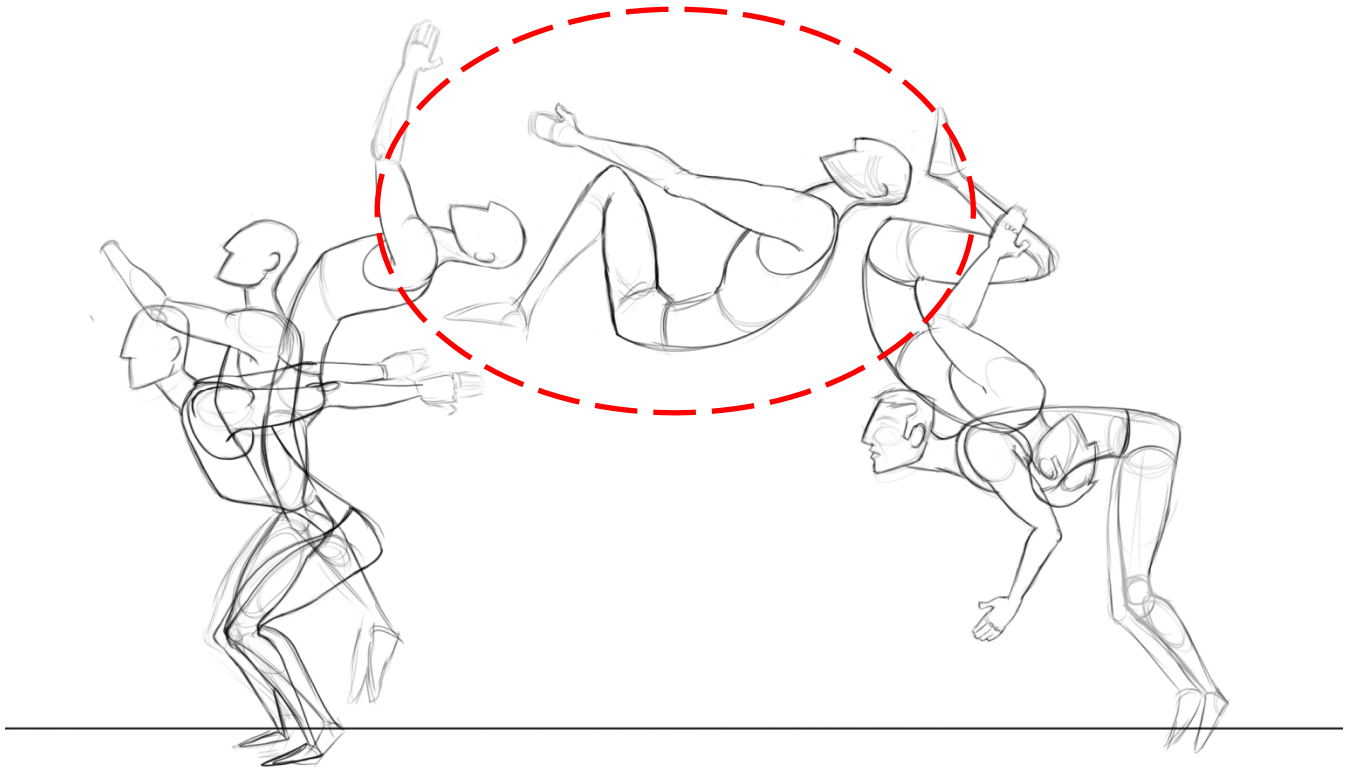
Somersaults & Twists

National Science Foundation
WHERE DISCOVERIES BEGIN

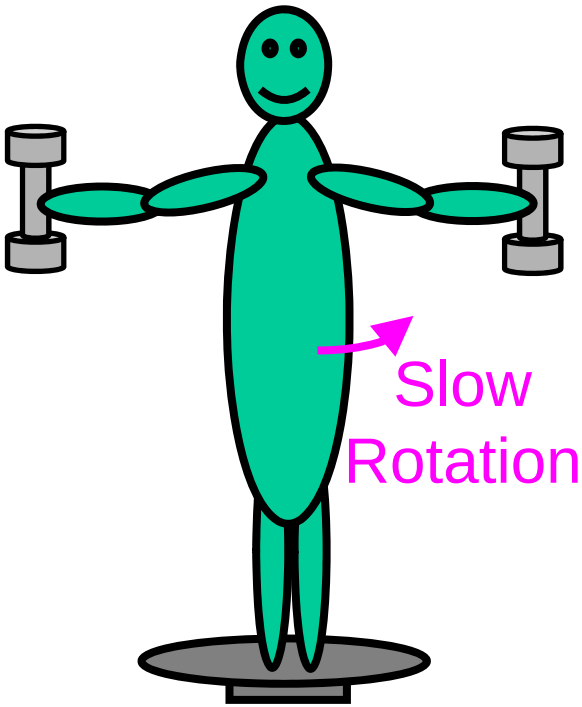
Gymnastic Somersault

Gymnast controls his rotation by entering and exiting from a tuck pose (legs pulled into the torso).

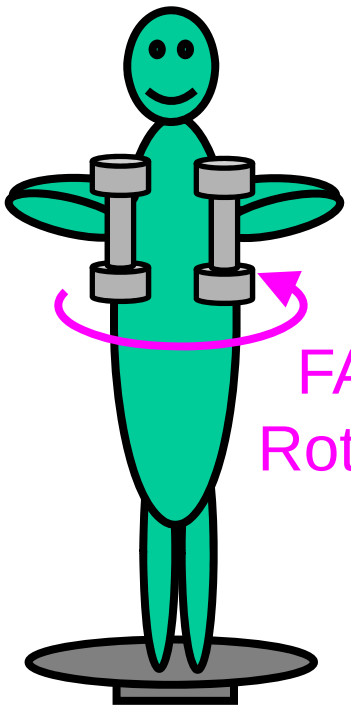


Skater's Spin Demo

Control rotation by varying rotational inertia.



Slow Rotation



FAST Rotation

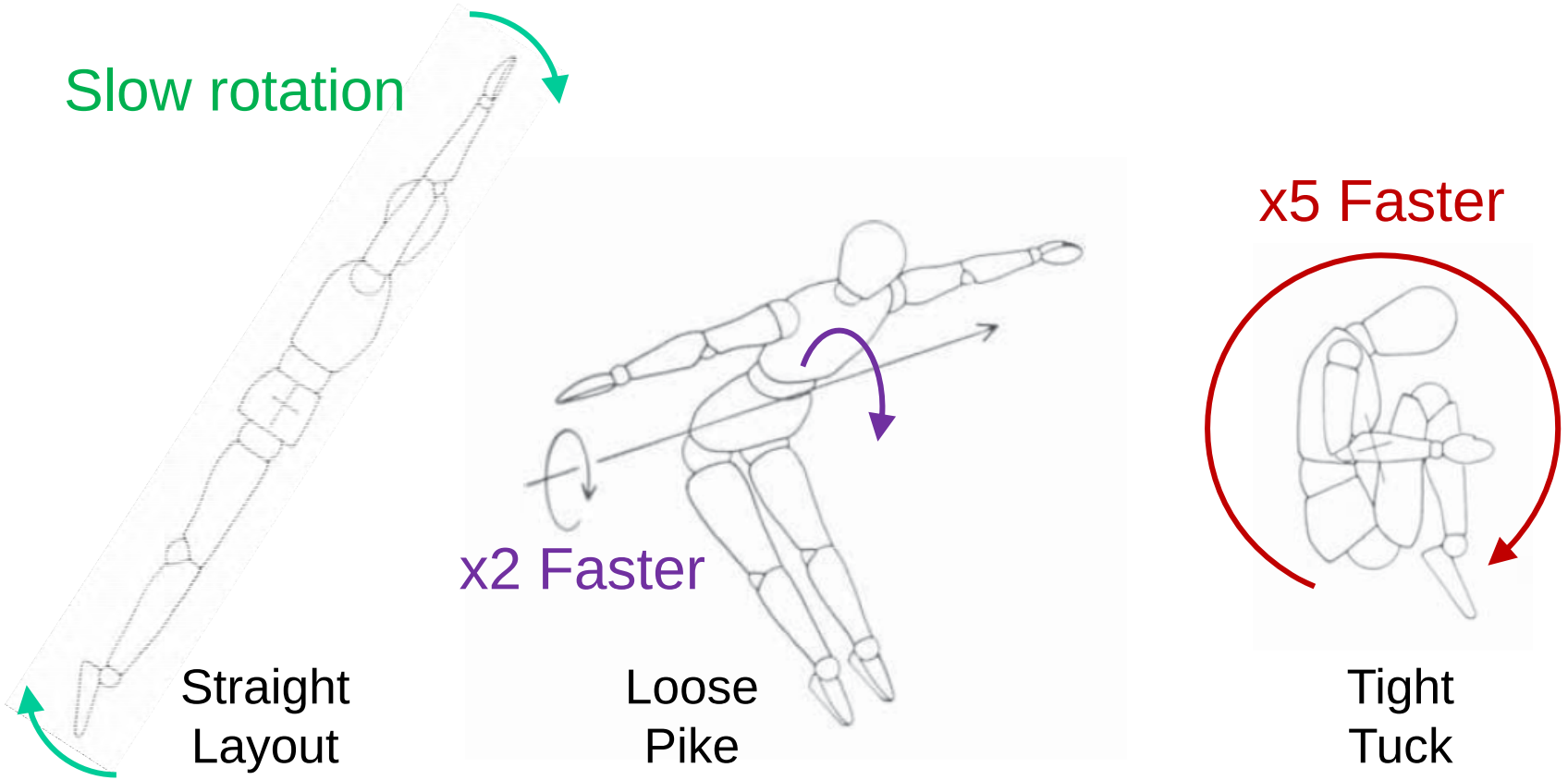
commons.wikimedia.org/wiki/File:Elena_Sokolova_04_NHK_2.jpg

Tucking the weights into the body decreases your rotational inertia and increases your rotation speed.

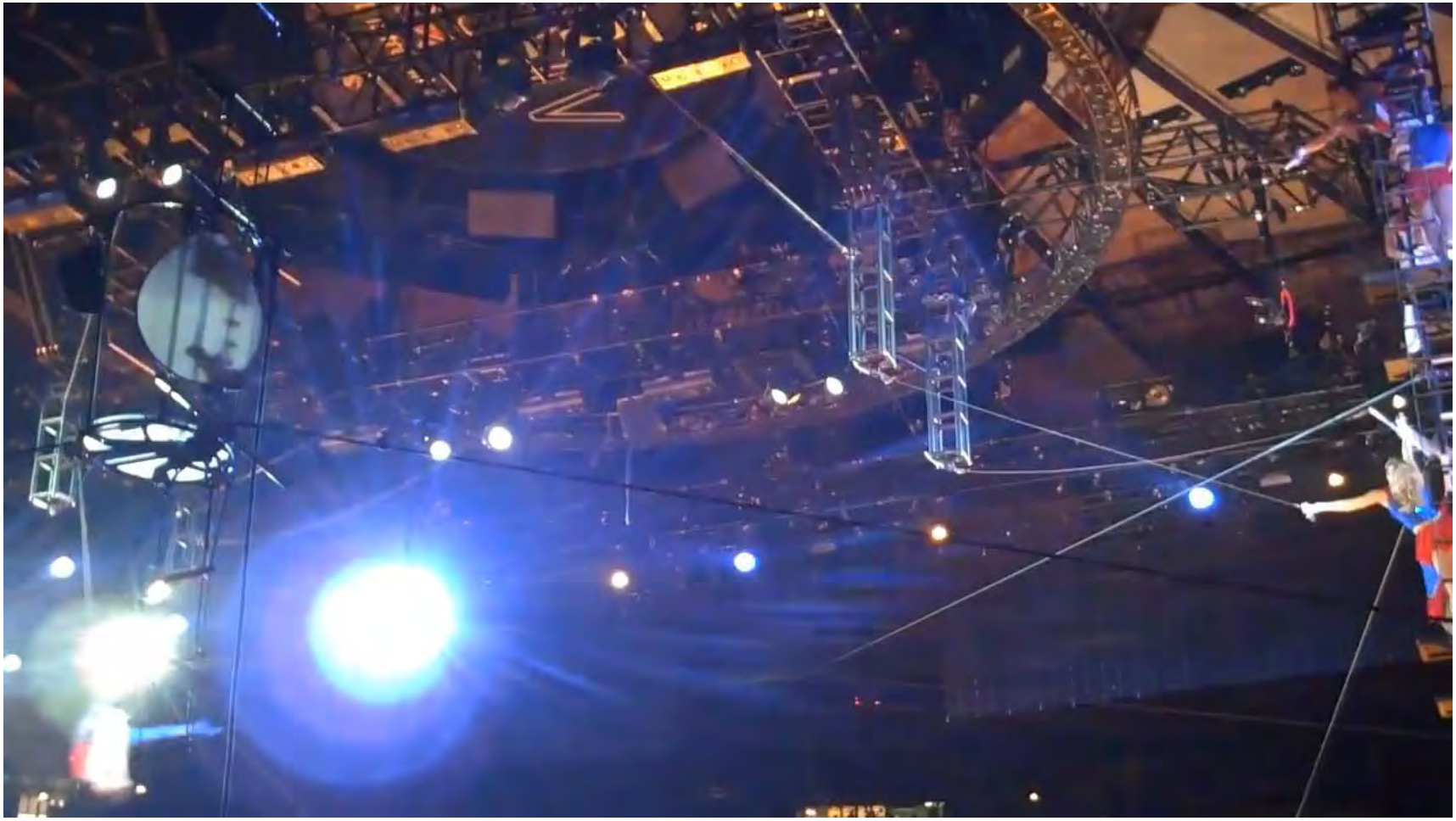
Skater’s Spin Demo

Rotation and Poses

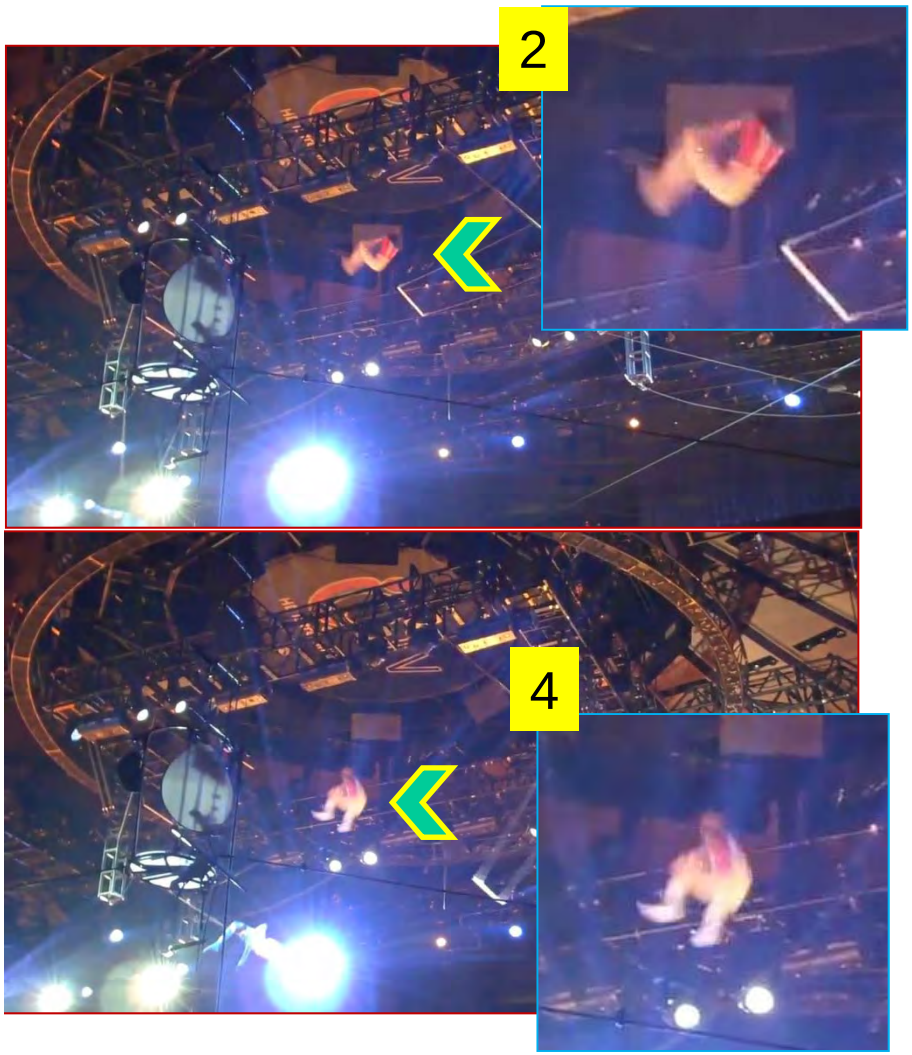
Large change in rotation for various poses.

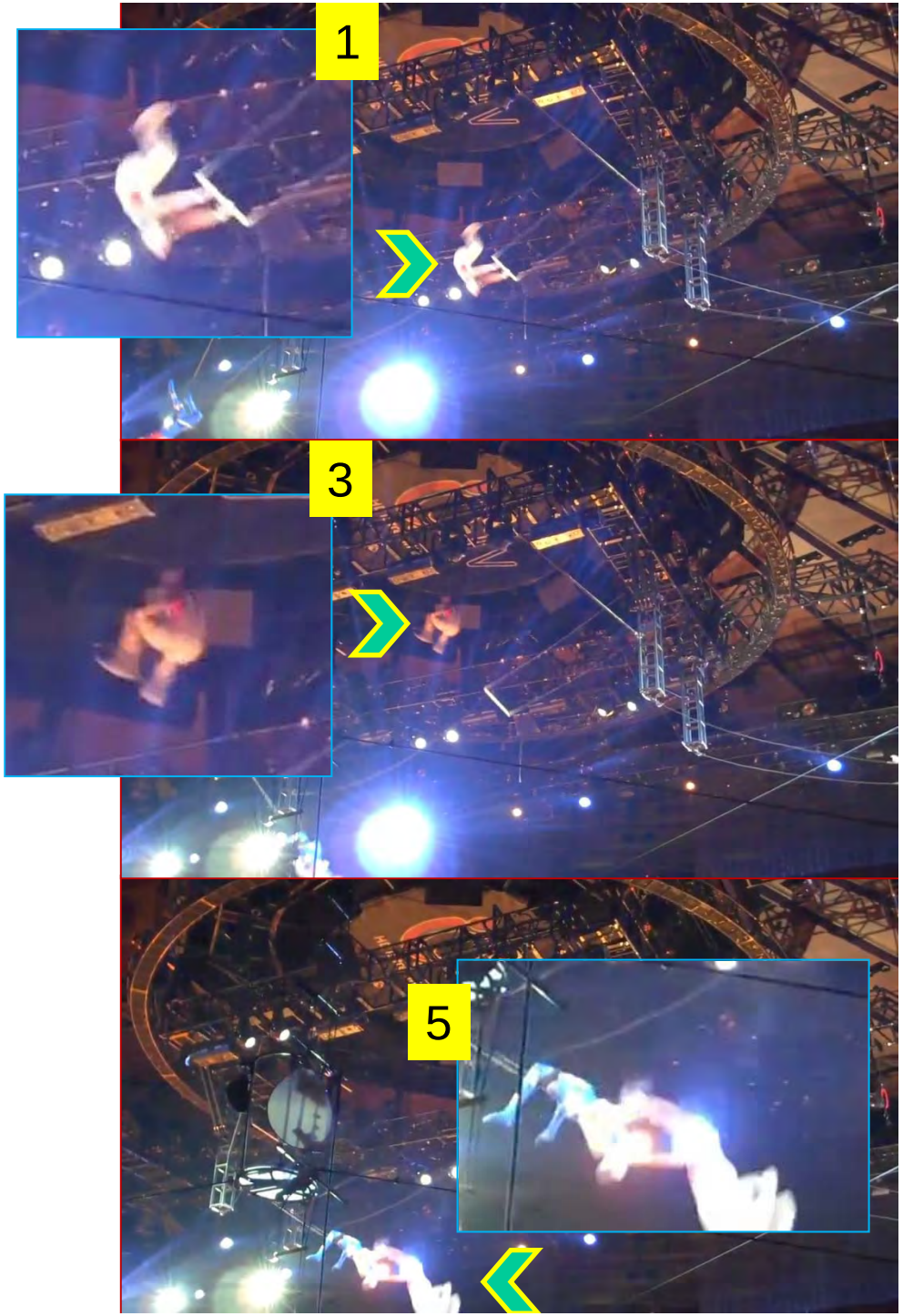


The Quadruple



The Quadruple

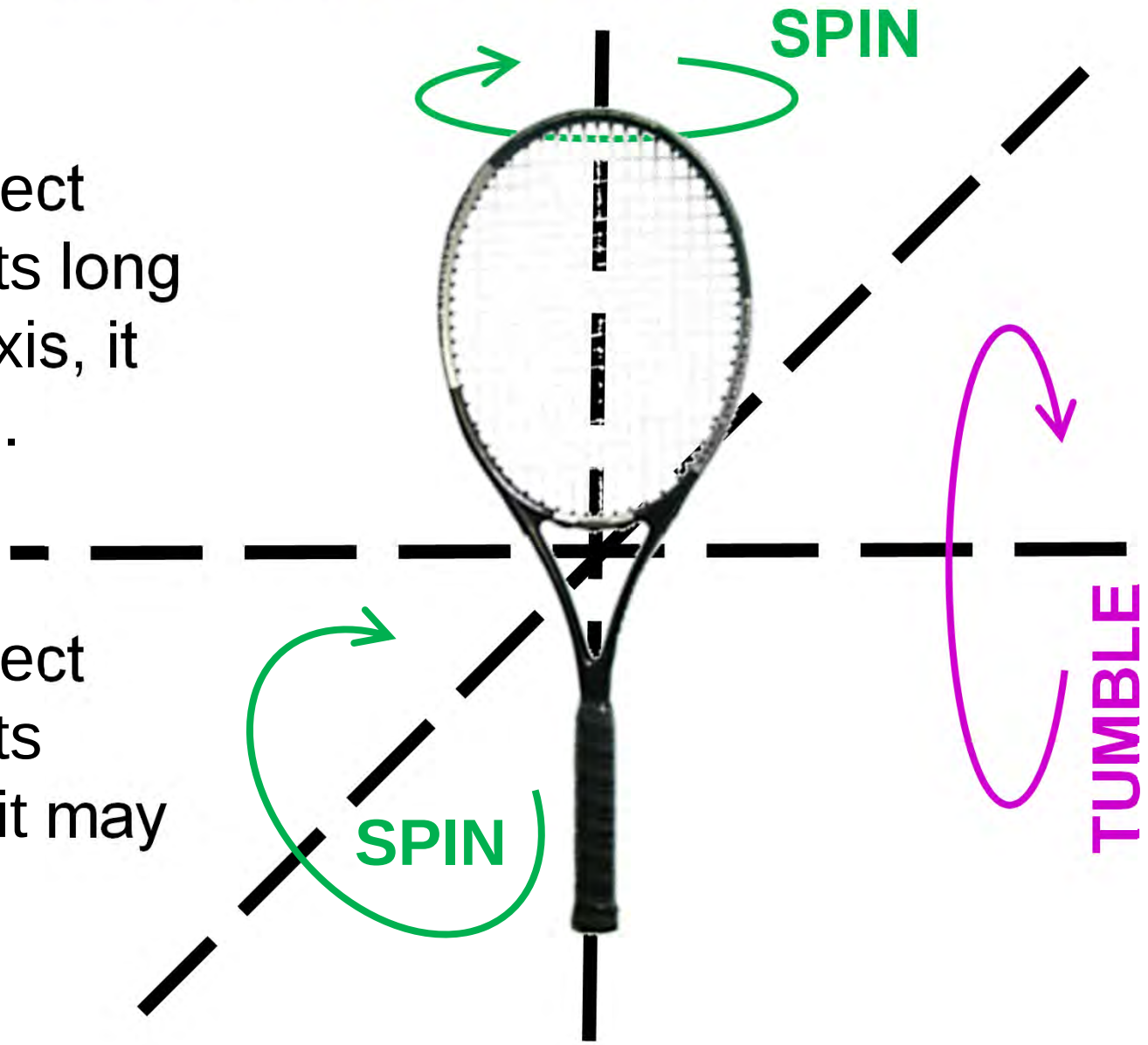




Tennis Racket Theorem

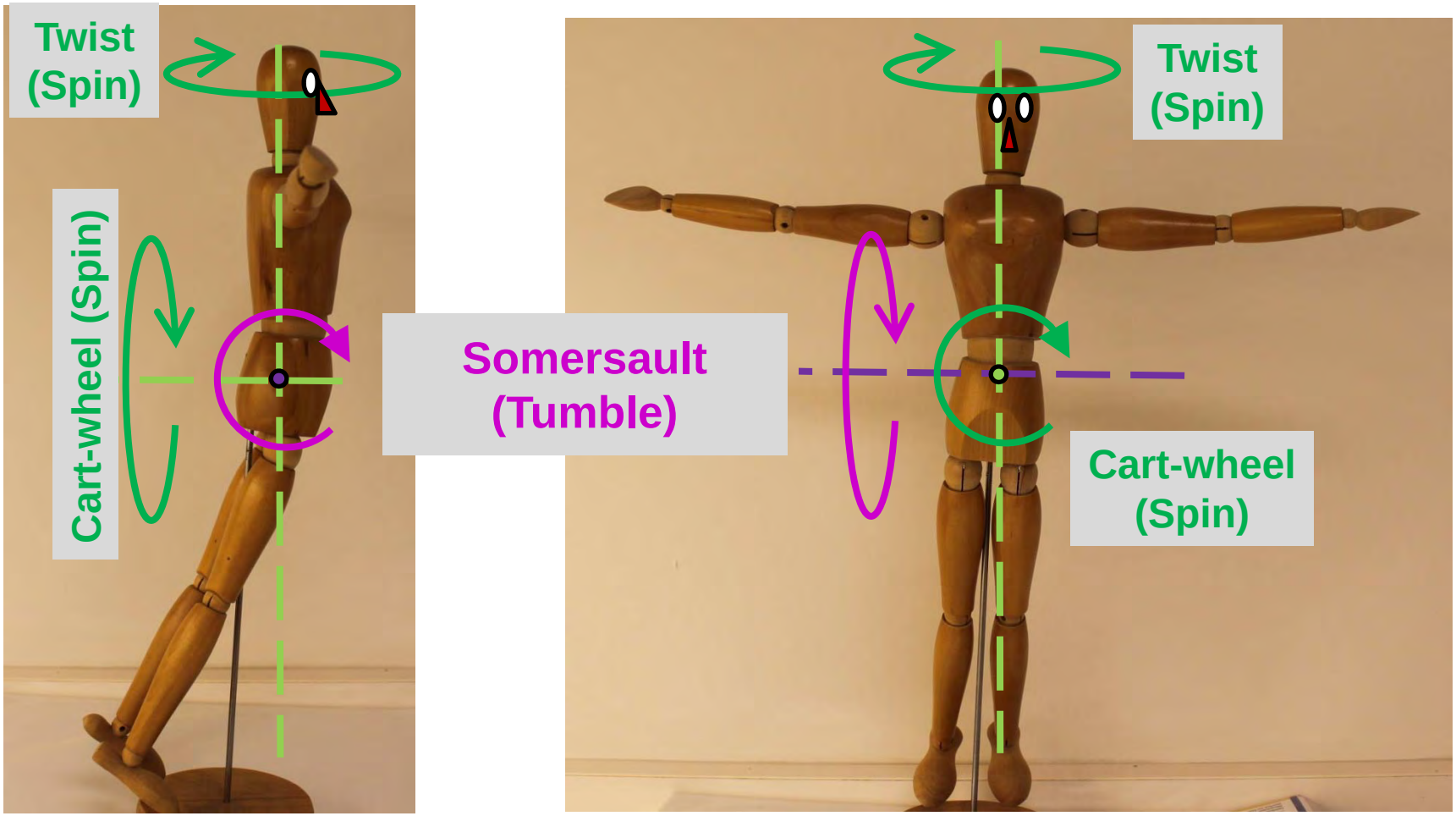
When an object turns about its long or its short axis, it tends to spin.

When an object turns about its middle axis, it may tumble.



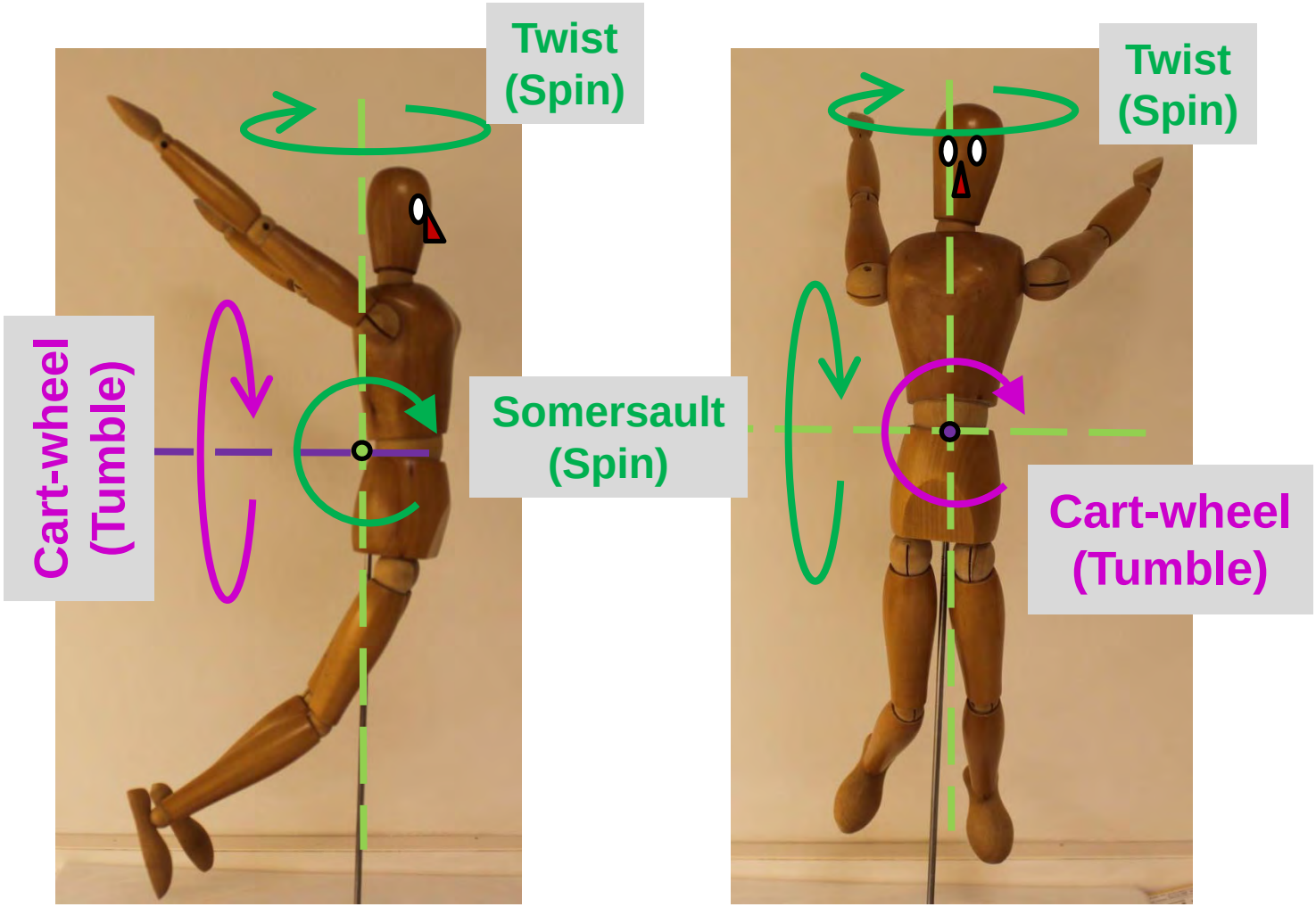
Rotations for Characters

Somersault rotation is tumbling axis in this pose.



Rotations for Characters

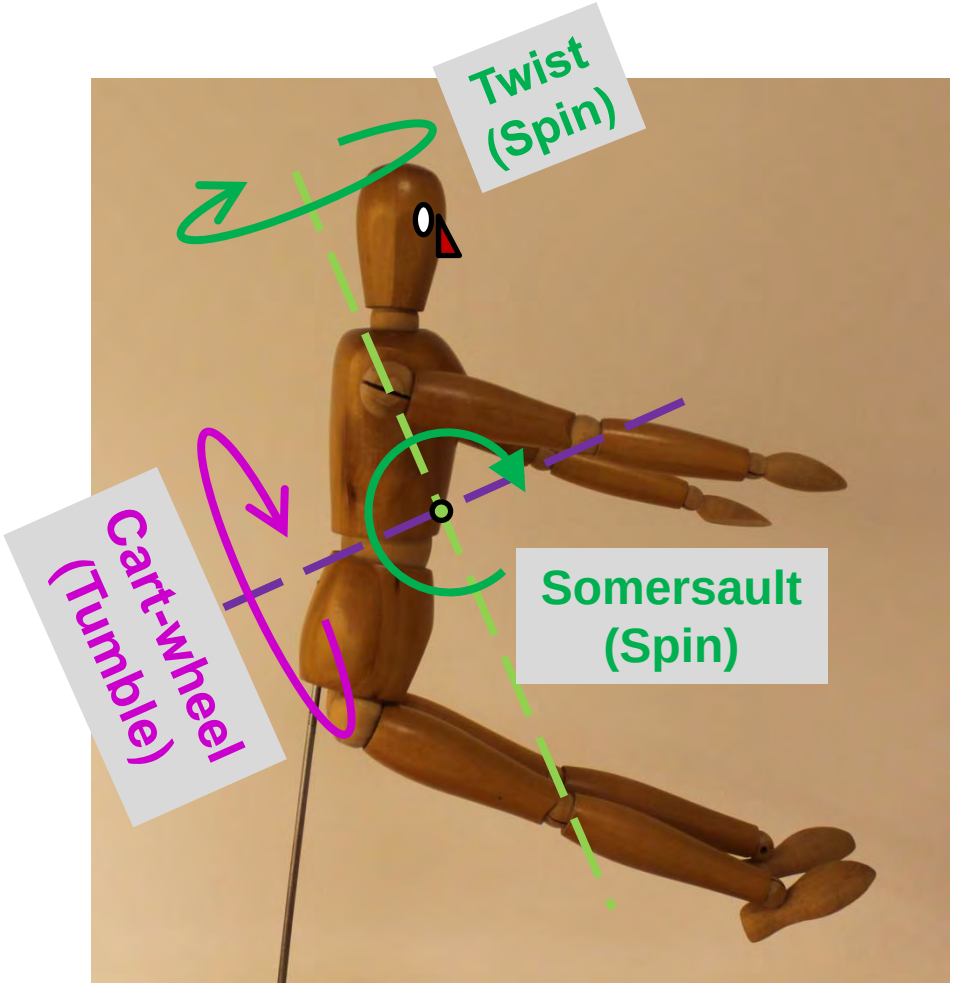
Somersault rotation is on a spin axis in this pose.

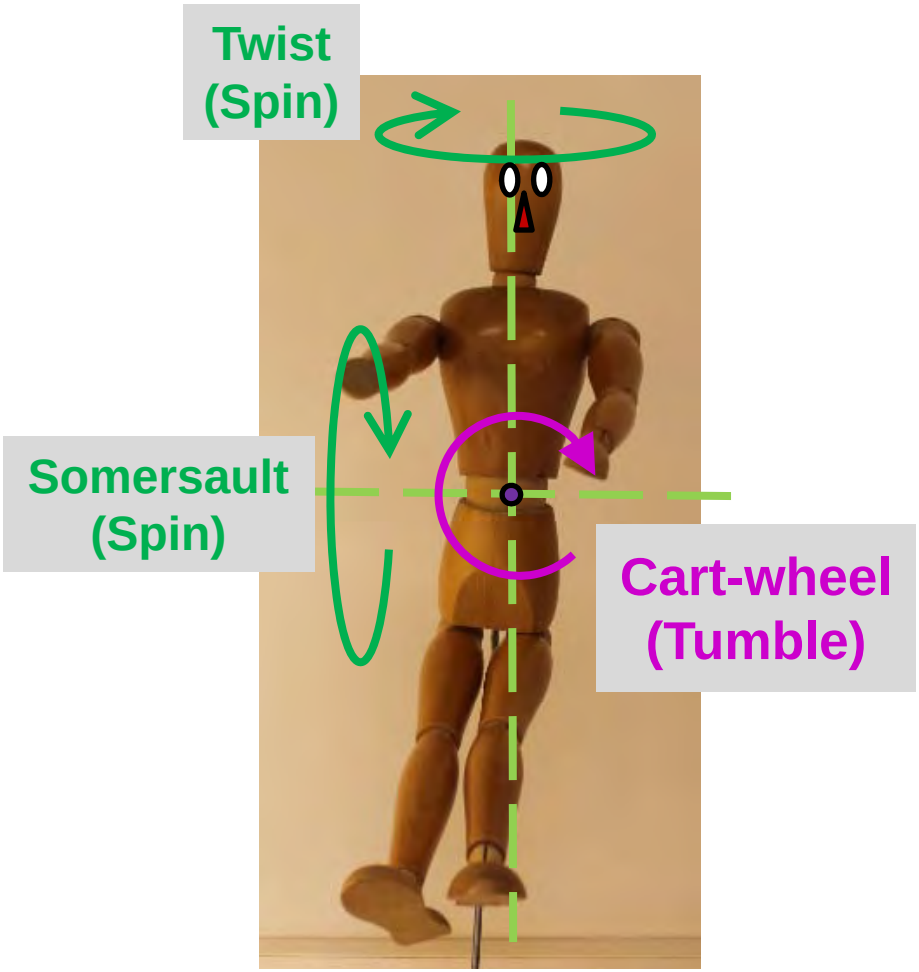


Stable Somersault

Rotations for Characters

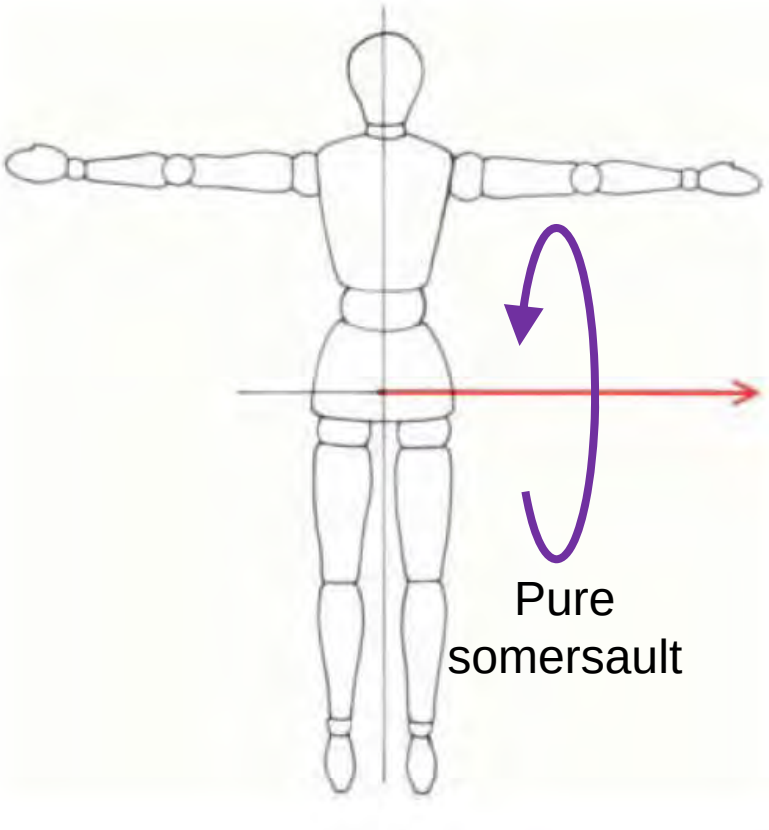
Somersault rotation is on a spin axis in this pose.

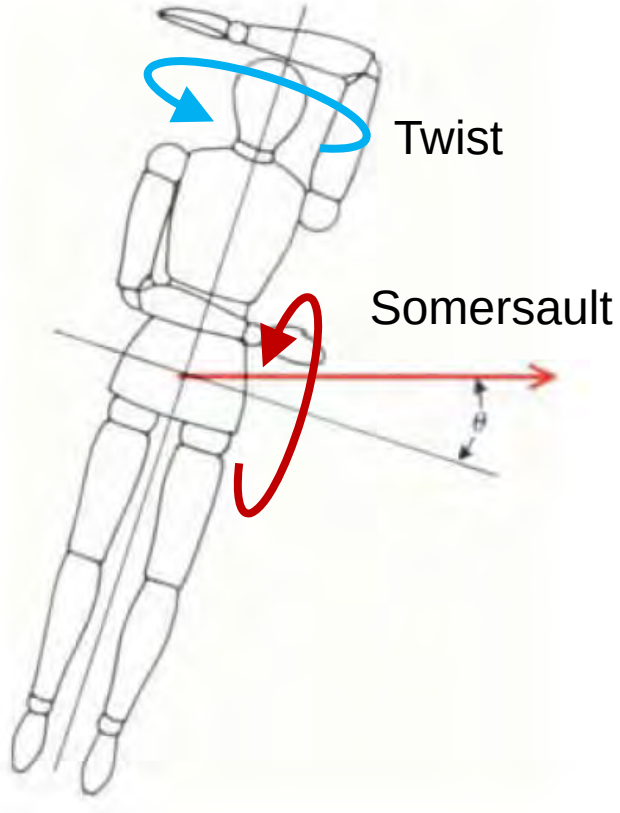


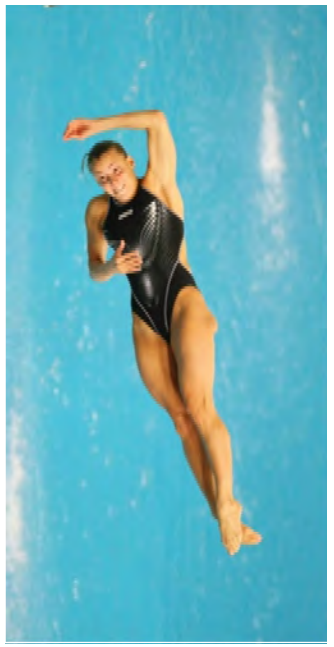


Changing Rotation Axis

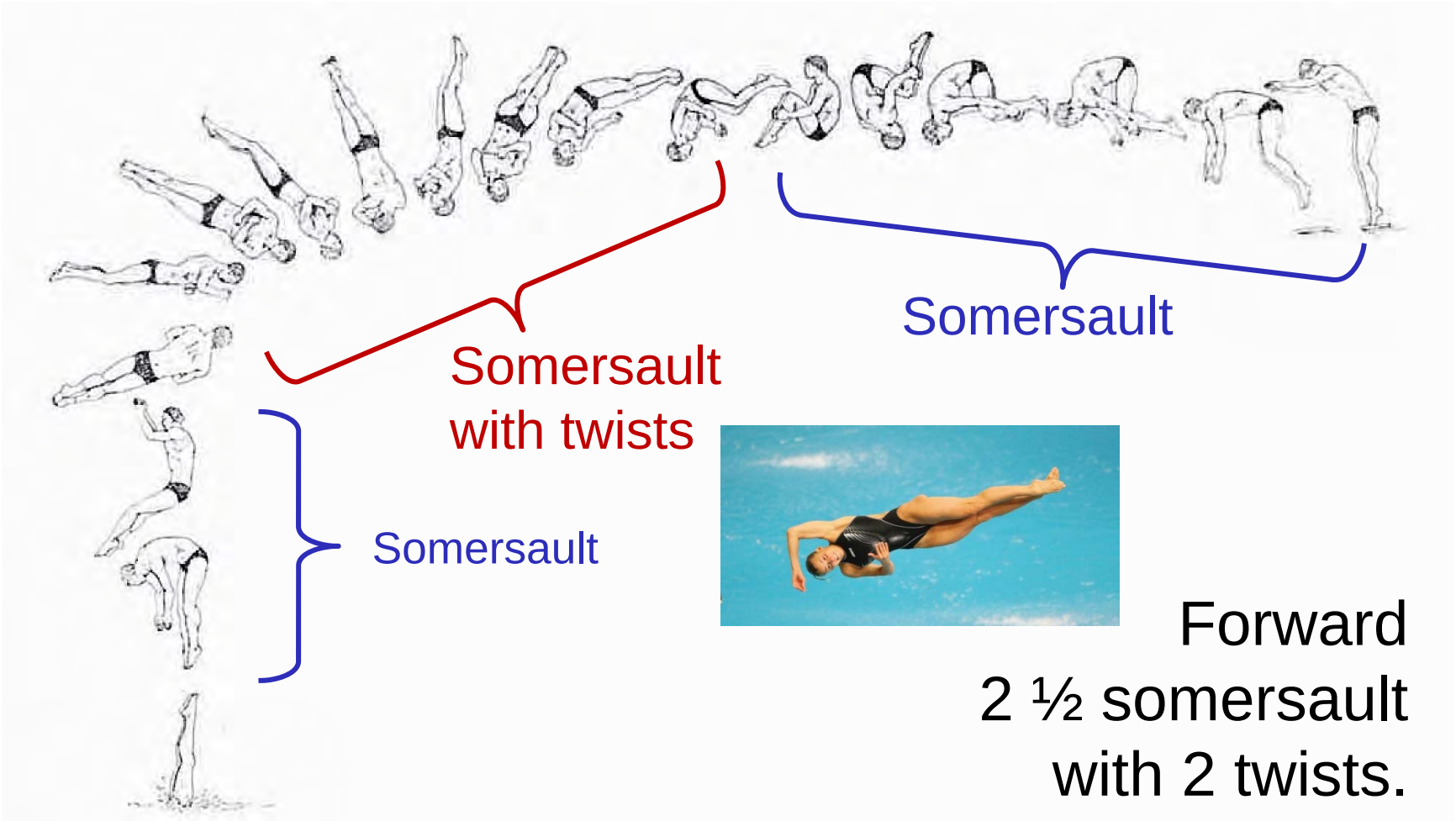
Somersault spin can become a wobbling somersault with twist by changing the pose.







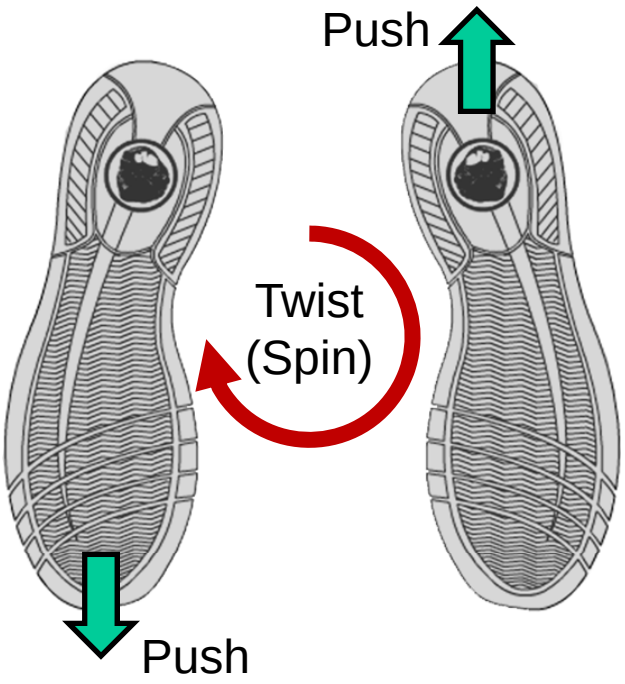
Diving Somersault + Twist



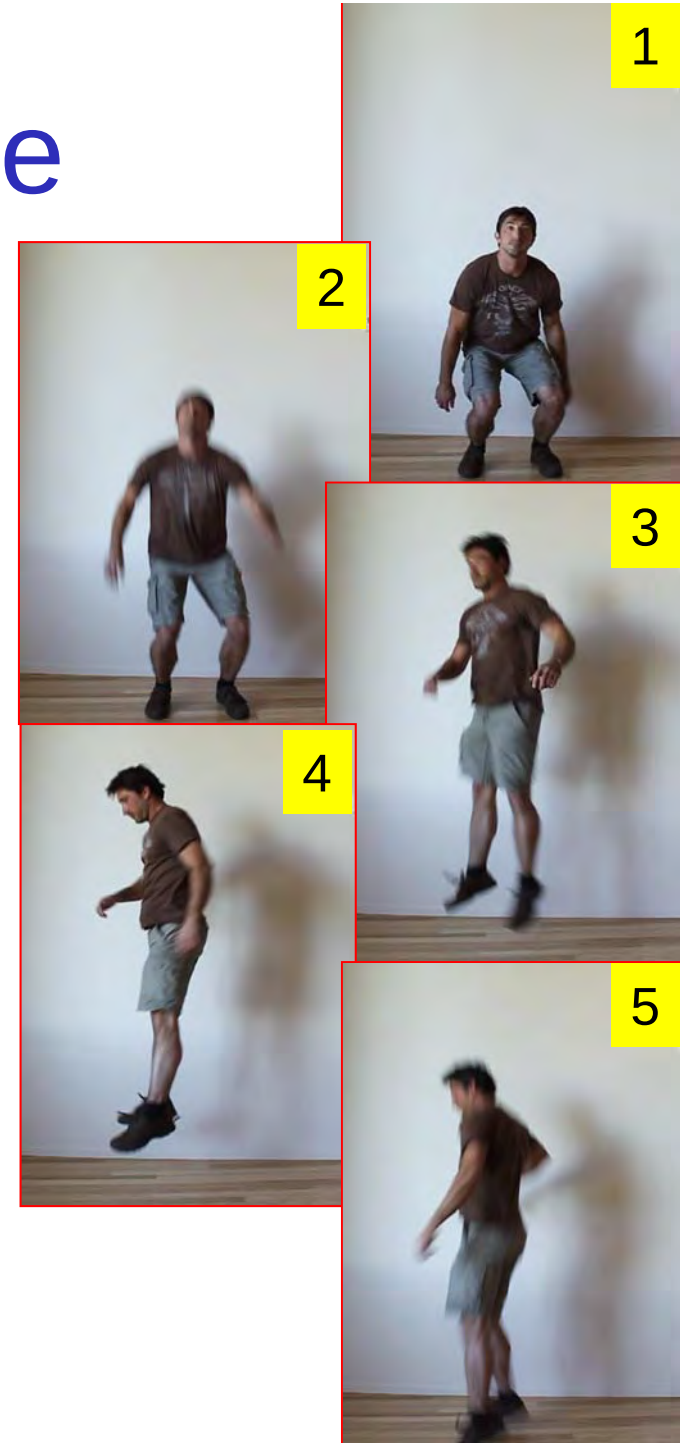
Forward
2 ½ somersault
with 2 twists.

Rotation with a Torque

Spinning is easy when you can create a torque with forces, such as pushing off.



Rick was told to jump up and to land facing toward his right.



Rotation With a Torque

Torque-less Rotation

Try the following:

Jump in the air and at the apex have a friend point either to the left or right.

You should be able to turn and face in that direction when you land.

Jump!

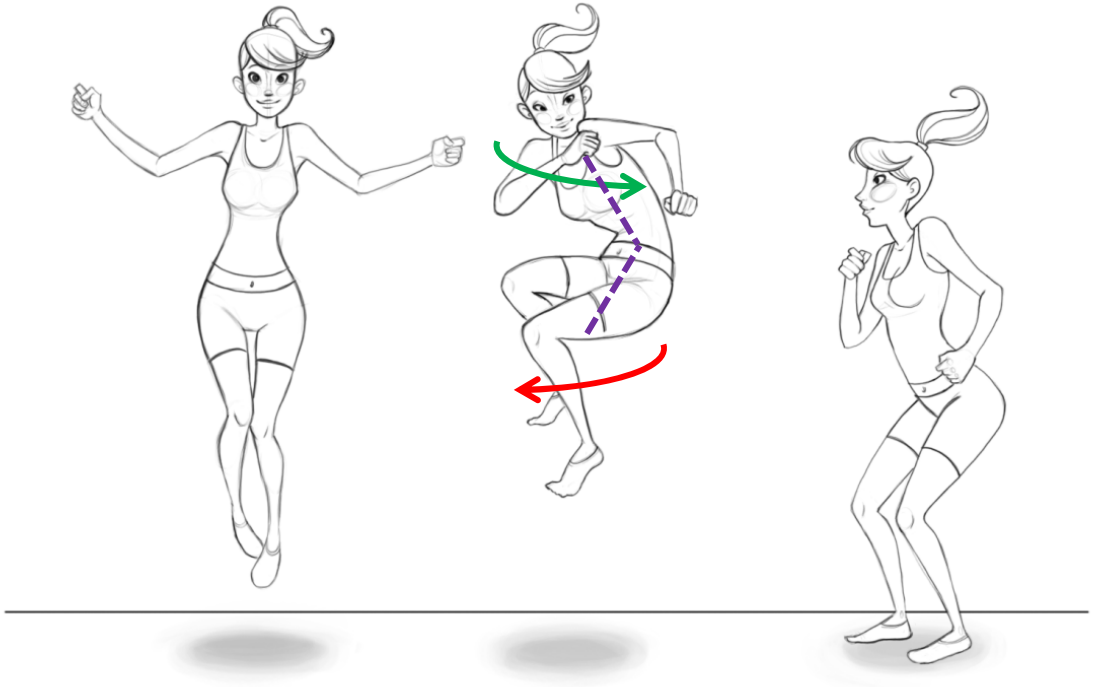
Land

How can you rotate in mid-air without pushing off of anything?

Torque-less Rotation

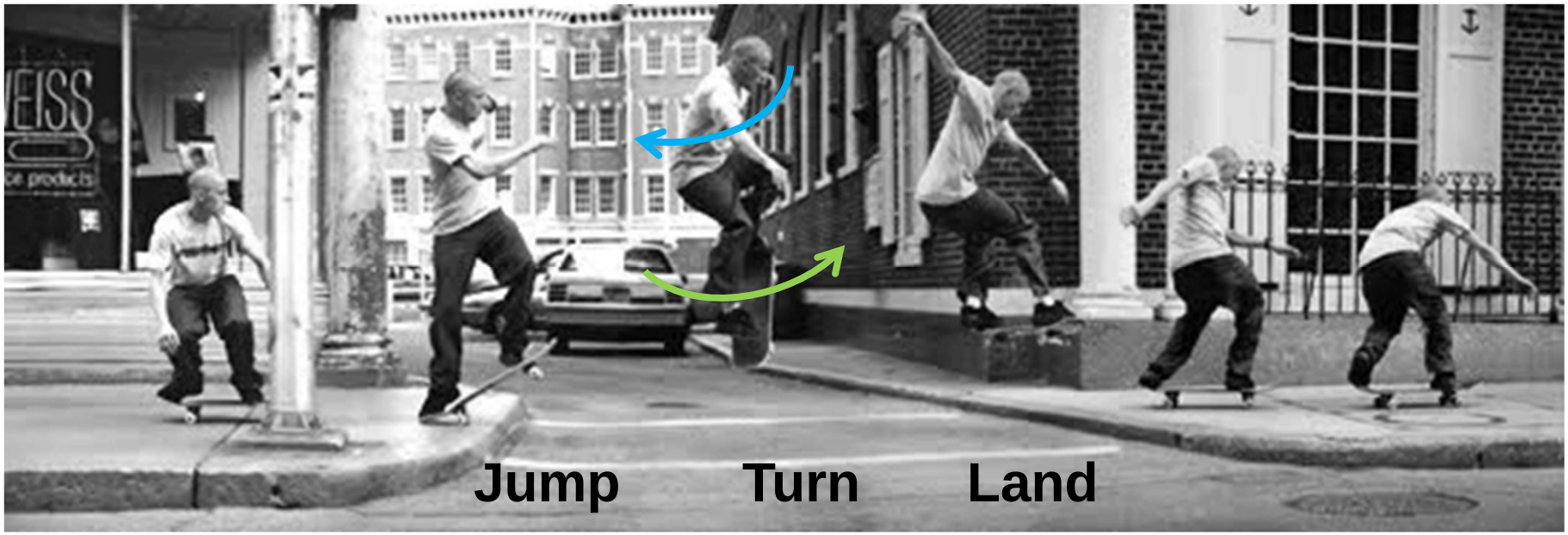
Torque-less Rotation

Twist upper body and lower body in opposite directions; after landing you straighten.



Angling the body helps you to twist it.

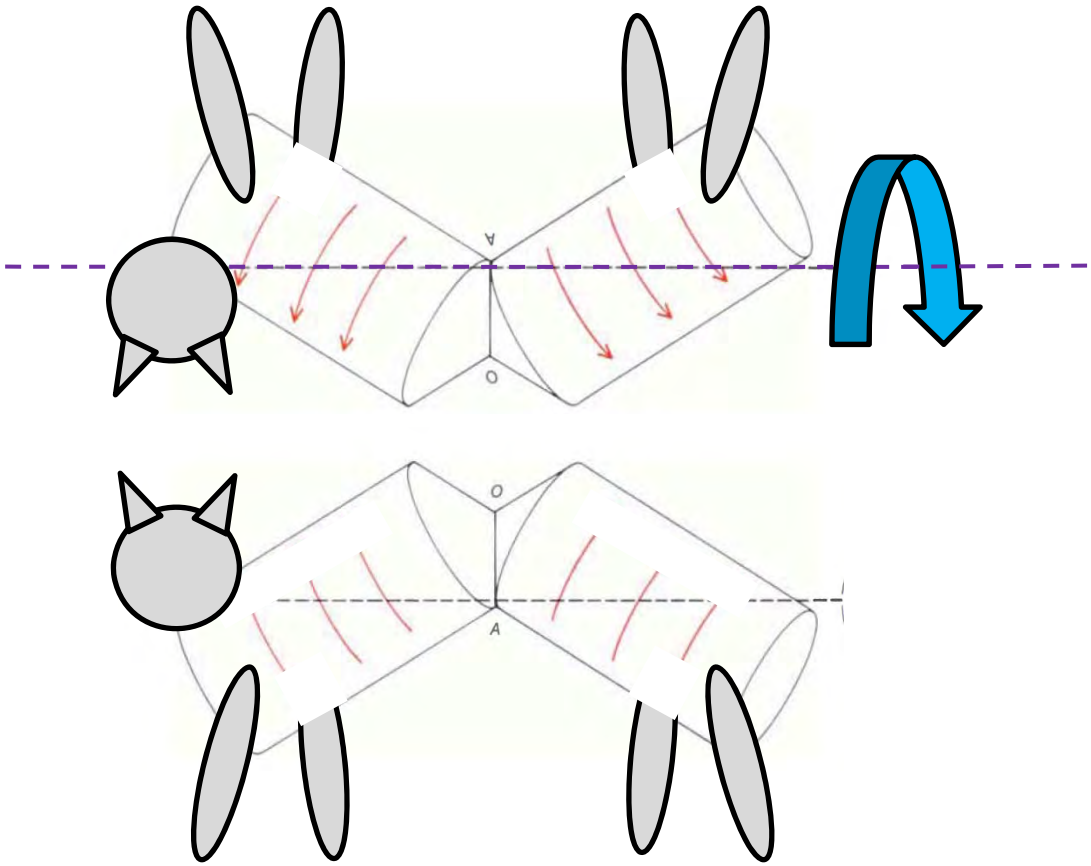
Front Side 180

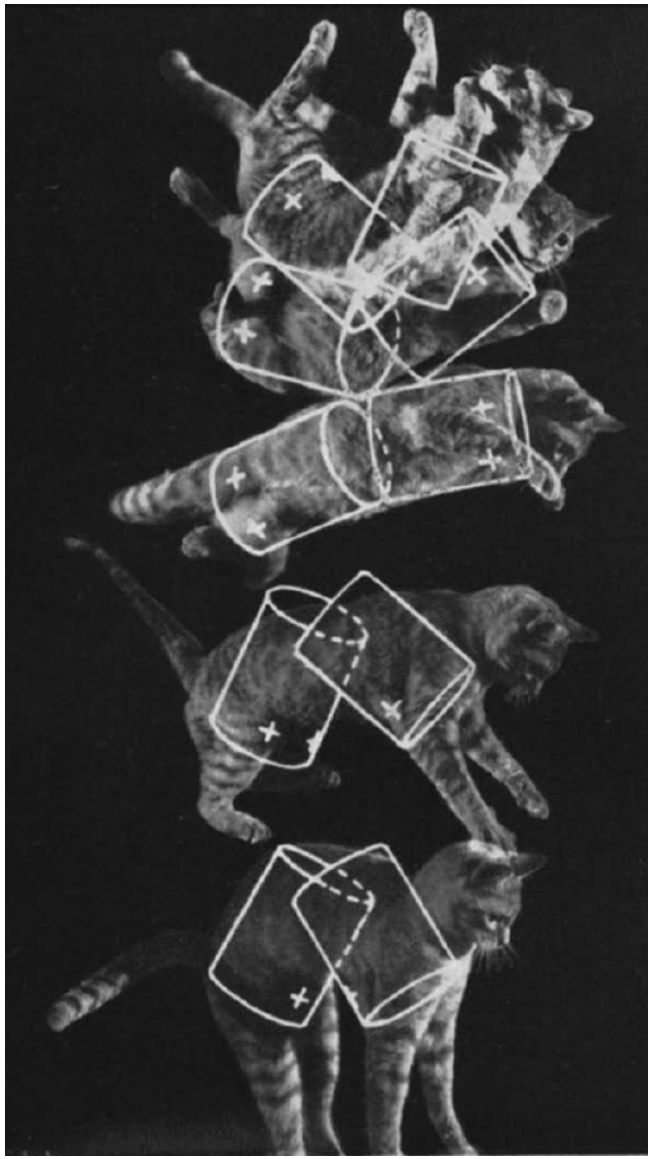


The same principle is used in skateboarding tricks, such as a front side 180, in which a skater does a half turn in mid-air, turning upper and lower torso in opposite directions.

Cat Twists

Cats twist upper and lower body at an angle in order to land feet first.





Cat Twist

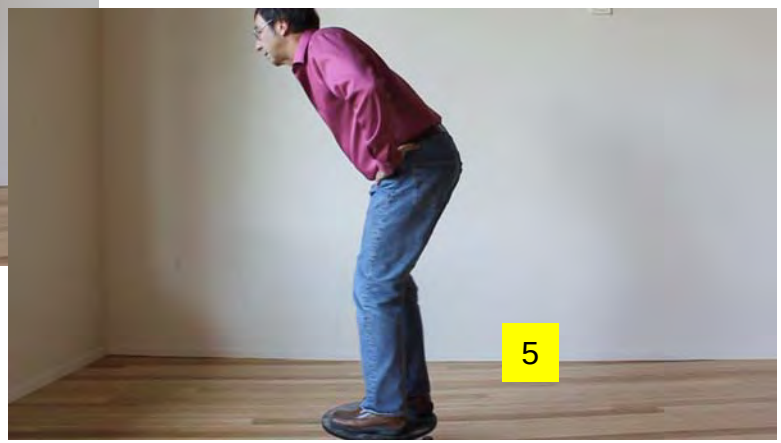
Here is a cat twist done by a real cat.

Mechanical Cat Twist

Human Cat Twist

Human Cat Twists

Swivel hips to perform cat twists standing on a turntable.



Summary

- Rotation can be sped up or slowed down by changing a character's pose.
- Somersaults, twists, and cart-wheel turns may be stable spins or unstable tumbles depending on the character's pose.
- The axis of rotation can change by changing a character's pose.
- Rotations are usually created by a torque but a character can turn without a torque.