Graphing Functions

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The function \( f(x) = x^2 \) is called the \textit{square function}. 
The function $f(x) = x^2$ is called the *square function*.
The function $f(x) = x^3$ is called the *cube function*. 
The function $f(x) = x^3$ is called the *cube function*.
The function $f(x) = \sqrt{x}$ is called the square root function.
The function $f(x) = \sqrt{x}$ is called the *square root function*. 
The function $f(x) = \sqrt[3]{x}$ is called the *cube root function*.
The function $f(x) = \sqrt[3]{x}$ is called the \textit{cube root function}.
The function $f(x) = |x|$ is called the *absolute value function*. 
The function $f(x) = |x|$ is called the *absolute value function*. 
Transformations of $f(x)$

<table>
<thead>
<tr>
<th>Expression</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f(x) + c$</td>
<td>vertical shift up $c$ units</td>
</tr>
<tr>
<td>$f(x) - c$</td>
<td>vertical shift down $c$ units</td>
</tr>
<tr>
<td>$f(x + c)$</td>
<td>horizontal shift left $c$ units</td>
</tr>
<tr>
<td>$f(x - c)$</td>
<td>horizontal shift right $c$ units</td>
</tr>
<tr>
<td>$-f(x)$</td>
<td>reflection over the $x$-axis</td>
</tr>
<tr>
<td>$f(-x)$</td>
<td>reflection over the $y$-axis</td>
</tr>
<tr>
<td>$cf(x)$</td>
<td>vertical stretch or compression by a factor of $c$</td>
</tr>
<tr>
<td>$f(cx)$</td>
<td>horizontal compression or stretch by a factor of $c$</td>
</tr>
</tbody>
</table>
Example 1.

Graph $g(x) = x^2 + 1$. 

 Joseph Lee  |  Graphing Functions
Example 1.

Graph $g(x) = x^2 + 1$.

Let $f(x) = x^2$. Note $g(x) = f(x) + 1$. 
Example 1.

Graph \( g(x) = x^2 + 1 \).

Let \( f(x) = x^2 \). Note \( g(x) = f(x) + 1 \).
Example 2.

Graph $g(x) = (x - 2)^2$. 
Example 2.

Graph $g(x) = (x - 2)^2$.

Let $f(x) = x^2$. Note $g(x) = f(x - 2)$. 
Example 2.

Graph $g(x) = (x - 2)^2$.

Let $f(x) = x^2$. Note $g(x) = f(x - 2)$. 
Example 3.

Graph $h(x) = (x + 4)^2 + 1$. 

Joseph Lee

Graphing Functions
Example 3.

Graph \( h(x) = (x + 4)^2 + 1 \).

Let \( f(x) = x^2 \) and \( g(x) = (x + 4)^2 \).
Example 3.

Graph \( h(x) = (x + 4)^2 + 1 \).

Let \( f(x) = x^2 \) and \( g(x) = (x + 4)^2 \).
Example 4.

Graph $k(x) = -(x - 3)^2 - 1$. 
Example 4.

Graph $k(x) = -(x - 3)^2 - 1$.

Let $f(x) = x^2$, $g(x) = (x - 3)^2$, and $h(x) = -(x - 3)^2$. 
Example 4.

Graph $k(x) = -(x - 3)^2 - 1$.

Let $f(x) = x^2$, $g(x) = (x - 3)^2$, and $h(x) = -(x - 3)^2$. 
Example 5.

Graph \( g(x) = \sqrt{x} - 2 \).
Example 5.

Graph \( g(x) = \sqrt{x} - 2 \).

Let \( f(x) = \sqrt{x} \). Note \( g(x) = f(x) - 2 \).
Example 5.

Graph \( g(x) = \sqrt{x} - 2 \).

Let \( f(x) = \sqrt{x} \). Note \( g(x) = f(x) - 2 \).
Example 6.

Graph \( g(x) = \sqrt{x - 2} \).
Example 6.

Graph \( g(x) = \sqrt{x - 2} \).

Let \( f(x) = \sqrt{x} \). Note \( g(x) = f(x - 2) \).
Example 6.

Graph $g(x) = \sqrt{x - 2}$.

Let $f(x) = \sqrt{x}$. Note $g(x) = f(x - 2)$. 
Example 7.

Graph \( k(x) = -\sqrt{x + 1} + 2 \).
Example 7.

Graph \( k(x) = -\sqrt{x + 1} + 2. \)

Let \( f(x) = \sqrt{x}, \ g(x) = \sqrt{x + 1}, \) and \( h(x) = -\sqrt{x + 1}. \)
Example 7.

Graph \( k(x) = -\sqrt{x+1} + 2 \).

Let \( f(x) = \sqrt{x} \), \( g(x) = \sqrt{x+1} \), and \( h(x) = -\sqrt{x+1} \).
Example 8.

Graph \( h(x) = (x - 5)^3 - 2 \).
Example 8.

Graph $h(x) = (x - 5)^3 - 2$.

Let $f(x) = x^3$ and $g(x) = (x - 5)^3$. 
Example 8.

Graph $h(x) = (x - 5)^3 - 2$.

Let $f(x) = x^3$ and $g(x) = (x - 5)^3$. 
Example 9.

Graph $k(x) = -|x + 2| + 1$. 
Example 9.

Graph $k(x) = -|x + 2| + 1$.

Let $f(x) = |x|$, $g(x) = |x + 2|$, and $h(x) = -|x + 2|$.
Example 9.

Graph \( k(x) = -|x + 2| + 1 \).

Let \( f(x) = |x| \), \( g(x) = |x + 2| \), and \( h(x) = -|x + 2| \).
Example 10.

The graph of the function $f$ is given below.

(a) Graph $g(x) = f(x) - 2$.

(b) Graph $h(x) = f(x + 2)$.

(c) Graph $k(x) = -f(x - 1) + 2$. 

Joseph Lee
Graphing Functions
Example 10.

(a) Graph $g(x) = f(x) - 2$. 

![Graph of $g(x) = f(x) - 2$.](image)
(b) Graph $h(x) = f(x + 2)$. 

![Graph of $h(x) = f(x + 2)$]
(c) Graph $k(x) = -f(x - 1) + 2$. 