Meet the Forces

Types of Forces

1. **F_g = Weight**
   - Present all the time, unless you are in the middle of space
   - F_g = mg & g=10 m/s^2 on Earth
   - F_g pulls objects towards the Earth.
2. **F_T = Tension = Force of a String**
   - F_T always **pulls** on an object. F_T indicates the tightness of a string. Loose strings have F_T = 0 N.
   - To experimentally measure F_T, cut the string anywhere and insert a spring scale
   - F_T always points away from an object, along the rope.
   - Each rope has a single tension throughout its length.
3. **F_{app} = Applied force**
   - When a human or engine pushes or pulls
   - If there is no friction, an applied force isn't needed to maintain motion.
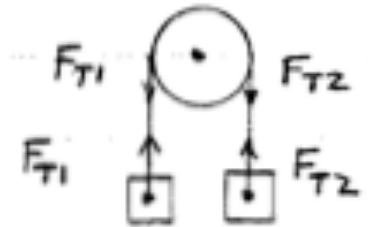
4. **F_S = Springs**

- Can be push or pull.
- Springs are restoring forces because they always pull or push the object back to the origin, regardless of the state of motion.
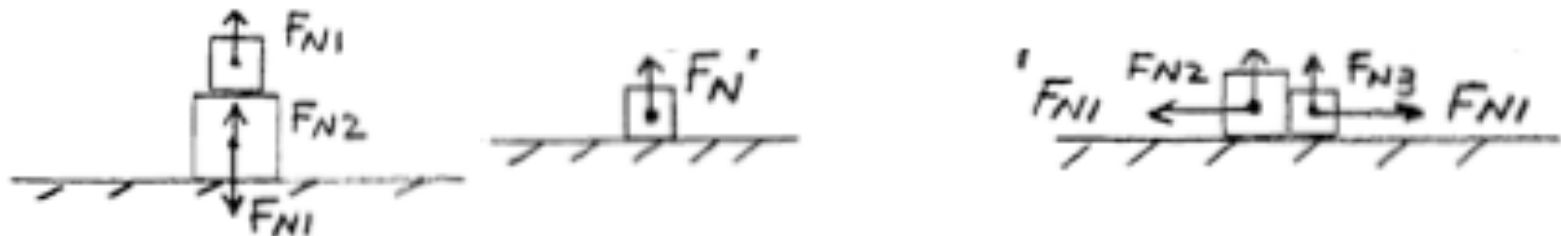
COMPRESSED   STRETCHED   AT EQUILIBRIUM:

F_S F_S $F_S = 0$

0   0   0
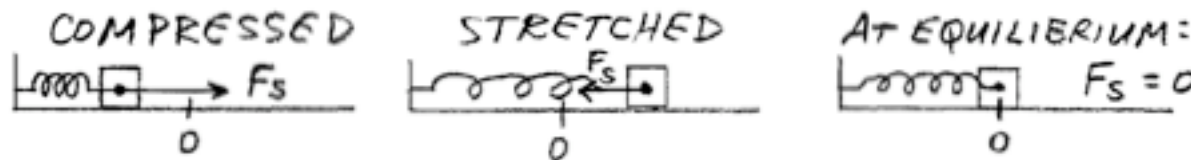
5. **F_f = Friction**

- When an object moves across a rough surface or experiences drag
- Always opposes motion or attempted motion

F_f FALLING APPLE

F_g
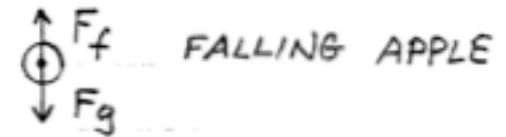
6. **F_N = Normal Force**

- F_N is caused by touching something and always points perpendicular away from what the object touches.

F_{N1}

F_{N2}

F_{NI}

F_N'

F_{NI} F_{N2} F_{N3} F_{NI}

Force (Free Body) Diagrams

- **Drawing complete and accurate force diagrams is ABSOLUTELY ESSENTIAL.**

- The mathematical equations to solve a dynamics problem come directly from the cartoons. Each problem has a unique diagram and therefore an individualized formula.

- **Recipe:**

1. Identify the body in which we are interested. Put a dot in the center of this object and our brain on this dot.

2. Put the relevant forces: F_g, F_T, F_S, F_f, and F_N, along with $F_{applied}$, emanating **out** of the dot.

3. Forces that are the same amount should be represented by arrows that are the same length.
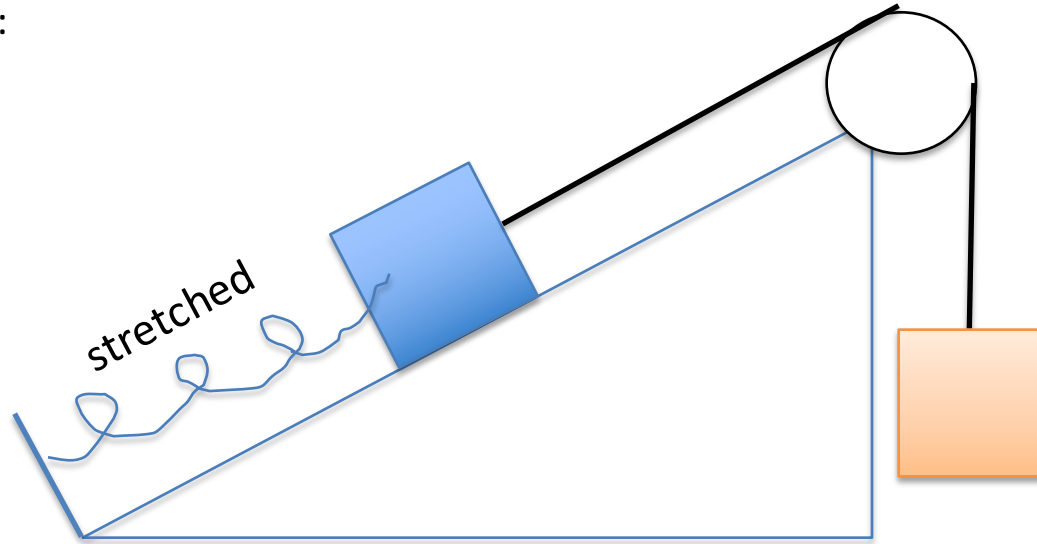
4. Warning: Motion is **NOT** a force.

Example: Elevator
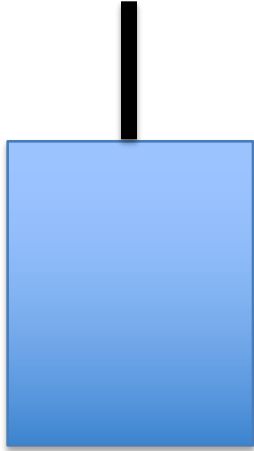
Example: Person pushing a block at constant speed
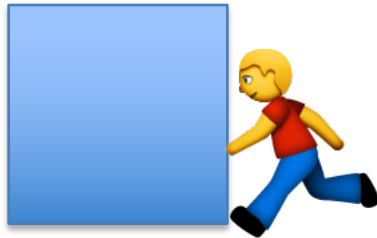
Force Diagram Examples:

System is not moving:

stretched

Tractor moving at constant speed to the left:

Tractor skidding to a stop: