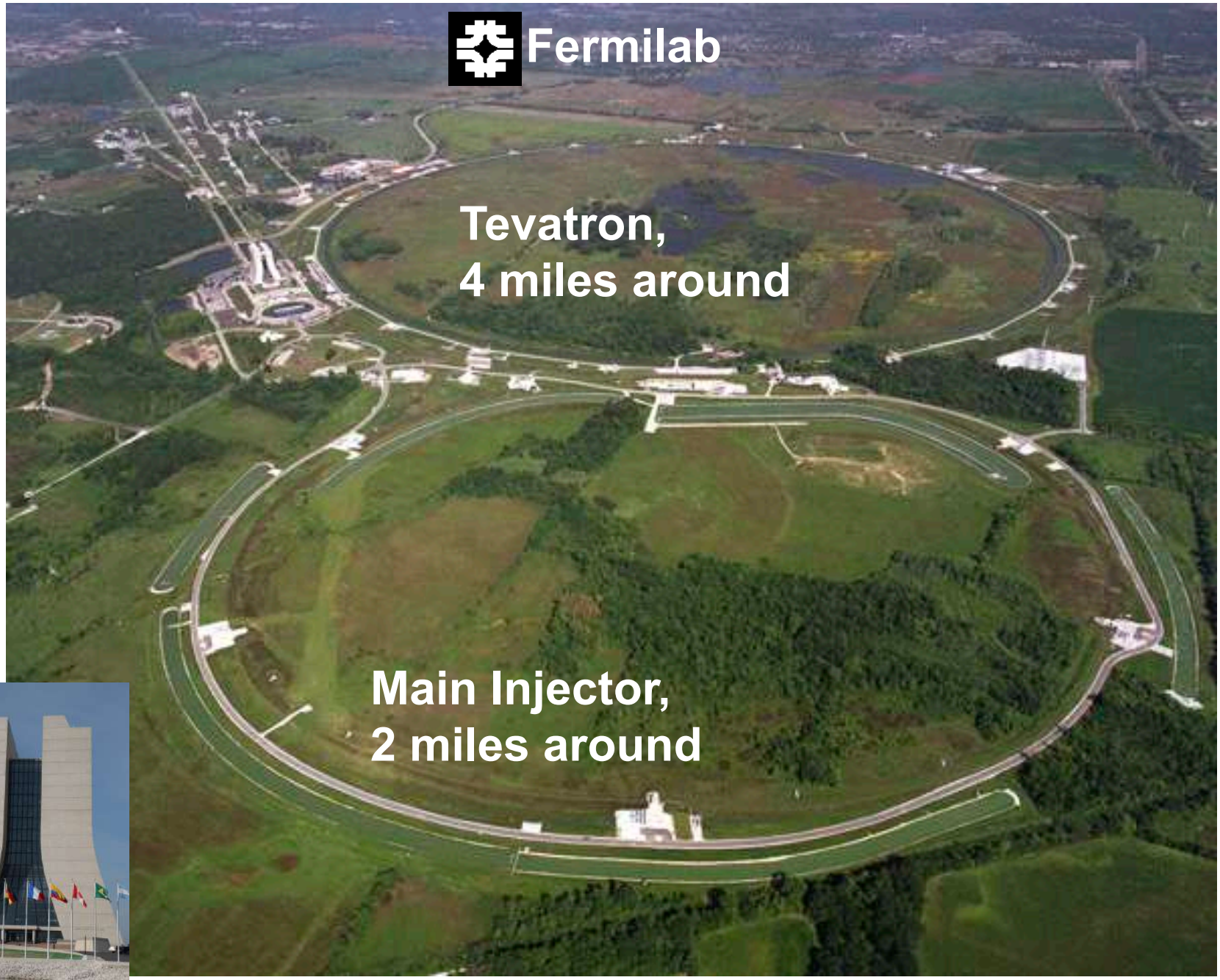
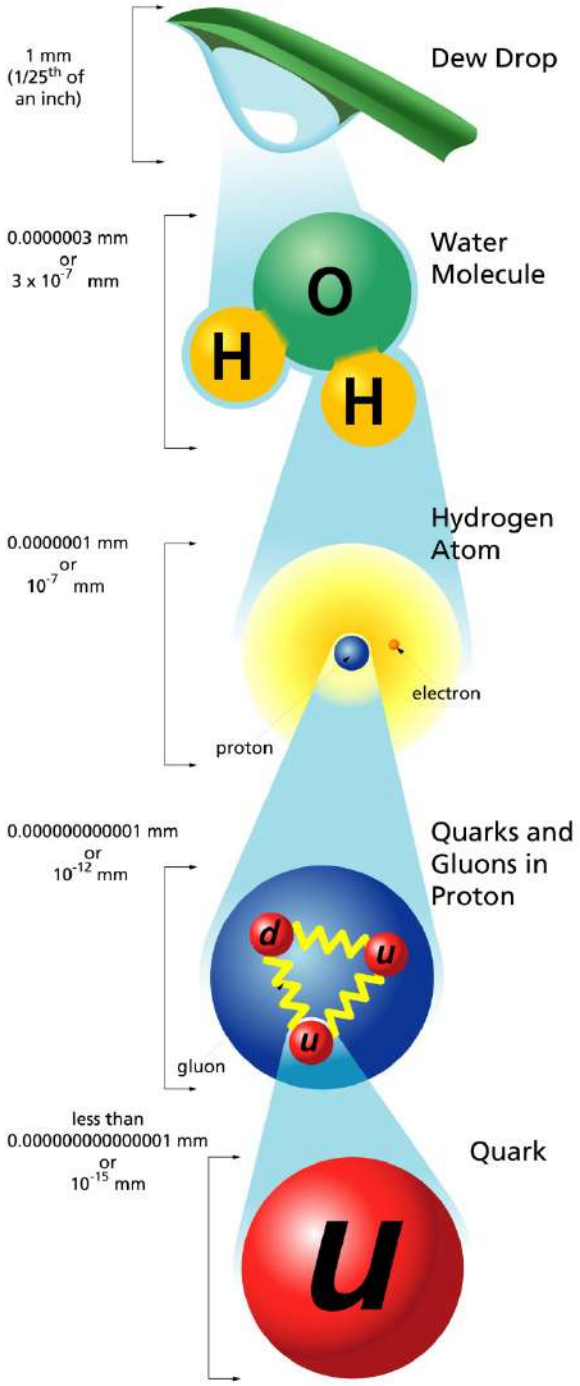
Forces and Motion


Fermilab
Tevatron,
4 miles around
Main Injector,
2 miles around

Physics explains things that are very, very large.

Physics explains things that are very, very small.



Physics explains things that are right in front of us.

Newton's First Law

- **Objects at rest remain at rest**
- **Objects in motion remain in motion**

UNTIL YOU APPLY A FORCE

Objects tend to resist a change in motion. This is called:

Inertia

Newton's Second Law

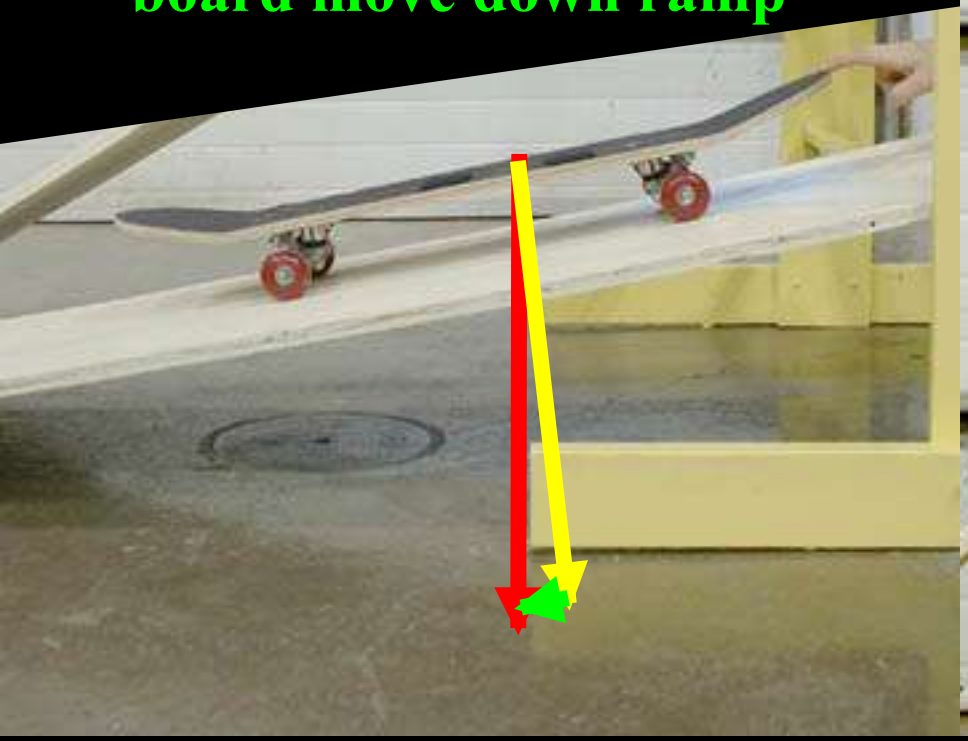
$$F = ma$$

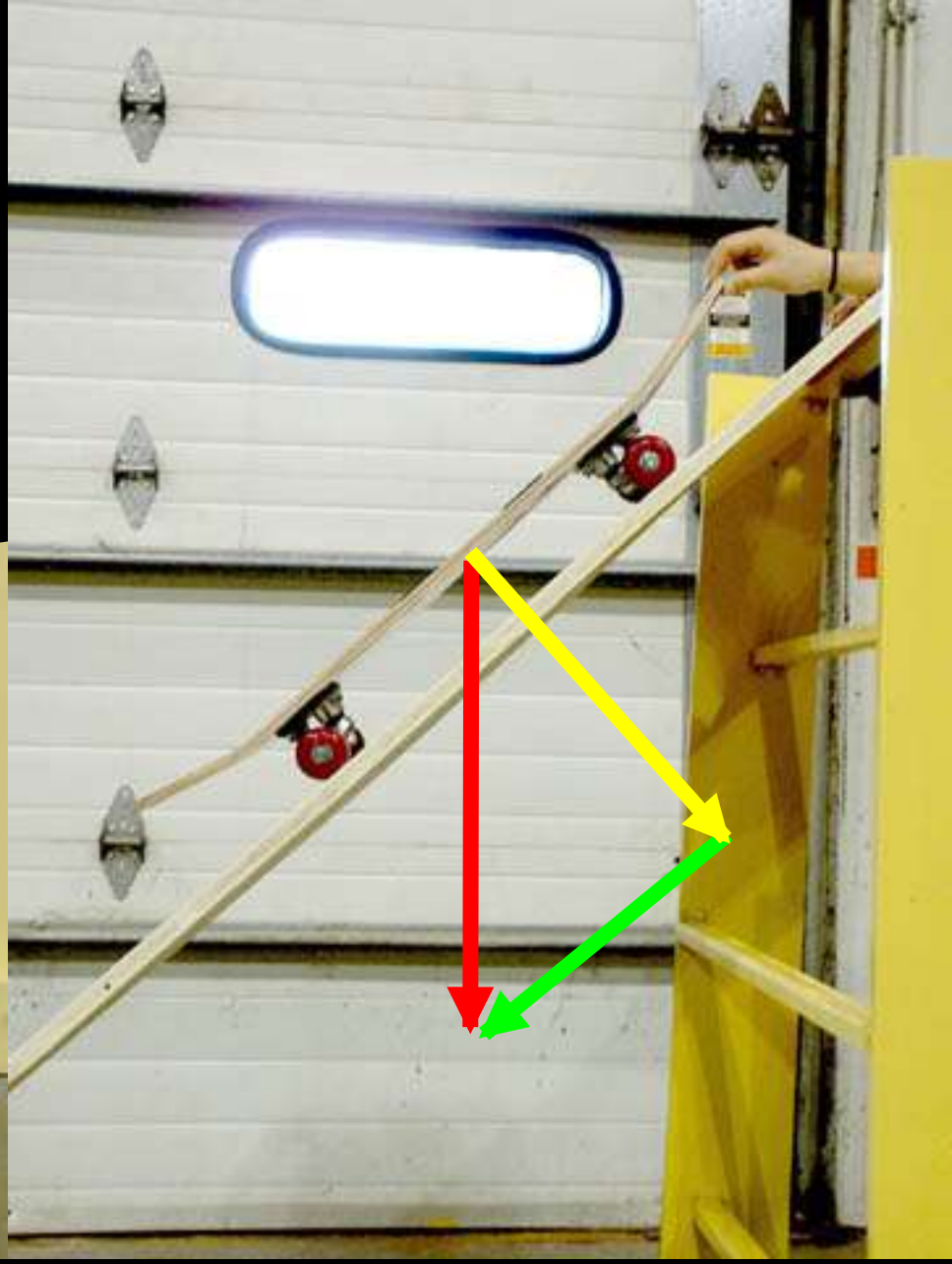
What is a force?

Weight due to gravity (down)

Amount of weight keeping board on ramp

Amount of weight making board move down ramp





Although weight doesn't change, the amount making the skateboard move does


Boards hit bottom at same time

Weight (force) goes up, but so does mass (inertia).

The two cancel out, so the two skateboards move at the same rate.

What do we expect to see with rings of the same size ?


Rings of the same size
move at the same rate

Do the shapes matter?

Rods roll faster than rings

Rings of the same size move at the same rate

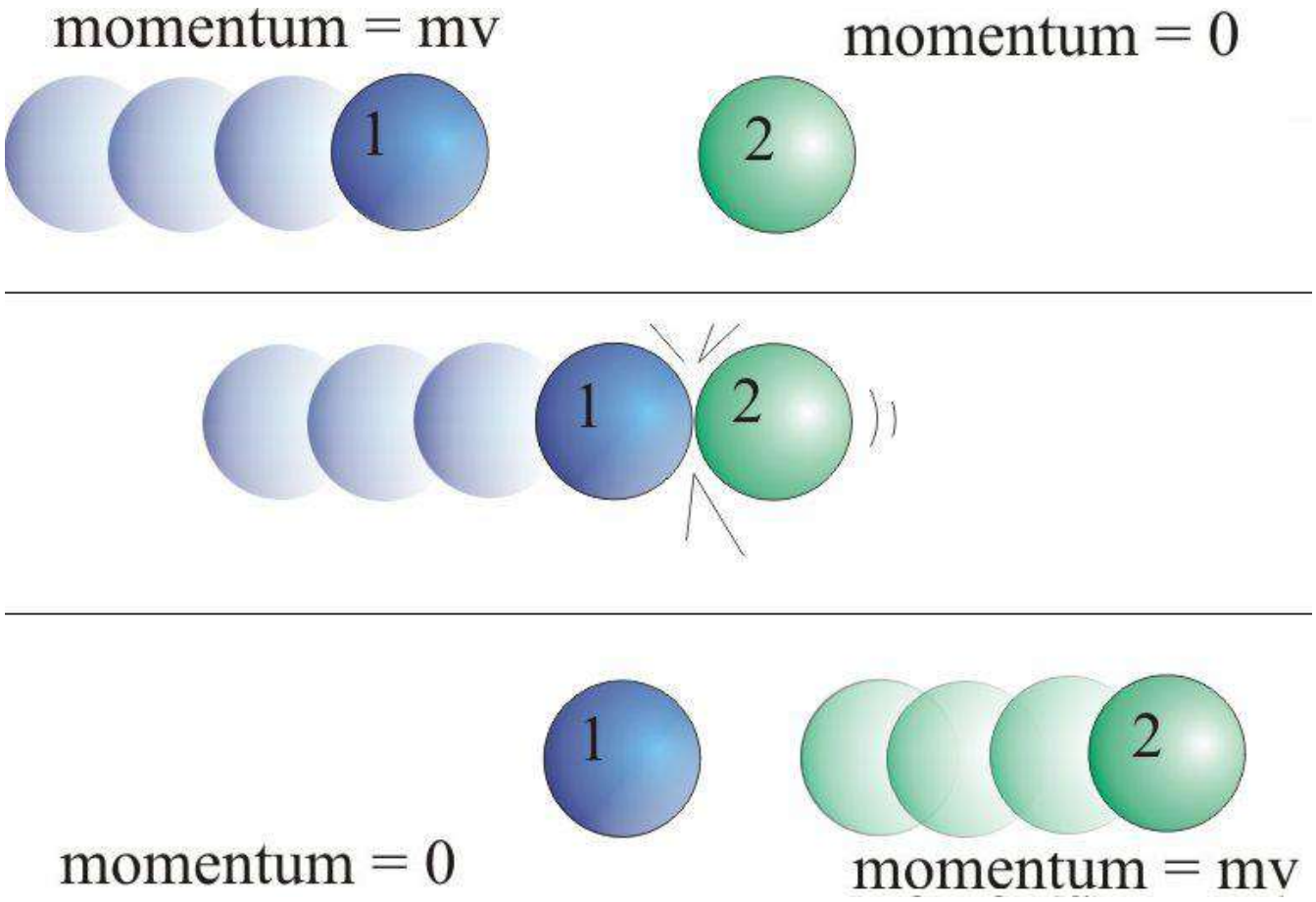
Rods roll faster than rings

In rolling cases, mass doesn't matter.
Shape does.

Newton's Third Law

For every action there is an equal and opposite reaction.

Conservation of Momentum



If $m_1 = m_2$, then $v_1 = v_2$

Conservation of Energy

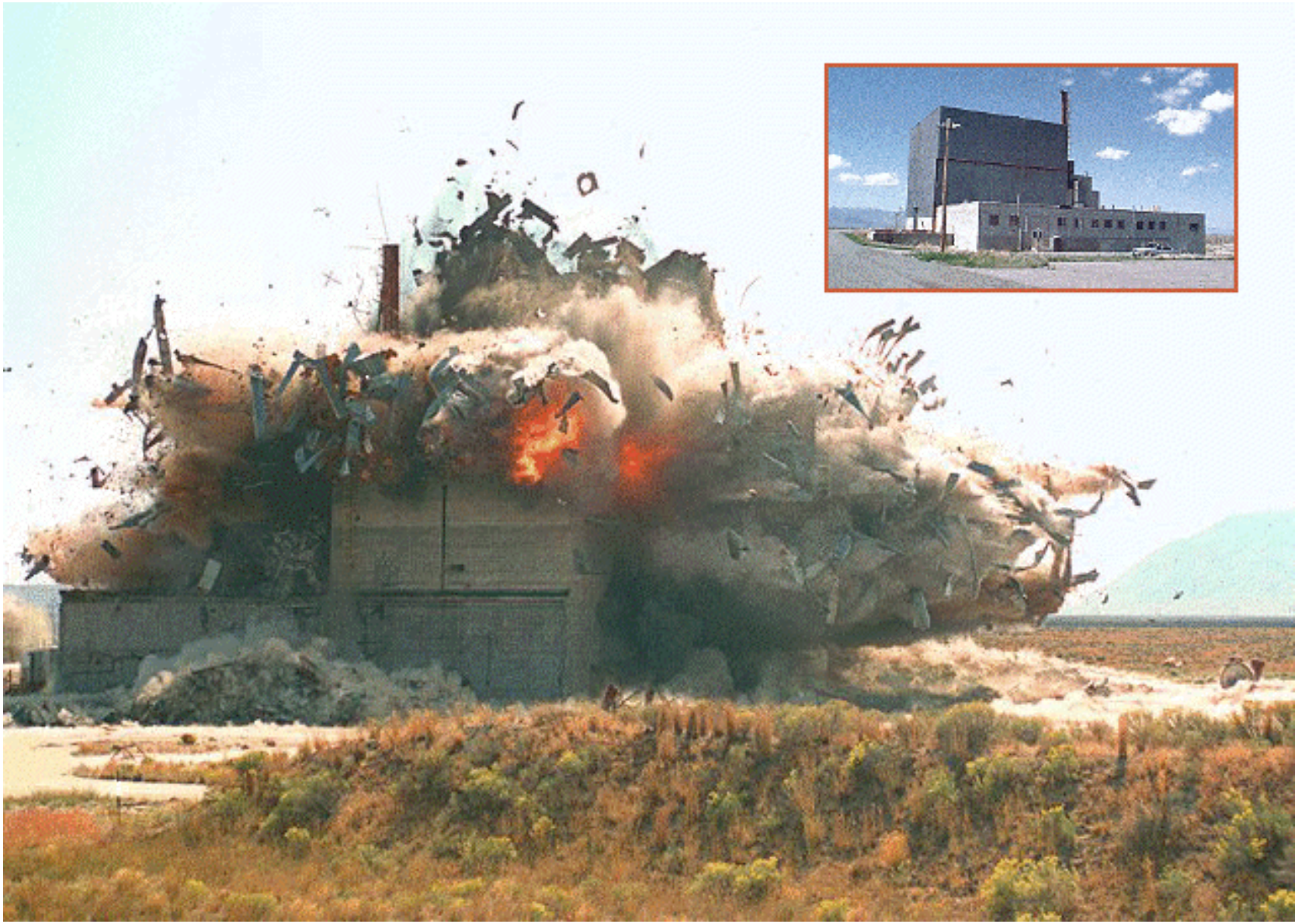
Potential Energy

Kinetic Energy

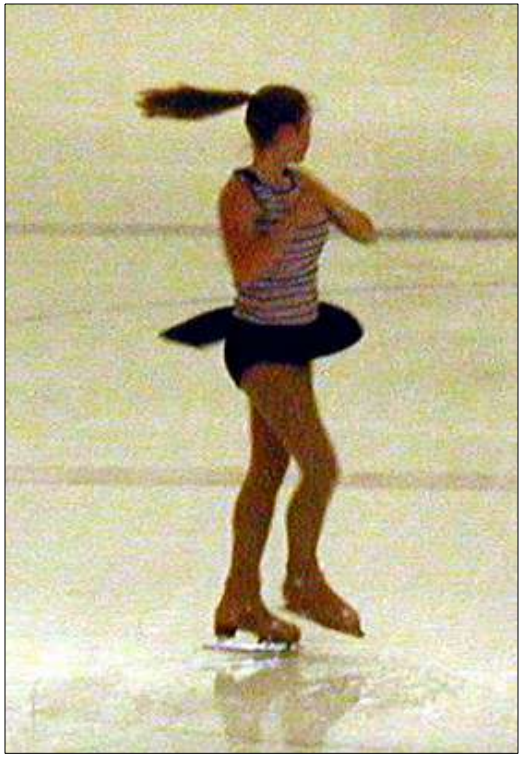
Kinetic Energy

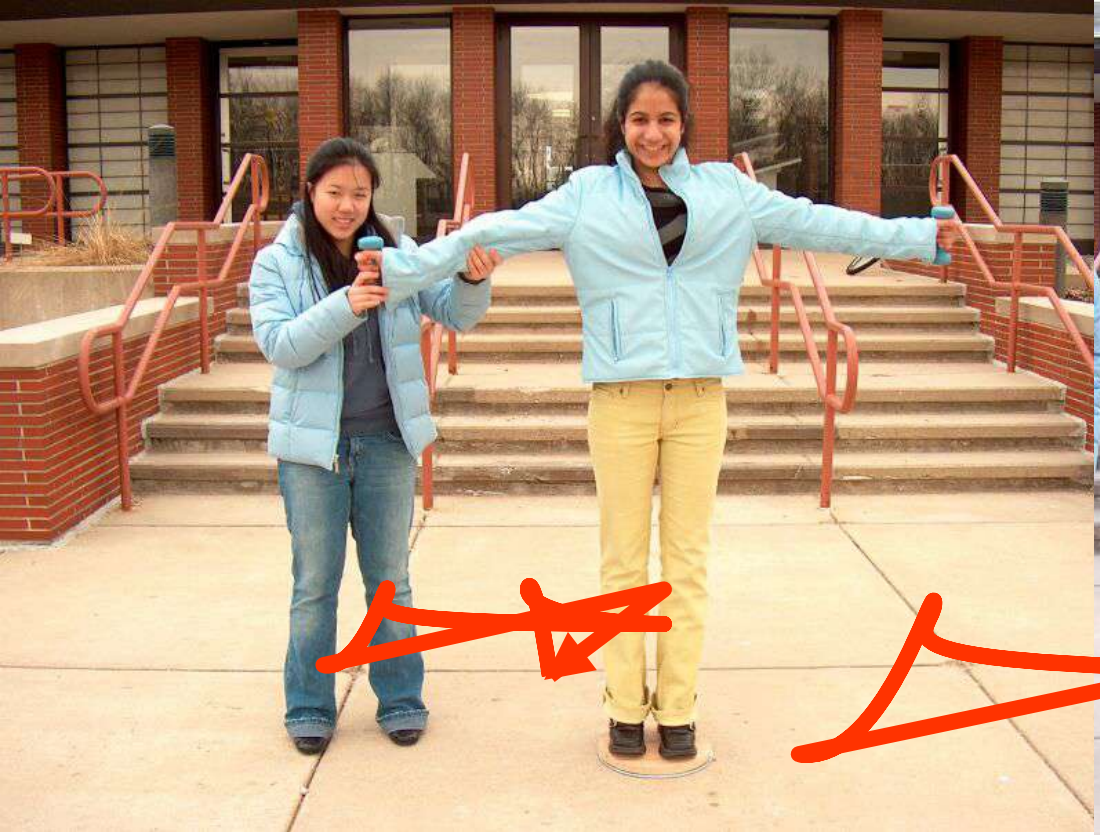
Compression Energy

Heat and Sound Energy

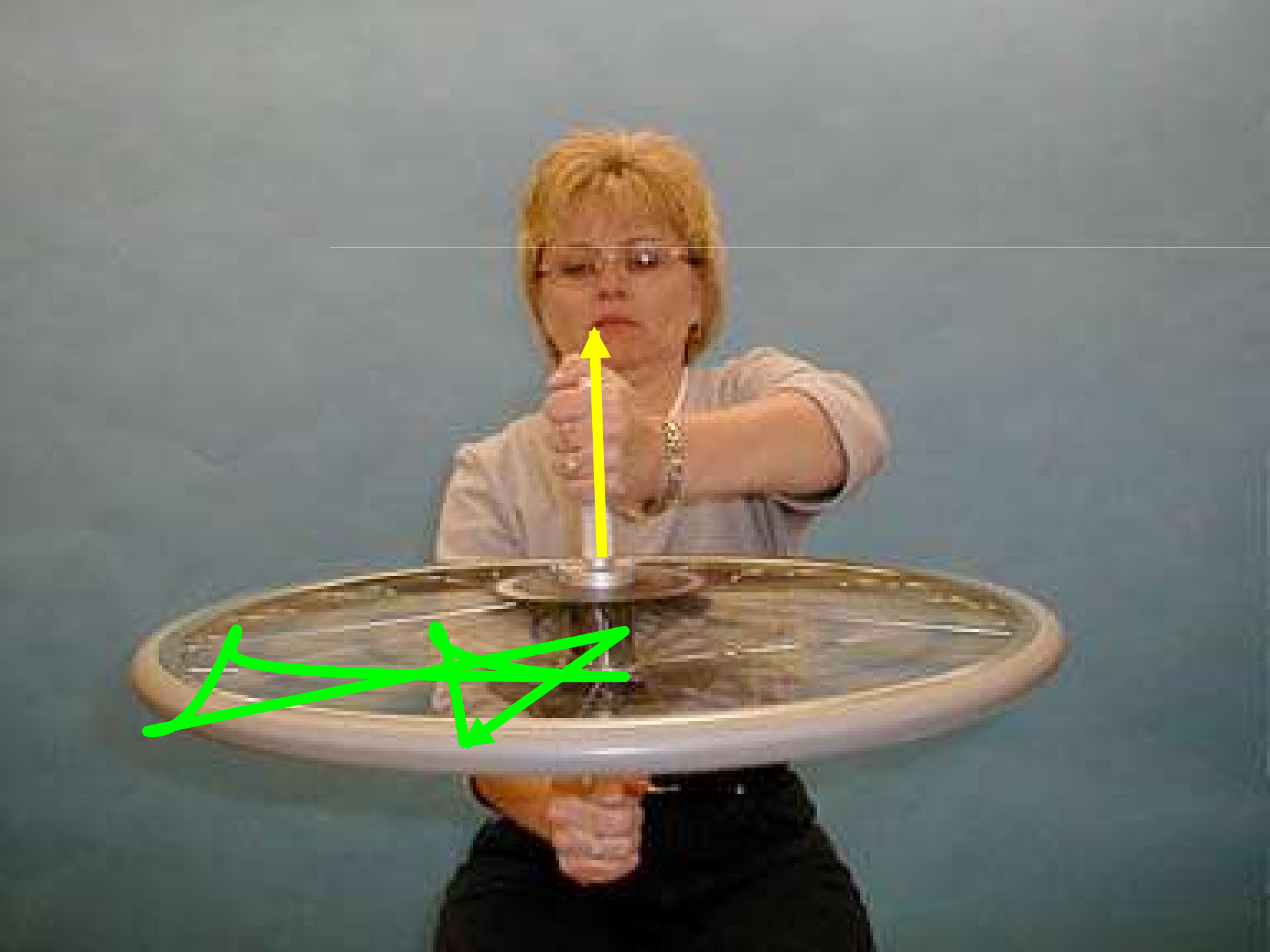


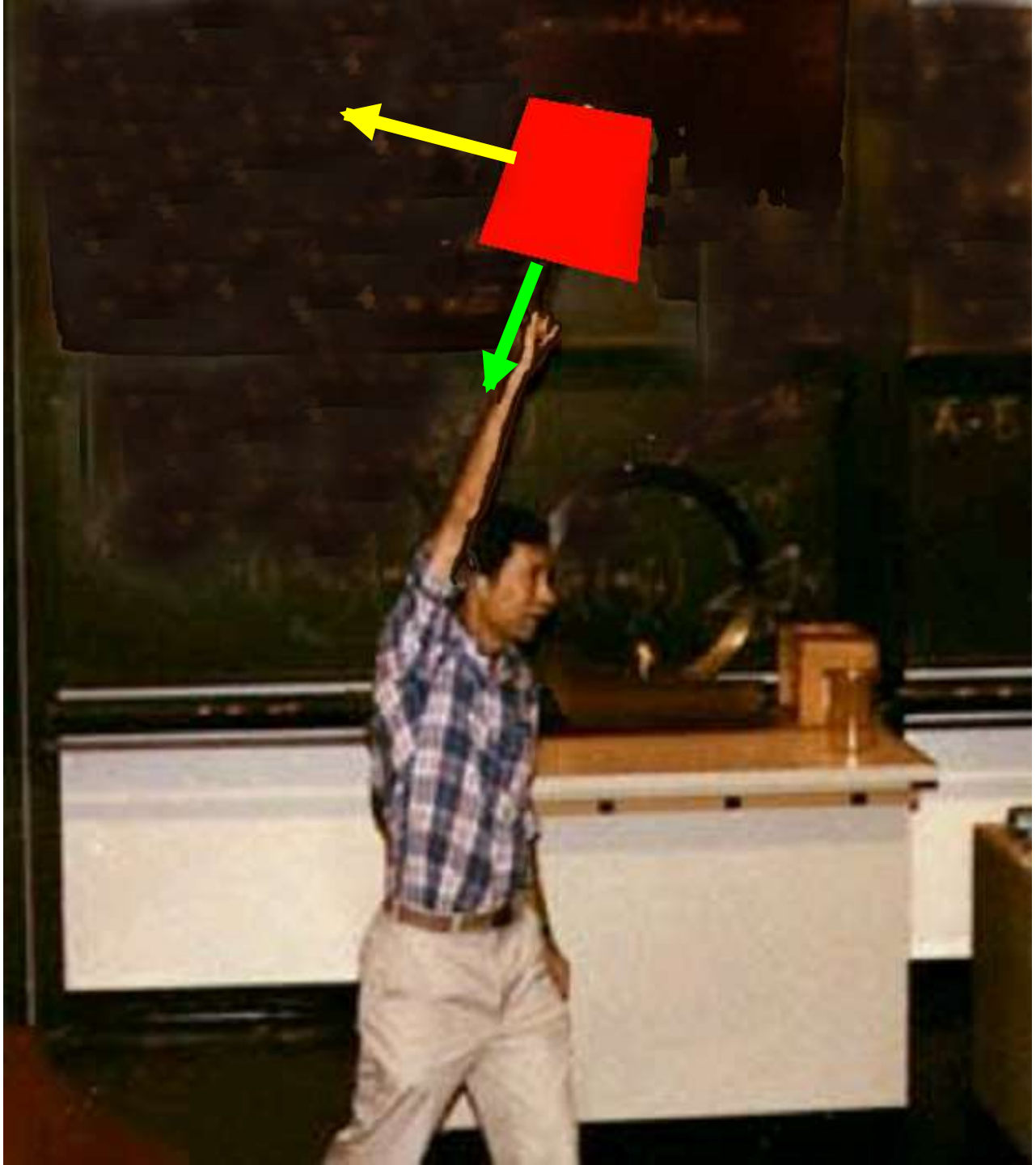
Spins in Figure Skating





Objects with weight far from the rotation axis spin more slowly than ones that are compact.





Things to Remember

- Inertia
  - Moving things stay moving, stationary things stay stationary
- All objects moved by gravity accelerate the same
- Rotating objects act funny
- Some things don't change and that's very useful.