A Pendulum as Simple Harmonic Motion
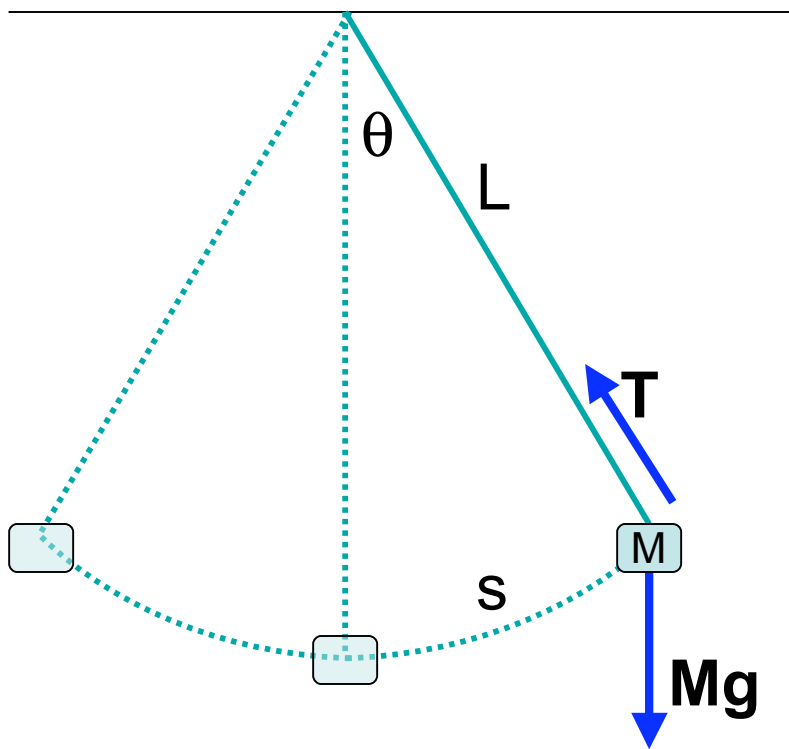

Mass **M** is not moving along string direction
Equilibrium in string direction: $T = Mg\cos\theta$

Mass **M** is accelerating perpendicular to string
$$Mg\sin\theta = Ma_s = -M(d^2s/dt^2)$$
$$s = L\theta$$
$$g\sin\theta = -L(d^2\theta/dt^2)$$
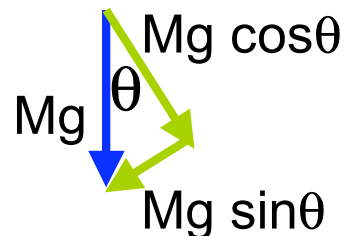$$d^2\theta/dt^2 = -(g/L)\sin\theta$$
Not exactly a restoring force equation
Make the small angle approx. $\sin\theta = \theta$
$$d^2\theta/dt^2 = -(g/L)\theta$$
Solution: $\theta(t) = \theta_m\cos(\omega t + \phi)$
with $\omega^2 = g/L$
Simple harmonic motion for a pendulum

Resolving the weight force **Mg**
1) Component along the string direction
2) Component perpendicular to the string