Name_____

All About Multiples

Multiples of a number are products of that number **and** another whole number. List multiples of the following numbers.

Multiples of 6: ____ ____ ____ ____ ____ ____ ____.....

Multiples of 9: ____ ____ ____ ____ ____ ____ ____.....

Multiples of 10: ____ ____ ____ ____ ____ ____ ____.....

Find the least common multiple (LCM) of the following numbers.

L C M

Least *means smallest.* *(LCM does not include 0.)*

Common means the multiple is "shared" by two or more numbers.

Multiples are found by starting with 0 and "counting by the number.

EXAMPLE:

1) List the multiples. 2) Circle the common multiples. 3) Find the smallest or least common multiple.

Multiples of 2: 2, 4, 6, 8, (10), 12.....

Multiples of 5: 5, (10), 15, 20..... The **LCM** of 2 and 5 is **10**

8 : _ _ _ _ _ _ _ _

10: _ _ _ _ _ _ _ _

The LCM of 8 and 10 is _____

3 : _ _ _ _ _ _ _ _

5: _ _ _ _ _ _ _ _

The LCM of 3 and 5 is _____

8 : _ _ _ _ _ _ _ _

6: _ _ _ _ _ _ _ _

The LCM of 8 and 6 is _____

10 : _ _ _ _ _ _ _ _

25: _ _ _ _ _ _ _ _

The LCM of 10 and 25 is _____

Factors and Products

Factors are numbers which multiply together to equal a product.

$$\underset{\text{factor}}{3} \times \underset{\text{factor}}{2} = \underset{\text{product}}{6}$$

Factors of a number divide evenly into the number without a remainder!

$6 \div 2 = 3$ and $6 \div 3 = 2$

To find factors of 12:

Think:

$1 \times 12 = 12$
$2 \times 6 = 12$
$3 \times 4 = 12$

or

Think:

$12 \div 12 = 1$
$12 \div 6 = 2$
$12 \div 4 = 3$
$12 \div 3 = 4$
$12 \div 2 = 6$
$12 \div 1 = 12$

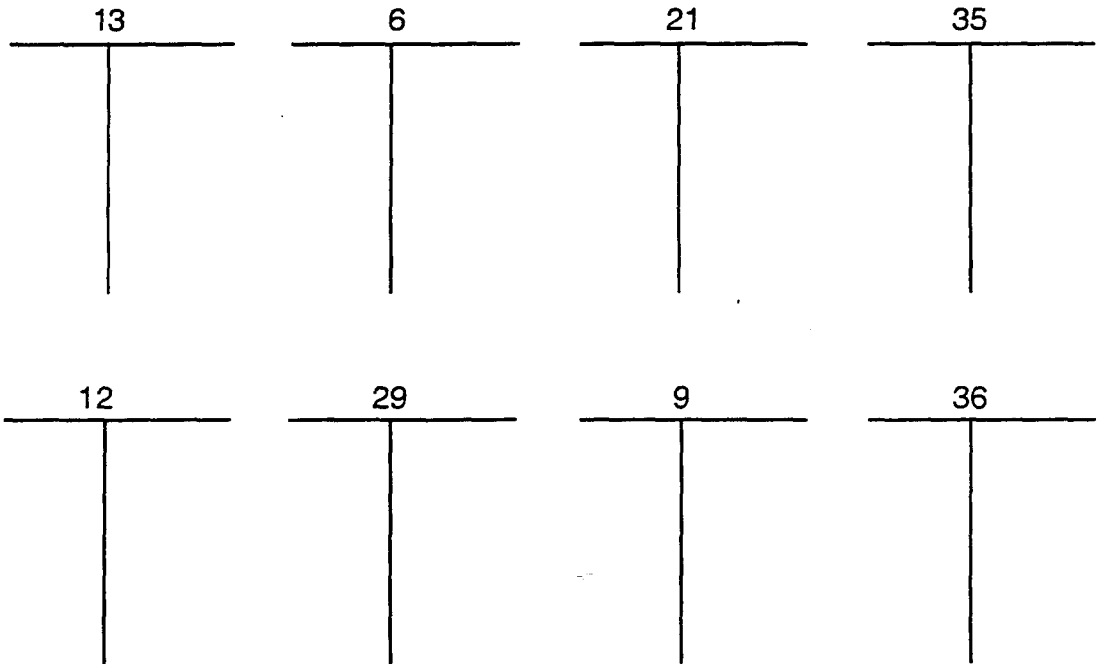
Factors of 12: ⟶ 1, 2, 3, 4, 6, 12

Name: _____

Finding Factors

Factors are numbers which multiply together to equal a product.

Can you find <u>all</u> of the factors for the following numbers?
List them as numbers which **multiply** together.



Factors of a number divide evenly into the number <u>without</u> a remainder!

Can you find <u>all</u> of the factors for the following numbers?
Think about **division**. Make a list of the numbers that divide into each number with no remainder.

40

Factors: _____

24

Factors: _____

49

Factors: _____

26

Factors: _____

19

Factors: _____

63

Factors: _____

Find the greatest common factor (GCF) of the following numbers:

Remember:

G C F

Greatest means largest. (GCF does not include 1.)

Common means the factor is "shared" by two or more numbers.

Factors are found by starting with 1 finding other numbers that divide with no remainder .

Factors of 6: ____ ____ ____ ____

Factors of 10: ____ ____ ____ ____

The **GCF** of 6 and 10 is ____

Factors of 5: ____ ____ ____ ____

Factors of 15: ____ ____ ____ ____

The **GCF** of 5 and 15 is ____

Factors of 12: ____ ____ ____ ____

Factors of 30: ____ ____ ____ ____

The **GCF** of 12 and 30 is ____

Factors of 50: ____ ____ ____ ____

Factors of 75: ____ ____ ____ ____

The **GCF** of 50 and 75 is ____

Writing About Factors

Think about which way you like to find factors. Is it easier for you to think about multiplication facts or about division. Explain why.

The Factor Game

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30

Player A	Player B

Player A	Player B

Rules for Playing the Factor Game

1. Take turns making the first move.

2. Player #1 picks one number on the factor board, records the number on the score sheet, and crosses off the number on the board.

3. Player#2 finds all the factors of that number that are on the board, records the numbers on the score sheet, and crosses off those numbers on the board.

4. Then player #2 picks one number on the factor board, records the number on the score sheet, and crosses off the number on the board.

5. Player #1 finds all the factors of that number that are left on the board, records the numbers on the score sheet, and crosses off those numbers on the board.

6. Players must choose a number which has factors left on the board or they lose a turn.

7. The game is over when no moves are left on the board.

8. Find a total sum for both players.

9. The winner is the player with the greatest sum.

Name _____ Transparency/Student Copies

Finding the Primes (Sieve of Eratosthenes)

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Factors

Factors of a number divide that number with a remainder of zero.

1, 2, 4, 8 are factors of 8

Multiples

Multiples of a number are products of that number and another whole number.

3 x 1 =3
3 x 2 =6
3 x 3 =9

Multiples of 3: 3, 6, 9, 12, 15 .....

Primes

A prime number has exactly two factors - itself and 1.

5 and 1 are the only factors of 5.

Composites

A composite number has more than two factors.

4, 9, 10 are composite numbers.

Name: _____

Review of Factors, Multiples, Primes and Composites

I. List the **factors** of each number.

1) 12	2) 17	3) 38	4) 64	5) 91
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

II. List the **factors** of each number. Write the **common factors** for each pair.

1) (9, 24)	2) (4, 16)	3) (10, 30)
9: _____	4: _____	10: _____
24: _____	16: _____	30: _____
Common Factors _____	_____	_____

III. List the **factors** of each number. Write the **greatest common factor** for each pair.

1) (12, 18)	2) (14, 28)	3) (13, 39)
12: _____	14: _____	13: _____
18: _____	28: _____	39: _____
GCF _____	_____	_____

IV. List the next four **multiples**.

a) 6, 12, 18, ____, ____, ____, ____

b) 12, 24, 36, ____, ____, ____, ____

c) 5, 10, 15, ____, ____, ____, ____

V. List the first five **multiples** of each number.

a) 4 _____

b) 20 _____

c) 15 _____

VI. Find the **least common multiple (LCM)** of the three numbers.

a) 2, 4, 5

2: _____

4: _____

5: _____

LCM _____

b) 3, 4, 8

3: _____

4: _____

8: _____

LCM _____

VII. Write **prime, composite,** or **neither.**

1) 100 _____

2) 28 _____

3) 3 _____

4) 19 _____

5) 2 _____

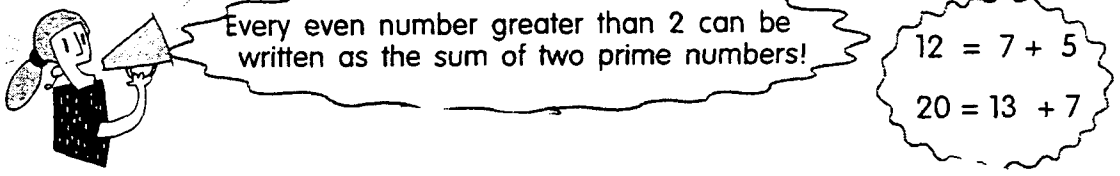
6) 77 _____

7) 59 _____

8) 1 _____

9) 39 _____

10) 86 _____



VIII. Write each number as the sum of two primes.

a) 18 = _____ + _____

b) 30 = _____ + _____

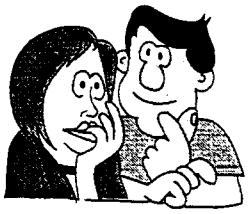
c) 42 = _____ + _____

d) 50 = _____ + _____

e) 26 = _____ + _____

f) 100 = _____ + _____

Problem Solving



Solve each problem. Study the clues.
(Some questions will have more than one answer!)

1) n is a factor of 16.
n is a multiple of 8
n = _____

2) y is an even number.
y > 90 and y < 110
y is a multiple of 5
y = _____

3) h is a composite number.
h > 42 and h < 56
h is a multiple of 7
h = _____

4) x is a prime number.
x > 50 and x < 59
x = _____

5) b is a multiple of 5
b can be divided by 8
b < 100
b = _____

6) k is an even number
k can be divided by 3
k is not a multiple of 9
k < 10
k = _____

What's the Number ?

1) I am a factor of 100. I am a multiple of 5 but not of 10.

What number am I? _____

2) I am the LCM of two numbers whose difference is 3 and whose sum is 27.

What number am I? _____

3) I am the LCM of two numbers whose sum is 40 and whose difference is 10.

What number am I? _____

4) I am the LCM of three consecutive even numbers whose sum is 18.

What number am I? _____

5) I am the GCF of two numbers whose sum is 20 and whose difference is 4.

What number am I ? _____

6) I am one of two numbers whose GCF is 3 and whose sum is 27. The other number is 15 greater than I am.

What number am I? _____

Name _____

Vocabulary Review

Sentence Completions. Complete the sentences with a math term in the box. Read the words carefully before you choose your answer.

composite	infinity	prime
factor	least common multiple	prime number
factors	multiples	product
greatest common factor		

1. A _____ number has only two factors, itself and 1.
2. The _____ is the largest number that can divide evenly into 2 or more numbers.
3. A _____ is a number that divides evenly into another number.
4. _____ of a number are the products of that number and any whole number.
5. A _____ number has more than 2 factors.
6. The smallest common multiple of 2 or more numbers is called the _____.
7. The result of multiplying 2 numbers together is the _____.
8. _____ means something goes on forever and has no limits.
9. Numbers that multiply together to equal a product are called _____.
10. The factors of the number 13 are 13 and 1. Therefore, 13 is a _____.

Answer Key
Obj.8

All About Multiples (p.10)

Multiples of 6 : 6, 12, 18, 24, 30, 36, 42
Multiples of 9: 9, 18, 27, 36, 45, 54, 63
Multiples of 10: 10, 20, 30, 40, 50, 60, 70

Find the LCM

8: 8, 16, 24, 32, (40), 48, 56...
10: 10, 20, 30, (40), 50, 60, 70 ... LCM = 40

3: 3, 6, 9, 12, (15), 18, 21, ...
5: 5, 10, (15), 20, 25, 30, 35... LCM = 15

8: 8, 16, (24) 32, 40, 48, 56...
6: 6, 12, 18, (24), 30, 36, 42 .... LCM = 24

10: 10, 20, 30, 40, (50) 60, 70.....
25: 25, (50) 75, 100, 125, 150,... LCM = 50

Finding Factors (p. 12)

13 = 1x13
6 = 1 x 6; 2 x 3
21 = 1 x 21; 3 x 7
35 = 1 x 35; 5 x 7

12 = 1 x 12; 2 x 6; 3 x 4
29 = 1 x 29
9 = 1 x 9; 3 x 3
36 = 1 x 36; 2 x 18; 3 x 12; 4 x 9; 6 x 6

Factors:

40 = 1 , 2, 4, 5, 8, 10, 20, 40
24 = 1, 2, 3, 4, 6, 8, 12, 24
49 = 1, 7, 49

26 = 1, 2, 13
19 = 1, 19
63 = 1, 3, 7, 9, 21, 63

GCF

Factors of 6: 1, (2), 3, 6
Factors of 10: 1, (2), 5, 10 GCF= 2

Factors of 12: 1, 2, 3, 4, (6), 12
Factors of 30: 1, 2, 3, 5, (6), 10, 15, 30 GCF= 6

Factors of 5: 1, (5)
Factors of 15 : 1, 3, (5), 15 GCF = 5

Factors of 50 : 1, 2, 5, 10, (25), 50
Factors of 75 : 1, 3, 5, 15, (25), 75 GCF= 25

Review of Factors, Multiples, Primes, and Composites (p.18)

I. List the factors

1) 12: 1,2,3,4,6,12
2) 17: 1, 17
3) 38: 1, 2, 19
4) 64: 1, 2, 4, 8, 16, 32, 64
5) 91: 1, 91

II. List the factors. Write the common factors.

1) 9: 1, 3, 9
   24: 1, 2, 3, 4, 6, 8, 12, 24
   Common Factors: 1, 3

2) 4: 1, 2, 4
   16: 1, 2, 4, 8, 16
   Common Factors : 1, 2, 4

3) 10: 1, 2, 5, 10
   30: 1, 2, 3, 5, 6,10,15, 30
   Common Factors: 1, 2, 5,10

III. List the factors. Write the GCF

1) 12: 1, 2, 3, 4, 6, 12
   18, 1, 2, 3, 6, 9, 18
   GCF: 6

2) 14: 1, 2, 7,14
   28: 1, 2, 4, 7, 14, 28
   GCF: 14

3) 13: 1, 13
   39: 1, 3, 13, 39
   GCF: 13

IV. List the next four multiples.

a) ... 24, 30, 36, 42

b) ... 48, 60, 72, 84

c) ... 20, 25, 30, 35

V. List the first five multiples.

a) 4, 8, 12, 16, 20 ...

b) 20, 40, 60, 80 100 ....

c) 15, 30, 45, 60, 75.....

VI. Find LCM

a) 2, 4, 5

2, 4, 6, 8, 10, 12, 14, 16, 18, **20** ...

4, 8, 12, 16, **20**, 24 .....

5, 10, 15, **20**, 25, 30 .... LCM=20

b) 3, 4, 8

3, 6, 9, 12, 15, 18, 21, **24**, ...

4, 8, 12, 16, 20, **24**, 28, 32 .....

8, 16, **24**, 32, 40, 48, ... LCM= 24

VII. Prime, Composite, Neither

1) Composite
2) Composite
3) Prime
4) Prime
5) Prime
6) Composite
7) Prime
8) Neither
9) Composite
10) Composite

VIII. Sum of two primes(ans. can vary)

a) 18 = 11 + 7
   5 + 13
b) 30 = 7 + 23
   11 + 19
c) 42 = 37 + 5
d) 50 = 47 + 3
e) 26 = 13 + 13
   23 + 3
f) 100 = 97 + 3
   87 + 13

IX. Problem Solving

1) 8
2) 100
3) 49
4) 53
5) 40,80
6) 6

What's the Number?

1) 25
2) 12, 15 ; LCM = **60**
3) 15, 25; LCM = **75**
4) 4, 6, 8 ; LCM = **24**
5) 8, 12; GCF = **4**
6) **6**, 21

Vocabulary Review (p.22)

1) prime
2) GCF
3) factor
4) multiples
5)composite
6) LCM
7) product
8) infinity
9) factors
10) prime number

Objective 9: Investigate, develop, and use the rules of divisibility for the numbers 2, 3, 4, 5, 6, 9, and 10.

Vocabulary

divisibility
divisible
product
multiple

Materials

calculators

Transparencies

- Divisibility Discovery Sheet
- Divisibility
- Thinking about Divisibility Rules

Student Copies

- Divisibility Discovery Sheet
- Practice with Divisibility
- Divisibility Puzzle
- Problem Solving with Divisibility
- Thinking About Numbers - Review of Factors, Multiples and Divisibility
- Divisibility
- Language Activity

Language Foundation

1. Ask students to tell you what the word **multiple** means. Hint: It looks like the word multiply. Explain that the prefix "multi" means MANY. Ask if they can think of any words with "multi". For example,
   multicolored = *many colors*
   multiplex cinema = many theaters
   multiple vitamins = many different vitamins in one tablet .

2. Discuss the words divide, divisible, and divisibility. Point out that these words all come from the verb divide which means to separate into equal groups. Divisible is an adjective used to describe a number and divisibility is a noun.

3. Explain that the word **divisibility** means that a number has the ability to be divided evenly with nothing left over. If you have 20 Snickers bars and 5 students, each student gets 4 Snickers bars. The twenty bars are divided evenly. Ask students if this is also true if you have 2, 4, or 10 students. (Yes, The candy bars can be evenly divided.) Ask what happens if there are 7 or 9 students. (The candy bars cannot be evenly divided by 7 or 9; therefore, 20 is not **divisible** by 7 or 9.)

4. Tell students that they will learn the **rules of divisibility** for the numbers 2, 3, 4, 5, 6 ,9, and 10 in this lesson. Explain that knowing these rules will help students tell quickly if one number is divisible by another.

5. Review the terms product and multiple from the previous lesson.

Mathematics Component

1. Introduce students to the terms "divisibility" and "divisible."
   - Review the meanings of the words divide, divisibility, and divisible as explained in the language foundation.
   - Put the number 86,454,324 on the board and say, "Is 86,454,324 **divisible** by 6?" Tell students they cannot use a calculator. Remind them that the word **divisible** means a number can be divided evenly by another number with no remainder.
   - Allow students time to respond and share their reasoning. Most will find it very difficult to determine if the number is divisible by 6! Be sure students understand that a number is only divisible by another if there is no remainder after dividing.
   - Tell students that there are rules that make it easier to tell quickly if one number is divisible by another without doing a division problem. Explain that during this class, students will work in groups to explore rules for **divisibility**. These rules will tell which numbers have the ability to be divided evenly by other numbers.

2. Investigate divisibility by the number 2.
   - Hand out one Divisibility Discovery Sheet and a calculator to each student.
   - Put a transparency of the Divisibility Discovery Sheet on the overhead.
   - Explain that the class will work as problem solvers to try to discover the divisibility rule for the number 2.
   - Ask students to explain what the divisibility rule for 2 will tell them. (The rule will tell which numbers have the ability to be divided evenly by 2.)
   - Ask students for suggestions on how to decide which numbers can be evenly divided by 2. Lead students to understand that one plan might be to list several numbers which they know are divisible by 2 and then look at what these numbers have in common.
   - Ask students to name at least ten numbers that they know are divisible by 2. Record the numbers in numerical order under the column labeled "Multiples" on the Divisibility Discovery Sheet. (Responses may include 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, etc.)
   - Ask students to record them in the column labeled "Multiples" on their Divisibility Discovery Sheet. Remind students that these are **multiples** of 2. Multiples occur when you count by a number.
   - Now, ask the students if they see what all of these numbers have in common--what is the same about this group of numbers. (The pattern may be difficult for students to see. If a hint is needed to lead students in the right direction say, "Maybe the beginning or the end of the numbers have something in common. How can we tell if a number is divisible by 2?" (Numbers are divisible by 2 if they end in 0, 2, 4, 6, or 8.)
   - Write the rule on the transparency in the appropriate column. (A number is divisible by 2 if it ends in 0, 2, 4, 6 or 8.) Have students copy the rule onto their papers.

- Remind students that they need to look back and check the solution to be sure it works. Show students that there are three numbers in the last column of the activity sheet. Tell them that two of these numbers are divisible by 2. Have the students circle the two numbers on their papers that are divisible by 2 according to the rule. Have them check their answers on a calculator. The two numbers that are divisible by 2 are 12,345,670 and 13,579,134.
- At this point, students should be able to work in groups to discover the divisibility rules for the remaining numbers. (Tell students that the rules for 7 and 8 are not as simple as the other numbers, and they may use a calculator when dividing by 7 or 8)

3. Students will work in groups to investigate, develop, and use the rules for divisibility for the numbers 3, 4, 5, 6, 9, and 10.
   - Ask students to work in groups of 3 or 4.
   - Explain that each group will work together to find divisibility rules for one of the remaining numbers on the activity page. Assign a different number from the activity sheet to each group. (3, 4, 5, 6, 9, or 10)
   - When finished, ask each group to choose one student to come up to the overhead and present their divisibility rule. Have the students fill in the rule and show how they found it.
   - As each group presents the divisibility rule for their assigned number, allow the class to discuss the rule and decide if it will always work. Once students have agreed upon a rule, they may fill in their individual sheets. Groups may find some numbers challenging, for example 6 or 9, and may need some hints such as adding the digits, looking at the last two digits,or seeing if they can divide the numbers by 2,3,4, etc. (See Answer Key for completed rules.)
   - Go back to the original example in this lesson of the number 86,454,324, and see if the "Rule for 6" works. (It does.)
   - The activity sheet Practice with Divisibility is provided for additional work with divisibility rules.

4. Extend students' understanding of divisibility by applying the rules discovered in the activity above.
   - Each student should receive a Divisibility Puzzle activity sheet. The students may **not use their calculators** for this activity.
   - Using their divisibility rules, have students work the puzzle sheet. Have the students check their answers in their groups. (See Answer Key for completed puzzle.)
   - The activity sheet Problem Solving with Divisibility will give students further practice on this topic while also providing exposure to reading word problems.
   - The activity sheet Thinking about Numbers provides a review of the topics in Objectives 8 and 9.
   - Divisibility is provided to use at any time as a quick review of divisibility rules. It may also be enlarged and posted in the room or given to students to keep in their math notebooks.

5. Apply students' understanding of divisibility to a problem solving situation.

   - Have students work in groups of 3 or 4.
   - Use the transparency Thinking about Divisibility and read the following problem to the class. (**Note**: If you think this problem may be too difficult for your students, you may want to begin with a smaller number of students such as 72.)

     > There are 240 students in the freshman class. How many different ways can you divide this class into groups with equal numbers in each group?

   - Give a few examples such as one group with 240 students or two groups with 120 students in each group.
   - Have groups work together to solve the problem using paper to record their ideas. Remind them to think about the rules for divisibility as they work to divide the class into different groups.
   - When finished, give each group of students a clean transparency to record their work and their solution to the problem.
   - Have one student from each group present their solution. Discuss each solution as a class.

   (There are **20** ways to divide the class. See below.)

1 group of 240	16 groups of 15
2 groups of 120	20 groups of 12
3 groups of 80	24 groups of 10
4 groups of 60	30 groups of 8
5 groups of 48	40 groups of 6
6 groups of 40	48 groups of 5
8 groups of 30	60 groups of 4
10 groups of 24	80 groups of 3
12 groups of 20	120 groups of 2
15 groups of 16	240 groups of 1

   - Ask students if they see any pattern and share responses. (If you go in order with the factors, they eventually repeat in the opposite order.)

Language Development Activities

- The Language Activity page provides students with the opportunity to apply and write about divisibility. Remind students to think also about factors in addition to divisibility rules for problem 2.

Name _____ Transparency / Student Copy

Divisibility Discovery Sheet

Number	Multiples	Rule	Check
2			12,345,670 22,468,029 13,579,134
3			123,456 2,862 3,335
4			444,414 8,988 11,116
5			55,552 91,360 8,325
6			444 1,113 954,312
9			621 425,700 912,587
10			893,540 128,970 902,001

Name: _____

Practice With Divisibility

Remember:
When a number is **divisible** by another number, there is NO remainder.

Complete the chart. Write YES or NO.

Number	Divisible by						
	2	3	4	5	6	9	10
20							
36							
72							
189							
6,480							
10,195							

1. If a number ends in _____ , _____ , _____ , _____ , or _____ , then it is divisible by 2. Check (√) each number that is divisible by 2.

   a) 367 ☐ b) 14,926 ☐ c) 950 ☐ d) 541 ☐

2. A number is divisible by 4 if the last _____ digits can be divided by _____. Check each number that is divisible by 4.

   a) 877 ☐ b) 4,112 ☐ c) 22, 088 ☐ d) 936 ☐

3) If the sum of all the _____ can be divided by 9, then the number is divisible by _____. Check each number that is divisible by 9.

   a) 747 ☐ b) 2,046 ☐ c) 99, 331 ☐ d) 141, 858 ☐

Practice With Divisibility

1) The last digit in 7,582 is _____.
The sum of the digits in 7,582 is _____.
Circle the numbers: 7,582 is divisible by 2 3 4 5 6 9 10

2) The last digit in 9,540 is _____.
The sum of the digits in 9,540 is _____.
Circle the numbers: 9,540 is divisible by 2 3 4 5 6 9 10

3) The last digit in 13,467 is _____.
The sum of the digits in 13,467 is _____.
Circle the numbers: 13,467 is divisible by 2 3 4 5 6 9 10

4) Is 38,913 divisible by 5? _____

How do you know? _____

5) Is 11,808 divisible by 6? _____

How do you know? _____

6) Is 200,505 divisible by 10? _____

How do you know? _____

Is the first number divisible by the second? Write YES or NO.

a) 12; 5 _____
b) 96; 9 _____
c) 142; 2 _____
d) 305; 10 _____
e) 2,039; 9 _____
f) 101; 10 _____
g) 156; 6 _____
h) 1230; 3 _____
i) 162; 9 _____
j) 8642; 4 _____

Name_____

Divisibility Puzzle

In each row, cross out the letters below all of the numbers which are **not** multiples of the circled number. You should cross out four letters in each row. Then copy the letters which were **not** crossed out in order in the spaces at the bottom of the page.

(2)	153	156	358	4,567	1,114	6,001	35,790	4,269	998	26
	A	N	O	S	W	T	I	H	U	N
(3)	111	335	6,711	7,146	874	222	437	882	575	918
	D	O	E	R	L	S	H	T	O	A
(4)	114	441	944	716	1,380	8,895	1,536	1,246	360	1,788
	R	T	N	D	T	A	H	N	E	R
(5)	6,140	9,875	5,553	1,110	50,301	257	1,465	6,660	122	9,045
	U	L	A	E	R	U	S	O	N	F
(6)	6,663	354	323	792	408	872	222	560	1,782	29,232
	M	D	A	I	V	T	I	H	S	I
(10)	1,0101	928	5,560	8,760	10,000	8,220	2,302	7,003	3,450	4,050
	O	N	B	I	L	I	O	S	T	Y

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

___ ___ ___ ___ ___ ___ ___ ___ ___ ___

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

Name:_____

Problem Solving with Divisibility

1) Marta has 156 cookies to share among 9 friends. Can she share the cookies equally? Use the rules for divisibility to explain why or why not.

2) Gum is sold in packages of 33 at K-Mart. How many packages would you need to buy so you and 5 of your friends could share equally?

3) I am a number between 25,330 and 25,340. I am divisible by 5.
What number am I? _____

4) I am a number between 270 and 280. I am divisible by 2 and 3.
What number am I? _____

5) I am a number between 370 and 380. I am divisible by 2, 3, and 9.
What number am I? _____

6) Write your own divisibility problem for any of these numbers : 2, 3, 4, 5, 6, 9, or 10. Exchange problems with a friend and see if you can solve each others problem.

_____

_____

Name: _____

Thinking about Numbers
Review of Factors, Multiples and Divisibility

Use the statements below to describe each given number.

It is even.
It is not even.
It is a multiple of 3.
It is divisible by 9.
It is divisible by 5

It is less than 20.
It is a factor of 64.
It is less than 10.
It is a prime number.
It is a multiple of 6

It is greater than 25.
It is not a multiple of 10.
It is not a multiple of 4.
It is a factor of 100.

Describe the number 16.

Describe the number 50.

Describe the number 8.

Describe the number 45.

Describe the number 29.

Divisibility

2 - the last digit is 0, 2, 4, 6, or 8

3 - the sum of all the digits is divisible by 3

4 - the last two digits are divisible by 4

5 - the last digit is 5 or 0

6 - the number is divisible by both 3 and 2

9 - the sum of all the digits is divisible by 9

10 - the last digit is 0

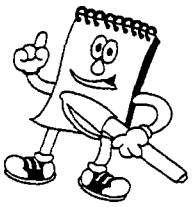
Thinking About Divisibility

There are 240 students in the freshman class.

How many different ways can you divide this class into groups with equal numbers in each group?

Name: _____

Language Activity



1) If a number is divisible by 10, is it also divisible by 5? Explain how you would know.

_____

_____

2) Can you explain how the rules for divisibility can help you decide whether a bunch of things can be put into equal groups?

Hint: Think about having a party at school with 126 kids and you want all the tables to have the same number of kids. Can you use tables of 4? 5? 6? 9? What do you think would be the best number of kids at each table?

_____

_____

_____

_____

_____

3) Now, work with a partner to write an example of your own that uses divisibility to help solve a problem.

Answer Key
Obj. 9

Divisibility Discovery Sheet

Number	Multiples	Rule	Check
2	2, 4, 6 ,8, 10, 12, 14...	A number is divisible by if it **ends** in 0, 2, 4, 6. or 8.	12,345,670 22,468,029 13,579,134
3	3, 6, 9, 12, 15, 18, 21...	A number is divisible by 3 if the **sum of its digits** is divisible by 3.	123,456 2,862 3,335
4	4, 8, 12, 16 20, 24, 28...	A number is divisible by 4 if its **last two digits** are divisible by 4.	444,414 8,988 11,116
5	5, 10, 15, 20, 25, 30, 35...	A number is divisible by 5 if it **ends** in 0 or 5.	55,552 91,360 8,325
6	6, 12, 18, 24, 30, 36, 42...	A number is divisible by 6 if it is divisible by **both** 3 and 2.	444 1,113 954,312
9	9, 18, 27, 36, 45, 54, 63, 72...	A number is divisible by 9 if the **sum of its digits** is divisible by 9.	621 425,700 912,587
10	10, 20, 30 40, 50, 60...	A number is divisible by 10 if it **ends** in 0.	893,540 128,970 902,001

Answer Key
Obj. 9

Practice with Disability

Complete the chart.

Number	Divisible by						
	2	3	4	5	6	9	10
20	Y	N	Y	Y	N	N	Y
36	Y	Y	Y	N	Y	Y	N
72	Y	Y	Y	N	Y	Y	N
189	N	Y	N	N	N	Y	N
6,480	Y	Y	Y	Y	Y	Y	Y
10,195	N	N	N	Y	N	N	N

1) 0, 2, 4, 6, 8 b, c
2) 2 digits ... by 4 b, c, d
3) digits.....by 9 a, d

Practice with Disability page 2

1) 2; 22; 2
2) 0; 18; 2, 3, 4, 5, 6, 9,10
3) 7; 21; 3
4) No; the last digit is not a 5.
5) Yes, it is divisible by 2 and 3
6) No, the last digit is not a 0

Is the first number divisible by the second?

a) no
b) no
c) yes
d) no
e) no
f) no
g) yes
h) yes
i) yes
j) no

Problem Solving with Disability

1) No. The sum of the digits of 156 is not divisible by 9 so the cookies can't be divided into equal groups.
2) 2 packages; 33 x 2 = 66
66 is divisible by 6 (you and 5 friends)
3) 25,335
4) 276
5) 378
6) Answers will vary.

Thinking About Numbers

The number 16

- It is even.
- It is less than 20.
- It is a factor of 64.
- It is not a multiple of 10.

The number 8

- It is even.
- It is less than 20.
- It is a factor of 64.
- It is not a multiple of 10.
- It is less than 10.

The number 29

- It is not even.
- It is not a multiple of 10.
- It is greater than 25.
- It is not a multiple of 4
- It is a prime number.

The number 50

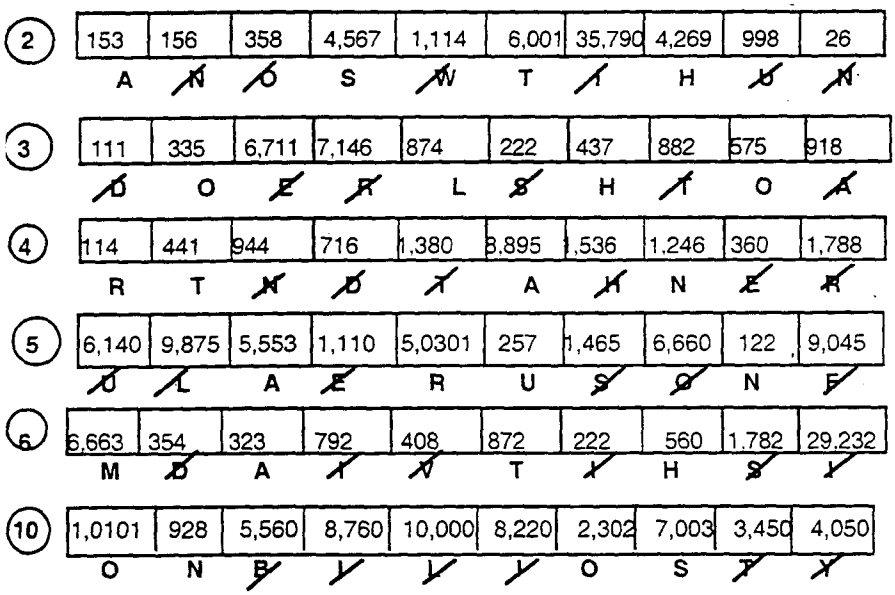
- It is even.
- It is divisible by 5.
- It is greater than 25.
- It is not a multiple of 4.
- It is a factor of 100.

The number 45

- It is not even.
- It is a multiple of 3.
- It is divisible by 9.
- It is not a multiple of 10.
- It is greater than 25.
- It is divisible by 5.
- It is not a multiple of 4.

Answer Key
Obj. 9
Divisibility Puzzle

In each row, cross out the letters below all of the numbers which are **not** multiples of the circled number. You should cross out four letters in each row. Then copy the letters which were **not** crossed out in order in the spaces at the bottom of the page.



NOW I UNDERSTAND
THE RULES OF
DIVISIBILITY

Language Activity

1) Yes, because numbers that end in 0 are divisible by 10; numbers that end in 5 and 0 are divisible by 5. Any number ending in 0 is divisible by both10 and 5.

2) If you know the rules for divisibility, you can quickly see if a group of things is evenly divisible or if there will be things left over.
Hint: With 126 kids, you can form tables of 2, 3, 6, 7, 9, 14, 21, 42 or 63. The most practical groupings would probably be 6, 7, 9, or 14 to a table.

3) Answers will vary

Objective 10: Review exponents. Identify prime factorization in a variety of ways and write in exponential form.

Vocabulary

exponent
power
base
factor
prime number
prime factorization
exponential form
inverted

Materials

calculators

Transparencies

Prime Numbers
Prime Factorization
Finding Prime Factorization: Two Methods

Student Copies

Prime Factorization Practice
Prime Factorization Challenge
Prime Factorization Triple Match

Language Foundation

1. Review the terms exponent, factor, and prime number.

2. Ask students if they know what a "shortcut" is. Explain that a shortcut is a quicker way of doing something. You can use a shortcut to write words or numbers without using all the letters or numbers to describe them. Give these examples: 2nd for second, 89° for eighty-nine degrees, $5.00 for five dollars, L_2 for second language. Ask students to give you other examples. Tell students that in math, there is a shortcut for writing numbers called **exponential form**. The number is written with an **exponent**. Show a few examples such as 2^2, 10^5, and 8^3. Explain that the number in the upper right is the exponent and tells how many times to multiply the bottom number by itself.

3. Ask students what they think of when they hear the word "power." Responses might include big, strong, or forceful. Tell them that in math, numbers have power. The **power** of a number is expressed by an exponent. Explain that as the exponent gets higher, the number gets larger. Have students practice saying expressions such as "to the fifth power," " to the third power," and "to the tenth power."

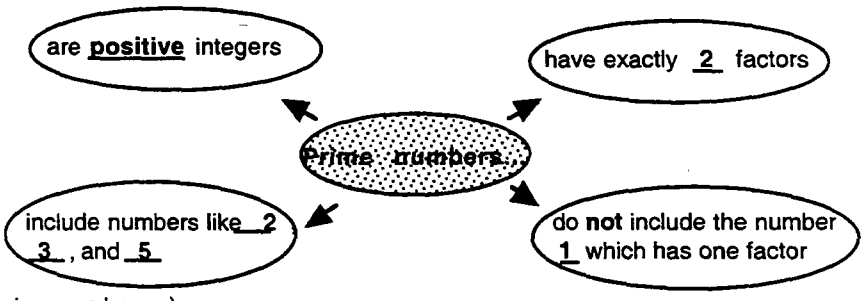
4. Explain to students that **base** is a word in English that has many meanings. Tell them to think of the definition that means "something that things rest on." It is the lowest part or the bottom of something. It gives support. Ask students for examples of things that have a base such as the Statue of Liberty or the base of a vase.

5. Tell students that the word **inverted** means to put something in the opposite direction or to turn it "upside down." If you turn something over, it is inverted. You can invert things such as a glass, a box, or a picture frame.

Mathematics Component

1. Review exponents.
   - Write 2^5 on the board.
   - Ask, "What is the 5 called in this expression?" (exponent or power)
   - Label it on the board as you say, "Five is called an **exponent**."
   - Ask, "What is the 2 called?" (base)
   - Label it on the board as you say, "Two is called the **base**."
   - Choose a student to explain what the expression 2^5 means? (It means two used as a factor five times or $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$.)
   - Allow students to share ideas on why we use exponents? (It is a math shortcut. Exponents give us a shorter way to describe a number.)
   - Ask students what 6^3 means? (It means six is used as a factor three times: $6 \cdot 6 \cdot 6 = 216$).
   - Keep giving examples until you are sure they have the concept of a base and an exponent.
   - At this point, you can model for students how to do exponents on the calculator if they have calculators with this ability.

2. Review prime numbers and introduce prime factorization.
   - Write the number 24 on the board.
   - Ask, "How can we write 24 as a product of two or more numbers?" ($1 \cdot 24$ or $2 \cdot 12$ or $2 \cdot 2 \cdot 3$, etc.)
   - Review the concept of a **prime number** using the transparency Prime Numbers.



(or any prime numbers...)

   - Remind students that a prime number has exactly two factors.
   - Have students name the first six prime numbers as you write them on the board. (2, 3, 5, 7, 11, 13)
   - Ask, "Is there a way to write 24 as a product of only prime numbers?" Allow time for students to discuss their ideas with a partner. ($2 \cdot 2 \cdot 2 \cdot 3$). Write the expression on the board as shown below.

$$2 \cdot 2 \cdot 2 \cdot 3 = 24$$

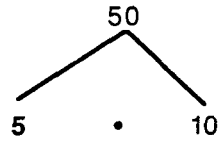
   - Point out that the order could change. For example, you could write $3 \cdot 2 \cdot 2 \cdot 2$. Explain that when you use just prime numbers, this is the only way to represent 24.

- Ask if 2 • 2 • 2 • 3 represents any number other than 24. Allow time for students to discuss. (No)
- Point to the expression 2 • 2 • 2 • 3 and say that this is called the **prime factorization** of 24. Tell students that each natural number has a unique, or different, prime factorization.
- Have students think about and suggest a shorter way to write the prime factorization using exponents. ($2^3 \cdot 3$)

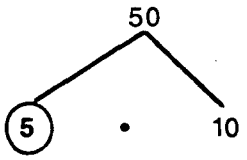
3. Explore two methods for finding prime factorization.
   - Say, "There are two different ways to find the prime factorization of a number." Show students the following methods:

FACTOR TREE:

- Using a blank transparency, write the number 50.
- Ask the students to name number pairs that multiply to equal 50 and list examples on the board. (2 • 25, 5 • 10, 1 • 50)
- Explain that we can write 50 as the product of any of these number pairs. Say, "For this example, we will use 5 • 10." Draw the following on the transparency below the number 50. Say, "We are drawing a **factor tree**. The lines are like **branches** on a tree.

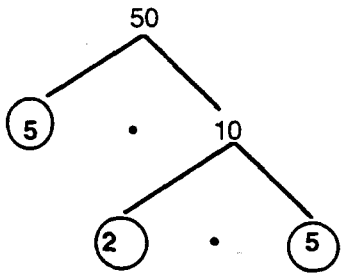


- Explain that on a factor tree, we circle the prime numbers. Model by circling the 5 as shown below. Say, "The circle tells you that this is a **prime** number and this "branch" is finished. Since 10 is not prime, this branch is not complete. You must continue this branch."



- Ask, "What number pair(s) multiply to equal 10? (2 • 5 or 10 • 1) Tell students that 1 is not used on a factor tree.
- Write 2 • 5 as a number pair below 10. Ask students if 2 or 5 should be circled and why. (They are both prime numbers and should be circled.)
- Point to the bottom line of circles and say, "The **factor tree** is complete when all of the branches end in a circle."

Factor Tree



Prime factorization: 2 x 5 x 5 **OR** 2×5^2

- Using the Prime Factorization transparency, write the number 50 in the first column.
- Explain that we will now write all of the circled prime factors from the factor tree in numerical order from the smallest to the largest. Model writing $2 \cdot 5 \cdot 5$ in the second column of the transparency. Be sure to include each circled number in your factor tree.
- Ask students if there is a shorter way to write the prime factorization of 50. Write $2 \cdot 5^2$ as the exponential form in the third column of the chart.
- Do several more factor trees with students, recording the number, its prime factorization and its exponential form on the Prime Factorization transparency.
- This is a good time to have students take turns going to the board and adding a different branch to a factor tree.
- Then, give everyone the same number and let the students try making a factor tree on their own. Choose a larger number (60,88, 100) with several possible factor trees. Ask students to write the prime factorization below their factor tree.
- Select students that have different factor trees to put their trees and the prime factorization on the board.
- Check to see if all students have the same prime factorization. Ask students why there are different trees on the board but each prime factorization is the same. (The students chose different products to make the factor trees, but the prime factorizations are the same because each student began with the same number and each number has one unique prime factorization.)

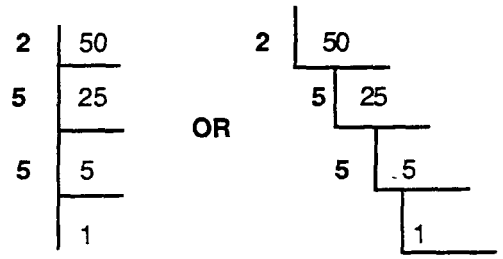
Note: This next method may need to be introduced on a second day to eliminate possible confusion between the two methods.

DIVISION: Explain that there is a second way to find prime factorization. (Either of the two division models below may be used. Depending on how students have learned to do division in their native countries, one method may be easier for them than another.)

- Write 50 on a blank transparency.
- Ask students for numbers that 50 can be **evenly** divided by. Hint: Remind students that this is where they can use their rules for divisibility that they discovered/reviewed earlier. (1, 2, 5, 10, 25, 50)
- Explain that you will use 2 because it is the smallest prime number. Remind students that 1 is not a prime number. Record the 2 as shown below using an inverted division frame. Tell students that this symbol is **inverted** or upside down from the division symbol commonly used in elementary schools in the United States. (⌐) Discuss the fact that some countries use this inverted symbol for all division problems.
- Elicit that 50 divided by 2 is 25. Once again, ask what number divides evenly into 25. (1, 5, 25) Lead students to understand that 5 will be used because it is the smallest prime.
- Record the 5 as shown below. Ask students what they think is on the next line. Allow a few minutes for discussion in pairs. Fill in the next line as shown. Have students explain.

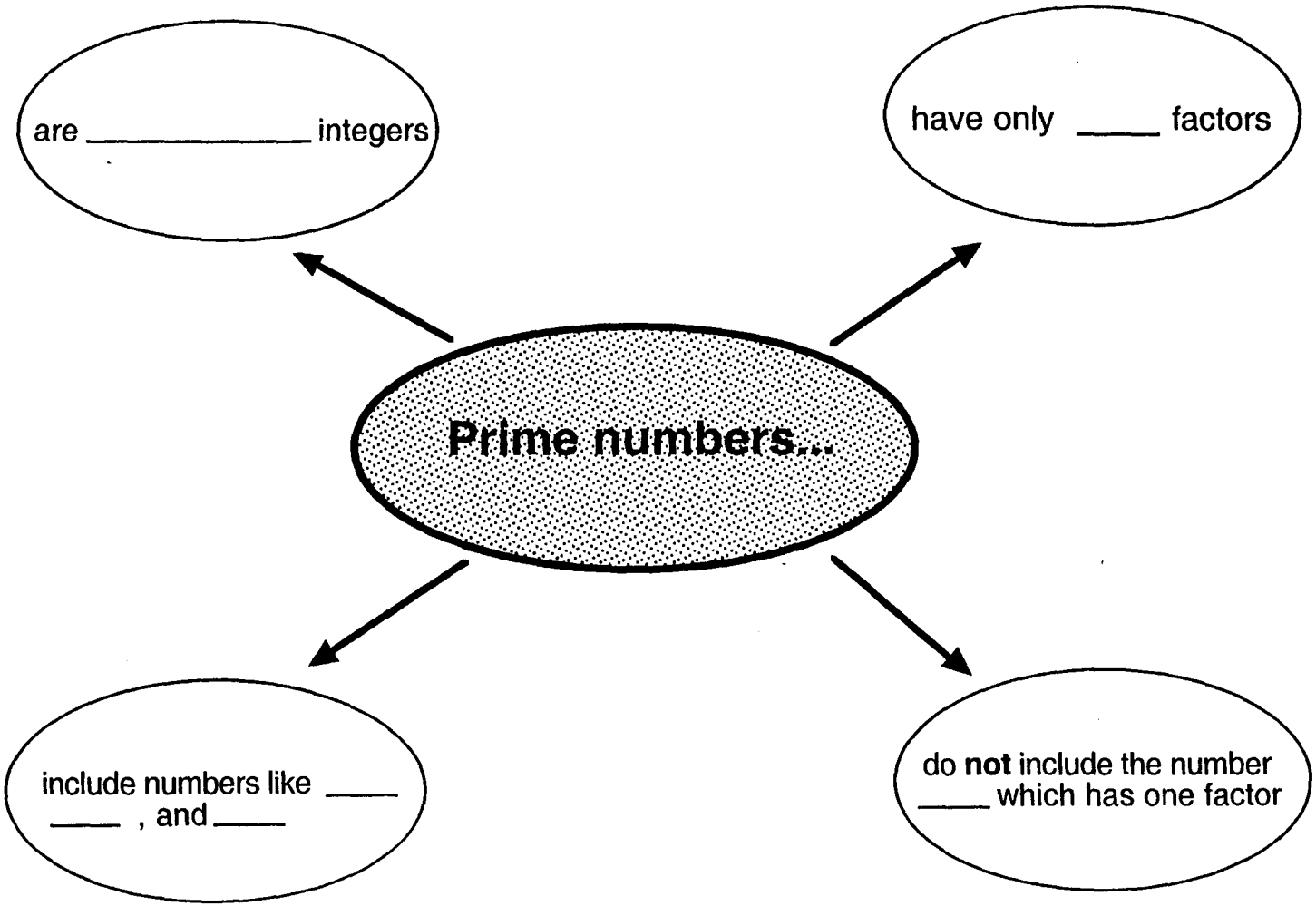
- Ask students what might be on the last line. Fill in the last line. Explain that you are done when you get to 1.

Division



- Go back to the Prime Factorization transparency and show that the prime numbers on the outside of the inverted division symbols are the same prime factorization found using the factor tree. ($50 = 2 \cdot 5 \cdot 5$)
- Point to the third column of the transparency and explain that the exponential form would also be the same. ($2 \cdot 5^2$).
- Do several more problems like this with the students.
- Have students tell which method is easier for them to use.
- Distribute the Prime Factorization Practice. After students complete the problems, check answers by having them put each prime factorization and, where possible, its exponential form, onto the Prime Factorization transparency.
- Use the transparency master, Finding Prime Factorization: Two Methods for review and/or enlarge and post for student reference.
- Use the Prime Factorization Challenge activity sheet as a homework assignment or a cooperative learning activity. You may want to allow students to use calculators and then have groups share how they worked the problems.
- The activity sheet Prime Factorization Triple Match is provided for further practice.

Prime Numbers



Prime Factorization

Number	Prime Factorization	Exponential Form (if possible)

Name _____
Date _____

Prime Factorization Practice

1. Using a factor tree, find the prime factorization for the following numbers.

128 36 125

Prime factorization _____ _____ _____

Exponential form _____ _____ _____

2. Using division, find the prime factorization of the following numbers.

154 64 66

Prime factorization _____ _____ _____

Exponential form _____ _____ _____

Name:_____
Date _____

Prime Factorization Challenge

1) Make two different factor trees for 220.

2) What is the prime factorization for 220?_____

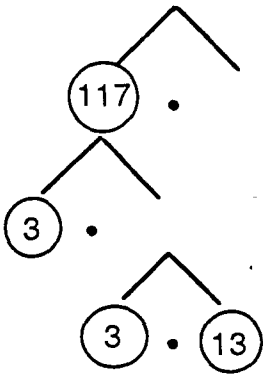
Fill in the missing numbers to <u>complete</u> each factor tree or division.

3) 2 | 84
42
21
7
1

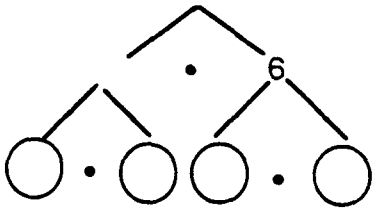
4) 3 | 45
3 | 15
5
1

5) 5 | 625
5
5
5

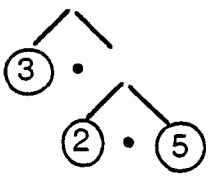
6) 1287



7) 462



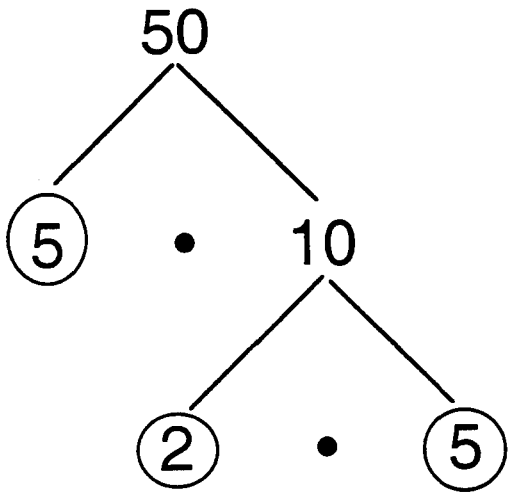
8)



9) 2
2
2
2
2
3
3
1

Finding Prime Factorization: Two Methods

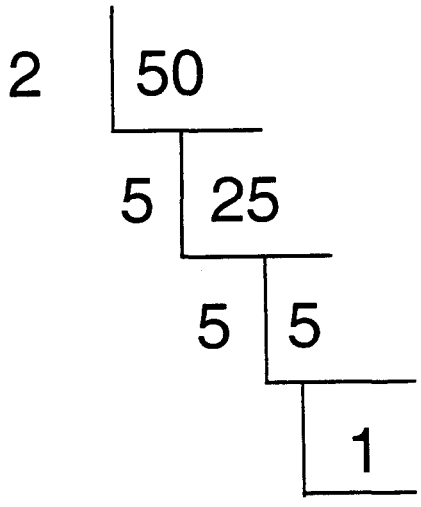
Factor Tree



Division

2	50
5	25
5	5
	1

OR



Name:_____

Prime Factorization Triple Match

Match the **number** to its **prime factorization** and then to its **exponential notation.**

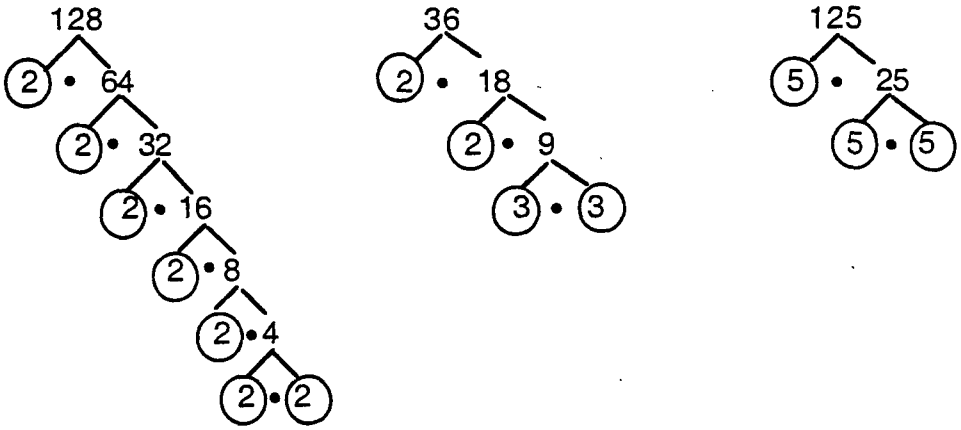
Draw lines to join the three parts.

Number	**Prime Factorization**	**Exponential Notation**
56	2 x 7 x 7 x 7	5 x 17
315	2 x 3 x 3 x 11	2^3 x 23
85	2 x 2 x 2 x 7	2 x 3^2 x 11
198	2 x 2 x 2 x 2 x 2 x 2 x 5	2 x 5 x 7
90	3 x 3 x 5 x 7	2 x 7^3
1020	2 x 5 x 7	2^3 x 7
70	2 x 2 x 2 x 2 x 2 x 3	2 x 3^2 x 5
184	2 x 3 x 3 x 5	3^2 x 5 x 7
320	5 x 17	2^2 x 3 x 5 x 17
96	2 x 2 x 2 x 23	2^5 x 3
686	2 x 2 x 3 x 5 x 17	2^6 x 5

Answer Key
Obj. 10

Prime Factorization Practice

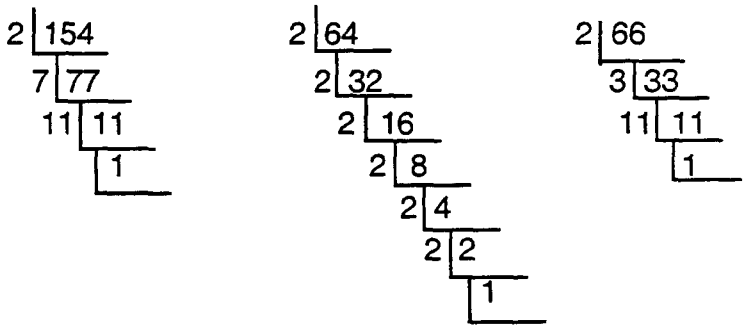
1. Using a factor tree, find the prime factorization for the following numbers.



Prime factorization: $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$; $2 \cdot 2 \cdot 3 \cdot 3$; $5 \cdot 5 \cdot 5$

Exponential form: 2^7 ; $2^2 \cdot 3^2$; 5^3

2. Using division, find the prime factorization of the following numbers.



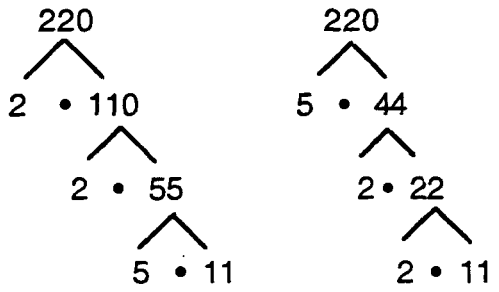
Prime factorization: $2 \cdot 7$; $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$; $2 \cdot 3 \cdot 11$

Exponential form: (none) ; 2^6 ; (none)

Answer Key
Obj. 10

Prime Factorization Challenge

1) Make two different factor trees for 220.



2) What is the prime factorization for 220? $2^2 \cdot 5 \cdot 11$

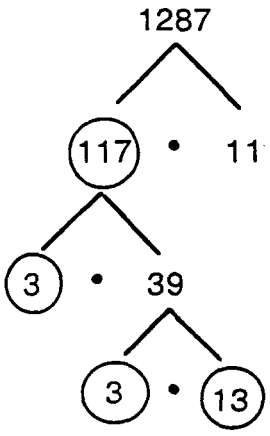
Fill in the missing numbers to complete each factor tree or upside down division.

3)
$$\begin{array}{r|l} 2 & 84 \\ 2 & 42 \\ 3 & 21 \\ 7 & 7 \\ & 1 \end{array}$$

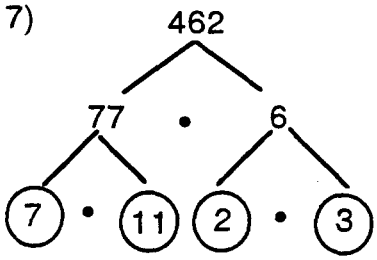
4)
$$\begin{array}{r|l} 3 & 45 \\ 3 & 15 \\ 5 & 5 \\ & 1 \end{array}$$

5)
$$\begin{array}{r|l} 5 & 62 \\ 5 & 125 \\ 5 & 25 \\ 5 & 5 \\ & 1 \end{array}$$

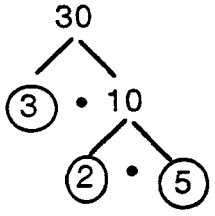
6)



7)



8)



9)
$$\begin{array}{r|l} 2 & 288 \\ 2 & 144 \\ 2 & 72 \\ 2 & 36 \\ 2 & 18 \\ 3 & 9 \\ 3 & 3 \\ & 1 \end{array}$$

Answer Key
Obj. 10

Prime Factorization Triple Match

Number	Prime Factorization	Exponential Notation
56	(686) $2 \times 7 \times 7 \times 7$	(85) 5×17
315	(198) $2 \times 3 \times 3 \times 11$	(184) $2^3 \times 23$
85	(56) $2 \times 2 \times 2 \times 7$	(198) $2 \times 3^2 \times 11$
198	(320) $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 5$	(70) $2 \times 5 \times 7$
90	(315) $3 \times 3 \times 5 \times 7$	(686) 2×7^3
1020	(70) $2 \times 5 \times 7$	(56) $2^3 \times 7$
70	(96) $2 \times 2 \times 2 \times 2 \times 2 \times 3$	(90) $2 \times 3^2 \times 5$
184	(90) $2 \times 3 \times 3 \times 5$	(315) $3^2 \times 5 \times 7$
320	(85) 5×17	(1020) $2^2 \times 3 \times 5 \times 17$
96	(184) $2 \times 2 \times 2 \times 23$	(96) $2^5 \times 3$
686	(1020) $2 \times 2 \times 3 \times 5 \times 17$	(320) $2^6 \times 5$

Objective 11: Explore the concept of square root.

Vocabulary

square number
perfect square
squared
square root
length
width
area
dimensions
estimate

Materials

transparent inch tiles
calculators

Transparencies:

- Exploring Square Root
- Sample Problems
- Table of Squares and Square Roots
- Squares and Square Roots (wall poster)

Student Copies

- Writing About Perfect Squares and Square Roots
- Working with Squares and Square Roots
- Square Root Activity Sheet
- Review of Square Root
- Squares and Square Roots Chart
- Squared Away!

Language Component

1. Discuss the word **square**. Ask students to describe what a square is: a shape with 4 equal sides and 4 right angles. Have students point out objects in the room that are squares.

2. Introduce expressions with the word square that students will use in this lesson - **square number, perfect square, squared, square root.**

3. Explain to students that the word **square** can be a noun or a verb. In the expression "the square of a number.." , square is a noun. In the expression " if we square the number...." , square is a verb.

4. Tell students that we will be using the word root in the mathematical expression **square root**. Ask students if they know any other uses of the word root (roots of trees or plants, family roots). Point out to students that in these cases, the word root relates to the beginning or foundation for something.

5. Remind students that **length** is how long something is and **width** is how wide something is.

6. Explain that when you measure objects by length, width, or height you are getting its **dimensions.** For 2 dimensional objects, you would measure length and width. For 3 dimensional objects, you measure length, width, and height.

Mathematical Component

1. Investigate the concept of square numbers also known as perfect squares.
   - Place one transparent inch tile on the overhead projector.
   - Ask, "What shape do your see?" (square)
   - Begin a chart on the board or overhead to record tiles that form a perfect square.

Number of Tiles	Square	Dimensions	Area
1	Yes	1 x 1 or 1^2	1

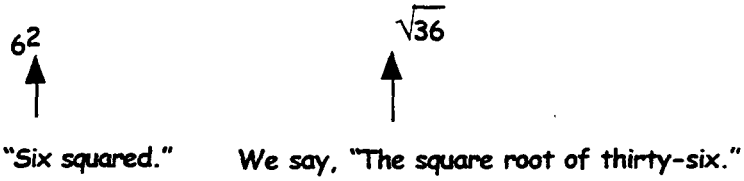
   - Ask, " What are the dimensions of this the square?" (1 x 1)
   - Ask, "Is there another way to write the dimensions?" (1^2) Fill in the dimensions on the chart.
   - Help the students make the connection between the dimensions (1^2), and the total number of tiles or area. (Area = 1) Fill in the area on the chart.
   - Place two transparent inch tiles on the overhead projector. ,
   - Ask, "Can you make a square out of two tiles?" (No) Add the number 2 to the chart as shown below.
   - Say, "How about 3 tiles?" (No) Add the number three to the chart as shown below. (Do not add dimensions or area for tiles which do not create a square.)

Number of Tiles	Square	Dimensions	Area
1	Yes	1 x 1 or 1^2	1
2	no		
3	no		

   - Place four tiles on the overhead and ask a student to come forward and try to make a square. (Yes)
   - Help the students again make the connection between the dimensions (2^2) and the area (4) as you fill in the appropriate information on the chart. (Yes for a square, 2^2, and 4.)
   - Tell the students that both 1 and 4 are called **perfect squares**. Ask <u>why</u> this is a good name for these numbers? (This total number of tiles can be arranged in a square.)
   - Give the students inch tiles and ask them to find the next 3 numbers which would be called **perfect squares**. (9, 16, 25)
   - Ask students to find other perfect squares (36, 49, 64, etc.) as you continue to help them make a connection between the dimensions and the area of squares. Lead students to see that the product of 2 identical factors will form a perfect square. (2 x 2, 3 x 3, ...)

2. Investigate square roots of perfect squares.
   - Place the transparency, <u>Exploring Square Root</u>, on the overhead projector. Cover the numbers on the right side of the transparency.

- Begin with the first square and ask, "What perfect square does this picture represent?" Remind students that this is the area. (36)
- Ask, "What are the **dimensions** that give us this square number?" (6 x 6 or 6^2) Label each side of the square with the number 6.
- Have students give the area of the square as you write it below the square on the transparency. (36)
- Uncover the information beside the square and demonstrate the symbols associated with square numbers and square root.



- Say, "The number 6 is **squared** to get 36. Six is called the **square root** of 36. To find the square root of a number, look for a number that you can multiply by itself to get the original number (36) as a product. Look at the dimensions of the square for help."
- Point to the second picture and ask students to name the perfect square which it represents. Remind students that it is the area. (49)
- Tell students that you want to find the square root of 49. Remind them that to find the square root of a number, look for a number that can be multiplied by itself to get the original number (49) as a product. Help students understand that we can find the square root by looking at the dimensions of the square. Label the dimensions on the transparency. Uncover the information beside the picture and remind students that since 7 x 7 = 49, the **square root** of 49 is 7.
- Help students understand the connection between squaring a number and finding the square root. Say, "I can begin with 7 and square it to get 49, or I can begin with 49 and "unsquare" it to get its **square root** which is 7."
- Repeat the same procedure with the third picture. (The area or **perfect square** is 100. The dimension or **square root** is 10.)
- Continue to reinforce the connection between perfect squares, square roots, area, and dimensions.
- Place the transparency, Sample Problems, on the overhead projector. Work through the first three sample problems with the students.
- As you work through problems, be sure to point out the following facts:

  1) Square root may be positive or negative. When you multiply two positive numbers **or** two negative numbers together you get a positive answer. For example, the positive square root of 81 is 9 because 9 • 9 = 81. The negative square root of 81 is -9 because -9 • -9 is also 81. (Integer operations will be introduced in Objective 20. If students are unfamiliar with the concept of multiplying two negative numbers, just go over this

information and explain that they will learn more about it later.)

2) The $\sqrt{\ }$ sign is used to mean positive square root.

3) A negative sign in front of the square root symbol will give you a negative answer. It may help students to think of the negative sign as meaning "the opposite of."

4) Finding the square root of fractions works the same way as for integers. To find the square root of $\sqrt{25/36}$, ask what fraction multiplied by itself will have 25/36 as a product? (5/6) Take the square root of 25 and the square root of 36 to get 5/6.

- The activity sheets Writing About Perfect Squares and Square Roots and Working With Squares and Square Roots are provided for further reinforcement.

3. Investigate the square root of any number.
   - Point to the last example on the Sample Problems transparency. Ask, "What do you think the square root of 15 is ?" (Since it is not a perfect square, students may struggle with this question.)
   - Explain to students that not all numbers are perfect squares and that there are several ways to find their square root.
     1) Show that one way is to **estimate** an answer by finding the square root of the two closest perfect squares. (The two closest perfect squares for 15 are 9 and 16. The square roots of 9 and 16 are 3 and 4. Therefore, the square root of 15 is between 3 and 4. Lead students to see that it would be closer to 4 since 15 is closer to 16 than to 9.)

Perfect squares	→	1	4	9	16	25	36
Square roots	→	(1)	(2)	(3)	(4)	(5)	(6)

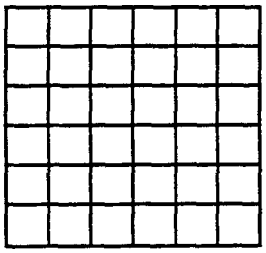
15

     2) Explain that another way to find square root is to use a square root chart. Show the students the transparency Table of Squares and Square Roots. Explain that these tables are found in most math books. Find the square root of 15. (3.873) Point out that it is closer to 4 than to 3 because 15 is closer to 16 than to 9. Let students practice finding the square and square root of other numbers on the chart.

     3) Demonstrate that a third way to find square root is to use a calculator. Find the square root of 15 using the square root key. Practice several other examples with students.

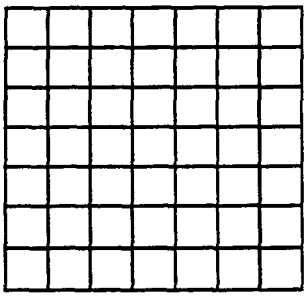
   - Square Root Activity Sheet will give additional practice with these three methods of finding square root.
   - Review of Square Root, Squares and Square Roots Chart, and Squared Away! are included for practice with topics covered in this objective. Squares and Square Roots is a review poster.

Exploring Square Root



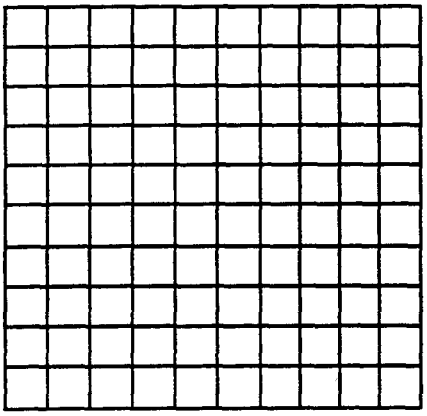
$6^2 = 36$

$\sqrt{36} = 6$



$7^2 = 49$

$\sqrt{49} = 7$



$10^2 = 100$

$\sqrt{100} = 10$

Sample Problems

$$\sqrt{81}$$

$$-\sqrt{64}$$

$$\sqrt{\frac{25}{36}}$$

$$\sqrt{15}$$

Name _____

Writing About Perfect Squares and Square Roots

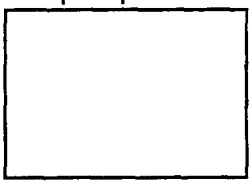
1. Explain what a **perfect square** is.

_____

_____

_____

Draw a picture to help explain.



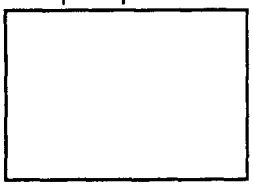
2. Explain what a **square root** is.

_____

_____

_____

Draw a picture to help explain.



Write each phrase or sentence using numbers and symbols.

Example: the square root of fifty-six Answer: $\sqrt{56}$

1. the square of six equals thirty-six _____
2. the positive square root of sixty-four _____
3. the square root of four twenty-fifths _____
4. the square of negative nine equals eighty-one _____
5. the opposite of five squared _____
6. the positive square root of 400 equals 20 _____

Write each expression or statement in words.

Example: $\sqrt{36}$ Answer: the square root of thirty-six

1. 12^2 _____
2. $\sqrt{25}$ _____
3. -9^2 _____
4. $-\sqrt{16}$ _____
5. $\sqrt{\frac{9}{25}}$ _____

Name _____

Working With Squares and Square Roots

Remember: The word **evaluate** means to find a solution, or answer, to a problem.

Evaluate each expression.

1) 9^2 = ____ 2) 3^2 = ____ 3) 30^2 = ____ 4) 11^2 = ____

5) 1^2 = ____ 6) 125^2 = ____ 7) 12^2 = ____ 8) 14^2 = ____

9) 50^2 = ____ 10) 36^2 = ____ 11) 8^2 = ____ 12) 21^2 = ____

Can you evaluate these algebraic expressions?

1) a^2 ; if a = 3 ____ 2) $(a+b)^2$; if a = 2 and b = 3 ____

3) $p^2 + r^2$; if p = 3 and r = 4 ____ $\frac{w^2}{s^2}$; if w = 6 and s = 3 ____

Find each square root.

1) $\sqrt{25}$ = 2) $\sqrt{64}$ = 3) $\sqrt{4}$ = 4) $\sqrt{16}$ =

5) $\sqrt{81}$ = 6) $\sqrt{49}$ = 7) $\sqrt{1}$ = 8) $\sqrt{36}$ =

9) $\sqrt{100}$ = 10) $\sqrt{144}$ = 11) $\sqrt{9}$ = 12) $\sqrt{121}$ =

Write True or False for each statement.

1) To square a number you multiply it by 2. _____
2) Square root is always a positive number . _____
3) To find square root you "unsquare" a number. _____
4) The exponent 4 shows that a number is squared. _____
5) A table may be used to find square root. _____

Table of Squares and Square Roots

NO.	SQUARE	SQUARE ROOT
1	1	1.000
2	4	1.414
3	9	1.732
4	16	2.000
5	25	2.236
6	36	2.449
7	49	2.646
8	64	2.828
9	81	3.000
10	100	3.162
11	121	3.317
12	144	3.464
13	169	3.606
14	196	3.742
15	225	3.873
16	256	4.000
17	289	4.123
18	324	4.243
19	361	4.359
20	400	4.472
21	441	4.583
22	484	4.690
23	529	4.796
24	576	4.899
25	625	5.000
26	676	5.099
27	729	5.196
28	784	5.292
29	841	5.385
30	900	5.477
31	961	5.568
32	1,024	5.657
33	1,089	5.745
34	1,156	5.831
35	1,225	5.916
36	1,296	6.000
37	1,369	6.083
38	1,444	6.164
39	1,521	6.245
40	1,600	6.325
41	1,681	6.403
42	1,764	6.481
43	1,849	6.557
44	1,936	6.633
45	2,025	6.708
46	2,116	6.782
47	2,209	6.856
48	2,304	6.928
49	2,401	7.000
50	2,500	7.071

NO.	SQUARE	SQUARE ROOT
51	2,601	7.141
52	2,704	7.211
53	2,809	7.280
54	2,916	7.348
55	3,025	7.416
56	3,136	7.483
57	3,249	7.550
58	3,364	7.616
59	3,481	7.681
60	3,600	7.746
61	3,721	7.810
62	3,844	7.874
63	3,969	7.937
64	4,096	8.000
65	4,225	8.062
66	4,356	8.124
67	4,489	8.185
68	4,624	8.246
69	4,761	8.307
70	4,900	8.367
71	5,041	8.426
72	5,184	8.485
73	5,329	8.544
74	5,476	8.602
75	5,625	8.660
76	5,776	8.718
77	5,929	8.775
78	6,084	8.832
79	6,241	8.888
80	6,400	8.944
81	6,561	9.000
82	6,724	9.055
83	6,889	9.110
84	7,056	9.165
85	7,225	9.220
86	7,396	9.274
87	7,569	9.327
88	7,744	9.381
89	7,921	9.434
90	8,100	9.487
91	8,281	9.539
92	8,464	9.592
93	8,649	9.644
94	8,836	9.695
95	9,025	9.747
96	9,216	9.798
97	9,409	9.849
98	9,604	9.899
99	9,801	9.950
100	10,000	10.000

NO.	SQUARE	SQUARE ROOT
101	10,201	10.050
102	10,404	10.100
103	10,609	10.149
104	10,816	10.198
105	11,025	10.247
106	11,236	10.296
107	11,449	10.344
108	11,664	10.392
109	11,881	10.440
110	12,100	10.488
111	12,321	10.536
112	12,544	10.583
113	12,769	10.630
114	12,996	10.677
115	13,225	10.724
116	13,456	10.770
117	13,689	10.817
118	13,924	10.863
119	14,161	10.909
120	14,400	10.954
121	14,641	11.000
122	14,884	11.045
123	15,129	11.091
124	15,376	11.136
125	15,625	11.180
126	15,876	11.225
127	16,129	11.269
128	16,384	11.314
129	16,641	11.358
130	16,900	11.402
131	17,161	11.446
132	17,424	11.489
133	17,689	11.533
134	17,956	11.576
135	18,225	11.619
136	18,496	11.662
137	18,769	11.705
138	19,044	11.747
139	19,321	11.790
140	19,600	11.832
141	19,881	11.874
142	20,164	11.916
143	20,449	11.958
144	20,736	12.000
145	21,025	12.042
146	21,316	12.083
147	21,609	12.124
148	21,904	12.166
149	22,201	12.207
150	22,500	12.247

Name _____

Square Root Activity Sheet

Find each square root.

1. $\sqrt{16}$
2. $\sqrt{49}$
3. $-\sqrt{121}$
4. $\sqrt{\frac{4}{49}}$
5. $\sqrt{225}$
6. $-\sqrt{100}$

Estimate what two whole numbers each square root would fall between.

7. $\sqrt{50}$ would be between 7 & 8
8. $\sqrt{72}$ would be between _____
9. $\sqrt{7}$ would be between _____
10. $\sqrt{27}$ would be between _____

Use a square root table or a calculator to approximate each square root to the nearest hundredths place.

11. $\sqrt{116}$ About _____
12. $-\sqrt{8}$ About _____
13. $\sqrt{40}$ About _____

It is a good idea to memorize some of the common square roots. Study these square roots and their answers.

$\sqrt{1} = 1$ $\sqrt{4} = 2$ $\sqrt{9} = 3$ $\sqrt{16} = 4$ $\sqrt{25} = 5$ $\sqrt{36} = 6$

$\sqrt{49} = 7$ $\sqrt{64} = 8$ $\sqrt{81} = 9$ $\sqrt{100} = 10$ $\sqrt{121} = 11$ $\sqrt{144} = 12$

Think about the square roots you have just studied. Use what you have learned to find these answers mentally.

1. $3 \cdot \sqrt{121} =$ ____ 2 $16 - \sqrt{64} =$ ____ 3. $\sqrt{81} + 11 =$ _____

4. $\frac{\sqrt{16}}{8} =$ ____ 5. $-\sqrt{100} =$ ____ 6. $\sqrt{36} \cdot 3 =$ _____

7. $\sqrt{\frac{144}{4}} =$ ____ 8. $\frac{1}{2} \cdot \sqrt{36} =$ ____ 9. $\sqrt{9} + \sqrt{25} + \sqrt{100} =$ ____

Choose the best estimate without using a table or a calculator.

1. $\sqrt{17}$ a. about 4.9 b. about 4.1 c. about 5.6

2. $\sqrt{39}$ a. about 6.2 b. about 7.5 c. about 5.2

3. $-\sqrt{10}$ a. about -3.8 b. about -3.2 c. about -4.1

4. $\sqrt{5}$ a. about 1.9 b. about 2.9 c. about 2.2

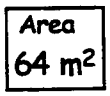
Use what you know about squares and square roots to help solve this problem.

Can you find the **perimeter** of a garden that has an area of 121 sq. feet? Show the work you do to solve the problem.

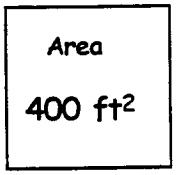
Name: _____

Review of Square Root

Find the length of one side(s) of each square.

1) 

s = _____ m

2) 

s = _____ ft

3) 

s = _____ cm

4) 

s = _____ yd

Find the square root.

1) $\sqrt{49}$ _____

2) $\sqrt{100}$ _____

3) $\sqrt{1}$ _____

4) $\sqrt{144}$ _____

5) $\sqrt{169}$ _____

6) $\sqrt{900}$ _____

7) $\sqrt{10,000}$ _____

8) $\sqrt{6,400}$ _____

9) $\sqrt{32}$ _____

10) $\sqrt{172}$ _____

11) $\sqrt{6}$ _____

12) $-\sqrt{130}$ _____

Simplify.

1) 16^2 = _____

2) 20^2 = _____

3) 2^2 = _____

4) $\sqrt{121}$ = _____

5) $-\sqrt{625}$ = _____

6) $\sqrt{25} + \sqrt{9}$ = _____

7) $\sqrt{0.81}$ = _____

8) $\sqrt{0.4}$ = _____

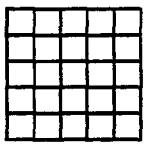
9) $\sqrt{25 + 9}$ = _____

Name:_____

Squares and Square Roots Chart

When you model a square using unit tiles, the number of unit tiles you use is a **perfect square**.

You would need 25 unit tiles to model this square.
It is made from 5 rows of 5 unit tiles.



So, 5 **squared** means $5 \times 5 = 5^2$, or 25.

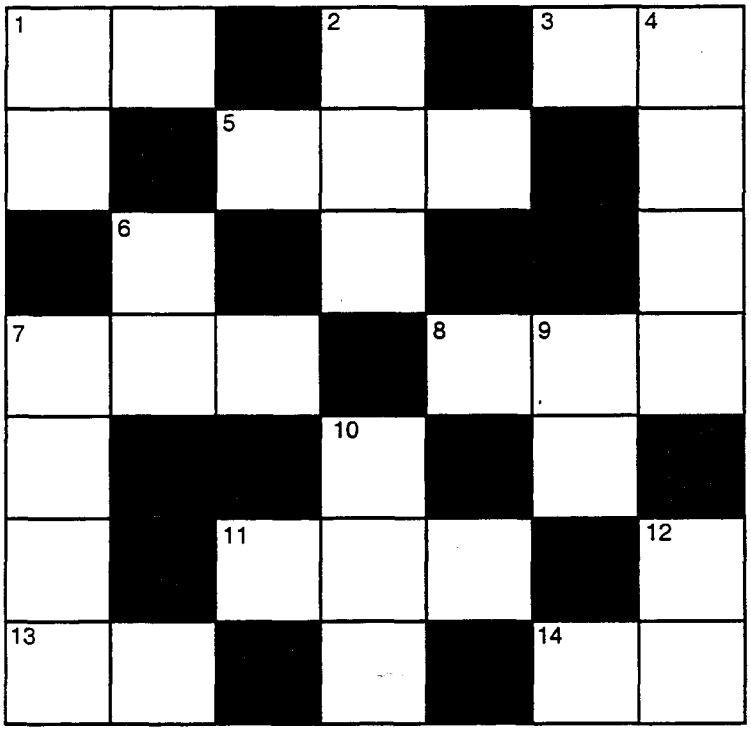
Complete the chart.

Length of Side	Square of Length of Side	Square Root
1	$1^2 = 1$	$\sqrt{1} = 1$
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

Name:_____

Squared Away!

Fill in the crossword puzzle by finding the squares and square roots of the numbers.



Across (Horizontal)

1) 4^2

2) $\sqrt{81}$

3) 9^2

5) 20^2

7) 16^2

8) 18^2

11) 12^2

13) $\sqrt{169}$

14) $\sqrt{1225}$

Down (Vertical)

1) $\sqrt{289}$

2) 30^2

4) 38^2

6) $\sqrt{225}$

7) 51^2

9) $\sqrt{484}$

10) 29^2

12) $\sqrt{625}$

Squares and Square Roots

When a number is multiplied by itself, the product is the ***square*** of the number.

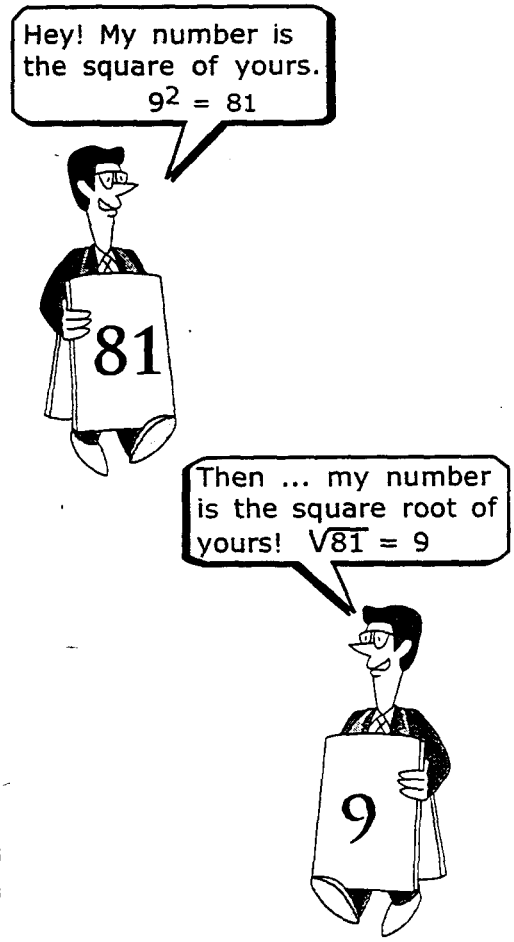
$4 \times 4 = 16$

Write: $4^2 = 16$

Say: 4 squared is equal to 16.

or

16 is the square of 4



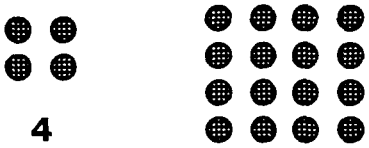
One of two equal factors of a number is the ***square root*** of the number ($4 \times 4 = 16$).

Write: $\sqrt{16} = 4$

Say: The square root of 16 is equal to 4.

Square Number

The number of dots in a square array.



4 **16**

4 and 16 are ***square numbers***.

Perfect Square

The product of an integer multiplied by itself.

25 is a **perfect square** because **5** x **5** = 25

PERFECT SQUARES		
4	9	64
25	1	
100	49	

NOT PERFECT SQUARES		
11	6	3
		42
50	18	

Answer Key
Obj. 11

Sample Problems Transparency p.6

$\sqrt{81} = 9$

$-\sqrt{64} = -8$

$\sqrt{\frac{25}{36}} = \frac{5}{6}$

$\sqrt{15} = 3.873$

Writing About Square Numbers and Square Roots p.7

1) • A perfect square is the same as a square number.
   • The number of tiles in a square (the area) is a perfect square.
   • The product of two identical factors is a perfect square. 5 x 5 = 25 25 is a perfect square.

2) • Square root is the opposite of squaring a number or squared.
   • To find the square root, ask what number multiplied by itself will give the original number.
   • $\sqrt{}$ is the symbol for square root. $\sqrt{25}$

Write the phrase or sentence using numbers.

1. $6^2 = 36$
2. $\sqrt{64}$
3. $\sqrt{4/25}$
4. $-9^2 = 81$
5. $-(5)^2$
6. $\sqrt{400} = 20$

Write each expression in words.

1. twelve squared or the square of twelve
2. the square root of 25
3. the square of negative nine; the opposite of nine squared
4. the opposite of the square root of sixteen
5. the square root of nine twenty - fifths

Working with Squares and Square Roots p. 8

Evaluate each expression.

1) 81 2) 9 3) 900 4) 121
5) 1 6) 15,625 7) 144 8) 196
9) 2,500 10) 1,296 11) 64 12) 441

Can you evaluate these algebraic expressions?

1) 9 2) 25 3) 25 4) 4

Find each square root.

1) 5 2) 8 3) 2 4) 4
5) 9 6) 7 7) 1 8) 6
9) 10 10) 12 11) 3 12) 11

Write True or False

1) F 2) F 3) T 4) F 5) T

Square Roots Activity Sheet p.10

1) 4 2) 7 3) -11
4) 2/7 5) 15 6) -10
7) 7 and 8 8) 8 and 9
9) 2 and 3 10) 5 and 6
11) 10.77 12) -2.83 13) 6.32

Find these answers mentally. p.11

1) 33 2) 8 3) 20
4) 1/2 5) - 10 6) 18
7) 6 8) 3 9) 18

Choose the best estimate.

1) b 2) a 3) b 4) c

Garden problem: $\sqrt{121} = 11$

11 | 121 | 11 (11 on top and bottom)

11 x 4 = **44**

Answer Key
Obj. 11

Review of Square Root p. 12

Find the length of the side.

1) 8 m 2) 20 ft 3) 3,2 cm 4) 12.2 yd

Find the square root.

1) 7 2) 10 3) 1 4) 12
5) 13 6) 30 7) 100 8) 80
9) 5.7 10) 13.1 11) 2.4 12) -11.4

Simplify.

1) 256 2) 400 3) 4
4) 11 5) -25 6) 8
7) 0.9 8) 0.2 9) 5.8

Squares and Square Roots Chart p.13

Side	Square of Length of Side	Square Root
1	$1^2 = 1$	$\sqrt{1} = 1$
2	$2^2 = 4$	$\sqrt{4} = 2$
3	$3^2 = 9$	$\sqrt{9} = 3$
4	$4^2 = 16$	$\sqrt{16} = 4$
5	$5^2 = 25$	$\sqrt{25} = 5$
6	$6^2 = 36$	$\sqrt{36} = 6$
7	$7^2 = 49$	$\sqrt{49} = 7$
8	$8^2 = 64$	$\sqrt{64} = 8$
9	$9^2 = 81$	$\sqrt{81} = 9$
10	$10^2 = 100$	$\sqrt{100} = 10$
11	$11^2 = 121$	$\sqrt{121} = 11$
12	$12^2 = 144$	$\sqrt{144} = 12$
13	$13^2 = 169$	$\sqrt{169} = 13$

Squared Away p.14

1 1	6	■	2 9	■	3 8	4 1
7	■	5 4	0	0	■	4
■	6 1	■	0	■	■	4
7 2	5	6	■	8 3	9 2	4
6	■	■	10 8	■	2	■
0	■	11 1	4	4	■	12 2
13 1	3	■	1	■	14 3	5

Objective 12: Write powers of ten as products of tens and in exponential form.

Vocabulary

power of 10

Materials

calculators

Transparencies

Powers of Ten Activity
Ways to Write a Large Number

Student Copies

Powers of Ten Activity
Practice with Powers of 10

Language Foundation

All vocabulary words in this lesson have been previously introduced. Highlight and review vocabulary as needed.

Mathematics Component

Note: This is a brief lesson and can be used as a warm-up to the next objective.

1. Write large numbers as products of ten and in exponential form.
   - Write several very large numbers on a transparency and call on students to read them out loud.
   - Discuss how difficult and time consuming it would be for scientists (e.g. astronomers) to read and write such big numbers when doing their research.
   - Also point out that very large numbers can be a problem for regular calculators. If you have regular four-function calculators available, have students enter an eight digit number. Have them multiply that number by any two digit number. The calculator will display an error message. The number is too big.
   - Tell the students they are going to learn a quick and scientific way to write large numbers with 10 as a base.
   - Remind students that for 100,000 you can write 10^5. Review the terminology for exponents by asking the following questions.
     - What is the base? (10)
     - What is the exponent? (5)
     - What does 10^5 mean?" (10 x 10 x 10 x 10 x 10)
     - Have students multiply this out on their calculators. (100,000).
     - How many zeros are there in 100,000? (5)
   - Write 10^7 on the board and ask what this number means? (10 x 10 x 10 x 10 x 10 x 10 x 10)
     Have students multiply this out on their calculators. (10,000,000)
     Ask how many zeros there are in 10,000,000. (7).
   - Explain to students that when you multiply 10's together, the product is called a power of ten. Instead of writing a lot of zeros, you can use an exponent to show a power of ten. The exponent tells the number of times that 10 is a factor.
   - Distribute Powers of Ten Activity and ask students to complete the sheet.
   - When finished, allow students to come up and show correct answers using a transparency copy of the activity sheet.
   - After reviewing correct answers, ask, "What do you notice about the exponent and the number of zeros in the number?" (They are the same.)
   - Ask if this pattern also works when using other bases, for example 4^5. Allow a student to demonstrate 4^5 on the board or on the overhead. (4 x 4 x 4 x 4 x 4 = 1,024) Stress that this pattern of powers of 10 only works when the base is 10. Have students name the base for 4^5. (The base is 4; therefore, the pattern does not work.)
   - The activity sheet Practice with Powers of 10 is included for further practice on this topic.
   - The transparency /wall poster Ways to Write a Large Number is provided for review.

Name: _____ Transparency/ Student Copy

Powers of Ten Activity

Complete the following table.

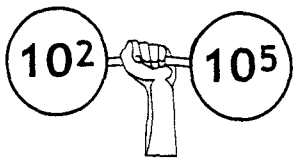
	Exponential Form	Expanded Form (Factor Form)	Value (Standard Form)
1.	10^5	10 x 10 x 10 x 10 x 10	100, 000
2.	10^2		
3.		10 x 10 x 10 x 10 x 10 x 10 x 10	
4.	10^1		
5.	10^{10}		
6.		10 x 10 x 10 x 10	
7.			1,000
8.		10 x 10 x 10 x 10 x 10 x 10 x 10 x 10 x 10 x 10 x 10 x 10	
9.	10^6		
10.			100,000,000

What do you notice about the exponent and the number of zeros in the number?

_____

_____

Name: _____



Practice with Powers of 10

Write the correct exponent in the box.

1) $10 \times 10 \times 10 \times 10 = 10^{\square}$

2) $10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^{\square}$

3) $10 \times 10 = 10^{\square}$

Complete:

4) $10^{\square} = 10 \times 10 \times 10$

5) $10 = 10^{\square}$

6) $10^3 =$ _____

7) $10^{\square} = 100{,}000{,}000{,}000$

Standard Form	Factor Form	Exponential Form	Say
100	10 x 10	10^2	ten squared or ten to the second power

Look at the box. Then fill in the blanks.

8) 10 x 10 x 10 x 10 x 10

Exponent form _____

Standard Form _____

Say: _____

10) 10 x 10 x 10

Exponent form _____

Standard Form _____

Say: _____

9) 10 x 10 x 10 x 10 x 10 x 10

Exponent form _____

Standard Form _____

Say: _____

11) 10 x 10 x 10 x 10 x 10 x 10 x 10

Exponent form _____

Standard Form _____

Say: _____

Tell how many zeros will be in the number written in standard form:

12) 10^1 _____

13) 10^{25} _____

14) 10^{10} _____

15) ten to the fifth power _____

16) ten squared _____

17) 10^{15} _____

Practice with Powers of 10

Write the number in standard form:

18) 10^4 _____

19) 10 x 10 x 10 x10 x 10 _____

20) ten cubed _____

21) 10^7 _____

22) 10^1 _____

Write each number in exponential form:

23) 10,000 _____

24) 1,000 _____

25) 100 _____

26) 100,000,000,000 _____

27) ten cubed _____

28) ten to the fiftieth _____

Reading and Writing Power

1) What is the *exponent* in 10^{11}? _____

2) What is the *base* in 10^4? _____

3) The number represented by 10^6 has how many zeros? _____

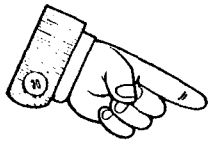
4) What is the number represented by 10^6? _____

5) How can you rename 100 using tens as factors? _____

6) How many times is 10 uses as a factor of 1,000? _____

Solve this riddle:

My base is 10. My exponent is an odd number. If you write a multiplication sentence to show my value, I will have fewer than 4 factor. My value is greater than 10. What number am I?



Ways to Write a Large Number - Powers of 10

FORM	EXAMPLE
Standard Form	1,000,000,000
Factor Form	10 x 10 x 10 x 10 x 10 x 10 x 10 x 10 x 10
Exponential Form	10^9 Say: Ten to the ninth power or Ten to the ninth

Answer Key
Obj. 12

Powers of Ten Activity

Complete the following table.

	Exponential Form	Expanded Form	Value
1.	10^5	10 x 10 x 10 x 10 x 10	100, 000
2.	10^2	10x10	100
3.	10^7	10 x 10 x 10 x 10 x 10 x 10 x 10	10,000,000
4.	10^1	10	10
5.	10^{10}	10x10x10x10x10x10x10x10x10x10	10,000,000,000
6.	10^4	10 x 10 x 10 x 10	10,000
7.	10^3	10 x 10 x 10	1,000
8.	10^{12}	10 x10 x10 x10 x10 x10x10x10x10x10x10x10	1,000,000,000,000
9.	10^6	10x10x10x10x10x10	1,000,000
10.	10^8	10x10x10x10x10x10x10x10	100,000,000

What do you notice about the exponent and the number of zeros in the number?

The exponent and the number of zeros in the number are the same.

Practice with Powers of 10

1) 4
2) 8
3) 2
4) 3
5) 1
6) 1,000
7) 11

8) 10^5 ; 100,000 ; ten to the fifth power

9) 10^6 ; 1,000,000 ; ten to the sixth power

10) 10^3 ; 1,000 ; ten cubed or ten to the third power

11) 10^7 ; 10,000,000 ; ten to the seventh power

Answer Key
Obj. 12

Tell how many zeros

12) 1
13) 25
14) 10
15) 5
16) 2
17) 15

Write the number in standard form.

18) 10,000
19) 100,000
20) 1,000
21) 10,000,000
22) 10

Write each number in exponential form.

23) 10^4
24) 10^3
25) 10^2
26) 10^{11}
27) 10^3
28) 10^{50}

Reading and Writing Power

1) 11
2) 10
3) 6
4) 1,000,000
5) 10 x 10
6) 3

RIDDLE : 10^3 = 10 x 10 x 10 = **1,000**

Objective 13: Multiply and divide by powers of ten.

Vocabulary

powers of ten

Language Foundation

Highlight and review terms from previous lessons as necessary.

Materials

calculators
paper

Transparencies

Multiplying by Powers of 10 / Dividing by Powers of 10 - wall poster

Student Copies

Practice Multiplying and Dividing by Powers of 10
Multiplication and Division by Powers of Ten
Language and Writing
Powers of Ten Assessment

Mathematics Component

1. Multiply whole and decimal numbers by ten.
   - Explain that the number ten has special characteristics. For example, 10^5 means 100,000. The exponent tells you how many zeros are at the end of the number.
   - Ask students what happens when you multiply a whole number by ten? Allow students to use a calculator to work several examples as you record the results.

     $2 \cdot 10 = 20$
     $3 \cdot 10 = 30$
     $5 \cdot 10 = 50$
     $25 \cdot 10 = 250$

   - Ask, "Do you see a pattern?" (One zero was added to the number itself.)
   - Say "Now what happens when you multiply a decimal value by ten." Allow students to use a calculator to work several examples as you record the results.

     $1.5 \cdot 10 = 15$
     $0.2 \cdot 10 = 2$
     $17.34 \cdot 10 = 173.4$
     $150.6 \cdot 10 = 15{,}060$

   - Ask, "Do you see a pattern?" (The decimal point moved one place to the right.)
   - Explain to students that what seems to be two different rules for multiplying by 10 is really the same rule.
   - Go back to the first whole number multiplied by 10 which was 2. Explain that the whole number 2 may also be written as 2.0. Write $2.0 \cdot 10 = ?$
   - Ask students what they have learned about multiplying a decimal value by 10. (The decimal point moved one place to the right.) Have a student fill in the answer to $2.0 \cdot 10 = ?$. (20)
   - Explain that adding a 0 to a whole number which is multiplied by ten is the same as moving the decimal point one place to the right. Students really only need to remember one rule for multiplying by 10.

     Rule: When multiplying by 10, the decimal point will move one place to the right.

   - Check this rule by applying it to several examples.

     $6 \cdot 10 = ?$ Think: $6.0 \cdot 10 = 60$
     $2.5 \cdot 10 = ?$ Think: $2.5 \cdot 10 = 25$
     $68 \cdot 10 = ?$ Think: $68.0 \cdot 10 = 680$
     $1.12 \cdot 10 = ?$ Think: $1.12 \cdot 10 = 11.2$

   - Tell students that they have been multiplying by one **power** of 10. Explain that a **power** is a base with an exponent. When working with powers of 10, the base is 10.

2. Multiply whole and decimal number by 100.
   - Ask, "How many powers of ten is 100?" (Two, because $100 = 10^2$.)
   - Ask students what they think will happen if they multiply by 100."
   - Have the students multiply several whole numbers by 100 on their calculators.

     $93 \cdot 100 = 9300$
     $2 \cdot 100 = 200$
     $186 \cdot 100 = 18{,}600$
     $77 \cdot 100 = 7700$

   - Ask if students can find a pattern. (Multiplying by 100 means you add two zeros to the number.) Remind students that when multiplying by 100, they are multiplying by two powers of ten.)
   - Work several examples multiplying 100 times a decimal value with a calculator.

     $2.9\,4 \cdot 100 = 294$
     $.36 \cdot 100 = 36$
     $5.925 \cdot 100 = 592.5$
     $198.7 \cdot 100 = 19{,}870$

   - Have students look for a pattern. (The decimal point moved two places to the right.)
   - Remind students that $100 = 10^2$ and the decimal point will move two places.
   - Lead a student to explain a rule for multiplying any whole or decimal number by 100.

     Rule: When multiplying by 100, the decimal point will move two places to the right.

3. Multiply whole and decimal numbers by 1,000.
   - Have students predict what will happen when you multiply by 1,000 or 10^3.
   - Work several examples together.

     $46 \cdot 1{,}000 = 46{,}000$
     $5.273 \cdot 1{,}000 = 5{,}273$
     $3.9 \cdot 1{,}000 = 3{,}900$

   - Lead students to verbalize a rule.

     Rule: When multiplying by 1,000, the decimal point moves three places to the right.
   - Remind students that 1,000 is the same as three powers of 10.

4. Generalize a rule for multiplying any whole or decimal number by a power of 10.
   - Ask, "What do you think will happen when you multiply a whole or decimal number by 1,000,000 or 10^6 ?" (Move the decimal to the right six places). Provide several practice problems.
   - Have students try to think of a rule that would work when multiplying a whole or decimal number by any power of 10.

     General Rule: When multiplying by a power of 10, the decimal point moves to the right the same number of places as the number of zeros in the power of 10.

- Point out to students that there is an easy shortcut for multiplying a whole number by a **power of 10.** Just count the number of zeros in the power of ten and then add that number of zeros to the factor. For example, 5 x 1,**000** ⟶ 5 with three zeros = 5,**000.** For a whole number, this is the same as moving the decimal point to the right.

5. Divide whole and decimal numbers by 10.
   - Say,"What do you think happens when you divide by 10 or 10^1? Think about what you have just done with multiplication." Allow students to make guesses about what will happen.
   - Try several problems to check students' theories. Examples:

$$\frac{20}{10} = 2 \qquad \frac{34.7}{10} = 3.47$$

$$\frac{50}{10} = 5 \qquad \frac{9.62}{10} = 0.962$$

$$\frac{140}{10} = 14$$

   - Have students look for a pattern and verbalize a rule for dividing by 10.

     Rule: When dividing a whole or decimal number by a power of 10, move the decimal point to the left one place.

   - Point out that this is the same number of places as the value of the exponent (10^1)
   - Follow the same procedure with 100 (10^2) and 1,000 (10^3) and 100,000 (10^5). Have students generalize a rule for dividing a whole or decimal number by any power of 10.

     Rule: When dividing by a power of 10, the decimal point moves to the left the same number of places as the number of zeros in the power of 10.

6. Look for a relationship between multiplication and division with powers of 10.
   - Tell students that an easy way to remember which way to move the decimal point is that when you multiply , the number **increases** in value. Moving the decimal to the right makes the number largerin value.
   - Explain that when you divide, it makes the value **smaller.** Moving the decimal to the left makes the number less in value.
   - Have students complete the activity Practice Multiplying and Dividing by Powers of 10.
   - Distribute Multiplication and Division by Powers of Ten activity sheets to each student. Students should be able to work most of these problems mentally, but the final word problems have several steps and may require a calculator.
   - Multiplying by Powers of 10/Dividing by Powers of 10 may be used as a review transparency or wall poster.

Language Development Activities

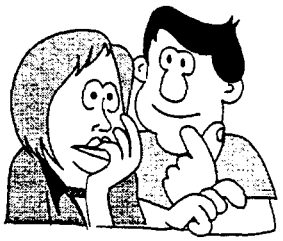
- The activities Language and Writing and Powers of Ten Assessment are provided to enable students to further explore and demonstrate their knowledge of **Powers of Ten** in written form.
- To complete the Powers of Ten Assessment sheet:
    - Have individual or pairs of students write problems of their own for division and multiplication with powers of 10 . (If working individually, 5 of each might be a good number.)
    - Tell students to show the solutions for the problems they have created on a separate sheet of paper.
    - Have students or pairs exchange papers and work the problems given to them.
    - When the students are finished working on each others problems, have them get their original papers back and check to see if the answers are correct.

Name: _____

Practice Multiplying and Dividing by Powers of 10

Tell the direction you will move the decimal point (left or right) and how many places you will move it.

		Direction	Number of Places
1)	100 x 3.01 =	_____	_____
2)	10 x 88 =	_____	_____
3)	46.32 ÷ 10 =	_____	_____
4)	12.7 ÷ 100 =	_____	_____
5)	1,000 x 5.561 =	_____	_____
6)	90.12 ÷ 10,000 =	_____	_____



Place the decimal point correctly in each answer.

7) 10 x 2.92 = 2 9 2

8) 64.3 ÷ 100 = 6 4 3

9) 17.3 ÷ 10 = 1 7 3

10) 1,000 x 4.762 = 4 7 6 2

11) 10,000 x 89.912 = 8 9 9 1 2

12) 263.4 ÷ 1,000 = 2 6 3 4

Find the mistake in each problem and correct it.

13) 10 x 38.17 = 3.817 _____

14) 178.912 ÷ 100 = 17.8912 _____

15) 0.7 ÷ 10 = 7 _____

16) 1,000 x 52.27 = 5,227 _____

Multiply.

17) 8 x 10 =

18) 7820 x 100 =

19) 65 x 10,000 =

20) 530 x 100 =

Divide.

21) 10,400 ÷ 100 =

22) 6,000 ÷ 1,000 =

23) 9725 ÷ 10 =

24) 110 ÷ 10,000 =

Practice Multiplying and Dividing by Powers of 10

Multiply or divide.

25) $0.78 \times 100 =$ _____

26) $0.97 \div 1{,}000 =$ _____

27) $5.95 \times 10^2 =$ _____

28) $8.4 \times 10^1 =$ _____

29) $93.77 \div 10^2 =$ _____

30) $19.1 \div 10^3 =$ _____

31) $28 \times 10^4 =$ _____

32) $1{,}560 \times 10^5 =$ _____

33) $0.002 \div 10^1 =$ _____

34) $365.9 \div 10^4 =$ _____

Fill in the charts.

x	10^1	10^2	10^3	10^4
13				
47.68				
0.59				
0.077				

÷	10^1	10^2	10^3	10^4
18.5	***1.85***			
2.9				
0.3				
6794				

Replace each ☐ with a number in standard form to make a true equation. Example: 100

1) $37 \div$ ☐ $= 0.037$

2) $5.322 \times$ ☐ $= 532.2$

3) $98 \div$ ☐ $= 9.8$

4) $46.077 \times$ ☐ $= 460.77$

5) $0.034 \div$ ☐ $= 0.0000034$

6) $0.094 \times$ ☐ $= 9.4$

7) $77.75 \times$ ☐ $= 77{,}750$

8) $6 \times$ ☐ $= 600$

9) $1.243 \div$ ☐ $= 0.01243$

10) $9.004 \div$ ☐ $= 0.0009004$

Practice Multiplying and Dividing by Powers of 10

Find the power of 10 that will make a true equation. Write your answer in exponential form ($10^1, 10^2, 10^3$ ...).

1) 0.05 = 5 ÷ **10^2**

2) 3,461,615 = 34.61615 x _____

3) 0.0003 = 3 ÷ _____

4) 4.056 = 4,056 ÷ _____

5) 9,000,000,000 = 9 x _____

6) 0.0011 = 1.1 ÷ _____

7) 157.2 = 0.1572 x _____

8) 0.0000451 = 4.51 ÷ _____

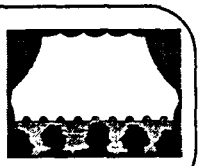
9) 292 = 29.2 x _____

5) 747.474 = 7,474,740 ÷ _____

Use the power (of 10!) to solve problems. (Try to do the problems mentally.)

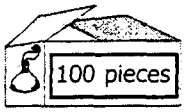
1) Minh, Parvit and eight other kids will share the cost of a cabin in the woods when they go camping. If the cabin costs $143.50 per night, how much will each boy have to pay if they want to rent the cabin for two nights?

2) If one hundred seventeen members of the high school drama club each invited ten friends to the new play, how many of their friends will be in the audience?



3) Find the price of one chocolate candy  from this box.

$8.00 /box



4) Each student in a class of thirty-nine students sells two shirts like this one to raise money. How much money will the class collect?

Name_____

Multiplication and Division by Powers of Ten

Multiply:

1. $398 \times 10^5 =$ _____
2. $4.74 \times 10^2 =$ _____
3. $5 \times 10^6 =$ _____
4. $980 \times 10^4 =$ _____
5. $0.38 \times 10^7 =$ _____
6. $700 \times 10^1 =$ _____
7. $17.3 \times 10^3 =$ _____
8. $12.345 \times 10^8 =$ _____
9. $2.0987890 \times 10^5 =$ _____
10. $0.0005 \times 10^2 =$ _____

Divide:

11. $300 \div 10^2 =$ _____
12. $67987.6 \div 10^3 =$ _____
13. $54389 \div 10^5 =$ _____
14. $45.98 \div 10^4 =$ _____
15. $0.6 \div 10^6 =$ _____
16. $\frac{906}{10^1} =$ _____
17. $\frac{58.3}{10^4} =$ _____
18. $\frac{0.084}{10^2} =$ _____

Problem Solving:

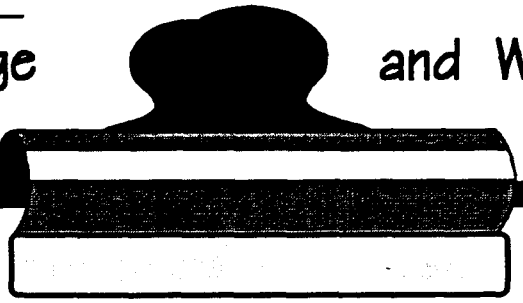
It takes approximately 5 days for a satellite to travel from the earth to the moon, a distance of 2.4×10^5 miles.

19. At this rate, about how many days would it take to travel from Mars to the earth, a distance of 3.5×10^7 miles?

20. At this rate, about how many days would it take to travel from earth to Pluto, a distance of 2.67×10^9?

Name: _____

Language and Writing



1) Multiply 248 by 1,000. Explain in your own words what you would do to get the answer and why.

_____

_____

_____

2) Multiply 2480 by 10,000. How many zeros are in the answer? Why are there that many?

_____

_____

_____

3) Describe how dividing by 100 is similar to multiplying by 100. How is it different? Use some examples in your explanation.

_____

_____

_____

Fill in the blanks.

4) To multiply by ten, move the decimal point ____ place to the _____.

5) To divide by one thousand, move the decimal point ____ places to the _____.

6) To multiply by one hundred, move the decimal point _____ places to the _____.

7) To divide by one hundred thousand, move the decimal point _____ places to the _____.