

- Week 1: Everything Is Electric
- Week 2: Is It Magic, or Is It Magnets?
- Week 3: On Your Wavelength: Electromagnetic Waves
- Week 4: Physics of Sound & Music
- Week 5: Energy, Thermodynamics & The Arrow of Time
- Week 6: Push and Pull: Force & Motion**
- Week 7: Go With the Flow: Physics of Fluids
- Week 8: A Warm Planet in a Cold Universe: How the Earth Stays Warm, and Why It's Getting Warmer

Physics Principles

Types of Forces

What Forces Do

Laws of Motion

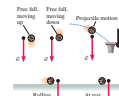
Torque and Rotation

Force and Motion

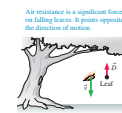
A change in motion is an acceleration.

Acceleration requires a net force

Weight



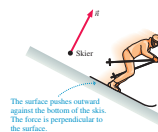
Drag



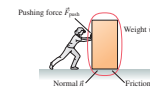
Tension



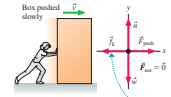
Normal



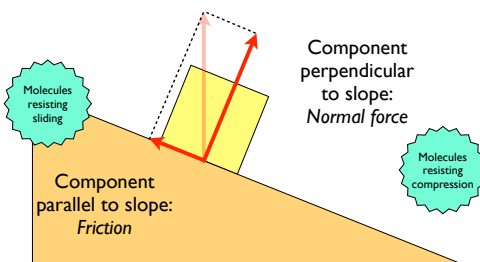
Static Friction



Kinetic Friction



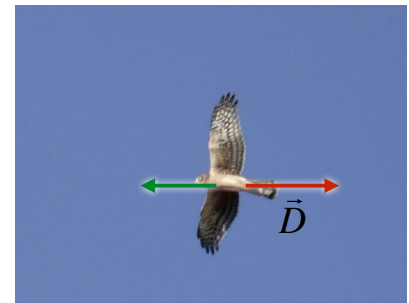
Friction and Normal Forces



Drag force

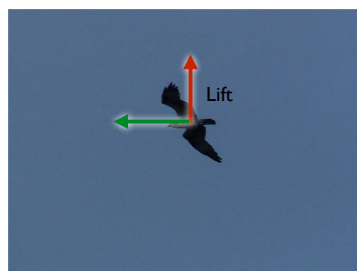
Direction:
Opposite motion of air

Magnitude:
$$D = \frac{1}{2} C_D \rho A v^2$$



Lift force

Direction:
Perpendicular to velocity



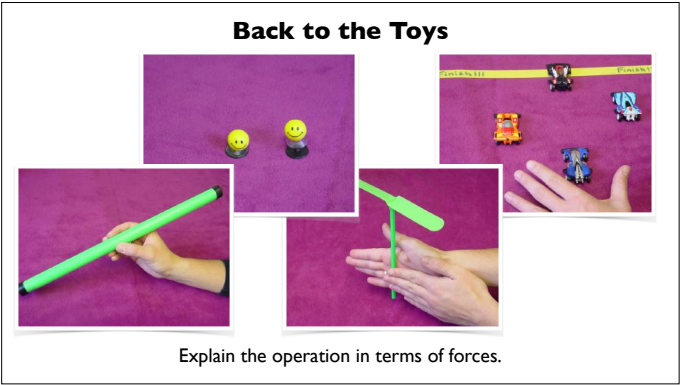
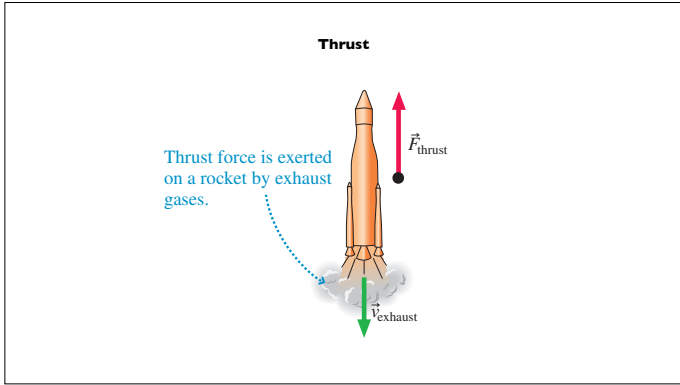
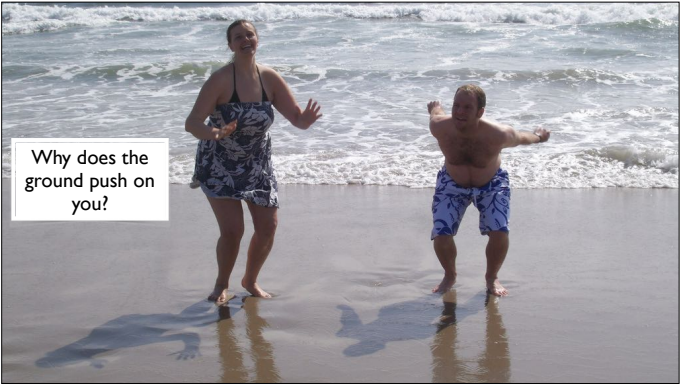
A force is a push or a pull.

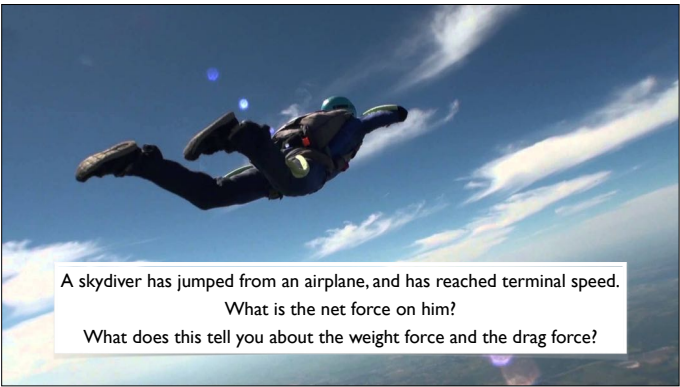
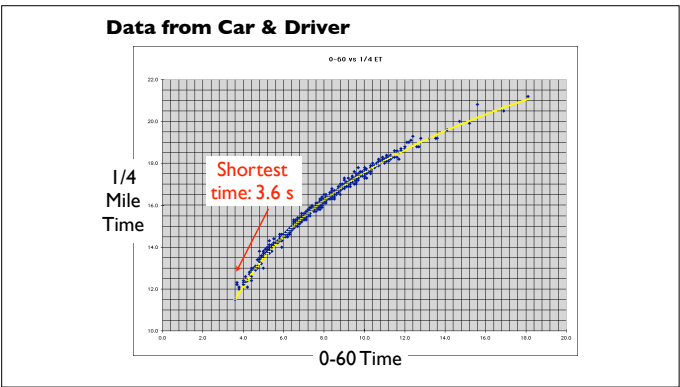


A force acts on an object.



A force requires an agent.



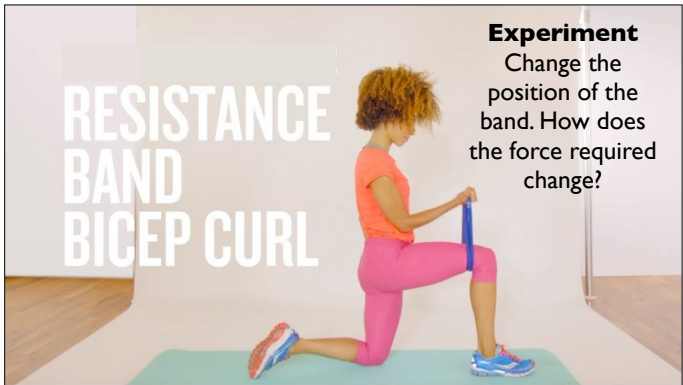
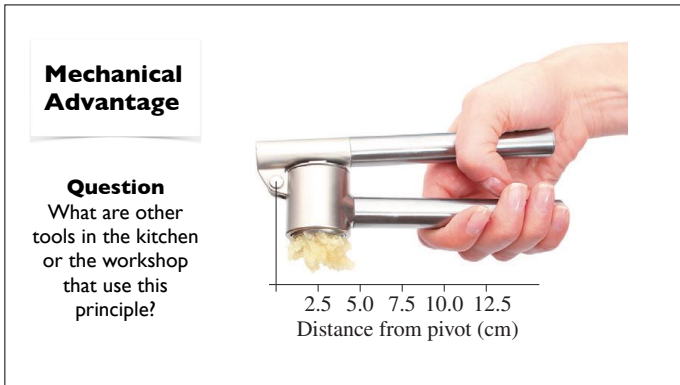
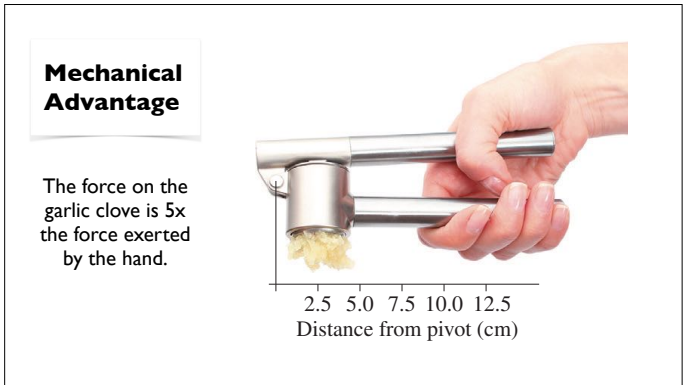
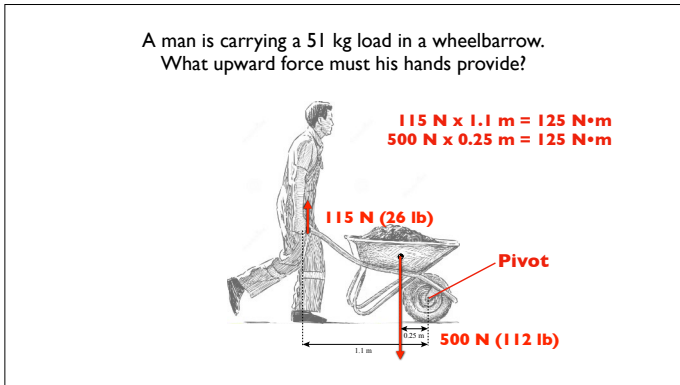
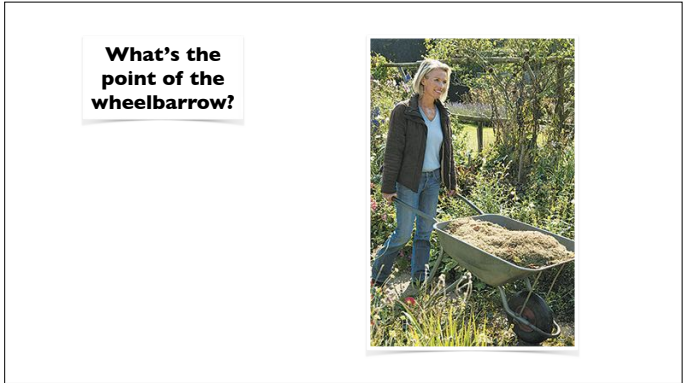
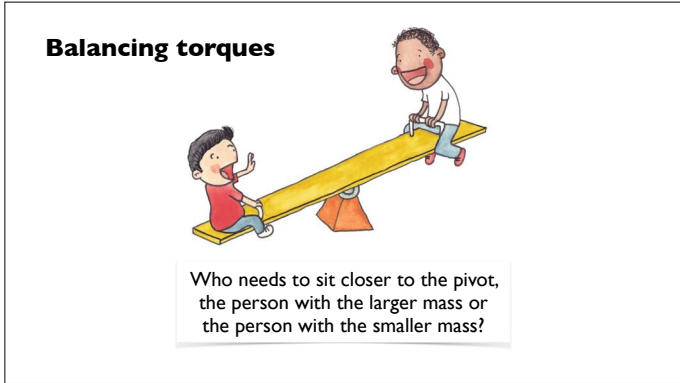
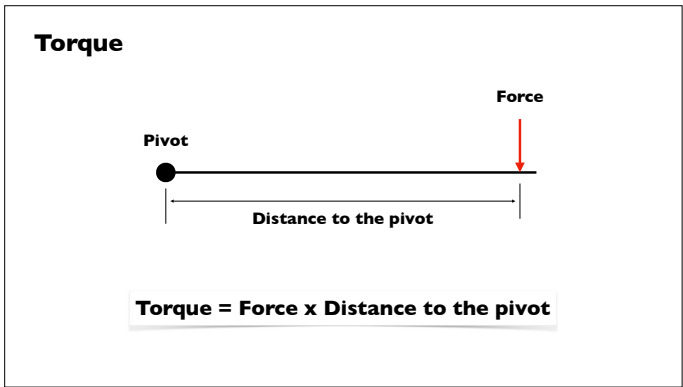


Apparent Weight

w_{app} = magnitude of supporting contact forces (5.4)
Definition of apparent weight

The man feels heavier than normal while accelerating upward.



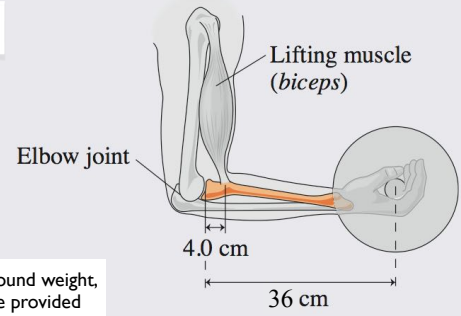


Negative Mechanical Advantage

The force provided by each quadriceps for this stance is more than 5x the person's weight

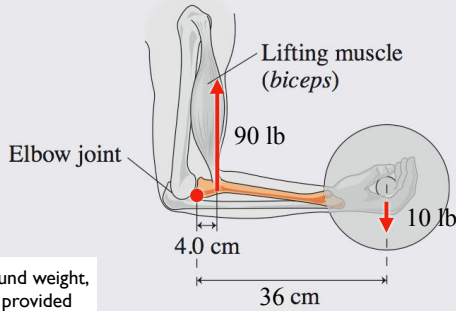


The Curl



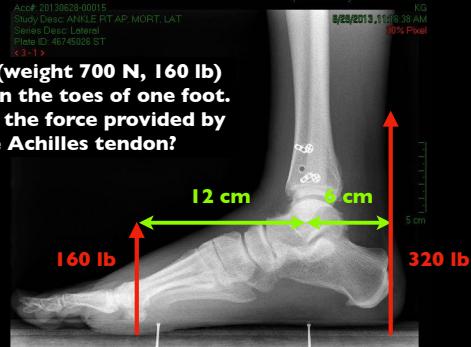
If you lift a 10 pound weight, what is the force provided by your biceps?

The Curl

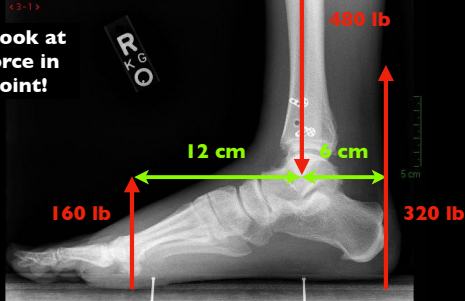


If you lift a 10 pound weight, what is the force provided by your biceps?

A man (weight 700 N, 160 lb) stands on the toes of one foot. What is the force provided by the Achilles tendon?



Now, look at the force in the joint!



Question
Every joint in your body has negative mechanical advantage.
Are there any beneficial tradeoffs?

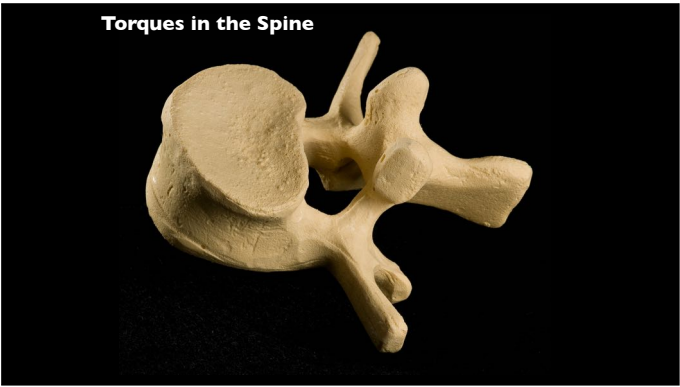


Which one is a digger, which one is a jumper?



Jumping





Bending at the Waist

A 70 kg man bends forward at the waist; the gravitational torque is balanced by muscles along the back. If you assume that 55% of his weight is in his torso, and the center of gravity of his torso is 43 cm from his hips, and the moment arm for his spinal muscles is 0.060 m, what is the force provided by the muscles?

Bending at the Waist

Man's weight: 690 N (150 lb)
Muscle force: 1370 N (310 lb)

Bite force

