Prime Time

Investigation 1

Standards: Essential for 6.NS.B.4 Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *Problems 1, 2, 3, and 4*

Essential for 6.EE.A.2a Write expressions that record operations with numbers and with letters standing for numbers. *Problem 4*

Essential for 6.EE.A.2b Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *Problem 4*

Essential for 6.EE.A.3 Apply the properties of operations to generate equivalent expressions. *Problem 4*

Objectives:

The Factor Game engages students in a friendly contest in which winning strategies involve distinguishing between numbers with many factors and numbers with few factors. Students are then guided through an analysis of game strategies and introduced to the definitions of prime and composite numbers.

In the Product Game, students find products of factors. Although students develop strategies for winning, the focus is on the multiplicative structure of numbers. Factor pairs are introduced as students find the whole-number dimensions of all rectangles that can be made with n unit squares. This Problem also reinforces basic multiplication facts.

The *Applications —Connections —Extensions* (ACE) provide rich connections to situations in which factors, multiples, prime numbers, and square numbers play a significant role. This Investigation provides an opportunity to assess students' basic understandings of factors and multiples, including their skills in recognizing when a situation calls for a factor or a multiple.

Investigation 2

Standards: 6.NS.B.4 Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *Problems 1, 2, and 3*

Essential for 6.EE.A.2a Write expressions that record operations with numbers and with letters standing for numbers. *Problems 1, 2, and 3*

Essential for 6.EE.A.2b Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *Problems 1, 2, and 3*

Objectives:

We use real-life situations to motivate student interest in common factors and common multiples. The concepts of least common multiple and greatest common factor occur naturally

within the context of the problems. The context of the problems and questions helps make it clear to students whether a solution involves finding a common multiple, a common factor, the least common multiple, or the greatest common factor.

Investigation 3

Standards: 6.NS.B.4 Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *Problems 3 and 4*

6.EE.A.1 Write and evaluate numerical expressions involving whole-number exponents. *Problems 2 and 3*

6.EE.A.2b Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *Problem 3*

Essential for 6.EE.A.2a Write expressions that record operations with numbers and with letters standing for numbers. *Problems 1, 2, 3, and 4*

Objective:

In previous Investigations, students found the factors and factor pairs of a number and the common factors and common multiples of two or more numbers. This Investigation provides opportunities for students to think about factorizations of whole numbers as the products of several whole numbers.

Finding longer and longer factor strings of a number leads students to the *Fundamental Theorem of Arithmetic*, which states that "a whole number can be written as a product of primes in exactly one way, disregarding order." The number 1 is not a prime number.

The intent of the Investigation is to help students see that every string shorter than the longest has at least one factor that is not prime. These non-prime factors can be broken down to make longer strings. The process ends when every number in the string is prime and no further decomposition can occur. This is the unique string of primes that can be multiplied to produce the original number—the prime factorization of the number.

Students use the prime factorization to find the least common multiple and greatest common factor of two numbers. Exponents are introduced as an efficient way to write repeated factors in the factorization of a number.

Investigation 4

Standards: 6.NS.B.4 Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *Problems 1, 2, 3, and 4*

6.EE.A.1 Write and evaluate numerical expressions involving whole-number exponents. *Problem 3*

6.EE.A.2b Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *Problems 2, 3, and 4*

Essential for 6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers. *Problems 1, 2, 3, and 4*

Essential for 6.EE.A.2a Write expressions that record operations with numbers and with letters standing for numbers. *Problems 1, 2, 3, and 4*

Essential for 6.EE.A.2c Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *Problems 1, 2, 3, and 4*

Essential for 6.EE.A.3 Apply the properties of operations to generate equivalent expressions. *Problems 1, 2, 3, and 4*

Essential for 6.EE.A.4 Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *Problems 1, 2, 3, and 4*

Objective:

Throughout this Unit, students have been looking at the multiplicative structure of a number. This Investigation explores the relationship between the multiplicative and additive structures of numbers. That is, numbers can be written as a product of factors or as a sum of terms.

Multiplicative and additive structures are explored through the introduction of the Distributive Property. The Distributive Property states that for any numbers a, b, and c, $a(b+c)=ab+ac$. The factored form, $a(b+c)$, and the expanded form, $ab+ac$, are equivalent expressions. They represent the same quantity.

Working with equivalent numerical expressions provides an opportunity to introduce the Order of Operations convention. The Investigation ends with several applications in which the students have to decide which operations are needed to solve problems.