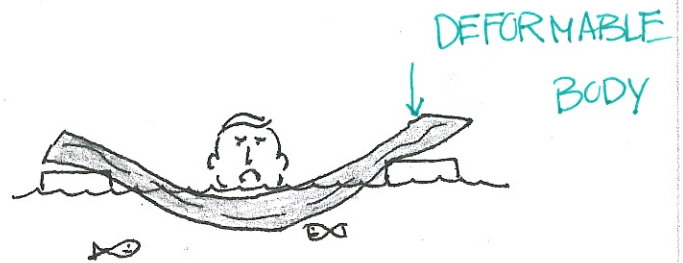
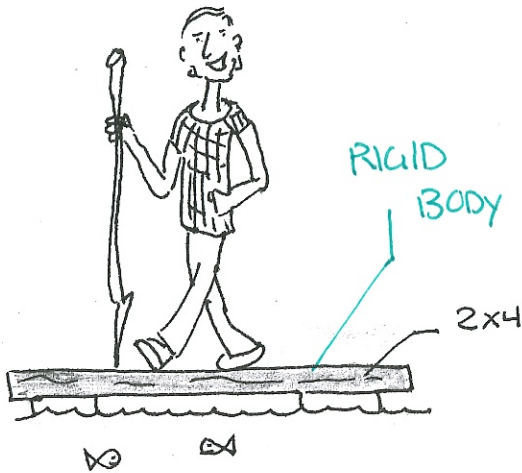


APPLY A LOAD TO A STRUCTURE AND IT CAN CAUSE IT TO MOVE.

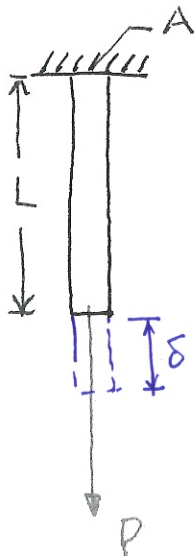
LOAD → TRANSLATES <sup>or</sup> ROTATES BUT  
NO Δ IN SIZE OR SHAPE.



LOAD → Δ IN SIZE OR SHAPE.



**DEFORMATION IN AXIAL LOADING**



PULLING MAKES BAR LONGER.

DEFORMATION IS CHANGE IN LENGTH.

$$= \delta$$

CHANGE IN LENGTH PER UNIT LENGTH

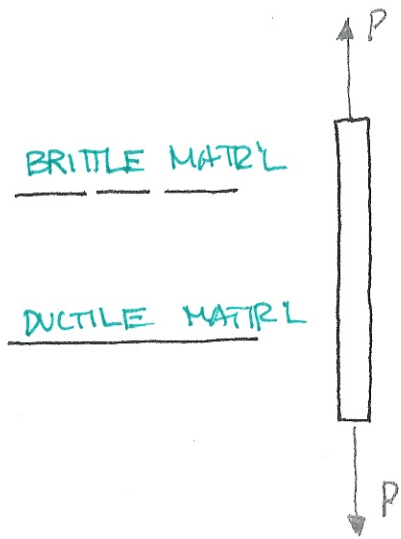
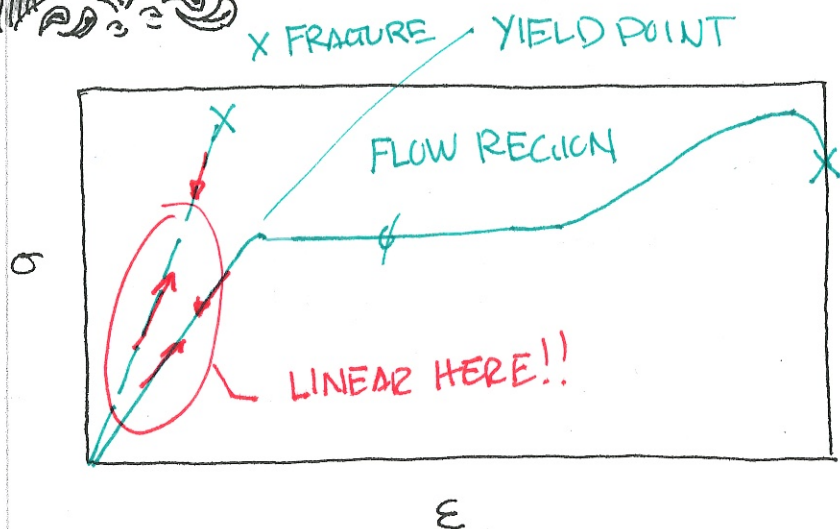
IS  
STRAIN

$$\equiv \epsilon = \frac{\delta}{L} \text{ STRAIN (AXIAL)}$$

UNITS & DIMENSIONS of  $\epsilon$ ?

$\frac{\Delta \text{LENGTH}}{\text{LENGTH}} \rightarrow$  NO DIMENSIONS!  $\rightarrow$  NO UNITS!

$\mu \text{ STRAIN} = 10^{-6}$  (PSEUDO-UNIT)



WHEN WE ARE IN THE LINEAR REGION, MATERIAL IS LINEARLY ELASTIC & RETURNS TO SAME PATH

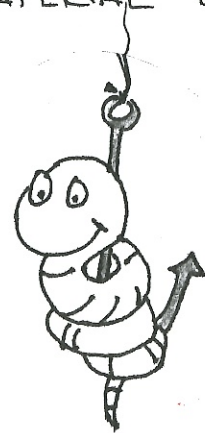
SLOPE = CONSTANT

HOOKE'S LAW

$$\sigma = E \epsilon$$

↑

YOUNG'S MODULUS (MOD. OF ELASTICITY)



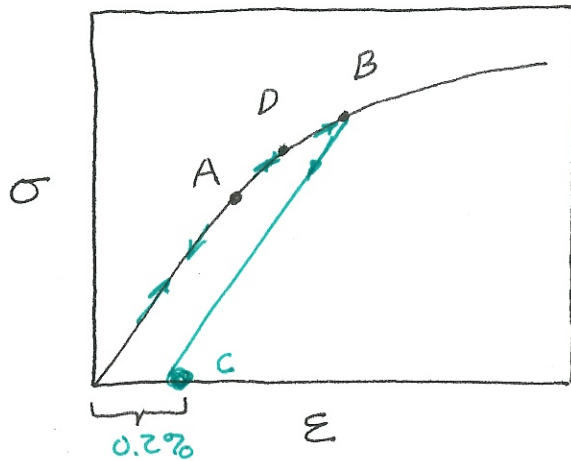
\* THIS IS AN EXAMPLE of a CONSTITUTIVE RELATION, SOMETIMES CALLED "LAWS" DESPITE A LACK of UNIVERSALITY. OTHERS INCLUDE OHM'S LAW & THE IDEAL GAS EQUATION.

STAYING IN THE ELASTIC REGION →

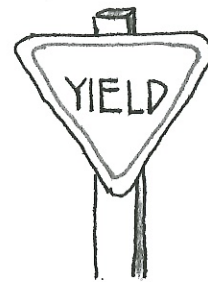
FOR SOME MATERIALS ⇒ YIELD POINT

FOR MOST MATERIALS

~~YIELD POINT~~ ⇒ YIELD STRENGTH



σ TO PRODUCE  
PERMANENT (PLASTIC)  
DEFORMATION of  
0.2%



A: PROPORTIONAL LIMIT → (NO LONGER LINEAR. HARD TO FIND)

D: ELASTIC LIMIT → NO LONGER RETURNS VIA SAME PATH)

B: YIELD STRENGTH (BY DEF'N)

OTHER TERMS

[ DUCTILE: LOTS OF PLASTIC DEFORMATION BY FRACTURE

[ BRITTLE: BREAKS SUDDENLY

[ WEAKER: LOWER STRESS @ FAILURE

[ STRONGER: HIGHER " " "

[ STIFFER: LARGER E

[ LESS STIFF: SMALLER E

$\sigma = E \epsilon$

↓

$P = k \delta$