Today's Objectives

- Orally describe **the process of long division** using the key words quotient, remainder, and dividend. Label each key word **in your mathematical work** using color-coded notes and visual diagrams.
- Success Criteria
  - Decipher the meaning of the division algorithm
  - Use long division to divide polynomials
- Vocabulary: Quotient, Remainder, Dividend

Division Algorithm for Polynomials

Let $f(x)$ and $d(x)$ be polynomials with the degree of f greater than or equal to the degree of d, and $d(x) \neq 0$. Then there are unique polynomials $q(x)$ and $r(x)$, called the **quotient** and **remainder**, such that $f(x) = d(x) \cdot q(x) + r(x)$ where either $r(x) = 0$ or the degree of r is less than the degree of d.

The function $f(x)$ in the division algorithm is the **dividend**, and $d(x)$ is the **divisor**.
If $r(x) = 0$, we say $d(x)$ **divides evenly** into $f(x)$.

Long Division

Use long division to find the quotient and remainder when 2635 is divided by 13.

$$f(x) = d(x) \cdot q(x) + r(x)$$

$$\begin{array}{r} 202 \\ 13\overline{)2635} \\ -26 \\ \hline 035 \\ -26 \\ \hline 9 \end{array}$$

$$\frac{2635}{13} = 202 + \frac{9}{13}$$

$$2635 = 202(13) + 9$$

Example Using Polynomial Long Division

Use long division to find the quotient and remainder when $2x^4 + x^3 - 3$ is divided by $x^2 + x + 1$.

$$f(x) = d(x) \cdot q(x) + r(x)$$

$$
\begin{array}{r l}
 & 2x^2 - x - 1 \\
x^2 + x + 1 & \overline{)\, 2x^4 + x^3 + 0x^2 + 0x - 3} \\
 & -(2x^4 + 2x^3 + 2x^2) \\
 & \quad -x^3 - 2x^2 + 0x \\
 & \quad -(-x^3 - x^2 - x) \\
 & \qquad -x^2 + x - 3 \\
 & \qquad -(-x^2 - x - 1) \\
 & \qquad\quad 2x - 2
\end{array}
$$

Divisor	$d(x) = x^2 + x + 1$
Dividend	$f(x) = 2x^4 + x^3 - 3$
Quotient	$q(x) = 2x^2 - x - 1$
Remainder	$r(x) = 2x - 2$
Fraction Form	$\frac{2x^4 + x^3 - 3}{x^2 + x + 1} = 2x^2 - x - 1 + \frac{2x - 2}{x^2 + x + 1}$
Polynomial Form	$2x^4 + x^3 - 3 = (2x^2 - x - 1)(x^2 + x + 1) + 2x - 2$

Fraction

$$\frac{f(x)}{d(x)} = q(x) + \frac{r(x)}{d(x)}$$

Polynomial

$$f(x) = q(x) \cdot d(x) + r(x)$$