# Friction = force that opposes motion

sliding friction

$$\mu = \frac{F \text{ to slide}}{F_g}$$

*no units*

# Friction

- force that opposes motion
- opposite direction from motion
- At point of contact with the surface
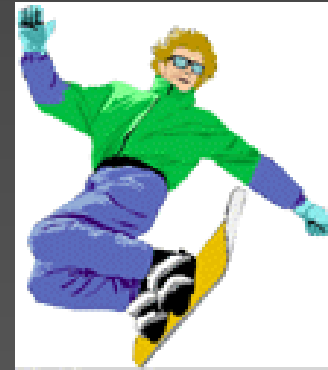
F → □ ← μ
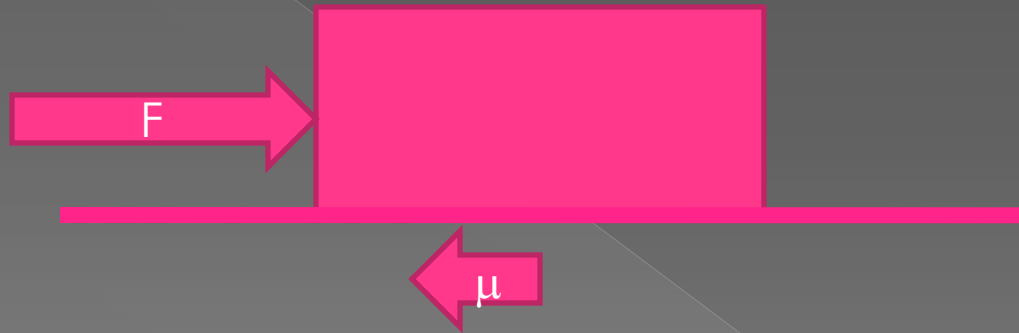
# Three types of friction



Airport Runway Friction Tester

# Sliding Friction

- solid surfaces slide against each another
- depends on the weight of object and surface involved

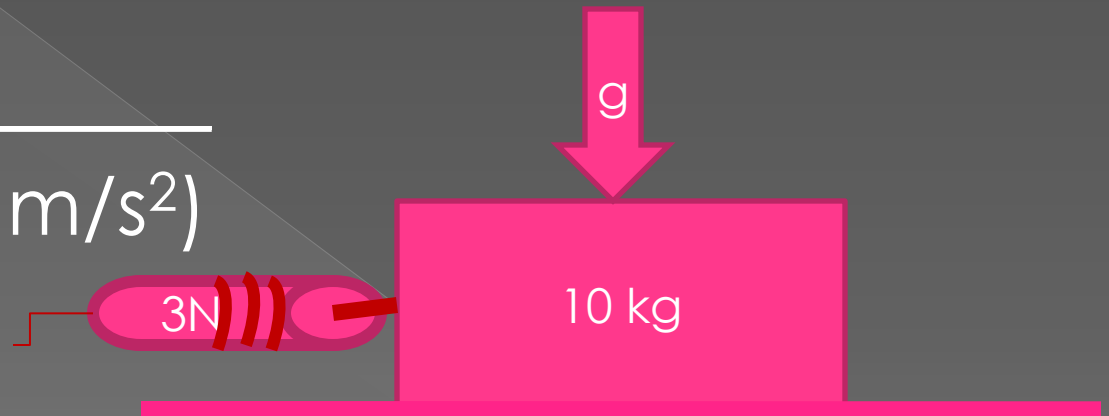- Example: Is it easier to slide on ice or gravel?

# Coefficient of friction

- $\mu =$ **Force** to slide object at constant velocity
  perpendicular **Force** of mass x gravity

Example: What is the coefficient of friction for a box with mass 10 kg that requires a force of 3 N to pull across a table at constant velocity?

$$\mu = \frac{3\ N}{(10\ kg)(9.81 m/s^2)}$$

$\mu = 0.03$

g

3N

10 kg

# Rolling Friction

- Object rolls over a surface
- less opposition than sliding friction; less surface area in contact.

- Example: Adding wheels or ball bearings helps reduce friction

# Fluid Friction

- Surfaces separated by layer of fluid (=liquid or gas)
- Least opposition to motion

- Example: oil in car engine