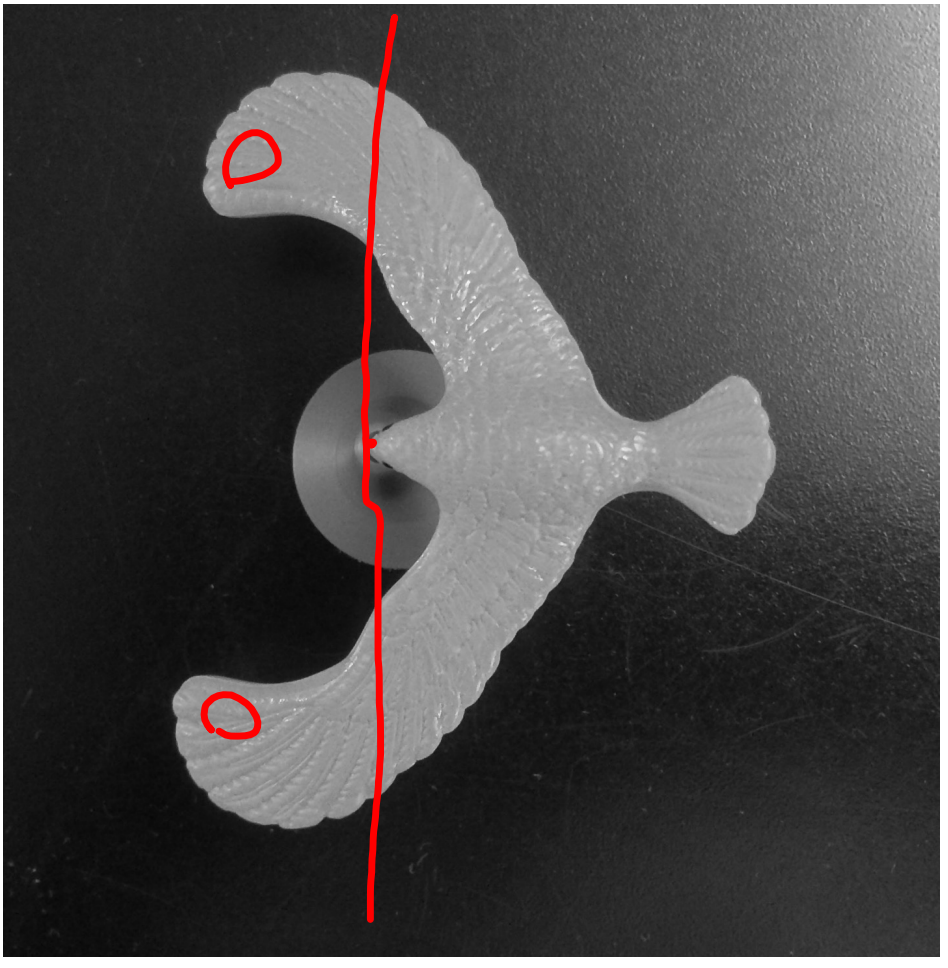


CM of an object can be calculated from the mass and position of the pieces.

$$X_{CM} = \frac{m_1 x_1 + m_2 x_2 + \cdots}{M_{Total}}$$

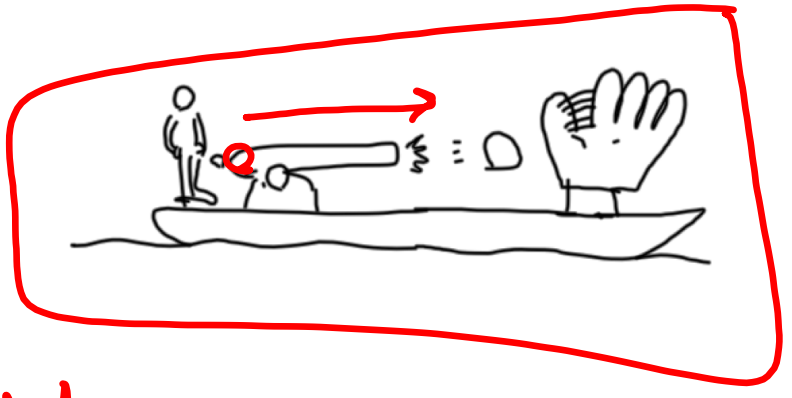
CM and The Laws of Motion

A system of objects can interact and push on each other...

but they can't change the position of their CM...

unless there's an external force (a force from an object outside the system.)

The Old 3rd Law Conundrums



You are stuck on frictionless ice. No help is coming, and the ice is so hard, you can't dig into it.

How do you escape?

Lucky you wore your hat & scarf - it's cold!

Systems Thinking: Deep Thoughts

Does the Moon orbit the Earth?

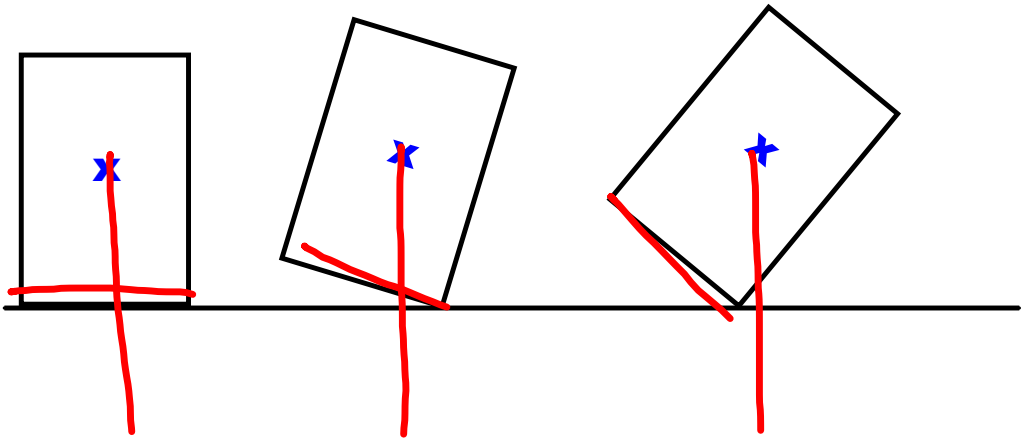
When you pick up a ball, what must happen to the Earth?

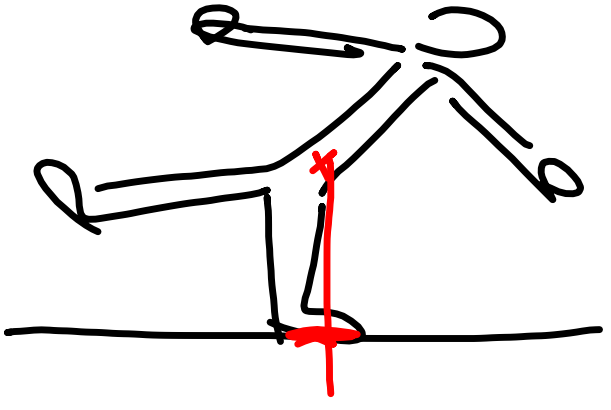
When a tree grows, what must happen to the Earth?

(heading toward a conservation law)

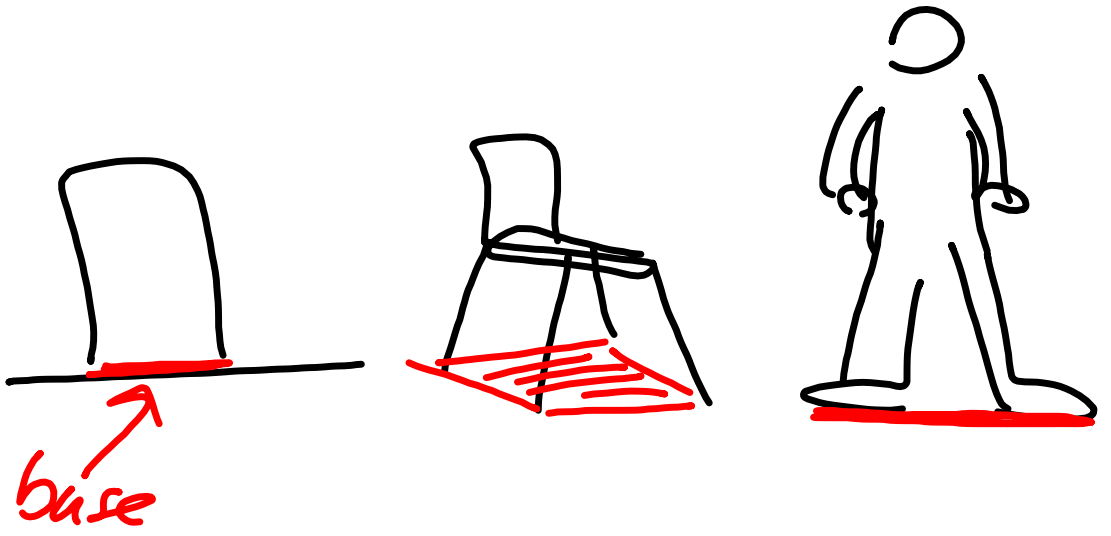
When do objects topple over?

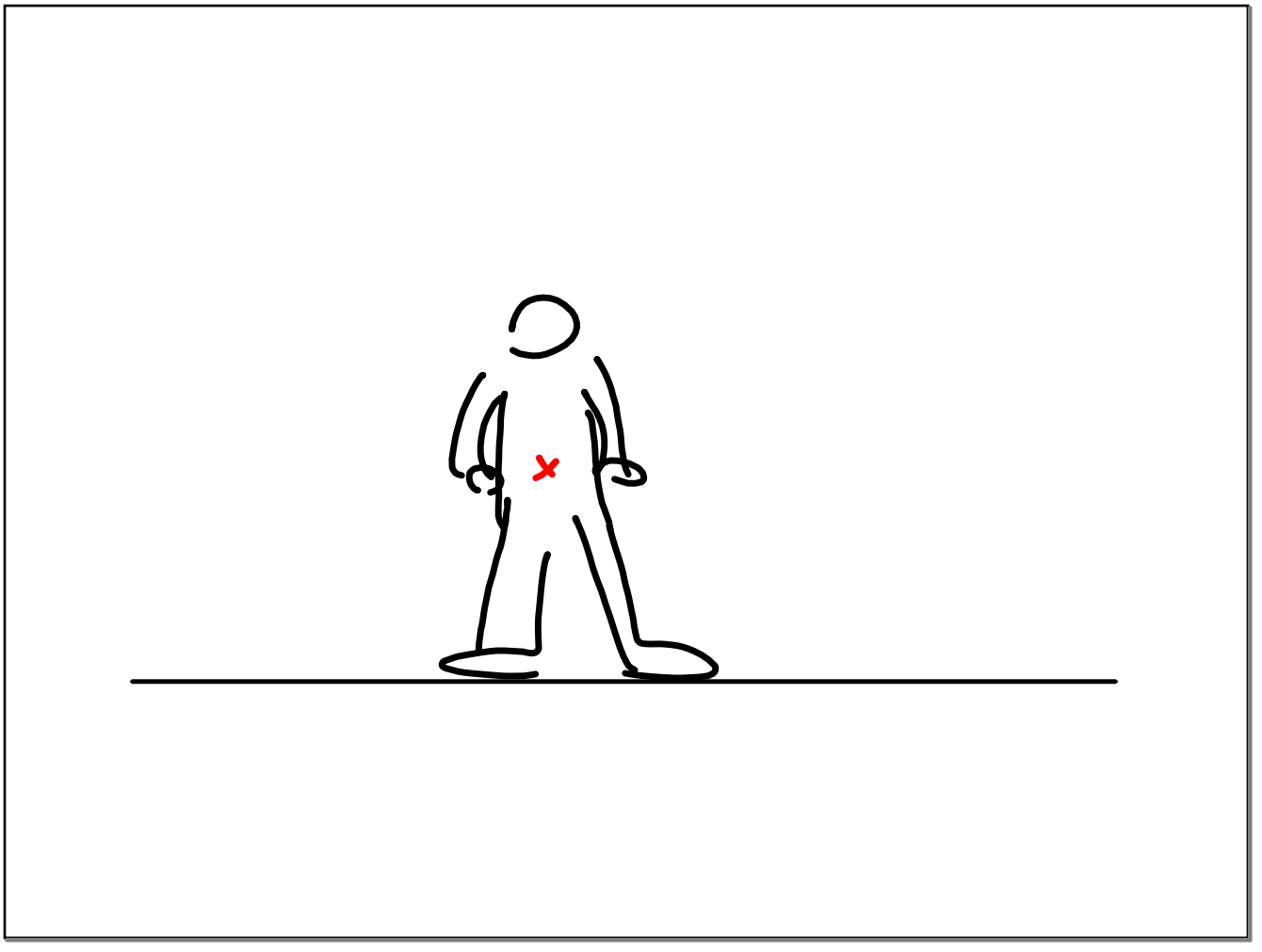
Things topple over when the center of mass is NOT over the BASE.

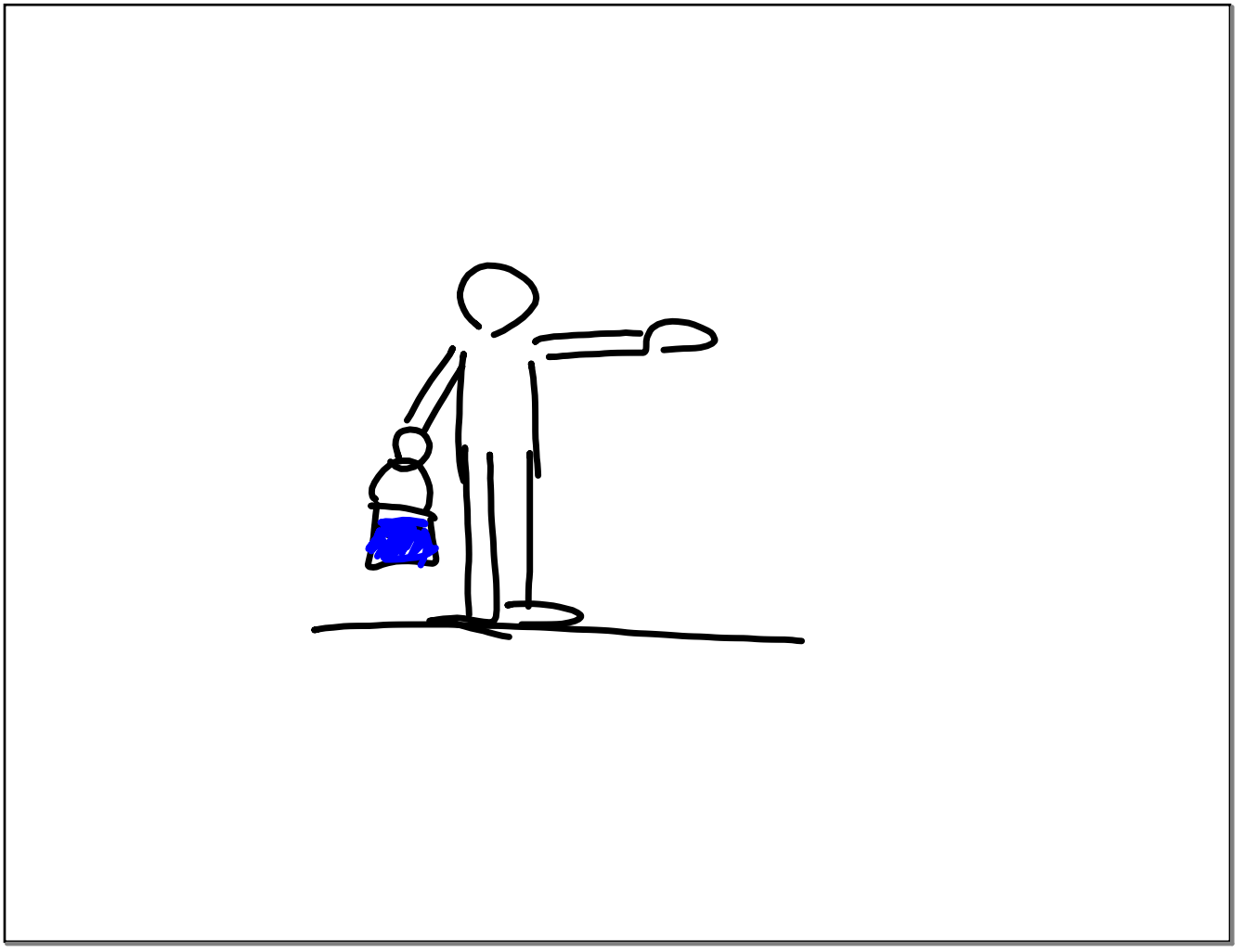




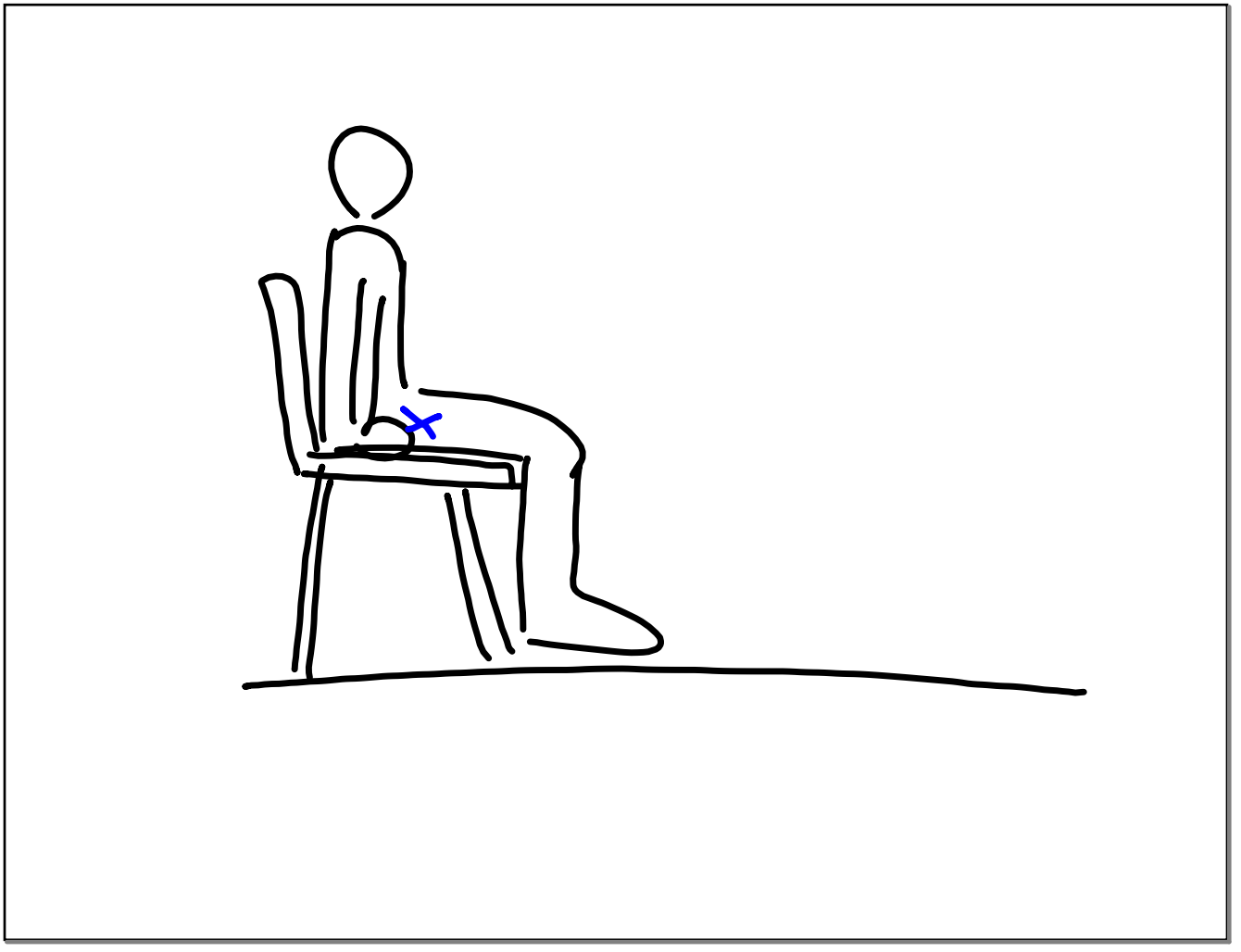
The Base of an Object

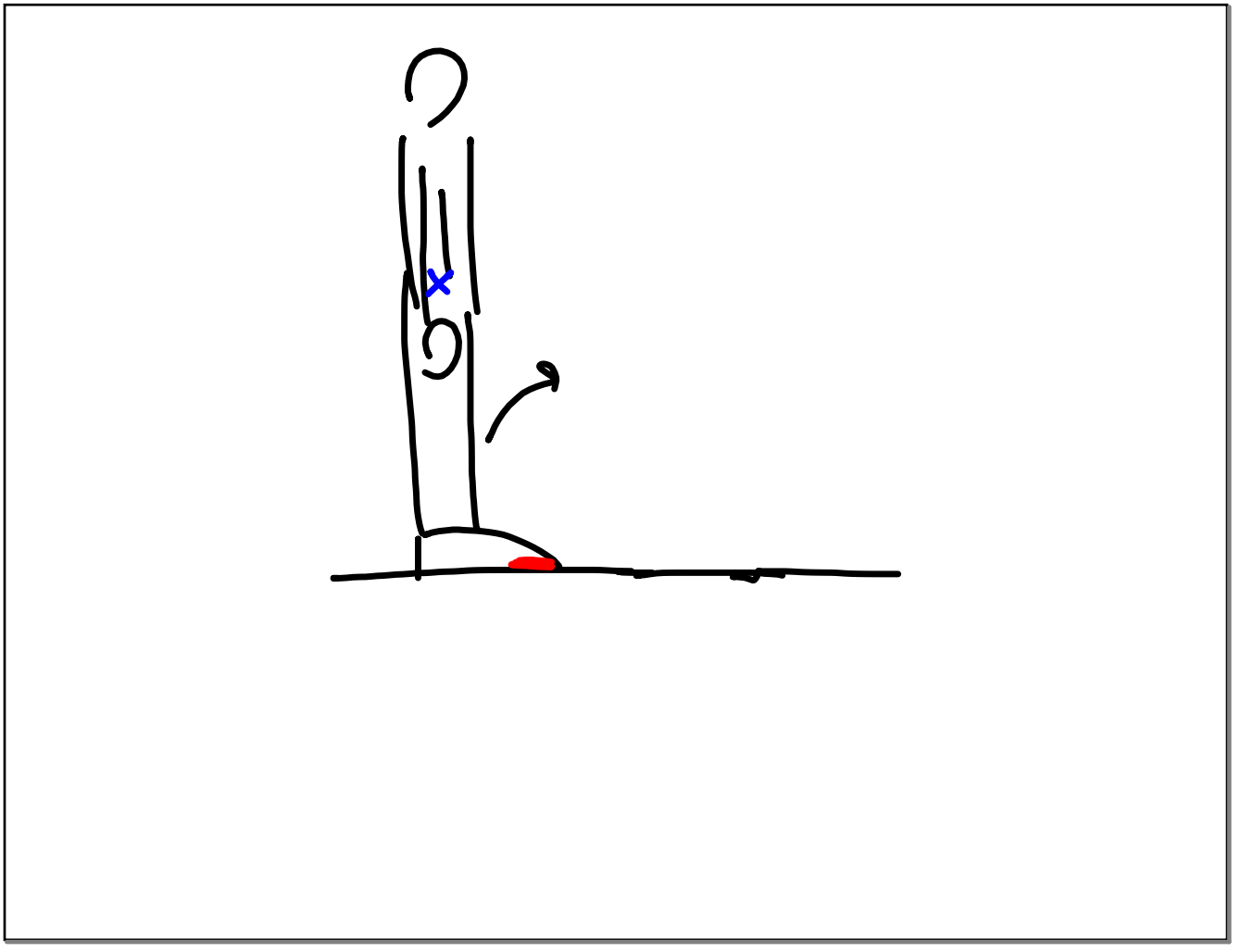


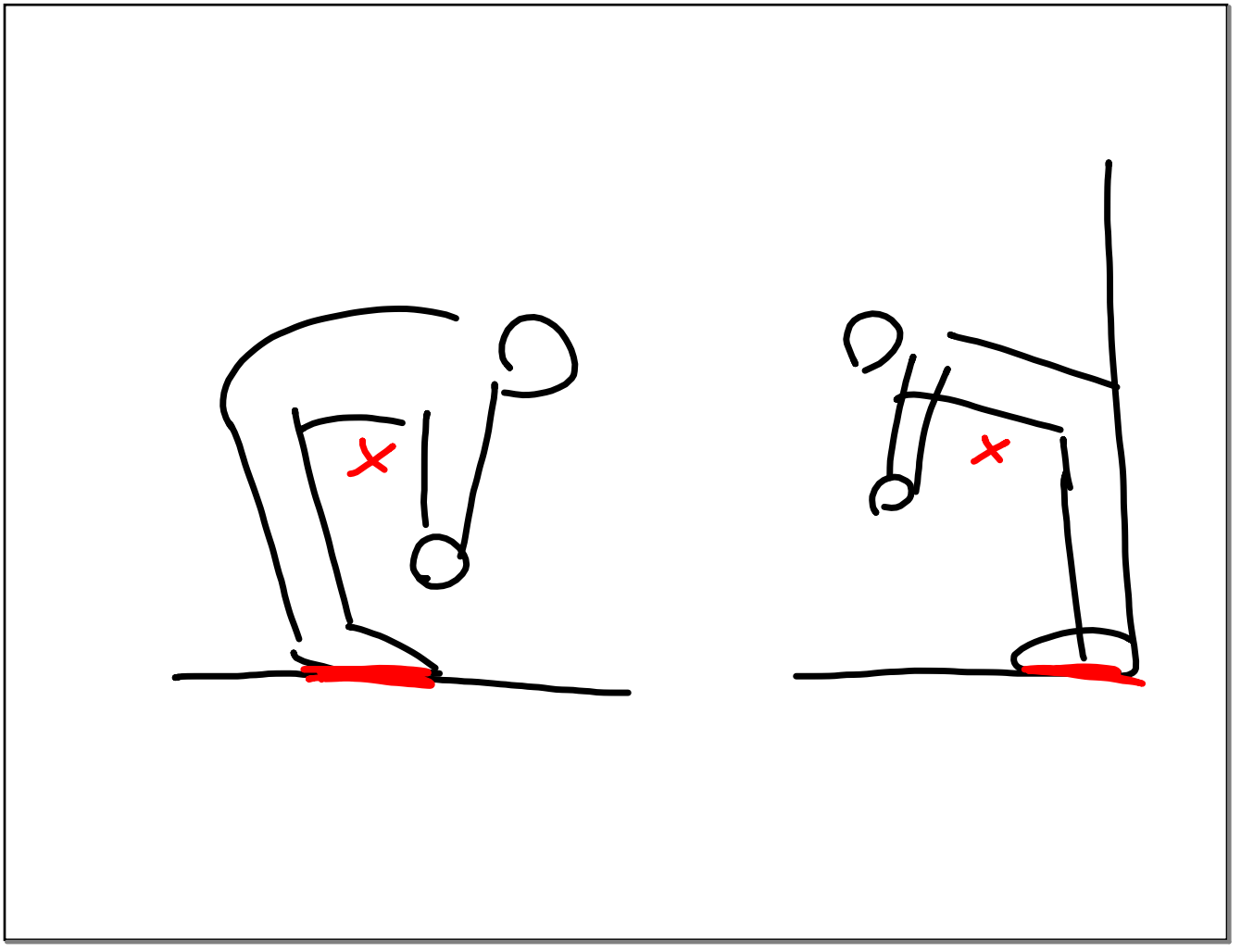


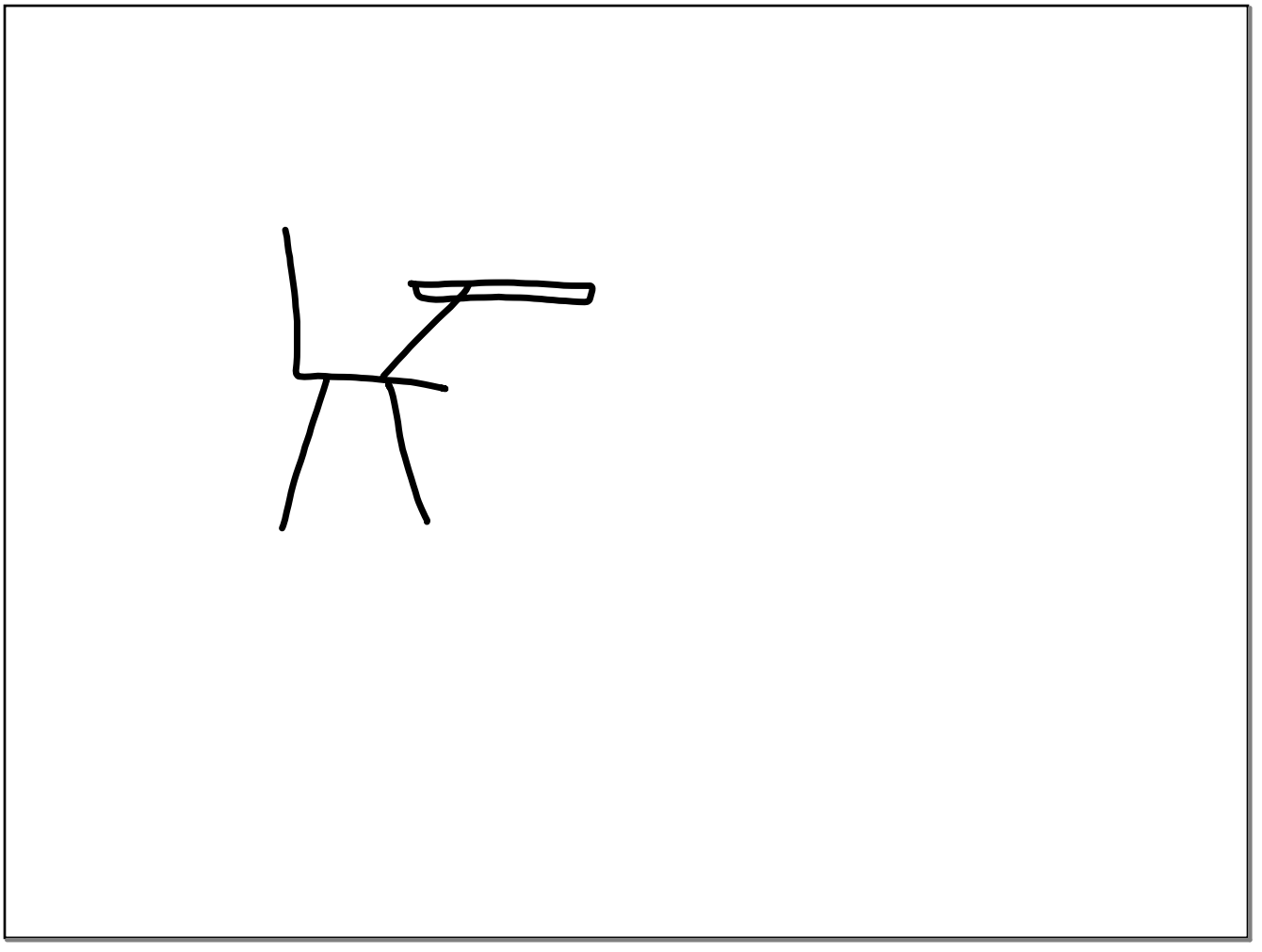



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20









How do you make something stable?

Using the blocks, make a stable structure.

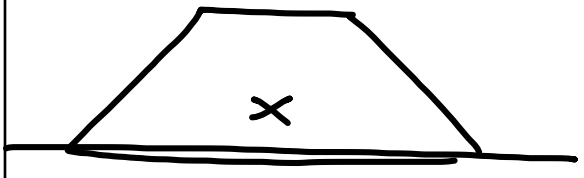
Using the blocks, make an unstable structure.

When do objects topple over?

Things topple over when the center of mass is NOT over the BASE.

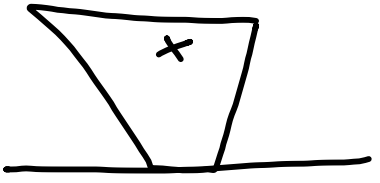
STABLE

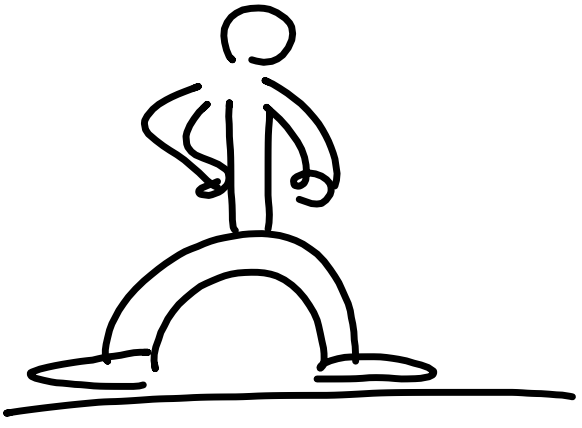
low CM
wide base



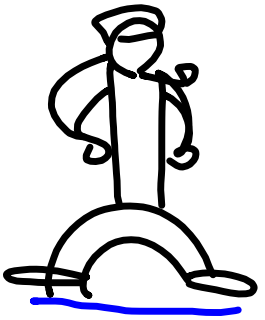
UNSTABLE

high CM
small base

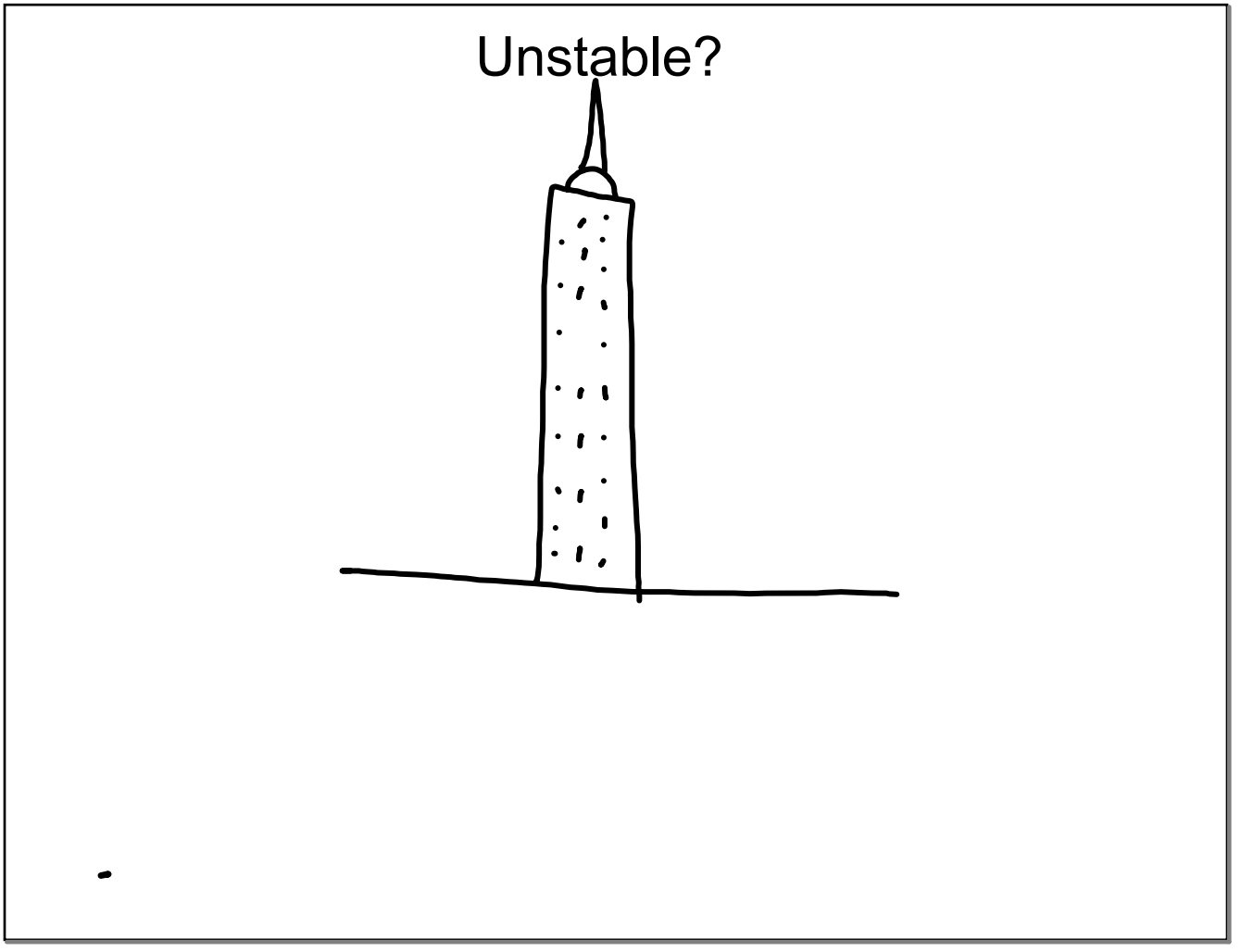


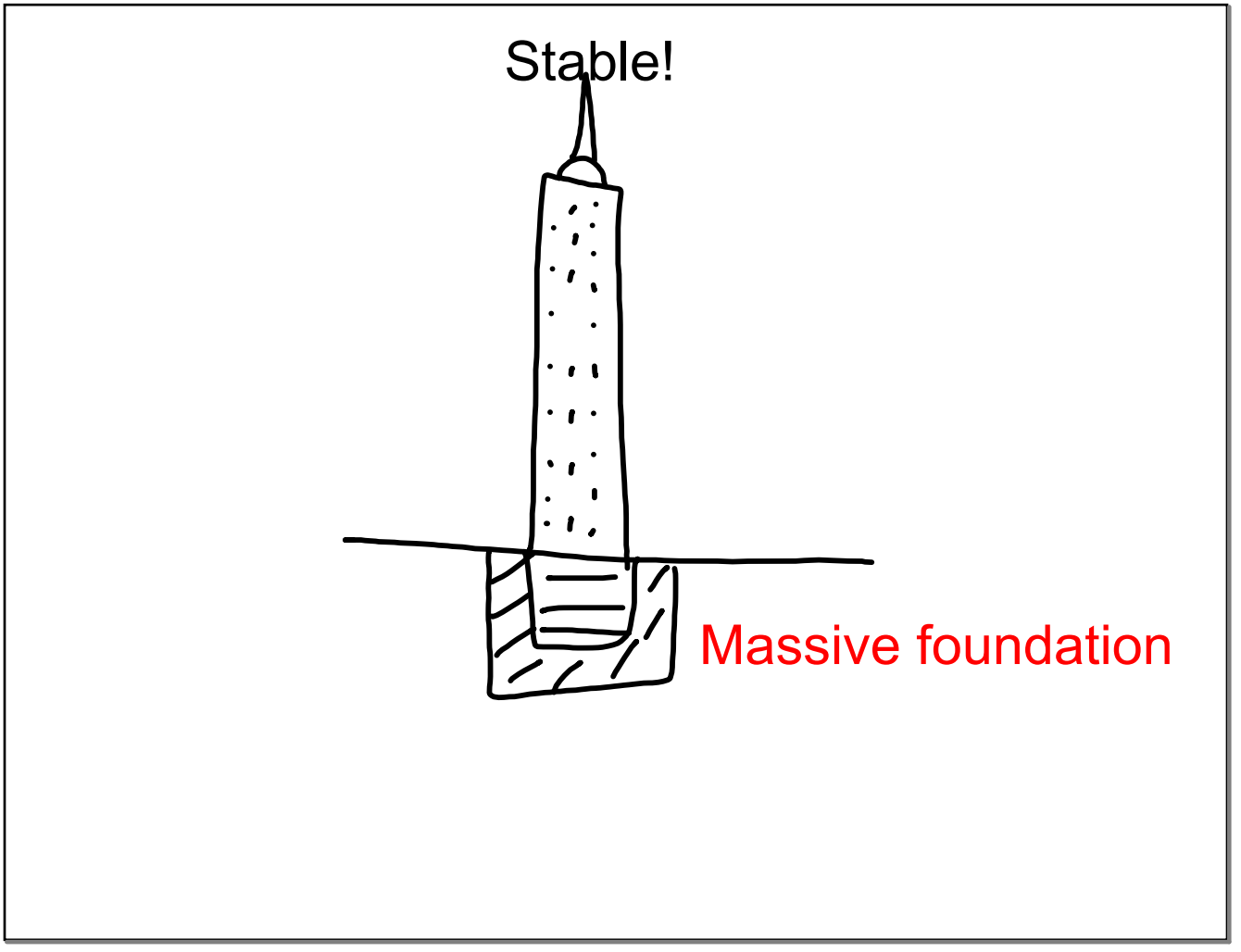


Popeye the Sailorman

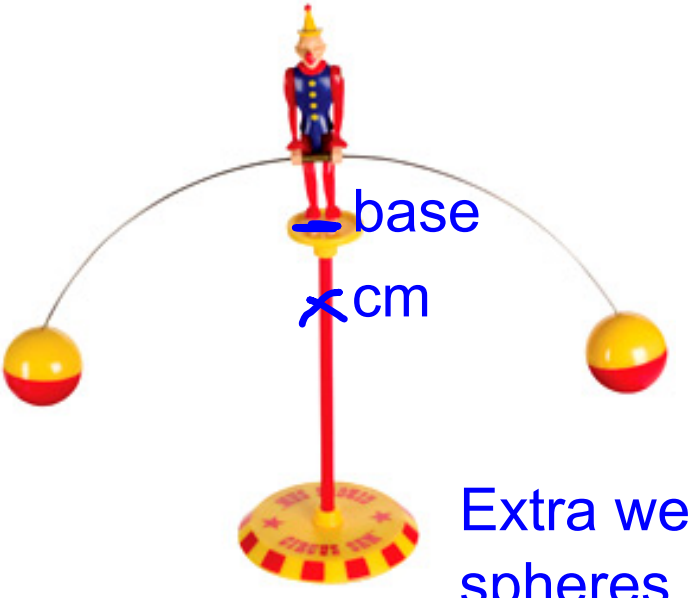


A sailor's wide stance is good for walking on a rocking boat.


Unstable?

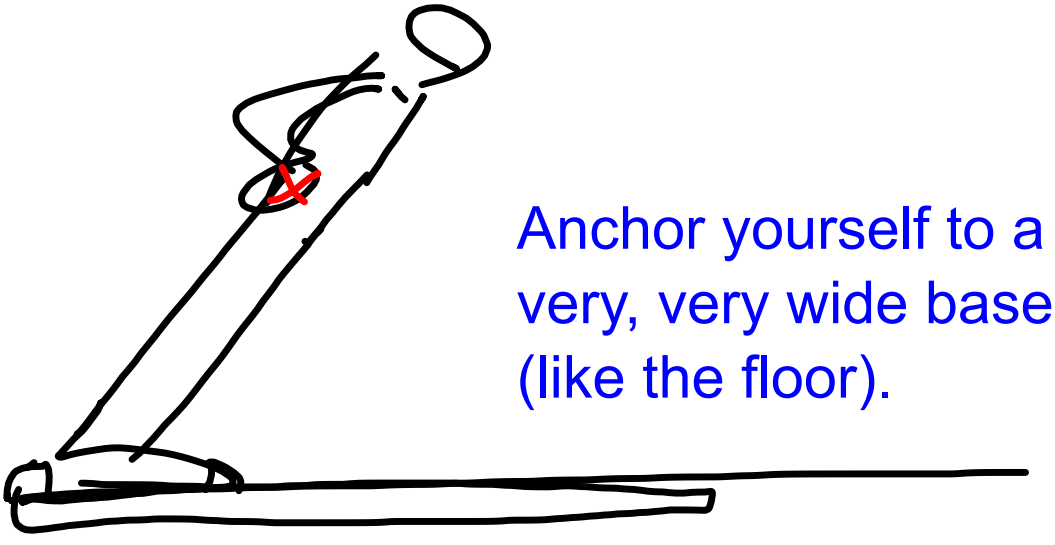

Stable!
Massive foundation

Becoming SUPER stable



Extra weight in the spheres puts Circus Sam's CM **below** his base.

Becoming SUPER stable



Anchor yourself to a very, very wide base (like the floor).

But you'll need good body strength.