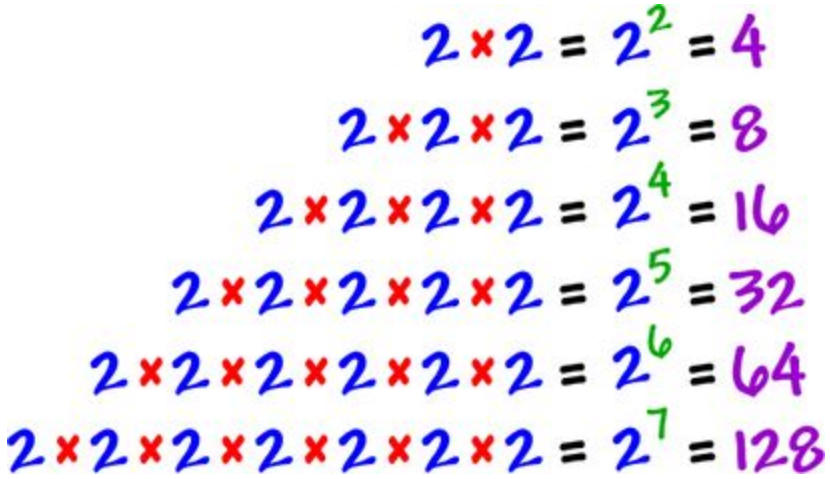
Powers and Exponents



Curriculum Outcomes:
Number: Develop number sense.

1. Demonstrate an understanding of powers with integral bases (excluding base 0) and whole number exponents by: *• representing repeated multiplication, using powers* *• using patterns to show that a power with an exponent of zero is equal to one* *• solving problems involving powers.*	*4. Explain and apply the order of operations, including exponents, with and without technology.*

Things You Need to Know

- Powers are used to represent repeated multiplication. They contain a base and an exponent.
    - Example: 8^3 = 8 x 8 x 8
    - 8 would be the base (the base is the number that gets multiplied by itself).
    - 3 would be the exponent (the exponent represents how many times the base is multiplied by itself.
- Be careful with negative powers.
    - If there are brackets surrounding the negative and the exponent is outside the brackets, the entire negative number is serving as the base.
        - (-5)^4 = (-5) x (-5) x (-5) x (-5) = 625
        - Note: in these cases, if the exponent is even, the answer will be positive. If it is odd, the answer will be negative.
    - If there aren't brackets surrounding the negative, or the exponent is inside the brackets with the negative base, then just the positive whole number will serve as the base, but your answer will always be negative (regardless of whether the exponent is even or odd).
        - -5^4 = - (5 x 5 x 5 x 5) = -625
        - Same thing with brackets, but exponent is on the inside of the brackets: (-5^4) = - (5 x 5 x 5 x 5) = -625
- There are six **Exponent Laws** that make operations involving powers simpler:
    - Rule 1: Product of Powers
        - When two or more powers with the same base are multiplied together, you can simplify this by adding the exponents and keeping the base the same.
            - 8^3 x 8^6 = 8^(3 + 6) = 8^9
    - Rule 2: Quotient of Powers
        - When two or more powers with the same base are divided, you can simplify this by subtracting the exponents and keeping the base the same.
            - 5^7 ÷ 5^4 = 5^(7 - 4) = 5^3
    - Rule 3: Zero Exponent
        - When any base has an exponent of 0, the answer is 1.
            - 7^0 = 1
    - Rule 4: Power of a Power
        - When a power is taken to another exponent, simplify this by multiplying the exponents together.
            - (4^7)^3 = 4^(7 X 3) 4^21

- Rule 5: Power of a Product
  - When two or more numbers multiplied together is taken to an exponent, the exponent attaches to each number in the product.
    - (5 x 9)^3 = 5^3 x 9^3
    - If these numbers already have exponents, then this becomes a Rule 4:
      - (3^6 x 7^2)^4 = (3^6)^4 x (7^2)^4 = 3^24 x 7^8
- Rule 6: Power of a Quotient
  - When two or more numbers divided together is taken to an exponent, the exponent attaches to each number in the quotient. (Basically the same thing as Rule 5).
    - (4 / 9)^5 = (4^5) / (9^5)

Powers can be used for applications such as surface area and volume:

- Surface area of a cube: there are 6 sides to a cube. Each side is the same. The length of the side of a cube is some number, we'll call it S. The area of each side is S x S = S^2.
  - The formula for surface area of a cube: 6 x S^2
- Volume of a cube: remember that volume is the interior space of something.
  - The formula for volume of a cube: S^3