Graphing families.

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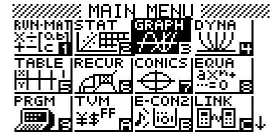
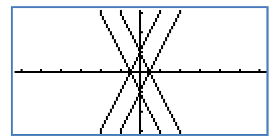


Select **GRAPH** mode from the **Main Menu** by using the arrow keys to highlight the **GRAPH** icon or pressing 3.

In this activity you will investigate the relationships between families of graphs based on the use of ±. For example for y = a there is another graph y = -a, so there is a family of y = ±a. Similarly $y = \pm ax \pm b$, $y = \pm ax^2 \pm bx \pm c$, $y = \pm ax^3 \pm bx^2 \pm cx \pm d$ where a, b, c and d ε I etc,. We will limit ourselves to linear, quadratic and cubic graphs, but you could consider higher degree polynomials, hyperbolic, exponential, logarithm and trigonometric graphs as extension activities to investigate the relationships between the graphing families.

1. Linear graphs



Consider $y = \pm 2x \pm 1$, this gives 4 different graphs $y = -2x - 1$, $y = -2x + 1$, $y = 2x - 1$ and $y = 2x + 1$. They look like this when drawn together.

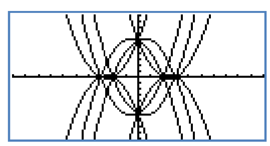
If you were to look at the entire family of graphs in the form $y = \pm 2x \pm a$ where a ε I, they would fill the screen with a crisscross pattern.

2. Quadratic graphs

Consider $y = \pm(x \pm 3)(x \pm 2)$, this would give 8 different graphs $y = (x-3)(x-2)$, $y = -(x-3)(x-2)$, $y = (x-3)(x+2)$, $y = -(x-3)(x+2)$, $y = (x+3)(x-2)$, $y = -(x+3)(x-2)$, $y = (x+3)(x+2)$ and $y = -(x+3)(x+2)$.

In expanded form:

Y1 =	$y = (x-3)(x-2)$	$= x^2 - 5x + 6$
Y2 = -Y1 =	$y = -(x-3)(x-2)$	$= -x^2 + 5x - 6$
Y3 =	$y = (x-3)(x+2)$	$= x^2 - x - 6$
Y4 = -Y3 =	$y = -(x-3)(x+2)$	$= -x^2 + x + 6$
Y5 =	$y = (x+3)(x-2)$	$= x^2 + x - 6$
Y6 = -Y5 =	$y = -(x+3)(x-2)$	$= -x^2 - x + 6$
Y7 =	$y = (x+3)(x+2)$	$= x^2 + 5x + 6$
Y8 = -Y7 =	$y = -(x+3)(x+2)$	$= -x^2 - 5x - 6$



3. Cubic graphs

Consider $y = \pm(x \pm 3)(x \pm 2)(x \pm 1)$, this would give 16 different graphs. What would the 16 graphs drawn on the same axes look like?

4. Extension activity:

1. What would the cubic graphs $y = \pm(x \pm 1)(x \pm 1)(x \pm 1)$ look like?
2. Can you predict what the cubic graphs with roots x = ± 1, x ± 3, x = ± 5 or x = ± 1, x ± 2, x = ± 4 or x = ± 1, x ± 3, x = ± 9 look like?
3. What would the graphs of $x = \pm ay \pm b$, $x = \pm y^2 \pm by \pm c$, $x = \pm ay^3 \pm by^2 \pm cy \pm d$ look like?