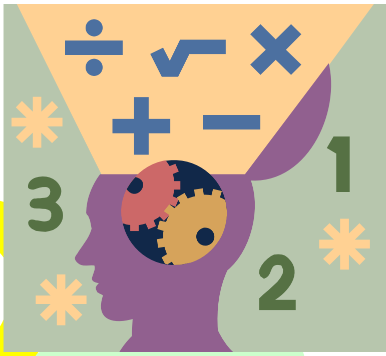
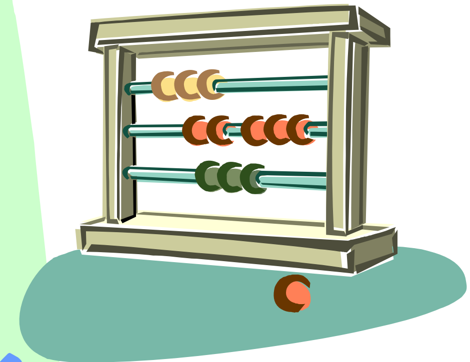




FUN FACT FLUENCY

Provided here is a small sampling of games and activities that can be used at home or in school. They can be played as part of class instruction, during indoor recess, during centers, at home after dinner, in a restaurant, on a trip, or in the grocery store. This sampling of games builds a sense of number, place value, and fluency with strategies and basic number facts in a fun and engaging way. Math is Fun!

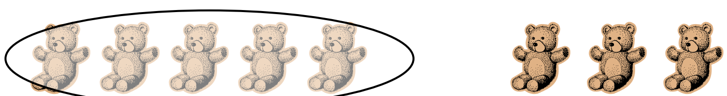
FPS 2007

THE QUESTION IS NOT, SHOULD CHILDREN LEARN MATH FACTS?, *BUT HOW?*

For students to develop computational fluency over time, it is important that they initially develop number sense and place value concepts. Math facts are more easily learned and retained longer, when students are able to make meaningful connections and identify number relationships. Research has shown that an overemphasis on rote learning can be counterproductive. Memorization and rote learning of basic facts taught in isolation or out of context can suggest to students that there is only one correct procedure and eventually limit computational fluency. Students are encouraged to learn math facts through the use of multiple strategies. The ultimate goal is to develop quick recall of basic number facts which can be applied, to develop more sophisticated understandings of numbers and number relationships.

Number relationships and strategies need to be explicitly taught with ample practice. Develop number sense first. Below are a few sample strategies.

COUNTING ON and the inverse counting back:

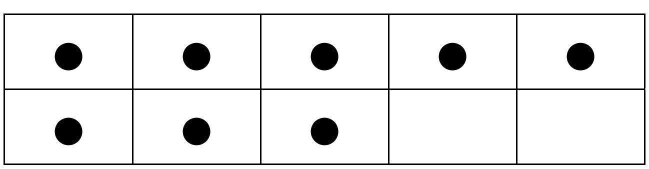


1 2 3 4 5 count on 6 7 8

MAKING 10:
Being able to visualize the relationship 7, 3 and 10 have with each other, understanding the ways to build “10” as well as the reciprocal for subtraction.

1+9,	2+8,	3+7,	4+6,	5+5,	6+4,	7+3,	8+2,	9+1
10-1,	10-2,	10-3,	10-4,	10-5,	10-6,	10-7,	10-8	10-9

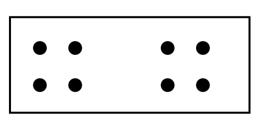
Visualize using manipulatives and models like *Ten Frame* for addition and subtraction:



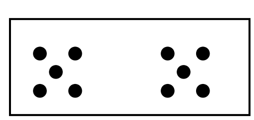
DOUBLES:

2 + 2 = 4,	4 + 4 = 8,	5 + 5 = 10
4 – 2 = 2	8 – 4 = 4	10 – 5 = 5

DOUBLES PLUS 1:
4 + 5 can be thought of as 4 + (4 +1) = 9



DOUBLES MINUS 1:



4 + 5 can be thought of as (5 + 5) – 1 = 9

Use 10s and 100s as a benchmark to build place value concepts to develop more complex understandings of number and number relationships.

7 + 5 can be thought of as (2 + 5) + 5 = 10 + 2 or 12

Using understandings of combinations for "10" and applying it to MULTIPLES OF 10s, 100s, 1,000,…

80 + 20 = 100 70 + 30 = 100 60 + 40 = 100 4,000 + 6,000 = 10,000

Students who are comfortable with partitioning and combining numbers can use their knowledge of place value and benchmarks to solve problems with larger numbers.

17 + 8 can be thought of as 17 + (3 + 5) = 25,

Problem Solving: Pay for an item that costs $11.49 at the cash register with a $20 bill. What mental strategy would you use to determine how much change you would receive? One example: $11.49 + .01 = $11.50, $11.50 + .50 = $12.00. $12 + ? = $20. Therefore the change you would receive is $8.51.

Continually foster mental math computational strategies in a variety of situations.

Provide students with experiences to select the most efficient strategy in solving problems.

Model:

Display the following addition problem and ask students to solve it mentally.

$$\begin{array}{r} 14 \\ +\ 29 \end{array}$$

State the answer "43" together as the correct answer is not in question but rather an expectation. Focus on the strategies used to solve the problem. Ask:"How did you solve the problem?"

Ask children to share different strategies for determining their answers. Include the standard algorithm as one of the models.

Ask: What strategy did you use to solve the problem? Which strategy is the most efficient for you? Why?

Challenge the children to come up with as many different strategies as they can for solving the next few problems.

$$\begin{array}{r} 19 \\ +\ 32 \end{array} \qquad \begin{array}{r} 12 \\ \underline{+\ 27} \end{array} \qquad \begin{array}{r} 27 \\ +\ 49 \end{array}$$

The standard algorithm is often, but not always, the most efficient method for a given problem or situation.

Skip counting by 2s, 3s, 5s, and 10s builds a foundation for multiplication and division.

5, 10, 15, 20, 25

or

5 five times = 25

DOUBLE FACTORS PLUS 1 GROUP:

5 x 6 = 30   or   (5 x 5) + 5

25 + 5 = 30

DOUBLE FACTORS MINUS 1 GROUP:

5 x 4   or   (5 x 5) – 5

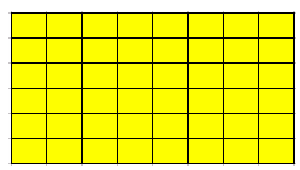
25 – 5 = 20

PARTIAL PRODUCTS

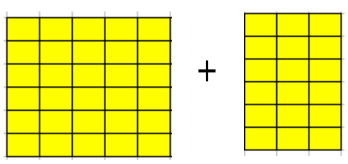
6 x 8

The factor “8” can be broken into partials.

6



X   8



(6 x 5) + (6 x 3)

30 + 18 = 48

DOUBLE AND HALF FACTORS

6 x 8 =   Double 6 and halve 8 is the same product as   12 x 4 =

Use this strategy to Solve 6 x 24 = ?

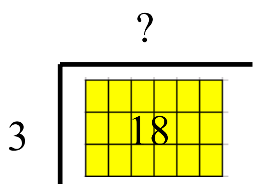
ONE & ONE HALF TIMES

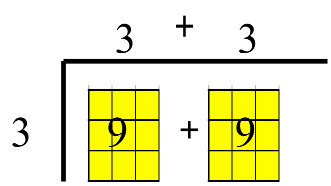
15 x 24 can be thought of as 10 x 24 plus half of 10 x 24

240 + 120 = 360

DIVISION USING PARTIAL PRODUCTS

18 ÷ 3 = ?



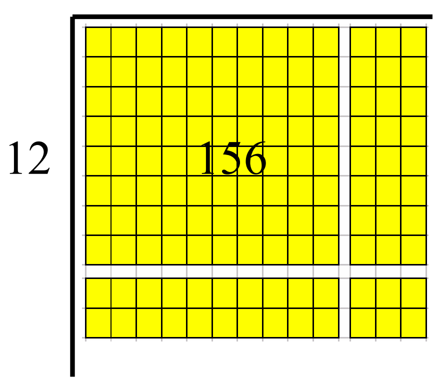


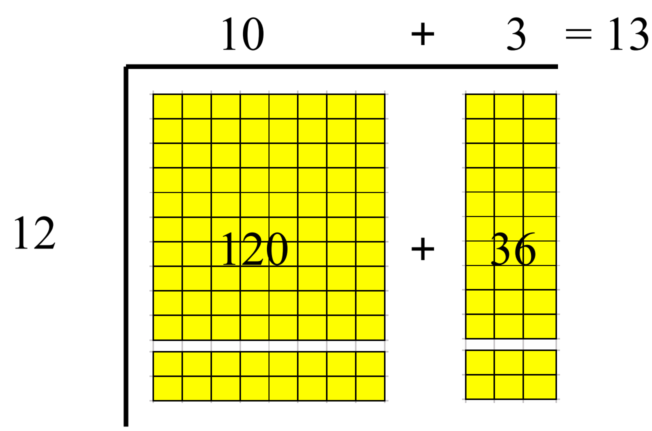
or 6

When doing math problems, make it friendly and connect it to what you already know!

Solve mentally 156 ÷ 12 = ?

One way to think about it…



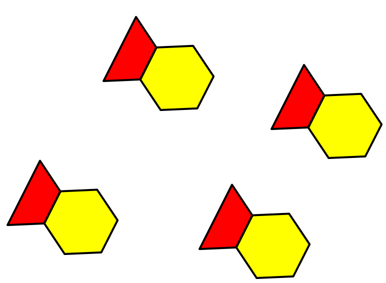


MULTIPLYING FRACTIONS

4 x 1 ½ =

4 x (1 + ½) =

4 + 2 =



Compute fluently and make reasonable estimates

Developing fluency requires a balance and connection between conceptual understanding and computational proficiency. On the one hand, computational methods that are over-practiced without understanding are often forgotten or remembered incorrectly (Hiebert 1999; Kamii, Lewis, Livingston, 1993; Hiebert and Lindquist 1990). On the other hand, understanding without fluency can inhibit the problem solving process (Thorton 1990). As children in prekindergaten through grade 2 develop an understanding of whole numbers and the operations of addition and subtraction, instructional attention should focus on strategies for computing with whole numbers so that students develop flexibility and computational fluency. Students will generate a range of interesting and useful strategies for solving computational problems, which should be shared and discussed. By the end of grade 2 students should know the basic addition and subtraction combinations, should be fluent in adding two-digit numbers, and should have methods for subtracting two-digit numbers. At the grades 3-5 level, as students develop the basic number combinations for multiplication and division, they should also develop reliable algorithms to solve arithmetic problems efficiently and accurately. These methods should be applied to larger numbers and practiced for fluency.

Researchers and experienced teachers alike have found that when children in the elementary grades are encouraged to develop, record, explain, and critique one another's strategies for solving computational problems, a number of important kinds of learning can occur (see e.g. Hiebert [1999]; Kamii, Lewis, and Livingston [1993]; Hiebert et al. [1997]). The efficiency of various strategies can be discussed. So can their generalizability: Will this work for any numbers or only the two involved here? And experience suggests that in the classes focused on the development and discussion of strategies, various "standard" algorithms either arise naturally or can be introduced by the teacher as appropriate. The point is that students must become fluent in arithmetic computation – they must have efficient and accurate methods that are supported by an understanding of numbers and operations. "Standard" algorithms for arithmetic computation are one means of achieving this fluency.

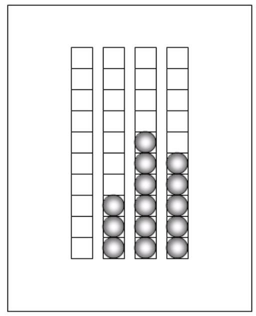
The development of rational-number concepts is a major goal for grade 3-5, which should lead to informal methods for calculating with fractions. For example, a problem such as $\frac{1}{4} + \frac{1}{2}$ should be solved mentally with ease because students can picture $\frac{1}{2}$ and $\frac{1}{4}$ or can use decomposition strategies, such as $\frac{1}{4} + \frac{1}{2} = \frac{1}{4} + (\frac{1}{4} + \frac{1}{4})$. In these grades, methods for computing with decimals should be developed and applied, and by grades 6-8, students should become fluent in computing with rational numbers in fraction and decimal form. When asked to estimate 12/13 + 7/8, only 24 percent of thirteen-year-old students in a national assessment said the answer was close to 2 (Carpenter et al. 1981). Most said is was close to 1, 19, or 21, all of which reflect common computational errors in adding fractions and suggest a lack of understanding of the operation being carried out. If students understand addition of fractions and have developed number sense, these errors should not occur. As they develop an understanding of the meaning and representation of integers, they should also develop methods for computing with integers. In grades 9-12, students should compute fluently with real numbers and have some basic proficiency with vectors and matrices in solving problems, using technology as appropriate.

Part of being able to compute fluently means making smart choices about which tools to use and when. Students should have experiences that help them learn to choose among mental computation, paper-and-pencil strategies, estimation, and calculator use. The particular context, the question, and the numbers involved all play roles in those choices. Do the numbers allow a mental strategy? Does the context call for an estimate? Does the problem require repeated and tedious computations? Students should evaluate problem situations to determine whether an estimate or an exact answer is needed, using their number sense to advantage, and be able to give a rationale for their decision.

– NCTM, Principals and Standards for School Mathematics. 2000. p. 35

Fill the Chute

Materials
1 Game board per player
Counters (beans, counters, raisins,…)
1 die (or 1-6 spinner)



Game board

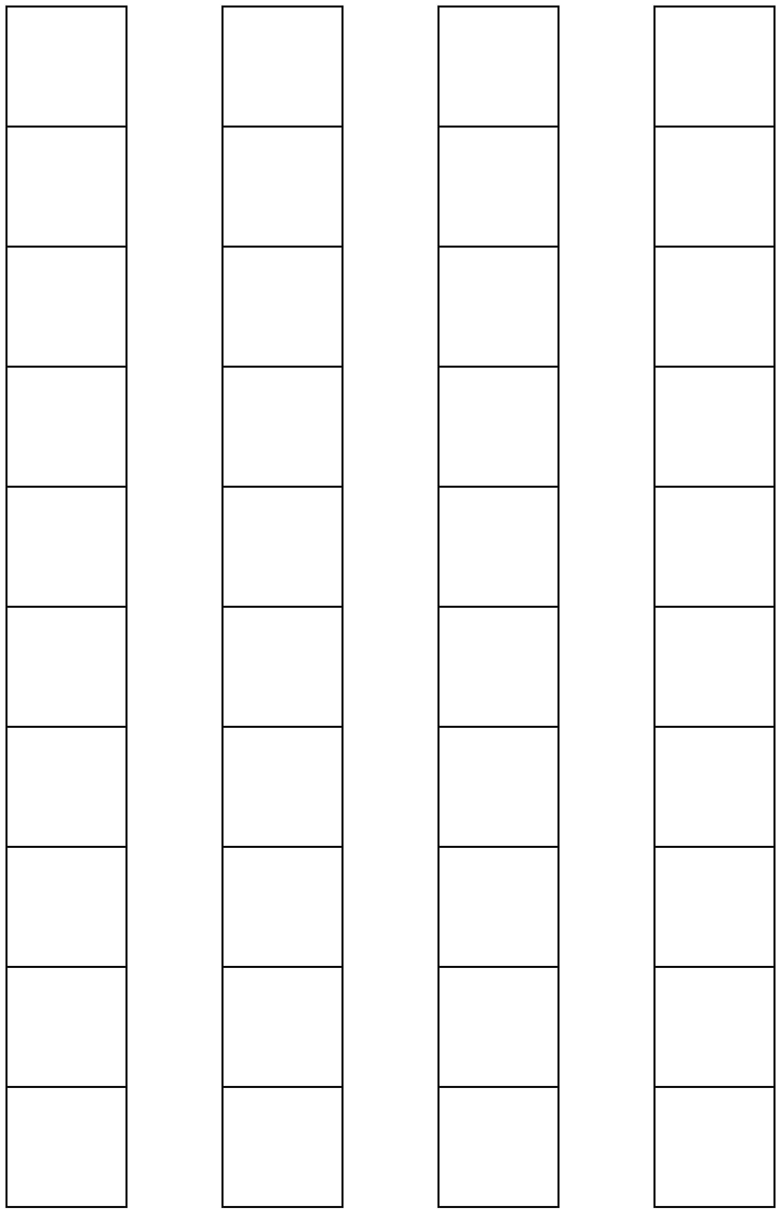
Number of Players
2 or more

Object of the Game
Fill the chutes with counters until they are filled exactly to ten.

Description
Player 1 rolls the die and picks up the number of counters indicated on the die. Player 1 then places the counters in one of the chutes. Then player 2 takes a turn. Each player rolls until one player fills all four chutes exactly. A roll of 6 cannot be used to fill a chute with 2 spaces.

Modifications
Players do not need to make exactly 10 for any one chute to be filled.
Play to 40 by filling each chute and counting on. Example: if 6 is filled in the first chute and the player rolls another 6, the first chute can be filled with 4 and 2 is placed in the next chute.
Change the game board to hold 12 instead of 10.

Fill the Chute Game Board



Cover The Counters

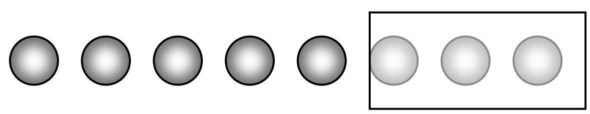
Materials
10 to 20 Counters (or pennies, chips, pebbles,…)

Number of Players
2 or more
This can be played as partners or in teams

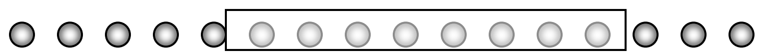
Object of the Game
Determine the missing addend

Description

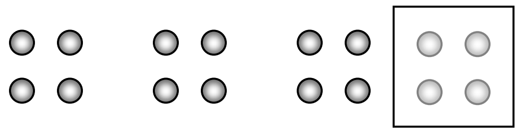
Line up 10 counters and count them aloud by pointing to each counter as you count. Cover 3 counters and ask: "How many counters are covered?" Then ask "How do you know?" then check to confirm the number covered. Take turns covering and determining different amounts.



Modifications
This game has many variations. It can be modified for students in grades 1 - 2 by placing the counters in or under a cup, or the total number of counters can be larger.



For grade 3 – 4 the counters can be arranged in recognizable groups and cover some of the groups.



Grades 2 – 5: use coins. Count up and show the value of the coins. Take away some of the coins and ask: "How much do I have in my hand?" You may extend this by asking: "What are the possible coins I have hidden in my hand? Or state the number of coins you have hidden and ask for the coin values.

PICK UP

Materials
Pair of dice
1 game board per player (see figure below)
11 counters (cheerios, counters, pennies…)

Number of Players
2 or more

Object of the Game
Remove all your chips from the game board

Description

Game board

2	3	4	5	6	7	8	9	10	11	12

Each player places a counter on each number of the game strip. The value the counter is equal to the corresponding number on the board. Players take turns rolling the dice and adding the numbers on the dice. The player must pick up counters that equal the sum rolled. This may be done by removing one counter with the value of the sum, or by removing a combination of counters that add to the sum of the dice.

Sample
If the player rolls a 4 and a 3 with the sum of 7, the player may pick up the counter on the 7, or any combination of numbers that equals 7: 1 and 6, 2 and 5, 3 and 4, 1 and 2 and 4.

When a player rolls and is unable to pick up the sum, the player forfeits his/her turn. The game continues until each player in a round is not able to pick up any counters. The winner is the player with the fewest counters on the board.

Salute the General

Materials
Deck of Cards

Number of Players
3 players

- One General
- Two Captains

Object of the Game
Object is to collect the most cards.

Description
Ace is worth 1
Number cards are worth their value.
Face cards are worth 10.

General shuffles cards. The General gives one card to each of the Captains. The Captains may not look at their cards.
When the General says, “Salute the General,” both Captains raise the card to their forehead with the card is facing the other players. The cardholder cannot see his/her own card.
The General then adds the two numbers and announces the sum.
The Captains then try to mentally figure out what number is on their card, and call it out.
If they are correct the Captains keep the cards. If they are not correct they give the card to the General.

To help build a repertoire of strategies, the General can asks: How do you know? The Captains can share their strategy for finding the sum.

Modifications
The same game can be played by multiplying the numbers and calling out the product. Decks can be “stacked” with cards that focus specific facts or strategies to be reinforced for the math level of the players.
Change the value of the face cards
J = 11, Q = 12, K = 13, or
J = 20, Q = 25, K = 50, or
J = 15, Q = 20, K = 25

Shake and Make the Sum

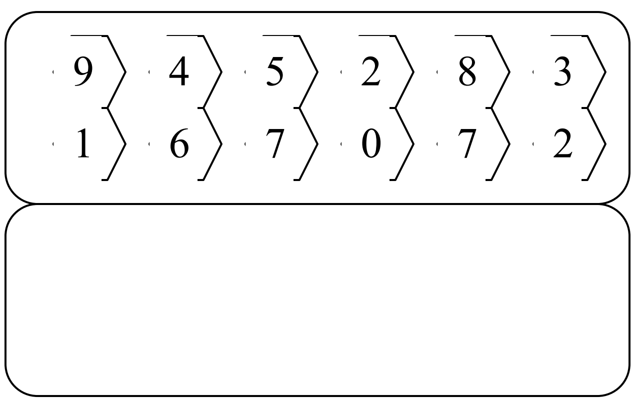
Materials
Egg carton
2 beans (or raisins, pebbles, small objects,…)
Pencil & paper

Number of Players
2 – 4

Object of the Game
The highest sum wins

Description

Label each section of the egg carton as shown below.



Place 2 beans in the egg carton. The first player closes the carton and shakes it. The player then opens the carton and finds the sum of the two numbers in the sections where the beans have landed. The player records the sum on a score sheet. The next player takes a turn, and so on. At the end of 6 turns, each player finds the sum of all their turns for a total score. The player with the highest sum wins.

To help build strategies for addition ask: What strategy did you use to find your sum?

Modifications

Take fewer turns
Take more than 6 turns
Use 3 beans. And, if a bean lands on the in the same section, the number is added twice.

Race to Zero

Materials
1 die (or a 1-6 spinner, six numbers written on pieces of paper to draw from in a bag,…)
Paper and pencil
Create a record sheet by writing 100 at the top of the sheet.

Number of Players
2 to 6 players or teams

Object of the Game
The player who is closest to Zero without going below wins.

Description

Player 1 rolls the die and decides whether subtract the number rolled or 10 times the number numbered. For example, if the player rolls a 6 the player can choose to subtract a 6 or 60. The play goes to the next player. Each player must take 6 turns and get as close to the target amount of zero as possible. A player records each number rolled and subtracts it from the remainder of previous turn. The player closest to zero without going below zero is the winner. If a player goes below zero, the player is out.

Modifications
Change the starting quantity to a smaller or lager number.
Start with 10 dimes and make change with pennies to model the subtraction
Change to addition by playing Race to 100.
Use a deck of cards instead and create a value for face cards
Use a pair of dice and subtract the total of rolled.

Addition War

Materials
Deck of cards

Number of Players
2 or more

Object of the Game
Player with the most cards at the end of the game wins.

Description
Ace is worth 1
Number cards are worth their value.
Face cards are worth 10.

Deal all the cards to each player so that each player has half of the deck. Both players flip over two cards each. They find the sum of their cards. The player with the greatest sum takes the cards in play. If both players have the same sum, each player places 3 cards face down and then flips over two more cards for a new sum. The highest sum takes all the cards in play. This continues until one player is out of cards.

Modifications
There are many modifications to this game.

Use multiplication and the player with the highest product takes all the cards in play.

Place a card in the center to start a play. Each player flips over one card. The player with the greatest difference between card and the center card takes all the cards in play.

Place a card in the center to start a play. Each player flips over two cards and find the sum. The player with the greatest difference between their sum and the center card takes all the cards in play.

The deck can be stacked to use only face value cards or a limited range of face value cards to focus on specific facts.

Target 300

Materials
1 die (or a 1-6 spinner, six numbers to draw from in a bag,…)
Paper and pencil
Create a record sheet by drawing a line down the center of the paper and label the top of each column with player 1 and player 2. See Diagram 1.

Number of Players
2

Object of the Game
The player who is closest to 300 wins.

Player 1	Player 2

Diagram 1

Description

Player 1 rolls the die and decides whether to multiply the number rolled by 10, 20, 30, 40, or 50. Each player must take 6 turns and get as close to the target number of 300 as possible. Both players write the multiplication sentence for the first player's choice and product. Example: Player 1 rolls a 3 and player 1 chooses to multiply it by 20, both players write: 3 x 20 = 60 under first player's column. Then it is the second player's turn. Each player keeps a running total by adding the new product to the score of the previous turn. After six turns each the player determines the difference between their total and three hundred. The player's compare their scores to see who was closest to 300. Players are allowed to exceed 300. The player with a score closest to 300 wins.

Modifications
Change the target number to 500 and increase the number of turns to 8.
Change the target number to 10,000 and multiply the number on the die by 10, 100, or 1,000

Guess My Rule

Materials
T-Tables. See Sample 1
Pencil and Paper

Number of Players
2 or more players or teams

Object of the Game
Determine the Rule

T	W
2	6
3	9
4	12
5	?
?	1 8

Sample 1

A	B
2	5
3	7
4	9
5	?
?	13

Sample 2

Description
Player 1 creates a rule that describes the relationship between column “T” and column “W.” Player 2 tries to identify the relationship between column “T” and column “W” by stating a number that fits the rule. If player 2 is correct, Player 1 says: “That fits my rule.” and writes the number in the corresponding place on the T-table. If the number does not fit the rule, Player 1 says: “That does not fit my rule.” and writes the number to the side. Player 1 may continue to add numbers that fit the rule to either the “T” side or “W” side if needed. After the player 2 has successfully provided two or more numbers that fit the rule, player 2 can attempt to state the rule for the number relationship.
Sample 1: The “T” relationship with “W” can be expressed in a few ways: T+ T +T = W, or 3T = W, or W ÷ 3 = T. Sample 2: The “A” relationship with “B” can be expressed as (A x 2) +1 = B, or (B – 1) ÷ 2 = A. To foster thinking and dialogue ask player 2 to explain how she/he determined the relationship. An extension is to challenge player 2 to more than one way to express the rule for the relationship as illustrated above.
Players take turns creating a rule for each game. It may be helpful when thinking of a rule to connect it to something you already know. For example: T = Tricycles, W=Wheels, cars and wheels, eggs and egg cartons.

Modifications

Rules can also focus on specific basic facts. For example: The rule could be multiples of 9 (A x 9) = B or multiples of 12 (B ÷ 12) = A. The rules can also include adding, subtracting, multiplying or dividing fractions or decimals. This game can be made as simple or complex as desired. It is important to create rules that are appropriate for the players involved to ensure success in the game.

Beat The Teach

Materials
Game board
One set (approximately 8) counters per player. Each player should have their own identifying color counters.
1 pair of counters for the 1-9 number strip (A different color from the players - paper clips, coins, pebbles)

Number of Players
2 or more
3 collaborative groups is best

Object of the Game
Get three color counters in a row

Description
Player 1 places two counters on two numbers on the top 1-9 number strip at the top of the game board. Player 1 then places his/her counter (team color) on the product found on the game board. It is now player 2's turn. Player 2 moves only of the counters on the 1-9 number strip to a different number make a new product. Player 2 places her (team color) on the product found on the game board. Players take turn until one player get three counters in a row, column, or diagonally. The counters on the number strip can be placed on top of each other. Example: 3 x 3. Or, players may opt to keep the same factors as the previous player and not move any counters on the 1-9 number strip.

Modifications
This game can be played using transparent counters on an overhead in the classroom.
The game board can be modified for addition, addition of fractions, addition of decimals, or limited to focus on a few facts.
Transparent color counters are helpful in seeing the numbers used in the play.

Beat The Teach
Multiplication

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

1	2	3	4	5	6
7	8	9	10	12	14
15	16	18	20	21	24
25	27	28	30	32	35
36	40	42	45	48	49
54	56	63	64	72	81

Beat The Teach
Fractions

1/8	**1/4**	**3/8**	**1/2**	**5/8**	**3/4**	**7/8**	**1**

1/4	3/8	1/2	5/8	3/4	7/8
1	1 1/8	1 1/4	1 3/8	1 2/4	1 5/8
1 3/4	1 7/8	2	2/8	3/8	4/8
5/8	6/8	7/8	1	1 1/8	1 1/4
1 3/8	1 4/8	1 5/8	1 6/8	1 7/8	2
1/4	3/8	1/2	5/8	3/4	7/8
1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8

Dealer's Multiple

Materials
Deck of Cards

Number of Players
3 players or more

Object of the Game
Object is to collect the most number of cards. Each player deals 2 times during a game.

Description
Ace is worth 1
Number cards are worth their value.
Face cards are worth 10.

Players take turns dealing. The dealer gives each player 3 cards face up. The dealer then turns over one card – the factor card - and identifies the card value. Players find the sum of their 3 cards. If the sum is a multiple of the dealer's card, the dealer collects the cards. If the sum of the player's cards does not add up to a multiple of the dealer's card, the player keeps the cards. The dealer always keeps the factor card. It is the next players turn to deal.

Sample

Dealer card	Player A cards	Player B cards
5	A + 3 + 9 = 13	2 + 5 + 8 = 15

The sum of player A's cards is 13 and is not multiple of the dealer's card "5." Player A keeps the cards. The sum of player B's cards is 15, a multiple of the dealer's card "5." Player B gives her/his cards to the dealer.

Modifications
If a player adds incorrectly or does not correctly identify a multiple, the player gives the cards to the dealer. When the dealer checks the player's cards and adds incorrectly or does not identify a multiple correctly, the dealer gives the player the factor card.

The following are a couple resources from which you will find variations of the games provided here as well as many more.

Family Math by Jean Kerr Stenmark, Virginia Thompson and Ruth Cossey. University of California, Berkeley, Lawrence; 18 edition (1986)

The Mathworks, Handbook of Activities for Helping Students Learn Mathematics. Greenes, Carol. et al. Creative Publications (June 1978)