ST Math
Summer Immersion

Grade 3 | Module 4

Topic: Comparing fractions on a number line

Module 4 Resources

Students work with puzzles involving representing fractions as a bar model, moving the bar model to a number line and understanding a fraction as a number on a number line. They represent a fraction 1/b on a number line by defining the interval from 0 to 1 and partitioning it into b equal parts. They recognize each of these parts as 1/b. They represent fractions a/b (b>0) by a length of 1/b from zero. Students use benchmark fractions and unit fractions to place fractions on a number line diagram. They understand that two fractions are equivalent when they occupy the same point on a number line. They express whole numbers as fractions and recognize fractions that are equivalent to whole numbers. Students use the number line diagram to compare fractions.

Module 4 at a Glance

Printed Resources

- **Bookmarks**
  - Problem Solving Process Bookmark
  - Problem Solving Facilitation Bookmark
- **Grades 3-5 Table Game Directions**
  - Race to 2
  - Five for Twenty-Five
  - *Traffic Lights Tic-Tac-Toe (optional)*
  - *Dara (optional)*
  - *Equivalent Fraction Concentration (optional)*
  - *Multiplication Connect Four(optional)*
  - *Number Line Fraction Bingo (optional)*
  - *Final Countdown (optional)*
  - Sudoku Puzzles (Day 5)
- **Mats**
  - Estimate Fractions Game Mat
  - Number Lines Math Mat
- **Problem Solving Journal** (pages 20–25)
  - My Thinking Path
  - Problem of the Day
  - Exit Tickets
  - ST Math Reflection
- **Design Challenge Station Booklet**
  - Page 16

Teacher Resources

- Teacher Planner

Optional Printed Resources

- Accomplishments Log
- ST Math Activity Pages
- Pre/Post Quizzes

Immersion Slide Deck (slides 41–53)

- The Immersion Slide Deck is intended to be projected to the class in a whole group setting.

Supplies for Table Games (per group)

- **Race to 2** -1 set of fraction cards, number line 0 to 2 for each player, 1 small game piece for each player
- **Five for Twenty-Five** - 1 deck of cards

My Thinking Path

- Daily reflection time for students on comparing fractions on the number line.

ST Math Puzzle Talks

- Estimate Fractions on a Number Line
- Fraction Trap

Problem Solving

Day 1:

- **Problem of the Day** - Create a number line including the numbers 0 to 2 and all halves and fourths. Name every half and fourth. Circle all of the names for the location of 1 and 2. Explain why these are equivalent.

Day 2:

- **Problem of the Day** - Use your number line from yesterday or create a new one. Write three comparison statements and prove them on the number line. Example: 1 = 4/4 and 3/4 > 1/2.

Day 3:

- **Problem of the Day** - 5/6, 3/4, 2/3, 10/9 Select the number closest to 1. Draw a number line, and place it on your number line. Explain how you knew this number was closest to 1. Explain how you knew where to place the number on the number line.

Day 4:

- **Problem of the Day** - 7/6, 1/4, 3/8, 8/9 Select the number closest to 1/2. Draw a number line, and place it on your number line. Explain how you knew this number was closest to 1/2. Explain how you knew where to place the number on the number line.

Instructional Stations

On Days 1–4, each student will visit two stations a day for 20 minutes each. On Day 5, students do not rotate. They can either be assigned to a station or allowed to choose which one to go to. Consider assigning students who need additional support to Station 1 to work with the teacher on concepts they are struggling with.

Station 1: Small Group Instruction

- Days 1 & 2: Explore number lines using the Number Lines Math Mat.
- Days 3 & 4: Discuss puzzles from the ST Math Game, *Number Line Trap*.

Station 2: ST Math Puzzles

- Have students sign in and play ST Math puzzles.
- Remind students to use manipulatives and/or paper and pencil to help them solve problems.
- With 5 minutes left, have students stop playing and complete their Puzzle Reflection and Accomplishments Log.

Station 3: Table Games

- Select Race to 2 or Five for Twenty-Five
- Have students play that game.
- Ask students to complete an Exit Ticket during the final 5 minutes.

Station 4: Design Challenge

- Days 1–4: Students will continue to make changes to their games, finalize their rules, and directions.
- Have students analyze their games and complete page 15 in their Design Challenge Station Booklet to reflect on their design.

Day 5: Design Challenge Station (Whole Group)

- Have the students test their games with the other students, get feedback, and then see what else they need to add to improve their games.
- As students are playing games, monitor student gameplay and use facilitation questions to help support their thinking about games and about math.

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Grade 3 | Module 4 | Day 1

My Thinking Path (5-10 minutes)

- Have students write in the topic, “Comparing fractions on a number line.”
- Have students work on the My Thinking Path page in their journals.
- Discuss their ideas and allow students to add to their paper any additional thoughts they have.
- Have students complete the Pre-Quiz (optional).

Puzzle Talk: Estimate Fractions on the Number Line (20-25 minutes)

¤ Focus on student thinking and developing problem solving skills using the Problem Solving Process.
¤ Provide students with Estimate Fractions Game Mat and whiteboards/dry-erase markers.

Notice and Wonder

- Display the first puzzle in Level 1. Ask: "What do you notice? What do you wonder? What do you think you need to do to solve this puzzle?" Allow a few students to share out.

Predict and Justify

- Have students make a prediction. After they have had some think time, have them think-pair-share about what they would like to try, what will happen when they try it, and why they think it will work.
- Have students share out their predictions and related strategy.

Test and Observe

- Select one of the students’ strategies. Ask the students if they agree or disagree with the strategy and why. How does it relate to their own strategy?
- Try a student’s solution, and watch the feedback. Ask students to describe what happened.

Analyze and Learn

- Show and have students solve other puzzles from Level 1. Ask students how they know how many partitions to divide the number line into. (Denominator)
- Give each student the Estimate Fractions Game Mat. Show a Level 2 puzzle.

Connect and Extend

- Have students represent this puzzle on their game mat by sliding the rocket over to the point on the number line, and discuss their reasoning with a partner.
- Engage in discussions about benchmark fractions and students comparing/equivalent fractions, pausing the feedback when necessary. Chart different student responses to:
  - What does the denominator tell you? (How many equal parts there are between each whole.) The numerator? (How many jumps JiJi makes.)
  - How did you partition the number line? Why?
  - Where do you think this fraction is located? Why?
  - How do we know this is a unit fraction?
- Show a puzzle in Level 3. You may repeat the Problem Solving Process again for more practice, and ask additional clarifying questions, such as: “How is this number line different from the other number line?”

How does the student:

- discuss strategies for partitioning a number line into fractions?
- define a unit fraction?
- estimate the location of a number on a number line by counting by unit fractions?
- discuss the role of the denominator in partitioning the number line?
- discuss the role of the numerator to locate a number on the number line?
- discuss the number of unit fractions that are equal to one?

Problem Solving (20-25 minutes)

Engage students in problem solving discussions. Read and discuss the problem, share student work, compare strategies, and make connections.

Problem of the Day

- Create a number line including the numbers 0–2 and all halves and fourths. Name every half and fourth. Circle all of the names for the location of 1 and 2. Explain why these are equivalent.

Instructional Stations (40 minutes)

Students will visit two stations today (20 minutes in each station). They will visit the other two tomorrow.

Station 1: Small Group Instruction

- Give students the Number Lines Math Mat. Have them locate 1/4, 2/4, 3/4, 4/4, and 5/4 on each of the number lines.
- Have students discuss their strategy for locating the numbers on one of the number lines.
- Discuss how they partitioned each number line.
- Compare the location of the numbers on each number line. What is the same? What is different?

Station 2: ST Math Puzzles

- Have students sign in and play ST Math puzzles.
- Remind students to use manipulatives and/or paper and pencil to help them solve problems.
- With 5 minutes left, have students stop playing and complete their Puzzle Reflection and Accomplishments Log.

Station 3: Table Games

- Select Race to 2 or Five for Twenty-Five.
- Have students play that game.
- Ask students to complete an Exit Ticket during the final 5 minutes.

Station 4: Design Challenge

- Students will finalize their games.
- Have students analyze their games and complete page 15 in their Design Challenge Station Booklet to reflect on their design.
- Then, give students a blank piece of paper to create an advertisement for their game, if time permits. The advertisement should describe their game, the math students learn from it, and why people should play it.

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Grade 3 | Module 4 | Day 2

My Thinking Path (5-10 minutes)

- Have students reflect on what they have learned about comparing fractions on a number line.

Puzzle Talk: Estimate Fractions on a Number Line (20-25 minutes)

- Focus on student thinking and developing problem solving skills using the guiding questions in each step of the Problem Solving Process.
- Provide students with paper or whiteboards/dry-erase markers.

Notice and Wonder

- Display the first puzzle in Level 4 that has a fraction greater than 1. Have them reflect on the differences from yesterday's puzzles and what they need to do to solve. Allow a few students to share out.
- Ask students to draw a 0–2 number line like the one in the puzzle on their paper/whiteboard.
- Ask: "What do you notice about this fraction? What does it mean when the numerator is greater than the denominator? Where do you think this fraction would be placed on this number line? Why?"

Predict and Justify

- Have students make a prediction. After some think time, have them share with a partner their strategies and reasoning.
- Have students share out their predictions and strategies as a whole group.

Test and Observe

- Select one of the students' strategies. Ask the students if they agree or disagree and why. How does it relate to their own? Have them turn and talk to a neighbor to discuss.
- Try the student's solution, and watch the feedback. Ask students to describe what happened.

Analyze and Learn

- Ask students: "What did they learn from the feedback? How does this affect their strategy?"
- Show the next puzzle. Ask students to determine how to partition the number line.
- Partition the number line to match the denominator, and then count fraction pieces until you reach the fraction in the puzzle. Remind students that fractions, like numbers, go on forever, and don't stop at 1.
- Repeat with additional puzzles in Level 4.

Connect and Extend

- Display the first puzzle in Level 5. Ask students to draw a 0–3 number line on their paper/whiteboard. Ask: "How should we partition the number line? How do you know?"
- Use the denominator to divide the number line into equal parts. Then ask students: "How many of these equal pieces do we need?"
- Use the numerator to count out the correct number of equal pieces.
- Ask: "Is this fraction greater than, less than, or equal to 1? How do you know?"
- Repeat with additional puzzles in Level 5.

How does the student:

- visually partition the number line?
- explain why do they partition the number line in this way?
- determine where to place the rocket?

Problem Solving (20-25 minutes)

Engage students in problem solving discussions. Read and discuss the problem, share student work, compare strategies, and make connections.

Problem of the Day

- Use your number line from yesterday or create a new one. Write three comparison statements, and prove them on the number line. Example: 1 = 4/4 and 3/4 > 1/2.

Instructional Stations (40 minutes)

Students will visit two stations today (20 minutes in each station). They will visit the other two tomorrow.

Station 1: Small Group Instruction

- Give students the Number Lines Math Mat. Have them locate 1/4, 2/4, 3/4, 4/4, and 5/4 on each of the number lines.
- Have students discuss their strategy for locating the numbers on one of the number lines.
- Discuss how they partitioned each number line.
- Compare the location of the numbers on each number line. What is the same? What is different?

Station 2: ST Math Puzzles

- Have students sign in and play ST Math puzzles.
- Remind students to use manipulatives and/or paper and pencil to help them solve problems.
- With 5 minutes left, have students stop playing and complete their Puzzle Reflection and Accomplishments Log.

Station 3: Table Games

- Select Race to 2 or Five for Twenty-Five.
- Have students play that game.
- Ask students to complete an Exit Ticket during the final 5 minutes.

Station 4: Design Challenge

- Students will finalize their games.
- Have students analyze their games and complete page 15 in their Design Challenge Station Booklet.
- Then, give students a blank piece of paper to create an advertisement for their game, if time permits. The advertisement should describe their game, the math students learn from it, and why people should play it.

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Grade 3 | Module 4 | Day 3

My Thinking Path (5-10 minutes)

- Have students reflect on what they have learned about comparing fractions on a number line.

Puzzle Talk: Fraction Trap (20-25 minutes)

- Focus on student thinking and developing problem solving skills using the Problem Solving Process.
- Provide students with whiteboards/dry-erase markers.

Notice and Wonder

- Display the first puzzle in Level 1. Ask: “What do you notice? What do you wonder? What do you think you need to do to solve this puzzle?” Allow a few students to share out.

Predict and Justify

- Have students make a prediction. After they have had some think time, have them think-pair-share about what they would like to try, what will happen when they try it, and why they think it will work.
- Have students share out their predictions and related strategy.
- Select one of the students’ strategies. Ask the students to think about if they agree/disagree with the strategy and why. How does it relate to their own strategy?

Test and Observe

- Try a student’s solution and watch the feedback. Ask students to describe what happened.

Analyze and Learn

- Ask students to think about how what they saw happen compares to their prediction. What did they learn from the feedback? How does this affect their strategy?
- Display the next puzzle in Level 1. Ask students to draw a 0–2 number line to match the one in the puzzle.
- Ask: "What do you notice? What do you wonder? What do you know about the fraction in this puzzle?" Have students think, pair, share their thinking with a partner.
- Share students’ thinking and solutions (e.g., drawing on their number line).

Connect and Extend

- Try a student’s solution for a new puzzle, and watch the feedback.
- Ask students:
  - What do you know about this number line?
  - How is it different from the number line in the last puzzle?
  - How do we represent 1 on this number line?
  - What does the denominator tell us? The numerator?
- Repeat with additional puzzles in Level 1.
- Ask students questions about the variety of fractions that show up in the puzzles. For example, “What does a numerator of 0 tell us? What does a numerator of 1 tell us? How do we know a fraction is greater than 1?”

How does the student:

- discuss the role of the numerator and denominator in locating a fraction on the number line?
- create and partition a number line to locate fractions?
- count fraction parts to place a number on a number line?
- represent 1 as a fraction on a number line?
- compare number lines?

Problem Solving (20-25 minutes)

Engage students in problem solving discussions. Read and discuss the problem, share student work, compare strategies, and make connections.

Problem of the Day

- 5/6, 3/4, 2/3, 10/9 Select the number closest to 1. Draw a number line and place it on your number line. Explain how you knew this number was closest to 1. Explain how you knew where to place the number on the number line.

Instructional Stations (40 minutes)

Students will visit two stations today (20 minutes in each station). They will visit the other two tomorrow.

Station 1: Small Group Instruction

- Work with students on the ST Math game, *Number Line Trap*.
- Use the Problem Solving Process to discuss the game with the group.
- Work through the levels, and discuss how students determine where to place each of the fractions on the number line.
- Make comparison statements as they explain the placement of the fractions. Write equations and inequalities for these comparisons.
- Discuss the numerator and denominator of each fraction as appropriate in comparing the fractions.

Station 2: ST Math Puzzles

- Have students sign in and play ST Math puzzles.
- Remind students to use manipulatives and/or paper and pencil to help them solve problems.
- With 5 minutes left, have students stop playing and complete their Puzzle Reflection and Accomplishments Log.

Station 3: Table Games

- Select Race to 2 or Five for Twenty-Five.
- Have students play that game.
- Ask students to complete an Exit Ticket during the final 5 minutes.

Station 4: Design Challenge

- Students will finalize their games.
- Page 15 in the Design Challenge Station Booklet should be complete.
- Then give students a blank piece of paper to create an advertisement for their game if time permits. The advertisement should describe their game, the math students learn from it, and why people should play it.

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My Thinking Path (5-10 minutes)

- Have students reflect on what they have learned about comparing fractions on a number line. Students should complete the My Thinking Path reflection page in their journal.

Puzzle Talk: Fraction Trap (20-25 minutes)

- Focus on student thinking and developing problem solving skills using the Problem Solving Process.
- Provide students with whiteboards/dry-erase markers.

Notice and Wonder

- Display the first puzzle in Level 2. Ask: “What do you notice that is similar/different to the puzzles we did yesterday? Is this fraction greater than, less than or equal to 1? How do you know?”
- Allow a few students to share out.

Predict and Justify

- Have students make a prediction. After they have had some think time, have them think-pair-share about what they would like to try, what will happen when they try it, and why they think it will work.
- Have students share out their predictions and related strategy.
- Select one of the students’ strategies. Ask the students to think about if they agree/disagree with the strategy and why. How does it relate to their own strategy?

Test and Observe

- Try a student’s solution, and watch the feedback. Ask students to describe what happened.

Analyze and Learn

- Display the next puzzle in Level 2. Ask students: "What do you know about the fraction in this puzzle? What do you know about this number line? How is it different from the number line in the last puzzle?"
  - Have students change the number line on their paper/whiteboards to match the puzzle.
- Solve the puzzles in Level 2, asking the same types of questions from Level 1.
- Display the first puzzle in Level 3.
- Ask: "How has the number line changed? How does this change our answers? How long could the number line get?" Discuss with students that as the number line extends to bigger numbers, the spaces between our whole numbers get smaller.

Connect and Extend

- Ask: "Is 1/2 in the same location on the first number line we used (0–2) as it is on this number line (0–5)? Does the size of our number line affect the size of the fraction pieces? Why or why not?"
- Have some students think silently first, and then take some responses to share whole group.
- Explain that the location of 1/2 doesn’t change. It is still halfway between 0 and 2, but the size of the 1/2 has gotten smaller because the size of the wholes on the number line have gotten smaller. Use an example to help the discussion, such as: “If we had 1/2 of a cookie or 1/2 of a pizza, they wouldn't be the same size because the wholes are different sizes.”
- Solve additional puzzles in Level 3.

How does the student:

- discuss the role of the numerator and denominator in locating a fraction on the number line?
- create a and partition a number line to locate fractions?
- count fraction parts to place a number on a number line?
- represent 1 as a fraction on a number line?
- compare number lines?

Problem Solving (20-25 minutes)

Engage students in problem solving discussions. Read and discuss the problem, share student work, compare strategies, and make connections.

Problem of the Day

- 7/6, 1/4, 3/8, 8/9 Select the number closest to 1/2. Draw a number line and place it on your number line. Explain how you knew this number was closest to 1/2. Explain how you knew where to place the number on the number line.

Instructional Stations (40 minutes)

Students will visit two stations today (20 minutes in each station). They will visit the other two tomorrow.

Station 1: Small Group Instruction

- Work with students on the ST Math game, *Number Line Trap*.
- Use the Problem Solving Process to discuss the game with the group.
- Work through the levels, and discuss how students determine where to place each of the fractions on the number line.
- Make comparison statements as they explain the placement of the fractions. Write equations and inequalities for these comparisons.
- Discuss the numerator and denominator of each fraction as appropriate in comparing the fractions.

Station 2: ST Math Puzzles

- Have students sign in and play ST Math puzzles.
- Remind students to use manipulatives and/or paper and pencil to help them solve problems.
- With 5 minutes left, have students stop playing and complete their Puzzle Reflection and Accomplishments Log.

Station 3: Table Games

- Select Race to 2 or Five for Twenty-Five.
- Have students play that game.
- Ask students to complete an Exit Ticket during the final 5 minutes.

Station 4: Design Challenge

- Students will finalize their games.
- Give students a blank piece of paper to create an advertisement for their game. The advertisement should describe their game, the math students learn from it, and why people should play it.

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Design Challenge Station (30-40 minutes)

- Have the students test their games on the other students, get feedback, and then see what else they need to do to improve their games.
- Divide the students into groups. Rotate the games that the students created through the groups (there should be one person in each group who helped create the game.)
- Give students 10-15 minutes to play the game.
- When students are done playing the game, ask them to rate the game using the Game Tester Report. You may want to have some students share their thoughts.
- Rotate the games, so each group will get a new game. Have students play that game and then complete a feedback sheet.
- As students are playing games, monitor student gameplay and use facilitation questions to help support their thinking about games and about math.
- Have students answer the Game Feedback Form on page 16 in their Design Challenge Station Booklet.

Whole Group Table Games (15-20 minutes)

During this time, you will introduce JiJi Sudoku. Students will play these games in the next module in Station 3.

- Introduce JiJi Sudoku using the simple picture game boards.
- Allow students to work together to solve the picture puzzles.
- If there's time, explain that Sudoku is usually played with numbers, and share one or two of the additional numeric Sudoku puzzles.

Optional: ST Math Activity Page (15 minutes)

ST Math Activity Page

- Project the game, *Estimate Fractions on a Number Line*.
- Play a few puzzles to help students understand the game.
- Have students turn to the ST Math Activity Page: *Estimate Fractions on a Number Line.*
- Ask students what they notice about the content on the page. What do they wonder? Where do they want to start on the page?
- Give them time to complete the page.
- Discuss the page, and have students share their thinking.
- Take the time to compare strategies, and have students share their work.
- Make connections to the game.

Focused Instructional Time (20 minutes)

Focused Instructional Time

- During this station time, students do not rotate. They can either be assigned to a station or allowed to choose one to go to.
- This is an excellent opportunity to pull students who need additional support to Station 1: Small Group Instruction, where they can work with the teacher on concepts they are struggling with. Use the Teacher Planner to help target this time with students.

Station 1: Small Group Instruction

- Identify specific students for intervention or extension.
- Choose the ST Math puzzle or problem solving question that the students struggled with.
- You may choose to use the Teacher Planner to help you plan your instruction.

Station 2: ST Math Puzzles

- Have students sign in and play ST Math puzzles.
- Remind students to use manipulatives and/or paper and pencil to help them solve problems. They can ask themselves the questions that are on the Problem Solving Process Poster.
- With 5 minutes left, have students stop playing and complete their Puzzle Reflection and Accomplishments Log.

Station 3: Table Games

- Allow students to choose one of the games they have learned.
- Have students play that game.
- Ask students to complete an Exit Ticket during the final 5 minutes.

Station 4: Design Challenge

- Have students continue to build their games.
- Once they have finished building their games, they will play the games as a group to test them out. Have students complete page 16 in the Design Challenge Station Booklet.
- After they test their games, students can make any changes to their games they see are needed. The goal is to have them done so other students can play their games on Day 5 to test them out.

Closing (10 minutes)

Thinking and Reflecting Time

- Have students complete the Post-Quiz (optional).
- Engage students in discussions about what they have learned in this module, what they have questions about, and what they would like to learn more about.
- Have students review ST Math Problem Solving Journal pages for the module: My Thinking Path, Problem of the Day, Exit Tickets, and Puzzle Reflections.