# MoM's Playoffs

A Game to Teach "**M**ultiplication **o**f **M**onomials"

| Die Toss example | Specially marked die | Coefficient for monomial | Standard 6-sided die | Exponent for monomial | Monomial |
|---|---|---|---|---|---|
| #1 | 2 ---→ | 2 | 5 ---→ | 5 | $2a^5$ |
| #2 | 3 ---→ | 3 | 4 ---→ | 4 | $3a^4$ |
| #1 x #2 ($2a^5 \cdot 3a^4$) | | 2 x 3 = 6 | | 5 + 4 = 9 | $6a^9$ |

This activity reinforces the multiplication of monomials, which involves multiplying coefficients and adding the exponents of expressions which have the same base.

**Topics:** Monomials, Multiplication

**Materials List**

- ✓ 6-sided die, standard
- ✓ Blank 6 sided die
- ✓ 10-sided die
- ✓ Permanent marker
- ✓ 26 small plastic chips of 4 different colors: e.g., 12 red, 12 blue, 1 yellow, and 1 green (or other colors as available)
- ✓ Scratch paper
- ✓ Pencils
- ✓ X-Y coordinate game board (see page 3

This activity can be used to teach:
Common Core Math:

- Expressions with exponents & variables; Equivalent expressions (Expressions and Equations, Grade 6, 1-4; Grade 7, 1-2; Grade 8, 1-2)
- Solve problems using numerical/ algebraic expressions/equations (Grade 7, Expressions and Equations, 3-4)
- Polynomials (High School, .Algebra/ Polynomials, 1)

## Assembly

1. On opposite sides of the blank die, use a permanent marker to write the number 1 twice. Similarly, write 2 and 3 twice on opposite blank sides.

## Playing the Game (for 2 players)

1. Players each roll the standard die: the one with the lowest number starts the game.
2. Player 1 rolls both the specially marked die and the standard 6-sided die. The number from the specially marked die determines the coefficient of the monomial, while the number from the standard die determines the exponent.
3. Player 1 writes the monomial on the scrap paper (pick a base such as "a" or "b") and then places chips on the X-Y game board as follows: take as many red chips as the exponent value and place them in a stack on the vertical line with the X-coordinate equal to the coefficient value. Move the stack of chips to the Y-coordinate equal to the exponent value. For example, if the marked die yields a 2 while the standard die roll shows the number 5, then the first monomial will be $2a^5$. Thus, place a stack of 5 red chips at the intersection (2,5)
4. Player 2 repeats step 2 and 3, and places a stack of blue chips on the X-Y game board corresponding to the coefficient and exponent values from the two dice.
5. Player 1 rolls the two dice a 2nd time, records the 2nd monomial on the scrap paper and places a 2nd stack of red chips on the X-Y game board as in step 3. Player 2 repeats this step using blue chips.
6. On the scratch paper, each player multiplies the 2 monomials obtained above. Then each player places a different colored chip on the X-Y game board to represent the product of the two monomials: the X-value is determined by the coefficients, while the Y-value is determined by the exponents.
7. Each player confirms the opponent's outcome on the game board:
   a. the product of the coefficients equals the coefficient of MOM's answer
   b. the sum of the exponents equals the exponent of the multiplied monomial.
8. Finally, each player rolls the 10-sided die, substitutes that value for the variable base in their monomial product. The player with the largest result wins the round.
9. Repeat steps 2-8 to determine the best-of-seven playoff winner.

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## The Math Behind the Activity

Monomials provide a convenient way to write repetitive numbers in "mathematical shorthand". For example, the expression $2 \cdot a \cdot a. \cdot .a \cdot a \cdot a$ can be written it in shorthand form as a monomial $2a^5$ with coefficient 2, variable base a raised to the exponent 5.

The multiplication rule for monomials is to multiply the coefficients and to add the exponents of the same base.

For example: $2a^5b^6 \cdot 3a^4b^2 = \mathbf{2 \cdot 3} \cdot a^{5+4} \cdot b^{6+2} = \mathbf{6}a^9b^8$

**Definition of a monomial:**

A monomial is a one term expression made up with constants, variables, and whole number (e.g., 0, 1, 2) exponents. A monomial has only 1 term; a polynomial has more than 1 term (e.g., a binomial has 2 terms, a trinomial 3 terms)

**Examples of Monomial:**

| Examples of Monomial | Coefficient | 1st Variable _ Exponent | 2nd Variable _ Exponent |
|---|---|---|---|
| 10 | 10 | No variable _ 0 | Not applicable |
| 3x | 3 | x _ 1 | Not applicable |
| xy | 1 | x _ 1 | y _ 1 |
| ½ $ab^2$ | ½ | a _ 1 | b _ 2 |
| $-1.5a^6$ | -1.5 | a _ 6 | Not applicable |

**Examples and reasons of "Not A Monomial":**

| Not A Monomial | Reason |
|---|---|
| 8 + x | A sum is not a monomial |
| 2/n | A monomial cannot have a variable in the denominator. |
| $5^x$ | A monomial cannot have a variable exponent |
| $a^{-1}$ | The variable must have a whole number exponent |

## Taking it Further

- Multiply monomials with more than one variable: use one specially marked die for the coefficient value and a two standard dice for the exponent values for 2 variables. Remember, always multiply the coefficients and apply the exponents rule to the variables (e.g., $3a^5b^4 \cdot 2a^6b^3 = 6a^{11}b^7$).

## Web Resources (Visit www.raft.net/raft-idea?isid=603 for more resources!)

- Exponents - http://www.mathsisfun.com/exponent.html
- More Exponents - http://www.coolmath.com/algebra/01-exponents/index.html

# Multiplication of Monomials XY Coordinate Grid