Focus Questions

Background

The student book is organized around three to five investigations, each of which contain three to five problems and a Mathematical Reflection that students explore during class.

In the Teacher Guide the Goals for each unit include two to four big concepts with an elaboration of the essential understandings for each.

In the Teacher Guide, a Focus Question is provided for each problem in an investigation. The Focus Question collapses the mathematical understandings and strategies embedded in the problem into one overarching question. The teacher can use the Focus Question to guide his/her instructional decisions throughout his/her planning, teaching, and reflections on student understanding.

Description

The Goals of the unit describe the mathematics content developed in the unit. The Focus Questions provide a story line for the mathematical development of an investigation. The set of Mathematical Reflections in the student book provide a story line for the mathematical development of the unit. The following contain all of the Goals, Focus Questions and Mathematical Reflections for each unit in CMP3.

Purpose

These stories can serve as an overview of the unit and as a guide for planning, teaching and assessing.

The Goals, Mathematical Reflections, and Focus Questions can be laminated and used a bookmark for the Teacher.

8-4: Frogs, Fleas and Painted Cubes

Unit Goals, Focus Questions, and Mathematical Reflections

Unit Goals

Quadratic Functions **Explore problem situations in which two variables are in a quadratic relationship**

- Identify situations that can be modeled by quadratic functions
- Identify the pattern of change between two variables that represent a quadratic function in a situation, table, graph, or equation
- Determine values of the independent and dependent variables in a quadratic function from a table, graph, or equation
- Represent a quadratic function with a table, graph, and equation
- Make connections among the equation of a quadratic function, its graph, and the patterns of change in its table
- Use a quadratic equation to describe the characteristics of its graph and table
- Determine whether a quadratic function will have a maximum or a minimum point and predict the maximum or minimum point from its equation, graph, or table
- Predict the *x*- and *y*-intercepts from the equation, graph, or table of a quadratic function
- Predict the line of symmetry from an equation, graph, or table of a quadratic function
- Interpret the information that the *x*- and *y*-intercepts and maximum or minimum point represent
- Use an equation, graph, and table to solve problems involving quadratic relationships
- Observe that one quadratic equation can model different contexts
- Compare linear, quadratic, and exponential functions

Equivalence **Develop an understanding of equivalent quadratic expressions**

- Write and interpret a quadratic expression to represent the dependent variable in a quadratic function
- Use an area model to develop an understanding of the Distributive Property
- Use the Distributive Property to write equivalent quadratic expressions in expanded or factored form
- Select and interpret the appropriate equivalent quadratic expression (in factored or expanded form) for predicting the *x*- and *y*-intercepts, maximum or minimum point, and the line of symmetry for a graph of a quadratic function

Focus Questions and Mathematical Reflections

Investigation 1 **Introduction to Quadratic Functions**	**Investigation 2** **Quadratic Expressions**	**Investigation 3** **Quadratic Patterns of Change**	**Investigation 4** **Frogs Meet Fleas on a Cube: More Applications of Quadratic Functions**
Problem 1.1 **Staking a Claim: Maximizing Area** Describe the shape of a graph that represents the areas of rectangles with a fixed perimeter.	**Problem 2.1** **Trading Land: Representing Areas of Rectangles** If the length n of a square is increased by 2 units and its width n decreased by 2 units, what two equivalent expressions represent the area of the new figure?	**Problem 3.1** **Exploring Triangular Numbers** How many dots (or squares) are in the n^{th} triangular number?	**Problem 4.1** **Tracking a Ball: Interpreting a Table and an Equation** How can you predict the maximum height of a ball from the graph of a quadratic function?
Problem 1.2 **Reading Graphs and Tables** How does the maximum area of rectangles with a fixed perimeter appear in a graph or a table?	**Problem 2.2** **Changing Dimensions: The Distributive Property** How does the Distributive Property apply to quadratic expressions? Explain.	**Problem 3.2** **Counting Handshakes: Another Quadratic Function** If each team has n members, how many handshakes will occur?	**Problem 4.2** **Measuring Jumps: Comparing Quadratic Functions** How can you predict the y-intercept of a quadratic function from its graph, table, or equation?
Problem 1.3 **Writing an Equation** How can you write an equation for the areas of rectangles with a fixed perimeter?	**Problem 2.3** **Factoring Quadratic Expressions** What is a method for factoring an expression as a product of two or more factors? How is this related to the Distributive Property?	**Problem 3.3** **Examining Patterns of Change** Describe the pattern of change between the number of people on a team and the number of handshakes that occur.	**Problem 4.3** **Painted Cubes: Looking at Several Functions** When a painted cube with edge length n is separated into n^3 small cubes, how many of these cubes will have paint on three faces? Two faces? One face? No faces?

	Problem 2.4 **Quadratic Functions and Their Graphs** How can you use a quadratic equation to predict the x- and y-intercepts, maximum/minimum points, and line of symmetry of its graph?	**Problem 3.4** **Quadratic Functions and Patterns of Change** Compare the pattern of change for a quadratic function to the patterns of change for linear and exponential functions.	**Problem 4.4** **Putting It All Together: Comparing Functions** What can you learn about a function from a table, graph, or equation that represents the function?
Mathematical Reflection 1. a. Describe the characteristics of graphs and tables of quadratic functions you have observed so far. b. How do the patterns in a graph of a quadratic function appear in the table of values for the function? 2. Describe two ways to find the maximum area for rectangles with a fixed perimeter. 3. How are tables, graphs, and equations for quadratic functions different from those for linear and exponential functions?	**Mathematical Reflection** 1. Explain how you can use the Distributive Property to answer each question. Use examples to help with your explanations. a. Suppose a quadratic expression is in factored form. How can you find an equivalent expression in expanded form? b. Suppose a quadratic expression is in expanded form. How can you find an equivalent expression in factored form? 2. Describe what you know about the shape of the graph of a quadratic function. Include important features of the graph and describe how you can predict these features from the equation of the function.	**Mathematical Reflection** 1. a. In what ways is the triangular-number relationship similar to the relationships in the handshake problems? In what ways are these relationships different? b. In what ways are the quadratic functions in this Investigation similar to the quadratic functions in Investigations 1 and 2? In what ways are they different? 2. a. In a table of values for a quadratic function, how can you use the pattern of change to predict the next value? b. How can you use a table of values to decide if a function is quadratic? 3. Compare the patterns of change for linear, exponential, and quadratic functions.	**Mathematical Reflection** 1. Describe three real-world situations that can be modeled by quadratic functions. For each situation, give examples of questions that quadratic representations help to answer. 2. How can you recognize a quadratic function from a. a table? b. a graph? c. an equation? 3. What clues in a problem situation indicate that a linear, exponential, or quadratic function is an appropriate model for the data in the problem?