

Manipulative Mathematics

Using Manipulatives to Promote Understanding of Math Concepts

Game of Twenty-four

Manipulatives used:
24@Game (optional)

Resources Needed:

Each student needs a worksheet. No other resources are required for this activity. The Game of Twenty-four is an old number game in which the players try to make 24 from a set of four numbers. A commercial version of the 24® Game, a boxed sets of cards with 4 numbers on each, grouped by difficulty level, is available at bookstores, teacher supply stores, game stores, and online at www.24game.com.

Background Information:

The Game of Twenty-four is a fun way to have students practice basic number facts, the order of operations, and correct algebraic notation, all critical to student success in Algebra. A good time to first use it is right after introducing the order of operations. Once students are familiar with the game, it can be used again at any time in your course.

To play the Game of Twenty-four, you start with a set of four numbers. The goal is to use each number once, and only once, with the four basic operations – addition, subtraction, multiplication, and division – to get 24. By creating their own expressions and verifying that they all give the answer 24, students apply the basic number facts and use the order of operations. The critical thinking process many students use to get 24 will help them throughout their math studies.

Directions:

- Explain the game to the students.
- Do one or more examples with the class, modeling the thought process you use to generate possible solutions. Students will usually volunteer solutions that use two numbers at a time, then combine their 'partial answers' to get 24. Demonstrate how to write the entire solution as one mathematical expression that simplifies to 24. Emphasize the link between the order of operations and correct algebraic notation.
- Let the students do the worksheet, working alone or with a partner.
- A whole class discussion after students have completed the worksheets may be very valuable, especially for students who found this activity difficult. Successful students should be encouraged to share the strategies they used to get 24. Modeling the thought process involved can teach struggling students how to begin the critical thinking process.

Suggestions:

The Game of Twenty-four is a good way to use the extra couple of minutes that are sometimes overlooked in class. Put a set of four numbers on the board at the start of class and have students try to make 24 as you take attendance. Use it as an end of class activity when there is a little time left, but not enough to start a new concept or example. You might want to put a set of four numbers on a test or quiz as a bonus question.

Encourage your students to play the Game of Twenty-four at home. It can be played with children, ages 5 and up. There are several websites where you can play the Game of Twenty-four online. One of them is http://www.mathplayground.com/make_24.html. On that website you actually drag number cards and operation symbols into a workspace to make a mathematical expression.

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Game of Twenty-four

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The Game of Twenty-four is a great way to think mathematically. Given four numbers, you add, subtract, multiply and/or divide them so that the result is 24. You must use each number once--but only once.

Start with the numbers 1, 1, 4, and 8.

- 1) How can you use these numbers to create 24? Don't worry yet about 1, 1, 4, and 8. Think of pairs of any two numbers that multiply to 24. List some of the pairs here:
- 2) First, let's think of 24 as the product of $3 \cdot 8$. We want to combine **1, 1, 4, 8** to get 3 and 8.

- (a) One way is to use 4 minus 1 to get 3, then 3 times 8 is 24. But we need to use the number 1. How can we use the 1 and still have 24? 24 times 1 is still 24.

Putting this all these steps together using good algebra notation gives $(4 - 1)(8)(1)$.

Verify that this expression simplifies to 24.

$$(4 - 1)(8)(1)$$

- (b) Here is another way to use the same four numbers, 1, 1, 4, 8, to get the product $3 \cdot 8$: 4 times 1 is 4, and then 4 minus 1 gives 3. Finally multiply that 3 by 8 to get 24. Show that this expression simplifies to 24:

$$(4 \cdot 1 - 1)(8)$$

- 3) This time, we'll use the fact that 24 is the product of $6 \cdot 4$.

- (a) Can we combine 1, 1, 4, 8 to make 6 times 4? Well, 1 plus 1 is 2, 8 minus 2 gives 6, and then 6 times 4 is 24. Show that this expression simplifies to 24:

$$[8 - (1 + 1)] \cdot 4$$

- (b) Can you think of another combination? Using good algebra notation, write a different expression and show that it simplifies to 24.

4) Another number fact that might help make 24 is $12 \cdot 2 = 24$.

(a) How can you combine 1, 1, 4, 8 to create 12 and 2?

4 plus 8 is 12, and 1 plus 1 is 2. Then twelve times two is 24!

Write this as one expression using good algebra notation, then show that it simplifies to 24.

(b) Can you think of another combination? Using good algebra notation, write a different expression and show that it simplifies to 24.

Now use the numbers 5, 3, 5, 4 to make 24.

5) Verify that each expression simplifies to 24.

(a) $5 \cdot 5 + 3 - 4$

(b) $(3 \cdot 5) + (5 + 4)$

6) Using good algebra notation, write a different expression that simplifies to 24.

Next try 3, 6, 6, 9.

7) Verify that each expression simplifies to 24.

(a) $3 + 6 + 6 + 9$

(b) $(6 \cdot 9) \div 3 + 6$

8) Using good algebra notation, write a different expression that simplifies to 24.

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Game of Twenty-four – Extra Practice

For each set of numbers use good algebra notation to write 2 different expressions that simplify to 24.

1) 1, 2, 3, 4

(a)

(b)

2) 1, 2, 5, 9

(a)

(b)

3) 1, 1, 7, 8

(a)

(b)

4) 1, 7, 8, 9

(a)

(b)

5) 2, 4, 6, 6

(a)

(b)

6) 2, 3, 3, 6

(a)

(b)

7) 2, 2, 4, 5

(a)

(b)

8) 3, 3, 4, 5

(a)

(b)

9) 3, 4, 5, 7

(a)

(b)

10) 3, 4, 7, 9

(a)

(b)

For more practice, there are several websites where you can play the Game of Twenty-four online. One of them is http://www.mathplayground.com/make_24.html.