1

Multiplication and Division

THE MYSTERY OF THE MIXED-UP PARTY LISTS

Objective

Students will work in groups to find the least common multiple.

Anticipatory Set

Speaking with the excited tone of a news reporter, announce to students, "Eight girls and boys were each planning their own birthday party. Each person was carrying a party list with the number of guests. They were all shopping at the same store to buy party supplies when suddenly the lights went out! Somehow, their party lists got mixed up. They don't remember how many guests are invited or how many supplies to buy. It is your job to help solve the mystery!"

Purpose

Tell students that they are detectives needed to solve a mystery. Their job is to use clues to figure out the number of guests each boy or girl invited to his or her party and exactly how many of each item to buy.

Input

Tell students that they will be working with multiples as clues: "A *multiple* of a number is the product of that number and another whole number." On the board, write two tables with examples of multiples. Across the top row of each table, write the numbers *1* through *12*. Across the bottom row of the first table, write multiples of 3 up to 36. Across the bottom row of the second table, write multiples of 5 up to 60.

Explain that the *least common multiple* is the smallest number into which two numbers can both be evenly divided. One way to find the least common multiple of two numbers is to make two tables. One table lists the multiples of one number. The other table lists the multiples of the other number. Compare the two tables with students, and circle the smallest number that appears on both lists. Explain that 15 is the least common multiple for the numbers *3* and *5*.

Modeling

Divide the class into eight small groups. Place a transparency of a multiplication table on the overhead projector, and give each student a photocopy. Review the table so students understand how to use it.

Provide an example so students can create their own tables. Say, "Pretend we are going to the store to buy prizes for a party. Toy cars come in packages of four. Balloons come in packages of seven. We want to buy the same number of toy cars and balloons. To help us find this number, we can draw two tables of multiples."

Distribute ½-in (1.27 cm) graph paper to students. On the board, draw two tables with two rows each. Have students copy the tables onto their graph

paper. Across the top of one table, write the numbers *1* through *12*. Label this row "Packages of Toy Cars." Across the bottom row, ask volunteers to suggest multiples of 4 for you to write. Encourage students to refer to their multiplication table as a guide. Label this row "Total # of Cars."

Draw a similar table for the packages of balloons, using multiples of 7. Have students copy the second table onto their graph paper. After both tables are completed, ask students to circle the smallest number in both tables. Ask, "What is the least number of packages of toy cars we need to buy?" (*7*), "What is the least number of packages of balloons we need to buy?" (*4*), and "What is the least common multiple of 7 and 4?" (*28*).

The Mystery of the Mixed-Up Party Lists												
Packages of Toy Cars	1	2	3	4	5	6	7	8	9	10	11	12
Total # of Cars	4	8	12	16	20	24	28	32	36	40	44	48

Packages of Balloons	1	2	3	4	5	6	7	8	9	10	11	12
Total # of Balloons	7	14	21	28	35	42	49	56	63	70	77	84

Checking for Understanding

Check to make sure students know how to draw tables comparing two multiples. Remind them that the least common multiple is the smallest number in both tables.

Guided Practice

Give each group a party gift bag. Each bag should contain one of eight cards cut from the **Shopping List Cards reproducibles (pages 4–5).** Inform groups that the clues they need to solve the mystery are in the gift bags. Instruct them to read the clues and make two tables of multiples on their graph paper. Students will use the information from these tables to answer the questions and solve the mystery of the mixed-up party lists.

Closure

Afterward, ask each group to read aloud its clues, report its answers, and explain how its members reached their conclusions. Then ask students to reflect on what they learned in their math journals.

Independent Practice

Place the gift bags at a math center with multiplication tables, graph paper, and pencils. Invite students to visit the center and solve the mystery of the mixed-up party lists following the clues in other groups' gift bags. Number each gift bag, and provide a self-check by writing the answers to each card on the bottom of the corresponding bag.

Shopping List Cards 1–4

1. Chad is buying prizes for his birthday party. Toy racecars are sold in packages of 9. Rubber snakes are sold in packages of 4. To have the same number of cars and snakes:
   a. What is the least number of packages of cars he needs to buy?
   b. What is the least number of packages of snakes he needs to buy?
   c. What is the least common multiple of 9 and 4?
   d. If the number of Chad's guests is the same as the least common multiple of 9 and 4, how many guests did he invite?

2. Jake is buying candy for his birthday party. Candy bars are sold in packages of 8. Peppermints are sold in packages of 5. To have the same number of candy bars and peppermints:
   a. What is the least number of packages of candy bars he needs to buy?
   b. What is the least number of packages of peppermints he needs to buy?
   c. What is the least common multiple of 8 and 5?
   d. If the number of Jake's guests is the same as the least common multiple of 8 and 5, how many guests did he invite?

3. Megan is buying party supplies for her birthday party. Paper plates are sold in packages of 5. Paper napkins are sold in packages of 6. To have the same number of plates and napkins:
   a. What is the least number of packages of paper plates she needs to buy?
   b. What is the least number of packages of paper napkins she needs to buy?
   c. What is the least common multiple of 5 and 6?
   d. If the number of Megan's guests is the same as the least common multiple of 5 and 6, how many guests did she invite?

4. Katrina is buying hot dogs and hot dog buns to serve at her birthday party. Hot dogs are sold in packages of 6. Hot dog buns are sold in packages of 8. To have the same number of hot dogs and hot dog buns:
   a. What is the least number of packages of hot dogs she needs to buy?
   b. What is the least number of packages of hot dog buns she needs to buy?
   c. What is the least common multiple of 6 and 8?
   d. If the number of Katrina's guests is the same as the least common multiple of 6 and 8, how many guests did she invite?

Shopping List Cards 5–8

5. Isabel is buying party supplies for her birthday party. Plastic spoons are sold in packages of 9. Plastic forks are sold in packages of 8. To have the same number of spoons and forks:
   a. What is the least number of packages of spoons she needs to buy?
   b. What is the least number of packages of forks she needs to buy?
   c. What is the least common multiple of 9 and 8?
   d. If the number of Isabel's guests is the same as the least common multiple of 9 and 8, how many guests did she invite?

6. Shakir is buying small bags of chips and pretzels to serve at his birthday party. Bags of chips are sold in packages of 4. Bags of pretzels are sold in packages of 5. To have the same number of bags of chips and pretzels:
   a. What is the least number of packages of chip bags he needs to buy?
   b. What is the least number of packages of pretzel bags he needs to buy?
   c. What is the least common multiple of 4 and 5?
   d. If the number of Shakir's guests is the same as the least common multiple of 4 and 5, how many guests did he invite?

7. Hannah is buying prizes to give away at her birthday party. Bracelets are sold in packages of 6. Hair clips are sold in packages of 3. To have the same number of bracelets and hair clips:
   a. What is the least number of packages of bracelets she needs to buy?
   b. What is the least number of packages of hair clips she needs to buy?
   c. What is the least common multiple of 6 and 3?
   d. If the number of Hannah's guests is the same as the least common multiple of 6 and 3, how many guests did she invite?

8. Jamal is buying party supplies for his birthday party. Glow string is sold in packages of 7. Noisemakers are sold in packages of 9. To have the same number of cans of glow string and noisemakers:
   a. What is the least number of packages of glow string he needs to buy?
   b. What is the least number of packages of noisemakers he needs to buy?
   c. What is the least common multiple of 7 and 9?
   d. If the number of Jamal's guests is the same as the least common multiple of 7 and 9, how many guests did he invite?

MEET THE FACT FAMILY

Objective

Students will work in groups to identify fact families for sets of numbers.

By simply adding a visual representation of a situation that is relevant to students, greater meaning can be obtained.

Anticipatory Set

Draw two rows of three triangles on the board. Ask volunteers to state a multiplication equation that describes the triangle arrangement ($2 \times 3 = 6$ or $3 \times 2 = 6$). Write both equations on the board. Repeat the activity, and ask students to state a division equation that describes the triangles ($6 \div 2 = 3$ or $6 \div 3 = 2$). Write both equations on the board.

Purpose

Ask for a volunteer who has four family members. Make a chart on the board. Write that student's last name at the top of the chart. Underneath, list the four family members' names.

Make a second chart on the board. At the top of the chart, write the numbers *2, 3,* and *6.* Explain to students that just as each of them has a family, each set of numbers has a family called a *fact family.* Say, "A fact family shows the multiplication and division equations that can be written for a set of numbers." On the chart, list the four equations for the fact family *2, 3,* and *6.*

The Lee Family
Mr. Lee
Mrs. Lee
Eric
Mina

The Fact Family for *2, 3,* and *6*
$2 \times 3 = 6$
$3 \times 2 = 6$
$6 \div 2 = 3$
$6 \div 3 = 2$

Input

Tell students, "Learning fact families will help you to multiply and divide. Just as identifying people in a family helps us see how they are related, identifying the fact family for a set of numbers helps us see how multiplication and division facts are related."

Write a set of numbers on the board, such as *3, 5,* and *15.* Say, "This is a set of numbers." Write the fact family for this number set on the board: $3 \times 5 = 15$, $5 \times 3 = 15$, $15 \div 3 = 5$, $15 \div 5 = 3$. Explain, "These multiplication and division equations form the fact family for this set of numbers." Ask volunteers to share how knowing a multiplication equation in a fact family, such as $3 \times 5 = 15$, can help them to answer a division problem such as $15 \div 3$.

Modeling

In this activity, students will work in small groups to write multiplication and division equations that form a fact family for an assigned set of numbers. They will then present these equations in a mock TV game show.

Model how to find the fact family for the number set *4, 3,* and *12.* Write the number set on the board. Say, "To identify the fact family for this set of numbers, first think of multiplication equations using these numbers. Write these equations on a piece of paper. The equations are $4 \times 3 = 12$ and $3 \times 4 = 12$. Now think of division equations using these numbers. Write these equations on a piece of paper. The equations are $12 \div 4 = 3$ and $12 \div 3 = 4$."

Model other examples on the board.

Checking for Understanding

Ask students to confirm that they understand the meaning of *fact family* and how to find the fact family for a set of numbers. If students need further instruction, provide more models on the board.

Guided Practice

Divide the class into groups of four. If you have two extra students, form them into a group, and be sure to give them a set of numbers that has only two equations in its fact family, such as *3, 3,* and *9.* (If you have only one student remaining, he or she can join a group to practice finding the fact family and then act as the announcer for the TV show.)

Give each student a small index card and scrap paper. Distribute to each group one large index card on which you have written one set of numbers, such as *9, 7, 63; 8, 5, 40; 7, 3, 21; 6, 7, 42; 5, 9, 45; 4, 6, 24; 3, 8, 24;* or *2, 5, 10.* Be sure each large index card has a unique set of numbers. Instruct students to work together in their groups to think of the multiplication and division equations that form the fact family for their group's number set. Encourage them to write their answers on scrap paper first.

Then have each student in the group choose one of the four equations to write on his or her own small index card. Each student should choose a different equation. When groups are finished, check to make sure each student has written a different equation for the group's number set.

Explain that students will now participate in a mock TV game show called Meet the Fact Family. Ask a student announcer to invite one group of students to stand while he or she announces, "Meet the fact family for the number set [X, Y, Z]!" (The announcer should state the number set written on the large index card for that group.) Ask all four students in the group to stand and take turns announcing their "names" by stating the equations on their small index cards. Encourage the class to applaud after the family is introduced. Ask group members to place their small index cards in a basket to use for the upcoming game.

Introduce each group the same way until all small index cards are collected in a basket. Mix up the cards in the basket, and then allow each student to

choose a card at random. Instruct students to place their cards facedown on their desks and wait for the signal to start the game. When the announcer says "Go," have students turn over the cards. The goal of the game is for each student to find the other members of his or her new fact family before time is up. When they find all the members of their fact families, they should stand together and "freeze" in place. After about 1 minute, the announcer should say, "Freeze!" Every group that has found its entire fact family within that time is a winner.

Closure

Invite volunteers to draw sets of triangles arranged in rows on the board. (Be sure that within each arrangement, there is the same number of triangles in each row.) Ask students to think of and share an equation that describes each arrangement.

Independent Practice

At the math center, place a small basket of index cards that each have a set of numbers listed on one side and the corresponding fact family written on the other. Provide paper, pencils, and a jar of manipulatives, such as dried macaroni. Encourage students to visit the math center and choose an index card from the basket. They should place the index card faceup on the table to show the number set and then arrange the manipulatives in equal rows to represent that set. Tell them to write the multiplication and division equations for the number set and then self-check their work by turning over the index card to see the fact family on the back.

Then have students write in their math journals in response to the question, "How does knowing the fact family for a set of numbers help me with math?"

GUESS-TIMATE ESTIMATES

Objective

Students will imagine real-life situations to estimate products.

Anticipatory Set

Ask students, "If 687 students are expected to buy school lunches this year, about how many school lunches does the cafeteria need to prepare each week?" Challenge students to think about a logical way to find the answer. Ask them if it is possible to find the exact answer (*No. Some days, students might be absent, and they would need fewer lunches. Other days, the cafeteria might serve pizza, and more students would buy lunches.*). Say, "Sometimes it is not necessary or possible to find an exact answer to a math problem. For some math problems, estimating an answer helps provide a reasonable guess for the solution."

Students need to recognize that many things cannot and need not be measured precisely.

Purpose

Tell students that estimating can help provide reasonable answers for problems that cannot or do not need to be measured in exact quantities. For this activity, they will practice determining the number of plates of food served by different restaurants.

Input

Review how to round numbers to their greatest place value. Write a number between 100 and 10,000 on the board. Say, "Let's round this number to the nearest hundred." Have each student whisper his or her answer to the classmate sitting next to him or her. Invite a volunteer to share the answer. Repeat the activity with several more numbers.

Write a number between 1,000 and 10,000 on the board. Say, "Let's round this number to the nearest thousand." Have each student whisper his or her answer to the classmate sitting next to him or her. Again, invite a volunteer to share the answer. Repeat the activity using several more numbers. Explain, "When we estimate, first round the number to its greatest place value."

Then repeat the original question: "If 687 students are expected to buy school lunches this year, about how many school lunches does the cafeteria need to prepare each week?" Remind students that a school week has 5 days. Ask a volunteer to explain a logical way to find the answer (*Round the number to 700, and multiply by 5.*). Ask, "Why is 3,500 a reasonable answer to this problem?"

Modeling

Tell students they will play a game to practice estimating products. First, you will give them a multiplication problem. Then, they will round the larger

number. Finally, they will multiply this new set of numbers and write the answer.

Divide the class into four teams. Invite one player from each team to stand at the board. Instruct each of the four players to write "493×5" on the board. When you say, "Go," have them round the larger number to 500, multiply it by the smaller number, and then write the answer. The first team to write the correct answer scores one point. Continue playing the game using new team members and new problems for each round until every student has had a turn at the board.

Checking for Understanding

Check to make sure everyone understands how to round numbers. Ask a volunteer to explain the steps to estimate a product. Remind students that for this activity, they are rounding only the larger number. The smaller number remains the same.

Guided Practice

Copy the **What's on the Menu? reproducible (page 11)** onto a transparency, and distribute copies to students. Read the sentences on the plate together, and complete a sample as a class. Instruct students to follow the instructions on the plate to complete their reproducibles. Have them cut out their plates and glue them to construction paper and then decorate the paper with crayons or markers to resemble a place setting. When finished, have students write the answers to their problems on the back.

Ask students to exchange papers with partners and solve their partners' problems. Students can check their answers on the back. Invite them to continue trading place settings with different classmates as time allows.

Closure

Remind students that some things cannot or do not require an exact answer. When estimating, they should round numbers to their greatest place value. Have students answer the following questions in their math journals: "How can estimating help you plan a birthday party, a school carnival, or a soccer league pizza party? When multiplying two numbers, how can estimating help you check if your answer is reasonable?"

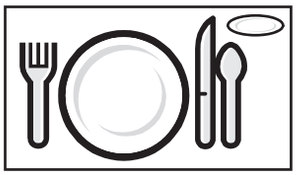
Independent Practice

For homework, have students complete a copy of the **Guess-timate Estimates reproducible (page 12).** Review how to round numbers to their greatest place value.

Name _____ **Date** _____

What's on the Menu?

Directions: Fill out the paper plate. Then cut it out and glue it to a piece of construction paper. Draw a napkin, knife, fork, spoon, and cup on the construction paper to make a place setting as shown.



_____'s Restaurant
(person's name)

serves _____.
(name of food)

It's everyone's favorite choice on the menu!

The restaurant serves _____ plates of it every day.
(number between 100 and 10,000)

If the restaurant is open

_____ days a week,
(number between 1and 7)

about how many plates does it serve each week?

Name _____ **Date** _____

Guess-timate Estimates

Directions: Estimate each product by rounding the greater number.

1. 84
   × 6
   Estimate: _____

2. 7,968
   × 3
   Estimate: _____

3. 987
   × 5
   Estimate: _____

4. 2,103
   × 7
   Estimate: _____

5. 52
   × 4
   Estimate: _____

6. 378
   × 9
   Estimate: _____

7. 8,014
   × 2
   Estimate: _____

8. 27
   × 8
   Estimate: _____

9. 122
   × 5
   Estimate: _____

10. 493
    × 3
    Estimate: _____

Directions: Write a number between 100 and 10,000 on each line. Then estimate the product.

11. _____ × 4 = _____

12. _____ × 7 = _____

POINT AND PLAY

Objective

Students will use quick recall of multiplication facts and recognize patterns of zero to play a call-and-response game.

Anticipatory Set

Write four progressive multiplication problems on the board, each one below the one before it: "3×4, 30×4, 30×40, 300×40." Invite students to compare and contrast the examples. Ask, "How are these equations the same? How are they different? Do you recognize any patterns?" Guide the discussion until students are able to identify that each example has the same basic multiplication fact (3×4) but that different numbers of zeros are in the factors.

Purpose

Explain that when one is working with math and numbers, it helps to look for patterns: "When multiplying multiples of 10 and 100, you can first identify the basic multiplication fact and then count the number of zeros to find the answer."

The brain's ability to detect patterns and make associations is one of its greatest strengths.

Input

Inform students that when multiplying multiples of 10 and 100, they should ask three questions: What is the fact? How many zeros? What is the answer? Write these questions on the board next to the four equations. Use an edible pointer such as a pretzel rod or a powdered candy straw. Point to and ask each question aloud, encouraging students to read along with you: "What is the fact? How many zeros? What is the answer?"

Modeling

Use the pointer to point to the equation 3×4. Then point to the first question, and say it aloud in unison: "What is the fact?" Write the answer on the board: "$3 \times 4 = 12$." Point to the second question, and say it aloud in unison: "How many zeros?" Write the answer: "0." Point to the third question, and say it aloud in unison: "What is the answer?" Write the answer: "12." Repeat the process using the equation 30×4: "What is the fact?" (*$3 \times 4 = 12$*); "How many zeros?" (*1*); and "What is the answer?" (*120*).

Explain that the class is going to play a call-and-response game to practice multiplying multiples of 10 and 100. Divide the class into two teams. Have the teams move their desks so they are facing each other. Give an edible pointer to a player on Team 1.

Begin the game by pointing to the third equation on the board: 30×40. Have Team 1 ask the first question in unison: "What is the fact?" The pointer (player with the edible pointer) points to a player on Team 2 to give the answer

($3 \times 4 = 12$). Team 1 then asks the second question in unison: "How many zeros?" The pointer points to a different player on Team 2 to give the answer (*2*). Finally, Team 1 asks the third question in unison: "What is the answer?" The pointer then points to a third player on Team 2 to give the answer (*1,200*). Invite this student to write the answer on the board.

Ask teams to repeat this process using the remaining equation. This time, give a pointer to a player on Team 2. Team 2 will now call out the questions and point to players on Team 1 to respond with answers.

Checking for Understanding

Check to make sure everyone understands how to play the game. Invite a volunteer to explain the steps to multiply multiples of 10 and 100. Model more examples as needed.

Guided Practice

Invite the teams to continue playing the game, making sure each player gets a chance to be the pointer. Give each player a fresh edible pointer to use. For the game, write four sets of similar equations on the board, such as 7×2, 70×2, 70×20, 700×20 and 5×3, 50×3, 50×30, 500×30. As students become more familiar with the process, refer to the **Multiplying Multiples reproducible (page 15)** for more examples to use during the game.

Closure

After every player has a turn as the pointer, award the class by letting them eat their edible pointers. Ask students to write in their math journals about the highlights of playing the game. Instruct them to answer the following question: "How did looking for and identifying patterns help you find the answers?"

Independent Practice

Reinforce the concept of how to multiply multiples of 10 and 100 by having students complete the Multiplying Multiples reproducible. Instruct them to fill in each answer with one digit per box.

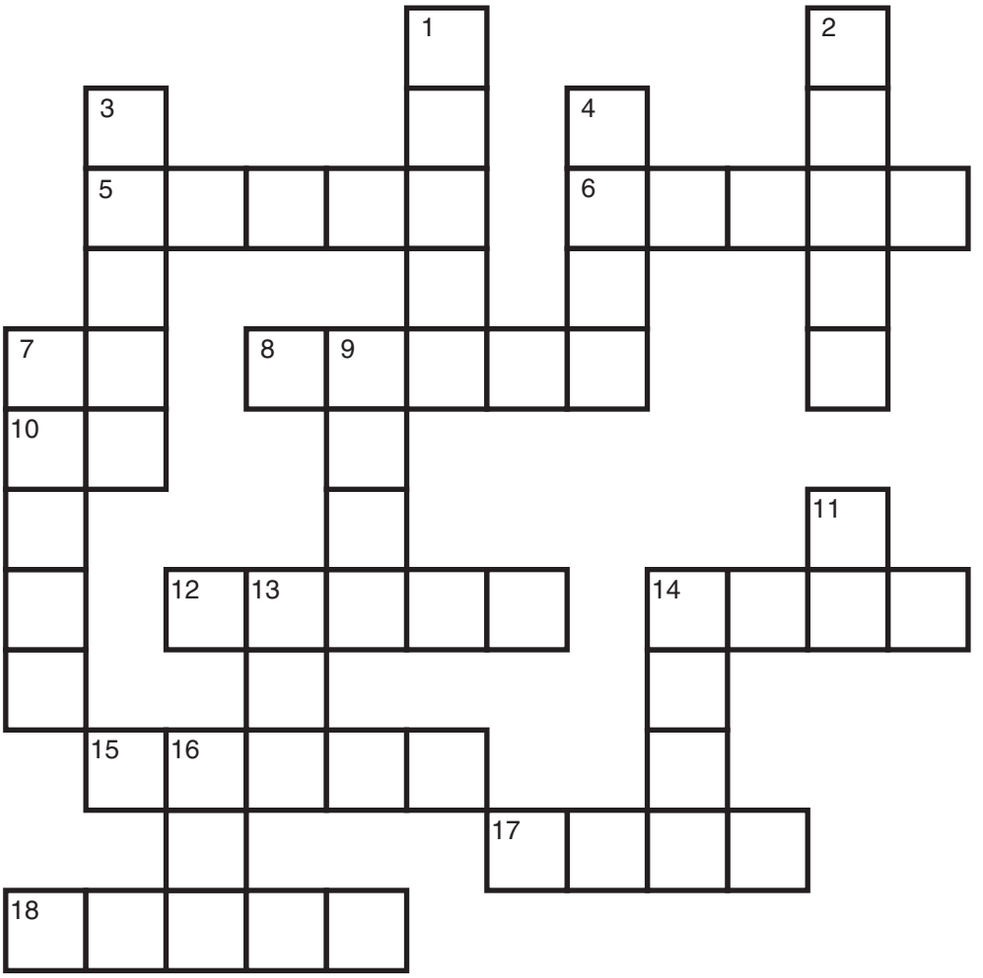
Extending the Activity

Read aloud the book *How Much Is a Million?* by David M. Schwartz. Then play an exciting game of Point and Play using multiples of 100 and 1,000 such as $30{,}000 \times 8{,}000$. Help students identify each large number by its correct name. Each time a product equals 1 million or greater, celebrate by having students congratulate themselves with cheers or high fives.

Name_____ **Date**_____

Multiplying Multiples

Directions: Find each product. Write the answers in the crossword puzzle, one digit per box.



Down

1. 70 × 600
2. 400 × 90
3. 90 × 300
4. 30 × 50
7. 800 × 80
9. 90 × 90
11. 3 × 30
13. 6 × 90
14. 400 × 6
16. 3 × 80

Across

5. 80 × 900
6. 80 × 700
7. 20 × 3
8. 700 × 40
10. 2 × 20
12. 900 × 50
14. 300 × 7
15. 200 × 60
17. 20 × 70
18. 600 × 30

200 CATCH GAME

Objective

Students will play a game and keep score using positive and negative numbers.

Anticipatory Set

Using the **200 Catch Game reproducible (page 18)** as a guide, draw a large vertical number line on the board or a long sheet of butcher paper taped to a classroom wall. Label the number line in increments of 25, starting with –200 at the bottom and ending with 200 at the top. For the 0 mark, draw a horizontal line at least 12 in across.

Point out the number line to students. Ask them to imagine a vertical number line outside where the ground represents 0. Draw grass and flowers on the 0 line to help students visualize this picture. Point to the positive integers on the number line. Explain that these numbers are above ground. Draw a sun and clouds at the top of the number line. Point to the negative integers. These numbers go down into a hole in the ground.

Purpose

Next to the number line, write the following scores: "Fly ball = 100 points, 1 bounce = 75 points, 2 bounces = 50 points, 3 or more bounces = 25 points." Explain that the class will be playing an outdoor ball game to earn these points. For instance, if students catch a fly ball, it is plus 100 points. If they try to catch the ball but drop it, it is minus 100 points. If the ball bounces once and they catch it, it is plus 75 points. Students will mentally add and subtract numbers up and down the number line to keep their own score.

Input

Inform students that numbers "above ground" are called *positive numbers.* (Point to the top half of the number line.) Positive numbers are all greater than 0. There is also a group of numbers called *negative numbers.* These numbers are less than 0. (Point to the bottom half of the number line that is "below ground.")

Ask students to identify the difference between positive and negative numbers on the number line (*Negative numbers have a minus sign in front of them.*). Invite students to look for a pattern on the number line (*Negative numbers continue in the same order as positive numbers except in the opposite direction from 0.*).

Modeling

For this game, divide the class into small teams. Explain that one player hits a tennis ball using a racquetball racquet while the other players try to catch the ball. Players earn points based on whether the hit results in a fly ball or bounces once, twice, or three or more times before they capture the ball.

When a player catches the ball, he or she earns a positive number of points. When a player drops the ball, he or she earns a negative number of points. Players will mentally keep track of their own points while they play, and a scorekeeper will keep track on paper. The first player to score 200 points is next up "at bat."

Model how to play the game in the classroom. Invite one student to the front of the room. Gently toss him or her a tennis ball. If the student catches a fly ball, ask the score (*100 points*). If the student drops the ball, ask the score (*–100 points*). Point to that number on the number line. Then toss the tennis ball to the student so it bounces one time, two times, and three times. Ask the score each time, and point to those numbers on the number line.

Checking for Understanding

Take time for students to confirm that they understand how to keep score for the game. Ask volunteers to take turns catching the tennis ball, stating each new score aloud.

Guided Practice

Move to an outdoor playing field. Divide the class into teams of 6 to 10 players. Be sure to distribute players who have prior baseball or softball experience among the teams. Provide each team with one tennis ball, one racquetball racquet, a clipboard, paper, and a pencil for scorekeeping. One player on each team is the scorekeeper, one is the "batter," and the rest are in the outfield. Position each team on the field or playground so it does not interfere with other teams as they play.

Have students watch as one team demonstrates how to play the game. The batter hits the ball out to the field. The last person to catch or touch the ball before dropping it scores points for that hit. Have each player mentally compute and then state his or her score aloud before tossing the ball back to the batter.

Invite teams to play simultaneously. Switch batters when someone scores 200 points, or have the player with the highest score become the new batter after about 5 minutes of play. The last batter becomes the new scorekeeper, and the scorekeeper joins the outfield. Each new game begins with everyone's score at 0. Continue to play for 15 to 20 minutes, instructing teams to switch batters about every 5 minutes.

Closure

When you return to the classroom, ask volunteers to share their highest and lowest scores. Prompt students to write in their math journals about their game experiences. Ask them to draw number lines in their journals and mark their highest and lowest scores.

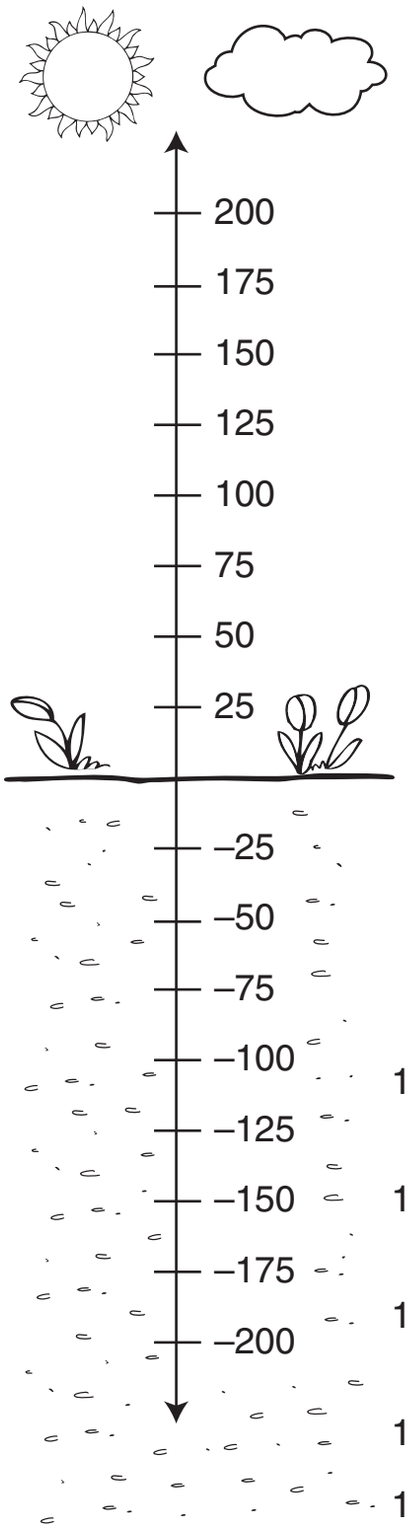
Independent Practice

Have each student complete a copy of the 200 Catch Game reproducible for homework. Remind students that negative numbers continue in the same order as positive numbers, except in the opposite direction from 0.

Name _____ **Date** _____

200 Catch Game

Directions: Use the number line to help you find the answers.



1. Felipe scored 100 points and then 50 points. What was his final score? _____
2. Sara scored –25 points, then 75 points, then 50 points. What was her final score? _____
3. Carlos scored 75 points, then –25 points, then 100 points, then 25 points. What was his final score? _____
4. Ryan scored 25 points, then –100 points, then –50 points. What was his final score? _____
5. Kelli scored –50 points, then –100 points, then –50 points. What was her final score? _____
6. Carmen scored –75 points and then 100 points. What was her final score? _____
7. Luke scored –75 points and then 50 points. What was his final score? _____

8 Jackson scored –100 points, then 100 points, then –50 points. What was his final score? _____

9. Emma scored 25 points, then 25 points, then 75 points. What was her final score? _____
10. Alex scored 50 points, then –75 points, then 100 points. What was his final score? _____
11. Lisette scored 100 points, then 25 points, then 75 points. What was her final score? _____
12. Jenny scored –25 points, then 25 points, then 50 points. What was her final score? _____
13. Who had the lowest score? _____
14. Who had the highest score? _____

BLOCKS OF DIVISION

Objective

Students will use place-value blocks and pictures to solve long division.

Anticipatory Set

Write the following situation on the board, and give students a few moments to think about the answer before asking them to respond:

"Gumballs are sold in bags, in tubes, and individually. Each bag holds 100 gumballs, and each tube holds 10 gumballs. If three children are given a total of 3 bags, 4 tubes, and 2 individual gumballs to share equally, how can we figure out how many gumballs each child gets?" (*divide*).

Purpose

Remind students that *division* is the process by which a starting number, or amount, is divided or distributed into equal groups. Then tell them that they will use place-value blocks and pictures to show what it actually means to divide a large number into equal groups through *long division* before they write and solve it numerically.

Input

Display a set of place-value blocks, and remind students that each square flat represents 100, each stick represents 10, and each small cube represents 1. Stack the blocks to show the equivalent amounts (1 flat = 10 sticks; 1 stick = 10 cubes).

On the board, draw simple picture representations of the place-value blocks, drawing a large square for the hundreds flat, a vertical line for the tens stick, and a dot for the ones cube. Label the pictures "1 hundred (100)," "1 ten (10)," and "1 one (1)."

Explain to students that they can use place-value blocks and pictures to help them solve a division problem, such as the gumball example, showing how to distribute and regroup amounts as they solve each step of the division process.

> Arithmetic and mathematical knowledge should be based first on concrete situations rather than abstract concepts. Numerical representations help students develop mental models of arithmetic that connect to their intuitive number sense.

Modeling

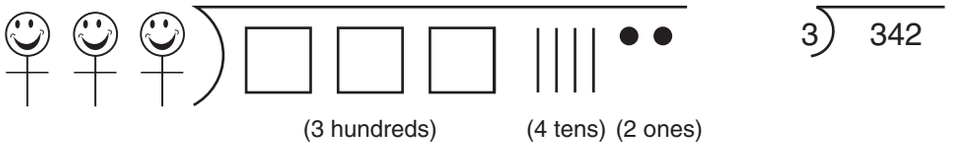
Return to the gumball example, and remind students that each bag contains 100, just like the hundreds flat, and each tube contains 10, just like the tens stick. Then write the following on the board, using place-value blocks to model the 3 bags (flats), 4 tubes (sticks), and 2 individual gumballs (cubes):

3 bags, 4 tubes, 2 individual gumballs =
3 hundreds, 4 tens, 2 ones =
300 + 40 + 2 =
342

Remind students that there are three children sharing the gumballs equally, which means dividing the amount into three equal groups (one group per child). Write

342 gumballs divided into 3 equal groups
$342 \div 3 = ?$
$3\overline{)342}$

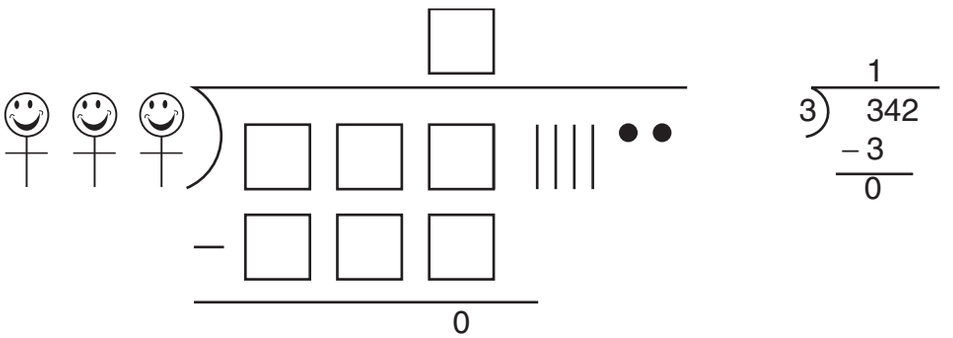
Draw a picture model of the division setup, showing a row of three squares, four vertical lines, and two dots (flats, sticks, cubes) inside a division bracket for the dividend *342*. Draw three stick people in front of the bracket to represent the divisor *3*.



Then use three volunteers to help model each step of the division process, starting with the greatest place value, the hundreds. Ask students the following questions:

- How many flats does each child get? (*1*). Give each volunteer one flat.
- How many gumballs does each child have so far? (*100 gumballs*).
- Are there any flats leftover? (*no*).

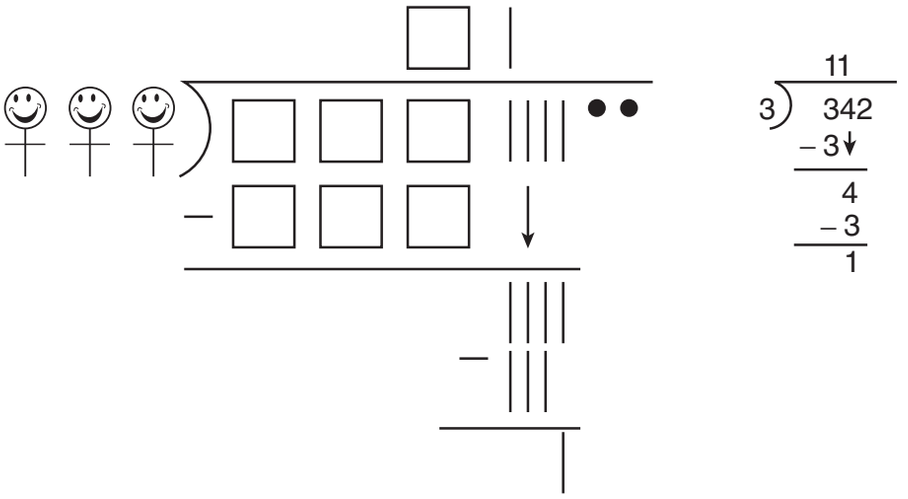
Draw the first step on the board. Write the numeric calculations next to the picture.



Continue with the next place value, the tens. Ask students the following:

- How many sticks does each child get? (*1*). Give each volunteer one stick.
- How many gumballs does each child have so far? (*100 + 10 = 110 gumballs*).
- Are there any sticks leftover? (*yes*).

Point out that there is one stick leftover since there is not enough for each child to have two sticks. To continue the division, the leftover stick must be traded for smaller pieces that can be shared equally. Show how to exchange one stick for 10 ones cubes. Ask students, "If we trade one stick for 10 cubes (an equivalent amount), how many ones do we have now?" (*2 originally + 10 more = 12 ones*). Show your computation on the board, both pictorially and numerically.



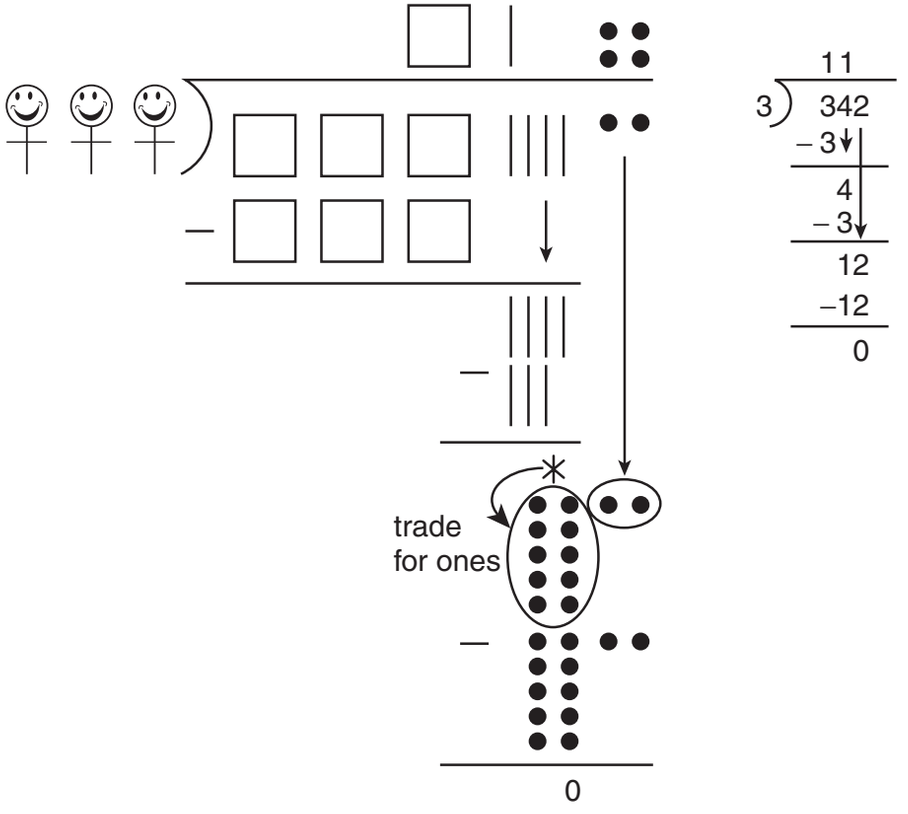
Finish the division process for the last place value, the ones. Ask students the following:

- How many cubes does each child get? (*4*). Give each volunteer four cubes.
- How many gumballs does each child have now? (*100 + 10 + 4 = 114 gumballs*).
- Are there any cubes leftover? (*no*).

Model how to check the final answer using multiplication (inverse operation):

(114 gumballs in each group × 3 groups) + 0 remainder = 342 total

Then show how to write the answer as an equation: 342 ÷ 3 = 114.



Checking for Understanding

Ask students to close their eyes and visualize the problem they just solved, reviewing the division process step by step. Prompt them to describe what was done first, next, and last. Then ask, "Why is it important to know how to divide?" (*Possible answer: so you can distribute equal amounts when sharing things with others*). "Why should you always divide a number from greatest to least place value (from left to right)?" (*Possible answer: so you can trade and regroup*).

Guided Practice

Give students a copy of the **Blocks of Division reproducible (page 23),** a set of place-value blocks (or use copies of the **Place Value Grid reproducible [page 24]**), and sheets of drawing paper. Remind students that each flat represents 100, each stick represents 10, and each cube represents 1.

Read the first problem aloud as students follow along silently. Ask, "How is this problem different from our example?" (*There is one more bag of gumballs, or a total of 442 gumballs.*). Have students work with partners or in small groups to solve the problem using place-value blocks. Then show them the division process, writing the final answer as an equation: "442 ÷ 3 = 147 R1." Have students self-check and correct their work. Ask, "How did the extra bag of gumballs affect the solution? How were the steps of this division problem different from our example?"

Closure

Have students discuss and review with a partner the sequence of steps they should follow when solving long division problems. Ask them to write the steps in their math journals. Encourage them to include an example using pictures and numbers.

Independent Practice

For homework, have students finish the Blocks of Division reproducible, encouraging them to use their place-value blocks and the examples from class to help them solve each problem. Assess students' work based on completeness and accuracy of the division process, both pictorially and computationally. Invite students to share the problem they wrote and challenge classmates to solve it.

Name _____ **Date** _____

Blocks of Division

Directions: Solve each problem. Draw pictures of place-value blocks to show each step of the division. Then use numbers to write the same solution.

1. Gumballs are sold in bags, in tubes, and individually. Each bag has 100 gumballs, and each tube has 10 gumballs. If 3 friends get 4 bags, 4 tubes, and 2 individual gumballs to share equally, how many gumballs does each friend get?

Draw the Solution	Write the Solution

Final answer: _____ ÷ _____ = _____

2. If 5 friends get 3 bags, 7 tubes, and 5 individual gumballs to share equally, how many gumballs does each friend get?

Draw the Solution	Write the Solution

Final answer: _____ ÷ _____ = _____

Write Your Own Problem

Directions: On the back of this paper, write your own division problem with a dividend of at least three digits. Then draw and write the solution.

Place Value Grid

Directions: Copy, laminate, and cut apart this grid to make sets of 100s, 10s, and 1s for students. Store each set in a resealable plastic bag.

WORDS OF DIVISION

Objective

Students will complete a word chart and division puzzle using correct terminology and equations.

Anticipatory Set

Write the following prompt in a thought bubble on the board: "How many division words do you know?" Ask students to brainstorm a list of words that describe or tell about division. After 1 minute, have pairs of students compare their words.

Purpose

Tell students that using correct terminology is important when communicating math ideas and solutions. In this activity, they will use their knowledge of division terminology and equations to complete a division crossword puzzle.

Input

Give students a copy of the **Words of Division Chart reproducible (page 28).** Display a transparency of the chart on the overhead projector. Then write the following vocabulary words on the board in random order: *dividend, divisor, divisible, quotient, remainder, compatible, inverse, regroup, operation,* and *equation.*

Read the vocabulary list aloud with students, and point out that the words are all about division. Ask students to help you decide the correct vocabulary word to write for each definition. Read aloud the first definition on the chart, and tell students to think about the correct answer. After a moment, write the answer on your chart while students copy it onto their own charts. Repeat with the remaining words.

Write an example for each vocabulary word, either a regular division equation (numbers only), an algebraic division equation (numbers and variables), or a word problem. (You might refer to problems in your math textbook.) Give students a few minutes to mentally solve each problem before you write the correct answer, for example, "The quotient of 1,035 ÷ 5 = ____" (*207*). Then have them write the example and the correct answer on their charts.

Graphic organizers are one type of visual tool that not only get students' attention but are also valuable devices for improving understanding, meaning, and retention.

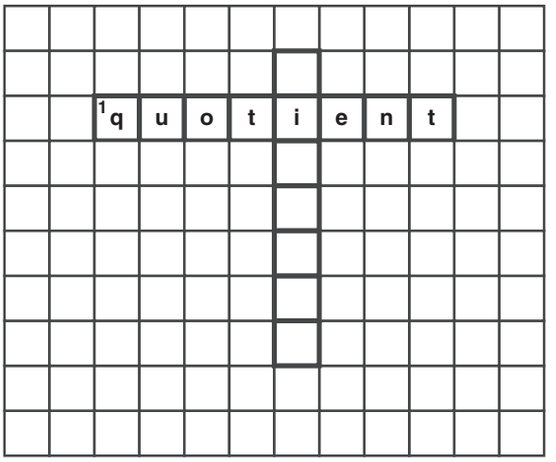
Modeling

Show students how to use their completed Words of Division Charts to help them create a division crossword puzzle:

1. Give each student a sheet of grid paper stapled to the top of white construction paper, leaving room below the grid to write the crossword clues.
2. Have students write two column titles for the clues, "Across" and "Down." (If needed, review the general setup of a crossword puzzle.)

3. Use a transparency or chart-sized grid paper to demonstrate how to write the first across clue, and outline the corresponding number of connected grid boxes in a row, one box per letter or digit. Refer to the Words of Division Chart when writing a clue for each vocabulary word.

For example, for the following clue, outline a row of eight connected grid boxes for the answer *quotient*. Write the location number in the top left corner of the first box of the answer.

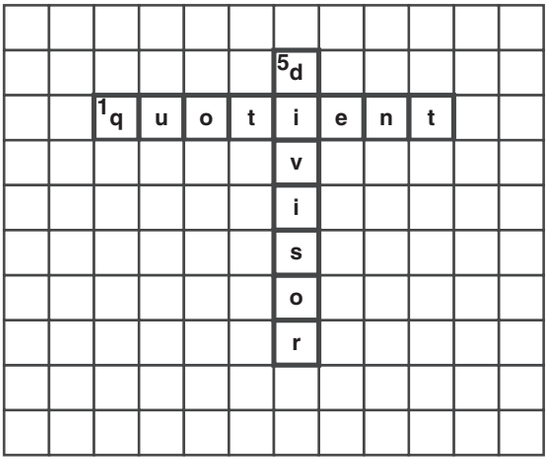


Across

1. The number *207* in the equation 1,035 ÷ 5 = 207.

4. Demonstrate how to write the first down clue, outlining the corresponding number of connected grid boxes in a downward column, one box per letter or digit. Make sure to use one of the letters or digits from the first across answer to connect the answers together.

For example, for the following clue, you may use the letter *i* (or the letter *o*) in *quotient* as part of the downward answer *divisor*.



Across

1. The number *207* in the equation 1,035 ÷ 5 = 207.

Down

5. The number *30* in the equation 9,000 ÷ 30 = 300.

Guided Practice

Guide students as they complete their crossword puzzles. Call on volunteers to suggest and help write clues for the remaining vocabulary words, showing how to outline those boxes on the crossword grid. Remind students that the crossword should consist of interconnecting answer boxes. After they complete their puzzles, give students a second sheet of grid paper to trace a duplicate crossword outline and fill in the correct answers to make an answer key.

Checking for Understanding

Ask a volunteer to explain how to solve and fill in the answers of a crossword puzzle. Have students demonstrate how to read a clue and fill in the correct answer on their answer keys.

Closure

Ask students to exchange crossword puzzles with classmates to solve. Ask students to summarize in their math journals what they learned in today's lesson and how it connected to something they had previously learned.

Independent Practice

For homework, have each student make a different crossword puzzle using the division terminology, including an answer key. Remind students to refer to their Words of Division Charts and to include other examples, such as division of greater numbers or multistep problems. Specify that the division problems must include dividends with at least three digits. You might also encourage them to use computer technology to help generate their crossword puzzles.

Extending the Activity

Challenge students to create a word search, a word scramble, or another creative math puzzle that includes a combination of operations (×, ÷, +, –).

Name _____ Date _____

Words of Division Chart

Directions: Write the correct division word for each definition. Then write an example division problem for that word.

Word	Definition	Example
	The number that is divided in a division problem.	
	The number by which a number is being divided.	
	A word describing a number that can be divided equally by another, resulting in a whole number with no remainder.	
	The answer of a division problem.	
	The number leftover after dividing one number by another.	
	A word that describes a pair of numbers easy to work with mentally and used in place of actual numbers to estimate division.	
	A word that describes the relationship of multiplication to division.	
	The process by which a larger place value is traded for equal numbers of a smaller place value.	
	A word that describes any of these symbols: +, –, ×, ÷.	
	A mathematical sentence showing the relationship of two equal expressions using numbers and symbols.	

DIVISIBILITY DASH

Objective

Students will use divisibility rules to determine the factors of greater numbers in a relay race.

Anticipatory Set

Write "1,237,365,289,516" on the board, and ask students to raise their hands if they think that the number is divisible by 4. Ask, "How would you like to do long division to prove it?" Then ask, "Who would like to learn a quick way to figure out the answer without doing long division or using a calculator?"

Purpose

Explain to students that there are situations in which they will need to quickly know if a large number is divisible by a certain factor. For example, without using long division, how could they determine if 148 cookies can be distributed equally into nine bags for a bake sale? Explain that *divisibility rules* can help them determine whether a large whole number is divisible by another. Tell students that they will learn these rules and use them to run a relay race.

Input

Remind students that a whole number is *divisible* by another if there is no remainder after the division. In that case, the second number (*divisor*) is a *factor* of the first number (*dividend*).

Display the following divisibility rules, and review them with students. Explain that these rules provide quick methods for finding factors of greater numbers. Point out the similarities in the rules for 3 and 9 and for 5 and 10. Have students write the rules and examples in their math journals, or give them photocopies.

Divisibility Rules

- **2:** A number is divisible by 2 if it is an even number (ending in 0, 2, 4, 6, or 8).

Example: 394 is divisible by 2 because it is an even number (it ends with 4).

- **3:** A number is divisible by 3 if the sum of its digits is divisible by 3.

Example: 828 is divisible by 3 because 8 + 2 + 8 = 18, which is divisible by 3.

- **4:** A number is divisible by 4 if the last two digits together are divisible by 4.

Example: 512 is divisible by 4 because 12 is divisible by 4.

- **5:** A number is divisible by 5 if it ends with 0 or 5.

Example: 79,345 is divisible by 5 because it ends with 5.

- **6:** A number is divisible by 6 if it is also divisible by both 2 and 3.

Example: 15,834 is divisible by 6 because it is also divisible by 2 and 3 (15,834 is an even number; 1 + 5 + 8 + 3 + 4 = 21).

- **8:** A number is divisible by 8 if the last three digits together are divisible by 8.

Example: 193,184 is divisible by 8 because 184 is divisible by 8.

- **9:** A number is divisible by 9 if the sum of its digits is divisible by 9.

Example: 828 is divisible by 9 because 8 + 2 + 8 = 18, which is divisible by 9.

- **10:** A number is divisible by 10 if it ends with 0.

Example: 79,340 is divisible by 10 because it ends with 0.

Point out that a number can have more than one of the factors listed above. For example, 79,340 is divisible by both 5 and 10.

Modeling

Ask students, "How could we use connecting cubes to prove that 24 is divisible by 2, 3, 4, 6, and 8?"

Model how to take a stick of 24 connected cubes and break it (divide it) into pairs to make 12 equal groups with no remainder, proving that 24 is divisible by 2. Write, "24 ÷ 2 = 12 pairs with no remainder, so 24 is divisible by 2." Invite volunteers to demonstrate how to repeat the process for the numbers *3, 4, 6,* and *8* to prove that 24 is divisible by all of them.

Then ask, "How could we use grid paper to prove that 160 is divisible by 2, 5, and 10?" Demonstrate the process of outlining a set of 160 grid squares and then coloring by groups of 2, 5, or 10 to prove that 160 is divisible by all of those numbers.

Checking for Understanding

The use of various models is important because relying on just one model may not be sufficient.

Ask students, "If you want to prove that 828 is divisible by 2, 3, 6, and 9, which method would you use: connecting cubes, grid paper, long division, or divisibility rules? Why?" (*divisibility rules because it is the quickest method*).

Guided Practice

Tell students that they can use divisibility rules to help them play a relay race. They will be racing to retrieve posted multidigit numbers that are divisible by factors you call out. The first player to return with a correct answer earns two points. The other players earn one point for a correct answer. The team with the most points at the end of the game wins.

Demonstrate how to play the game by posting on a wall the numbers *19,482, 64,836,* and *50,270,* written on separate sheets of paper. Then ask students the following questions:

- If I call out "9," which number would you grab off the wall? Why? (*64,836. It is the only number divisible by 9 because 6 + 4 + 8 + 3 + 6 = 27.*).
- If I call out "2," which number could you grab? Why? (*I could grab any of the numbers because they are all even numbers.*).
- If I call out both "2" and "4," which number is the only one you could grab? Why? (*64,836. It is the only even number with the last two digits divisible by 4.*).

Independent Practice

Write the following numbers (excluding answers in parentheses) on separate sheets of paper. Tape them to a wall outside the classroom for a relay race (you may choose to reapply them after each round of the game).

9,060 (2, 3, 4, 5, 6, 10)	5,944 (2, 4, 8)
9,675 (3, 5, 9)	2,736 (2, 3, 4, 6, 8, 9)
6,200 (2, 4, 5, 8, 10)	6,480 (2, 3, 4, 5, 6, 8, 9, 10)
2,424 (2, 3, 4, 6, 8)	9,112 (2, 4, 8)
5,070 (2, 3, 5, 6, 10)	3,126 (2, 3, 6)
1,890 (2, 3, 5, 6, 9, 10)	3,012 (2, 3, 4, 6)
6,765 (3, 5)	1,728 (2, 3, 4, 6, 8, 9)
2,744 (2, 4, 8)	4,320 (2, 3, 4, 5, 6, 8, 9, 10)

Divide the class into four or five teams, and ask teams to line up single file behind a starting line. Then have teammates take turns racing to the wall to retrieve a number that is divisible by a factor you call out. They earn two points (first team with correct answer), one point (correct answer but not the first team), or no points (wrong answer). Start with single factors, and then increase the challenge by calling out factor pairs, trios, or quartets. Remind students to use the divisibility rules to help find correct answers as quickly as possible.

Closure

Ask students to answer the following questions in their math journals: "What math skills did you learn today? How can those skills help you in the future, both in math class and outside of school?"

SCUBA DIVISION

Objective

Students will work in cooperative groups using their division and other math skills to write and solve word problems about scuba diving.

Anticipatory Set

Gain students' attention by having them join you in creating a folded paper project. Have students follow along as you demonstrate each step:

1. Fold the paper in half lengthwise and vertically, and then open it to show two creases.
2. Draw a wavy line along the horizontal crease, and draw a straight line down the vertical crease.
3. Use the vertical line to make a number line, writing "0" at the point at which it crosses the wavy line. Write positive numbers upward from 0 at equal intervals of 10 and negative numbers downward.

Ask students, "What do you think we are going to learn in math class today?" Allow students to respond, and then write "Scuba Division" on the board.

Purpose

Explain to students that the word *scuba* stands for "self-contained underwater breathing apparatus" and involves the use of specialized equipment that helps divers stay underwater for long periods of time. Point out that scuba diving is used in a variety of professions, including oceanography, photography, coast guarding, and underwater rescue. In this activity, students will use their division skills and other math skills to write and solve word problems about scuba diving.

Input

Give each student a copy of the **Scuba Diving Facts and Figures reproducible (page 35).** Read the reproducible aloud. Suggest that students inhale deeply to feel their lungs expand and exhale to feel their lungs contract and deflate. Point out that if someone were sitting on a student's chest or hugging him or her tightly, much like the effects of water pressure on a scuba diver, it would be much harder for the student to expand his or her lungs and breathe.

Encourage students to ask questions about scuba diving. Remind them that the ocean is home to a variety of life forms, including schools of fish, pools of plankton, sharks, whales, and thousands of other marine animals. If possible, show pictures of the ocean and scuba divers exploring the aquatic environment.

Then tell students that they will use their Scuba Diving Facts and Figures sheets and four-section papers to write scuba diving problems (one per section) for classmates to solve. List and discuss the following criteria for the problems:

- All of the problems must be word problems about scuba diving or the ocean.
- At least two problems must involve division and dividends greater than three digits.
- At least one problem must be a multistep problem.
- At least one problem must involve addition or subtraction of negative numbers.
- At least one problem must involve the use of number patterns.

Modeling

Model how to use the vertical number line to add and subtract positive and negative numbers as students follow along on their own number lines. (You might encourage them to move counters along their number lines.) For example, ask the following questions:

- A scuba diver drops to a depth of 10 ft/m below sea level. Then she dives down 20 ft/m more. At what depth is she now? ($-10 + -20 = -30$ *ft/m*).
- A scuba diver is at 50 ft/m below sea level. He ascends 20 ft/m. At what depth is he now? ($-50 + 20 = -30$ *ft/m*).

Then demonstrate how to solve a problem using patterns and mental math. For example, "How can you use the fact 36 ÷ 12 and patterns of zero to determine how many times deeper the Marianas Trench is compared to the average ocean depth?" (*Use stacked division and cross off common zeros, multiples of ten, to show that the Marianas Trench is three times deeper: 36,000 ft/m ÷ 12,000 ft/m = 36,~~000~~ ft/m ÷ 12,~~000~~ ft/m = 36 ft/m ÷ 12 ft/m = 3 times deeper.*).

Model the enjoyment of numbers and number patterns. Creating and using conceptual subitizing patterns helps children develop abstract number and arithmetic strategies.

Guided Practice

Guide students as they write four division problems. Circulate around the room to answer any questions and to check that students are writing their problems correctly, one problem per section. Ask each student to include a separate answer key on another sheet of paper that shows the solution for each problem.

Remind students to refer to the listed criteria and their Scuba Diving Facts and Figures sheet. Encourage them to refer to your examples. You might also permit them to use calculators. If some students finish early, invite them work on a picture or cartoon about scuba diving that illustrates one of their problems.

Divide the class into groups of four, and have group members exchange papers (or assign students to groups according to mixed ability levels). Tell students that they will have 5 minutes to solve one of the four problems on the papers they receive. When you say time is up, they should exchange papers again and solve a problem on the next sheets they receive. They may choose any remaining problem. But before they begin, they must check and correct any mistakes made on the previously completed problem. Students should cross out mistakes (not erase) and write the correct answers. Direct students to write their initials next to each problem they solve as well as any corrections they make to someone else's work.

Checking for Understanding

Invite a group to demonstrate how to exchange papers within the group, rotating the papers clockwise around the circle. Remind students that you will announce that time is up four times, every 5 minutes. Point out that for the last round, each student will solve the final problem on his or her own paper.

Independent Practice

Start the clock, and invite students to begin. After 5 minutes, tell them that time is up and to rotate papers within their groups. Repeat the process three more times until each group has completed the four problems on each paper.

Closure

Have students use their answer keys to check and critique the work completed on their math papers. Invite them to discuss the results and provide feedback. If students disagree on an answer, ask the whole group to work together to rework the problem and determine the correct answer.

Name _____ Date _____

Scuba Diving Facts and Figures

- The average depth of an ocean is about 12,000 feet (3,657.60 meters). But some trenches, such as the Marianas Trench, can reach a depth of almost 36,000 feet (10,972.80 meters).

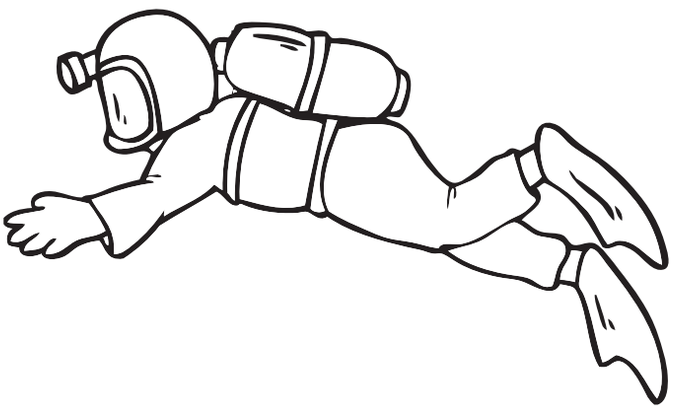
- Open-water scuba divers descend to about 60 feet below sea level (8.29 meters). Deep-sea divers descend to about 120 feet below sea level (36.58 meters).

- As a diver descends into the ocean, the water applies increasing pressure of about 1 bar per 30 feet of depth (100,000 pascals per 9.14 meters). This makes it harder for the diver to breathe, as if he or she is being squeezed. Divers must use a diving regulator to get breathing gas from a cylinder. The gas has equal pressure to the surrounding water pressure. This helps the diver to inhale and exhale naturally. The deeper the dive, the greater the pressure and the more oxygen used.

- Water conducts heat 25 times better than air. Scuba divers should wear a diving suit that lessens heat loss to avoid a "chilling" condition called hypothermia. Some suits can also be inflated to reduce the "squeeze" caused by increased pressure. These suits have vents that allow excess air to escape on ascent.

- Scuba divers often wear a belt of lead weights to counteract the force pushing them upward so they can move downward. This force is called buoyancy. The diver's positive buoyancy determines the number of weights. Positive buoyancy depends on the diver's body makeup. It also includes the buoyancy of the diving suit and gear worn, water salt, and water temperature. Divers often wear 4 to 30 pounds (1.81 to 13.61 kilograms) of weights. In an emergency, divers can drop weights to provide instant buoyancy and a quick ascent to the surface.

- Decompression illness (DCI) results from nitrogen bubbles that form inside the diver's blood or tissue because of changing pressure. To reduce the risk of DCI, divers should ascend slowly back to the surface. They should move no faster than 30 feet (9.14 meters) per minute. Divers should also stop once in a while to give absorbed nitrogen bubbles time to be exhaled from the lungs at reduced pressure.



SHOW THE ORDER

Objective

Students will use the order of operations to simplify and solve math problems.

Anticipatory Set

Ask students if they have ever been confused by instructions for making or doing something, such as a recipe or a game. Explain that complicated instructions can be broken down into smaller steps to make the task more manageable.

Display the following example for the class. Explain that one answer is correct and the other is incorrect: $(42 - 12) \div (3 + 3) + (2 \times 5) = 75$ or 15. Ask students to whisper to their neighbors the answer they think is correct. Tell them that they will learn how to break down this and other problems like this into smaller steps to find the correct answer.

Purpose

Tell students that they should always use the *order of operations* to simplify complex math expressions. Compare it to simplifying a wordy sentence such as "I enjoy the presence of your company" to "I like you." In this activity, student teams will simplify and solve math problems using the order of operations.

Process mnemonics are powerful memory devices that help students with mathematics difficulties learn basic arithmetic operations.

Input

Display the following rules for the order of operations, and have students copy them into their math journals. You might also have students refer to the mnemonic device "**P**lease **E**xcuse **M**y **D**ear **A**unt **S**ally" to help them remember the order. Invite students to offer other mnemonic devices that could help their classmates.

Order of Operations

1. Simplify the terms within **parentheses.**
2. Simplify the terms with **exponents.**
4. **Multiply** and **divide** from left to right.
5. **Add** and **subtract** from left to right.

Modeling

Use a transparency of the **Order of Operations Chart reproducible (page 39)** to demonstrate how to simplify a complex math expression step by step. Have students copy the following example in their math journals:

$$(7^2 + 6) \div (19 - 8) \bullet 4 \Rightarrow$$
$$(49 + 6) \div (19 - 8) \bullet 4 \Rightarrow$$
$$55 \div 11 \bullet 4 \Rightarrow$$
$$5 \bullet 4 \Rightarrow$$
$$20$$

Point out that the associative property (which states that you can move parentheses and regroup without changing the sum or product) applies only to an expression that contains all addition or all multiplication, not a combination of operations. For example, $(5 + 4) + 2 = 5 + (4 + 2)$, but $(5 \bullet 4) + 2 \neq 5 \bullet (4 + 2)$.

Then show students another math expression to simplify, such as $(9 - 5)^3 - (6 \bullet 4) \div 2$. This time, have students help you decide which operation to use at each step either by writing the operation on individual white boards or by holding up one of six word cards they have made: *addition, subtraction, multiplication, division, parentheses,* and *exponent.* For example,

$$(9 - 5)^3 - (6 \bullet 4) \div 2 \Rightarrow \text{parentheses}$$
$$4^3 - (6 \bullet 4) \div 2 \Rightarrow \text{parentheses}$$
$$4^3 - 24 \div 2 \Rightarrow \text{exponent}$$
$$64 - 24 \div 2 \Rightarrow \text{division}$$
$$64 - 12 \Rightarrow \text{subtraction}$$
$$52$$

After showing students how to simplify numerical expressions, demonstrate how to simplify algebraic expressions, such as $(2x + 6y) \div x$, given $x = 3$ and $y = 5$. Plug in the values for x and y, and then use the order of operations to solve (*12*). Again, ask students to help you decide the correct order of operations.

Checking for Understanding

Ask students to recite chorally the rules for the order of operations. Remind them always to follow these rules when simplifying an expression and to check that they simplify the expression completely. (Suggest that they cross off each part and rewrite the expression after each step.) Then refer to the expression and two answers given at the beginning of the lesson. Invite a volunteer to show the solution step by step, and ask the class to check his or her work. Confirm the correct answer (*15*).

Guided Practice

Divide the class into teams of three or four students, and give each team several Order of Operations Charts and two sets of operation cards (*addition, subtraction, multiplication, division, parentheses,* and *exponent*). Explain that you will show them an expression to simplify, and the team must stand in a row using the word cards to show the correct order of operations for the solution. Then they must simplify and solve the expression. For example, for

$3 \bullet (9 - 3) + 5$, the operation cards are *parentheses, multiplication,* and *addition* for an answer of 23.

The first team with the correct solution wins one point. The team with the most points at the end of the game wins. Use the following math problems for the game, starting with the simpler expressions and increasing the level of difficulty to include algebra. Have teams rotate the role of "recorder," who writes the sequence of steps for each solution.

$4 + (24 \div 6) \bullet 8$	(Correct order: *p, m, a;* answer = 36)
$14 - 3 \bullet (2 + 1)$	(Correct order: *p, m s;* answer = 5)
$(6 \bullet 4) - 3^2 + (2 \bullet 8)$	(Correct order: *p, p, e, s, a;* answer = 31)
$20 - 12 \div 4 + 5 + 3 \bullet 5$	(Correct order: *d, m, s, a, a;* answer = 37)
$(2x + 3y) - y$, given $x = 3$, $y = 5$	(Correct order: *p, a, s;* answer: = 16)
$16 + (x - 4) \div y^2$, given $x = 8$, $y = 2$	(Correct order: *p, x, d;* answer = 17)

Closure

Prompt students to discuss the skills and strategies they used to play the game and share how their teams were successful (or not) at working together. Invite them to write about their experiences in their math journals.

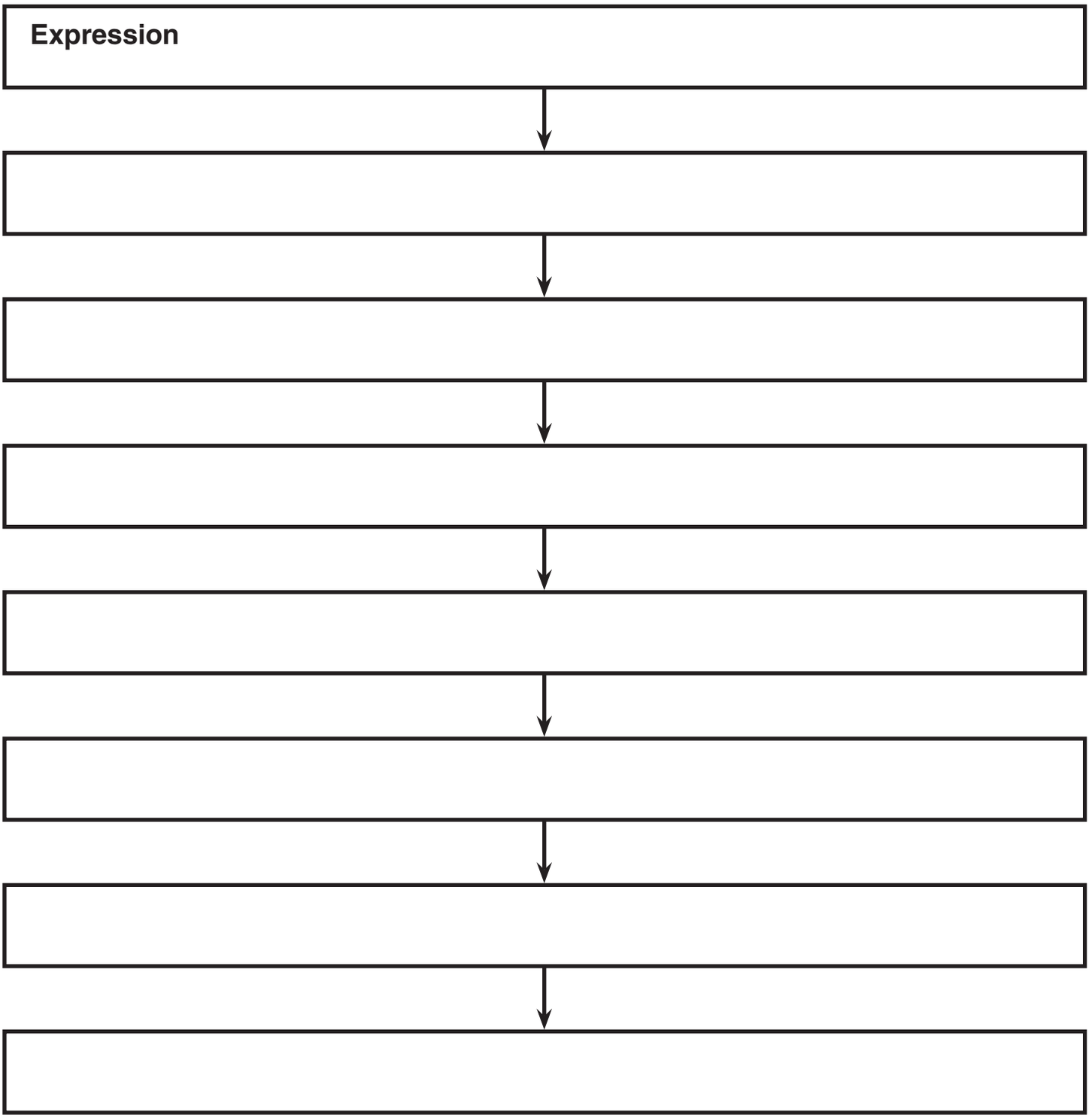
Independent Practice

Have students complete the **Show the Order reproducible (page 40).** Remind them to follow the order of operations and simplify. Before collecting the papers, have partners compare answers and rework any errors together.

Name _____ **Date** _____

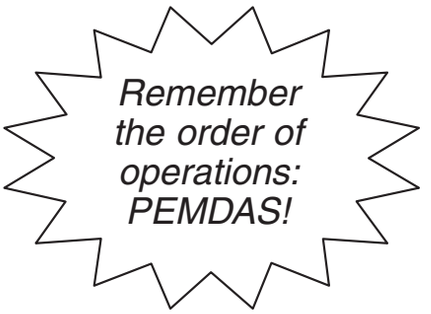
Order of Operations Chart

Directions: Write and simplify a math expression using the order of operations: *parentheses, exponents, multiplication or division, addition or subtraction.*



Name _____ **Date** _____

Show the Order



Directions: Use the order of operations to simplify and solve.

1. Insert parentheses so this expression equals 17.

   $2 \bullet 6 + 5 - 18 \div 2 + 2^2$

2. Write a math expression that equals 16 and uses only 24, 8, 4, and 2 in that order.

3. Simplify $100 \div x^2 + 3(y - x)$, given $x = 2$ and $y = 6$.

4. There are 112 customers in a restaurant. Then 4 groups of 6 customers leave, and 3 groups of 5 more come in. How many customers are there now?

Math Expression: _____

Step-by-Step Solution:

5. A team of chefs must prepare 168 meals for their customers. The first chef prepares 6 groups of 5 meals. The second chef prepares half the number of meals as the first chef. The third chef prepares three times the number of meals as the second chef. The last chef prepares 19 meals. How many meals are left to prepare?

Math Expression: _____

Step-by-Step Solution:

Write Your Own Problem

On the back of this paper, write and solve your own complex math problem about a store or restaurant. Use the order of operations.