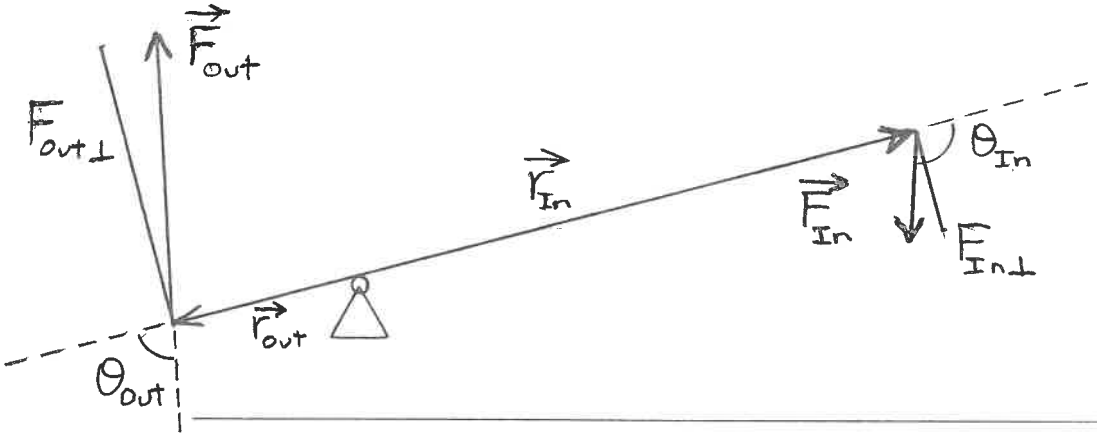
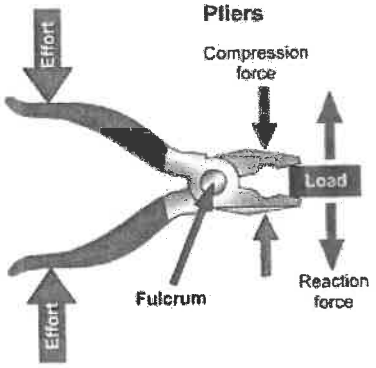
Levers: Simple Machines consisting of a Rod and a Fulcrum (Pivot)

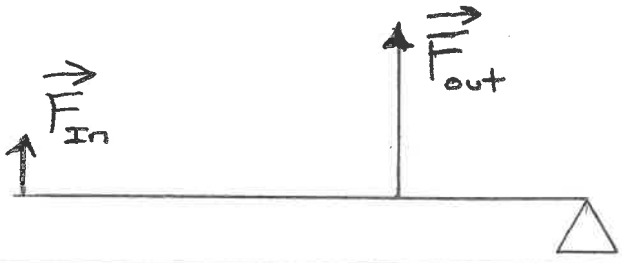
Class #1: Fulcrum is between Input and Output Forces.
Examples: crow bar; see-saw; Opposing Levers with a common Fulcrum: Plyers, scissors, clothespin while opening; Push-down Bottle Opener; Oars on a Boat; 2nd Stage of a Can Tab.
Demonstrate with Case Scissors and Leatherman Skeletool

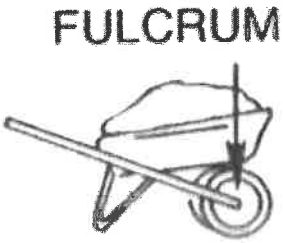
$\mathbf{F}_{In} = \mathbf{F}_{Input} = \mathbf{F}(Lever,Worker)$: $\tau_{Input} = \mathbf{r}X\mathbf{F} = (r_{Input}F_{In}\sin\theta_{In})(-\mathbf{k}) = (r_{In}F_{In_Perpendicular})(-\mathbf{k}) =$
The Input Torque on the lever due to $\mathbf{F}(Lever,Worker) = -r_{In}F_{In_P}$
$\mathbf{F}_{Out} = \mathbf{F}_{Output} = \mathbf{F}(Load,Lever) = -\mathbf{F}(Lever,Load)$ by Newton's 3rd Law => $F(Lever,Load) = F_{Out}$
The Output Torque on the lever due to $\mathbf{F}(Lever,Load) = \tau_{Output} = r_{Output}F_{Out}\sin\theta_{Out}\mathbf{k} = +r_{Out}F_{Out_P}$
The Net Torque on the lever $= -r_{In}F_{In_P} + +r_{Out}F_{Out_P} = 0$ for Equilibrium
=> **The Law of the Lever defining the Mechanical Advantage**: $F_{Out_P}/F_{In_P} = r_{In}/r_{Out}$
where r_{In} & r_{Out} are the distances from the Fulcrum to the Points of Application of the Input & Output Forces. This Law could also be stated as $F_{Out}/F_{In} = r_{In_P}/r_{Out_P}$
where r_{In_P} & r_{Out_P} are the Perpendicular Distances from the Fulcrum to the Lines of Actions of the Input & Output Forces (ie the Moment Arms of these Forces).
The Mechanical Advantage of a Lever $\equiv r_{In}/r_{Out}$ which is > 1 or < 1 or = 0 for Class #1





Class #2: Output Force is between Fulcrum and Input Force.
$r_{In} > r_{Out}$ => Mechanical Advantage > 1
Examples: Pull-up Bottle Opener; Wheelbarrow; Nutcracker (Opposing Levers with a common Fulcrum); 1st Stage of a Can Tab.
https://en.wikipedia.org/wiki/Drink_can





Class #3: Input Force is between Output Force and Fulcrum.
$r_{In} < r_{Out}$ => Mechanical Advantage < 1
Examples: Forearm; Fishing Rod lifting a Fish out of water; Office Stapler; crane; Broom; atlatl (spear thrower) with fulcrum initially at elbow and finally at wrist; Opposing Levers with a common Fulcrum: Tweezers, Jaw, clothespin when clamping cloths
Class 2 & 3 may look like each other as in tweezers & nutcracker.

