Introduction

Hi there! I'm so glad you could join me for this lesson in Algebra I, where you will explore the quadratic function family and discover how transformations of its parent function affect the domain and range.

Exploring Quadratic Functions

Click the examples below to learn more.

- Example One
- Example Two
- Example Three
- Self-Check
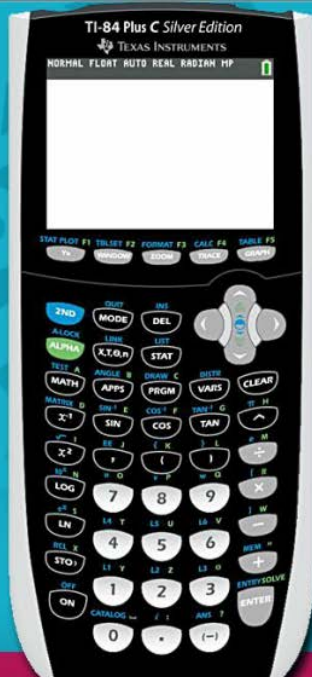
Example 1

Images used with permission by Texas Instruments Incorporated.

Use the graphing calculator to investigate the parent function of the quadratic function family.
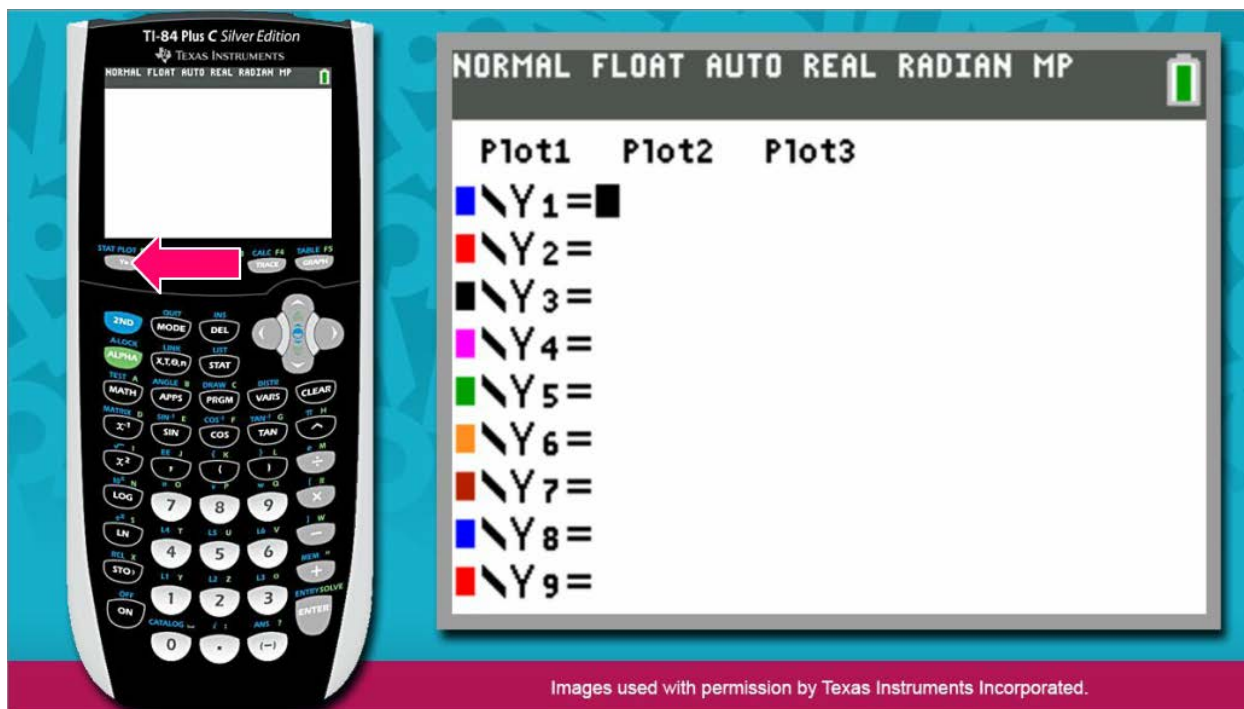
$$f(x) = x^2$$

The parent function of the quadratic function family is $f(x) = x^2$. Enter the function into the graphing calculator.

Example 1 (continued)

Images used with permission by Texas Instruments Incorporated.

Press the Y= key.

Example 1 (continued)

Images used with permission by Texas Instruments Incorporated.

Now, enter x^2 to the right of Y1. Press the key to the right of the green ALPA key to type the variable x.
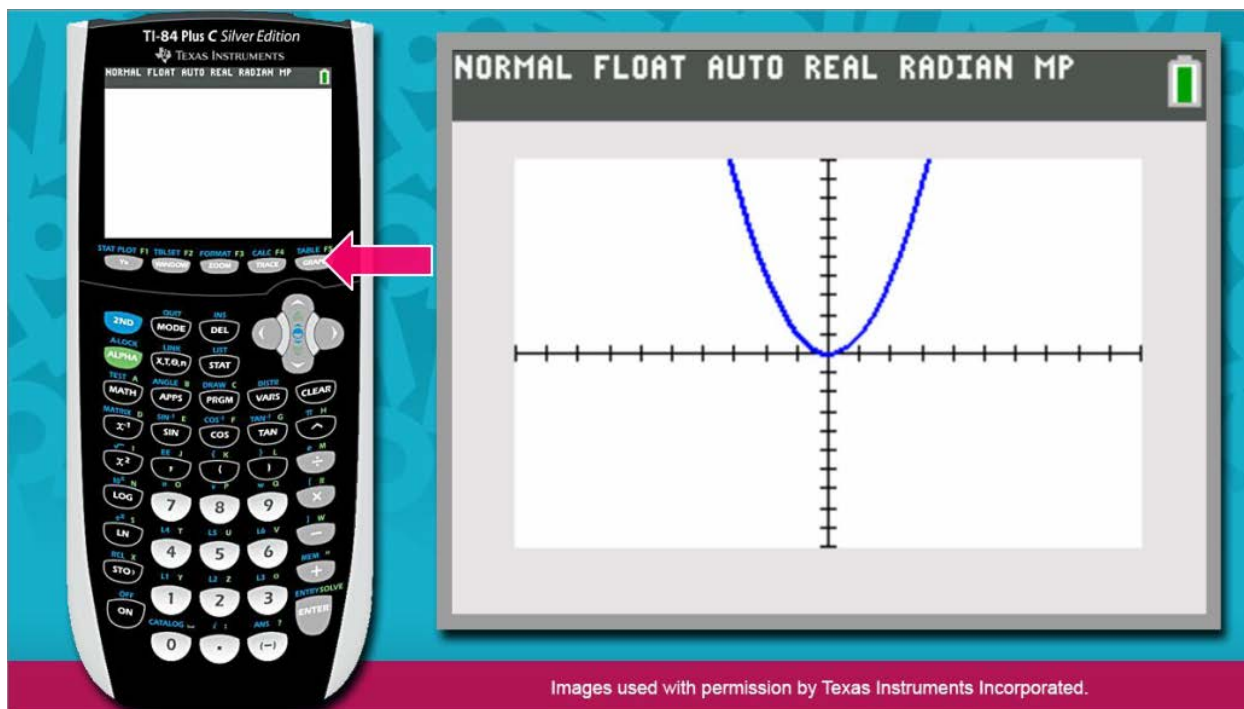
Then, press the x^2 key located a few keys below the green ALPHA key.

Example 1 (continued)

Images used with permission by Texas Instruments Incorporated.

Now, press GRAPH.

Example 1 (continued)

Domain: The set of all real numbers

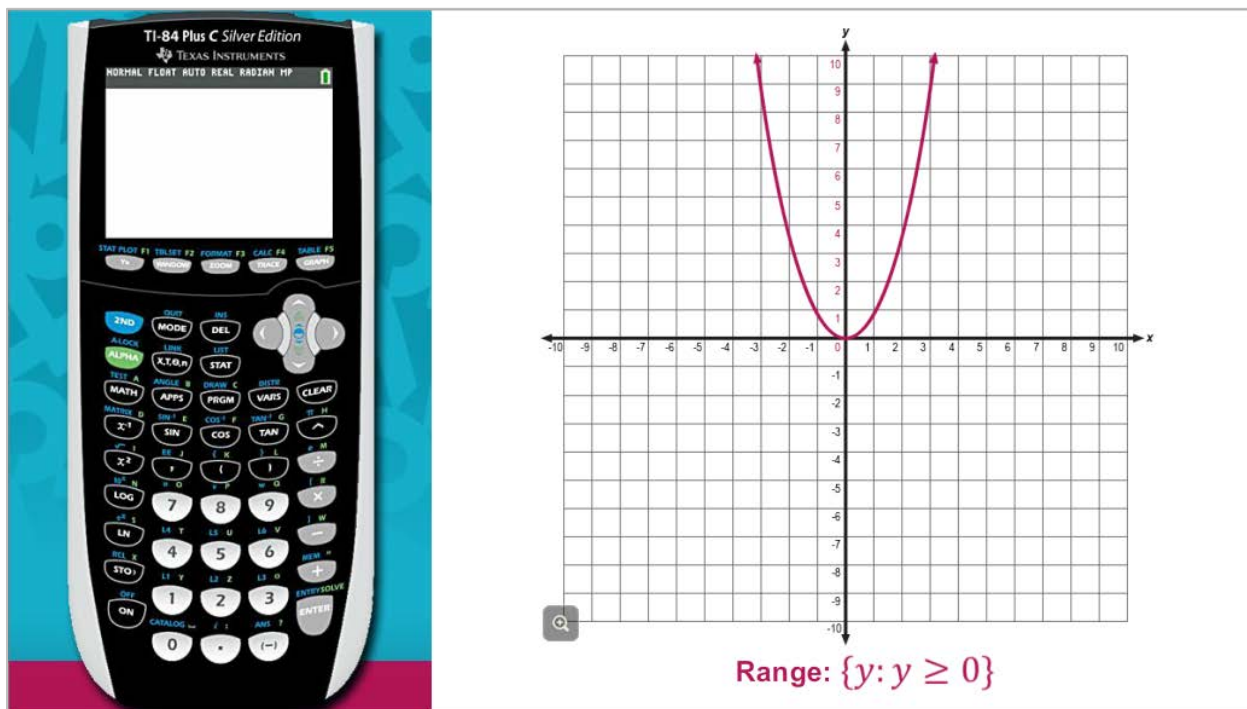Notice that the function is defined for all values of x. Or in other words, a y-value exists for all possible values of x – all negative values, 0, and all positive values. Therefore, the domain of the quadratic parent function is the set of all real numbers.
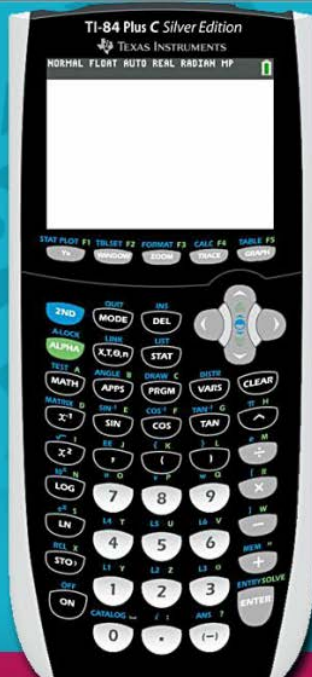
Example 1 (continued)

Range: $\{y: y \geq 0\}$

Notice that all of the output values of the parent function are greater than or equal to 0. You can use set notation to represent the range as: $\{y: y \geq 0\}$.
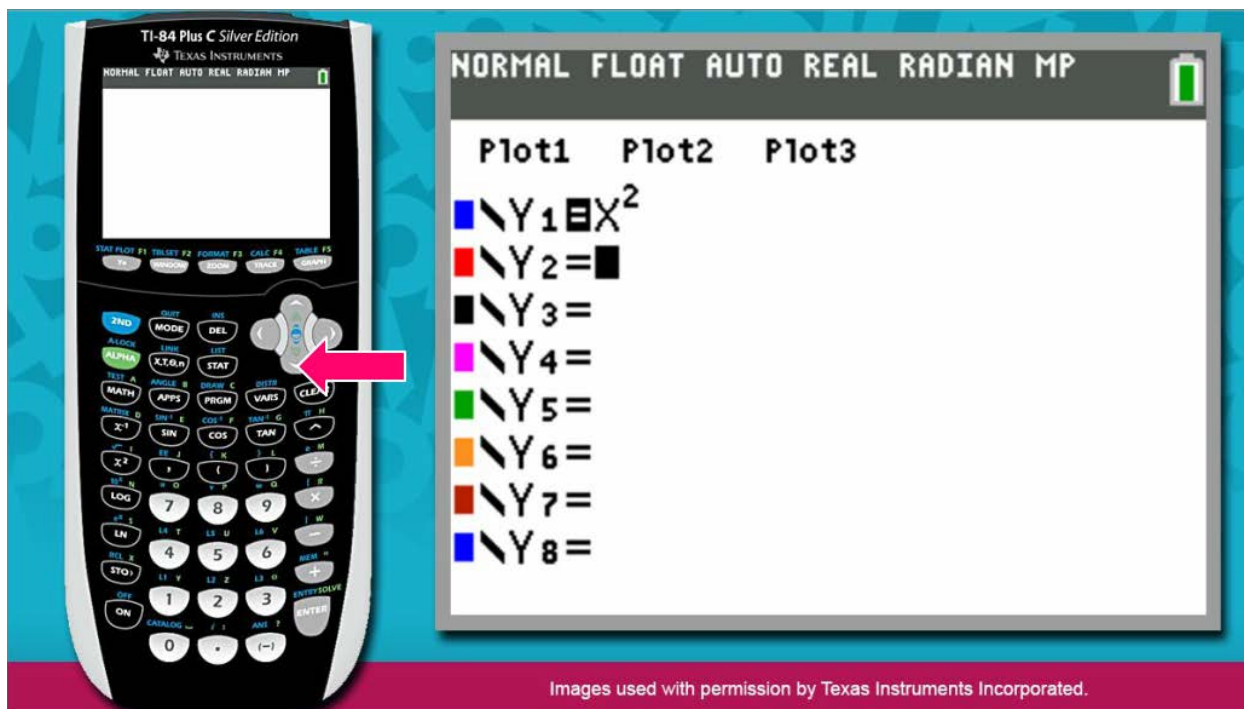
Example 2

Use the graphing calculator to discover how vertical translations of the parent function affect the domain and range.

$$j(x) = x^2 + 3.$$

Example 2 (continued)

Images used with permission by Texas Instruments Incorporated.

Press the Y= key. Then press the down arrow so that the cursor is blinking to the right of Y2.

Example 2 (continued)

Images used with permission by Texas Instruments Incorporated.
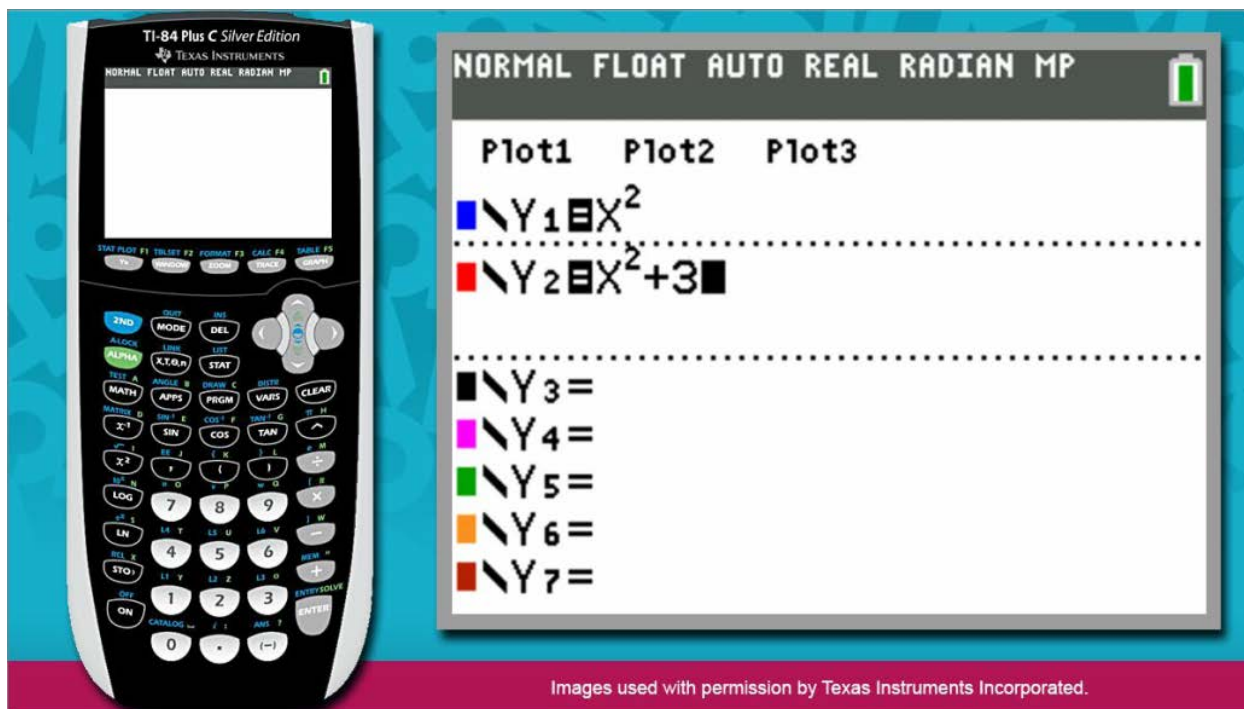
Enter the expression $x^2 + 3$ to the right of Y2.

Example 2 (continued)
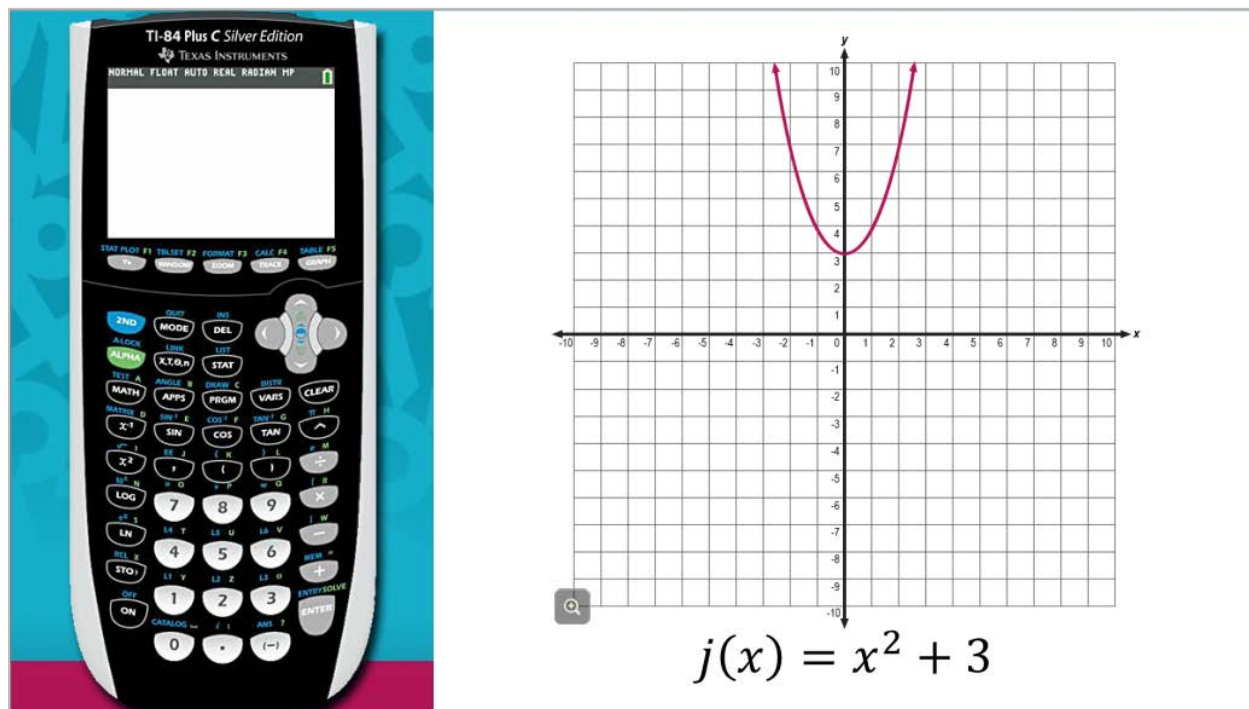
$$j(x) = x^2 + 3$$

Now, press GRAPH.

Notice that the graph of the function $j(x) = x^2 + 3$ is a translation of the parent function 3 units up.

Example 2 (continued)

How did translating the parent function up 3 units affect the domain?

What is the domain of $j(x) = x^2 + 3$?

- All real numbers
- All real numbers greater than or equal to 3
- $\{x : x \geq 0\}$
- $\{x : x \leq 3\}$

$j(x) = x^2 + 3$

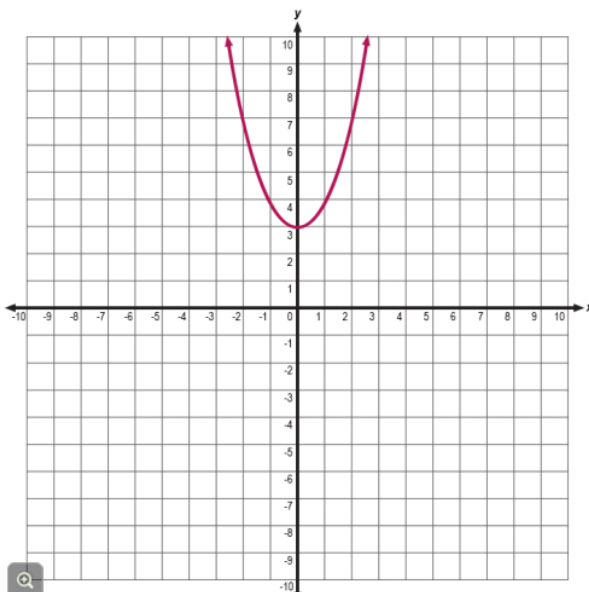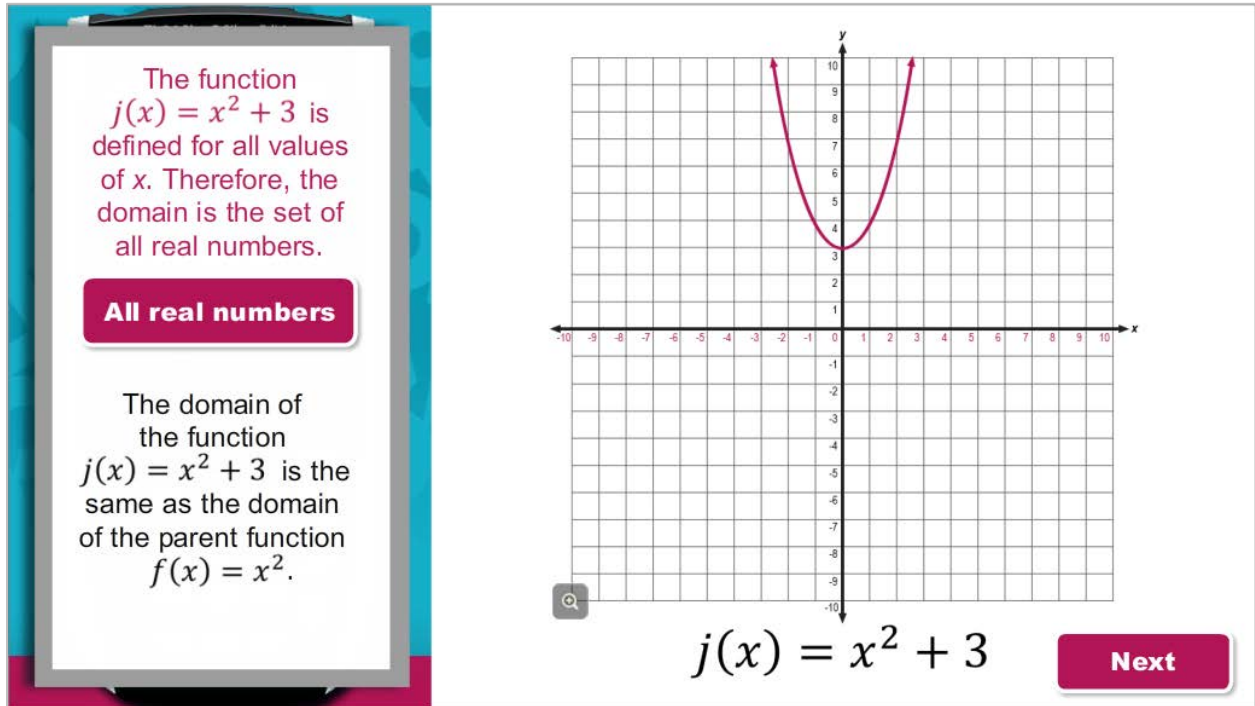How did translating the parent function up 3 units affect the domain?

What is the domain of $j(x) = x^2 + 3$?

A) all real numbers
B) all real numbers greater than or equal to 3
C) $\{x : x \geq 0\}$
D) $\{x : x \leq 3\}$

Example 2 (continued)

The function $j(x) = x^2 + 3$ is defined for all values of x. Therefore, the domain is the set of all real numbers.

All real numbers

The domain of the function $j(x) = x^2 + 3$ is the same as the domain of the parent function $f(x) = x^2$.

$$j(x) = x^2 + 3$$

Next

The function $j(x) = x^2 + 3$ is defined for all values of x. Therefore, the domain is the set of all real numbers.

The domain of the function $j(x) = x^2 + 3$ is the same as the domain of the function $f(x) = x^2$.

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Example 2 (continued)

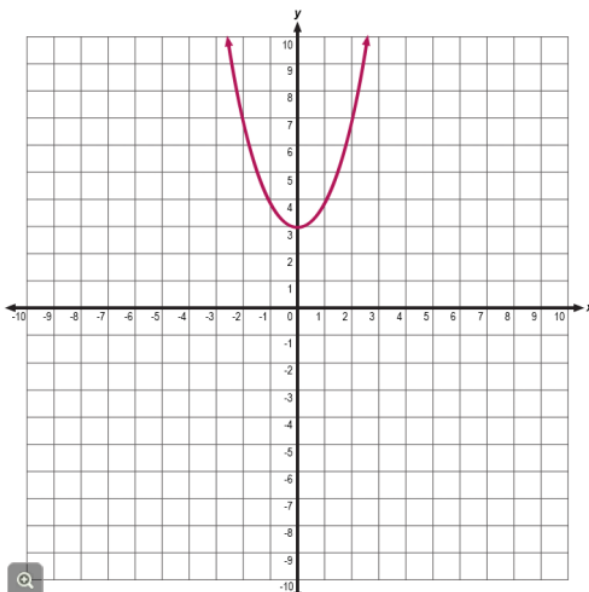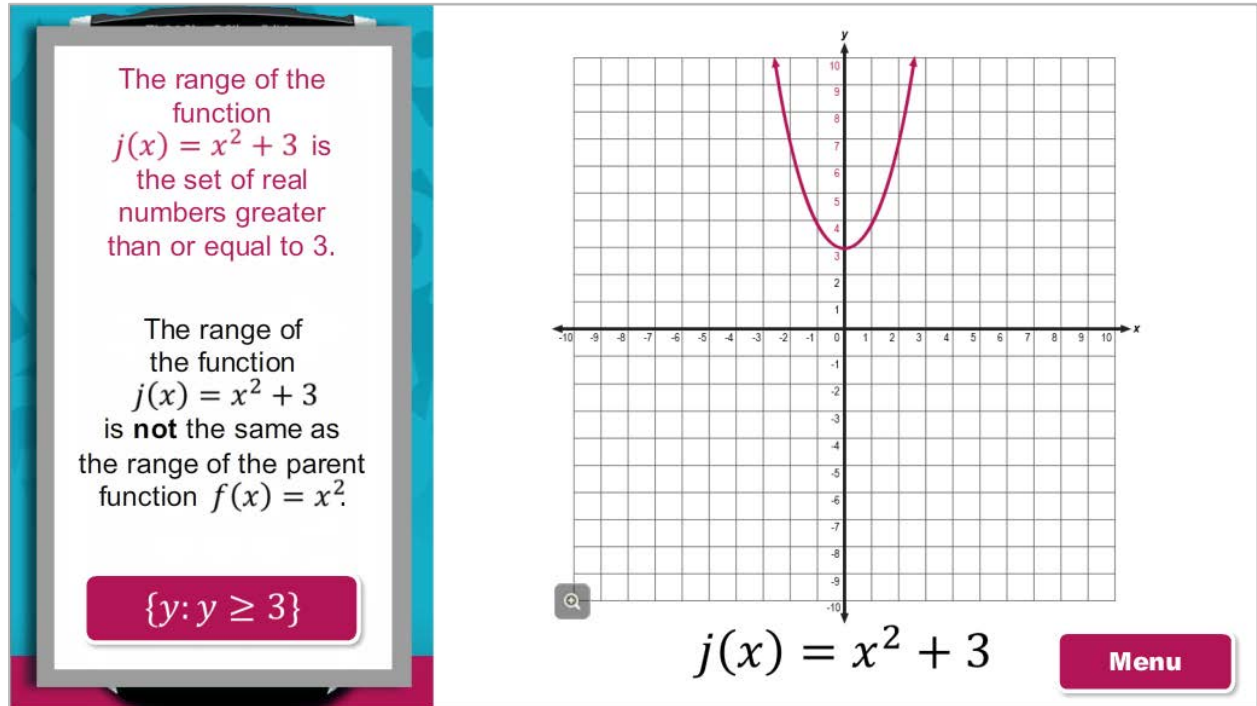How did translating the parent function up 3 units affect the range?

What is the range of $j(x) = x^2 + 3$?

A) all real numbers
B) all real numbers less than or equal to 3
C) $\{y : y \geq 0\}$
D) $\{y : y \geq 3\}$

Example 2 (continued)

The range of the function $j(x) = x^2 + 3$ is the set of real numbers greater than or equal to 3.

The range of the function $j(x) = x^2 + 3$ is **not** the same as the range of the parent function $f(x) = x^2$.
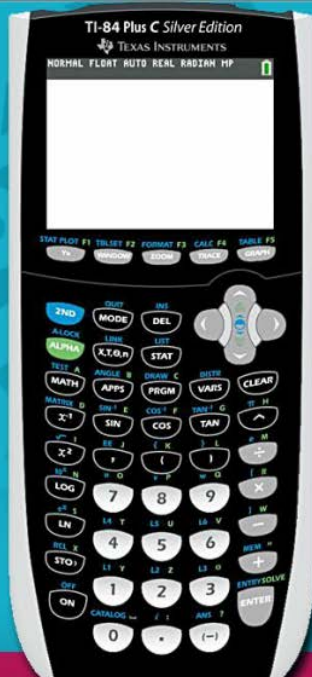
$\{y : y \geq 3\}$

$j(x) = x^2 + 3$

Menu

The range of the function $j(x) = x^2 + 3$ is the set of real numbers greater than or equal to 3.

The range of the function $j(x) = x^2 + 3$ is *not* the same as the range of the function $f(x) = x^2$.
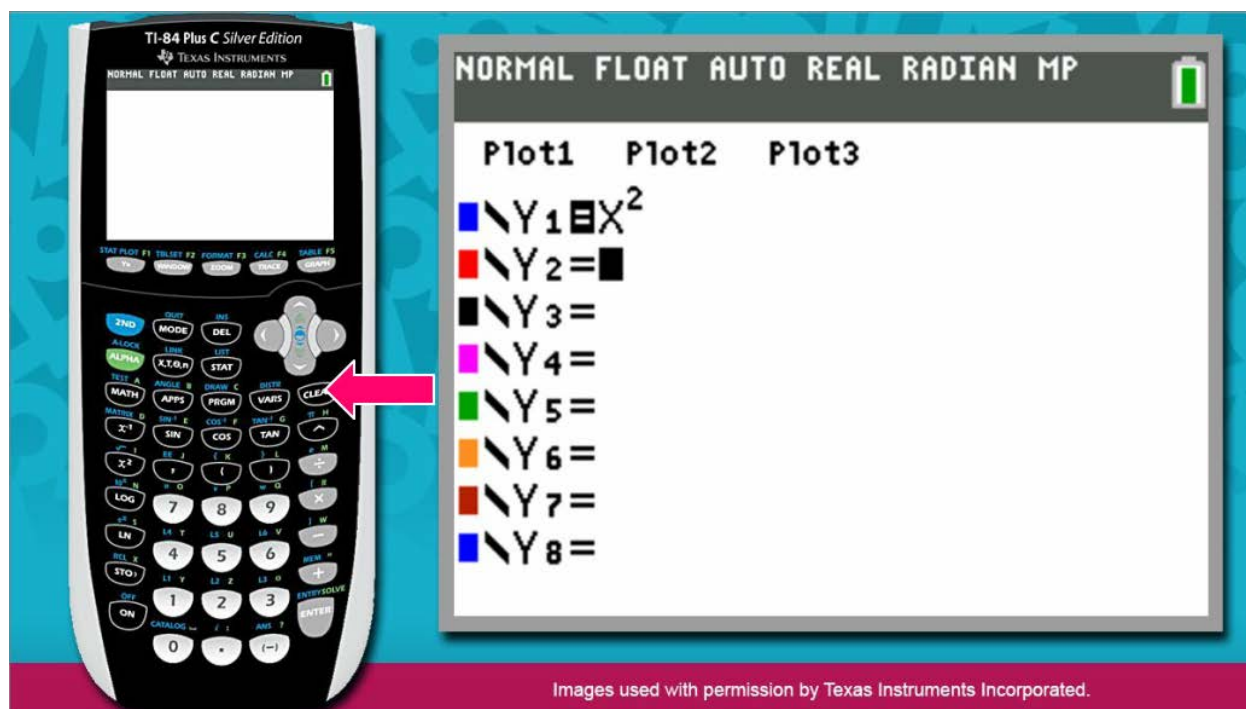
Example 3

Use the graphing calculator to explore how horizontal translations of the parent function affect the domain and range.

$$j(x) = (x + 3)^2$$

Example 3 (continued)

NORMAL FLOAT AUTO REAL RADIAN MP

Plot1   Plot2   Plot3

$Y_1 = X^2$
$Y_2 = \blacksquare$
$Y_3 =$
$Y_4 =$
$Y_5 =$
$Y_6 =$
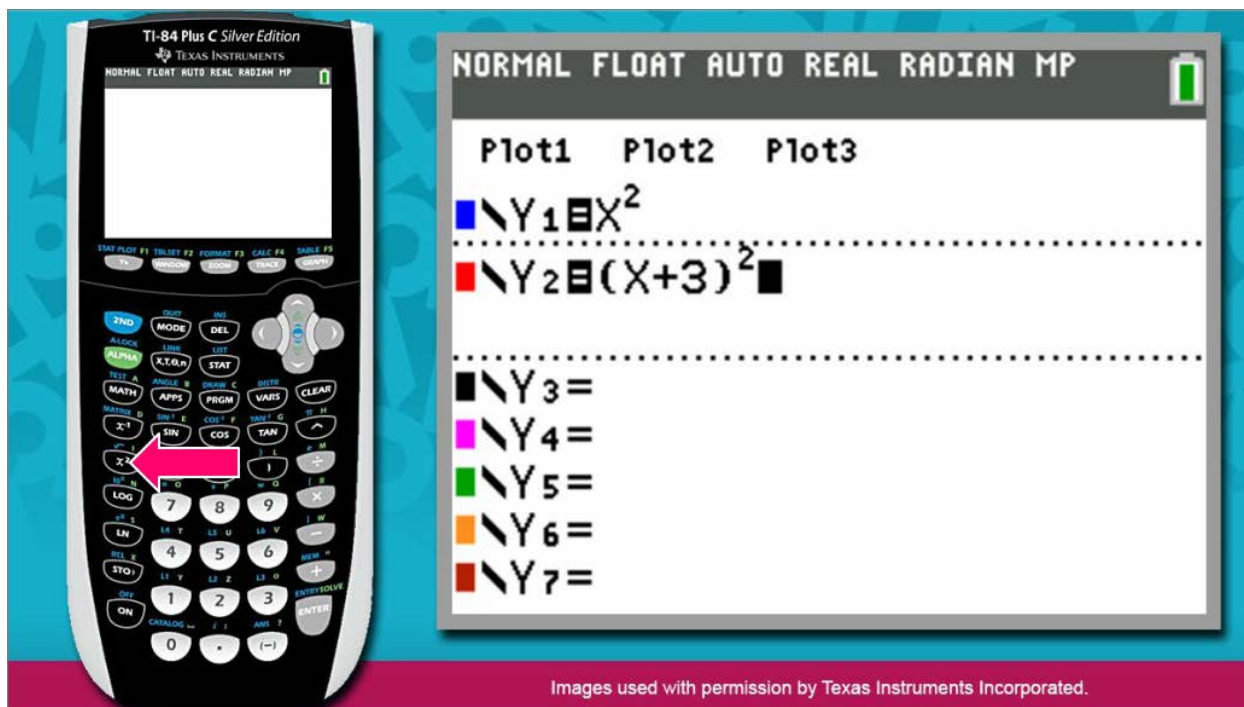$Y_7 =$
$Y_8 =$

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Press the Y= key. Then, press the down arrow. Next, press CLEAR to remove any expression that may be to the right of Y2.

Example 3 (continued)

Images used with permission by Texas Instruments Incorporated.
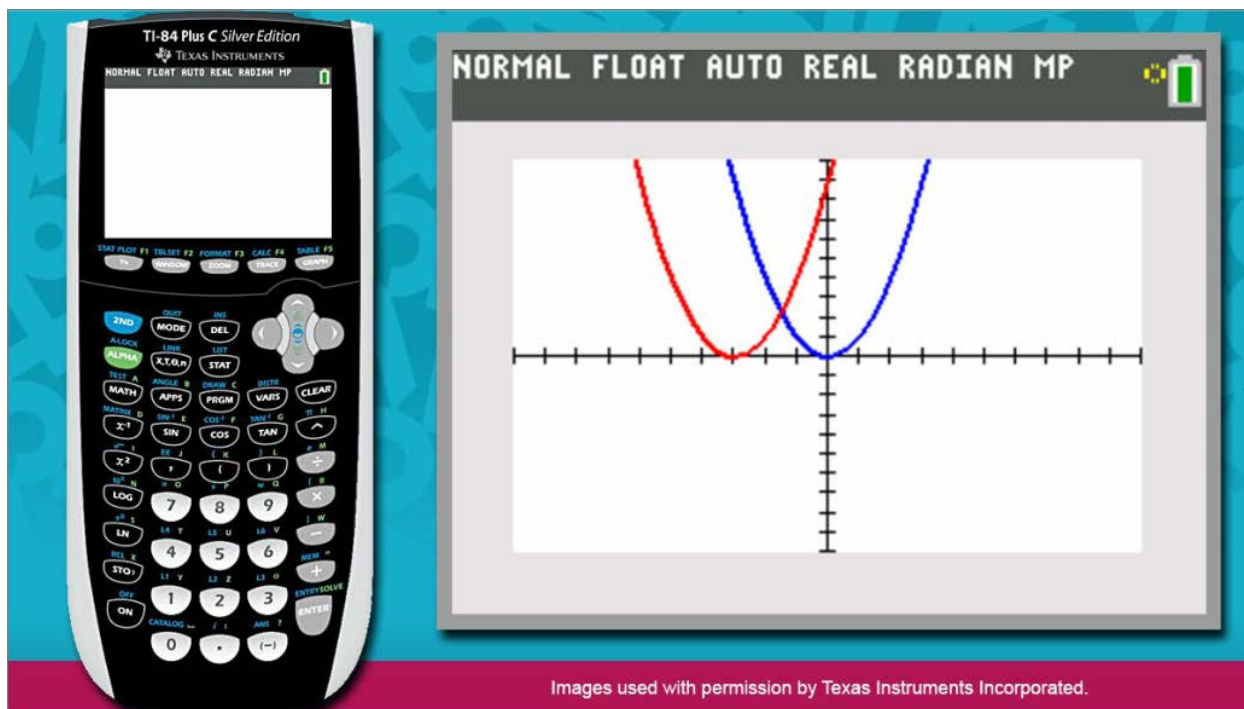
Enter $(x + 3)^2$ to the right of Y2.

Press the left parentheses key located above the 8 key. Then, press the x key, the addition key, and then the 3 key. Next, press the right parentheses key located above the 9 key. Then, press the x^2 key.

Example 3 (continued)

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Press GRAPH.

Example 3 (continued)

Describe the transformation of the parent function $f(x) = x^2$
given by the graph of $j(x) = (x + 3)^2$.

Translated 3 units up

Translated 3 units down

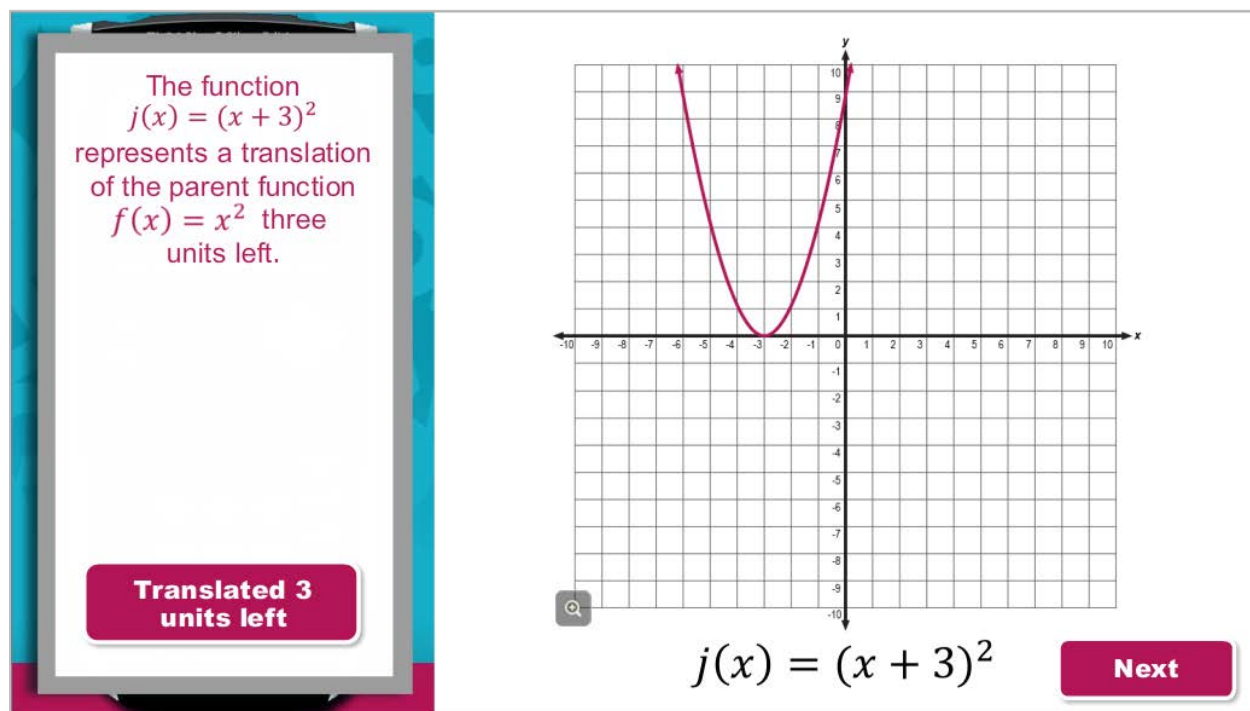Translated 3 units right

Translated 3 units left

$$j(x) = (x + 3)^2$$

Describe the transformation of the parent function $f(x) = x^2$ given by the graph of $j(x) = (x + 3)^2$.

    A) translated 3 units up
    B) translated 3 units down
    C) translated 3 units right
    D) translated 3 units left

Example 3 (continued)

The function
$j(x) = (x + 3)^2$
represents a translation
of the parent function
$f(x) = x^2$ three
units left.

Translated 3
units left

$j(x) = (x + 3)^2$

Next

The function $j(x) = (x + 3)^2$ represents a translation of the parent function $f(x) = x^2$ three units left.

Example 3 (continued)

How did translating the parent function left 3 units affect the domain?

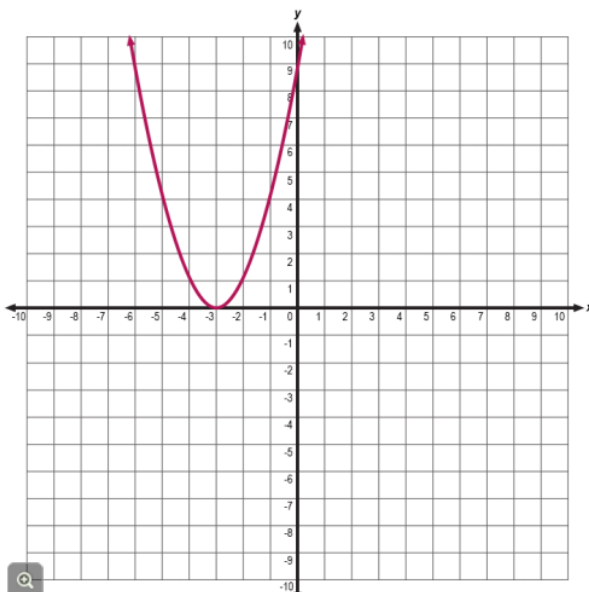What is the domain of $j(x) = (x + 3)^2$?

All real numbers

$\{x | x \geq 0\}$

$\{x | x \geq 3\}$

$\{x | x \leq 3\}$

$j(x) = (x + 3)^2$

How did translating the parent function left 3 units affect the domain?

What is the domain of $(x) = (x + 3)^2$?

A) all real numbers
B) $\{x | x \geq 0\}$
C) $\{x | x \geq 3\}$
D) $\{x | x \leq 3\}$

Example 3 (continued)

The domain is the set of all real numbers.

All real numbers

$$j(x) = (x + 3)^2$$

Next

The domain is the set of all real numbers.
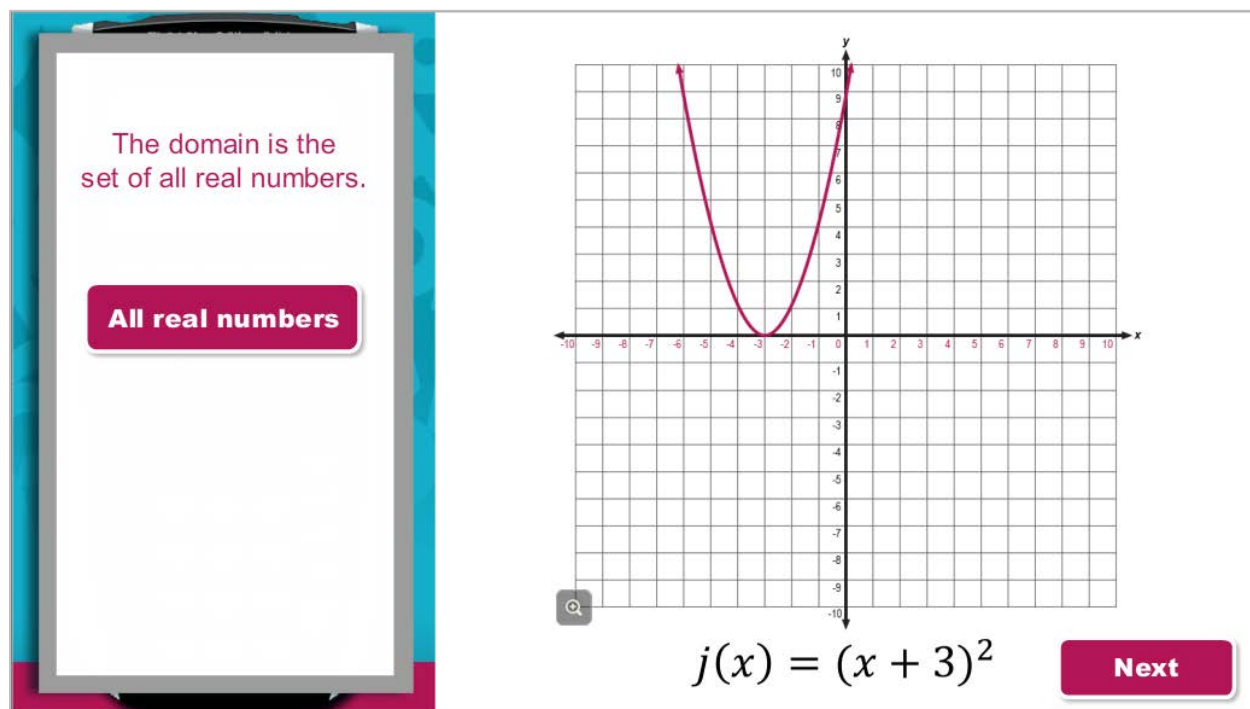
Example 3 (continued)

How did translating the
parent function left 3
units affect the range?

What is the range of
$j(x) = (x + 3)^2$?

All real numbers

$\{y|y \geq 0\}$

$\{y|y \leq 0\}$

$\{y|y \geq 3\}$

$j(x) = (x + 3)^2$

How did translating the parent function left 3 units affect the range?

What is the range of $(x) = (x + 3)^2$?

A) all real numbers
B) $\{y|y \geq 0\}$
C) $\{y|y \leq 0\}$
D) $\{y|y \geq 3\}$

Example 3 (continued)

The range is
$\{y|y \geq 0\}$.

$\{y|y \geq 0\}$

$$j(x) = (x + 3)^2$$

Menu
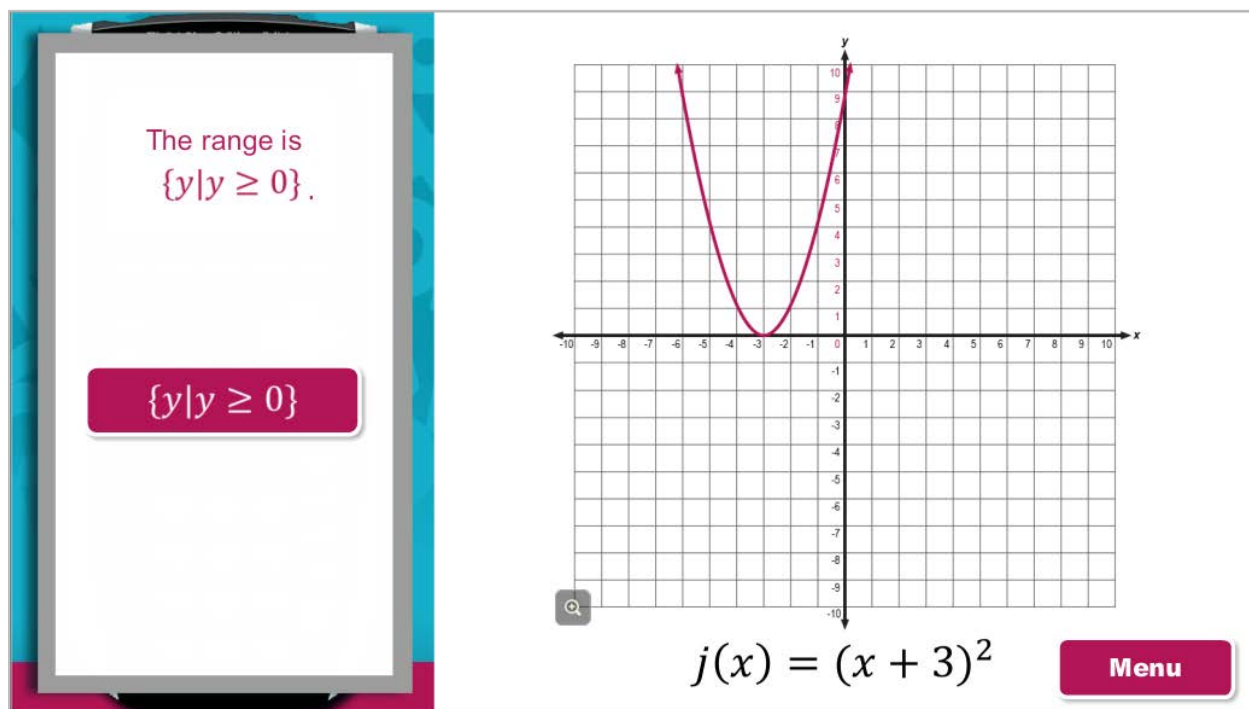
The range is the set of all real numbers greater than or equal to 0.

Self-Check 1

Self-Check
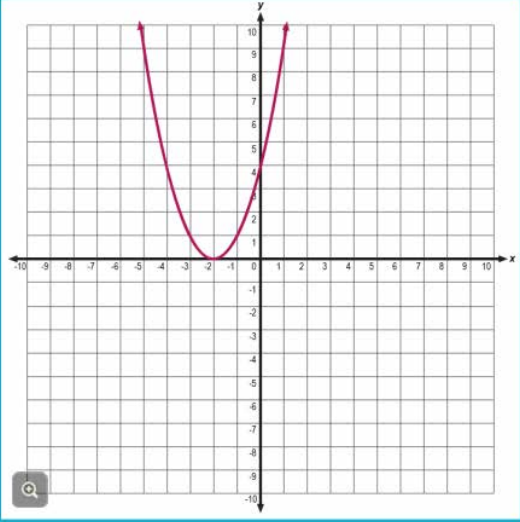
Choose the graph that represents the transformation of the quadratic parent function given by the equation

$j(x) = x^2 - 2$

○ Graph A

○ Graph B

○ Graph C

○ Graph D

SUBMIT

Graph A

CLICK HERE to view additional options.

Solve the problem in the image above to check your understanding of the content.
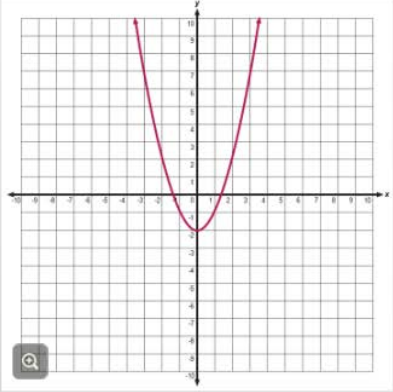
Self-Check 1: Answer

Correct

That's correct! The correct answer is Graph B.

The function $j(x) = x^2 - 2$ represents a translation of the parent function $f(x) = x^2$ two units down.

For your reference, the image above shows the correct solution to the self-check problem.
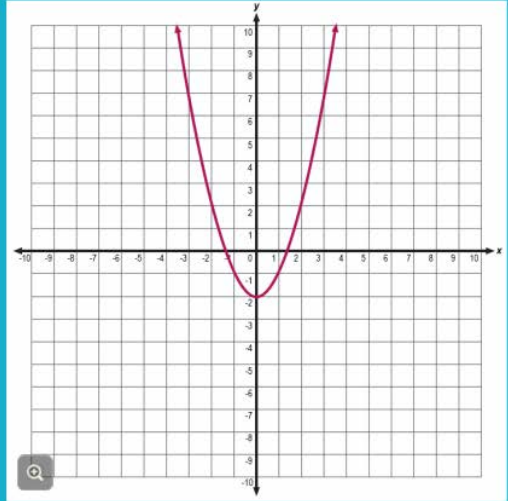
Self-Check 2

✓ **Self-Check**

Given the function: $j(x) = x^2 - 2$

Complete the statements below.

The [--Select--] is the set of all real numbers greater than or equal to –2.

The [--Select--] is the set of all real numbers.

SUBMIT

Solve the problem in the image above to check your understanding of the content.

Self-Check 2: Answer

For your reference, the image above shows the correct solution to the self-check problem.

Self-Check 3

Self-Check

Choose the correct description of the transformation of $f(x) = x^2$ given by the equation $j(x) = (x - 2)^2$.

- translated right 2 units
- translated left 2 units
- stretched by a factor of 2
- compressed by a factor of 2

SUBMIT

Solve the problem in the image above to check your understanding of the content.
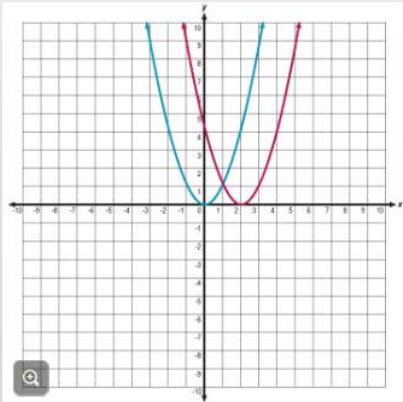
Self-Check 3: Answer

Self Check

Correct

That's correct!

The function $j(x) = (x - 2)^2$ represents a translation of the parent function $f(x) = x^2$ two units right.

Continue

SUBMIT

For your reference, the image above shows the correct solution to the self-check problem.
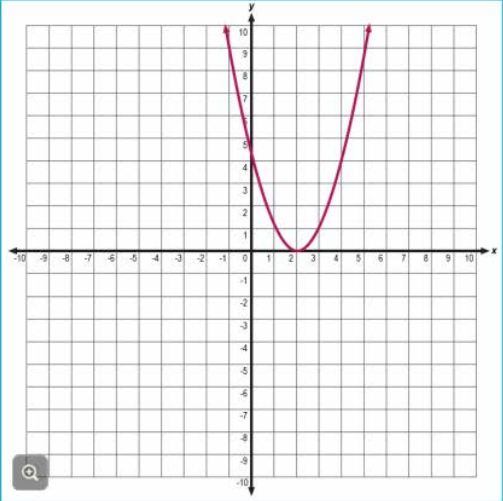
Self-Check 4

Self-Check

Given the function: $j(x) = (x - 2)^2$

Complete the statements below.

The ⎡--Select-- ▾⎤ is the set of all real numbers.

The ⎡--Select-- ▾⎤ is the set of all real numbers greater than or equal to 0.

SUBMIT

Solve the problem in the image above to check your understanding of the content.
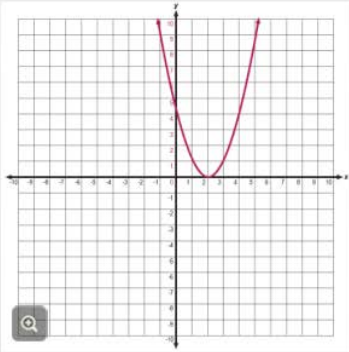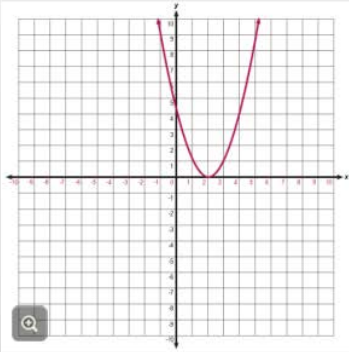
Self-Check 4: Answer

Correct

That's correct!

The domain is the set of all real numbers.
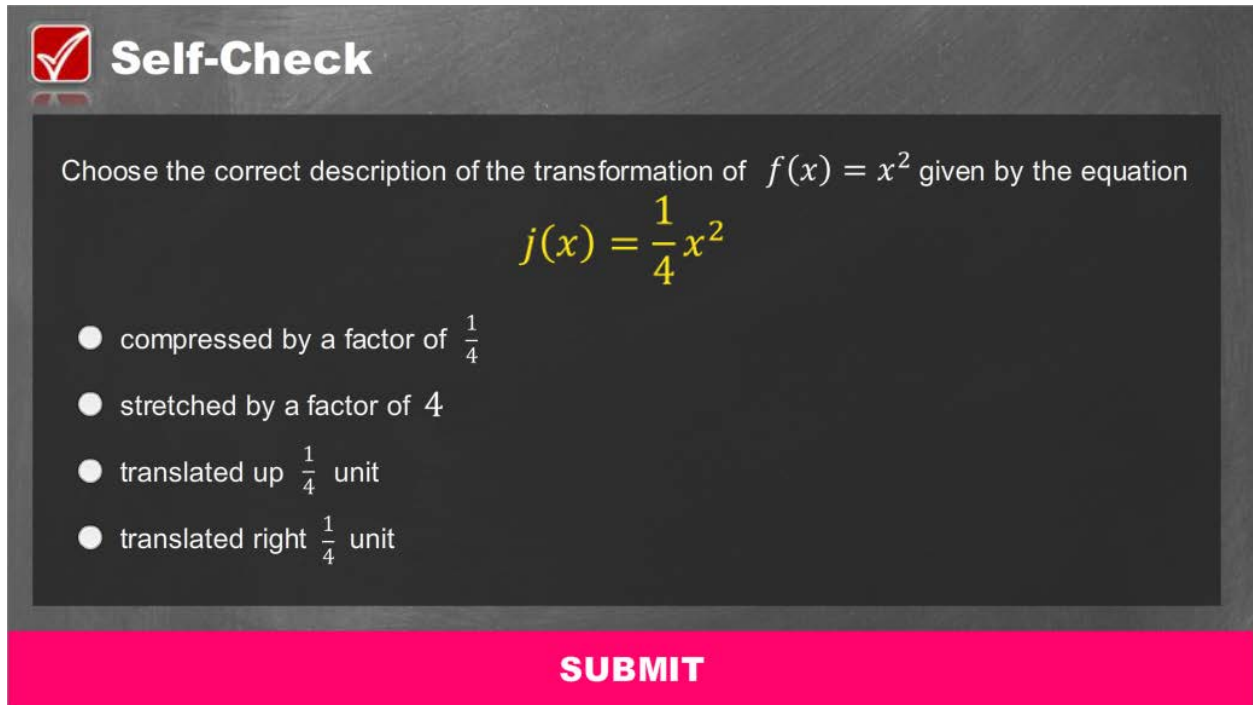
The range is the set of all real numbers greater than or equal to 0.

Continue

SUBMIT

For your reference, the image above shows the correct solution to the self-check problem.

Self-Check 5

Self-Check

Choose the correct description of the transformation of $f(x) = x^2$ given by the equation

$$j(x) = \frac{1}{4}x^2$$

- ○ compressed by a factor of $\frac{1}{4}$
- ○ stretched by a factor of 4
- ○ translated up $\frac{1}{4}$ unit
- ○ translated right $\frac{1}{4}$ unit

SUBMIT

Solve the problem in the image above to check your understanding of the content.
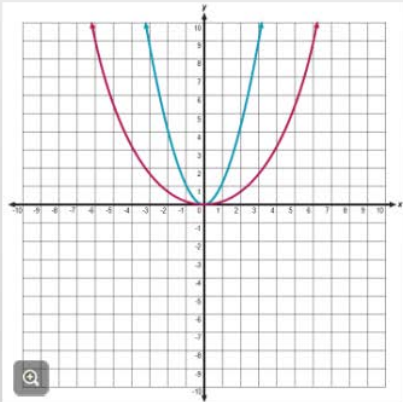
Self-Check 5: Answer

Correct

That's correct!

The function $j(x) = \frac{1}{4}x^2$ represents a compression

of the parent function $f(x) = x^2$ by a factor of $\frac{1}{4}$.

Continue

SUBMIT

For your reference, the image above shows the correct solution to the self-check problem.

Self-Check 6

Solve the problem in the image above to check your understanding of the content.

Self-Check 6: Answer

Correct

That's correct! The domain of the functions $j(x) = \frac{1}{4}x^2$ and $f(x) = x^2$ is the set of all real numbers.
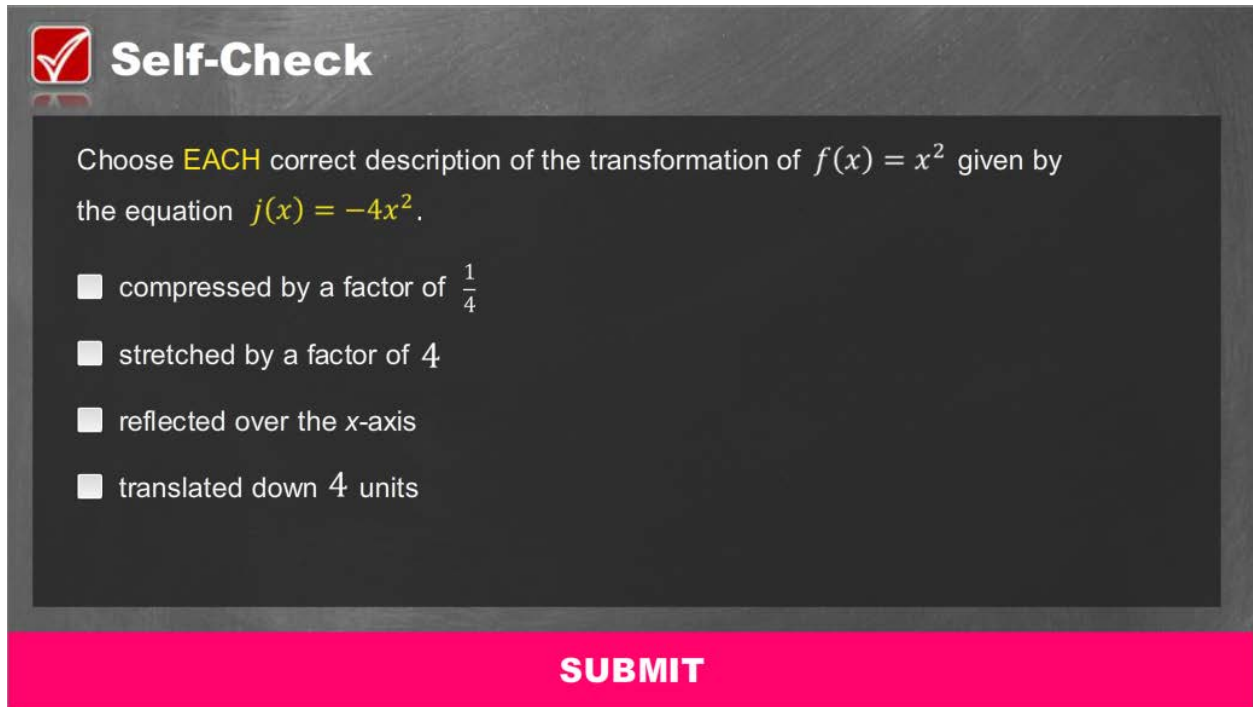
For your reference, the image above shows the correct solution to the self-check problem.

Self-Check 7

Self-Check

Choose **EACH** correct description of the transformation of $f(x) = x^2$ given by the equation $j(x) = -4x^2$.

☐ compressed by a factor of $\frac{1}{4}$

☐ stretched by a factor of 4

☐ reflected over the x-axis

☐ translated down 4 units

SUBMIT

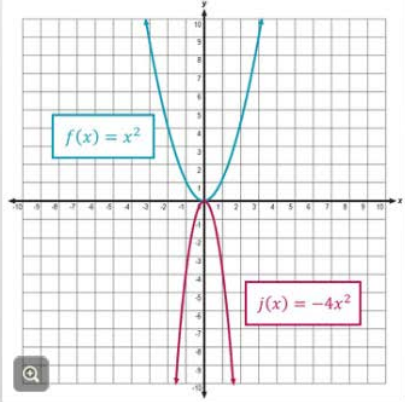Solve the problem in the image above to check your understanding of the content.

Self-Check 7: Answer

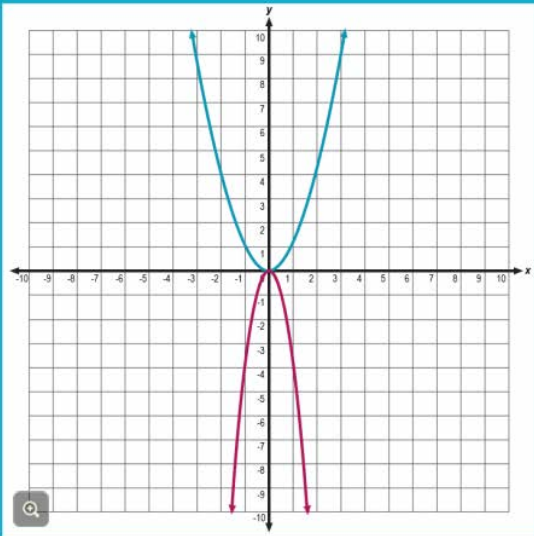For your reference, the image above shows the correct solution to the self-check problem.

Self-Check 8

Self-Check

Choose EACH correct description of the transformation of $f(x) = x^2$ given by the equation $j(x) = -4x^2$.

- ☐ The functions have the same domain.
- ☐ The functions have different domains.
- ☐ The range of each function is the same.
- ☐ The range of each function is different.

SUBMIT

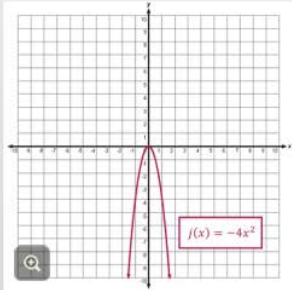Solve the problem in the image above to check your understanding of the content.

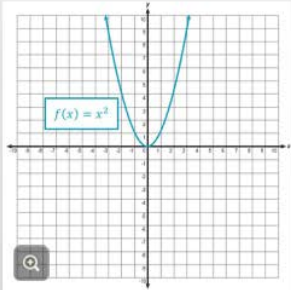Self-Check 8: Answer

Correct

That's correct! The functions have the same domain, but the range of each function is different.

$f(x) = x^2$

$j(x) = -4x^2$

Domain: the set of all real numbers
Range: $\{y|y \leq 0\}$

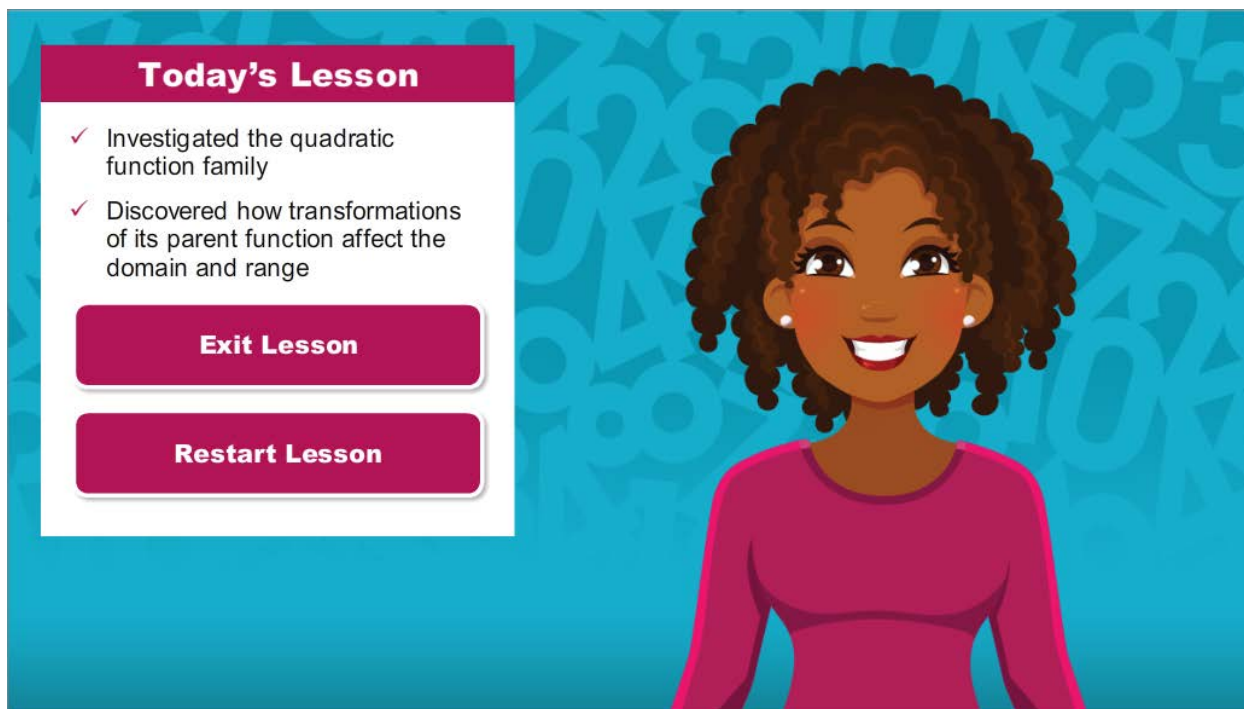Domain: the set of all real numbers
Range: $\{y|y \geq 0\}$

Continue

SUBMIT

For your reference, the image above shows the correct solution to the self-check problem.

Conclusion

You have reached the conclusion of this lesson where explored the quadratic function family and discovered how transformations of its parent function affect the domain and range.