Prime and Composite Numbers

Student Probe

Is 27 a prime number or a composite number? Explain how you know.
Is 17 a prime number or a composite number? Explain how you know.

Answer: 27 is a composite number, because it has factors other than 1 and 27.
17 is a prime number, because its only factors are 1 and 17.

Lesson Description

In this lesson students will create a Sieve of Eratosthenes or hundreds chart display of the prime numbers from 1 to 100.

Rationale

The ability to quickly recognize whether a whole number is prime, composite, or neither enables students to efficiently find least common multiples, greatest common factors and equivalent fractions. Students who are able to quickly determine the prime factorization of a whole number will be able to effectively deal with fractions and their operations. As students encounter square roots and irrational numbers, prime factorization will again prove to be a useful tool as they simplify radicals.

Preparation

Prepare a visual display of a hundreds chart or Sieve of Eratosthenes for teacher use. Prepare a hundreds chart or Sieve of Eratosthenes for each student. Each student will need two colored pencils of different colors.

At a Glance

What: Students will determine the prime numbers between 1 and 100.
Common Core State Standard: CC.4.OA.4. Find all factor pairs for a whole number in the range 1–100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1–100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1–100 is prime or composite.
Mathematical Practices:
Reason abstractly and quantitatively.
Use appropriate tools strategically.
Attend to precision.
Look for and make use of structure.
Who: Students who cannot differentiate between prime and composite numbers
Grade Level: 4
Prerequisite Vocabulary: multiple, factor
Prerequisite Skills: Multiplication facts, finding multiples
Delivery Format: small group, whole class
Lesson Length: 15-30 minutes
Materials, Resources, Technology:
Hundreds chart or Sieve of Eratosthenes, colored pencils, calculator (optional), www.worksheetworks.com/math/numbers/sieve-of-eratosthenes.html (optional)
Student Worksheets: Hundreds Chart or Sieve of Eratosthenes

Lesson

The teacher says or does…	Expect students to say or do…	If students do not, then the teacher says or does…
1. Distribute the hundreds chart (or Sieve) and two colored pencils (different colors) to each student. Ask students to circle the number 1 in the chart. (See Teacher Notes.) Model on the display.	Circle 1.	Model on the display and monitor the students.
2. Color the square which contains 2. (Students may use any color they wish. For this example red will identify prime numbers.)	Color the square which contains 2 with the red pencil.	Model.
3. What are the multiples of 2? (Record the first few multiples of 2 on the display.)	2, 4, 6, 8, 10… List out the first few multiples of 2.	What numbers do you say when you skip count by 2?
4. Using your other colored pencil, color the squares containing the multiples of 2. (For this example blue will identify the composite numbers.)	Color in all multiples of 2 from 4-100 using the blue colored pencil.	Model on the display and monitor the students.
5. Did you see any patterns or shortcuts that made coloring the multiples of 2 easier?	They were in alternate columns.	Model on the display.
6. What is the next square that has not been colored? Color the number 3 with your red pencil.	3	Model on the display and monitor the students.

The teacher says or does…	Expect students to say or do…	If students do not, then the teacher says or does…
7. What are the multiples of 3?	3, 6, 9, 12, 15, … List out the first few multiples of 3.	What numbers do you say when you skip count by 3?
8. Use your blue pencil to color the squares that contain the multiples of 3.	Color all of the multiples of 3 from 6-100 using the blue colored pencil.	Model on the display and monitor the students.
9. Did you find any patterns or shortcuts that made coloring the multiples of 3 easier? Were any multiples of 3 already colored? Which ones? (Encourage students to say the even multiples of 3.)	I colored every third one. Yes. 6, 12, 18, …	Model on the display.
10. Repeat this process with 4, 5, and so on until all numbers 2-100 are color coded appropriately. (In this example, the prime numbers will be red, and the composite numbers will be blue.) (See Teacher Notes.)	Color as directed	Model on the display and monitor the students. List multiples as needed.
11. Let's look at our grid now, what do we notice? Are there any numbers not colored?	Some numbers are colored red and some numbers are colored blue. Yes. 1 is not colored.	Model on the display and monitor the students.
12. Let's make a list of the numbers we colored red.	Students should write the prime numbers on the sheet. 2, 3, 5, 7, 11, 13, …	Model on the display and monitor the students.
13. These numbers are called prime numbers. They are very important numbers. Who would like to read all the prime numbers to us?	Read the prime numbers (red numbers) aloud.	
14. What do you think makes a number prime?	Answers may vary, but listen for, "It only has two factors."	

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15. How many factors does the number 3 have? What are they? Does 3 have any other factors?	2 1, 3 No	What number times what number equals three?
16. We know 3 is a prime number because it has <u>exactly</u> 2 factors, 1 and 3. (Repeat this with different prime numbers as often as necessary to ensure everyone understands.)		
17. Choose a blue number from your chart. (For this example, suppose 12 was chosen.)	Answers may vary.	
18. What are the factors of 12?	1, 2, 3, 4, 6, 12	Which counting numbers divide 12 evenly?
19. Is 12 a prime number? How do you know?	No It has 6 factors, not exactly 2 factors.	
20. Numbers that have more than two factors are called composite numbers. What is an example of a composite number?	Answers may vary.	Let's look at the number 10.
21. What are the factors of 10?	1, 2, 5, 10	Which counting numbers divide 10 evenly?
22. What is the difference between prime numbers and a composite numbers?	Prime Numbers have exactly 2 factors. Composite numbers have more than 2 factors.	How many factors do the red numbers have? How many factors do the blue numbers have?
23. We can think of PRIme numbers as a PRIvate party—only two people can attend. (1 and itself) COMPosite is a COMPany party—lots of people (factors) can attend!		

The teacher says or does…	Expect students to say or do…	If students do not, then the teacher says or does…
24. What is the only number not colored on your chart? What do you think that means? How do you know?	1 One is not composite or prime. It only has one factor, 1.	Model on the display. How many counting numbers divide 1 evenly?

Teacher Notes

1. While some students may need a calculator for this lesson, it provides a good opportunity for reinforcing multiplication and division facts.
2. Eratosthenes (276-196 B.C.E.) was a Greek mathematician who created the Sieve.
3. Only the natural numbers greater than or equal to 2 are considered prime or composite.
4. One is neither prime nor composite. By definition, a prime number must have exactly two factors. Since 1 has only one factor, 1, it does not meet the definition of a prime number. Since all composite numbers can be written as a product of prime numbers (The Fundamental Theorem of Arithmetic), 1 is not a composite number.
5. Ask students to keep the prime number chart in their math notebook to use as a resource until they become more proficient at knowing them.
6. There are an infinite number of prime numbers.
7. Two is the only even prime number.
8. When testing for prime numbers $1-n$, all primes will be found when $\sqrt{n}$ is reached. For 1-100, the largest number that needs to be tested is $\sqrt{100}=10$.

Variations

1. Find additional Prime Numbers larger than 100.
2. Visit www.hbmeyer.de/eratosiv.htm and complete the Sieve electronically.

Formative Assessment

Is 86 a prime number or a composite number?
Explain how you know.
Is 29 a prime number or a composite number?
Explain how you know.

Answers: 86 is a composite number since it has factors 1, 2, 43, and 86.
29 is a prime number since its only factors are 1 and 29.

References

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