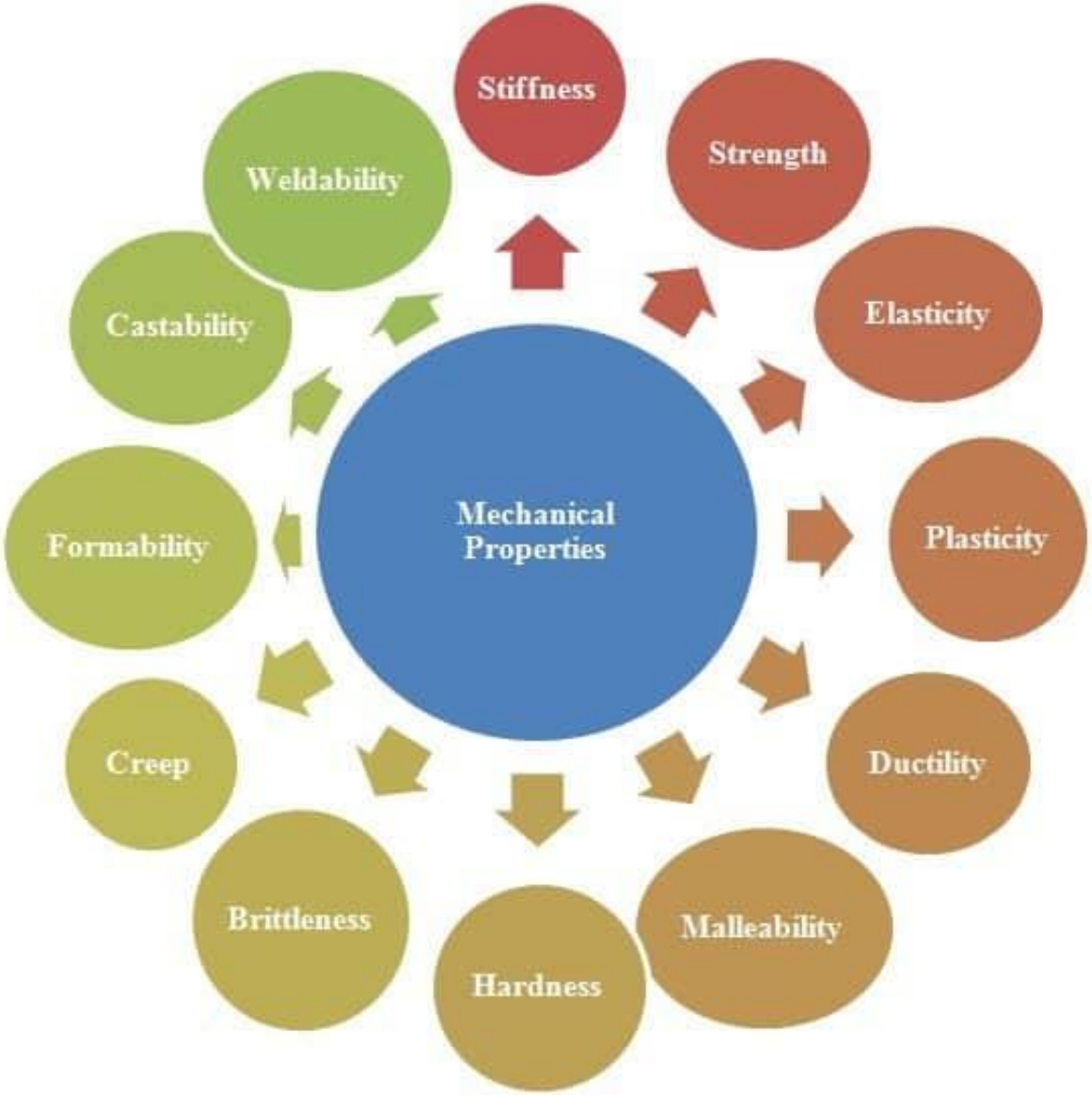
Workshop Technology
[Material Properties]

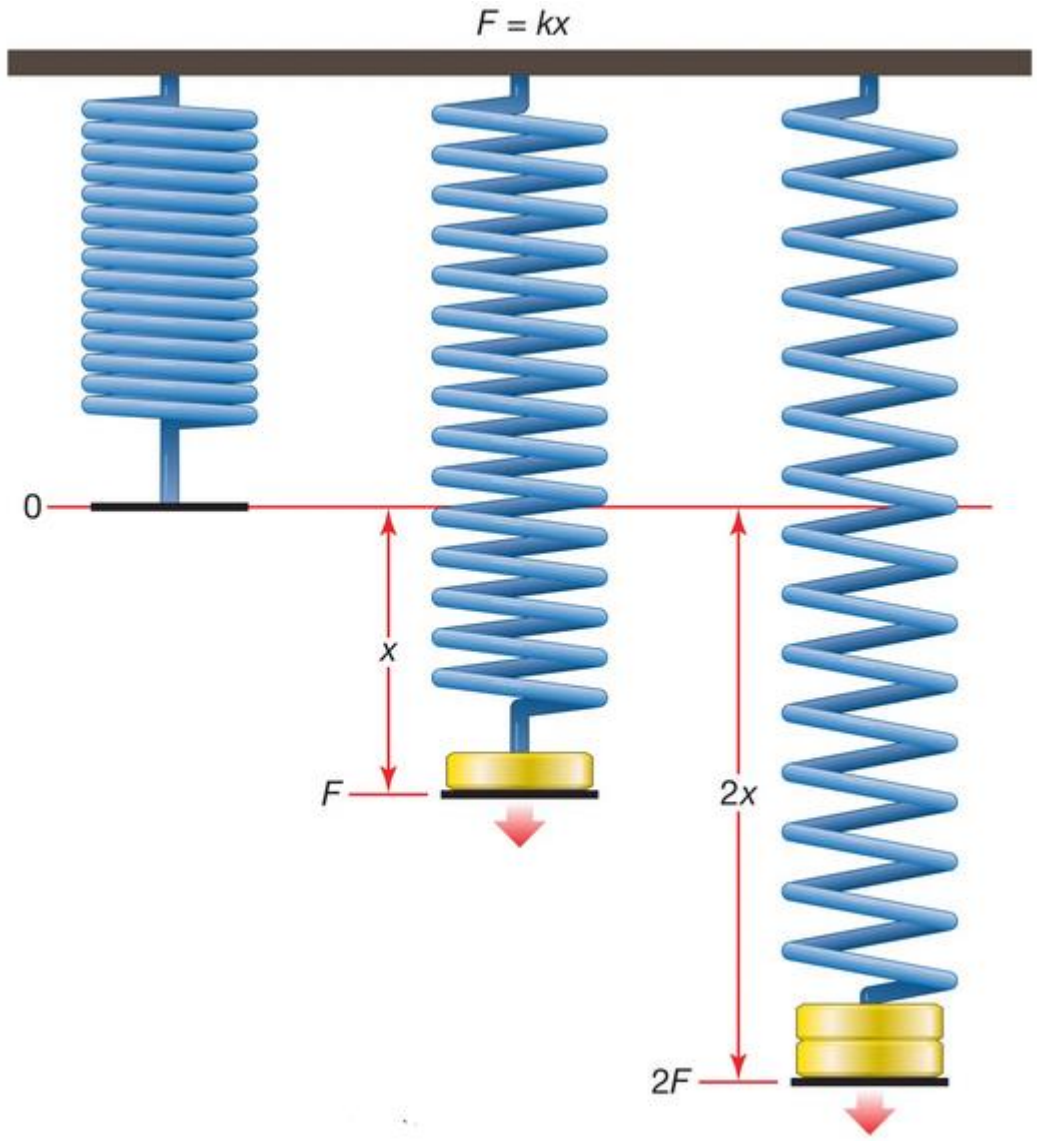
Major Material Properties

- Physical
- Chemical
- Mechanical
- Thermal
- Electrical
- Magnetic
- Acoustical
- Optical



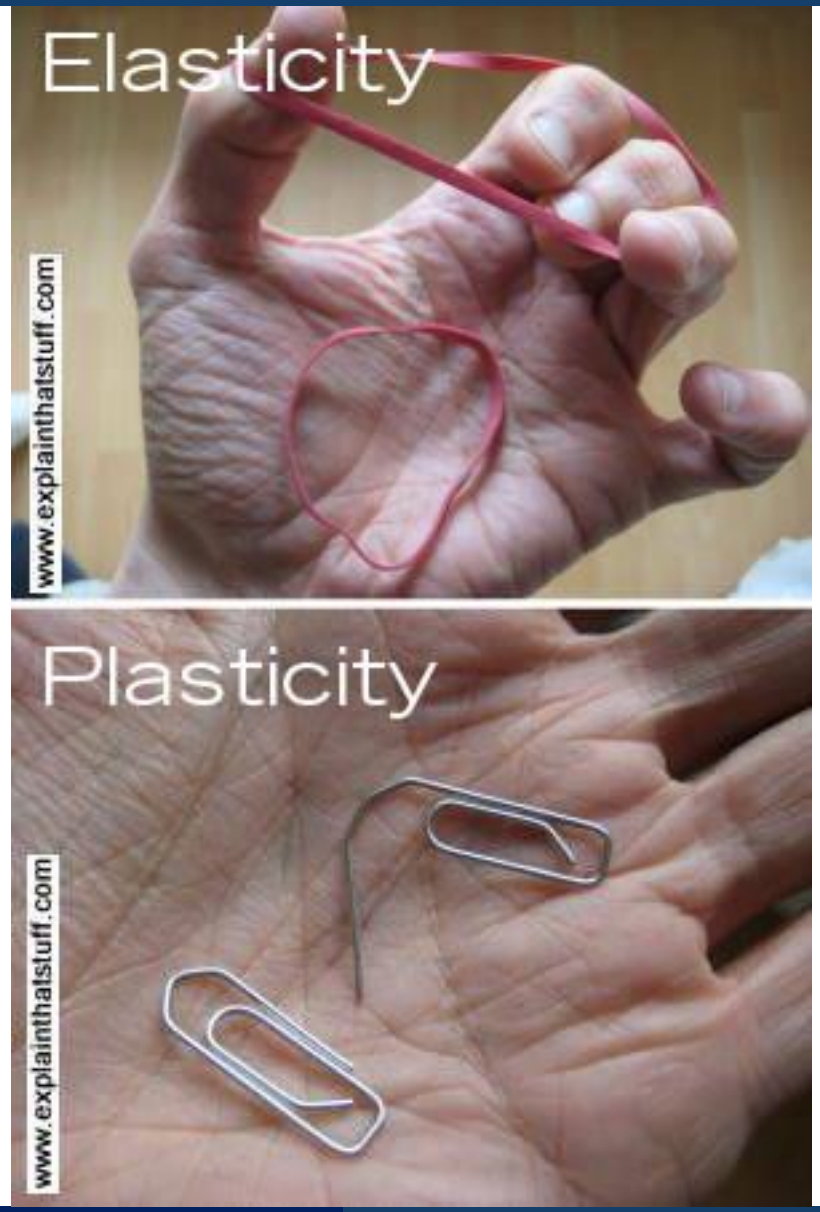
Elasticity

- Elasticity is the ability of a body to resist a distorting influence and to return to its original size and shape when that influence or force is removed.
- Solid objects will deform when adequate loads are applied to them; if the material is elastic, the object will return to its initial shape and size after removal.



Plasticity

- Plasticity is the ability of a solid material to undergo permanent deformation, a non-reversible change of shape in response to applied forces.
- In engineering, the transition from elastic behavior to plastic behavior is known as yielding.



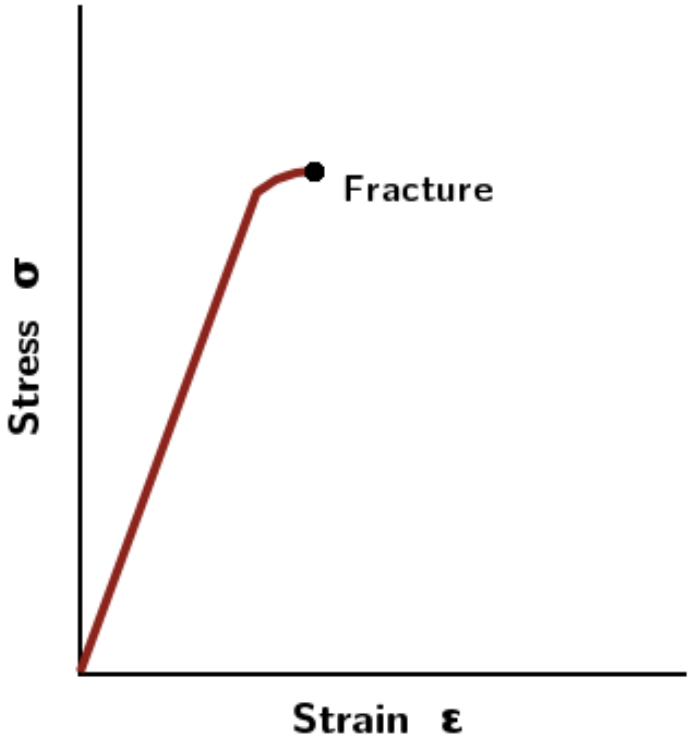
Brittleness

- A material is brittle if, when subjected to stress, it fractures with little elastic deformation and without significant plastic deformation.

(b)

(a)

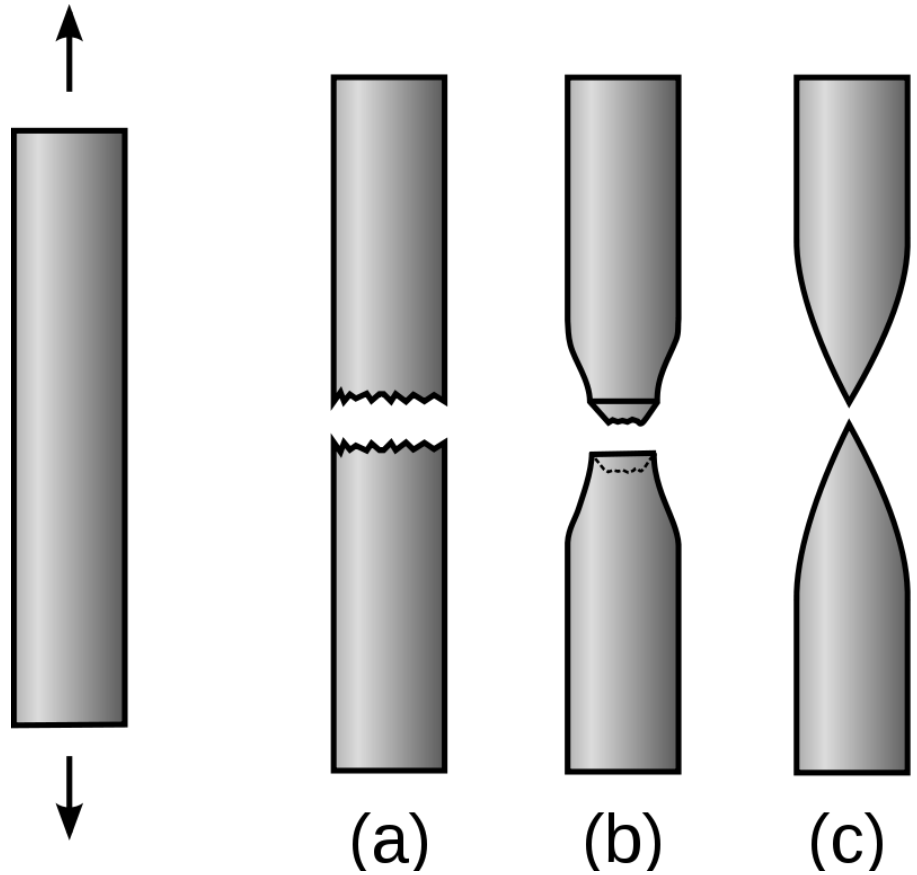
Brittle fracture in
(a) Cast Iron and
(b) Glass



Stress-strain diagram for a brittle material

Ductility

- Ductility is defined by the degree to which a material can sustain plastic deformation under tensile stress before failure.
- Ductile materials are able to sustain more stress due to their ability to absorb more energy prior to failure than brittle materials are.



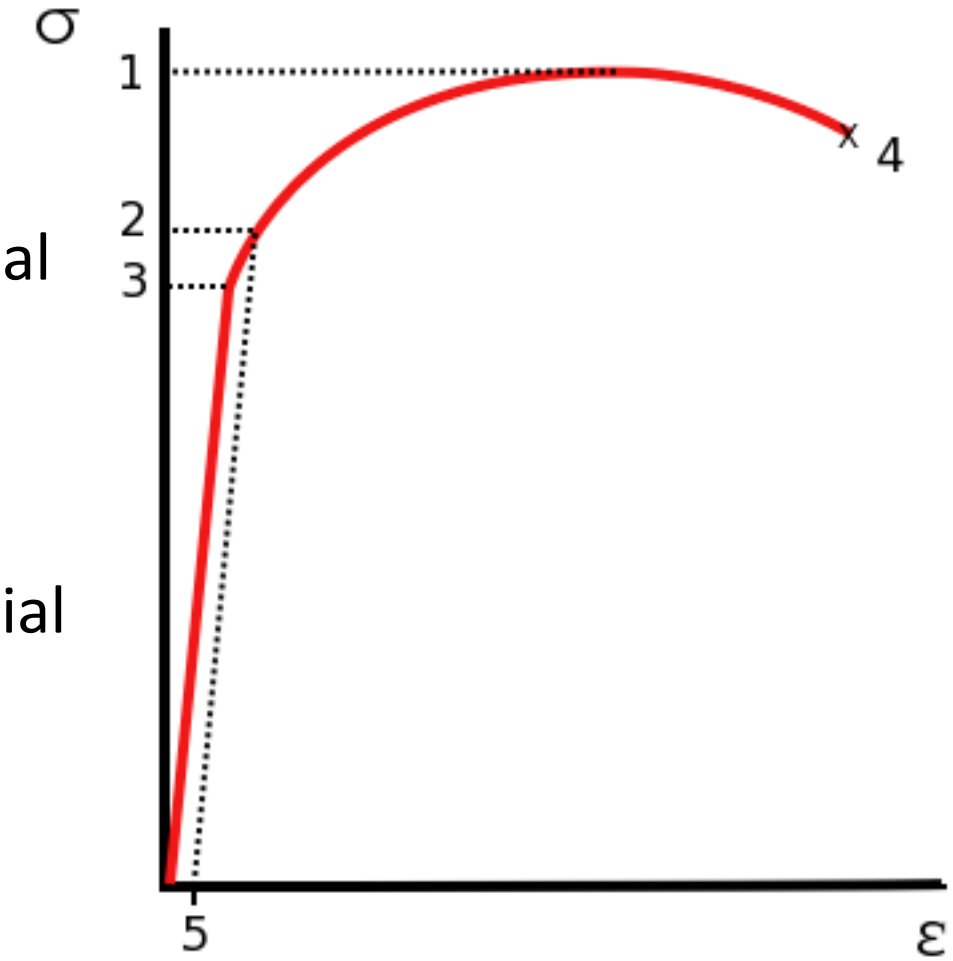
Schematic appearance of round metal bars after tensile testing.
(a) Brittle fracture
(b) Ductile fracture
(c) Completely ductile fracture

Malleability

- Ability of the material to be flattened into thin sheets under applications of heavy compressive forces without cracking by hot or cold working means.
- This property of a material allows it to expand in all directions without rupture.

Strength

- **Flexural strength**: Maximum bending stress a material can withstand before failure
- **Shear strength:** Maximum shear stress a material can withstand
- **Ultimate tensile strength:** Maximum tensile stress of a material can withstand before failure
- **Compressive strength**: Maximum stress a material can withstand before compressive failure (MPa)
- **Yield strength:** The stress at which a material starts to yield plastically
- **Specific strength**: Strength per unit density (Nm/kg)

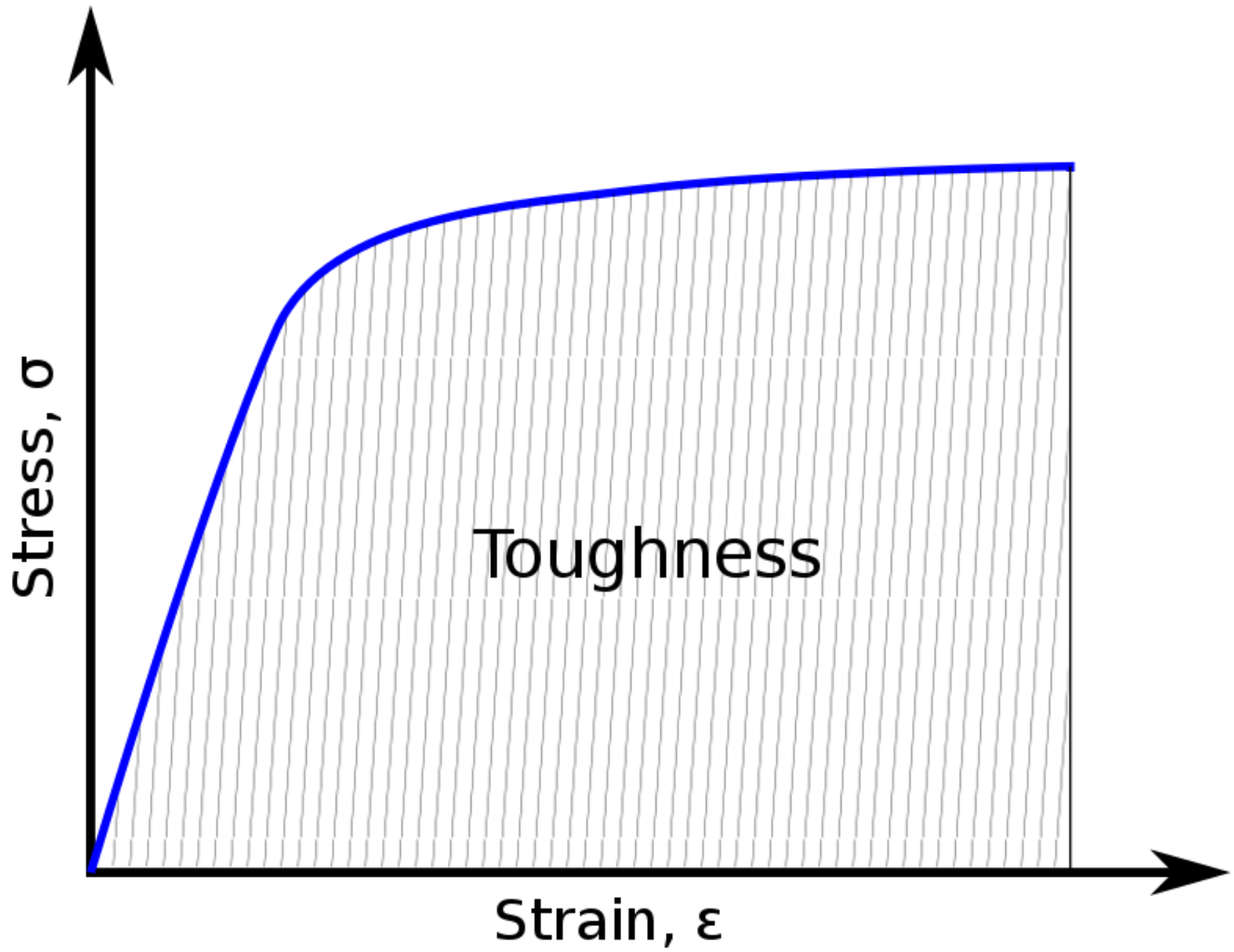


stress–strain (σ–ε) curve typical of aluminum

1. Ultimate strength
2. Yield strength
3. Proportional limit stress
4. Fracture
5. Offset strain (typically 0.2%)

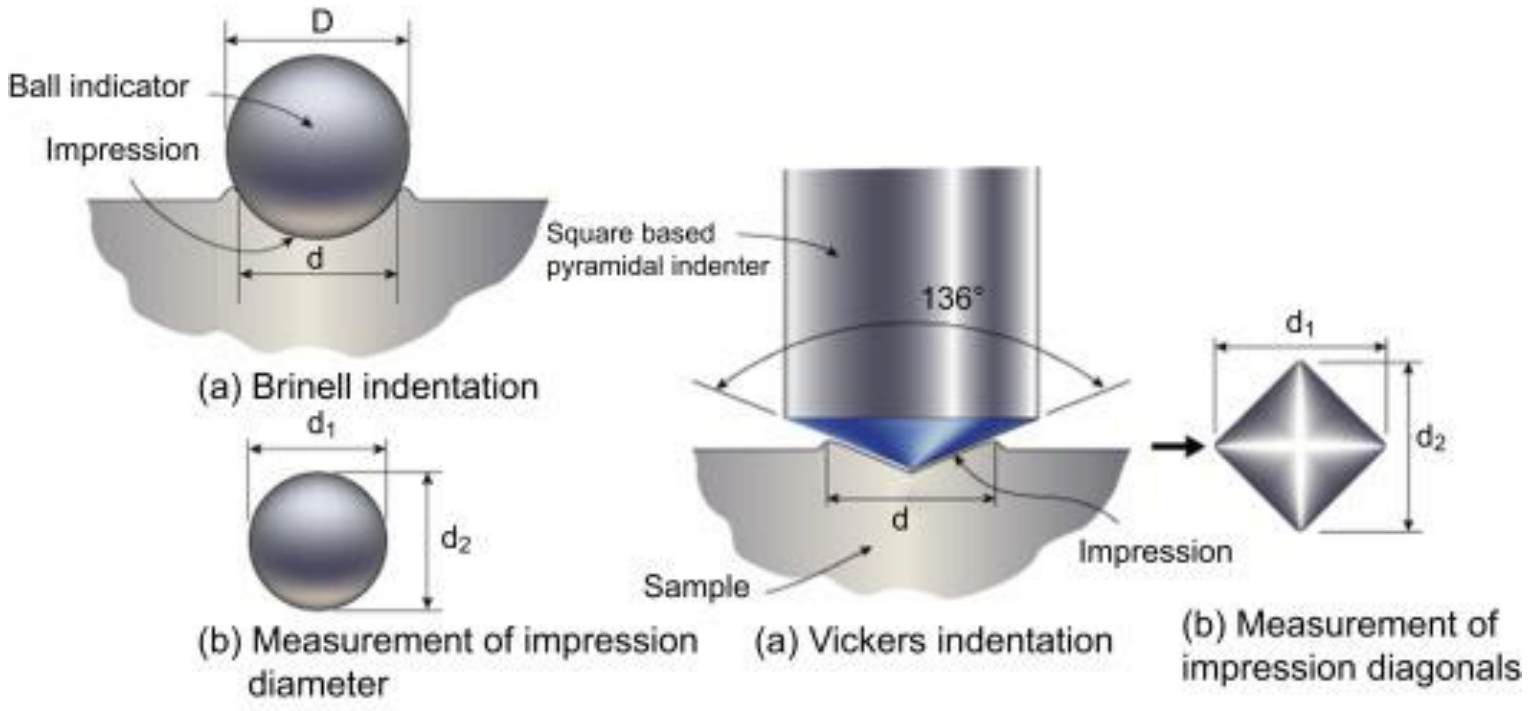
Toughness

- Ability of a material to absorb energy (or withstand shock) and plastically deform without fracturing (or rupturing);
- A material's resistance to fracture when stressed;
- Combination of strength and plasticity



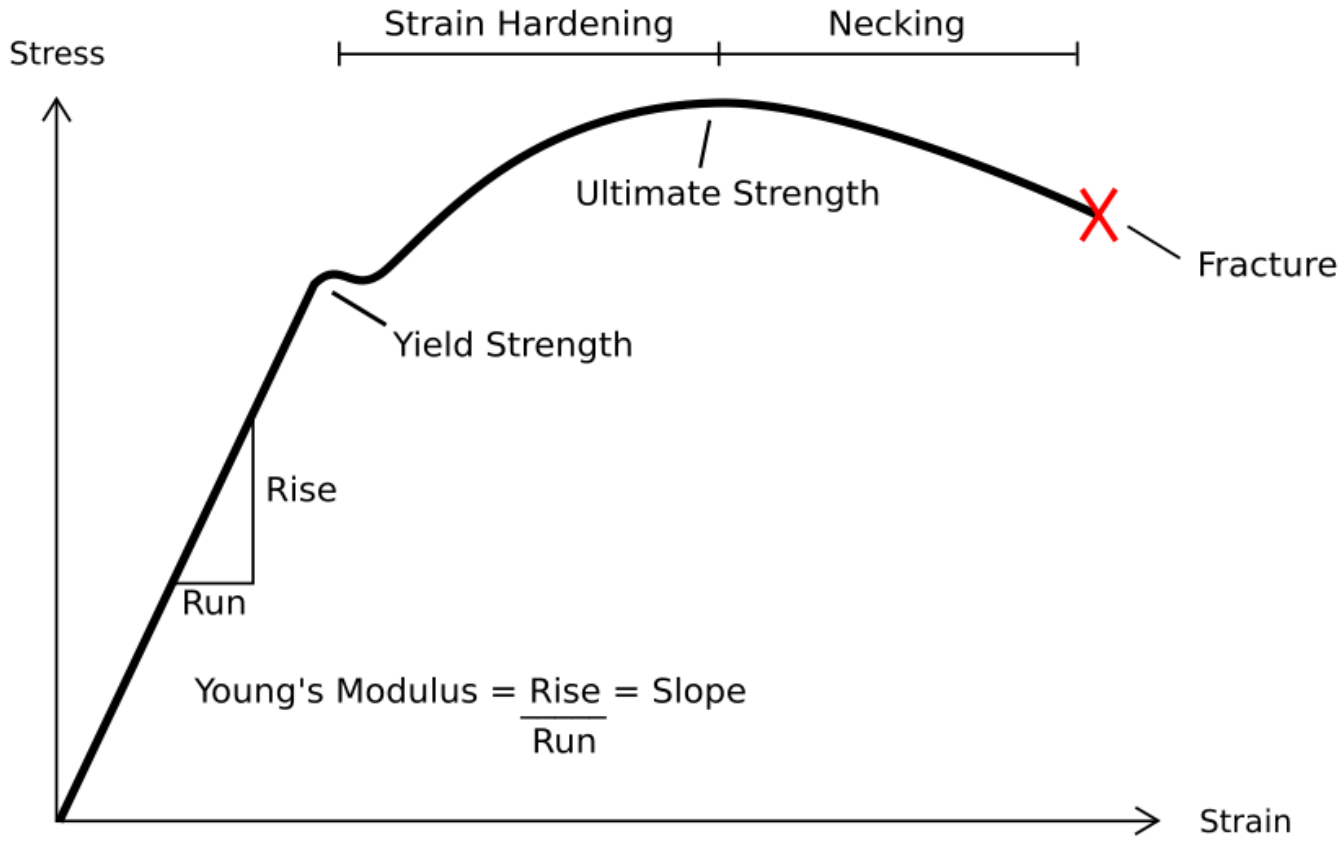
Hardness

- Ability to withstand surface indentation and scratching (e.g. Brinell hardness number)
- A measure of the resistance to localized plastic deformation induced by either mechanical indentation or abrasion
- Hardness is dependent on ductility, elastic stiffness, plasticity, strain, strength, toughness, viscoelasticity, and viscosity.



Resilience

- Ability of a material to absorb energy when it is deformed elastically (MPa); combination of strength and elasticity



The area under the linear portion of a stress–strain curve is the resilience of the material.

Creep (Cold flow)

- The slow and gradual deformation of an object with respect to time
- It can occur as a result of long-term exposure to high levels of stress that are still below the yield strength of the material.

The movement of ice in a glacier is an example of creeping in solids.

Thank You