

# Recovering Balance



National Science Foundation  
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# Recovering Balance

For static balance a tightrope walker has to maintain her center of gravity (CG) over the narrow wire.

Typical wire is half-inch in diameter so more than a  $1/3$  degree tilt to either side causes walker to tip over.

She is rarely in balance but rather she is constantly recovering her balance.



# Using a Pole for Balance

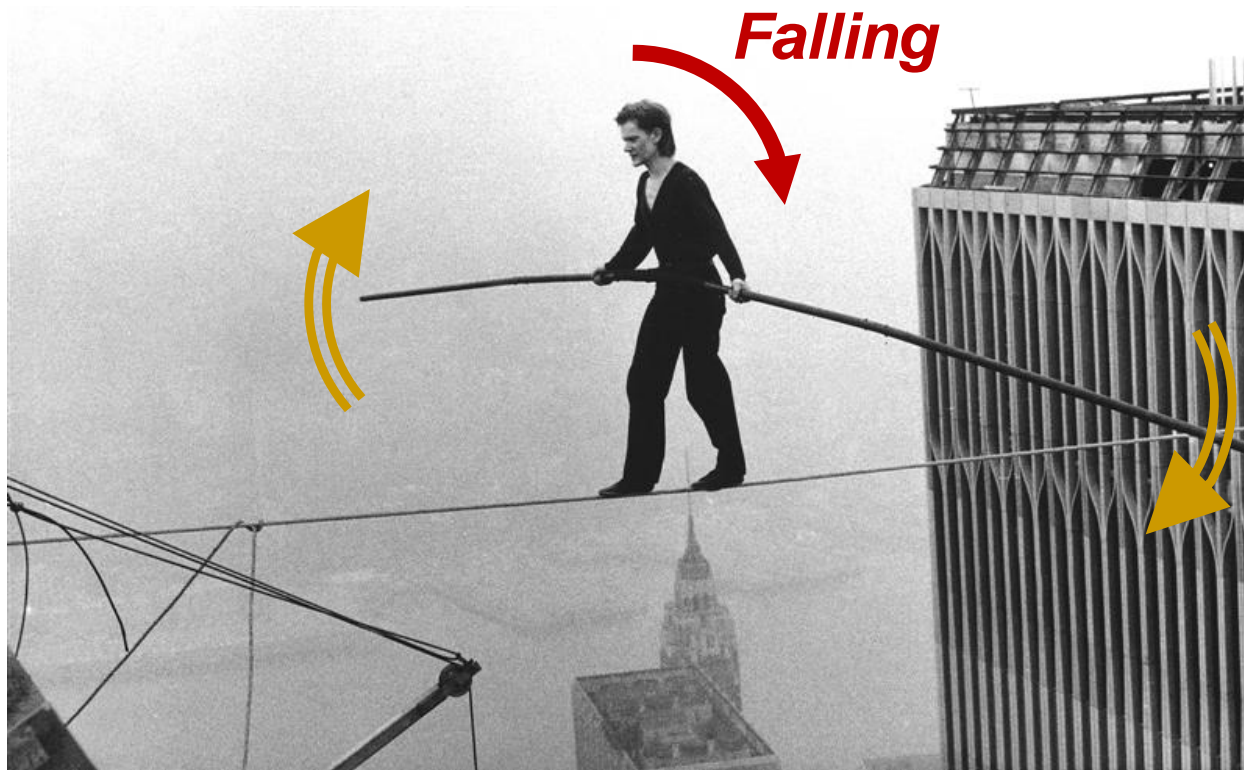
Maintain balance by moving the heavy pole side-to-side, adjusting the center of gravity.



As Laurie swings her leg out to screen left she also shifts the pole to screen right, keeping her center of gravity over the “wire.”

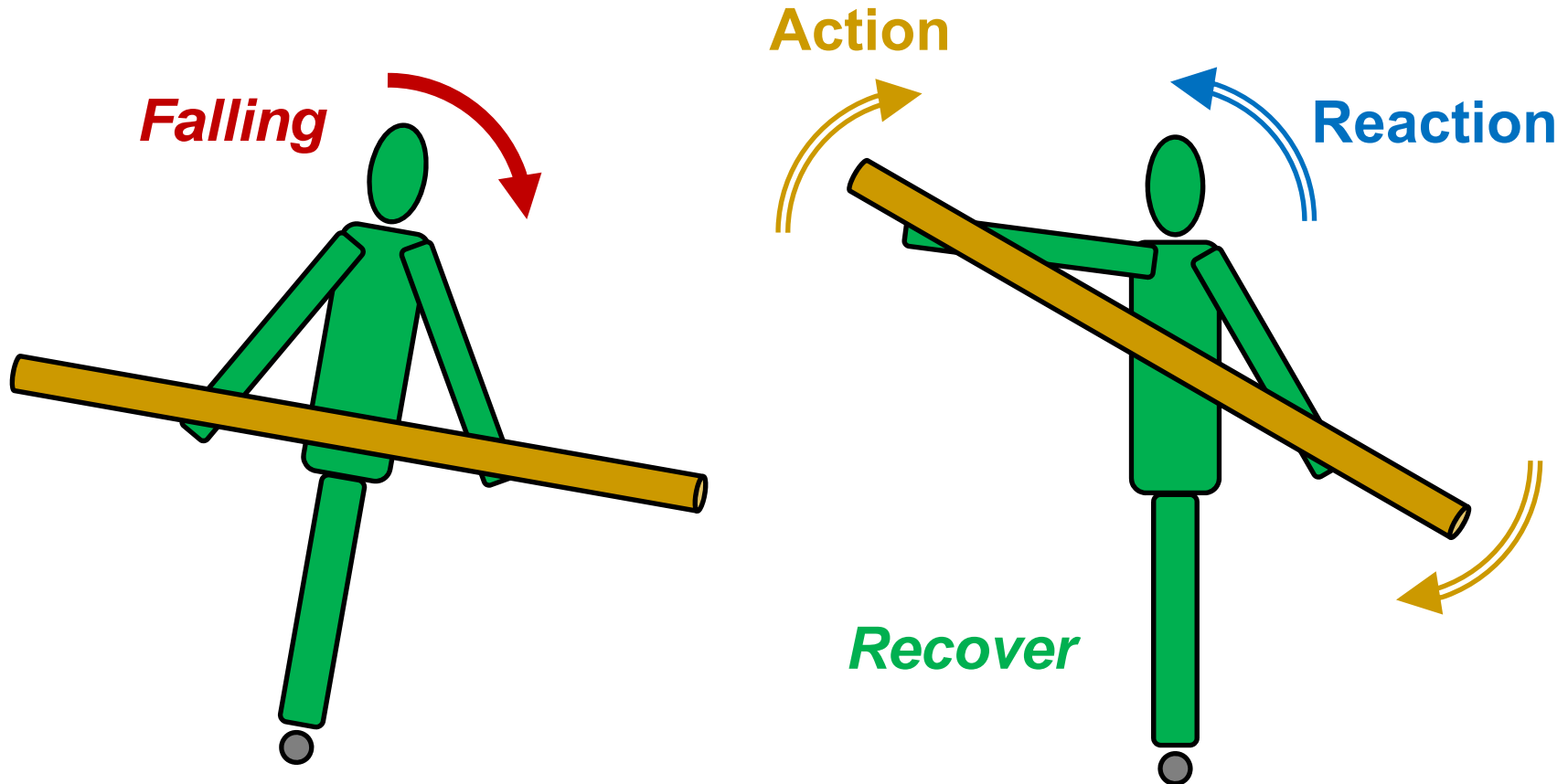
# Using a Pole for Recovery

Walkers can recover balance by rotating the pole *into the direction they're falling*.



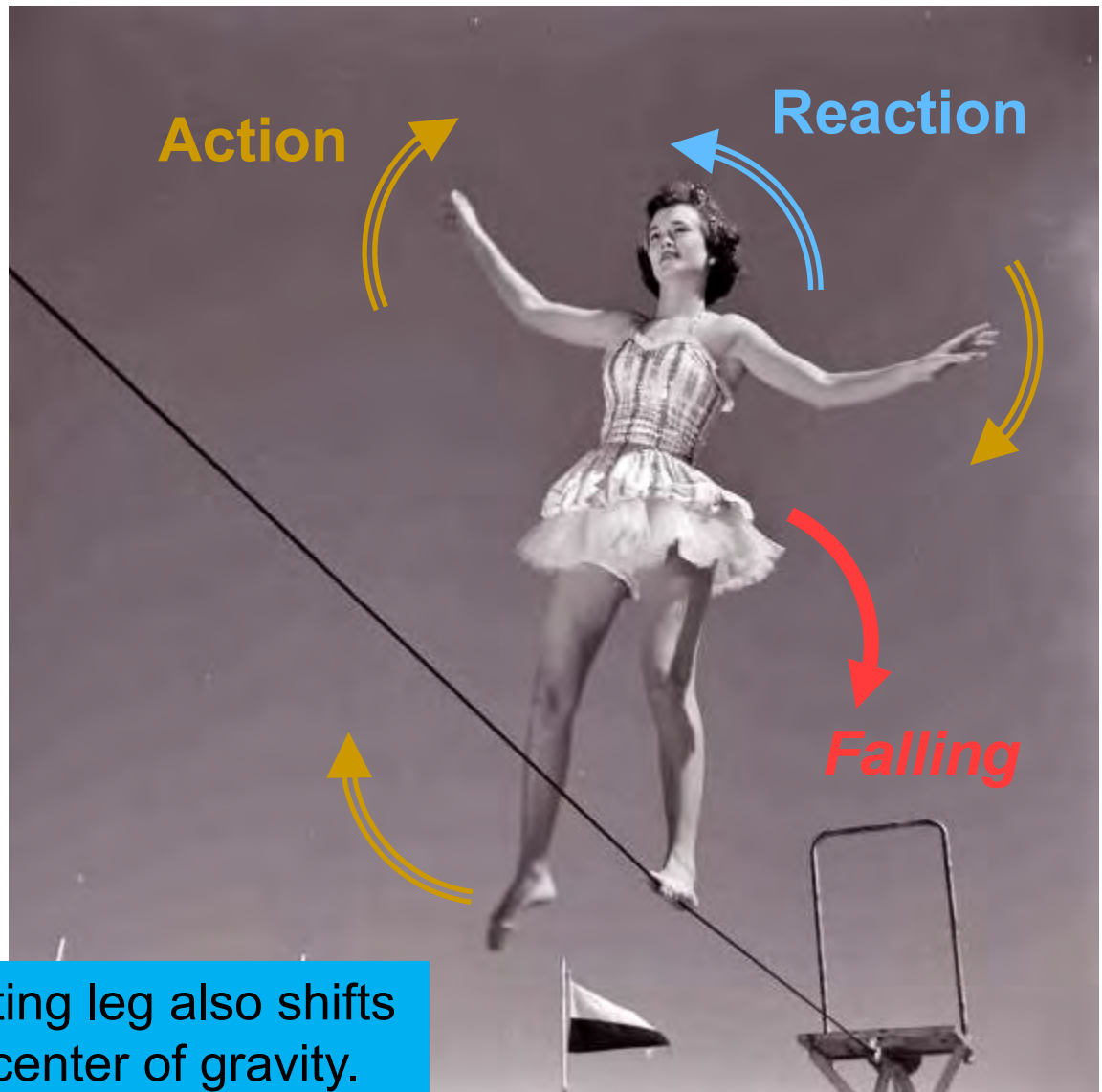
# Action/Reaction with a Pole

Recover using action/reaction with the pole.



# Action/Reaction with Arms & Legs

Swing limbs in the direction of falling so that the reaction turns the body in the opposite direction.



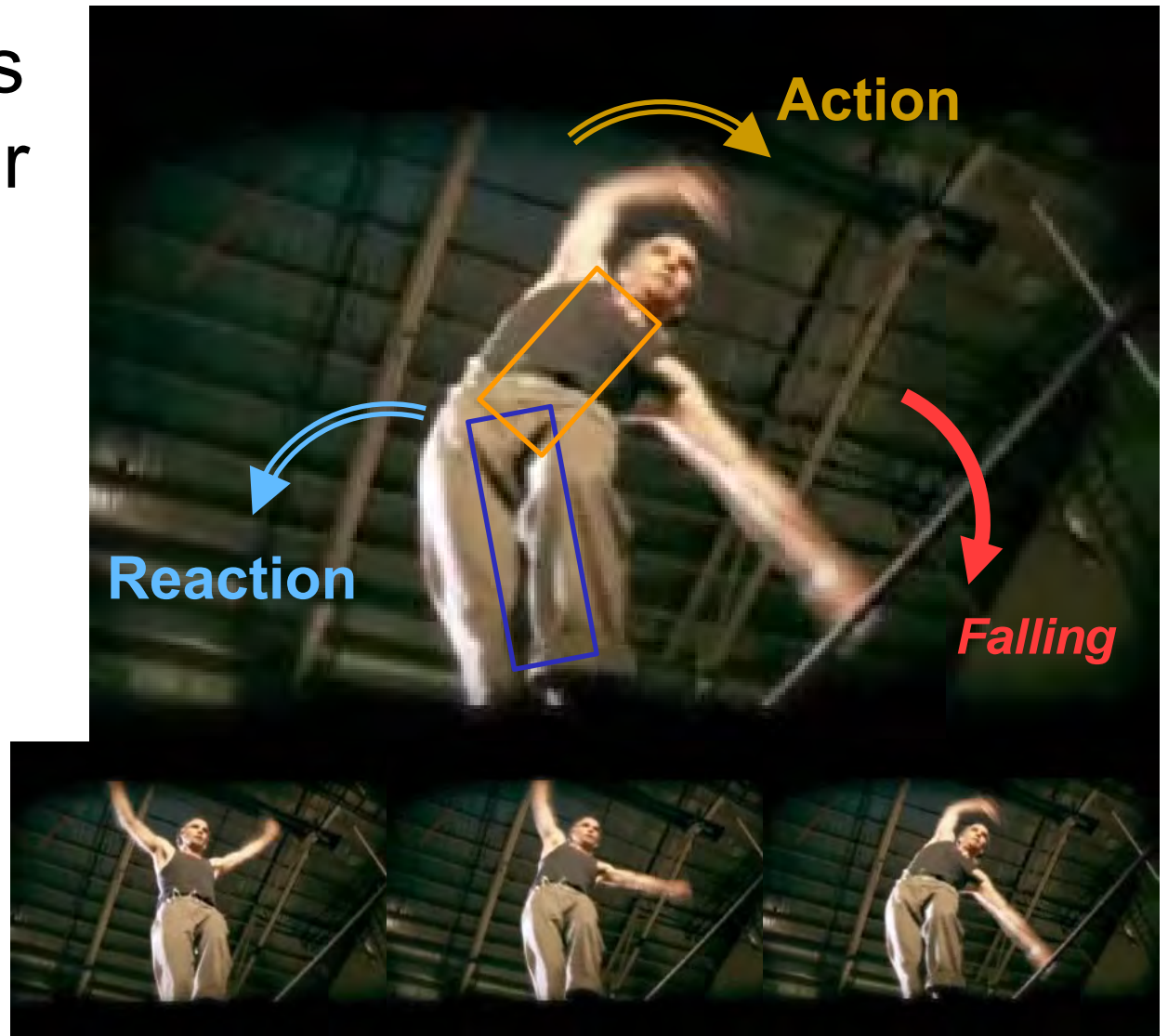
Shifting leg also shifts the center of gravity.



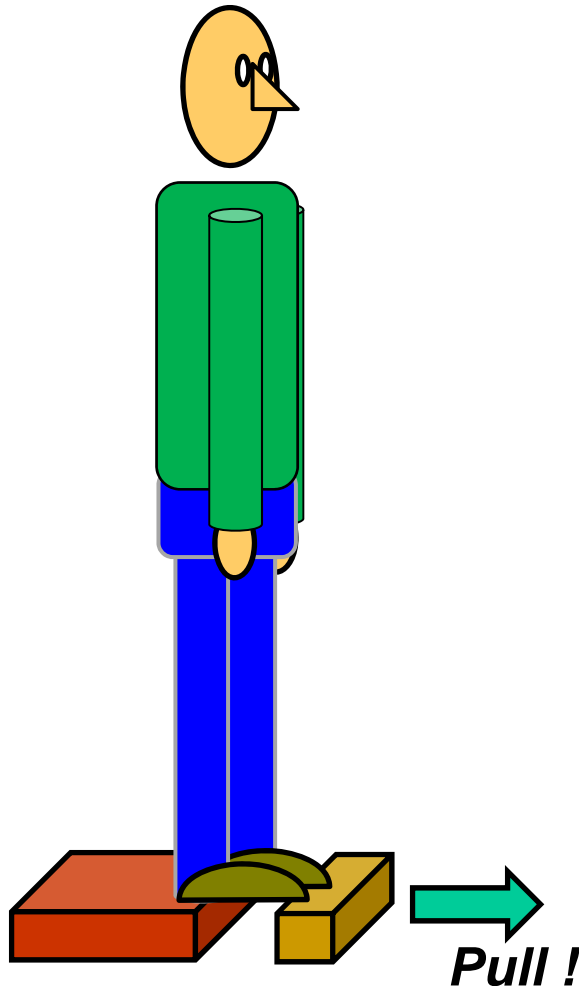
# Swinging Torso into the Fall

Moving the hips shifts the center of gravity back over the wire.

Do this by swinging the upper body *into the fall*.



# Recovering Balance



The volunteer's base of support is suddenly changed when the block under their toes is pulled out.

How do they recover balance to avoid falling off the platform?



# Recovering Balance



# Recovering Balance



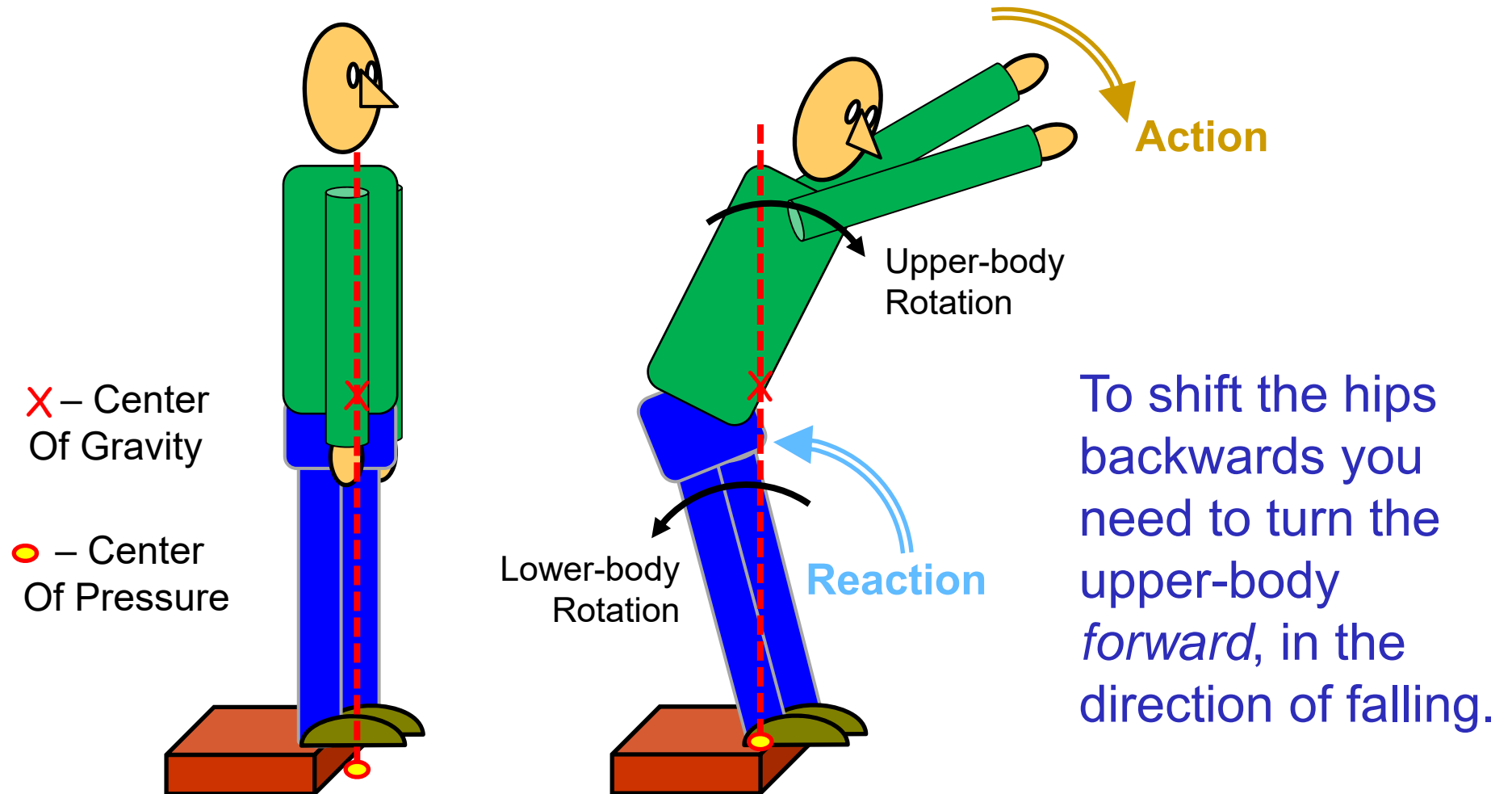
Laurie pulls the block out from under Rick's toes...



...and he instinctively throws his upper body forward.



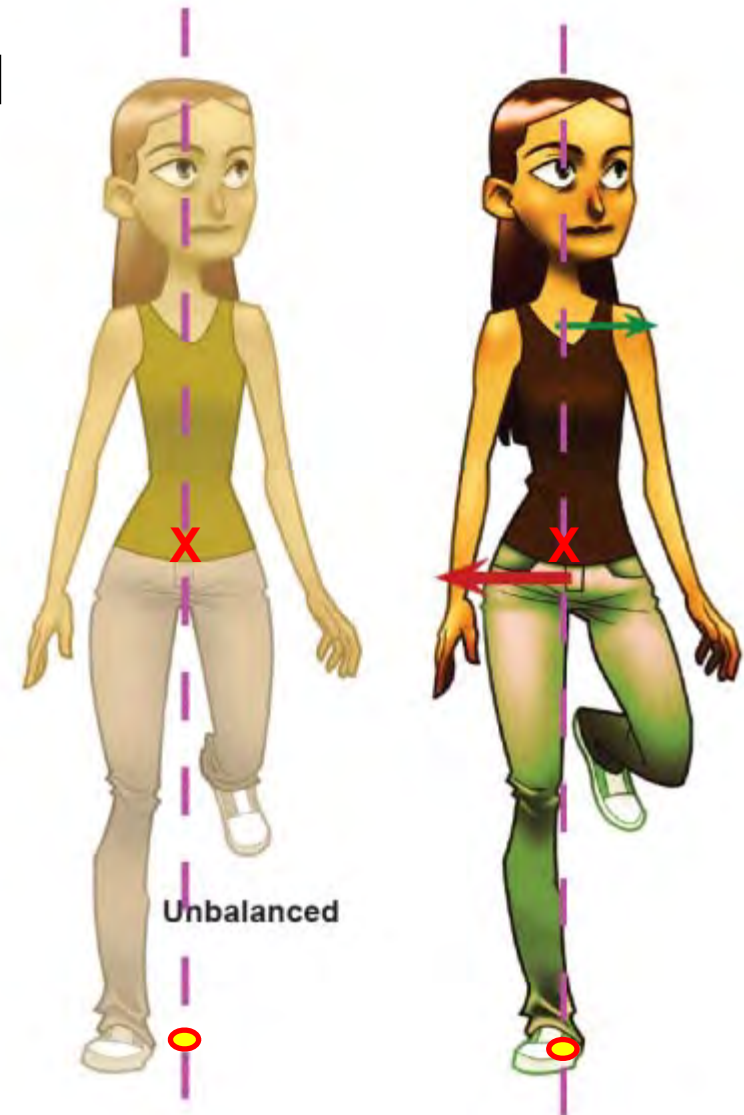
# Recovering Balance



# Weight Shift on One Leg

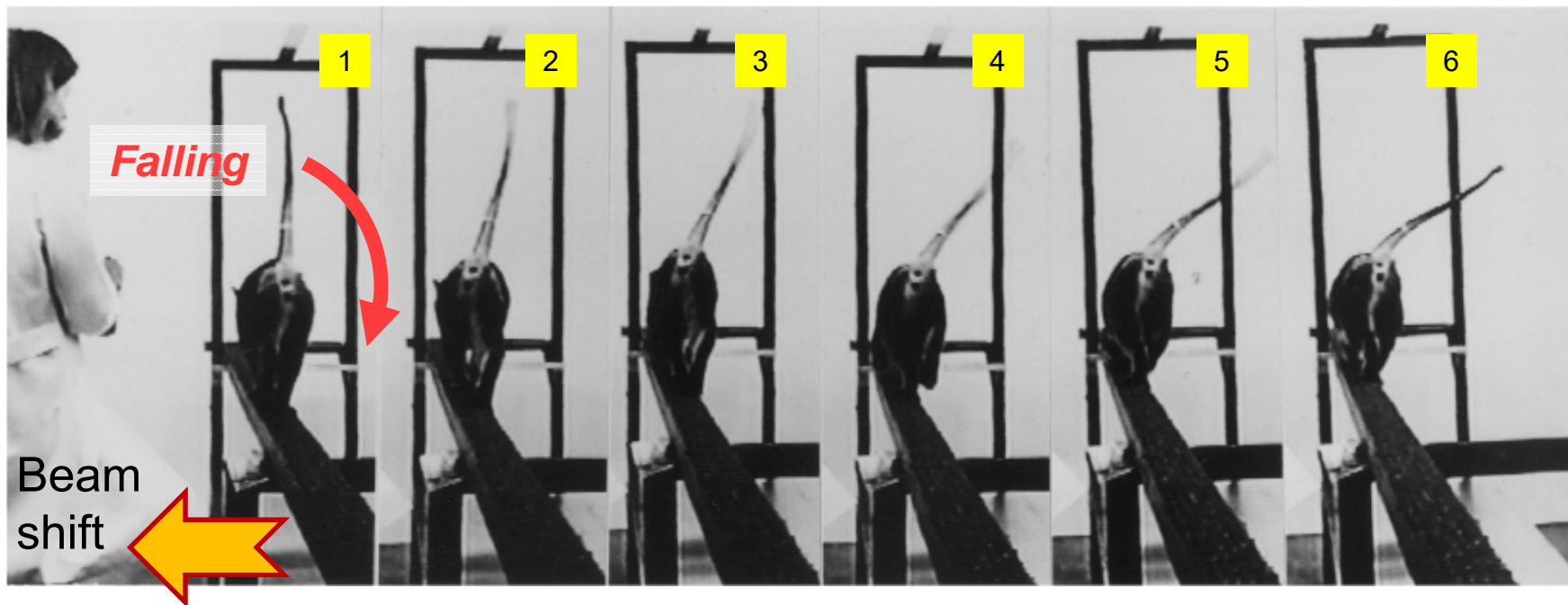
To balance on one foot you need to shift your center of gravity over that foot and this is most easily done by shifting your hips to that side.

Notice that as you shift your lower torso to one side your upper torso will shift a bit to the *other* side so that your momentum doesn't cause you to tip too far sideways.



# Using Tail to Recover Balance

“This series of photographs captured from videotape depicts rightward movement of the tail in response to rapid leftward movement of the narrow beam. The cat pictured was moving away from the camera, and did not fall from the runway. Note the shift in hip position, indicating a shift in the cat’s center of gravity.” from *Behavioral Brain Research* (1998)



# Summary

- To recover balance the Center of Gravity has to shift in order to reposition it above the Base of Support.
- For small adjustments the action of swinging the arms into the fall causes a reaction that can restore balance.
- Throwing the upper torso in the direction of falling causes a reaction that shifts the CG in the opposite direction.