number line?
2. What information tells you which numbers cannot be the mystery number?

Brainstorming Sheet

NAME

Lesson 8-7A

SCRATCH ID DATE TIME

Brainstorming a Number-Line Mystery

Write your own Fraction Number-Line Mystery.

① First pick a mystery fraction between 0 and 1. Use thirds, fourths, sixths, or eighths. ____

② Write your clues. Fill in the blanks and complete the number-line drawing.

My Mystery Answers vary.

Background: I am a number between 0 and 1 on a number line with ____ equal parts.

Clues:

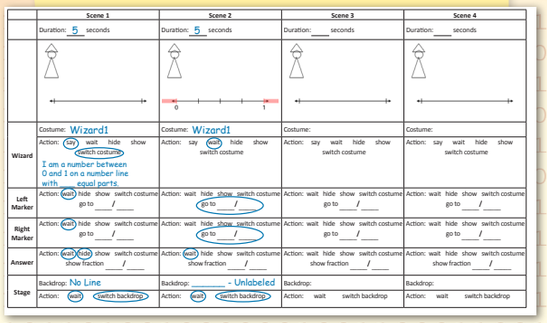
1. _____.

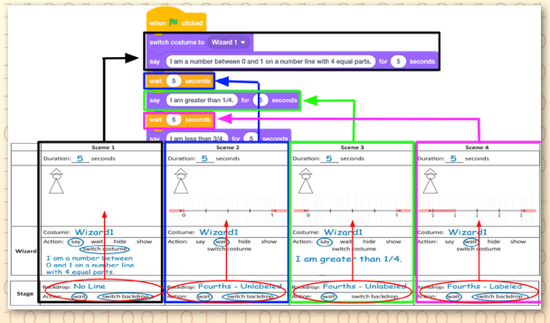
2. _____.

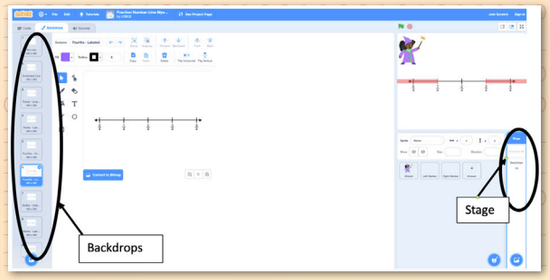
Question: Which number am I?

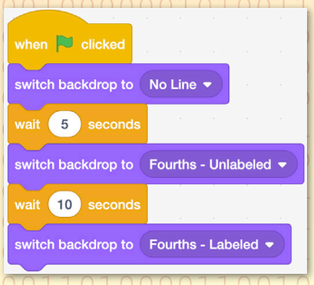
Answer: ____

Storyboard Organizer, p. 1

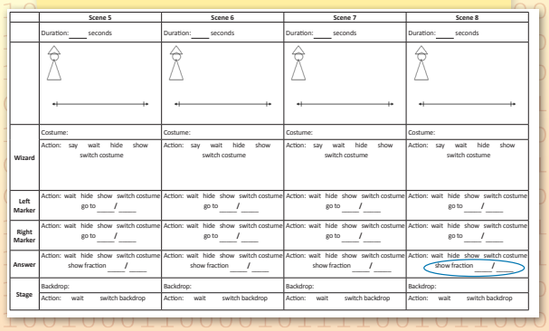








Storyboard Organizer, p. 2



Example Storyboard Organizer:

	Scene 1	Scene 2	Scene 3	Scene 4
	Duration: 5 seconds	Duration: 5 seconds	Duration: 5 seconds	Duration: 5 seconds
		0 1	0 1	$\frac{0}{4}$ $\frac{1}{4}$ $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$
Wizard	Costume: Wizard1 Action: (say) wait hide show switch costume I am a number between 0 and 1 on a number line with 4 equal parts.	Costume: Wizard1 Action: say (wait) hide show switch costume	Costume: Wizard1 Action: (say) wait hide show switch costume I am greater than 1/4.	Costume: Wizard1 Action: say (wait) hide show switch costume
Left Marker	Action: (wait) hide show switch costume go to ___/___	Action: wait hide show switch costume go to (0) / (4)	Action: (wait) hide show switch costume go to ___/___	Action: wait hide show switch costume go to (1) / (4)
Right Marker	Action: (wait) hide show switch costume go to ___/___	Action: wait hide show switch costume go to (4) / (4)	Action: (wait) hide show switch costume go to ___/___	Action: (wait) hide show switch costume go to ___/___
Answer	Action: (wait) (hide) show switch costume show fraction ___/___	Action: (wait) hide show switch costume show fraction ___/___	Action: (wait) hide show switch costume show fraction ___/___	Action: (wait) hide show switch costume show fraction ___/___
Stage	Backdrop: No Line Action: (wait) (switch backdrop)	Backdrop: Fourths - Unlabeled Action: (wait) (switch backdrop)	Backdrop: Fourths - Unlabeled Action: (wait) switch backdrop	Backdrop: Fourths - Labeled Action: (wait) (switch backdrop)

As you SEE the project, point out how the drawings and text in the first three frames of the Example Storyboard Organizer match up to the sprites and scripts in the Scratch project (see margin).

Ask: *Does anyone remember how to change a Sprite's costume like we did in the Fraction Comic Animation project?* Add a "switch costume to [_]" block to the Sprite's script. Explain that changing the Stage/backdrop is similar to this. Point out the Stage row on the Example Storyboard (see margin). In Scratch, click on the Stage and then click on a few of the different backdrops. Look at the Stage's script for When Green Flag clicked and point out the "switch background" blocks (see margin). Tell children that this storyboard would have been done during the planning of the Scratch project, so it will be helpful to use the details of the project to figure out the missing details from the storyboard. As needed, use the incomplete student Storyboard Organizer to have children help you complete the last 4 scenes of the Example Storyboard Organizer by clicking on each sprite and asking children how they can use the visible scripts to fill in the missing details.

Point out that children will now do things in the reverse order—like in the Fraction Comic lessons, they will plan and storyboard first and then Remix and Modify a starter Scratch project with preloaded sprites and backgrounds to make their own Number-Line Mystery. Distribute the Storyboard Organizer pages and have children work in partnerships to plan their projects based on their completed Brainstorming sheets. Once children have finished planning, you may wish to have them show their storyboards to you for review and approval.

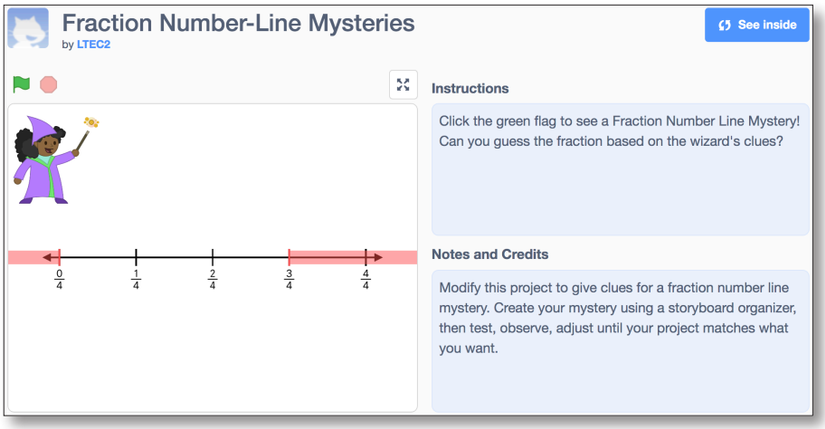
Creating in Scratch

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

Now have children log into their Scratch accounts and open Fraction Number-Line Mysteries project (https://scratch.mit.edu/projects/309655313/). Tell them to click See inside, Remix, Rename, and Share the project to include their name(s). Children should work

individually to complete their projects, but they can talk to their partners as they work.

Student Starter Project:



Using their completed Storyboard Organizers to guide them, have children add the text for their clues using "say __ for __ secs" blocks to the Wizard sprite. They should adjust the number of seconds to allow time for each line of text to be displayed and read. Once the clues are in, children should build scripts on the other sprites so that they hide or show at the correct time. Children should use wait blocks and adjust the seconds as needed to make the program do what they want it to do. It may be helpful to remind them of their experiences debugging The Frog and The Fly project – ***Test*** (run the program), ***Observe***, ***Adjust*** (the timing or blocks in the scripts of each Sprite), ***Repeat*** until the program runs as expected.

Wrap Up

WHOLE CLASS | SMALL GROUP | PARTNER | INDEPENDENT

When children have had sufficient time to create their Mysteries, bring them together for a discussion. Ask:

- *How did you use decomposition in this project?* Sample answer: I used the organizer to plan each of the frames/drawings/text.
- *How did using the storyboard help you create your project in Scratch?* Sample answers: It helped us break down the story into smaller parts, so we could make each piece in Scratch. It helped us plan our steps ahead of time so our story stayed organized.
- *Did you need to rework any parts of your mysteries more than others? Which parts needed the most tries before you got them just right?* Sample answer: Changing the number of seconds to make each sprite wait, so that they entered at the right time with the text.

If time allows, you may wish to have a gallery walk where children can view each other's projects or choose a few projects to display and share with the entire class.

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

"I Can ..." statements

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- *I can decompose or break a problem into smaller parts.*
- *I can use the hide/show, go to, and wait blocks in Scratch as part of my program.*
- *I can use a storyboard organizer to plan my project.*