# 8A.3: Applications of Sinusoids

The Sine and Cosine functions are oscillating functions that are used for modeling real life situations that involve repetition or circular-type motion. To make a sine or cosine model function, we must keep in mind the key characteristics of these curves.

**Characteristics of Sine and Cosine Curves**

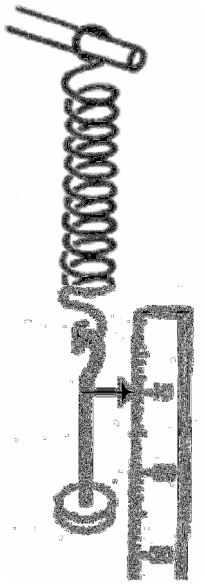
For **both** $f(x) = a\sin(bx + c) + d$ and $g(x) = a\cos(bx + c)$, we have

$$Amplitude = |a|, \qquad Period = \frac{2\pi}{|b|}, \qquad Frequency = \frac{|b|}{2\pi}$$

*Consider This:*

A spring is mounted on a stand with a weight attached to it. At its maximum height ($M$), the spring is 50 cm from the ground. At its minimum height ($m$), the spring is 10 cm from the ground. When the spring is released, it takes 1 second for one complete cycle of the spring.

Write a function $h(t)$ to model the height of the weight in $cm$ at time $t$ in seconds.



**Modeling with Sine or Cosine Functions**

From the problem, we first determine maximum ($M$) and minimum ($m$) values, and the period ($p$). Then calculate the parameters of the function:

1. Determine amplitude: $A = \frac{1}{2}(M - m)$.
2. Determine vertical shift: $C = \frac{1}{2}(M + m)$.
3. Determine horizontal stretch factor: $B = \frac{2\pi}{p}$
4. Choose the appropriate sinusoid and phase shift ($T$)

   $f(t) = A\cos(B(t - T)) + C, \qquad or\ f(t) = A\sin(B(t - T) + C$

   *(If necessary, you may make A negative.)*

## Ocean Tides

On February 25th, 2015, the tides at Brookings, Oregon are shown in the table below.

| Day | Low | High | Moon | Sunrise | Sunset |
|---|---|---|---|---|---|
| Wed 25 | 11:23 AM PST / 0.77 ft | 5:45 PM PST / 5.07 ft | First Quarter | 6:58 AM PST | 6:02 PM PST |

Assuming that the depth of the water is a sinusoidal function of time,

**a)** Find a function to model the tides if midnight is time $t = 0$.

**b)** What will the approximate depth of the water be at 12 pm?

**c)** When is the first time that the tide will be 3 feet deep?