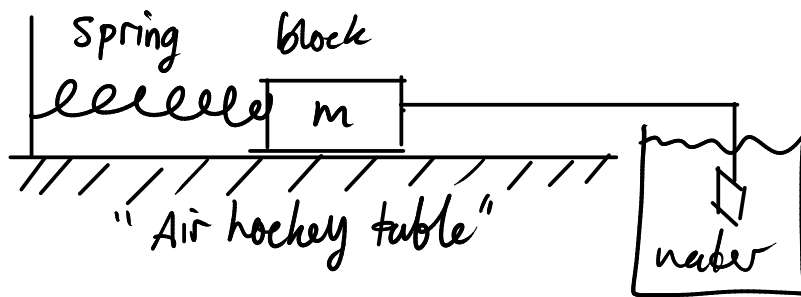


# The Damped Oscillator

This is a simple physical system that illustrates all of the mathematical phenomena

## The apparatus



This is called a "dashpot"

The block slides left and right, the spring exerts a restoring force, while the dashpot exerts a damping force.

$m$  = mass of block

$x$  = displacement from equilibrium

$k$  = spring constant

Spring force =  $-kx$

$c$  = damping coefficient

damping force =  $-cV = -c \frac{dx}{dt}$

Newton says  $ma = -kx - cV$

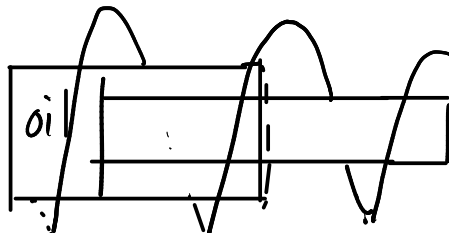
or  $ma + cV + kx = 0$

or  $m \frac{dx^2}{dt^2} + c \frac{dx}{dt} + kx = 0$

or  $m x'' + c x' + kx = 0$

This is a second-order linear homogeneous constant coefficient differential equation.

Real world  
Shock  
absorber



Spring is wrapped around piston