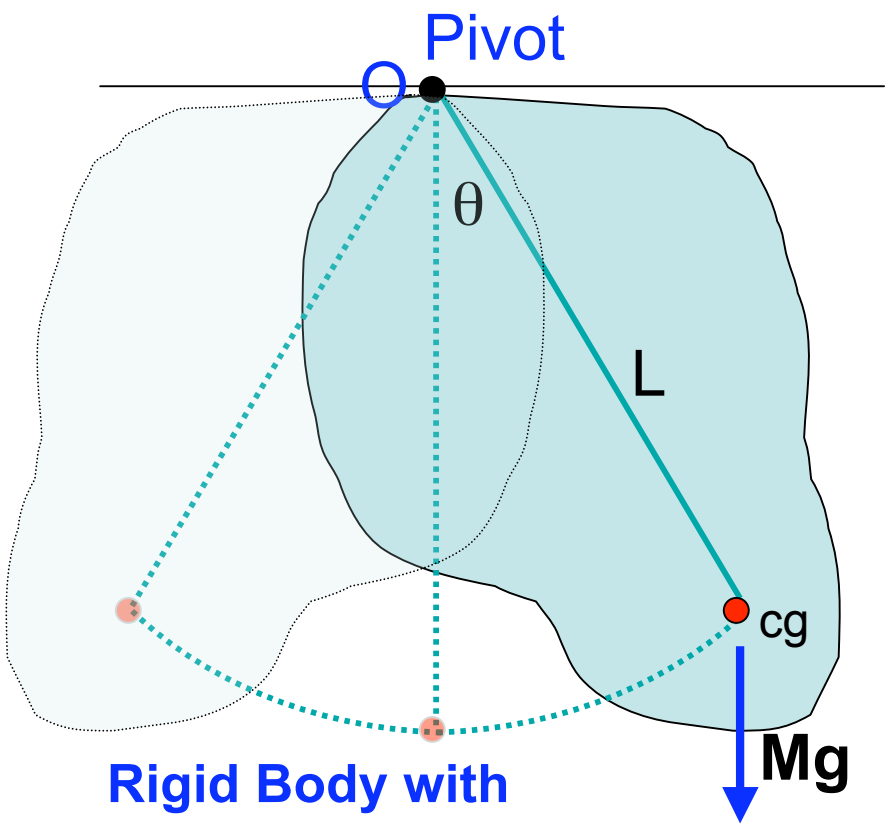
A *Physical* Pendulum as Simple Harmonic Motion



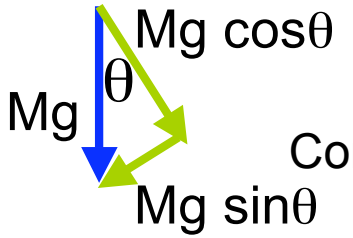
Rigid Body with Mass M and Moment of Inertia I CG is L Away from O

Rigid body with Mass **M** and **cg** fixed location
CG is rotated by an angle θ wrt vertical
Rigid body will rotate about a pivot point **O**
Rotation is due to torque τ from weight
The component of weight Mg $\sin\theta$ gives τ

$$\tau = -Mg \sin\theta L = I\alpha = -I\,(d^2\theta/dt^2)$$
$$d^2\theta/dt^2 = -(MgL/I)\sin\theta$$

Not exactly a restoring force equation
Make the small angle approx. $\sin\theta = \theta$
$$d^2\theta/dt^2 = -(MgL/I)\theta$$

Solution: $\theta(t) = \theta_m \cos(\omega t + \phi)$
with $\omega^2 = MgL/I$
SHM for a *physical* pendulum



Resolving the weight force **Mg**
Component perpendicular to **L** provides τ