Intentionality in Elementary Programming: From Debugging to Planning

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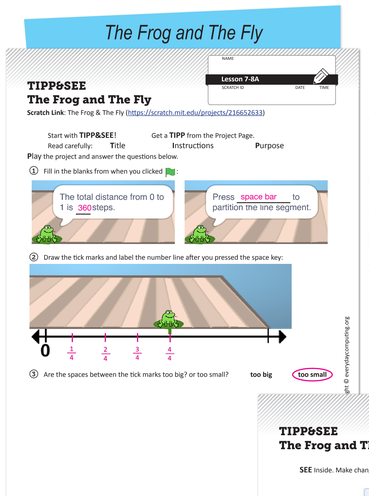
Purpose: To describe and explore the role of intentionality in programming, and articulate a way in which learning activities might be sequenced to support the development of this intentionality in the *Action Fractions* curriculum—designed to introduce 3rd and 4th grade students to computational thinking, integrated with their existing mathematics instruction.

Exploring and Debugging

When students first Use a program, they may proceed to explore the program without a particular goal in mind and need not think about intentions. When students debug, they decide whether there is an error and find and fix it. To discern whether or not a bug exists, students must consider the intention of the programmer who created the program–what was the programmer trying to do?

The Frog and The Fly


TIPP&SEE
The Frog and The Fly
Lesson 7-8A
Scratch Link: The Frog & The Fly (https://scratch.mit.edu/projects/216652633)
Start with TIPP&SEE! Get a TIPP from the Project Page.
Read carefully: Title Instructions Purpose
Play the project and answer the questions below.
① Fill in the blanks from when you clicked :
The total distance from 0 to 1 is 360 steps.
Press space bar to partition the line segment.
② Draw the tick marks and label the number line after you pressed the space key:
③ Are the spaces between the tick marks too big? or too small? too big too small
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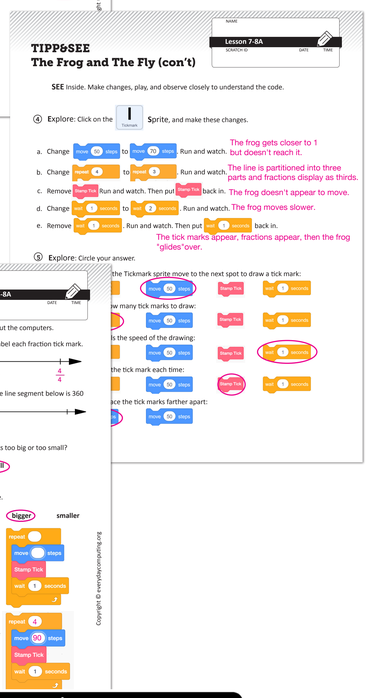
Math Connections:
Students partition a line segment into equal parts.

CS Connections:
Students explore using the repeat block and practice debugging code using a test, observe, adjust cycle to arrive at an expected output.


TIPP&SEE
The Frog and The Fly (con't)
Lesson 7-8A
SEE Inside. Make changes, play, and observe closely to understand the code.
④ Explore: Click on the Sprite, and make these changes.
a. Change move 60 steps to move 30 steps. Run and watch. The frog gets closer to 1 but doesn't reach it.
b. Change repeat 4 to repeat 3. Run and watch. The line is partitioned into three parts and fractions display as thirds.
c. Remove Stamp Tick. Run and watch. Then put Stamp Tick back in. The frog doesn't appear to move.
d. Change wait 1 seconds to wait 2 seconds. Run and watch. The frog moves slower.
e. Remove wait 1 seconds. Run and watch. Then put wait 1 seconds back in. The tick marks appear, fractions appear, then the frog "glides"over.
⑤ Explore: Circle your answer.
Tickmark sprite move to the next spot to draw a tick mark:
how many tick marks to draw:
is the speed of the drawing:
the tick mark each time:
ace the tick marks farther apart:
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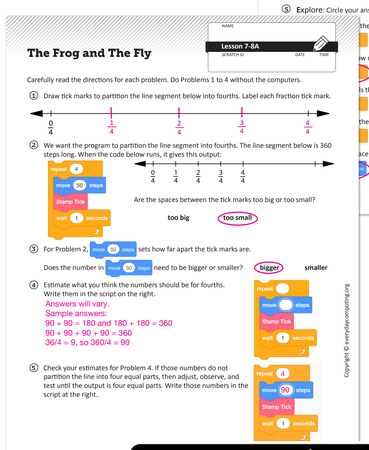
The Frog and The Fly
Lesson 7-8A
Carefully read the directions for each problem. Do Problems 1 to 4 without the computers.
① Draw tick marks to partition the line segment below into fourths. Label each fraction tick mark.
② We want the program to partition the line segment into fourths. The line segment below is 360 steps long. When the code below runs, it gives this output:
Are the spaces between the tick marks too big or too small?
too big too small
③ For Problem 2, move 90 steps sets how far apart the tick marks are.
Does the number in move 90 steps need to be bigger or smaller? bigger smaller
④ Estimate what you think the numbers should be for fourths. Write them in the script on the right.
Answers will vary.
Sample answers:
90 + 90 + 180 and 180 + 180 = 360
90 + 90 + 90 + 90 = 360
36/4 = 9, so 360/4 = 90
⑤ Check your estimates for Problem 4. If those numbers do not partition the line into four equal parts, then adjust, observe, and test until the output is four equal parts. Write those numbers in the script at the right.
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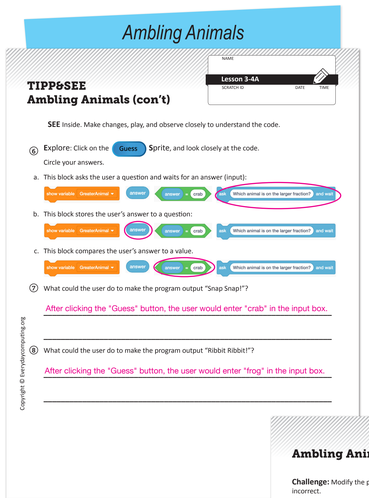
Planning Changes

When students are asked to Modify a program to achieve a specific goal, they must hold an expectation for the result of their changes. As they plan a change and attempt to implement it, they test, observe, and adjust, using debugging skills to clarify their intention and result. By reconciling expected and actual outcomes, they begin to develop intention–what they want to happen.

Ambling Animals


TIPP&SEE
Ambling Animals (con't)
Lesson 3-4A
SEE Inside. Make changes, play, and observe closely to understand the code.
⑥ Explore: Click on the Guess Sprite, and look closely at the code.
Circle your answers.
a. This block asks the user a question and waits for an answer (input):
b. This block stores the user's answer to a question:
c. This block compares the user's answer to a value.
⑦ What could the user do to make the program output "Snap Snap!"?
After clicking the "Guess" button, the user would enter "crab" in the input box.
⑧ What could the user do to make the program output "Ribbit Ribbit!"?
After clicking the "Guess" button, the user would enter "frog" in the input box.
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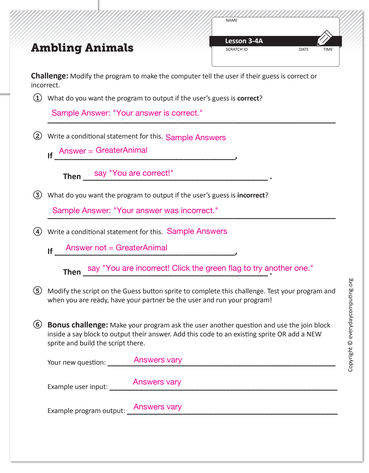
Math Connections:
Students compare fractions represented on number lines.

CS Connections:
Students work with variables and conditionals to create programs that store and react to user input in a program.


Ambling Animals
Lesson 3-4A
Challenge: Modify the program to make the computer tell the user if their guess is correct or incorrect.
① What do you want the program to output if the user's guess is **correct**?
Sample Answer: "Your answer is correct."
② Write a conditional statement for this. Sample Answers
If Answer = GreaterAnimal,
Then say "You are correct!".
③ What do you want the program to output if the user's guess is **incorrect**?
Sample Answer: "Your answer was incorrect."
④ Write a conditional statement for this. Sample Answers
If Answer not = GreaterAnimal,
Then say "You are incorrect! Click the green flag to try another one.".
⑤ Modify the script on the Guess button sprite to complete this challenge. Test your program and when you are ready, have your partner be the user and run your program!
⑥ **Bonus challenge:** Make your program ask the user another question and use the join block inside a say block to output their answer. Add this code to an existing sprite OR add a NEW sprite and build the script there.
Your new question: Answers vary
Example user input: Answers vary
Example program output: Answers vary
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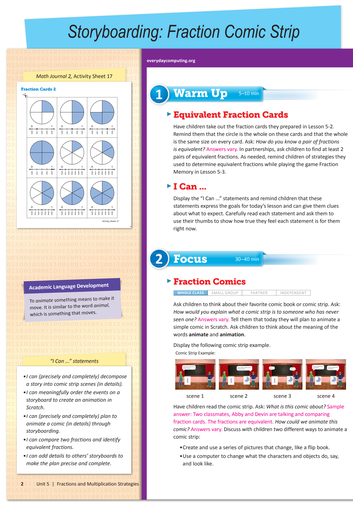
Planning Programs

When students decide to Modify code, they begin to form their own intentions about what else they want a program to do, and compare the outcome of their efforts to their intentions to gauge their level of success.

Storyboarding: Fraction Comic Strip


Math Journal 2, Activity Sheet 17
Fraction Cards 2
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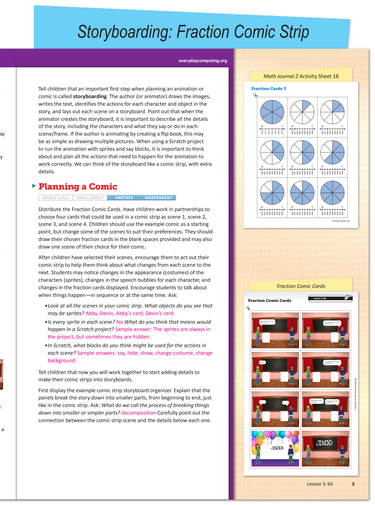
1 Warm Up 5–10 min
Equivalent Fraction Cards
Have children take out the fraction cards they prepared in Lesson 5-2. Remind them that the circle is the whole on these cards and that the whole is the same size on every card. Ask: *How do you know a pair of fractions is equivalent?* Answers vary. In partnerships, ask children to find at least 2 pairs of equivalent fractions. As needed, remind children of strategies they used to determine equivalent fractions while playing the game Fraction Memory in Lesson 5-3.
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 30–40 min
Fraction Comics
WHOLE CLASS SMALL GROUP PARTNER INDEPENDENT
Ask children to think about their favorite comic book or comic strip. Ask: *How would you explain what a comic strip is to someone who has never seen one?* Answers vary. Tell them that today they will plan to animate a simple comic in Scratch. Ask children to think about the meaning of the words **animate** and **animation**.
Display the following comic strip example.
Comic Strip Example
scene 1 scene 2 scene 3 scene 4
Have children read the comic strip. Ask: *What is this comic about?* Sample answer: Two classmates, Abby and Devin are talking and comparing Fraction cards. The fractions are equivalent. *How could we animate this comic?* Answers vary. Discuss with children two different ways to animate a comic strip:
• Create and use a series of pictures that change, like a flip book.
• Use a computer to change what the characters and objects do, say, and look like.
Academic Language Development
To animate something means to make it move. It is similar to the word *animal*, which is something that moves.
"I Can ..." statements
• *I can (precisely and completely) decompose a story into comic strip scenes (in details).*
• *I can meaningfully order the events on a storyboard to create an animation in Scratch.*
• *I can (precisely and completely) plan to animate a comic (in details) through storyboarding.*
• *I can compare two fractions and identify equivalent fractions.*
• *I can add details to others' storyboards to make the plan precise and complete.*
2 Unit 5 | Fractions and Multiplication Strategies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Tell children that an important first step when planning an animation or comic is called **storyboarding**. The author (or animator) draws the images, writes the text, identifies the actions for each character and object in the story, and lays out each scene on a storyboard. Point out that when the animator creates the storyboard, it is important to describe all the details of the story, including the characters and what they say or do in each scene/frame. If the author is animating by creating a flip book, this may be as simple as drawing multiple pictures. When using a Scratch project to run the animation with sprites and say blocks, it is important to think about and plan all the actions that need to happen for the animation to work correctly. We can think of the storyboard like a comic strip, with extra details.
Planning a Comic
WHOLE CLASS SMALL GROUP PARTNER INDEPENDENT
Distribute the Fraction Comic Cards. Have children work in partnerships to choose four cards that could be used in a comic strip as scene 1, scene 2, scene 3, and scene 4. Children should use the example comic as a starting point, but change some of the scenes to suit their preferences. They should draw their chosen fraction cards in the blank spaces provided and may also draw one scene of their choice for their comic.
After children have selected their scenes, encourage them to act out their comic strip to help them think about what changes from each scene to the next. Students may notice changes in the appearance (costumes) of the characters (sprites), changes in the speech bubbles for each character, and changes in the fraction cards displayed. Encourage students to talk about when things happen—in sequence or at the same time. Ask:
• *Look at all the scenes in your comic strip. What objects do you see that may be sprites?* Abby, Devin, Abby's card, Devin's card
• *Is every sprite in each scene?* No *What do you think that means would happen in a Scratch project?* Sample answer: The sprites are always in the project, but sometimes they are hidden.
• *In Scratch, what blocks do you think might be used for the actions in each scene?* Sample answers: say, hide, show, change costume, change background
Tell children that now you will work together to start adding details to make their comic strips into storyboards.
First display the example comic strip storyboard organizer. Explain that the panels break the story down into smaller parts, from beginning to end, just like in the comic strip. Ask: *What do we call the process of breaking things down into smaller or simpler parts?* decomposition Carefully point out the connection between the comic strip scene and the details below each one.

Math Journal 2, Activity Sheet 18
Fraction Cards 3
Fraction Comic Cards
Fraction Comic Cards
JINX!
JINX!
Lesson 5-3A 3

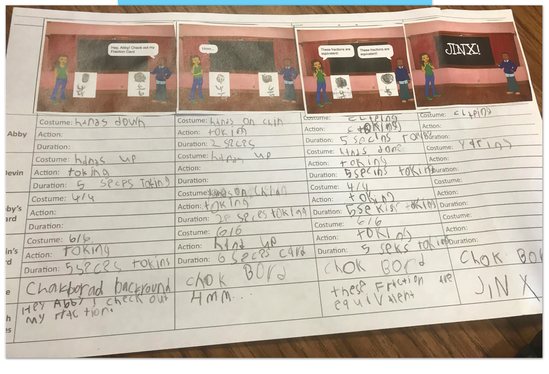
Math Connections:
Day 1 - Students identify equivalent fraction cards.
Day 2 - Students create a number story comparing equivalent fractions.

CS Connections:
Day 1 - Students prepare to create animations in Scratch, by decomposing a simple story into a comic strip Storyboard with four scenes.
Day 2 - Students create animations in Scratch, using a detailed plan in the form of a storyboard. They learn to use wait blocks to synchronize the actions on the stage given a limited set of instructions (commands).

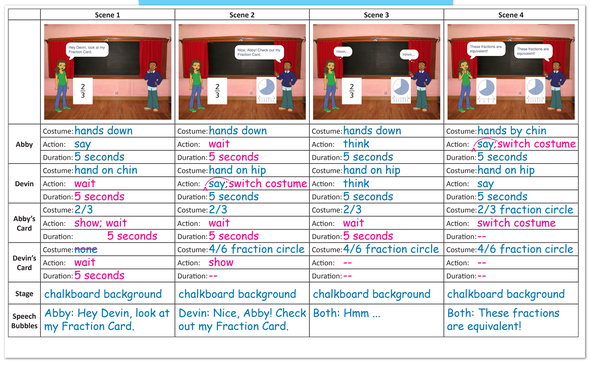
Creating Programs

After debugging and planning changes to programs, students may be better equipped to express more complex intentions. Carrying out complex intentions may require Creating their own programs. Planning tools can help students map out programs that align with their intentions.

Fraction Comic Animation: Day 1 Storyboard

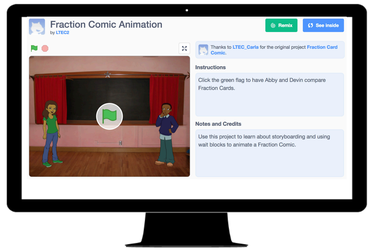


Fraction Comic Animation: Example Storyboard



	Scene 1	Scene 2	Scene 3	Scene 4
Abby	Costume: hands down Action: say Duration: 5 seconds	Costume: hands down Action: wait Duration: 5 seconds	Costume: hands down Action: think Duration: 5 seconds	Costume: hands by chin Action: ~~say~~ switch costume Duration: 5 seconds
Devin	Costume: hand on chin Action: wait Duration: 5 seconds	Costume: hand on hip Action: ~~say~~ switch costume Duration: 5 seconds	Costume: hand on hip Action: think Duration: 5 seconds	Costume: hand on hip Action: say Duration: 5 seconds
Abby's Card	Costume: 2/3 Action: show; wait Duration: 5 seconds	Costume: 2/3 Action: wait Duration: 5 seconds	Costume: 2/3 Action: wait Duration: 5 seconds	Costume: 2/3 fraction circle Action: switch costume Duration: --
Devin's Card	Costume: ~~none~~ Action: wait Duration: 5 seconds	Costume: 4/6 fraction circle Action: show Duration: --	Costume: 4/6 fraction circle Action: -- Duration: --	Costume: 4/6 fraction circle Action: -- Duration: --
Stage	chalkboard background	chalkboard background	chalkboard background	chalkboard background
Speech Bubbles	Abby: Hey Devin, look at my Fraction Card.	Devin: Nice, Abby! Check out my Fraction Card.	Both: Hmm ...	Both: These fractions are equivalent!

Fraction Comic Animation



Interactive Demo:

bit.ly/ActionFractions

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