

## Factor Game



**Strand A:** Number Sense, Concepts, and Operations

**Benchmark MA.A.5.2.1:** The student understands and applies basic number theory concepts, including primes, composites, factors, and multiples.

**Grade Level Expectation:** The student:

- knows multiples of whole numbers (with products of 60 or more).
- uses a model to determine factors of whole numbers through 100 (for example, array).

### Overview:

In this activity, students will use a game setting to identify the properties of prime and composite numbers. Using a Factor Game Board comprised of the numbers from 1 to 30 placed in a 5 by 6 grid, the teacher challenges students to a game. The rules are explained as the game progresses. Player A circles any number and, using a different color, Player B circles all the factors of that number. Once a number is circled, it cannot be used again. The game continues with Player B picking a number and so on. If a player picks a number that has no available factor, he/she gains those points but the next loses a turn. The winner is determined by adding the numbers circled by each player. The player with the highest total wins. After playing a game between the teacher and the class, students are given game boards and play against each other. The game is analyzed by filling in a table of first moves. On the basis of the data, students rate each number as a "good" or "not good" first move. Students learn that they can score more points by picking certain numbers. Students then play the game using the strategies they discovered.

### Materials:

- Transparency: *Factor Game Board 1 and 2*
- *Factor Game Board 1 Worksheet*
- *Factor Game Board 2 Worksheet*
- Colored pencils
- Calculators

**Procedures:**

1. Use the transparency of *Factor Game Board 1* or draw a 5 by 6 grid containing the numbers from 1 to 30 on the board. Use two different colors or two different symbols to distinguish the moves made by the two opposing teams. The teacher can circle the squares.
2. Explain to your students that they will be playing a game. The object of the game is to obtain more points than their opponent.
3. In the first game, the teacher challenges the entire class. The teacher will be Player A and the class as a whole will be Player B. Player A begins by circling one of the numbers on the game board.
4. Explain the rules to the class.

Rules of the Factor Game

- Player A selects a number from the Factor Game Board and circles it with his/her colored pencil. Player B then finds all of the factors of that number and circles them with a different colored pencil. Player B will receive points for finding the factor.
  - Next, Player B selects and circles a number from the game board. Player A then finds all of the available factors of that number and circles them.
  - Play continues until there are no more numbers left on the board that have available factors.
  - Illegal Move (Penalty Move): If a player chooses a number that has no available factors, this is called an illegal move. While the player gains those points, the next turn is lost.
  - As a result, the opponent selects the starting number for the next two rounds. Electing to make an illegal move could be considered a winning-strategy move. If only illegal moves are possible, this signals the end of the game and no more points are awarded.
  - Each should total all of the numbers that are circled in their respective color. The student with the highest total is declared the winner.
5. Have the Player B students identify all of the factors of that number and circle them in a different color. Scores can be subtotaled as each opponent earns points while the game is in play or students can be in suspense until the game is over, at which time the points are totaled.
  6. Following the initial teacher-student game, place students in groups of two or four to play each other.



7. Provide each group with several factor game boards and two different colored pencils. Allow students time to play the game several times.
8. Have students keep track of their moves on a sheet of paper.
9. Have students categorize those moves that are "good" moves. All moves that provide a player with more points than his/her opponent are considered to be a good first move. For example, if Player A's first move is a 5, then Player A's score is 5. Player B chooses 1 for a score of 1, because 1 is the only factor of 5. This is considered to be a good first move for Player A.

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

10. Next, have students begin to formally analyze the Factor Game by posing the following questions:
  - Which is the best possible first move?
  - Which is the worst possible first move?
11. Discuss questions similar to the following:
  - What are all of the first moves that will allow your opponent to only score 1 point? (These numbers are called prime numbers.)
  - Are all prime numbers good first moves?
  - What seems to make prime numbers special?
  - What are the first moves that will allow your opponent to score more than 1 point? (These numbers are called composite numbers.)
  - Are composite numbers good first moves? Explain why or why not?
  - Are perfect numbers good first moves? Why or why not?
12. As students classify first moves as good or not good, the possibilities for the sums of the proper factors of numbers will emerge. There are three possibilities for these sums: they can be larger than the number, smaller than the number, or equal to the number. Mathematicians used these patterns to classify numbers as either abundant, deficient, or perfect numbers respectively.
13. Allow them to play the game at least one more time as they apply their strategies in order to win.





