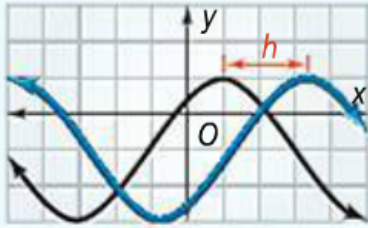


## 13-7 Translating Sine and Cosine Functions

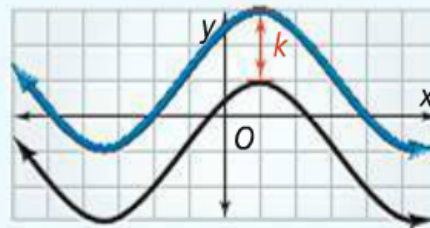
**Essential Understanding** You can translate periodic functions in the same way that you translate other functions.

### Phase Shift



$g(x)$ : horizontal translation of  $f(x)$   
 $g(x) = f(x - h)$

### Vertical Shift



$h(x)$ : vertical translation of  $f(x)$   
 $h(x) = f(x) + k$

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take note

### Concept Summary Families of Sine and Cosine Functions

#### Parent Function

$$y = \sin x$$

$$y = \cos x$$

#### Transformed Function

$$y = a \sin b(x - h) + k$$

$$y = a \cos b(x - h) + k$$

- $|a|$  = amplitude (vertical stretch or shrink)
- $\frac{2\pi}{b}$  = period (when  $x$  is in radians and  $b > 0$ )
- $h$  = phase shift, or horizontal shift
- $k$  = vertical shift ( $y = k$  is the midline)

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**Ex.1 Describe any phase shifts and/or vertical shifts.**

a.  $y = \cos(x + 4)$   
 ↳ left 4

b.  $y = \sin x - 3$   
 ↳ down 3

c.  $y = \cos(x - 2) + 7$   
 ↳ right 2, up 7

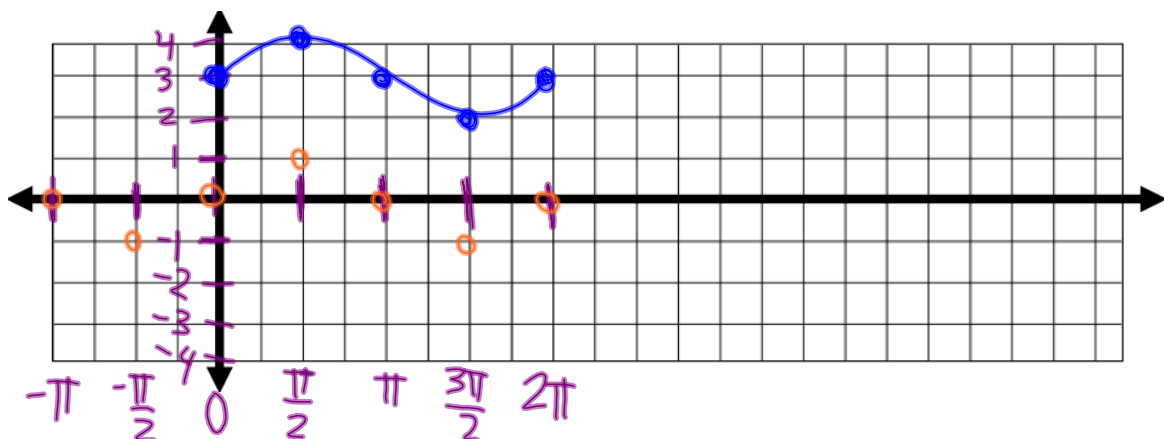
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**Ex.2 Using the graph of the parent function  $y = \sin x$  or  $y = \cos x$ , graph each translation in the interval  $0$  to  $2\pi$ .**

$$y = \sin x + 3$$

Period:  $\frac{2\pi}{b} = \frac{2\pi}{1} = 2\pi$

↳  $b=1$  up 3

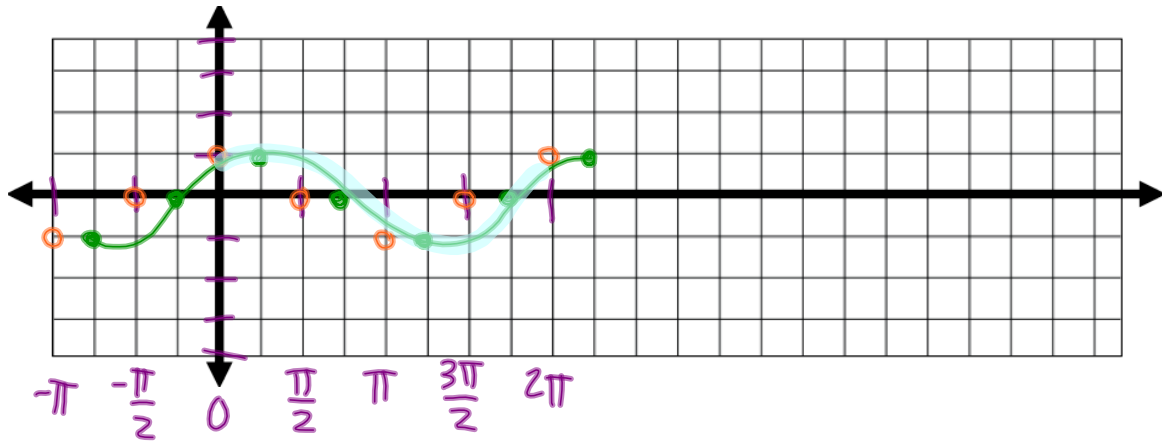


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**Ex.3** Using the graph of the parent function  $y = \sin x$  or  $y = \cos x$ , graph each translation in the interval  $0$  to  $2\pi$ .

$$y = \cos\left(x - \frac{\pi}{4}\right)$$

Phase Shift: Right  $\frac{\pi}{4}$   
(one block right)

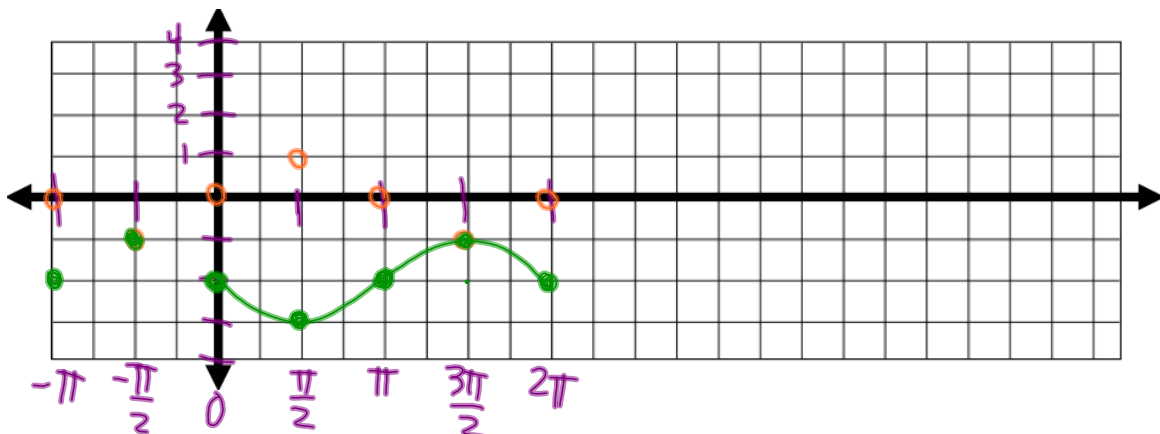


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**Ex.4** Using the graph of the parent function  $y = \sin x$  or  $y = \cos x$ , graph each translation in the interval  $0$  to  $2\pi$ .

$$y = \sin(x + \pi) - 2$$

down 2 blocks)  
left  $\pi$  (left 4 blocks)



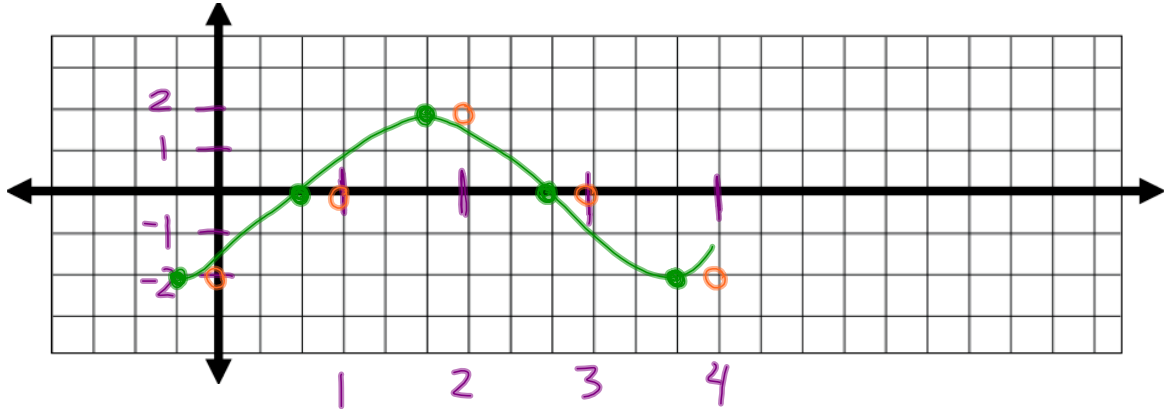
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**Ex.6 Graph one cycle. (LEVEL 4)**

$$y = -2 \cos\left(\frac{\pi}{2}\left(x + \frac{1}{3}\right)\right)$$

left  $\frac{1}{3}$  (left one block)

Period:  $\frac{2\pi}{b} = \frac{2\pi}{\frac{\pi}{2}} = 4 \div 4 = 1$



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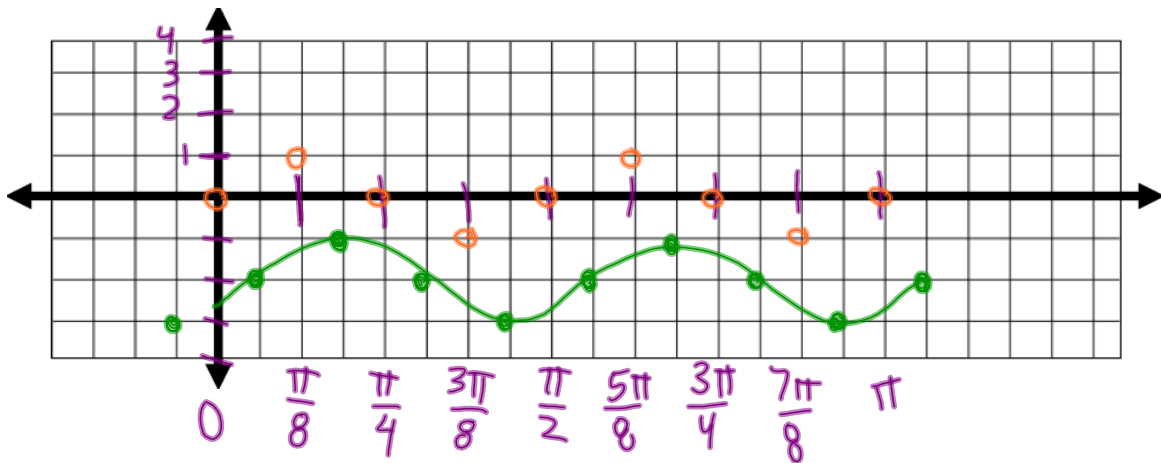
**Ex.5 Graph in the interval 0 to 1pi. (LEVEL 4)**

$$y = \sin\left(4\left(x - \frac{\pi}{16}\right) - 2\right)$$

Right  $\frac{\pi}{16}$  (one block)

Down 2 blocks

$P = \frac{2\pi}{4} = \frac{\pi}{2} \div 4 = \frac{\pi}{8}$



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**HW:**

**p.880:**

**1,3,18,21,26,28 - 31 all,  
33,55,56,57**

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