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.

8-3: Growing, Growing, Growing

Unit Goals, Focus Questions, and Mathematical Reflections

Unit Goals

Exponential Functions **Explore problem situations in which two or more variables have an exponential relationship to each other**

Identify situations that can be modeled with an exponential function
Identify the pattern of change (growth/decay factor) between two variables that represent an exponential function in a situation, table, graph, or equation
Represent an exponential function with a table, graph, or equation
Make connections among the patterns of change in a table, graph, and equation of an exponential function
Compare the growth/decay rate and growth/decay factor for an exponential function and recognize the role each plays in an exponential situation
Identify the growth/decay factor and initial value in problem situations, tables, graphs, and equations that represent exponential functions
Determine whether an exponential function represents a growth (increasing) or decay (decreasing) pattern, from an equation, table, or graph that represents an exponential function
Determine the values of the independent and dependent variables from a table, graph, or equation of an exponential function
Use an exponential equation to describe the graph and table of an exponential function
Predict the y-intercept from an equation, graph, or table that represents an exponential function
Interpret the information that the y-intercept of an exponential function represents
Determine the effects of the growth (decay) factor and initial value for an exponential function on a graph of the function
Solve problems about exponential growth and decay from a variety of different subject areas, including science and business, using an equation, table, or graph
Observe that one exponential equation can model different contexts
Compare exponential and linear functions

Equivalence **Develop understanding of equivalent exponential expressions**

Write and interpret exponential expressions that represent the dependent variable in an exponential function
Develop the rules for operating with rational exponents and explain why they work
Write, interpret, and operate with numerical expressions in scientific notation
Write and interpret equivalent expressions using the rules for exponents and operations

Solve problems that involve exponents, including scientific notation

Focus Questions and Mathematical Reflections

Investigation 1 **Exponential Growth**	**Investigation 2** **Examining Growth Patterns**	**Investigation 3** **Growth Factors and Growth Rates**	**Investigation 4** **Exponential Decay**	**Investigation 5** **Patterns with Exponents**
Problem 1.1 **Making Ballots: Introducing Exponential Functions** What are the variables in this situation and how are they related?	**Problem 2.1** **Killer Plant Strikes Lake Victoria: y-intercepts Other Than 1** What information do you need to write an equation that represents an exponential function?	**Problem 3.1** **Reproducing Rabbits: Fractional Growth Patterns** How is the growth factor in this Problem similar to that in the previous Problems? How is it different?	**Problem 4.1** **Making Smaller Ballots: Introducing Exponential Decay** How does the pattern of change in this situation compare to growth patterns you have studied in previous Problems? How does the difference show up in a table, graph, and equation?	**Problem 5.1** **Looking for Patterns Among Exponents** What patterns did you observe in the table of powers?
Problem 1.2 **Requesting a Reward: Representing Exponential Functions** In what ways are the relationships represented in a chessboard and ballot-	**Problem 2.2** **Growing Mold: Interpreting Equations for Exponential Functions** How is the growth factor and initial population for an exponential function	**Problem 3.2** **Investing for the Future: Growth Rates** How are the growth factor and growth rate for an exponential function related? When might you use each in an	**Problem 4.2** **Fighting Fleas: Representing Exponential Decay** How can you recognize an exponential decay function from a contextual setting, table,	**Problem 5.2** **Rules of Exponents** What are several rules for working with exponents and why do they work?

cutting situations similar? Different?	represented in an equation that represents the function?	exponential growth pattern?	graph, and equation that represents the function?	
Problem 1.3 **Making a New Offer: Growth Factors** How does the growth pattern for an exponential function show up in a table, graph, or equation that represents the function and how does it compare to the growth pattern in a linear function?	**Problem 2.3** **Studying Snake Populations: Interpreting Graphs of Exponential Functions** How is the growth factor and initial population for an exponential function represented in a graph that represents the function?	**Problem 3.3** **Making a Difference: Connecting Growth Rate and Growth Factor** How does the initial population affect the growth patterns in an exponential function?	**Problem 4.3** **Cooling Water: Modeling Exponential Decay** How can you find the initial population and decay factor for an exponential decay relationship?	**Problem 5.3** **Extending the Rules of Exponents** How are the rules for integral exponents related to rational exponents? How are the rules for exponents useful in writing equivalent expressions with exponents?
				Problem 5.4 **Operations with Scientific Notation** How does scientific notation help to solve problems?
				Problem 5.5 **Revisiting Exponential Functions**

				What are the effects of a and b on the graph of $y = a(b^x)$, b ≠ 0.
Mathematical Reflection 1. Describe an exponential growth pattern. Include key properties such as growth factors. 2. How are exponential functions similar to and different from the linear functions you worked with in earlier Units?	**Mathematical Reflection** 1. How can you use a table, a graph, and an equation that represent an exponential function to find the y-intercept and growth factor for the function? Explain. 2. How can you use the y-intercept and growth factor to write an equation that represents an exponential function? Explain. 3. How would you change your answers to Questions 1 and 2 for a linear function?	**Mathematical Reflection** 1. Suppose you know the initial value for a population and the yearly growth rate. a. How can you determine the population several years from now? b. How is a growth rate related to the growth factor for the population? c. How can you use this information to write an equation that models the situation? 2. Suppose you know the initial value for a population and the yearly growth factor. a. How can you determine the population several years from now? b. How can you determine the yearly growth rate? 3. Suppose you know the equation that represents	**Mathematical Reflection** 1. How can you recognize an exponential decay pattern from the following? a. a table of data b. a graph c. an equation 2. How are exponential growth functions and exponential decay functions similar? How are they different? 3. How are exponential decay functions and decreasing linear functions similar? How are they different?	**Mathematical Reflection** 1. a. Describe some of the rules for operating with exponents. b. What is scientific notation? What are its practical applications? 2. Describe the effects of a and b on the graph of $y = a(b^x)$. 3. Compare exponential and linear functions. Include in your comparison information about their patterns of change, y-intercepts, whether the function is decreasing or increasing, and any other information you think is important. Include examples of how they are useful.

		the exponential function relating the population p and the number of years n. How can you determine the doubling time for the population?		