

Investigations

In Number, Data, And Space[®]

UNIT GUIDES: GRADE 3



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GRADE

3

Investigations

In Number, Data, And Space®

UNIT GUIDES: Grade 3



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Unit Guides: Introduction

Preparation to teach individual units in *Investigations*

The Unit Guides for *Investigations in Number, Data and Space* are designed as study guides to help teachers become familiar and comfortable with the mathematical content, the activities, and the overall structure of each unit. The Unit Guides provide a structure for working through student activities, reading support material, looking at student work that is embedded in the materials, and discussing critical issues about mathematics and pedagogy. The expectation is that groups of teachers will work together on these Guides in preparation to teach a unit in their classroom. Below are some suggestions of how best to incorporate these Unit Guides into your professional development program.

- In order to get the most use from these Guides, it is important that groups of teachers from the same grade level work on a Guide together. This way, teachers can do the activities together and respond to the discussion questions.
- The Unit Guides are written with the assumption that teachers will read the “Mathematics in This Unit” essay before attending the Unit Guide session.
- A list of suggested materials and photocopied handouts for each unit is found at the beginning of each guide and should be prepared before the session begins.
- Unit Guides may be used independently by groups of teachers, with one teacher taking on the lead role, or you may have a Teacher Leader/Coach who can contribute some guidance or experience. The leader’s role during the session is to act as a resource: answering questions, clarifying instructions, and prompting discussion when appropriate.
- In order to gain a real sense of the preparation, effort, and mathematics in the activities, it is imperative that teachers not just read through but actually *do* all of the activities suggested in the Unit Guides.
- As a follow up to a Unit Guide session, it is helpful for teachers to meet periodically while the unit is ongoing in their classrooms to support each other, seek and offer advice, and work together to evaluate sets of student work.

Each Unit Guide is designed to take three hours, but could also be adapted and used flexibly in a variety of different settings.

Unit Guide for Grade 3, Unit 1:
Trading Stickers, Combining Coins
Addition, Subtraction, and the Number System 1



Unit Guide for Grade 3, Unit 1

Trading Stickers, Combining Coins

Addition, Subtraction, and the Number System 1

Unit Summary:

Students solve addition problems with two and small three-digit numbers, solve subtraction problems involving two-digit numbers, find combinations of numbers that add to 100, and work with coins and coin values. Their understanding of place value develops as they add and subtract 10s to and from three-digit numbers, break three-digit numbers into hundreds, tens, and ones in different ways, and solve story problems involving hundreds, tens, and ones.

Materials:

Trading Stickers, Combining Coins (1 copy per person)

Resource Master M4, 100 Chart (1 per person)

Student Activity Book pp. 15-16, How Many More Stickers to Get 100? (1 per person)

Resource Master M12, 100 Grids (1 per person)

Resource Master M13, Capture 5 (1 per pair)

Resource Masters M14-M15, Change Cards (1 deck per pair, see Materials to Prepare, p. 25)

Resource Master M16, Capture 5 Recording Sheet

Resource Master M30, *Close to 100* (1 per pair)

Student Activity Book p. 39, Close to 100 Score Sheet (1 per pair)

Digit Cards (1 deck per pair) Use manufactured decks or Resource Masters M33-M35, see Materials to Prepare, p. 97

Student Activity Book p. 49, Story Problems 4 (1 per person)

Do the following activities from *Trading Stickers, Combining Coins*:

1. Identify the mathematics in the unit

To get an overview of the mathematics students will be doing in this unit, refer to these sections in the unit front matter. As you look at these sections, begin thinking about the main mathematical ideas students work on in this unit.

- Turn to pp. 8-9, *Overview of This Unit*. Look at the title of each Investigation and read the summary for each Investigation.
- Review the *Mathematics in This Unit* essay, pp. 10-13. Look at the Mathematical Emphases and Math Focus Points. (The emphases are numbered, and can be found above bulleted lists of Math Focus Points.)

- Read the “Benchmarks in This Unit” in the table on p. 15, *Assessing the Benchmarks*.

Discuss

- What mathematical ideas and skills are students working on in this unit?
- What mathematics are students expected to know at the beginning of the unit? At the end?

2. Introducing How Many More Stickers to Get 100? (Session 1.4)
How Many More Stickers to Get 100? (Session 1.4)

(Note: In Grade 2, a context used for representing the place-value of 2- and 3-digit numbers is stickers sold at a “Sticker Station” in sheets of 100, strips of 10s and singles. This context is also used in Grade 3.)

In this session, students consider a context in which stickers are stored in books with 100 to a page. Students solve missing addend problems in which they determine how many more stickers are needed to make 100. They use 100 grids and number lines as tools for solving the problems and representing their strategies.

- Read the Activity, *Introducing How Many More Stickers to Get 100?*, pp. 53-55. Solve the problems on Student Activity Book pp. 15-16, *How Many More Stickers to Get 100?*

Discuss

- How does the context of Sticker Station help students understand the structure of our base-ten number system, particularly 100?
- What strategies do you expect to see your students using to solve these problems?

- Read the Discussion, *Representing Strategies on the Number Line*, pp. 56-59, including the Algebra Note, *The Relationship Between Addition and Subtraction*, p. 57, and the Math Note, *Representing Subtraction on the Number Line*, p. 58.

- Use an unmarked number line to represent the strategies you used to solve the first two problems on Student Activity Book p. 15.

Discuss

- Compare how people in your group used the number line to represent their solution. What was the same and different?
- How does using the unmarked number line in these problems highlight the relationship between addition and subtraction?
- How can the use of the number line as a representation support students’ understanding of subtraction as the difference between two numbers?

3. *Capture 5* (Session 1.5)

Capture 5 is a game that involves students in adding and subtracting multiples of 10 and 1 to and from numbers up to 100.

- Play the game *Capture 5*, following the directions on Resource Master M13, including recording your equations on Resource Master, M16, *Capture 5* Recording Sheet.

Discuss

- What strategies did you use as you played *Capture 5*?
- How can you support students in developing more efficient strategies as they play this game, for example moving from counting by 1s to making moves in larger chunks? (Refer to the *Ongoing Assessment: Observing Students at Work* and *Differentiation: Supporting the Range of Learners*, pp. 63-64.)

- Read the Discussion, *Strategies for Capture 5*, on pp. 72-74 in Session 1.7, and the Dialogue Box, *Strategies for Capture 5*, p. 171.

Discuss

- How does *Capture 5* highlight the relationship between addition and subtraction?

4. *Close to 100* (Session 2.2)

Close to 100 is a game that involves using knowledge of place value and known combinations with sums of 100 ($20 + 80$, $25 + 75$, $50 + 50$, etc.) to find pairs of 2-digit numbers that add to 100 or close to 100.

- Play the game *Close to 100*, following the directions on Resource Master M30. Keep score on Student Activity Book p. 39, *Close to 100* Recording Sheet.

Discuss

- What strategies did you use as you played *Close to 100*? For example, did you use familiar combinations (e.g., $50 + 50$ or $75 + 25$) to help you? If so, explain how.
- How did your understanding of place value help you choose two numbers with a sum of 100 or close to 100?

- Read the *Differentiation: Supporting the Range of Learners*, p. 108, and the Discussion, *Strategies for Close to 100*, pp. 113-115, in Session 2.3.

Discuss

- How can you support students who are making combinations randomly?
- How can you scaffold the activity for them to help them consider combinations they know that make 100 or to encourage them to consider the sum of the tens digits when picking two numbers?

5. Story Problems (Session 2.5) Story Problem Strategies (Session 2.6)

Students revisit and extend the work they have done in this unit solving story problems. In this session, they solve problems that involve sums over 100.

- Solve Problems 1 and 3 on Student Activity Book p. 49, Story Problems 4. Read the Activity *Story Problems*, pp. 123-124.

Discuss

- What strategies did you use to solve these two problems?
- What will you look for as your students do this work?
- What tools or representations might you encourage students to use to help them make sense of these problems and/or become more efficient in solving them?

- Read the Discussion, *Story Problem Strategies*, pp. 126-130, in Session 2.6, and the Teacher Note, *Addition Strategies*, pp. 149-151.

Discuss

- As the students in this discussion share their strategies, the teacher refers to the problem context as she questions them. How does this help the students keep track of the parts of the problem that have been solved and the parts that remain to be solved?
- How does the use of cubes help the students visualize the strategy of adding by place?
- How does the unmarked number line help them visualize and compare Gil and Kim's strategies of adding one number in parts?

6. Wrap Up

- Look back at the unit overview, pp. 8-9.

Discuss

- How do the activities done during this unit study fit into the overall mathematical storyline of the unit?

Other Key Features of *Trading Stickers, Combining Coins*

- Algebra Connections in this Unit, pp. 16-17
- Classroom Routine and Ten-Minute Math in This Unit, p. 18
 - What's the Temperature?*
 - Practicing Place Value*
 - More or Less?*
- Assessment
 - Adding and Subtracting 10s (Sessions 1.6-1.7)
 - Resource Master, M3 Assessment Checklist
 - Hundreds, Tens, and Ones (Session 1.9)
 - Teacher Note, pp. 153-158
 - Addition Combinations (Session 2.5)
 - Teacher Note, pp. 161-163
 - End-of-Unit Assessment (Session 2.8)
 - Teacher Note, pp. 164-169

Unit Guide for Grade 3, Unit 2:
Surveys and Line Plots
Data Analysis



Unit Guide for Grade 3, Unit 2

Surveys and Line Plots

Data Analysis

Unit Summary:

Students collect, represent, describe, categorize, and interpret both categorical and numerical data. They begin the important work of seeing a data set as a whole as they design and carry out their own data investigations, create representations of the data collected, and compare and discuss these representations. Students draw conclusions about the data by identifying characteristics in their representations. (Where is most of the data clumped? Where is the mode?) Students' collection of numerical data includes measuring length in inches and feet. Students review the basic units of inches, feet, and yards and their relationships (e.g., one foot is equivalent to 12 inches, one yard is equivalent to 3 feet or 36 inches) by measuring lengths longer than one foot.

Materials:

Surveys and Line Plots (1 copy per person)

Resource Master M1, Places Where We Like to Eat: Data from Ms. Cutter's Grade 3 Class (one per pair)

Student Activity Book p. 1, What Did You Find Out About Ms. Cutter's Grade 3 Class? (1 per person)

Student Activity Book pp. 7-9, How Do You Get to School? (1 per person)

Student Activity Book p. 21, How Many Years in This School? (1 per person)

Student Activity Book p. 31, A Survey Question (1 per pair)

Do the following activities from *Surveys and Line Plots*:

1. Identify the mathematics in the unit

To get an overview of the mathematics students will be doing in this unit, refer to these sections in the unit front matter. As you look at these sections, begin thinking about the main mathematical ideas students work on in this unit.

- Turn to pp. 8-9, *Overview of This Unit*. Look at the title of each Investigation and read the summary for each Investigation.
- Review the *Mathematics in This Unit* essay, pp. 10-13. Look at the Mathematical Emphases and Math Focus Points. (The emphases are numbered, and can be found above bulleted lists of Math Focus Points.)
- Read the "Benchmarks in This Unit" in the table on p. 15, *Assessing the Benchmarks*.

Discuss

- What mathematical ideas and skills are students working on in this unit?
- What mathematics are students expected to know at the beginning of the unit? At the end?

2. Classifying Data (Session 1.1)

In Investigation 1, students collect, organize, represent, and describe categorical data. They develop a survey question and collect data from other classrooms in order to compare data from more than one group. In this session students collect and organize data about places where they like to eat. They work in pairs to organize a set of “Places Where We Like to Eat” data from a fictional third grade class.

- Do the Activity, *Classifying Data*, using Resource Master M1, Places Where We Like to Eat: Data From Ms. Cutter’s Class.
- Answer the questions on Student Activity Book p. 1, What Did You Find Out About Ms. Cutter’s Grade 3 Class?

Discuss

- How did the question you posed affect the way you organized your data?
- Did the categories you created effectively answer your question?
- How could a different arrangement of the data be used to answer a different question about the data?

- Read the Teacher Note, *About Categorical Data in this Unit*, pp. 159-161.

Discuss

- What are some of the issues that students encounter as they attempt to organize categorical data?

3. Comparing Double Bar Graphs (Session 1.4) More Than Half, Less Than Half (Session 1.6)

In Session 1.4, students review how to make and read a bar graph and then answer questions about a bar graph that compares two groups. In Session 1.6, students compare data from two groups and use “useful phrases” such as *more than half*, *less than half*, and *about half* to summarize the data.

- Use the double bar graph on Student Activity Book p. 7, How Do You Get to School?, to answer the questions on Student Activity Book pp. 8-9.

Discuss

- What comparisons can you make from the double bar graph about how students travel to school at Lincoln and Parks Schools?
- What reasons did you think might account for the similarities and differences?
- What further data questions might you ask based on the information in this graph?

- Refer to the “mini” on p. 59 in Session 1.5 of Student Activity Book p. 13, What is Your Favorite Mealtime? Read the Discussion, *More Than Half, Less Than Half*, pp. 64 – 67, the Teaching Note, “What Does *Most* Mean?” p. 44 in Session 1.3, and the Math Note, “How Important is the Mode?”, p. 66.

Discuss

- How does the teacher in this discussion help students move from simply making observations about the data to using it to compare the two groups?
- How does the teacher help the students think about the importance of summarizing data?

4. How Many Years Have You Been in This School? (Session 2.1)

Brainstorming Questions (Session 2.3)

Developing a Survey Question (Session 2.3)

In Investigation 2, students represent ordered numerical data with line plots and bar graphs, and describe the data in order to answer questions. They carry out data projects based on survey questions that they design, and they collect data from two groups. In Session 2.1, they are introduced to a line plot for representing data. In Session 3, they develop and revise survey questions that will result in numerical data.

- Read the Discussion, *How Many Years Have You Been in This School?*, pp. 83-85, and the Teacher Note, *Focusing on the Shape of the Data*, pp. 164-165.
- Use a line plot to represent the data on Student Activity Book p. 21, How Many Years in This School?

Discuss

- What statements can you make about the number of years the fifth grade students have been at their school?
- What types of statements do you expect your students to make?
- How can you help your students move towards looking at the data set as a whole, rather than at just individual values?

- Read the Activity, *Brainstorming Survey Questions*, pp. 98-99. Work with a partner to complete the questions on Student Activity Book p. 31, A Survey Question, including trying your question with another pair/group.

Discuss

- Was your question clear to the other person or group that you asked?
- Did your question result in the type of information you were looking for?
- If the answer to either of the questions above is no, how can you revise your question to make it clearer and/or to better result in the information you want?
- What issues do you think will arise for your students as they do this activity?

5. How Far Can a Grade 3 Student Jump? (Session 3.2)

In Investigation 3, students collect and analyze data by measuring lengths and distances. They measure in inches and feet, and discuss issues of measuring with accuracy.

- Read the Activity, *How Far Can a Grade 3 Student Jump?*, pp. 136-138. Read the Dialogue Box, *How Far Can a Grade 3 Student Jump?*, pp. 194-195.

Discuss

- How does the teacher in the first class (p. 194) help the students make statements that summarize the data set as a whole?
- Why does the teacher in the second class call the students' attention to the outlier? (p. 195)

6. Wrap Up

- Look back at the unit overview, pp 8-9.

Discuss

- How do the activities done during this unit study fit into the overall mathematical storyline of the unit?

Other Key Features of *Surveys and Line Plots*

- Classroom Routine and Ten-Minute Math in This Unit, p. 16
 - What's the Temperature?*
 - More or Less?*
 - Guess My Rule*
 - Today's Number*
- Assessments
 - Reading and Interpreting Bar Graphs (Sessions 1.5-1.6)
 - Resource Master M9, Assessment Checklist
 - Representing and Describing Survey Data (Sessions 2.5-2.7)
 - Resource Master M13, Assessment Checklist: Data Projects
 - Assessment: How Many People Live in Your Home? (Session 2.6)
 - Teacher Note, pp. 171-175
 - End-of-Unit Assessment (Session 3.5)
 - Teacher Note, pp. 176-183

Unit Guide for Grade 3, Unit 3:
Collections and Travel Stories
Addition, Subtraction, and the Number System 2

Unit Guide for Grade 3, Unit 3

Collections and Travel Stories:

Addition, Subtraction, and the Number System 2

Unit Summary:

Students practice and refine their strategies for solving addition problems with three-digit numbers to 400 and subtraction problems with two- and three-digit numbers to 300. In addition to solving removal problems, they expand their understanding of subtraction as they solve comparison problems and problems in which they find the missing part of a whole. They increase their understanding of place-value as they extend their work into three-digit numbers up to 1,000 and study the structure of 1,000.

Materials:

Collections and Travel Stories: Addition, Subtraction, and the Number System 2 (1 copy per person)

Resource Masters M24-M25, Go Collecting (1 per person)

Resource Master M26, Go Collecting Recording Sheet (1 per person)

Collection Cards (1 deck per pair) Use manufactured decks or Resource Masters M9-M16, see Materials to Prepare, p. 25

Student Activity Book pp. 25-27, Combining Collections (1 per person)

Student Activity Book pp. 49-50, Distance Riddles (1 per person)

Student Activity Book p. 57, More Distance Riddles (1 per person)

Resource Master M54, How Far from 100? (1 per person)

Resource Master M55, How Far from 100? Recording Sheet (1 per person)

Digit Cards (1 deck per pair) Use manufactured decks or Resource Masters M21-M23, see Materials to Prepare, p. 25

Student Activity Book pp. 71-72, *Related Problems* (1 per person)

Do the following activities from *Collections and Travel Stories*:

1. Identify the mathematics in the unit

To get an overview of the mathematics students will be doing in this unit, refer to these sections in the unit front matter. As you look at these sections, begin thinking about the main mathematical ideas students work on in this unit.

- Turn to pp. 8-11, *Overview of This Unit*. Look at the title of each Investigation and read the summary for each Investigation.
- Review the *Mathematics in This Unit* essay, pp. 12-15. Look at the Mathematical Emphases and Math Focus Points. (The emphases are numbered, and can be found above bulleted lists of Math Focus Points.

- Read the “Benchmarks in This Unit” in the table on p. 17, *Assessing the Benchmarks*.

Discuss

- What mathematical ideas and skills are students working on in this unit?
- What mathematics are students expected to know at the beginning of the unit? At the end?

2. Go Collecting (Session 1.3)

In this session, students play *Go Collecting* (based on the game *Go Fish*) in which they generate addition problems with 2- and 3-digit numbers by pairing Collection Cards from the same category. They use their knowledge of place value and known combinations to determine the number of 100s in the sum of each problem.

- Read the game directions on Resources Masters M24-M25, *Go Collecting*. Play the game with a partner. Use Resources Master M26, *Go Collecting Recording Sheet*, to record the number of 100s in the sum of each pair of Collection Cards that you make.

Discuss

- What strategies are you using to determine the number of 100s in the sum of each pair of cards?
- What knowledge of place value are you using? Of known combinations of 2-digit numbers that sum to 100?
- What strategies do you expect to see your students using as they play this game?

- Read *Ongoing Assessment: Observing Students at Work* and *Differentiation: Supporting the Range of Learners*, p. 44. Read the Discussion, *How Many 100s?*, pp. 55-56, in Session 1.5.

Discuss

- What ideas about estimation are highlighted in this discussion?
- Why does the teacher ask students if they agree with Bridget’s statement that, “Our scores are the same because we both have three 100s plus two 100s.”

3. Combining Collections (Session 2.2)

In Investigation 2, students develop strategies for adding 2- and 3-digit numbers and represent their strategies using number lines and place value models.

- Read the Teacher Note, *Addition Strategies*, pp. 195-197. Solve the problems on Student Activity Book pp. 25-27, *Combining Collections*, without using the standard U.S. algorithm. Share the strategies you used with a partner.

Discuss

- How were your strategies like those described in the Teacher Note? How were they different?

- Try a strategy that you didn't use (for example, *changing to a landmark* or *creating an equivalent problem*) to solve one of the Combining Collections problems. Use a representation to show that strategy. Read the Math Note, "Representing Different Strategies," p. 78.
- Read the Dialogue Box, *Breaking Numbers Apart for Addition*, pp. 219-220 and review section 3, *Computational Fluency*, in *Mathematics in this Unit*, pp.13-14.

Discuss

- What do students need to understand about numbers and the operation of addition in order to use these strategies?
- How can the use of tools and representations like stickers, 1,000 charts, or number lines help them to build this understanding?

4. Distance Riddles (Session 3.2)

In Investigation 3, students work on problems and activities that focus their attention on the use of 100 (and multiples of 100) as a landmark in solving subtraction problems. In this session they solve distance riddles in which they find pairs of 2- and 3-digit numbers at given distances from 100 and determine the difference between the numbers in each pair.

- Read the Activity, *Introducing Distance Riddles*, pp. 116-118. Complete the problems on Student Activity Book pp. 49-50, Distance Riddles.
- Read the Discussion, *What Numbers Can I Be?*, pp. 119-121.

Discuss

- What strategies do you want students to use to find numbers at given distances from 100? To find the difference between the 2- and 3-digit number in each pair?
- How does the number line help students visualize the difference between the numbers in each pair?
- Why might a 200 chart representation be helpful to some students?

5. Related Problems (Session 4.3)

In this session, students are introduced to related problems in which one of the numbers either increases or decreases, and they consider how that affects the solution. The Math Workshop activity, *Related Problems* asks students to solve these types of problem sets.

- Read the Discussion, *Who Has More?* pp. 170-172. Complete the problems on Student Activity Book pp. 71-72, *Related Problems*. Choose one of the problem sets and create a context or representation that shows how the numbers are changing among the problems within the set.
- Read the Math Note, "Does the Answer Get Larger or Smaller?," p. 171.

Discuss

- What will your students need to understand about the relationships among the problems in each set in order to solve the problems?
- What contexts and/or representations can you use and encourage them to use to help them visualize how the numbers are changing?

6. Wrap Up

- Look back at the unit overview, pp. 8-11.

Discuss

- How do the activities done during this unit study fit into the overall mathematical storyline of the unit?

Other Key Features of *Collections and Travel Stories*

- Algebra Connections in This Unit, pp. 18-19
- Classroom Routines and Ten-Minute Math in This Unit, p. 20
 - What's the Temperature?*
 - Class Collection*
 - Today's Number*
 - What Time Is It?*
- Assessment
 - Numbers on the 1,000 Chart (Session 2.3)
 - Resource Master M39, Assessment Checklist
 - Addition Strategies (Session 2.7)
 - Teacher Note, pp. 198-201
 - How Far did They Travel? (Session 3.6)
 - Teacher Note, p. 205-209
 - End-of-Unit Assessment (Session 4.6)
 - Teacher Note, pp. 212-218

Unit Guide for Grade 3, Unit 4:
Perimeter, Angles, and Area
2-D Geometry and Measurement



Unit Guide for Grade 3, Unit 4

Perimeter, Angles, and Area

2-D Geometry and Measurement

Unit Summary:

Students define and categorize polygons by identifying sets of shapes that have a common attribute and use 90 degrees as a reference for finding the measurement of other angles. They continue their measurement work from earlier grades by measuring distance and perimeter, using both U.S. and metric units and finding the area of polygons in square units.

LogoPaths, a Logo programming environment designed for *Investigations* students in Grades 3–5 is introduced in this unit. It allows students to explore geometrical relationships, especially focusing on angle, length, and perimeter, patterns in sides and angles, and characteristics of specific shapes.

Materials:

Perimeter, Angles, and Area, (1 copy per person)

Student Activity Book p. 9, p. 1 of 2, Perimeter Problems (1 per person)

Student Activity Book pp. 25-26, Tetromino Puzzle (1 per person)

Resource Master M17, Square and Triangle Cutouts (1 per person)

Scissors (1 per pair)

Glue sticks (1 per pair)

Student Activity Book p. 40, Tricky Triangles (1 per pair)

Straw Building Kits, (1 per pair) Use manufactured sets or see Materials to Prepare, p. 101

Student Activity Book pp. 45-46, Building Quadrilaterals (1 per pair)

Do the following activities from *Perimeter, Angles, and Area*:

1. Identify the mathematics in the unit

To get an overview of the mathematics students will be doing in this unit, refer to these sections in the unit front matter. As you look at these sections, begin thinking about the main mathematical ideas students work on in this unit.

- Turn to pp. 8-9, *Overview of This Unit*. Look at the title of each Investigation and read the summary for each Investigation.
- Review the *Mathematics in This Unit* essay, pp. 10-13. Look at the Mathematical Emphases and Math Focus Points. (The emphases are numbered, and can be found above bulleted lists of Math Focus Points.)

- Read the “Benchmarks in This Unit” in the table on p. 15, *Assessing the Benchmarks*.

Discuss

- What mathematical ideas and skills are students working on in this unit?
- What mathematics are students expected to know at the beginning of the unit? At the end?

2. An Ants Path (Session 1.2)
Comparing Strategies and Results (Session 1.2)
Pilar’s Yard (Session 1.4)

Students are introduced to perimeter as the measure around the outside edge of a 2-dimensional figure. They measure the perimeter of an 8 ½ x 11 inch paper and compare strategies and results. In Session 1.3, they create different shapes with the same perimeter.

- Read the Activity, *An Ant’s Path*, pp. 30-31 and the Discussion, *Comparing Strategies and Results*, pp. 32-34.

Discuss

- What strategies do you expect students to use to compute the perimeter of the paper?
- What important idea about the perimeter of a rectangle is highlighted in this discussion?

- Solve Problem 2 on Student Activity Book p. 9, Perimeter Problems. Draw more than one possible plan for what Pilar’s yard might look like. Read the Discussion, *Pilar’s Yard* pp. 46-47.

Discuss

- What important idea about perimeter is highlighted in this discussion?
- What difficulties do you anticipate students may have? How will you support students having difficulty with this task?

3. Making Tetrominoes (Session 2.1)
Tetromino Puzzle (Session 2.3)

- Read the Teacher Note, *What’s an –Omino?*, p. 143.
- Read the Activity, *Introducing Tetromino Puzzle*, p. 75, including the Math Note, “Unit of Measure for Area.”
- Use Resource Master M17, Square and Triangle Cutouts and Student Activity Book pp. 25-26, Tetromino Puzzle to complete the Activity, *Tetromino Puzzle*, pp. 76-77.

Discuss

- What is the total area of each tetromino you covered?
- What is the area of each of the squares and triangles you used to cover the tetrominoes? Explain how you know.

- Read the Teacher Note, *Understanding the Area of Triangles*, p. 144 and the Dialogue Box, *The Space is the Same*, p.155.

Discuss

- What ideas about area are students working on as they determine the area of each tetromino they covered? As they determine the area of the small and large triangles?
- In the Dialogue Box, what confused Becky when she tried to determine the area of her puzzle? What arguments did the other students use to prove that the area of Gil's puzzle and Becky's are the same?

4. Introducing Building Triangles (Session 3.1)
Attributes of Triangles (Session 3.1)
Tricky Triangles (Session 3.2)

Students build triangles and consider the attributes that make them triangles.

- Read the Activity, *Introducing Building Triangles*, pp. 105-106 including the Math Note, "Vertices and Angles", p. 105. Read the Discussion, *Attributes of Triangles*, pp. 108-109.

Discuss

- What attributes of triangles are students expected to notice in this activity and to identify in the discussion that follows?
- What vocabulary is introduced or reviewed?

- With a partner, look at the triangles on Student Activity Book p. 40, Tricky Triangles.

Discuss

- Which shapes do you think that your students are likely to identify as triangles? Which are they likely to identify as **not** triangles?
- Which shapes do you think they might incorrectly place in either category?
- What do you think might be the causes of their confusion about some of these shapes?

- Read the Dialogue Box, *Building a Definition of Triangles*, pp. 158-159.

Discuss

- What argument did Kathryn use to prove that Shape F is a triangle? Why is this idea important for students to consider?

5. Building Quadrilaterals (Session 3.3)
Squares and Rectangles (Session 3.3)
Right Angles and Not Right Angles (Session 3.4)

Students use building kits to make quadrilaterals, including some with angles that are not right angles. They discuss the relationship between squares and rectangles and identify a right angle as having 90° .

- Using the Straw Building Kits, work with a partner to complete Student Activity Book pp. 45-46, Building Quadrilaterals.
- Read the Discussions, *Squares and Rectangles*, pp. 120-122 and *Right Angles and Not-Right Angles*, pp. 124-126 in Session 3.4.
- Read the Math Notes, “Why 90 Degrees?”, “Is a Square a Rectangle?” p. 121, and “Acute and Obtuse Angles”, p. 126.

Discuss

- As students do this activity, what evidence will you look for of their understanding of the attributes of squares and rectangles?
- What new ideas about polygons are students likely to encounter as they make quadrilaterals that are **not** squares or rectangles?

6. Wrap Up

- Look back at the unit overview, pp. 8-9.

Discuss

- How do the activities done during this unit study fit into the overall mathematical storyline of the unit?

Other Key Features of *Perimeter, Angles, and Area*

- *LogoPaths* Software
Teacher Note, *Introducing and Managing the LogoPaths Software*, pp. 139-141
Teacher Note, *About the Mathematics in the LogoPaths Software*, p. 142
- Classroom Routines/Ten Minute Math in This Unit, p. 16
What’s the Temperature?
Practicing Place Value
Quick Images: 2-D
- Assessment
Measuring Perimeter (Session 1.3)
Resource Master M14: Assessment Checklist
Make a Shape (Session 2.6)
Teacher Note, pp. 145-147
End-of-Unit Assessment (Session 3.6)
Teacher Note, pp. 149-154

Unit Guide for Grade 3, Unit 5:
Equal Groups
Multiplication and Division



Unit Guide for Grade 3, Unit 5

Equal Groups

Multiplication and Division

Unit Summary:

Students develop an understanding of multiplication as combining a number of equal groups and division as splitting a quantity into equal groups. This understanding is developed as students highlight multiples on 100 charts, describe patterns in sets of multiples, and compare sets of multiples to each other. Students represent multiplication and division situations with groups, rectangular arrays, and by writing multiplication and division story problems. Students achieve fluency with multiplication combinations with products to 50 and consider the relationship between multiplication and division (e.g., $6 \times 4 = 24$; $24 \div 6 = 4$).

Materials:

Equal Groups (1 copy per person)

Student Activity Book pp. 4-5, Picture Problems (1 per person)

Resource Master M12, 100 Chart with Skip Counting Circles (2 per person)

Student Activity Book pp. 14-16, Related Problems (1 per person)

Resource Master M14, Half-Inch Grid Paper (2 per person)

Resource Master M15, Arranging Chairs (1 per pair)

Connecting cubes or color tiles (30-40 per pair)

Do the following activities from *Equal Groups*:

1. Identify the mathematics in the unit

To get an overview of the mathematics students will be doing in this unit, refer to these sections in the unit front matter. As you look at these sections, begin thinking about the main mathematical ideas students work on in this unit.

- Turn to pp. 8-9, *Overview of This Unit*. Look at the title of each Investigation and read the summary for each Investigation.
- Review the *Mathematics in This Unit* essay, pp. 10-13. Look at the Mathematical Emphases and Math Focus Points. (The emphases are numbered, and can be found above bulleted lists of Math Focus Points.)
- Read the “Benchmarks in This Unit” in the table on p. 15, *Assessing the Benchmarks*.

Discuss

- What mathematical ideas and skills are students working on in this unit?
- What mathematics are students expected to know at the beginning of the unit? At the end?

2. Pictures of Things That Come in Groups (Session 1.2) Picture Problems (Session 1.3)

In this Investigation, students make list of things that come in groups of 2 to 12 and use these lists to create and illustrate multiplication situations. They connect skip counting and repeated addition to multiplication and learn multiplication notation.

- Read the Activity, *Pictures of Things That Come in Groups*, pp. 29-30. Follow the directions on p. 29, assigning different numbers to each person or pair.
- Read the Discussion, *Writing “Groups of” as Multiplication*, pp. 31-33. Read the Math Notes p. 31, “Standard Notation for Multiplication” and “Is It 4×5 or 5×4 ?”

Discuss

- What strategies do you expect your students to use to find the products of their multiplication situations?
 - How can students’ illustrated multiplication situations help them understand the relationship between skip counting, repeated addition, and multiplication?
- Read *Introducing Picture Problems*, pp. 36-37. Solve the problems on Student Activity Book pp. 4-5, Picture Problems, as you think your students will solve them. Read *Ongoing Assessment: Observing Students at Work* and *Differentiation: Supporting the Range of Learners*, pp. 37-38.

Discuss

- How can you help students move towards the use of more efficient strategies to solve these problems?

3. Relationships Between the Multiples of 5 and 10 (Session 2.2) Solving Related Problems (Session 2.3)

In this Investigation, students highlight multiples on 100 charts and discuss patterns and relationships. They use known multiplication combinations to solve more difficult combinations.

- Read the Activity, *Highlighting the Multiples of 2*, pp. 49-50. Highlight the multiples of 5 and 10 on separate copies of Resource Master M12, 100 Chart with Skip Counting Circles. Be sure to fill in the skip counting circles at the bottom of each page.
- Read the Discussion, *Relationships Between the Multiples of 5 and 10*, pp. 54-55 and the Dialogue Box *Relationships Between the Multiples of 5 and 10*, p. 170.

Discuss

- What relationships do you want students to notice between the multiples of 5 and 10?
- How can these relationships help students in the development of computational fluency with multiplication and division?

- Solve the problems on Student Activity Book pp. 14-16, Related Problems. As you work, think about how the answer to the first problem in each set can be used to help solve the second problem in the set.

Discuss

- What relationships did you notice between the numbers in these problems? How did you use the relationships to help you solve them?
- What questions can you ask to help students use the double and half relationships between the numbers in each set as they solve these problems?

4. Arranging Chairs (Session 3.1)

In Investigation 3, students are introduced to arrays to represent multiplication. They use arrays to learn multiplication combinations with products to 50 and to find factors of numbers up to 50. In this activity, students are introduced to arrays to represent multiplication.

- Read the Activity, Introducing Arranging Chairs, pp. 83-84. Work with a partner to complete Resource Master M15, Arranging Chairs. Use cubes to make all of the possible arrays for the number 24. Choose a second number (some participants should do 19 and some should do 36) and repeat the activity.

Discuss

- How does the *Arranging Chairs* activity help students in making sense of the commutative property of multiplication?
- What characteristics of numbers do students encounter as they make arrays for different numbers (e.g. 19 or 36?)

- Read the Dialogue Box, *Finding the Number of Squares in an Array*, p. 174.

Discuss

- In the Dialogue Box, *Finding the Number of Squares in an Array*, what ideas about arrays and multiplication does the teacher focus on?

5. Multiply or Divide? (Session 4.2)

In Investigation 4, students examine the inverse relationship between multiplication and division. They are introduced to division notation. They write story problems for a class multiplication and division book.

- Look at the “minis” of Student Activity Book pp. 42-43, Story Problems, on p. 122 of Session 4.2. Read the Discussion: *Multiply or Divide?*, pp. 122-124 and the Dialogue Box, *Is It Multiplication or Division?*, p. 175.

Discuss

- What strategies do you think student might use to solve the division problems on these Student Activity Book pages?
- How does the Multiplication and Division Chart shown on p. 124 help students understand the relationship between multiplication and division?

6. Wrap Up

- Look back at the unit overview, pp. 8-9.

Discuss

- How do the activities done during this unit study fit into the overall mathematical storyline of the unit?

Other Key Features of *Equal Groups*

- Algebra Connections in This Unit, pp. 16-17
- Classroom Routine and Ten-Minute Math in This Unit, p. 18
 - What's the Temperature?*
 - What Time is It?*
 - Counting Around the Class*
- Assessment
 - Solving Problems About Our Pictures, (Session 1.4)
 - Teacher Note, pp. 149-151
 - Counting Around the Class, (Session 2.5)
 - Teacher Note, pp. 155-156
 - End-of-Unit Assessment (Session 4.7)
 - Teacher Note, pp. 165-169

Unit Guide for Grade 3, Unit 6:
Stories, Tables and Graphs
Patterns and Functions



Unit Guide for Grade 3, Unit 6

Stories, Tables, and Graphs

Pattern and Functions

Unit Summary:

Students use tables and line graphs to show changes over time. These include representations of functions involving constant change that can be described by mathematical rules and functions involving variable changes that cannot, such as temperature over time. Students interpret graphs to describe and compare temperature trends. They also compare different situations of constant change. In addition, students construct, describe, and extend visual and number sequences.

Materials:

Stories, Tables and Graphs (1 copy per person)

Student Activity Book pp. 7-10, Temperatures Over a Year (1 per person)

Student Activity Book, pp. 15-18, Summer Days (1 per pair)

Student Activity Book p. 27, Cube Patterns: Red, Blue, Green (1 per pair)

Cubes (a set available for use)

Student Activity Book p. 44, Bolar's Marbles (1 per pair)

Student Activity Book pp. 53-55, Comparing Tovar, Winger, and Jorad (1 per pair)

Do the following activities from *Stories, Tables, and Graphs*:

1. Identify the mathematics in the unit

To get an overview of the mathematics students will be doing in this unit, refer to these sections in the unit front matter. As you look at these sections, begin thinking about the main mathematical ideas students work on in this unit.

- Turn to pp. 8-9, *Overview of This Unit*. Look at the title of each Investigation and read the summary for each Investigation.
- Review the *Mathematics in This Unit* essay, pp. 10-13. Look at the Mathematical Emphases and Math Focus Points. (The emphases are numbered, and can be found above bulleted lists of Math Focus Points.)
- Read the “Benchmarks in This Unit” in the table on p. 15, *Assessing the Benchmarks*.

Discuss

- What mathematical ideas and skills are students working on in this unit?
- What mathematics are students expected to know at the beginning of the unit? At the end?

2. Temperature Differences (Session 1.2)

In Investigation 1, students read, describe, and represent temperature graphs from different locales. They consider the overall shape of the graph and how the temperature changes over a certain amount of time. In this session, students describe the overall trends shown by the shape of a line graph and find changes in temperature.

- Read the Discussion, *The Shape of the Graph*, pp. 33-34.
- Read the Activity, *Temperature Differences*, pp. 34-37, answering questions that are posed in the text. Complete Student Activity Book pp. 7-10, *Temperatures Over a Year*.
- Read the Teaching Note, “Arm Movements,” p. 34, and the Math Note, “Two Points at the Same Location on a Graph,” p. 37.

Discuss

- How does this activity support students in understanding and interpreting information in a graph?
 - How would you describe the general trend of the temperature change on the graph?
 - What questions or confusions might arise for students as they work on these sheets?
- Read the Teacher Note, *Using Line Plots to Represent Change*, pp. 117-118 and the Dialogue Box, *The Shape is Kind of Slanted*, pp. 143-144.

Discuss

- In what way is this work different from reading and interpreting graphs that show frequency?
- How do students in the Dialogue Box describe the overall trend of the graph?

3. Summer Days (Session 1.4)

Students match stories to temperature graphs by considering how features of the story match the overall shape of the graph.

- Read and do the Activity, *Summer Days*, p. 45. With a partner, complete Student Activity Book pp. 15-18, *Summer Days*.
- Read the Discussion, *Matching Stories*, p. 46.

Discuss

- What information in the story did you use to match it with one of the graphs?
- How does this activity support students in reading and interpreting graphs that represent change over time?
- How might you support students who are having difficulty with this activity?

4. Cube Patterns (Session 2.1)

In this Investigation, students work with a repeating pattern of connecting cubes with a unit of red-blue-green. They determine the number of sequences for each of the different colors in the pattern using what they know about multiples of 3.

- Read the Discussion, *Numbering Repeating Patterns*, pp. 57-58. Work with a partner to complete Student Activity Book p. 27, Cube Patterns: Red, Blue, Green.
- Read the Activity, *Cube Patterns*, pp. 58-60.

Discuss

- Share your solutions on Student Activity Book p. 27.
- How did you determine the element of the pattern associated with the particular counting number? (e.g. What color is the 13th cube?) What tools or representations did you use?
- How could students use a number line, hundreds chart or cubes to help them solve these problems?

- Read the Teacher Note, *Repeating Patterns and Counting Numbers*, pp. 124-125.

Discuss

- What strategies for finding the 25th cube in a red-blue-green pattern are described in this Teacher Note?
- What are some of the math ideas students are working on as they work to associate counting numbers with the elements in a repeating pattern?

5. Representing Marble Stories (Session 3.1)

In Investigation 3, students work with a situation with a constant rate of change in a story context in which students receive a certain number of marbles every night.

- Read the Activity *The Magic Marbles of Rhomaar*, pp. 79-80 to see how this context is introduced to students.
- Do Activity 2, *Representing Marble Stories*, p. 81- 82. Work with a partner to complete Student Activity Book p. 44, Bolar's Marbles.

Discuss

- What kind of representations did you make?
- What did you discuss with your partner as you made your representation?
- What range of representation do you think you might see as your students work on their representations?

- Read the Discussion *Comparing Representations*, pp. 83-84, and the Teacher Note, *Students' Representations of Change*, pp. 126-127.

Discuss

- How could this fantasy situation support students as they work to understand and describe situations with a constant rate of change?
- How do students describe the relationship between two quantities in a situation with a constant rate of change?

6. Using a Table to Compare (Session 3.3)

Students use a table to represent and compare two situations with a constant rate of change. They develop rules that describe the relationship between two variables (the number of days and the total number of marbles).

- Do the Activity, *Using a Table to Compare*, pp. 93-94. Work with a partner to complete Student Activity Book pp. 53-55, Comparing Tovar, Winger, and Jorad.

Discuss

- How did you figure out the number of marbles on Days 5, 10, 15 and so on?
- How would you describe how the number of marbles changes over time for each child on Rhomaar?
- What rule did you write for figuring out the number of marbles Winger has on any given day?

- Read the Teacher Note, *Using and Interpreting Tables*, pp. 128-129.

Discuss

- How does this activity support students in understanding and using information in a table?
- What might students learn from the table about the change in marbles over time?

7. Wrap Up

- Look back at the unit overview, pp. 8-9.

Discuss

- How do the activities done during this unit study fit into the overall mathematical storyline of the unit?

Other Key Features of *Stories, Tables and Graphs*

- Algebra Connections in This Unit, pp 16-17
- Classroom Routines and Ten Minute Math in This Unit, p. 18
 - What's the Temperature?*
 - Guess My Rule*
 - Today's Number*
- Assessment
 - A Summer Day in Cairo, Egypt (Session 1.5)
 - Teacher Note, pp. 119-123
 - End-of-Unit Assessment (Session 3.7)
 - Teacher Note, pp. 134-142

Unit Guide for Grade 3, Unit 7:
Finding Fair Shares
Fractions and Decimals



Unit Guide for Grade 3, Unit 7

Finding Fair Shares

Fractions and Decimals

Unit Summary:

Using a variety of contexts (rectangles representing “brownies,” pattern block “cookies,” and groups of objects), students develop their understanding of fractions as representing equal parts of a whole. They work with commonly used fractions and their equivalencies (e.g., $\frac{3}{6}$ and $\frac{2}{4}$ both equal one-half of the same whole) and use fractions and mixed numbers as they solve sharing problems and build wholes from fractional parts. They are introduced to decimal fractions in the context of money and gain familiarity with decimal equivalents for one-fourth and one-half.

Materials:

Finding Fair Shares (one per person)

Student Activity Book pp. 1-2, Sharing One Brownie (1 per person)

Resource Master M6, Large Brownies (1 per person)

Student Activity Book p. 8, Sharing 12 Things (1 per person)

Pattern Blocks (One set, a handful per pair)

Student Activity Book p. 18, Hexagon Cookies (1 per person)

Student Activity Book p. 33-34, Sharing With and Without a Calculator (1 per person)

Do the following activities from *Fair Shares*:

1. Identify the mathematics in the unit

To get an overview of the mathematics students will be doing in this unit, refer to these sections in the unit front matter. As you look at these sections, begin thinking about the main mathematical ideas students work on in this unit.

- Turn to pp. 8-9, *Overview of This Unit*. Look at the title of each Investigation and read the summary for each Investigation.
- Review the *Mathematics in This Unit* essay, pp. 10-13. Look at the Mathematical Emphases and Math Focus Points. (The emphases are numbered, and can be found above bulleted lists of Math Focus Points.)
- Read the “Benchmarks in This Unit” in the table on p. 15, *Assessing the Benchmarks*.

Discuss

- What mathematical ideas and skills are students working on in this unit?
- What mathematics are students expected to know at the beginning of the unit? At the end.

2. One Brownie to Share (Session 1.1) and Fractions of 12 (Session 1.4)

In Investigation 1, students work with unit fractions, looking at parts that make up a single whole as well as a set of objects that are a fraction of a group. In Session 1.1, students use an area model for fractions, finding fractions by dividing one brownie into different shares. In Session 1.4, students use a set model for fractions, dividing groups into equal parts.

- Read the Activity, *One Brownie to Share*, pp. 25-27, answering the questions as they're posed in the text. Use Resource Master M6, Large Brownies, to complete Student Activity Book pp. 1-2. Label each fraction and consider how students might divide these up for the first time.
- Read the Activities, *Introducing Fractions of 12*, and *Fractions of 12*, pp. 44-45 in Session 1.4. Solve the problems on Student Activity Book p. 8, Sharing 12 Things.
- Read the Math Note, "Fractions of a Set of Objects," p. 44.

Discuss

- In what ways is it different to find a fraction of a brownie than to find a fraction of a set?
- What kind of pictures or models help to identify fractions in both activities?
- What knowledge of fractions do you need in order to find $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, etc?

- Read the Teacher Note, *Why Are Fractions so Difficult? Developing Meaning for Fractions*, pp. 109-110.

Discuss

- What are some of the important ideas students need to understand about fractions?
- What are some confusions students often bring to their work with fractions?

3. Cutting Up Cookies (Session 2.1) and Writing Equations (Session 2.1)

In Investigation 2, students build their knowledge of fraction equivalencies as they represent whole and fractional qualities with pattern blocks. In this session, students use pattern blocks to make one whole with combinations of halves, thirds, and sixths.

- Read the Activity, *Cutting Up Cookies*, pp. 61-64. Complete Student Activity Book p. 18, Hexagon Cookies, including writing the corresponding fraction for each of the pattern block pieces. Read the Teaching Note, "Same or Different," p. 63.
- Read the Activity, *Writing Equations*, pp. 64-65. Write the equations for each of your hexagon "cookies."

Discuss

- What equivalent fractions do you notice in your equations? (For example: $\frac{2}{3} + \frac{1}{3} = 1$ and $\frac{4}{6} + \frac{2}{6} = 1$).
- What other relationships among the fractions do you notice?

- Read the Teacher Note, *Visualizing Fraction Equivalencies*, pp. 113-114.

Discuss

- How do the “cookies” and “brownies” help students identify equivalent fractions?

4. Sharing With and Without a Calculator (Session 3.2)

In Investigation 3, students are introduced to decimals. In this session, students discuss the meaning of equivalent fraction and decimal notation, using problems about dividing money. They examine the relationship of fractions and decimals by solving problems both with and without a calculator.

- Look at Problem 4 on the “mini” of the Student Activity Book on p. 94. Read the Discussion, *Fractions and Decimals*, pp. 97-99.
- Complete, Student Activity Book pp. 33-34, Sharing With and Without a Calculator.

Discuss

- How do the fractions and decimal answers relate to one another?
- How might students make sense of these equivalencies?

- Read the Dialogue Box, *Sharing Dollars*, p. 123

Discuss

- What are students finding out about the relationship between fractions and decimals?

5. Wrap Up

- Look back at the unit overview, pp. 8-9.

Discuss

- How do the activities done during this unit study fit into the overall mathematical storyline of the unit?

Other Key Features of *Finding Fair Shares*

- Classroom Routines and Ten Minute Math in This Unit, p. 16
 - What's the Temperature?*
 - Today's Number*
 - What Time Is It?*
- Assessment
 - Sharing Four Brownies (Session 1.6)
 - Teacher Note, pp. 111-112
 - Many Ways to Make a Share (Sessions 2.3-2.4)
 - Resource Master M17, Assessment Checklist
 - End-of-Unit Assessment (Session 3.4)
 - Teacher Note, pp. 115-119

Unit Guide for Grade 3, Unit 8:
How Many Hundreds? How Many Miles?
Addition, Subtraction, and the Number System



Unit Guide for Grade 3, Unit 8

How Many Hundreds? How Many Miles?

Addition, Subtraction, and the Number System

Unit Summary:

Students refine their addition strategies with problems involving any three-digit numbers as they identify and name these strategies. They continue to solve a variety of subtraction problems and examine their strategies for subtracting any two- and three-digit numbers. Students extend their work with place value by estimating the sum of three-digit numbers (Will the sum be more or less than 400?) and adding and subtracting multiples of 10 and 100 to and from three-digit numbers. Students are assessed on fluency with multiplication facts and subtraction facts.

Materials:

How Many Hundreds? How Many Miles? (1 copy per person)

Resource Master M9, 100 Grids (2 per person)

Student Activity Book pp. 2-4, Paper Clip Problems (1 copy per person)

Student Activity Book p. 11, Related Subtraction Problems (1 copy per person)

Student Activity Book pp. 22-24, Addition Starter Problems (1 copy per person)

Student Activity Book p. 45, Write and Solve a Subtraction Problem 1 (1 copy per person)

Do the following activities from *How Many Hundreds? How Many Miles?*:

1. Identify the mathematics in the unit

To get an overview of the mathematics students will be doing in this unit, refer to these sections in the unit front matter. As you look at these sections, begin thinking about the main mathematical ideas students work on in this unit.

- Turn to pp. 8-9, *Overview of This Unit*. Look at the title of each Investigation and read the summary for each Investigation.
- Review the *Mathematics in This Unit* essay, pp. 10-13. Look at the Mathematical Emphases and Math Focus Points. (The emphases are numbered, and can be found above bulleted lists of Math Focus Points.)
- Read the “Benchmarks in This Unit” in the table on p. 15, *Assessing the Benchmarks*.

Discuss

- What mathematical ideas and skills are students working on in this unit?
- What mathematics are students expected to know at the beginning of the unit? At the end?

2. Paper Clip Problems (Session 1.1) Related Subtraction Problems (Session 1.3)

Students use the context of paper clips packed in boxes of 100 to solve problems in which they subtract 2- and 3-digit numbers from multiples of 100. They later solve sets of related problems that involve subtracting from multiples of 100 and numbers near multiples of 100.

- Read the Activity, *Introducing Paper Clip Problems*, pp. 31-33. Complete Student Activity Book pp. 2-4, Paper Clip Problems. Use 100 grids and/or number lines to represent your solutions.

Discuss

- How do number lines and 100 grids help students visualize what is happening in these problems?
- How can these representations help them visualize how problems like $200 - 12$ and $100 - 12$ are related?

- Read the Activity, *Related Subtraction Problems* pp. 43-45. Solve Problem Sets 3 and 4 on Student Activity Book p. 11, Related Subtraction Problems. Use number lines, 100 grids, or other representations to show the relationships among the problems within each set.

Discuss

- What are the relationships among the four problems in Set 4? How do your representations highlight these relationships?

3. Are These Equal? (Session 2.1) Making Representations (Session 2.1)

Students examine, represent, and discuss equivalent expressions, such as $96 + 145$ and $100 + 141$.

- Read the Discussion, *Are These Equal?*, pp. 65-66. Make a representation to show that $88 + 105 = 90 + 103$. Use number lines, drawings, or 100 grids to help you show why adding an amount to one addend and subtracting the same amount from the second addend does not change the sum. When you have finished, share solutions with a partner or in your small group.
- Read the Discussion, *How Do You Know It Is True?*, pp. 69-71, the Algebra Note, “Making Generalizations” p. 67, and the Dialogue Box, *Are These Equal?*, p. 178.

Discuss

- How do number lines, other representations, and story contexts help students explain the mathematics of making equivalent problems in addition?
- How do these contexts and representations help children to start making generalizations about creating equivalent problems in addition?

4. Addition Starter Problems (Session 2.2) Categorizing Addition Strategies (Session 2.3)

Students solve addition problems with 3-digit numbers by using different first steps. After solving more addition problems, they share and discuss their strategies and classify them according to how each strategy starts.

- Read the Activity, *Addition Starter Problems*, pp. 75-76. Solve the problems on Student Activity Book pp. 22-24, Addition Starter Problems, following the directions on each page.
- Read the Teacher Note, *Addition Strategies*, pp. 152-154.

Discuss

- What addition strategies did you use as you solved these problems?
 - Did the numbers in each problem influence the starter problem you chose to help you solve the problem? If so, how?
 - What accommodations could you make for students who find these problems too challenging? For students needing more of a challenge?
- Read the Discussion, *Categorizing Addition Strategies*, pp. 81-84 and the Math Note, “The U.S. Standard Algorithm”, p. 84.

Discuss

- What two broad categories do student strategies fall under?
 - Where would you place the following first steps for the problem $548 + 253$? Why?
- $500 + 200 = 700$ $548 + 2 = 550$ $540 + 250 = 790$ $548 + 200 = 748$

5. Solving a Subtraction Problem (Session 3.3)

Students write and solve a story about a 3-digit subtraction problem. They discuss their solutions and ways to represent their strategies.

- Complete the work on Student Activity Book p. 45, Write and Solve a Subtraction Problem
- 1. Read the Discussion, *Breaking Apart Numbers to Subtract*, pp. 118-121.
- Read the Teacher Note, *Subtraction Strategies*, pp. 163-164.

Discuss

- What type of subtraction problems did the people in your group write (removal, comparison, missing part)?
- What strategies did you use to solve them (subtracting in parts, adding up, subtracting back, changing one or both numbers)?
- How can a number line representation help students visualize the strategies of subtracting in parts, adding up, or subtracting back?
- Can you use a number line to show what happens when you change one or both numbers to solve the problem?

6. Wrap Up

- Look back at the unit overview, pp. 8-9.

Discuss

- How do the activities done during this unit study fit into the overall mathematical storyline of the unit?

Other Key Features of *How Many Hundreds? How Many Miles?*

- Algebra Connections in this Unit, pp. 16-19
- Classroom Routine and Ten-Minute Math in This Unit, p. 20
 - What's the Temperature?*
 - Guess My Rule*
 - Counting Around the Class*
- Assessment
 - Multiplication Combinations (Session 1.4)
 - Teaching Notes, “About the Assessment”, p. 53; “Explaining the Assessment”, p. 54
 - Teacher Note, pp. 149-151
 - Adding and Subtracting Multiples of 10 and 100 (Session 1.5)
 - Resource Master M24, Assessment Checklist
 - Addition Strategies (Session 2.5)
 - Teacher Note, pp. 156-159
 - Subtraction Strategies (Session 3.3)
 - Teacher Note, pp. 165-167
 - Subtraction Facts (Sessions 3.4 and 3.5)
 - Activity 2C, p. 127
 - End-of-Unit Assessment (Session 3.9)
 - Teacher Note, pp. 171-175

Unit Guide for Grade 3, Unit 9:
Solids and Boxes
3-D Geometry and Measurement



Unit Guide for Grade 3, Unit 9

Solids and Boxes

3-D Geometry and Measurement

Unit Summary:

Students develop ideas about the attributes of 3-D shapes and how these attributes determine classification as they sort and build common geometric solids. Throughout the unit, they move back and forth between 2-D and 3-D as they build and describe 2-D representations of 3-D objects and create 3-D objects from their 2-D representations. They begin to develop important ideas about the measurement of volume as they examine the structure of 2-D box patterns and the number of cubes the 3-D box will hold.

Materials:

Solids and Boxes (one per person)

Geometric Solids (1 set per group of 4-6)

1-inch cubes (2 per person)

Resource Master M16, Inch Grid Paper (4 per person plus extras as needed)

Scissors (1 per person)

Connecting cubes (20 per person)

Resource Masters M21-M25, How Many Cubes?, (1 per person)

Resource Master M27, Three-Quarter Inch Grid Paper, (5 per person, plus extras as needed)

Do the following activities from *Solids and Boxes*:

1. Identify the mathematics in the unit

To get an overview of the mathematics students will be doing in this unit, refer to these sections in the unit front matter. As you look at these sections, begin thinking about the main mathematical ideas students work on in this unit.

- Turn to pp. 8-9, Overview of This Unit. Look at the title of each Investigation and read the summary for each Investigation.
- Review the Mathematics in This Unit essay, pp 10-11. Look at the Mathematical Emphases and Math Focus Points. (The emphases are numbered, and can be found above bulleted lists of Math Focus Points.)
- Read the “Benchmarks in This Unit” in the table on p. 13, Assessing the Benchmarks.

Discuss

- What mathematical ideas and skills are students working on in this unit?
- What mathematics are students expected to know at the beginning of the unit? At the end?

2. Playing What's My Shape? (Session 1.2)

Students develop knowledge of the components of various geometric shapes as they ask questions to identify mystery geometric solids.

- Before beginning, read the Teaching Note, “Teaching This Unit”, on p. 23.
- Read the Activity, *Introducing What's My Shape?*, pp. 29-30. In a small group, play a few rounds of the game, taking turns being the “Chooser.”

Discuss

- What attributes of the solids did you pay attention to as you played this game?
- What questions did you ask that helped you to eliminate certain solids or groups of solids?

- Read the Ongoing Assessment: Observing the Students at Work and Differentiation: Supporting the Range of Learners, p. 31, and the Dialogue Box, *Playing What's My Shape?* p. 108.

Discuss

- What math ideas will you be looking for as students play this game?
- What types of questions will demonstrate to you that your students are attending to important attributes? What types of questions will concern you?
- How will you support students having difficulty moving beyond a description of the shape as a whole?

3. Patterns for 2-Cube Boxes (Session 2.2)

What Do We Notice About Our Patterns? (Session 2.3)

After making patterns for 1-cube boxes, students design patterns for open boxes to hold 2 cubes. They discuss their patterns and consider why they must be composed of either 8 or 9 square units.

- Read the Activity, *Patterns for 2-Cube Boxes*, pp. 57-58. Following the “Open-Box Pattern Rules” p. 54, use the cubes, one-inch grid paper, and scissors to do the activity. Challenge yourself to make as many different box patterns as you can. When you're done, share your patterns with a partner or in your small group.

Discuss

- How many different patterns were you able to make? What strategies did you use to determine whether or not you were duplicating any patterns?
- Did you use cubes to help you or were you able to visualize the patterns without the cubes?

- Read the Discussion, *What Do We Notice About Our Patterns?*, pp. 60-61 and the Dialogue Box, *Making Patterns for the 2-Cube Solid*, p. 112.

Discuss

- In the Dialogue Box, how does the teacher help Dwayne and Jung move from the single “cross pattern” they made to creating other patterns for the 2-cube box?
- How do students explain why some patterns are composed of 8 square units and others are composed of 9?

4. Determining the Number of Cubes in a Box (Session 3.1)
Strategies for Determining the Number of Cubes in a Box (Session 3.1)

Students examine the structure and volume of rectangular prisms by working with patterns for open boxes.

- Read the Activity, *Determining the Number of Cubes in a Box*, pp. 71-72. Solve the problems on Resource Masters, M21-M25, *How Many Cubes?*
- Read the Discussion, *Strategies for Our Boxes*, pp. 78-79 and the Teacher Note, *Strategies for Boxes That Hold 12 Cubes*, p. 100.

Discuss

- What strategies did you use to design your boxes?
- What strategies do you expect your students to use?
- How can knowledge of factors of 12 help students design their boxes?

5. Wrap Up

- Look back at the unit overview, pp. 8-9.

Discuss

- How do the activities done during this unit study fit into the overall mathematical storyline of the unit?

Other Key Features of *Solids and Boxes*

- Classroom Routine and Ten-Minute Math in This Unit, p.14
 - What's the Temperature?*
 - Practicing Place Value*
 - More or Less?*
 - Quick Images: 3-D*
- Assessment:
 - Building Polyhedra from Descriptions (Sessions 1.4 and 1.5)
 - Resource Master M12, Assessment Checklist
 - Writing About How Many Cubes (Session 3.3)
 - Teacher Note, pp. 97-99
 - End-of-Unit Assessment (Session 3.5)
 - Teacher Note, pp. 101-105