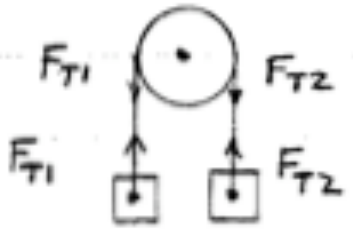
Meet the Forces

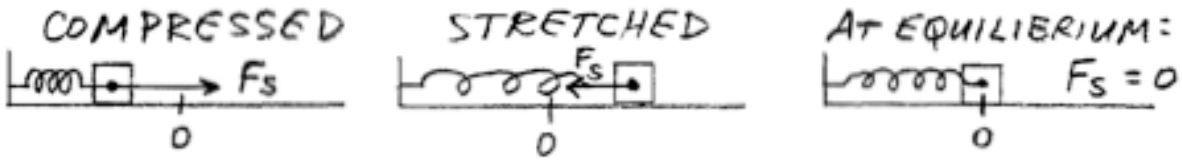
Types of Forces

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 **<u>pulls</u>** 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.

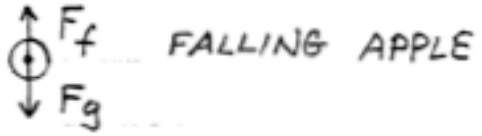


3. **F_{app} = Applied force**
   - When a human or engine pushes or pulls
   - If there is no friction, an applied force isn't needed to maintain motion.

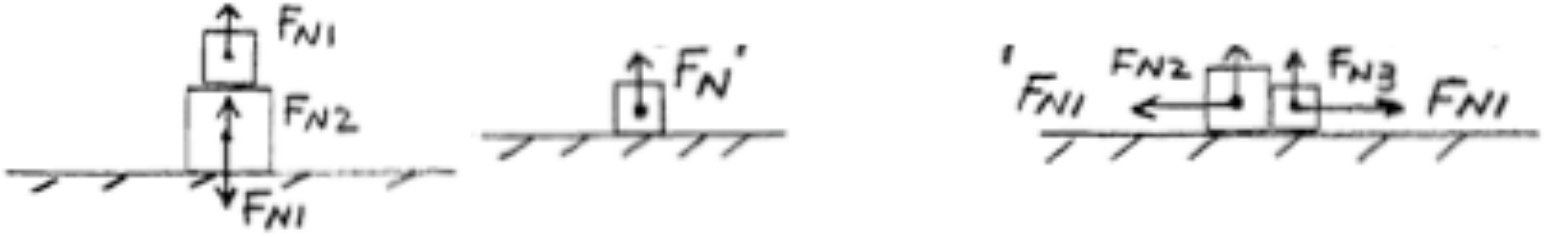
4. **F_S = Springs**
   - Can be push or pull.
   - Springs are restoring forces because they always pull or push the object back to the origin, regardless of the state of motion.



5. **F_f = Friction**
   - When an object moves across a rough surface or experiences drag
   - Always opposes motion or attempted motion



6. **F_N = Normal Force**
   - F_N is caused by touching something and always points perpendicular away from what the object touches.



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.

Force Diagram Examples:

Newton's 2nd Law Problems

$$m\vec{a} = \Sigma\vec{F}_{external}$$

- Recipe:

  1. Draw a force diagram
  2. Write Newton's equation for each axis.

$$ma_x = \Sigma F_x$$

$$ma_y = \Sigma F_y$$

$$F_g = mg$$

  3. Note, forces are always (+). The direction the force points is (+) or (-).
  4. Each force diagram gets its own Netwon's formulas.

Example: Elevator (Pure Vectors)

Example: Hanging Street Sign (Mixed Vectors)