Unit 2
The Kitchen Floor: Area and Subproblems

Standards

M/J Mathematics 2

- 1.1 Find area and perimeters of rectangular shapes and non-rectangular shapes.
- 1.2 Develop procedures for finding areas and perimeters of rectangles, parallelograms, triangles, and circles.
- 1.3 Use area and perimeter to solve applied problems.
- 1.6 Use models and representations of models to solve problems.

Algebra I

- 1.1 Simplify expressions with and without grouping symbols.
- 1.2 Use the distributive property to combine similar terms.

Day 1
The Paint Job: Introduction to Subproblems

Connections

Prior Work	Current Big Idea	Future Work
• Find areas and perimeters of rectangles. • Perform arithmetic operations with positive and negative rational numbers.	• Introduction to the strategy of breaking larger problems into more manageable parts.	• Understanding of area that goes beyond memorizing formulas.

Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
Launch 8-10 minutes	• Read KF-1. • Talk should be confined to clarifying questions.	• Read KF-1 together with students. • Hand out KF-1 Resource Page. • Ask each team to put their pencils down and plan on how they will solve the problem. • Analyze strategies needed: finding area, using a scale, measuring. • Remind students of the format of writing a mathematics problem: ✓ Restate the problem ✓ Show work or process ✓ State the solution together with any extension. • Ask each team to complete KF-1 and KF-2. • Student might want to work on KF-1	• Do not dictate the strategies or steps in find the solution to the problem.

Steps	Student Activity	Teacher Support	Comment/Evaluation
		and KF-2 at the same time.	
Explore 20-30 minutes	• Work on KF-1 and KF-2 with study team. • Each student should complete his/her own individual write-up.	• Suggest that students record all arithmetic calculations in readable format. • Students may need help in working with the scale. • Inform students that they may use calculators. • If teams are spending too much time negotiating the lengths of walls, remind them that they can find the nearest multiple of five. • Do not interrupt each teams creative method of solving the problem. • Did students remember to 'chain' all the parts together for the final solution?	• Regardless of how the team solves the problem, and regardless of whether the team finds the 'correct' answer, they will be forced to break the problem down into smaller pieces. • Take notice of the different strategies each team is using to come to a solution so that orchestration can be used for the presentation of strategies for summarization.
Summarize 10-15 minutes	• Share strategies used in solving KF-1 with class.	• Select teams to present strategies and solutions for KF-1. • Teams do not have to present every step for the entire problem, they need only to present the different strategies used.	• Solutions may vary slightly due to estimations and rounding. • Focus student attention on the different strategies used in breaking up a problem into subproblems. • Emphasize that one problem solving strategy is to break a complicated problem into smaller pieces.
Homework	• KF-5, KF-6, KF-7, KF-8, KF-9 • Add definition for 'subproblems' to the		

Steps	Student Activity	Teacher Support	Comment/Evaluation
	tool kit.		

Day 2
Area of Triangles and Subproblems

Connections

Prior Work	Current Big Idea	Future Work
• Find area of rectangles. • Use subproblems as a problem solving strategy.	• Understanding of area that goes beyond memorizing formulas	• Develop procedures for finding areas of various two dimensional geometric figures. • Breaking rectangles into smaller pieces for demonstrating the distributive property.

Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
Launch 10-15 minutes	• Read PZL-11. • Follow teacher on vase assembly.	• Ask students to read PZL-11. • Start with the vase (Resource Page) assembled on the overhead. • Challenge the student to consider how to rearrange the pieces to make a square. • Ask students to come to the overhead and demonstrate. • **"Which has more area, the vase or the Square? Why?"** • Regardless of how the pieces are moved around, the area remains the same. • Do not spend more than 5 minutes on	• Move teams to KF-11. • Let teams discuss the problem first and decide how to attack it.

Steps	Student Activity	Teacher Support	Comment/Evaluation
		this activity. • Move to KF-11, KF-12, and KF-13.	
Explore 15-20 minutes	Work on KF-11, KF-12, and KF-13 with team.	• Let team discuss the problem first and decide how to attack it. • Teams that remain stuck might e asked, **"What shapes can you find the area of?"** • **"Do you see any of them?"**	• Students need to see that there are often several different ways to break up figures in to shapes they are familiar working with.
Summarize 15-20 minutes	• Follow teacher's lead in working with the triangles form the Resource Page. • Enter the formula for finding the area of a triangle together with an explanation on how to use the formula in the tool kit. • Post the different strategies of breaking up a figure for easy solutions.	• Work together with students on KF-14. • **"How do you find the area of a rectangle?"** • Area = base x height. • **"Does this work for all rectangles?"** • Show figure b) from KF-14 on the overhead. • **"What fraction of the rectangle is ∆ABE?"** • Ask each member of the team to choose one of the figures on the resource page. • Compare the areas of the shaded portion to the area of the white portion. • Complete the formulas for finding the area of a triangle. • Ask students to enter the formula and an explanation or example of how to find the area of a triangle for their tool kit.	• Have students post the different strategies of breaking up a figure for easy solutions.

Steps	Student Activity	Teacher Support	Comment/Evaluation
Homework	KF-16, KF-18, KF-19, KF-20, KF-21		

Day 3
Area and Circumference of Circles

Connections

Prior Work	Current Big Idea	Future Work
• Find areas of rectangles.	• Investigate the circumference and areas of circles.	• Develop procedures for finding areas of various two dimensional geometric figures.

Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
Launch 8-10 minutes	• Record definitions of circle, center, radius, and diameter for the tool kit.	• Sketch circle and give definitions for circle, center of circle, radius, and diameter. • Each study team should have string, circular items (cups, jar tops, etc.) rulers, scissors.	• Hands-on investigations take time.
Explore 15-20 minutes	• Complete KF-23. • Find method of computing class average for part c. • Complete KF-24.	• Help students measure circumference for difference circular item properly. • Teams should create a way to compute a class average for part c. • The average should be close to p . • Provide closure for KF-23 with a discussion about p . • Reinforce the fact that p is a constant	• Students have encountered the formula for finding the circumference of a circle, the purpose of the lesson is to give students time to discover the formulas and view them in a logical manner, • Student will not automatically

Steps	Student Activity	Teacher Support	Comment/Evaluation
	• Complete KF-25 and KF-26.	and that we would get the same result no matter what the size of the circle. • Be sure that students write a summary of how to find a circumference given a radius or diameter. • Distribute Resource Page for KF-25. • Students may need help in finding the base of the rectangular shape. • Help students complete KF-25.	know that if $\frac{C}{d} = \pi$, then $C = \pi d$.
Summarize 10-12 minutes	• Share findings with class.	• Discuss the idea that if the circle is partitioned into smaller and smaller sectors, the 'shape' will more and more resemble a rectangle. • Do not formalize the notion of 'limits.'	• Each team should decide on how to phrase their response for KF-26.
Homework	KF-27, KF-28, KF-30		

Day 4
Circles and Subproblems

Connections

Prior Work	Current Big Idea	Future Work
• Find areas of rectangles. • Find circumferences and areas of circles.	• Find solutions to problems by breaking problem into subproblems.	• Algebra tiles as areas of rectangles.

Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
Launch 10-15 minutes	• Add definition of circumference of circle and formula for finding circumference in tool kit. • Add definition of area of circle and formula for finding the area in tool kit.	• Help student complete items for tool kit. • Two formulas are given for finding the circumference of a circle. Are they ($2\pi r$ and πd) the same?	• Remind students about the various approximations used for π.
Explore 20-25 minutes	• Complete KF34, KF-35, KF-36	• Give students an opportunity to decide how to encounter the problems.	• Are students using the strategy of breaking given problems into subproblems?
Summarize 10-12 minutes	• Discuss strategies for solving the burner problem. • Add definition and example for substitution in the tool kit.	• Discuss strategies for solving the burner problem. • Demonstrate one or two problems from KF-31.	

Steps	Student Activity	Teacher Support	Comment/Evaluation
Homework	KF-39, Kf-40, KF-41, KF-42, KF-43		

Day 5
Circles and Subproblems

Connections

Prior Work	Current Big Idea	Future Work
• Find areas of rectangles. • Find circumferences and areas of circles.	• Apply the strategy of breaking larger problems into more manageable parts.	• Apply area of rectangles to algebra tiles.

Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
Launch 5-8 minutes	• Read KF-45.	• Read KF-45 with students.	
Launch 25-30 minutes	• Complete KF-45 and KF-46.	• Read problem carefully. There is a difference between KF-45 and KF46. • Suggest that teams strategize for the first five minutes. • Resist the urge to give hints until teams have tried the problem. • Guide students in recording their findings systematically. • Are students able to describe the procedures use in clear language?	• Give students ample time to strategize. • Students may question the length of the radius for the small semi-circle. • Good time to discuss the notion of not taking diagrams at face value just because it is drawn a certain way. • Students may want to assign the radius of the small semi-circle as being half the length

Steps	Student Activity	Teacher Support	Comment/Evaluation
			of the square.
Summarize 8-10 minutes	• Present strategies used in completing KF-45 or KF-46.	• Students may present only the strategies for completing the problem but not present all numerical calculations.	
Homework	KF-47, KF-48, KF-49, KF-50, KF-51		

Day 6
Grouping and the Distributive Property

Connections

Prior Work	Current Big Idea	Future Work
• Find areas of rectangles.	• Use areas of rectangles as a method of demonstrating the Distributive Property.	• Use of Distributive Property to rewrite given expressions.

Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
Launch 10-12 minutes	• Follow as teacher demonstrate multiplication of monomials with algebra tiles. • Work with teacher on KF-54.	• Model the multiplication of monomials with algebra tiles. • Use algebra tiles to model $4(2x) = 8x$ $x(2x) = 2x^2$ • Work with class on KF-45.	• A restating of the dimensions for each algebra tile might be helpful at the beginning of the lesson.
Explore 20-25 minutes	• Complete KF-55, KF-56, KF-57	• Give brief demonstration of KF-55. • Start by placing 3 'x's and 12 '1's on the overhead. • Arrange the tiles into a rectangle and then split the rectangle in two ways to show the different possible grouping as shown in KF-55. • Emphasis that the variable x is a symbol for **any** strip length one might	• The Distributive Property will be revisited in depth in Days 7 and 8.

Steps	Student Activity	Teacher Support	Comment/Evaluation
		choose. • Help students summarize their observations. • Student may prefer to use algebra tiles to rewrite KF-58. • Allow plenty of time for students to abstract the Distributive Property.	
Summarize 5 minutes		• When the same tiles are grouped differently, the area remains the same.	
Homework	KF-60, KF-62, KF-63, KF-64		

Day 7
Developing the Distributive Property

Connections

Prior Work	Current Big Idea	Future Work
• Represent multiplication of monomials with algebra tiles.	• Rewrite given expressions using the Distributive Property.	• Factor polynomials.

Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
Launch 10-12 minutes	• Complete KF-66 with teachers.	• Complete KF-66 with students. • Model expressions by drawing or using algebra tiles.	• Develop full understanding of distributive Property.
Launch 20-30 minutes	• Complete KF-67, KF-68, KF-69, KF-70, KF-71, KF-72	• In KF-71, 4 and 8 have more than one common factor. • Guide students in recording their findings systematically for KF-72. • Are students able to describe the procedures use in clear language?	• Introduction of using the Distributive Property for factoring.
Summarize 10 minutes	• Discuss the solutions for KF-71.	• Discuss the solutions for KF-71.	

Steps	Student Activity	Teacher Support	Comment/Evaluation
Homework	KF-74, KF-75, KF-76, KF-77		

Day 8
Using the Distributive Property

Connections

Prior Work	Current Big Idea	Future Work
• Find areas of rectangles. • Rewrite expressions using the Distributive Property.	• Solve Distributive Property problems using the Generic Rectangle. • Rewrite expressions using the Distributive Property.	• Factor polynomials.

Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
Launch 10-12 minutes	• Add the informative related to the Distributive Property to the tool kit. • Follow teacher in simplifying expressions using the proper order of arithmetic operations.	• Assist students in adding information related to the Distributive Property to their tool kit. • Model and review the order of operations $7\times 9 + 3$ $= 63 + 3$ $= 66$ $5(7 + 6) – 8^2$ $= 5(7 + 6) – 64$ $= 5(13) – 64$ $= 54 – 64$ $= -10$	• The "=" between steps are missing in the text. Unless the "=" are present, each line is an individual expression and the transitive property cannot be used to justify that the first expression is equivalent to the last.

Steps	Student Activity	Teacher Support	Comment/Evaluation
Explore 25-30 minutes	• Add example for order of operations in tool kit. • Complete KF-94, KF-95	• Guide students in completing problems step by step. • Help students understand that multiplication and division first means complete the multiplication and division from left to right. It does not mean that multiplication is completed first, then division. • Remind students about the use of "=" signs.	• Students should be familiar with scientific notation from previous mathematics classes or science classes.
Summarize 5 minutes	• Demonstration of arithmetic calculations.	• Student demonstration of completed problems.	
Homework	KF-87, KF-88, KF-89, KF-90, KF-100, KF-101, KF-102		

Day 9
Tiling the Kitchen Floor

Connections

Prior Work	Current Big Idea	Future Work
• Find areas of rectangles. • Find circumferences and areas of circles.	• Apply the strategy of breaking larger problems into more manageable parts. • Rewrite expressions using the Distributive Property.	• Apply the strategy of breaking larger problems into more manageable parts. • Rewrite expressions using the Distributive Property.

Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
Launch 10-12 minutes	• Read KF-106.	• Read KF-16 with students.	• Back to the theme problem.
Explore 30-35 minutes	• Complete KF 106 and KF-107.	• Be prepared to clarify vocabulary. • Expect the problem to take all period. • Guide students in recording information and calculations systematically. • Help students write procedures and explanations in clear sentences.	• Students should apply strategy of breaking problem into subproblems.
Summarize	• Read PZL-12	• Discuss PZL-12.	

Steps	Student Activity	Teacher Support	Comment/Evaluation
5-10 minutes		• Student may have time to start KF-108 or KF-111.	
Homework	KF-108, KF-109, KF-110, KF-111		

Day 10
Unit Summary and Review

Connections

Prior Work	Current Big Idea	Future Work
• Apply the strategy of breaking larger problems into more manageable parts. • Rewrite expressions using the Distributive Property.	• Consolidation of concepts and skills from the unit. • Construct summary of unit.	• Write summaries for given units.

Lesson Process

Steps	Student Activity	Teacher Support	Comment/Evaluation
Launch 10-12 minutes	• Follow teacher's explanation and demonstration of process for completing summaries.	• Today is a day for consolidation. It is NOT a "review" day. • Explain the process for completing a summary. • Student do not necessarily have to complete summaries on posters. They may use transparencies or just notebook paper.	• Summaries need to be share with entire class.
Explore 15-20 minutes	• Complete given assigned problems. • Prepare problem for presentation to class.	• Assign one problem from KF-115 through KF-126 to each study team. • Guide student in writing procedures and explanations in clear language.	

Steps	Student Activity	Teacher Support	Comment/Evaluation
Homework	• Problems KF-115 through KF-126 not assigned for summary.		