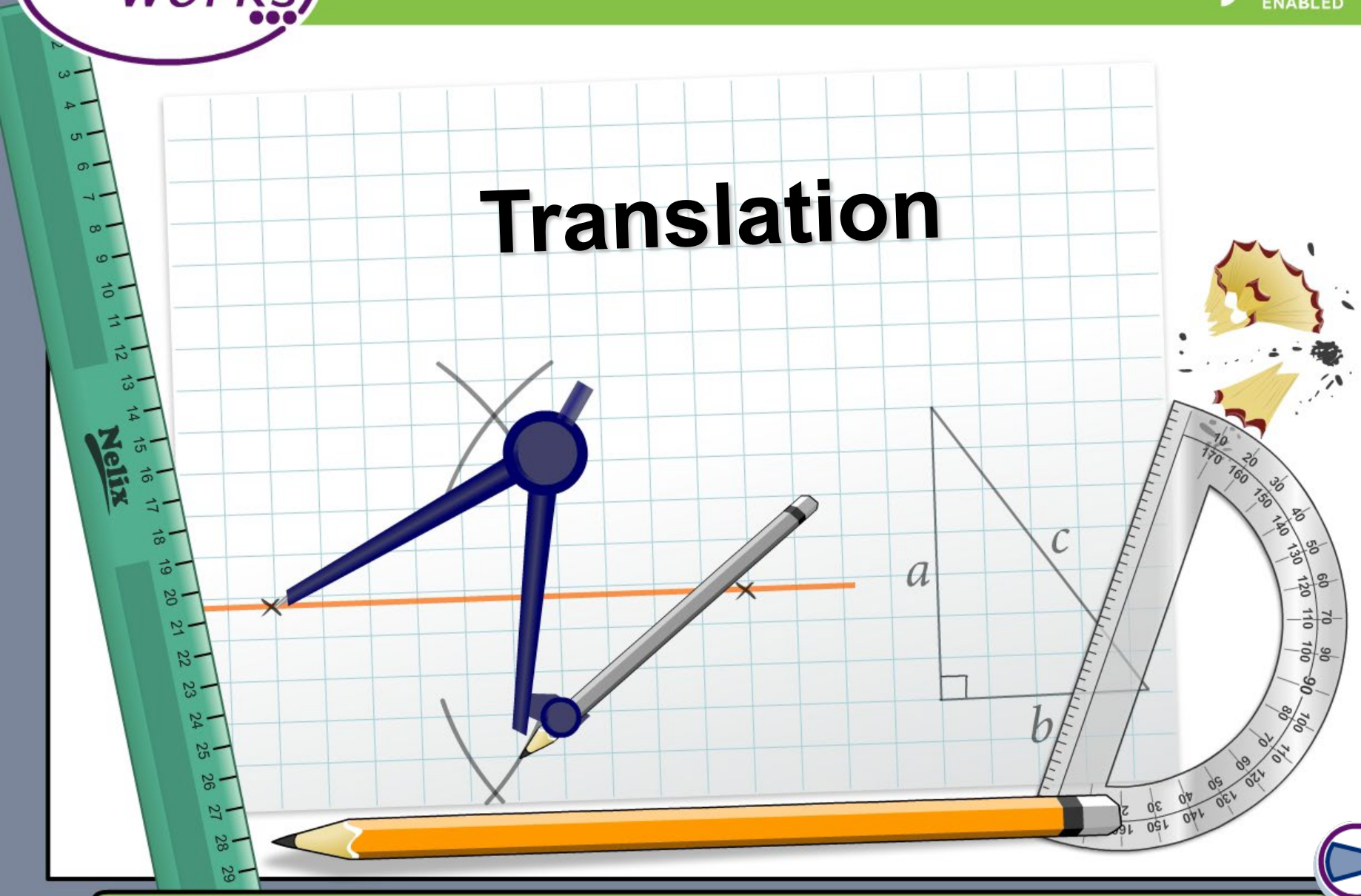
# Translation



# Information

## Common core icons

This icon indicates a slide where the Standards for Mathematical Practice are being developed. Details of these are given in the Notes field.


Slides containing examples of mathematical modeling are marked with this stamp.

This icon indicates an opportunity for discussion or group work.

The **Standards for Mathematical Practice** outlined in the Common Core State Standards for Mathematics describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

These are:

**1) Make sense of problems and persevere in solving them.**

**2) Reason abstractly and quantitatively.**

**3) Construct viable arguments and critique the reasoning of others.**

**4) Model with mathematics.**

**5) Use appropriate tools strategically.**

**6) Attend to precision.**

**7) Look for and make use of structure.**

**8) Look for and express regularity in repeated reasoning.**

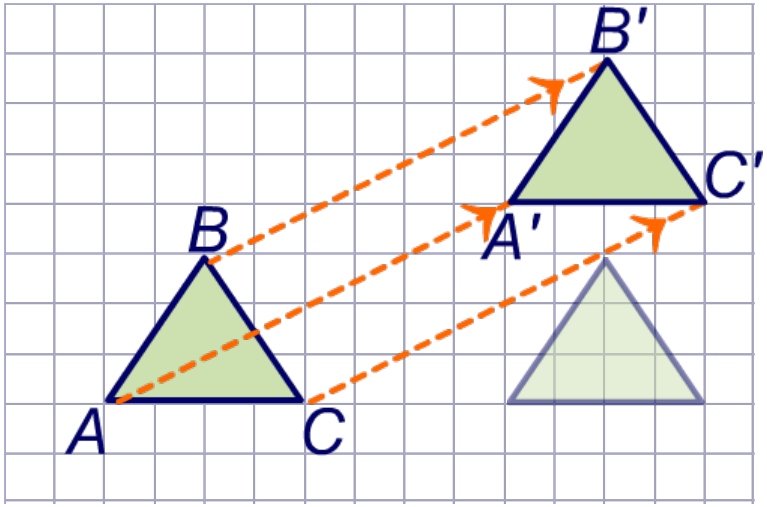
This icon indicates that the slide contains activities created in Flash. These activities are not editable.

This icon indicates teacher's notes in the Notes field.

# Translation

A **translation** is a transformation that moves all of the points in an object the same distance in a given direction.

For example, we can translate $\triangle ABC$ 8 squares to the right and 4 squares up to get triangle $\triangle A'B'C'$.




Every point in the shape moves the same distance in the same direction.

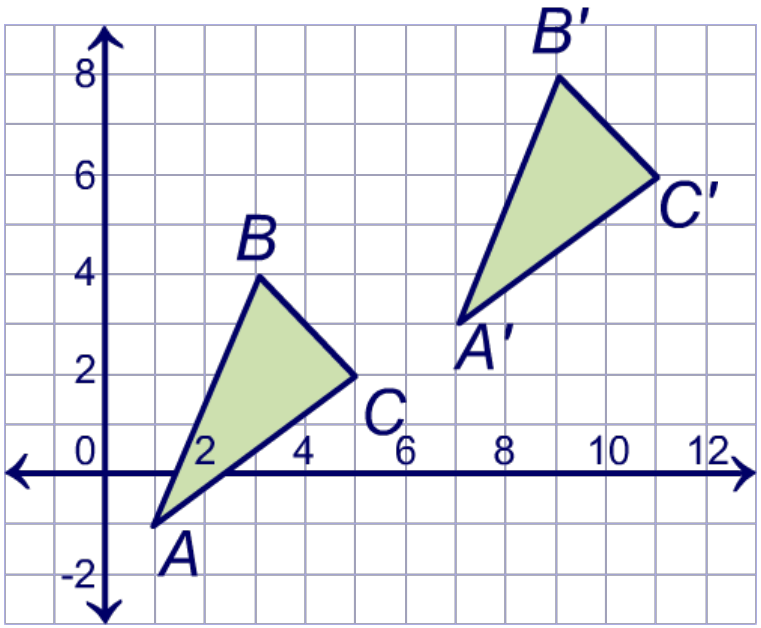
We can describe this translation using the vector $\langle 8, 4 \rangle$.

across up

# Translation in the coordinate plane

Objects on a coordinate plane are translated by changing the $x$- and $y$- coordinates of every point by the same values.

**Translate $\triangle ABC$ with vertices $A(1, -1)$, $B(3, 4)$, and $C(5, 2)$ by the vector $\langle 6, 4 \rangle$.**




$A'\ (1 + 6, -1 + 4) = (7, 3)$

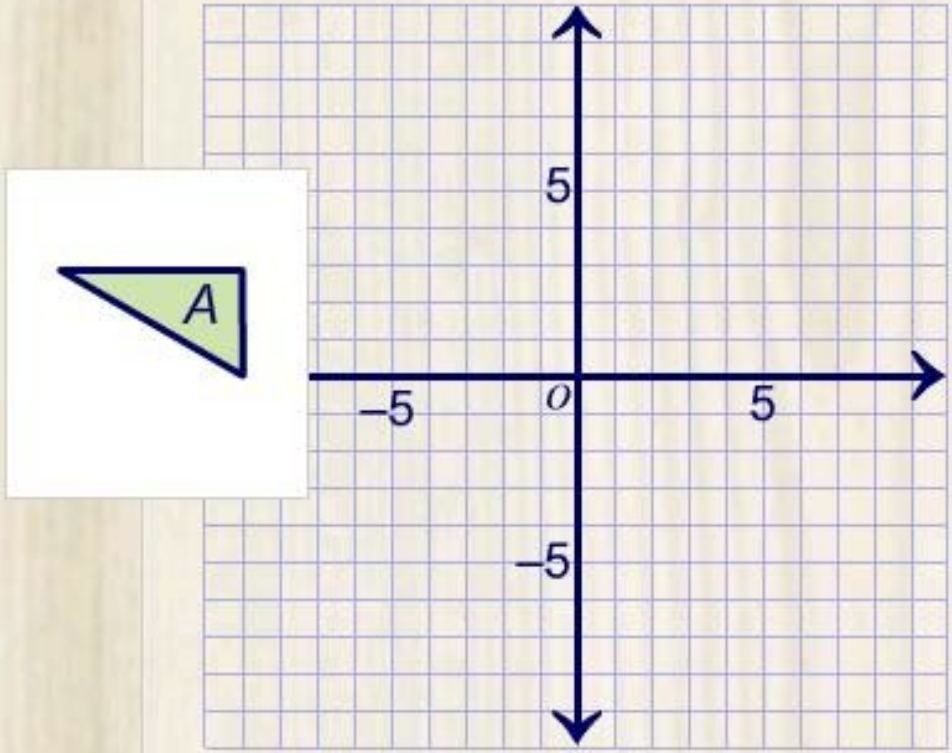
$B'\ (3 + 6, 4 + 4) = (9, 8)$

$C'\ (5 + 6, 2 + 4) = (11, 6)$

## Drawing a translation

A translation occurs when an object is moved the length and direction of a vector.

Press **play** to see how to construct a translation using a coordinate grid on tracing paper.



# Translation in chess

Each chess piece can move along certain vectors.

- The king can move one space in any direction: horizontal, vertical, or diagonal.
- The knight can move two spaces, horizontal or vertical, followed by one space, horizontal or vertical.
- The rook can move unlimited spaces either horizontal or vertical.
- The bishop can move unlimited spaces diagonally.

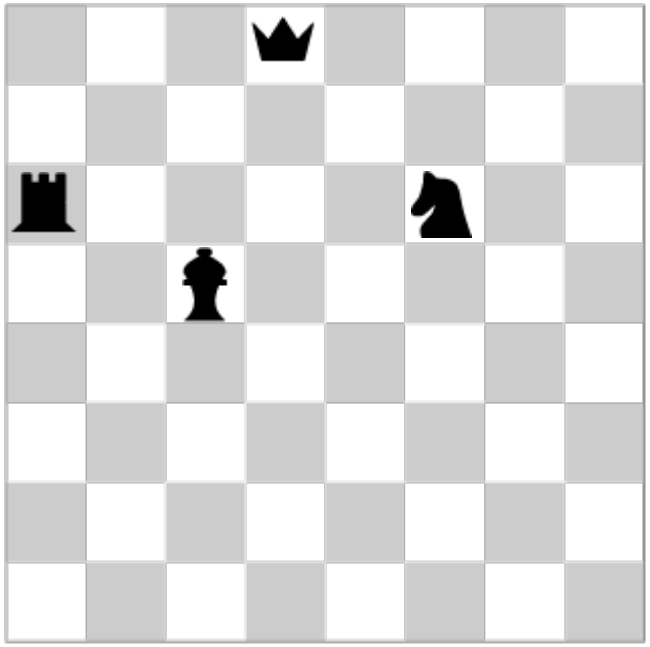
**Describe possible vectors for each piece.**

- $\langle 0, 1 \rangle$, $\langle 1, 0 \rangle$, $\langle 1, 1 \rangle$
- $\langle 1, 2 \rangle$, $\langle 2, 1 \rangle$
- $\langle 0, x \rangle$, $\langle y, 0 \rangle$
- $\langle a, a \rangle$

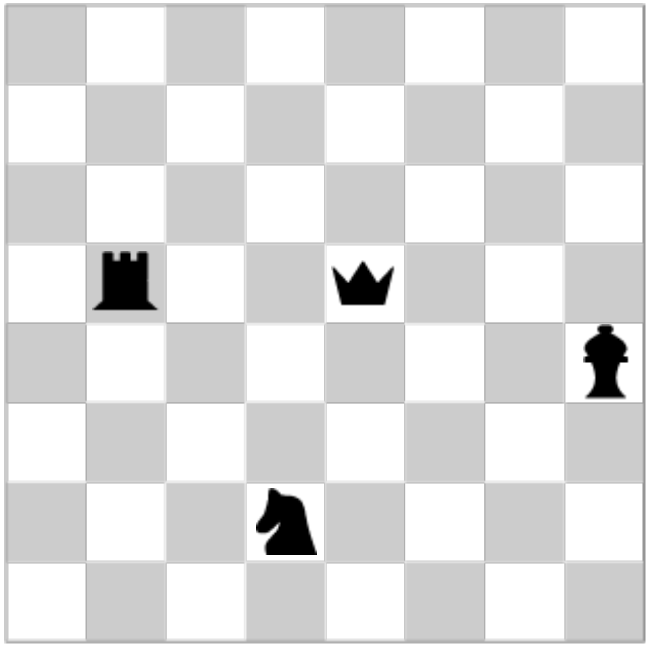
# Translation in chess

**Describe all the translations that could occur for the pieces on board 1 to get to their position on board 2 in one move.**

Board 1



Board 2



**What space could each piece on board 2 move to next?**

# Congruency

The image of a translated object is congruent to the object.

**$\overline{AB}$ has been translated by vector $\vec{v}$ $\langle 4, -2 \rangle$ to create $\overline{A'B'}$. Prove that $\overline{AB} \cong \overline{A'B'}$.**

use the Pythagorean theorem to find $A'B'$:

$$(A'B')^2 = 3^2 + 3^2$$

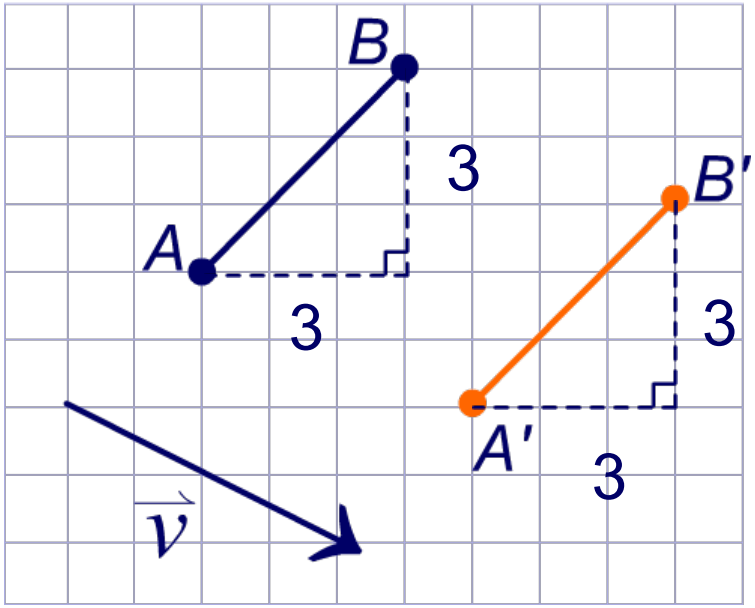
$$A'B' = \sqrt{18}$$

use the same method to find $AB$:

$$(AB)^2 = 3^2 + 3^2$$

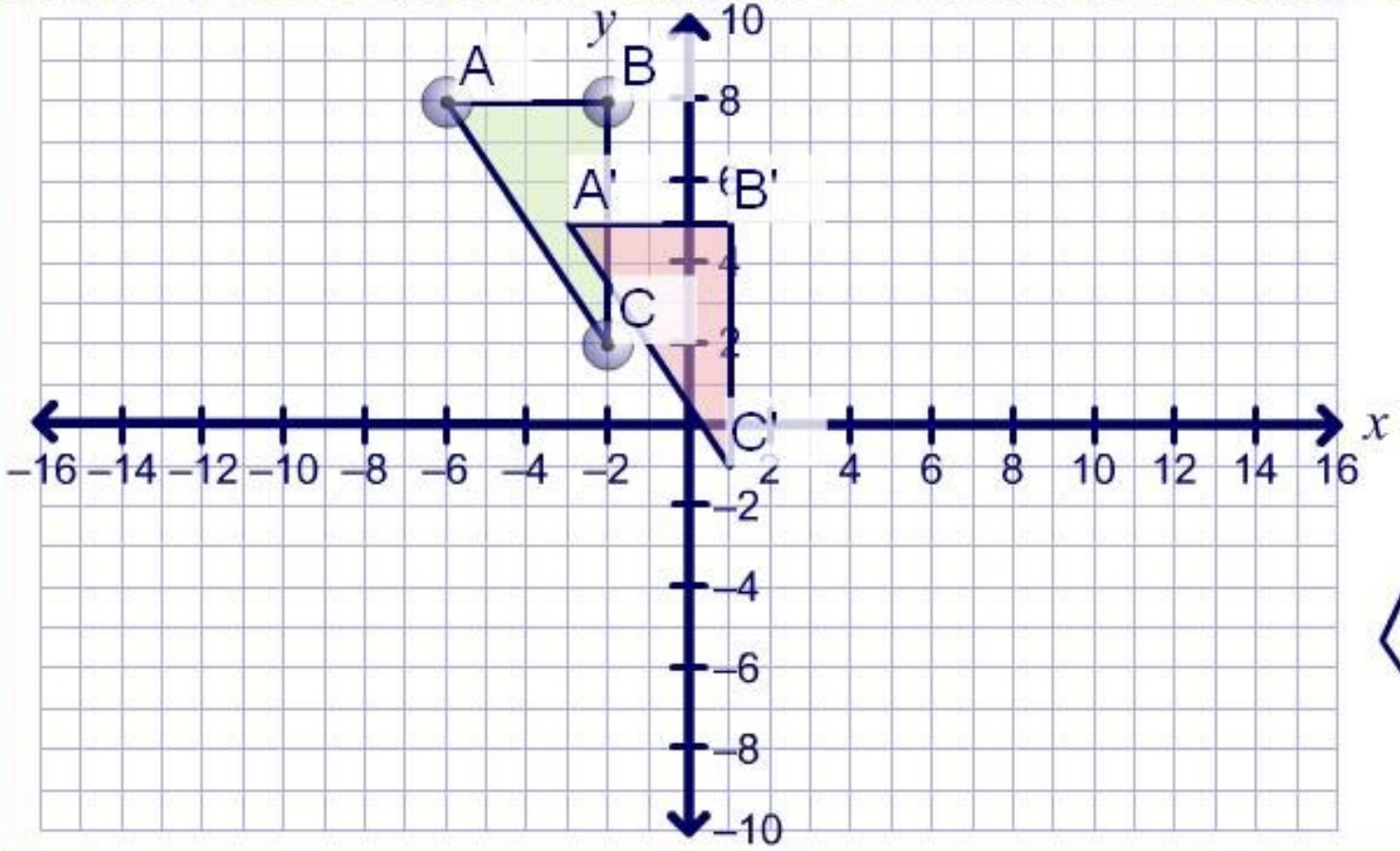
$$AB = \sqrt{18}$$

$$\overline{AB} \cong \overline{A'B'} \checkmark$$



# Translations in the coordinate plane

Drag the points to adjust the triangle. Press the arrows to change the translation.



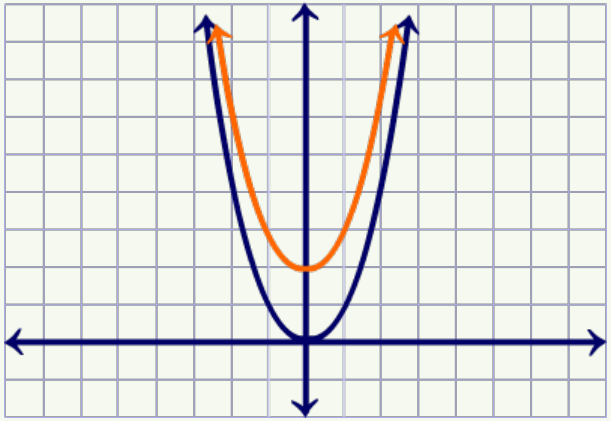

3 , -3

# Translating functions

When a function is translated, the equation of the new graph is found as follows:

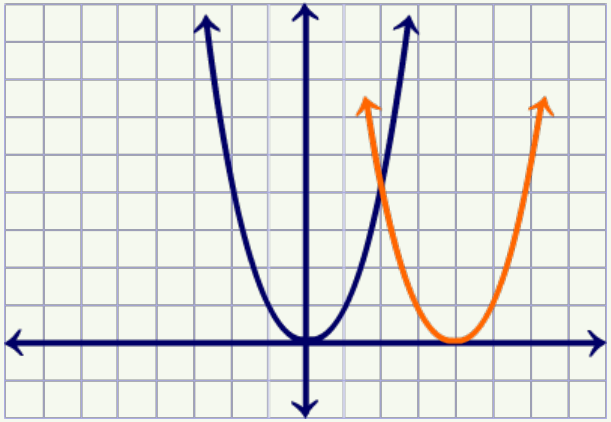
## vertical translation

$$y = f(x) + k$$



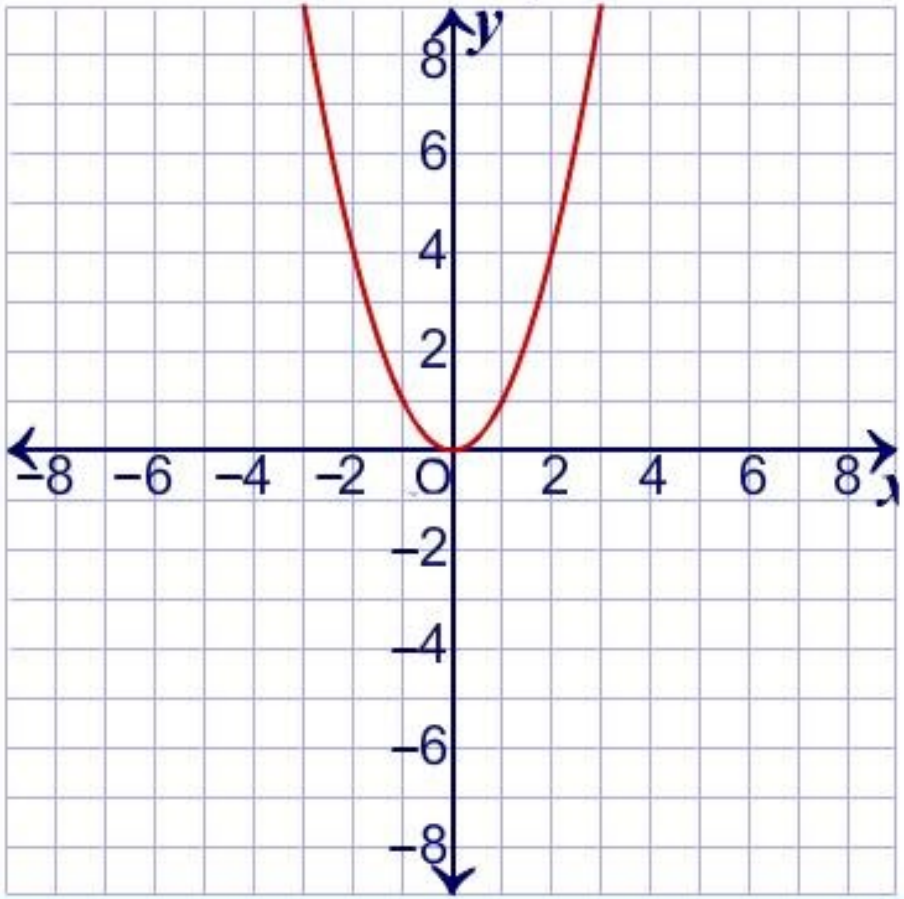
## horizontal translation

$$y = f(x - h)$$



# Translating functions

## Alter the equations to translate the function.




$$y = (x + 0)^2 + 0$$

# Translating functions

A translated function will have a new equation.

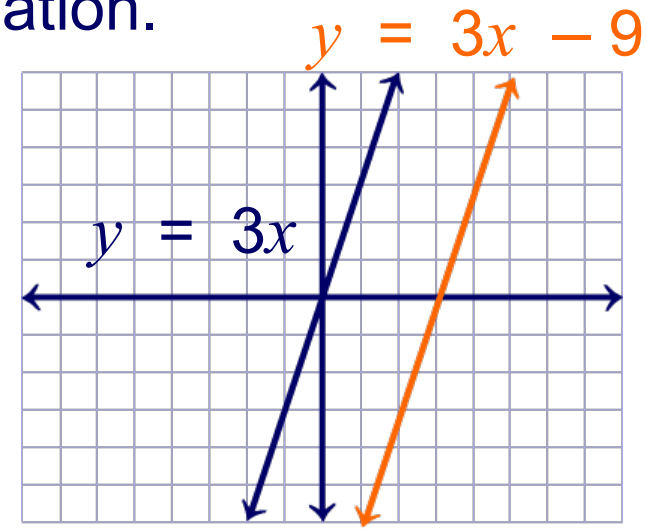
**Translate the graph $y = 3x$ in the $x$-direction by 3. What is the equation of the translated function?**

find the new $x$-intercept:

$0 = 3(3) + b$

$b = -9$

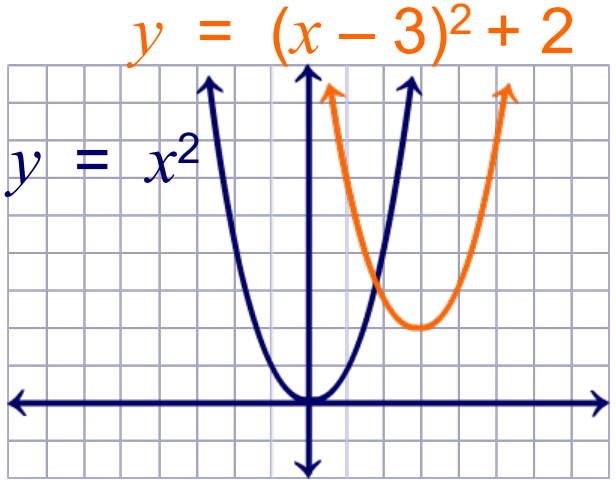
$y = 3x - 9$




**Translate the graph $y = x^2$ along the vector $\langle 3, 2 \rangle$. What is the equation for the translated function?**

$(y - 2) = (x - 3)^2$

$y = (x - 3)^2 + 2$



## Translating Functions

**Question: 1/3**

The graph of the function $f(x) = (x + 1)^2 - 2$ is translated by the vector $\langle 3, 9 \rangle$. What is the new equation?

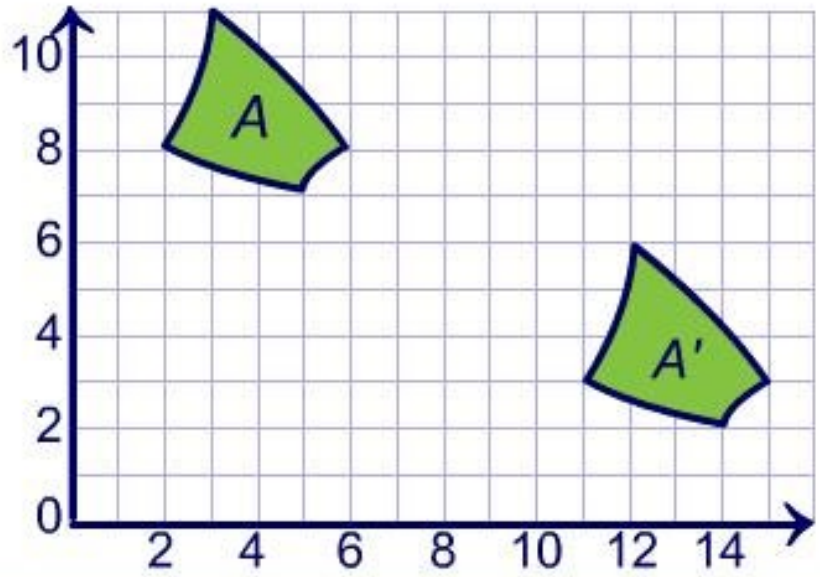
$$y = (x + \square)^2 + \square$$

*type the answer*
*in the boxes above*

## Translations summary

**Question: 1/3**

Figure $A$ has been translated. What is the vector that maps figure $A$ onto $A'$?




$\langle \square, \square \rangle$

*type the answer in the boxes above*