

Data from the book "Introduction to Biomechanical Engineering (in Japanese)": published by Corona Publishing Co., Ltd. Tokyo, Japan.

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Fig. 3.1: Spring

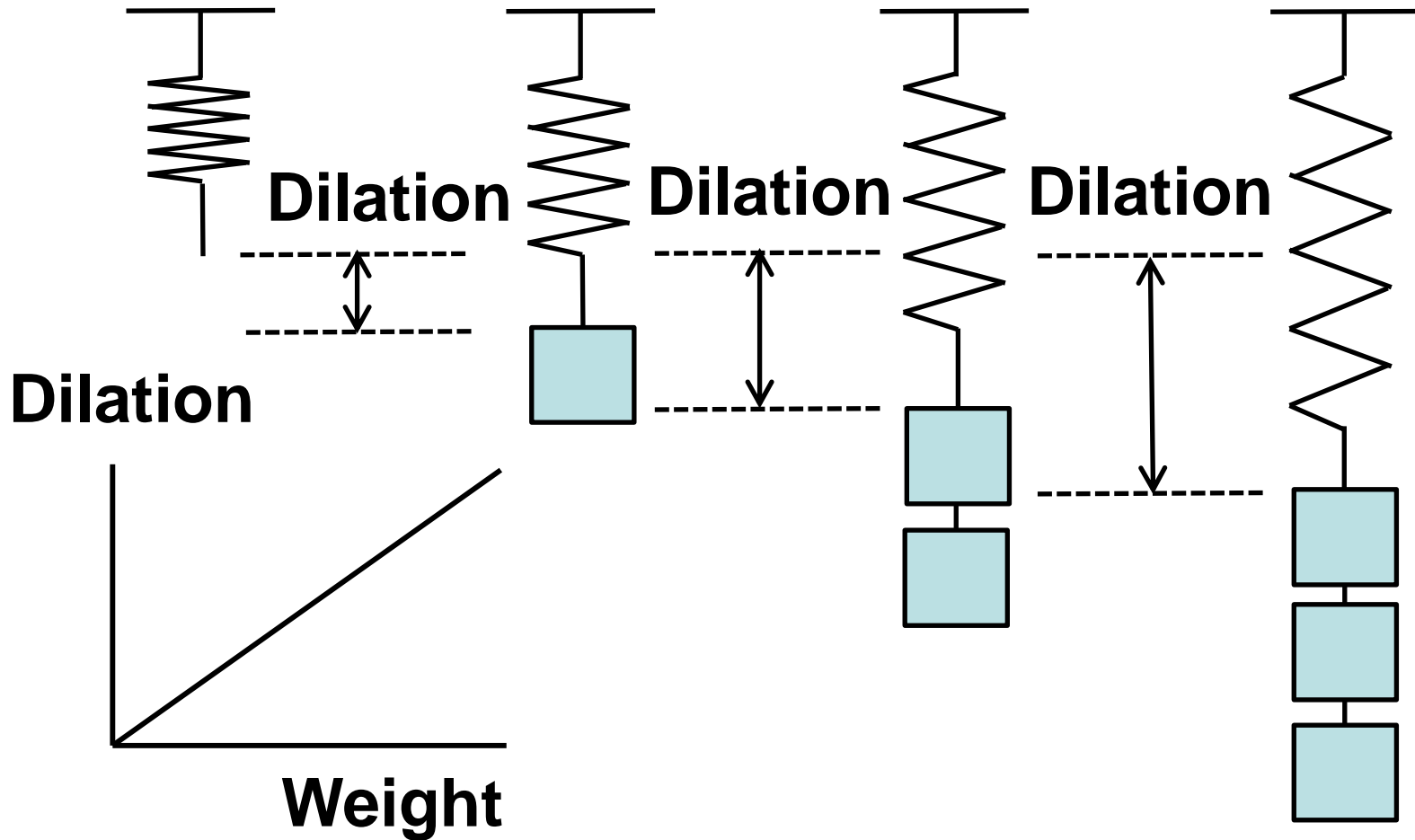


Fig. 3.2: Mode of deformation

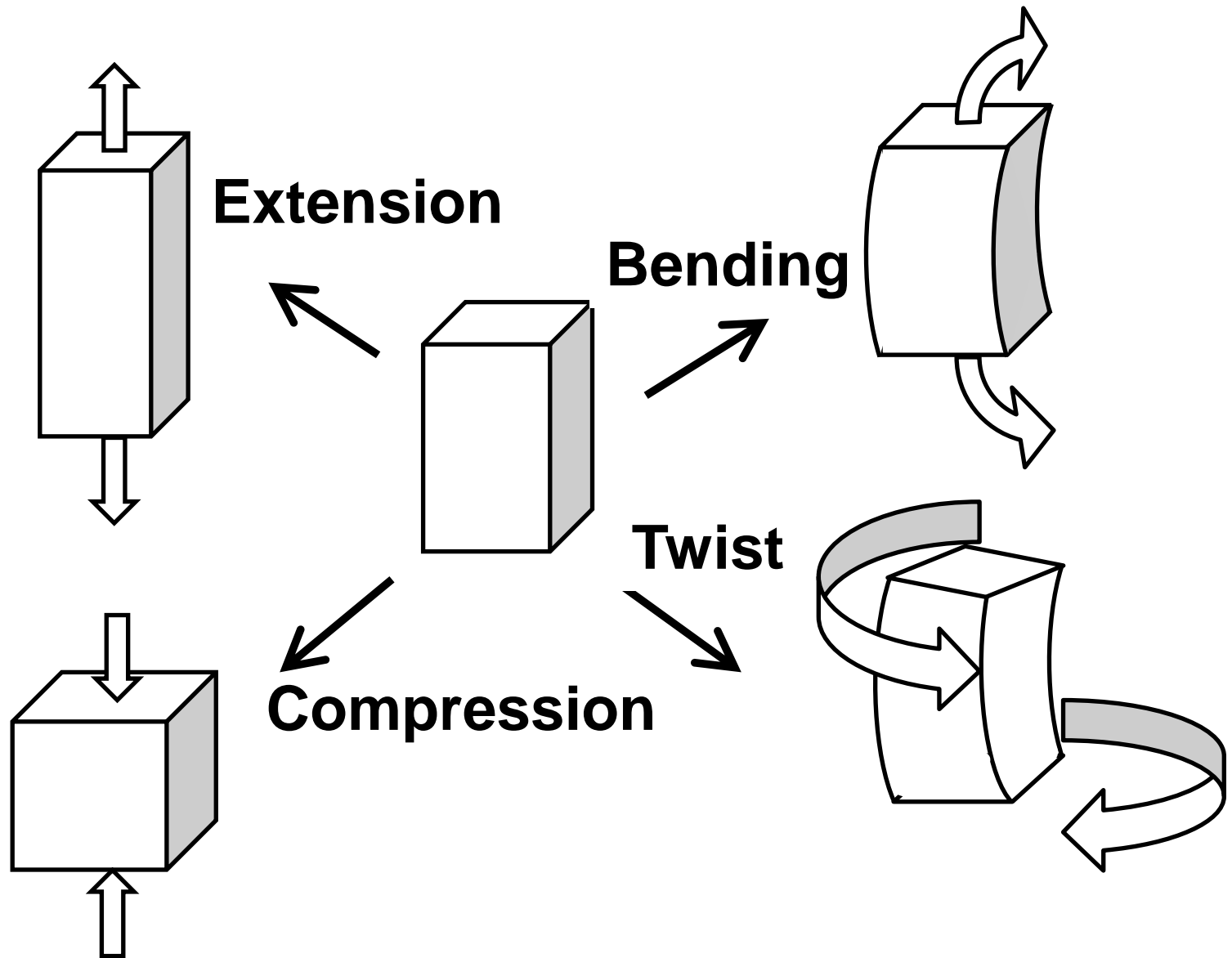
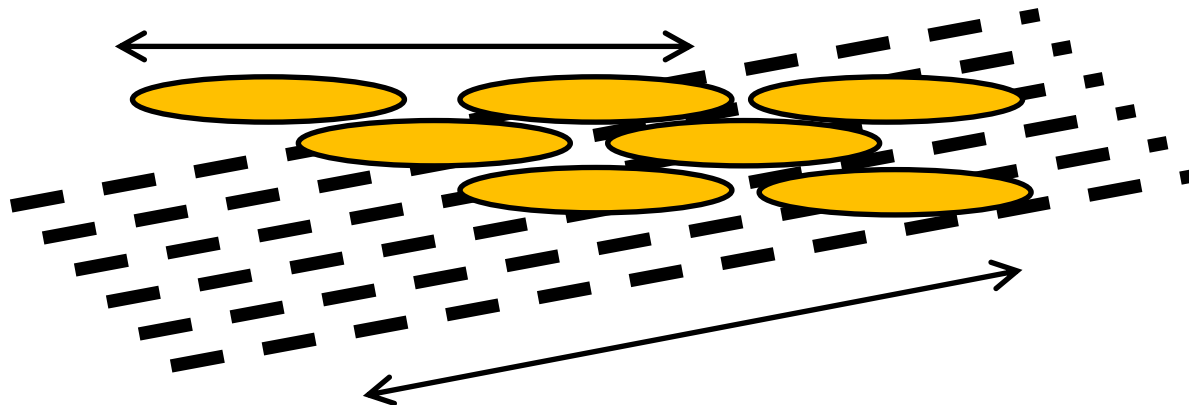


Fig. 3.3: Orientation of cells and matrices

Longitudinal direction of cell



Orientation of cells



Orientation of extracellular matrices

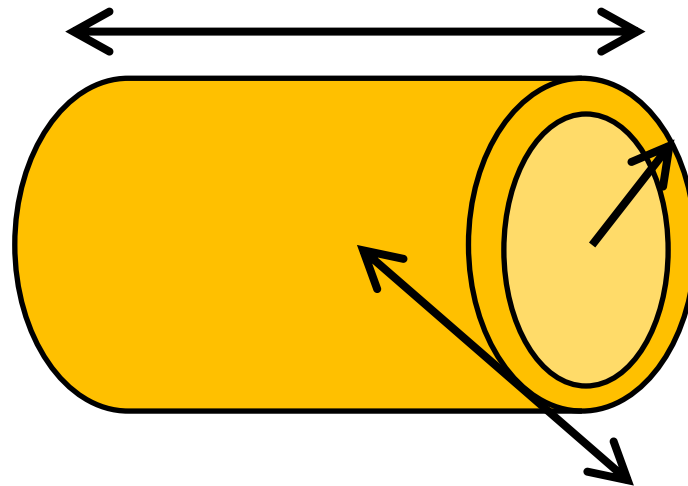
(Endothelium)

Longitudinal direction of extracellular matrix



Fig. 3.4: Direction of forces at tube wall

Longitudinal



Radial

Tangential

Fig. 3.5: Transmission of force

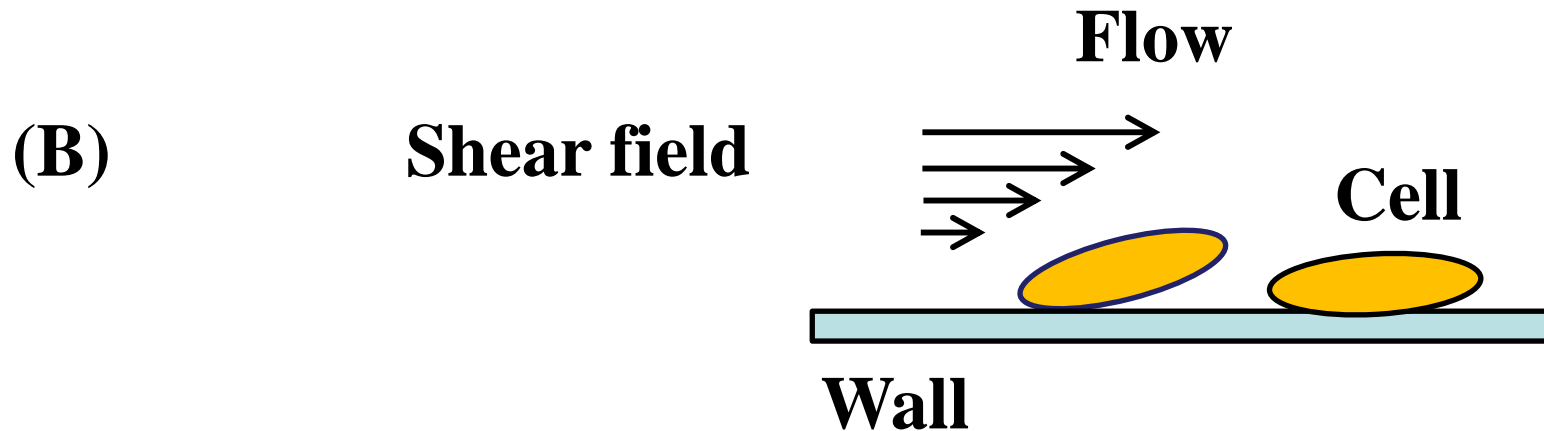
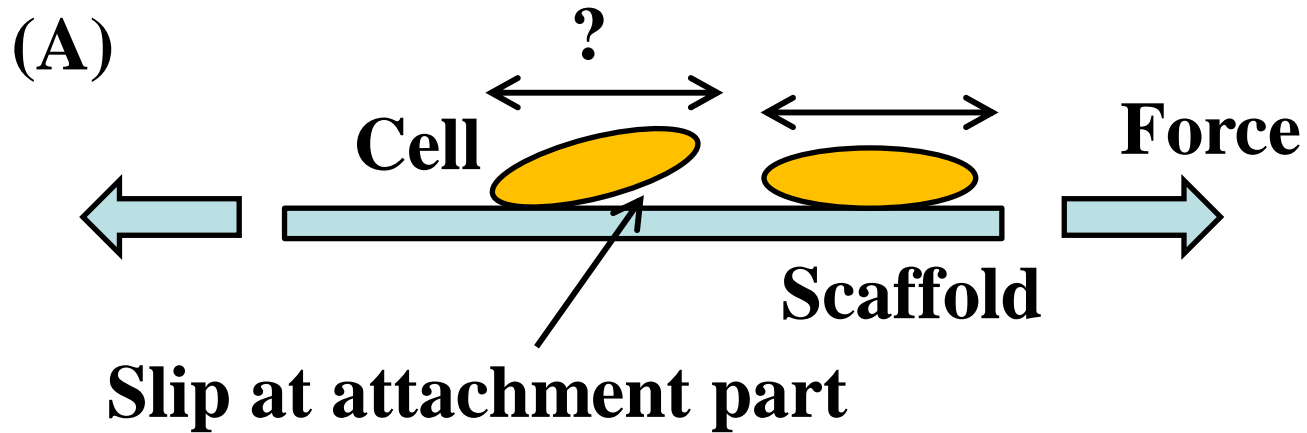


Fig. 3.6: Fixation

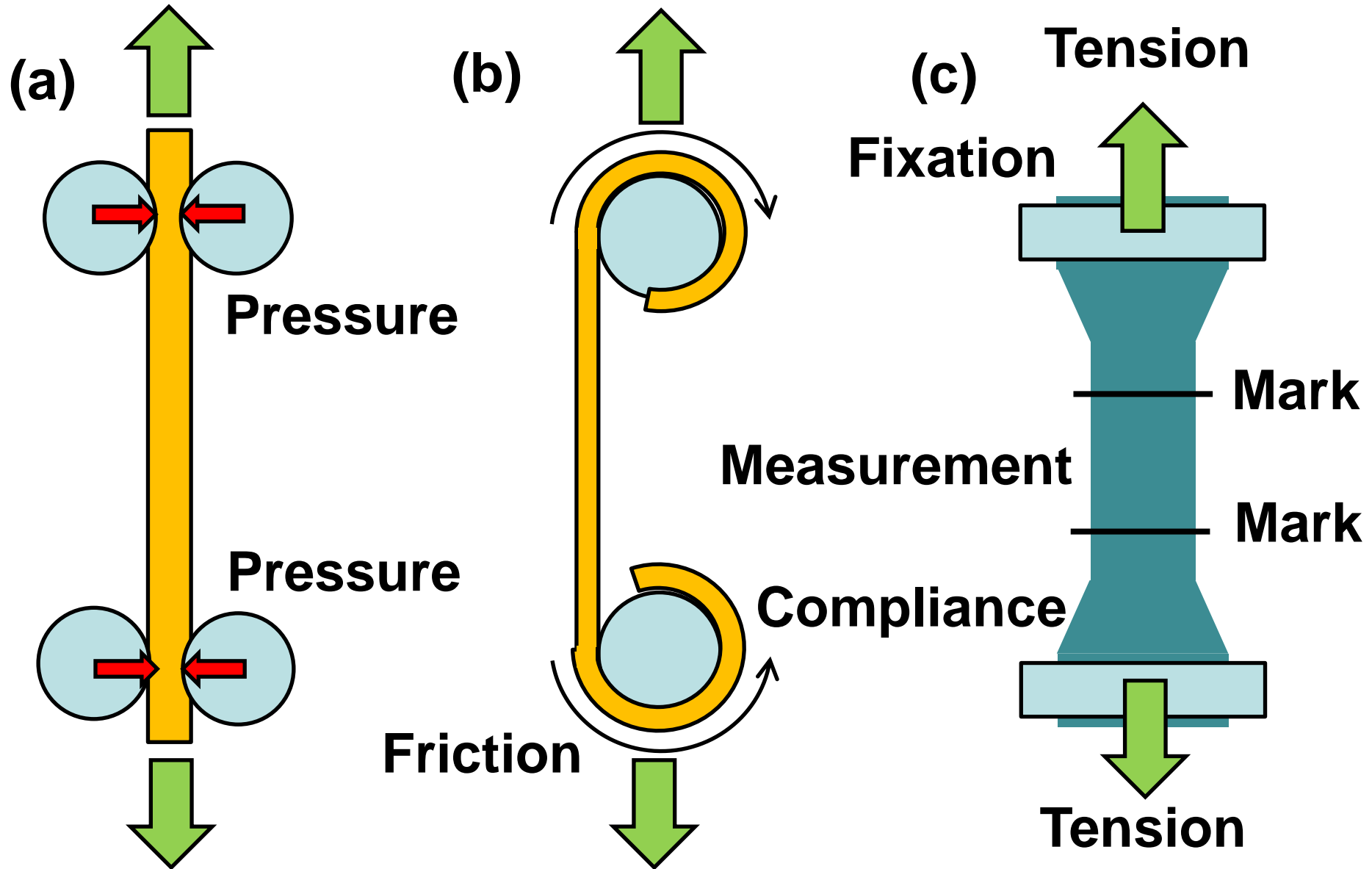


Fig. 3.7: Origin

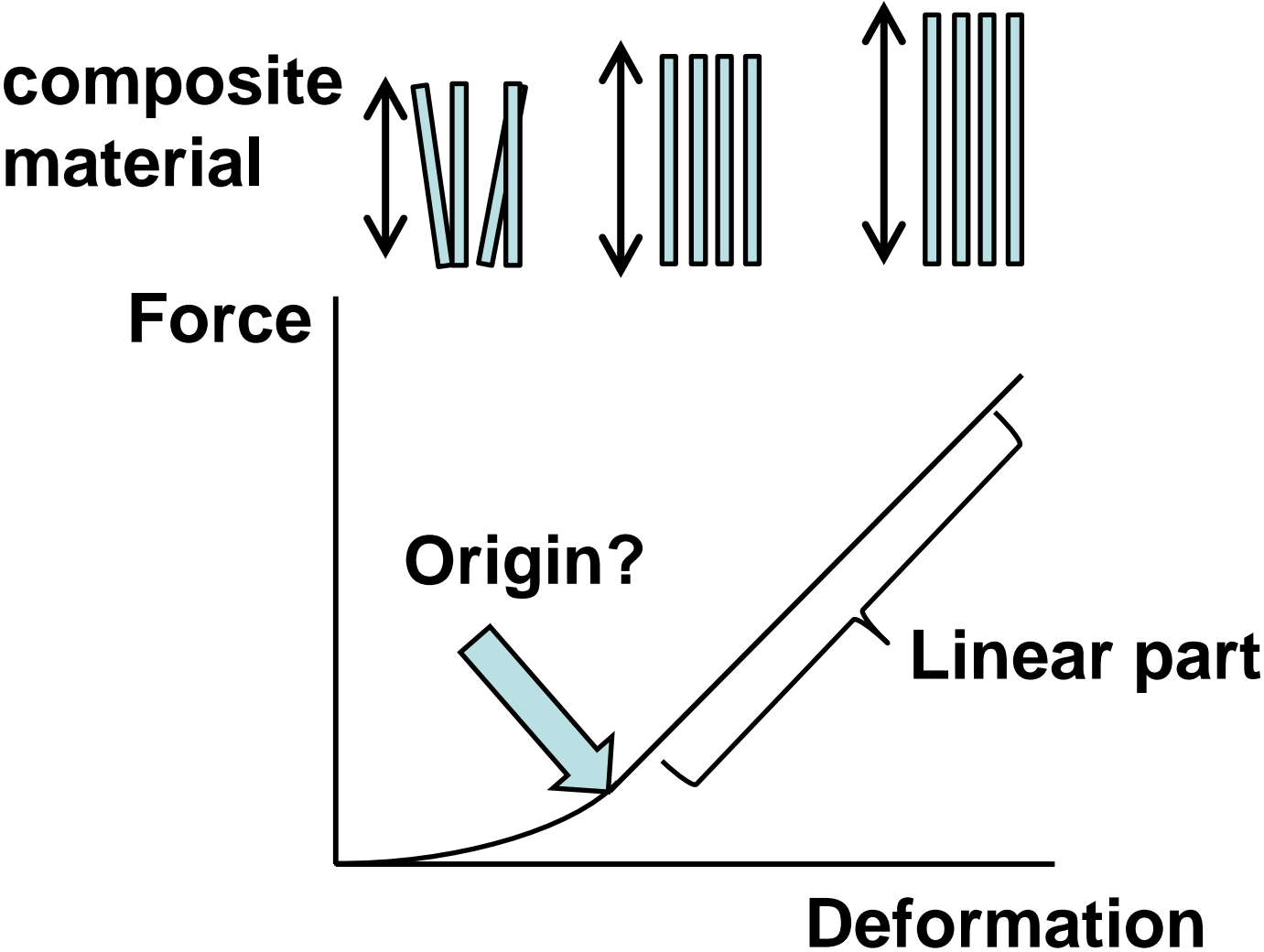
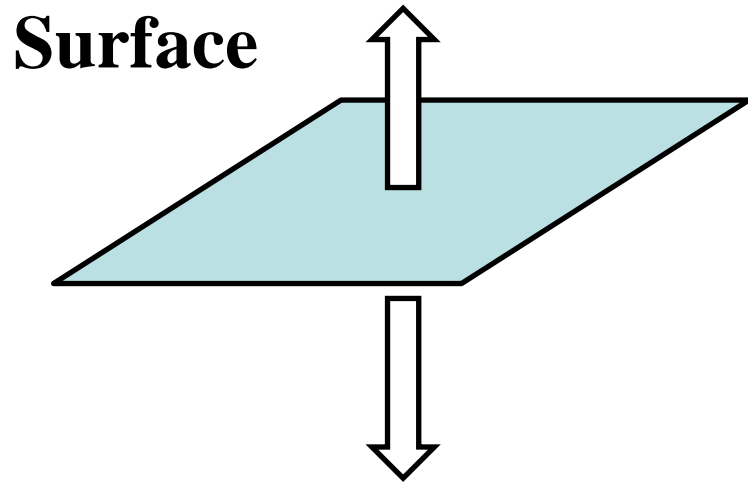
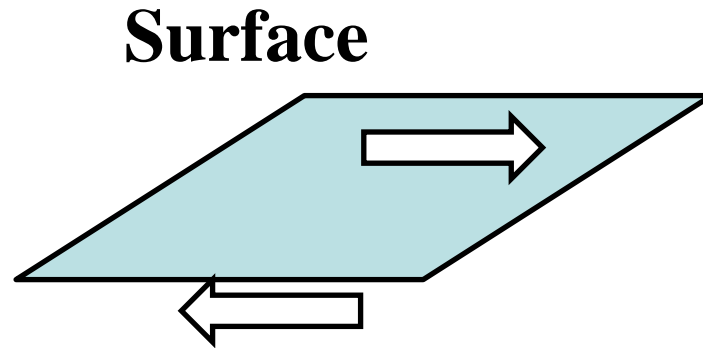


Fig. 3.8: Stress



Normal stress



Shear stress

Fig. 3.9: Poisson's ratio

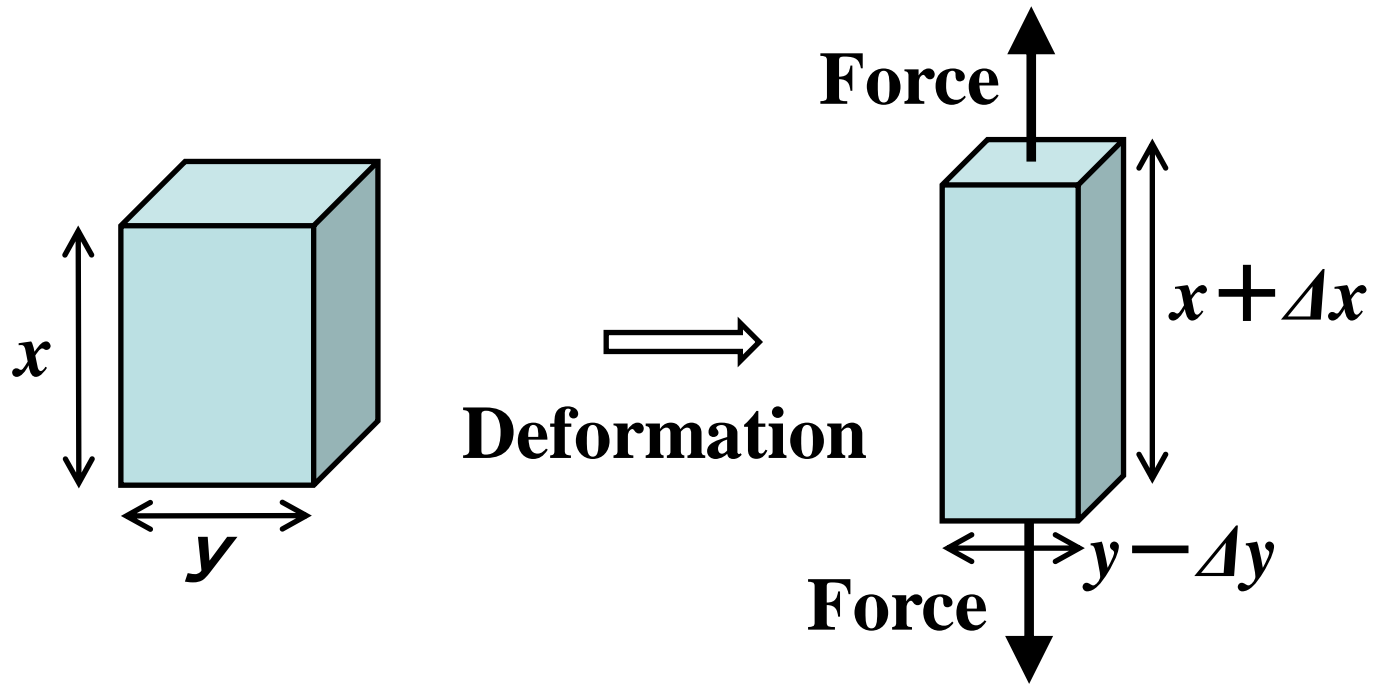


Fig. 3.10: Strains in tension

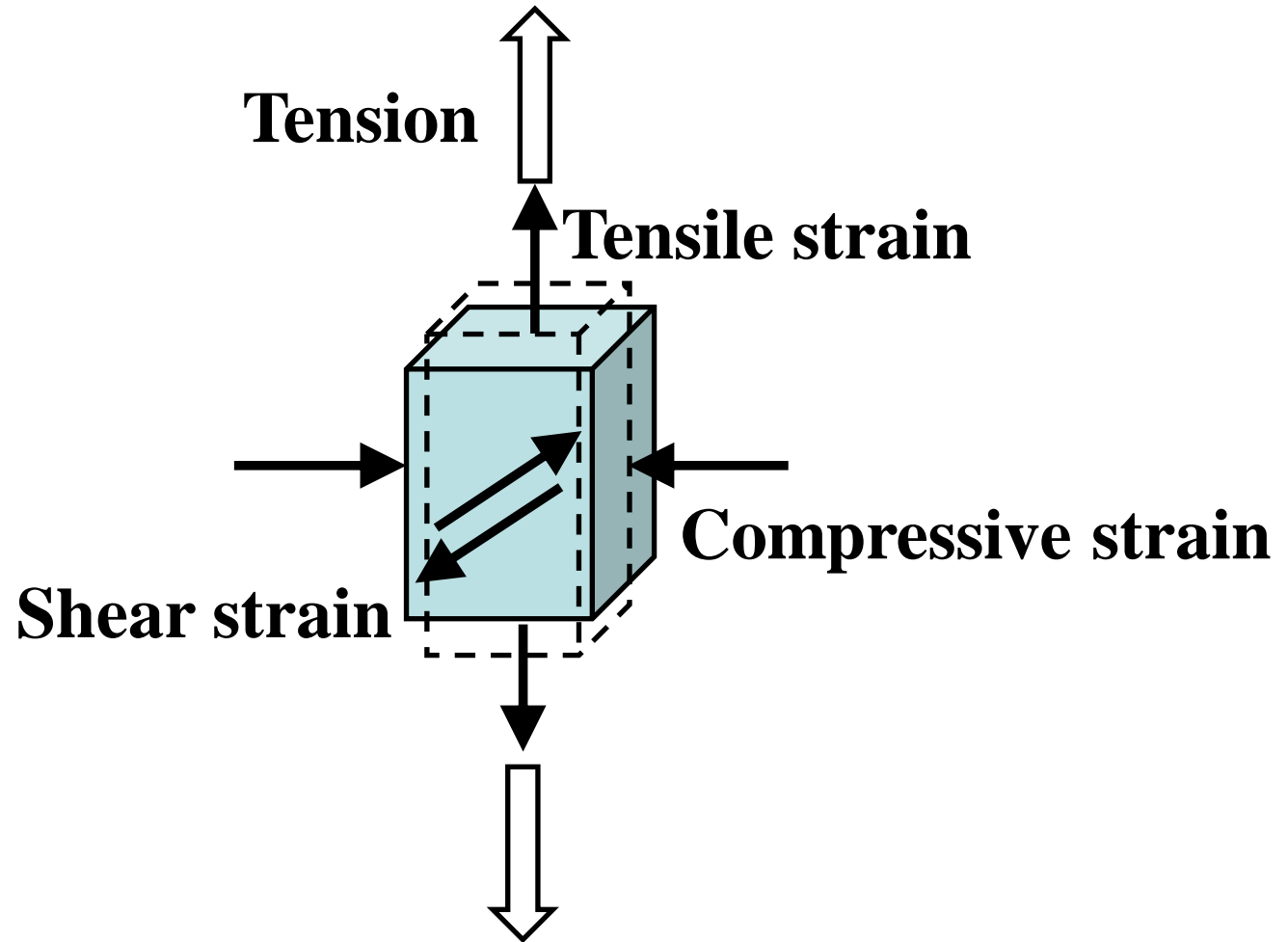


Fig. 3.11: Strain gauge

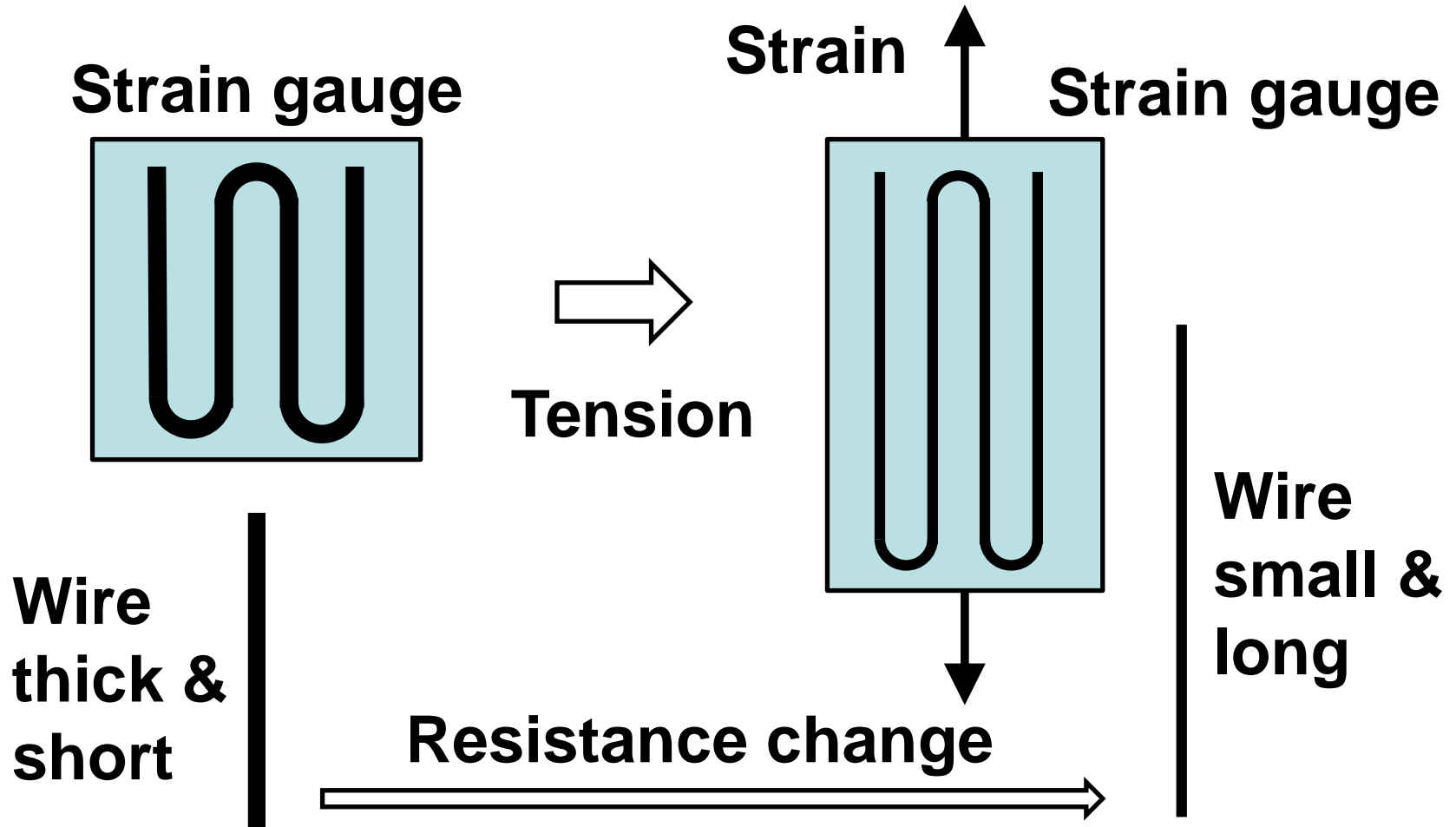


Fig. 3.12: Stress-strain diagram

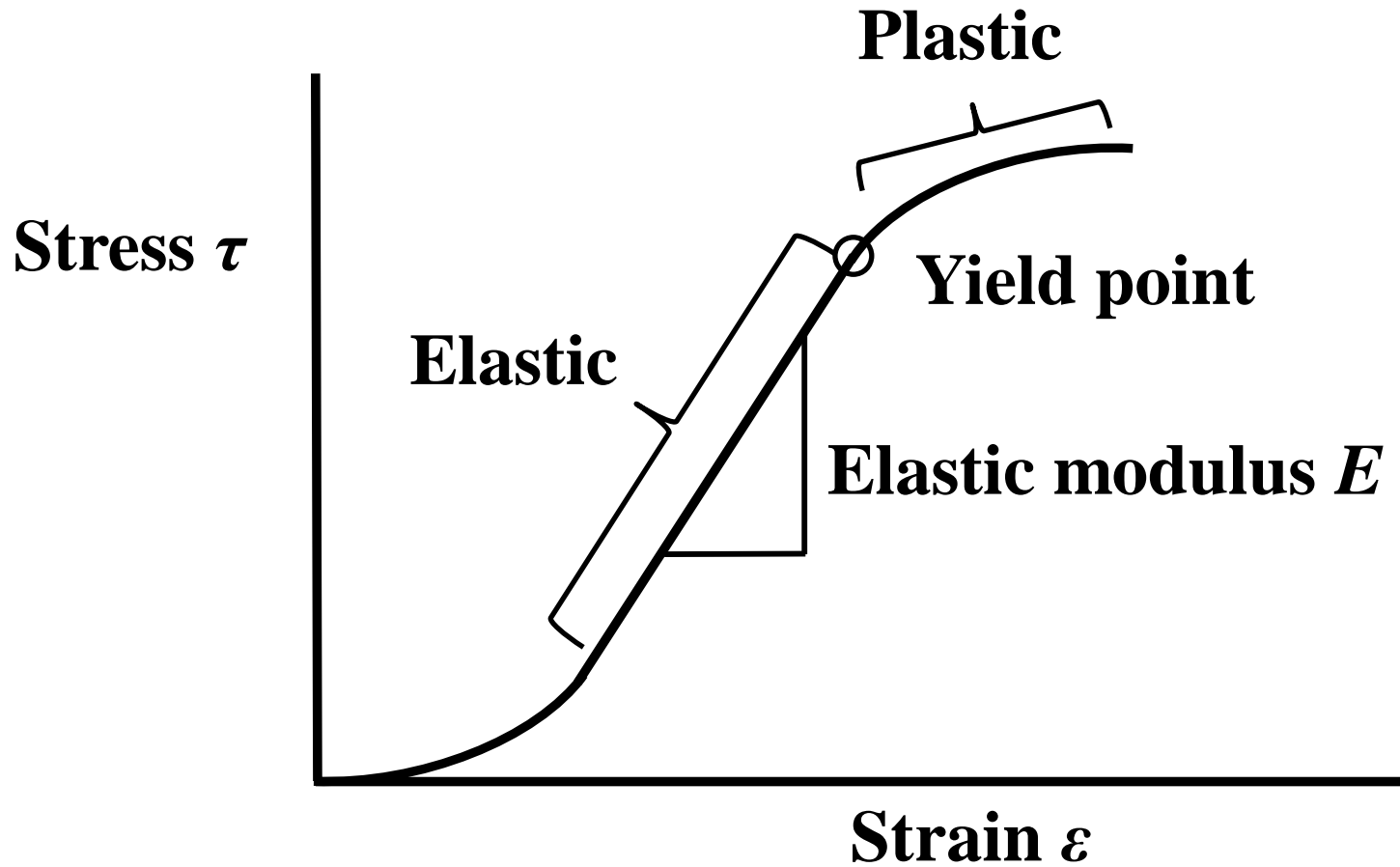
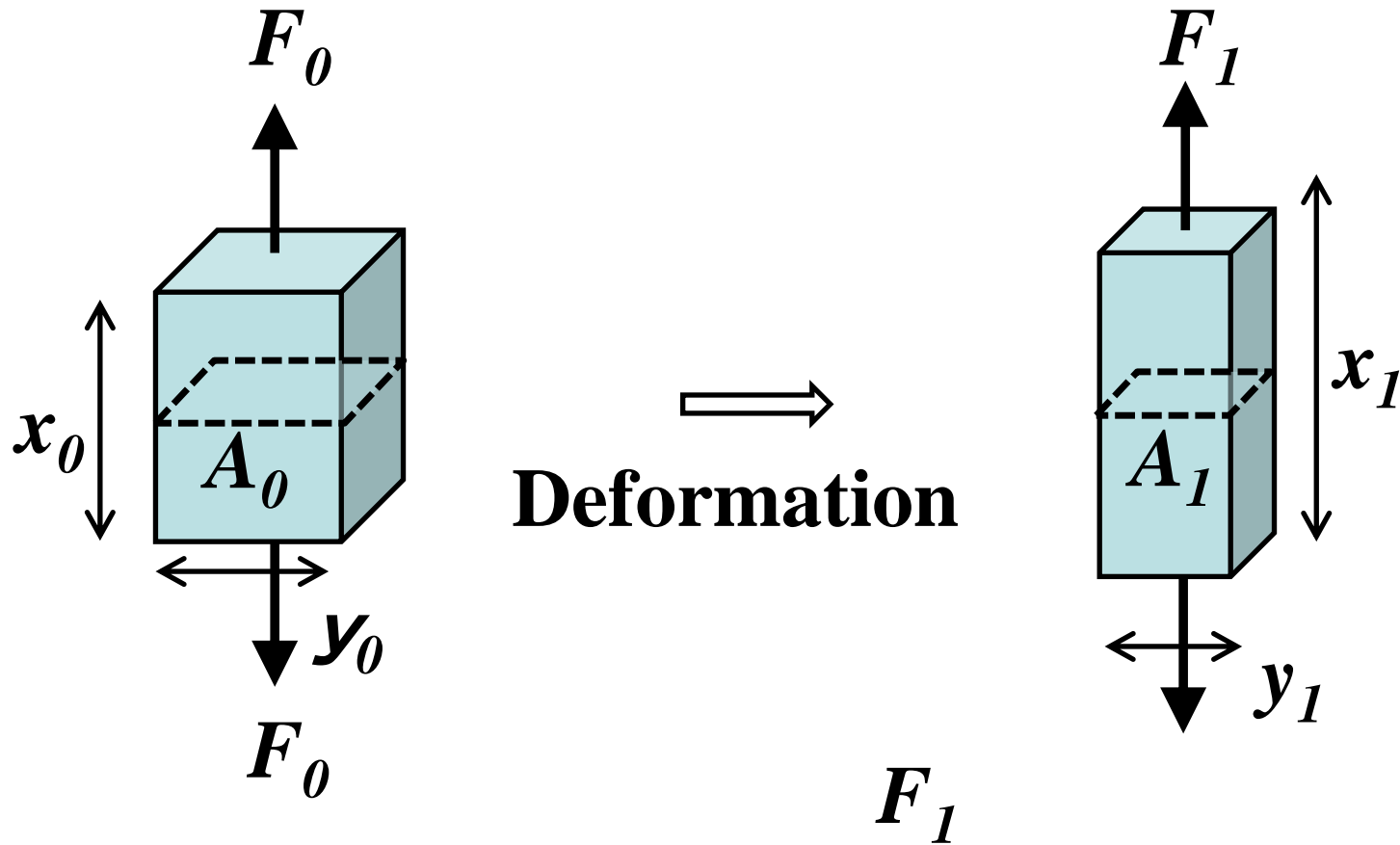


Fig. 3.13: True stress

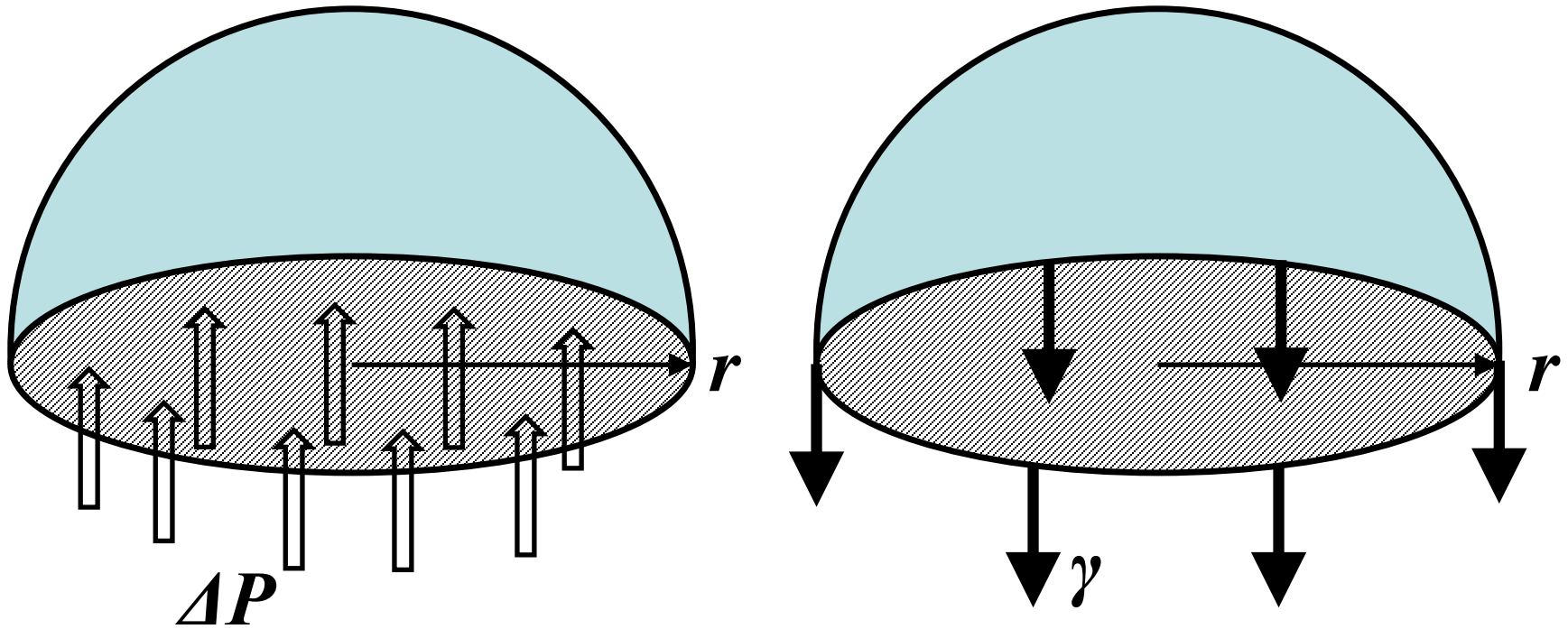


$$\tau_0 = F_0 / A_0$$

$$\tau_1 = F_1 / A_1: \text{True stress}$$

$$\tau = F_1 / A_0: \text{Nominal stress}$$

Fig. 3.14: Balance of forces in hemisphere



$$\Delta P \pi r^2 = 2\pi r \gamma \quad (3.10)$$

$$\Delta P = 2\gamma / r \quad (3.11)$$

Equation of Young-Laplace

Fig. 3.15: Tensile force at membrane of erythrocyte

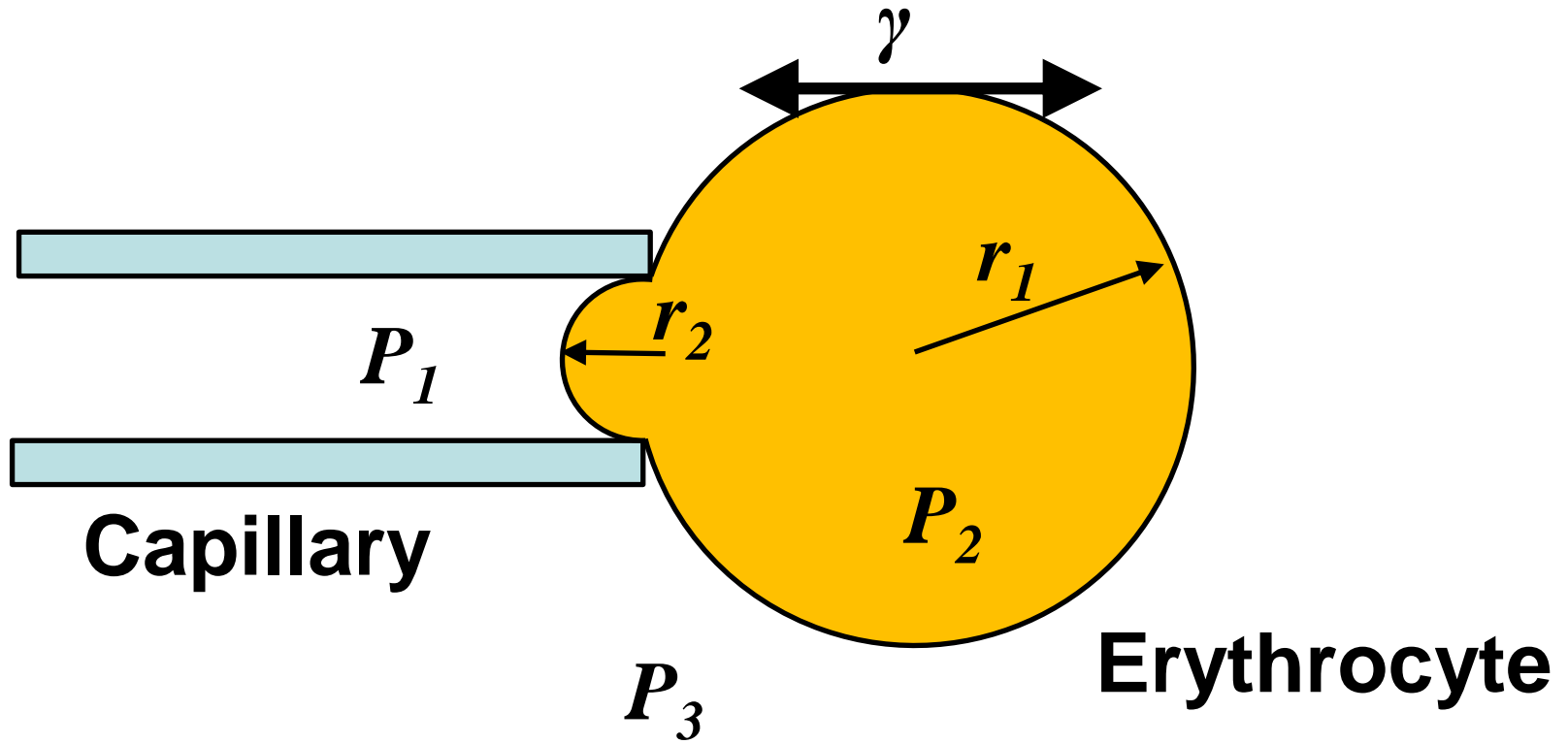
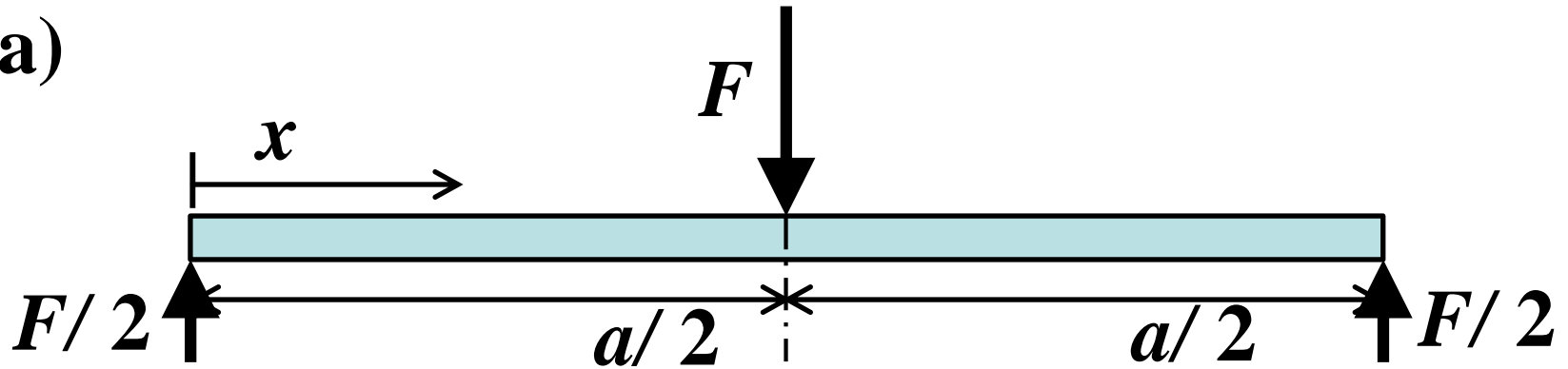


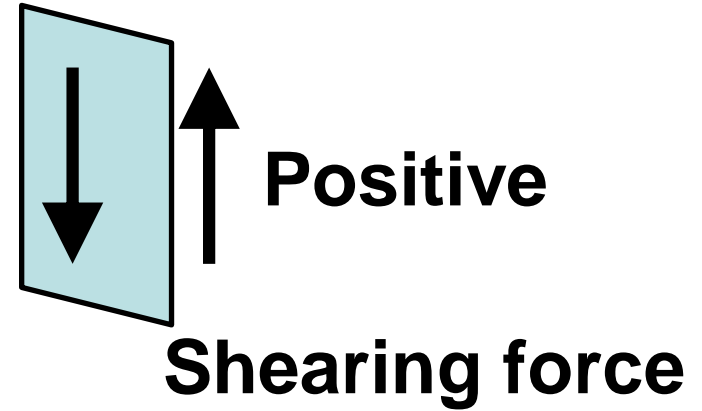
Fig. 3.16: Bending

(a)

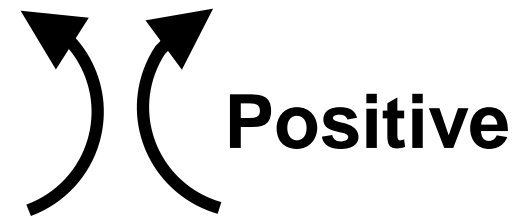
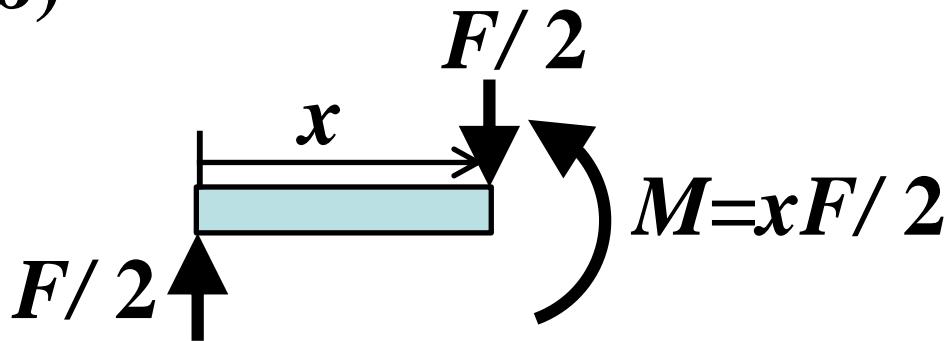


$$F/2 + F/2 - F = 0 \quad (3.12)$$

$$-(a/2)F + a(F/2) = 0 \quad (3.13)$$



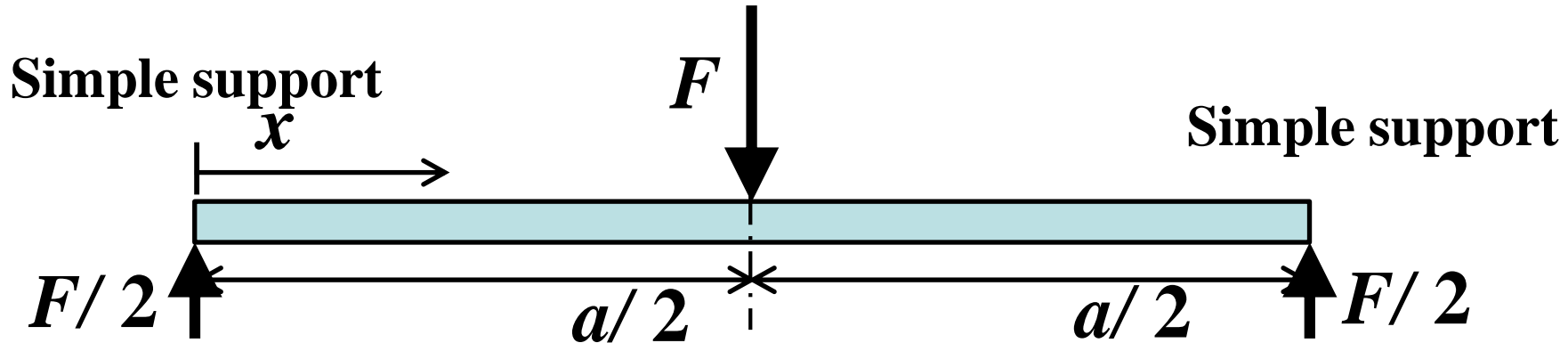
(b)



Bending moment

Fig. 3.17: Simple & rigid support

(a) Simple support



(b) One side rigid support

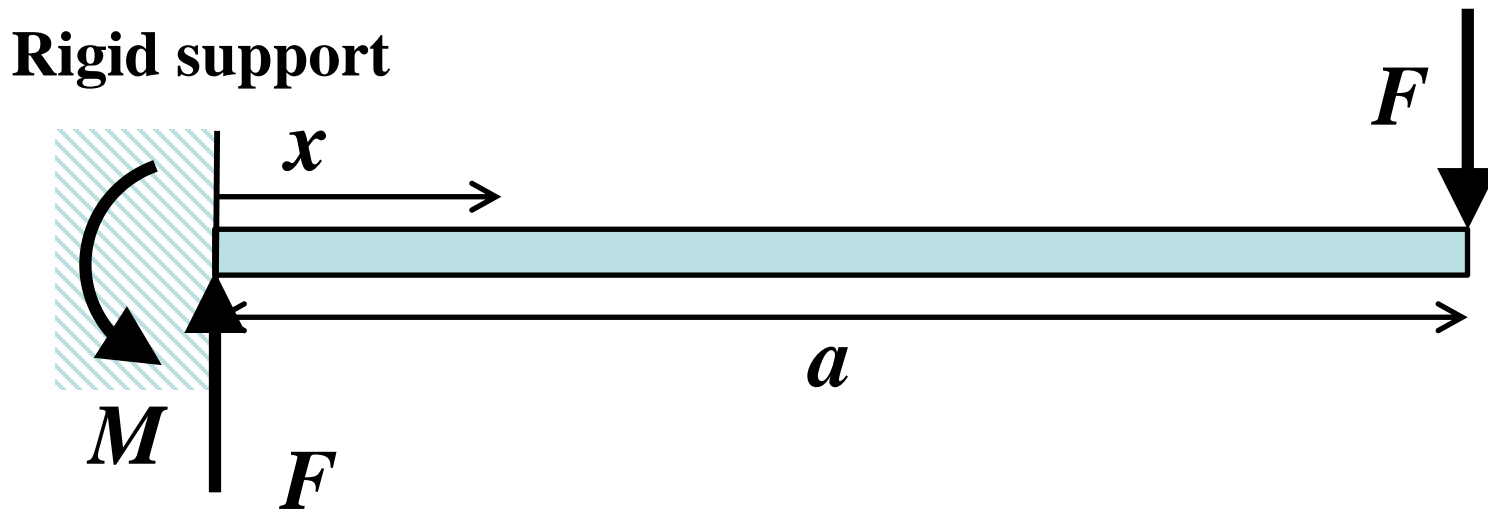
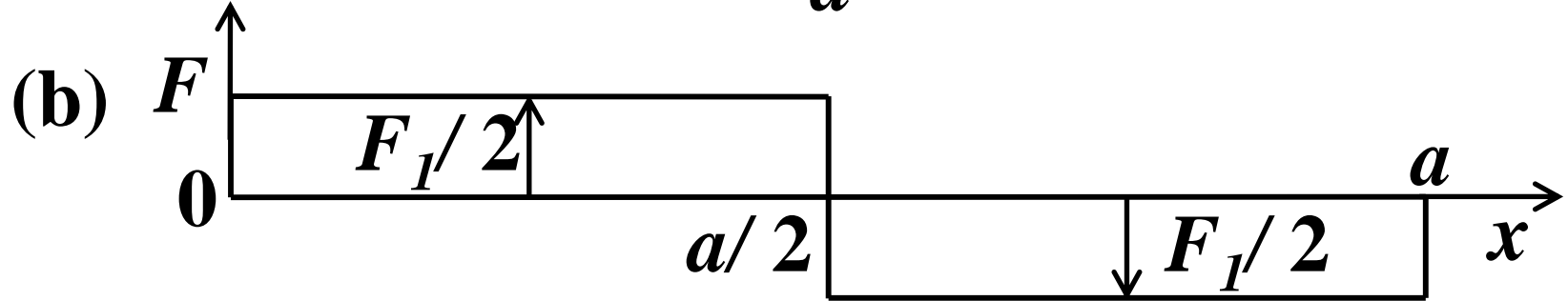
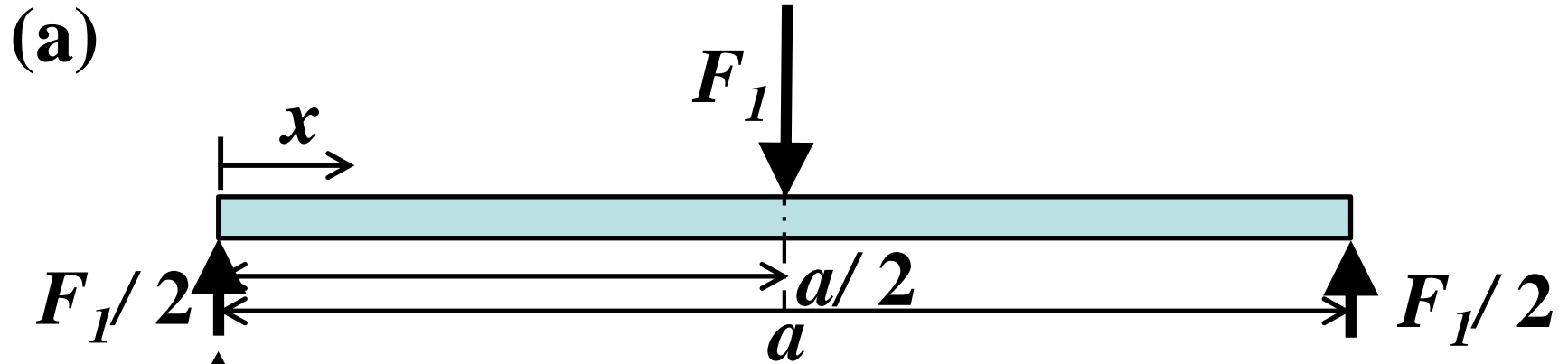
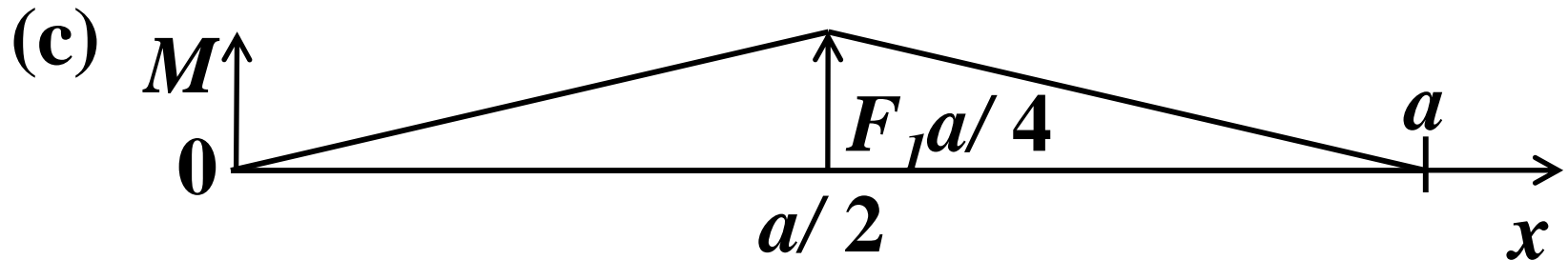


Fig. 3.18 Three-point bending test



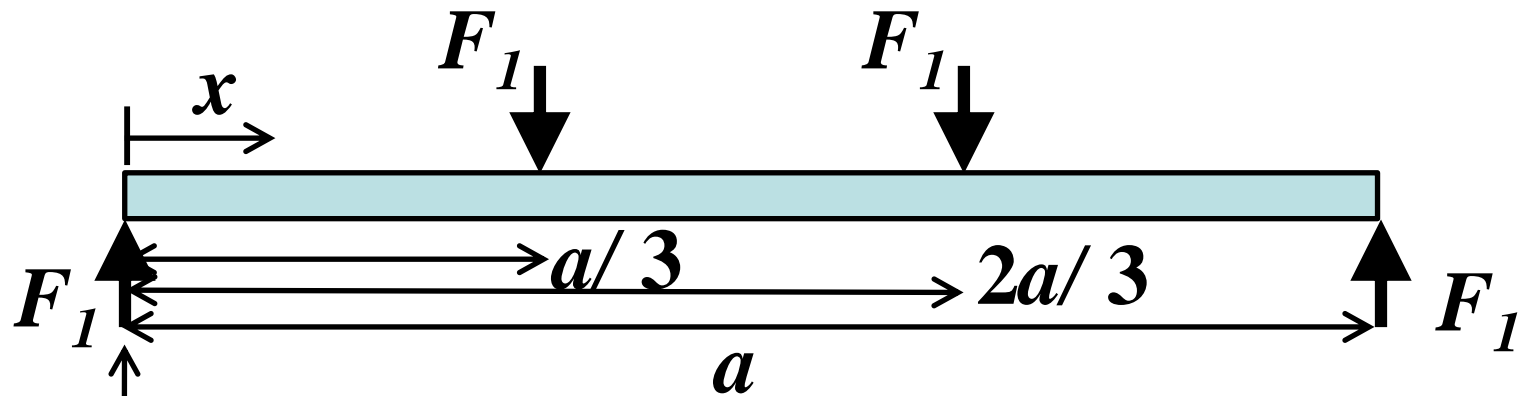
Shearing force diagram



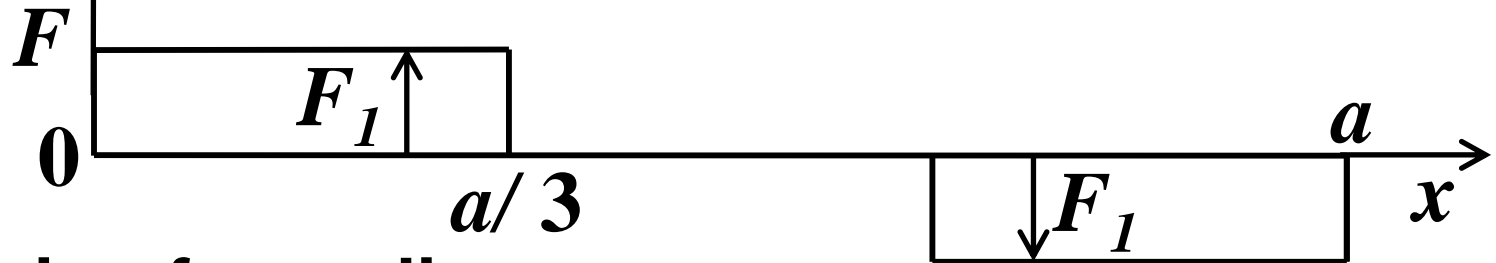
Bending moment diagram

Fig. 3.19: Four-point bending test

(a)

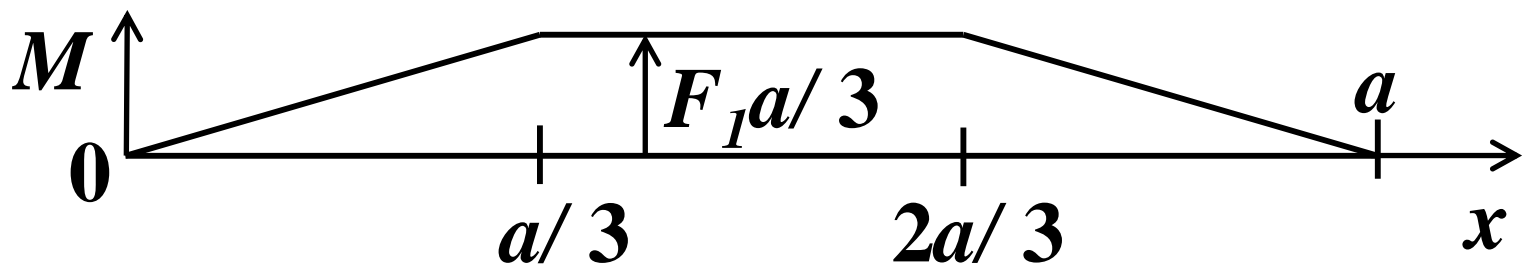


(b)



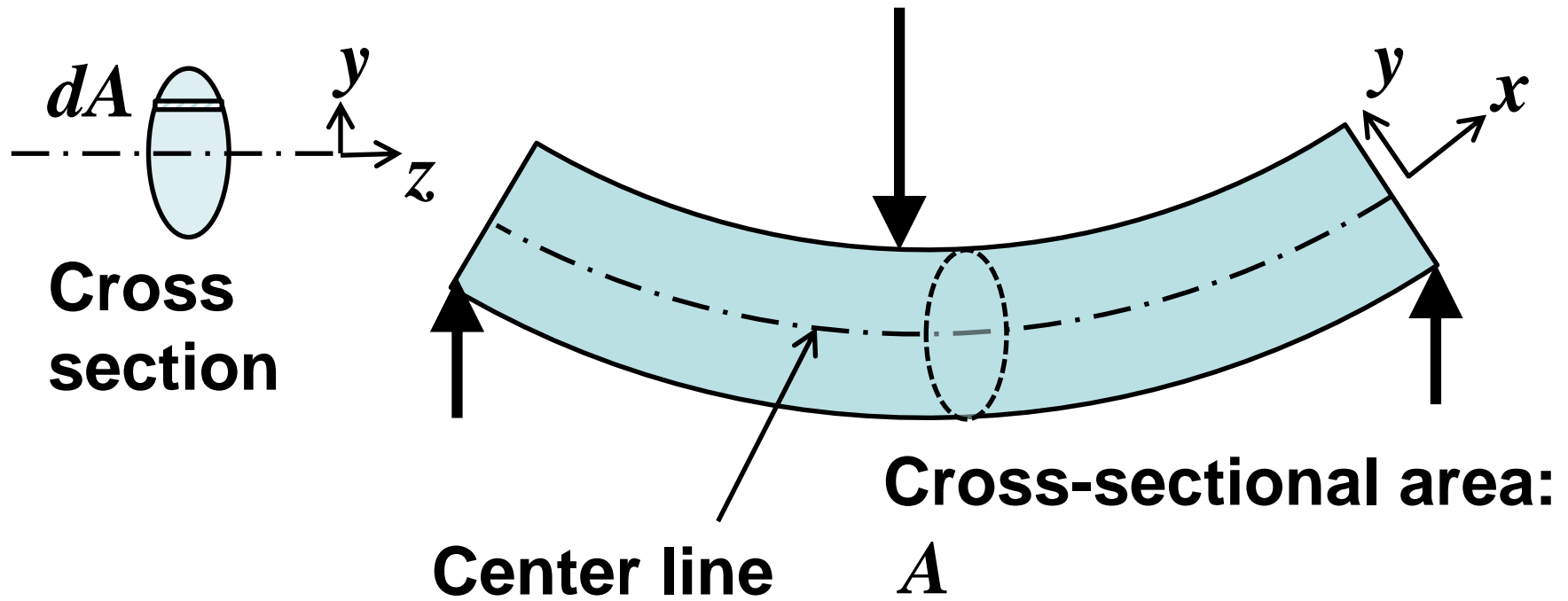
Shearing force diagram

(c)



Bending moment diagram

Fig. 3.20: Center line and strain



Moment of inertia: I_z

$$I_z = \int y^2 dA \quad (3.15)$$

Fig. 3.21: Yield and fracture

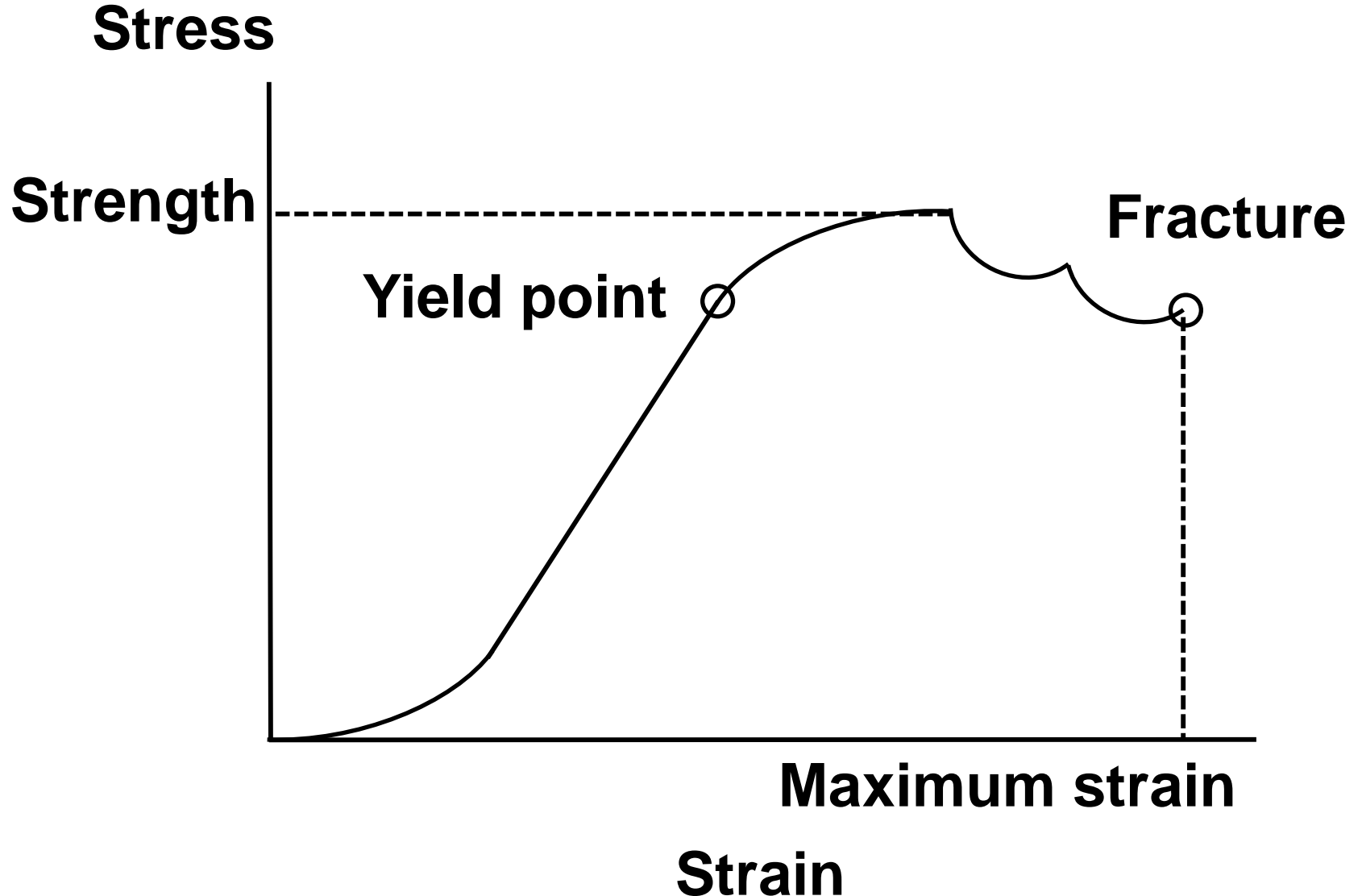
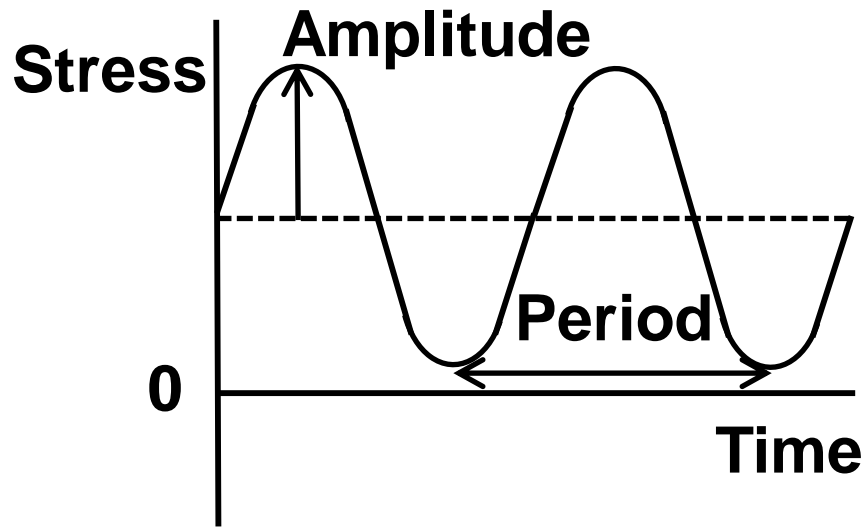
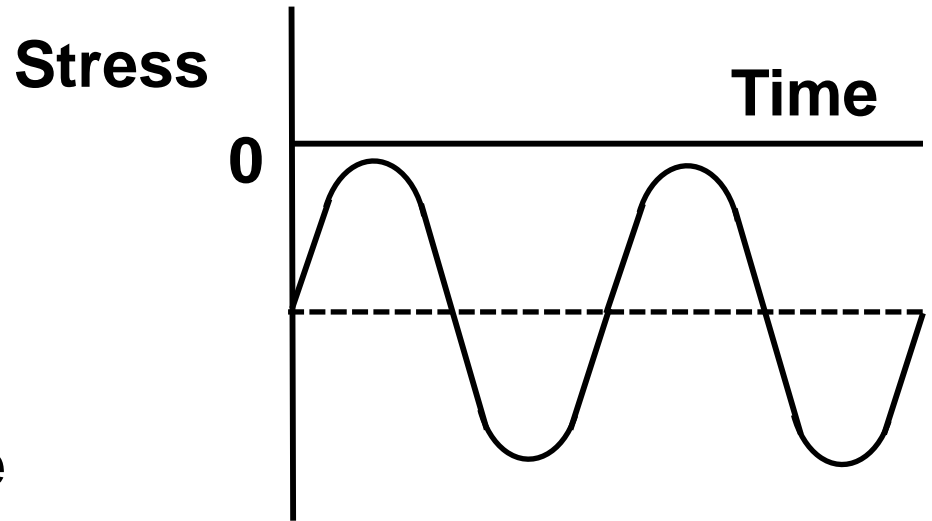


Fig. 3.22: Repetitive load

(a) Extension



(b) Compression



(c) Extension & Compression

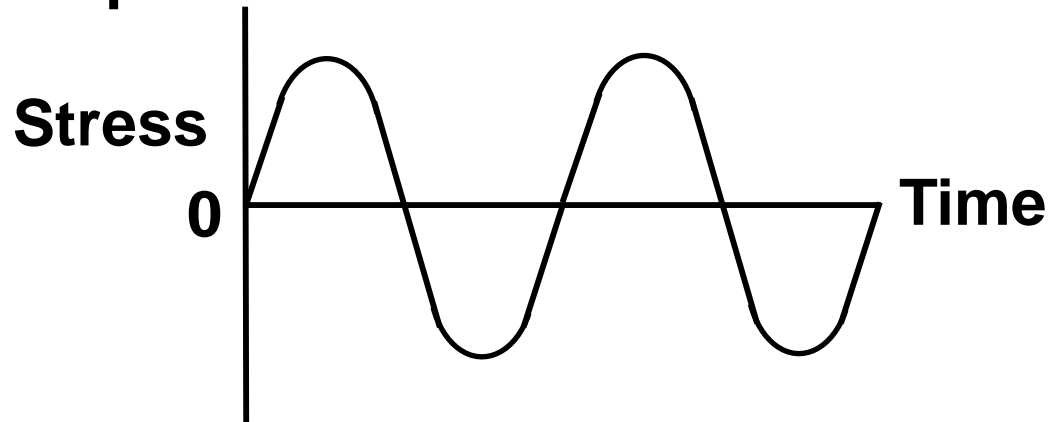


Fig. 3.23 Fracture surface

Striation

Dimple

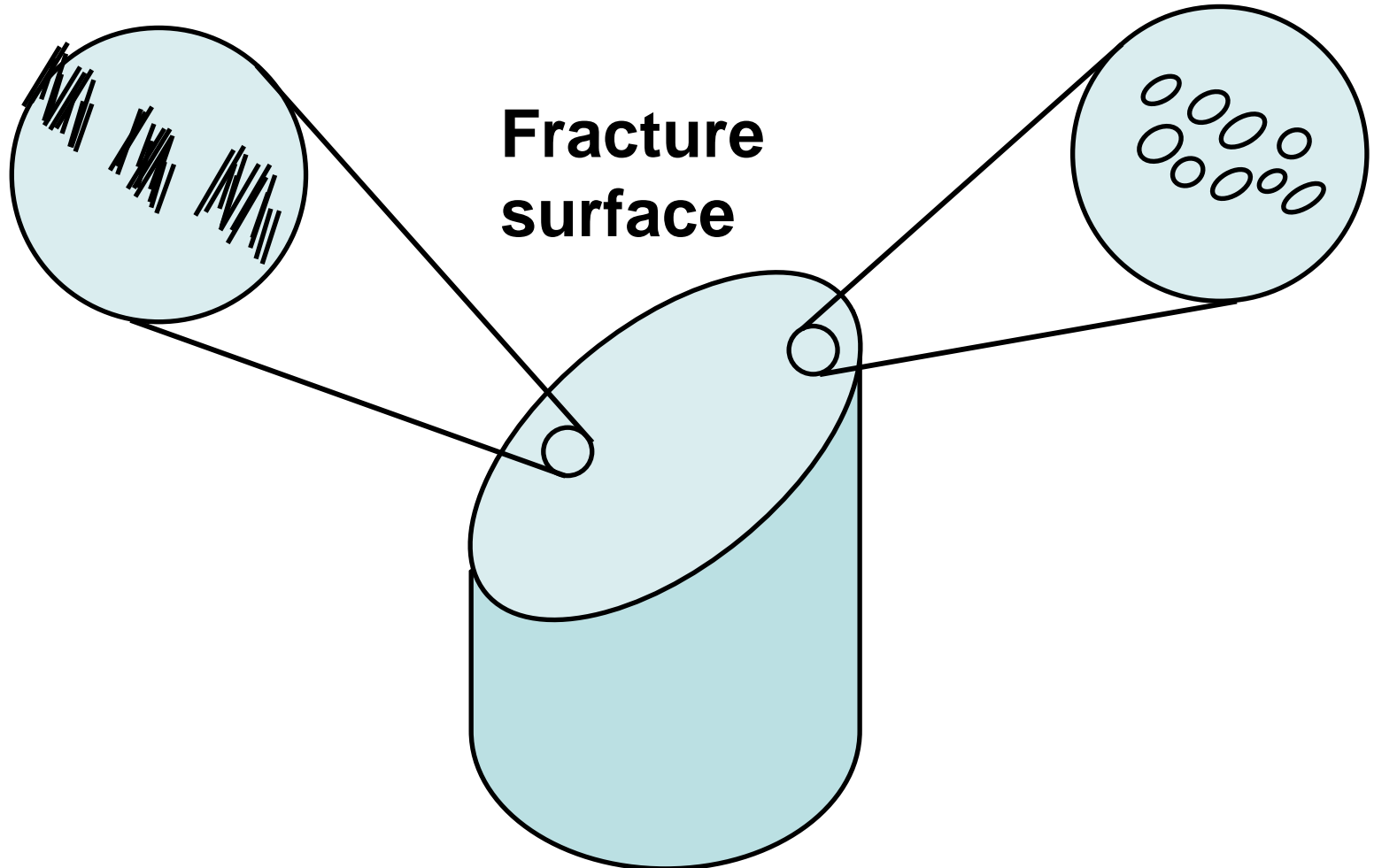


Fig. 3.25: Erythrocyte fatigue in flow

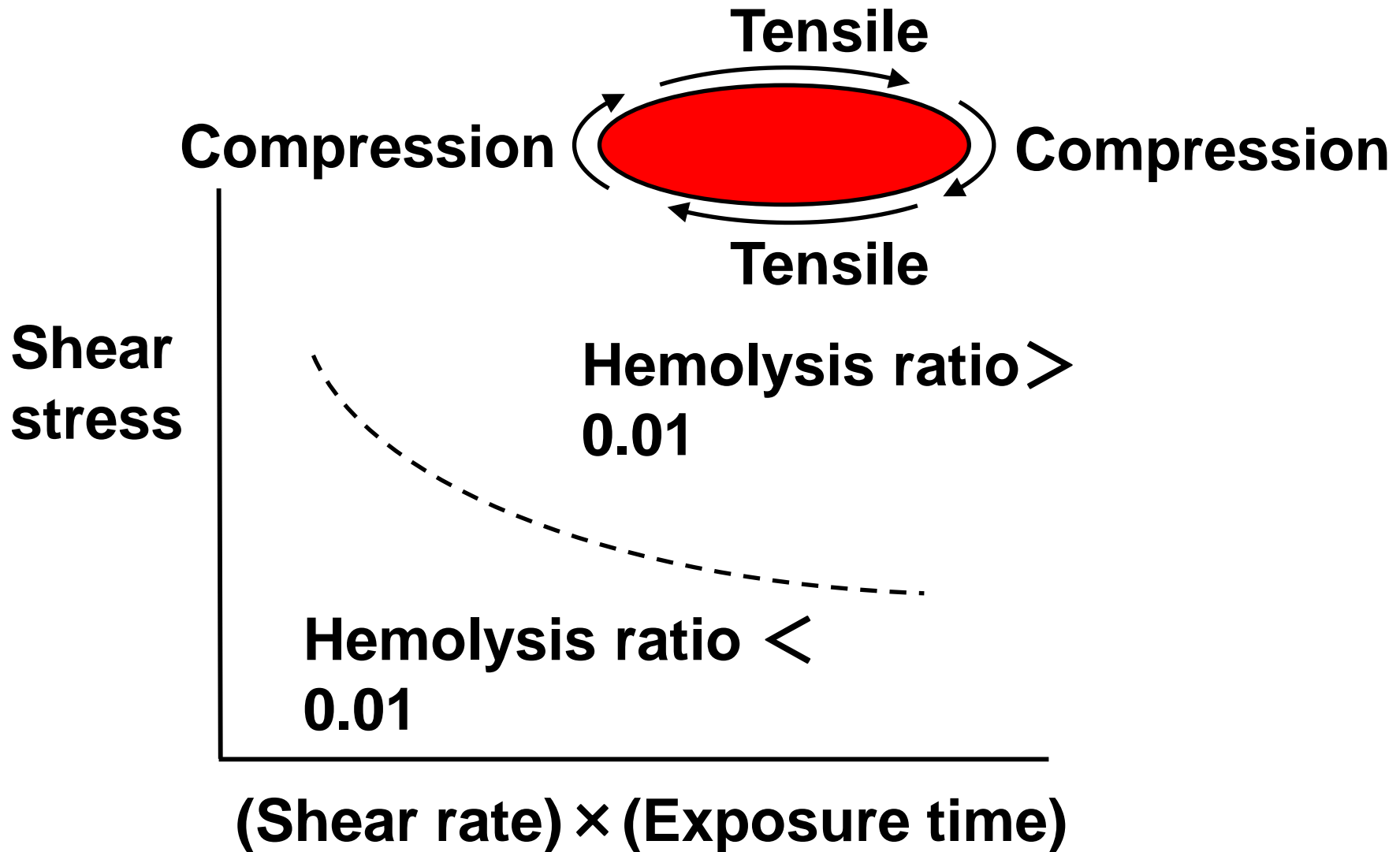


Fig. 3.26: Erythrocyte destruction

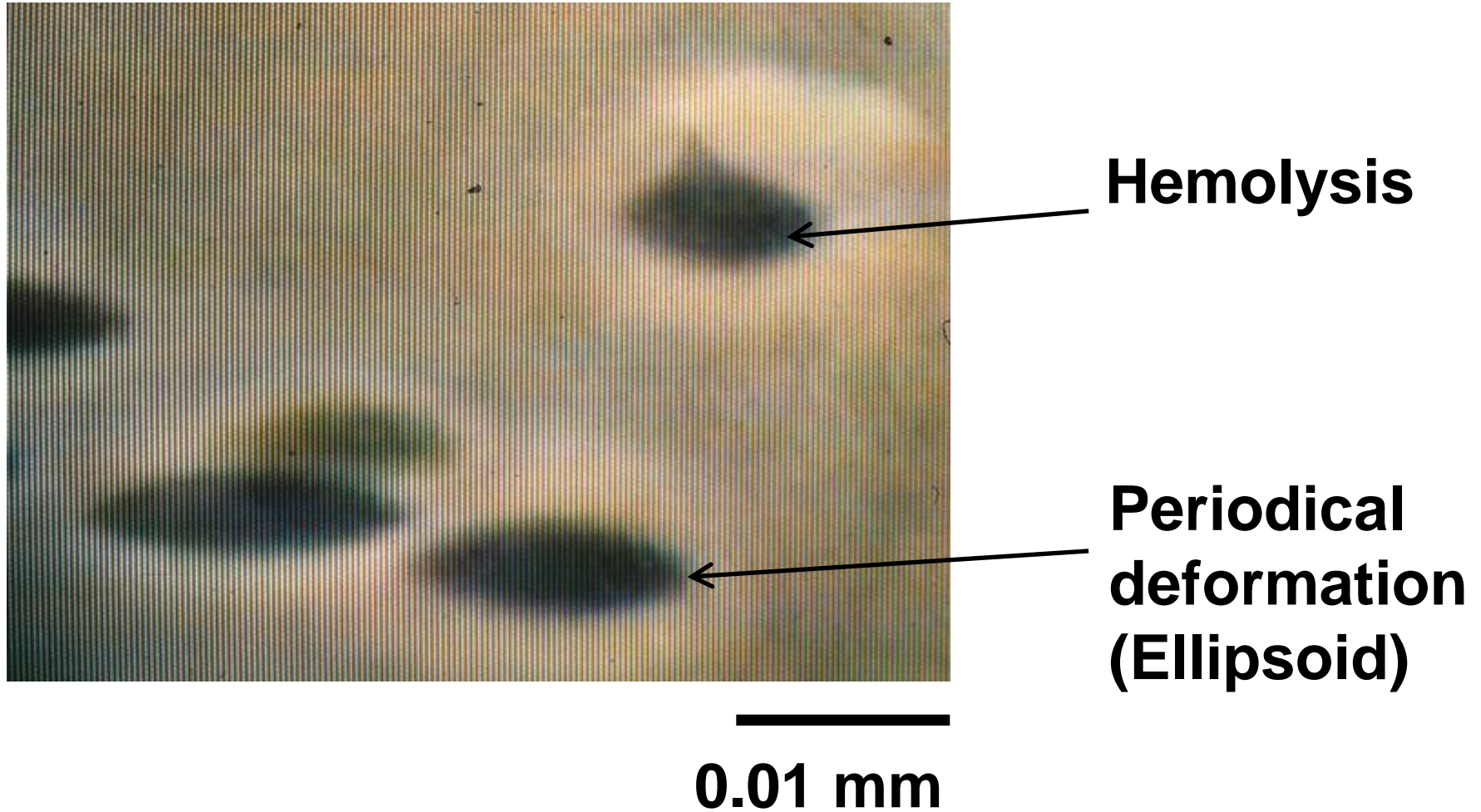
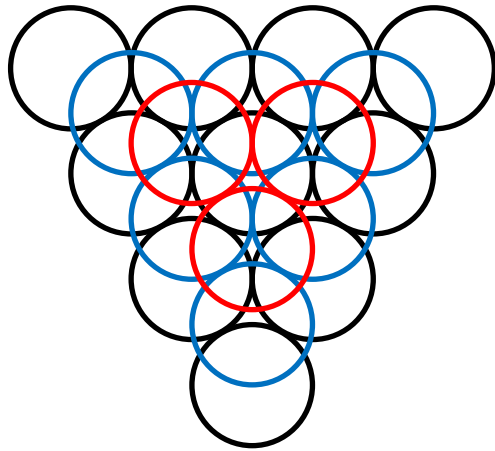
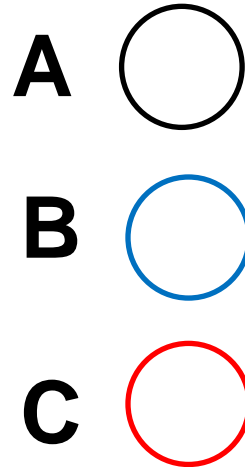


Fig. 3.27: Close-packed lattice

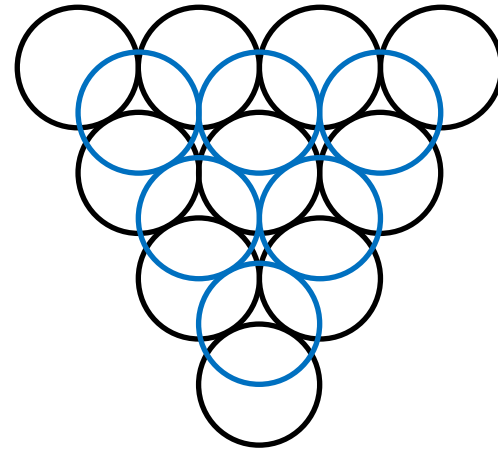
Face-centered cubic lattice



ABCABC



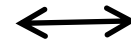
Close-packed hexagonal lattice



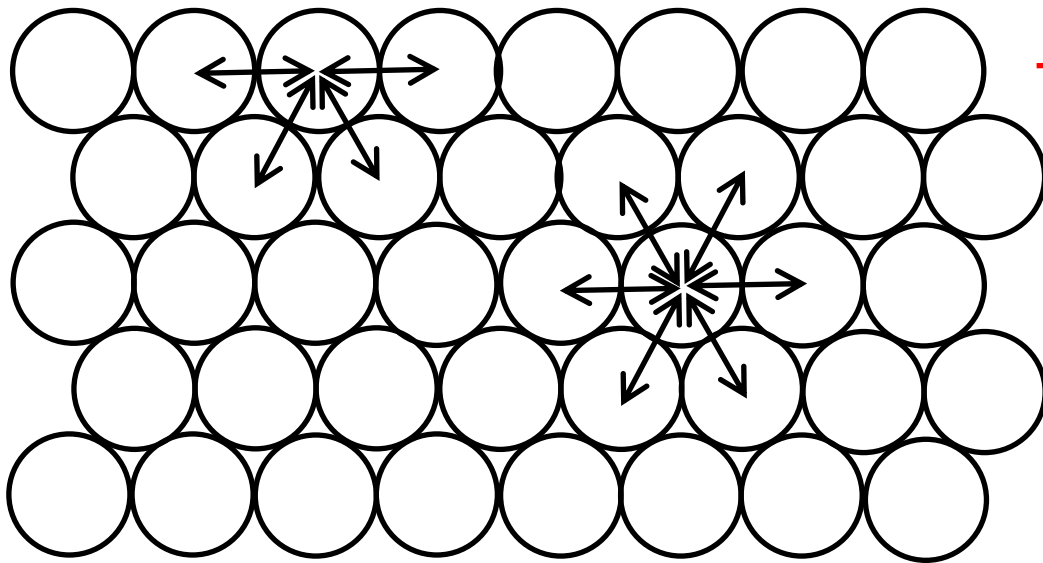
ABABAB

Fig. 3.28: Surface

Interaction



Surface



Inside

Fig. 3.29: Poly-crystal

Crystal grain

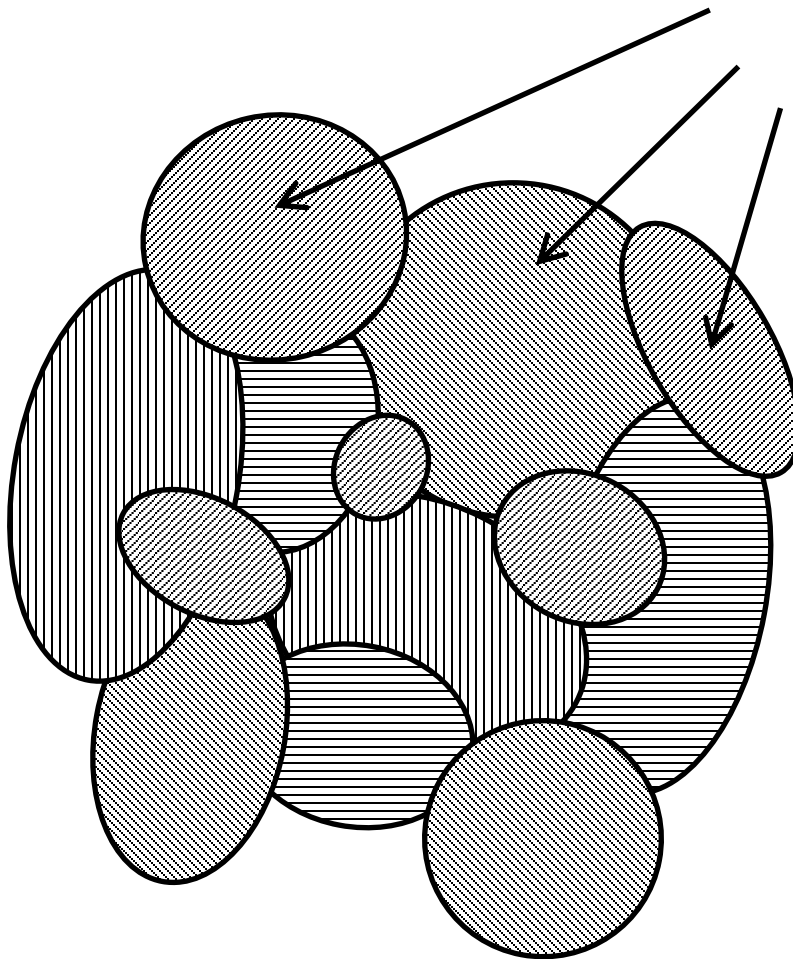
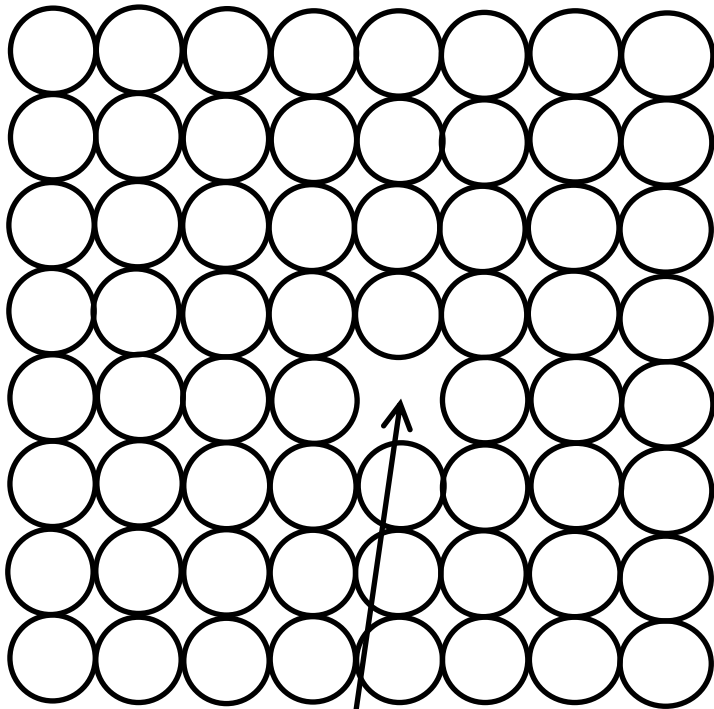
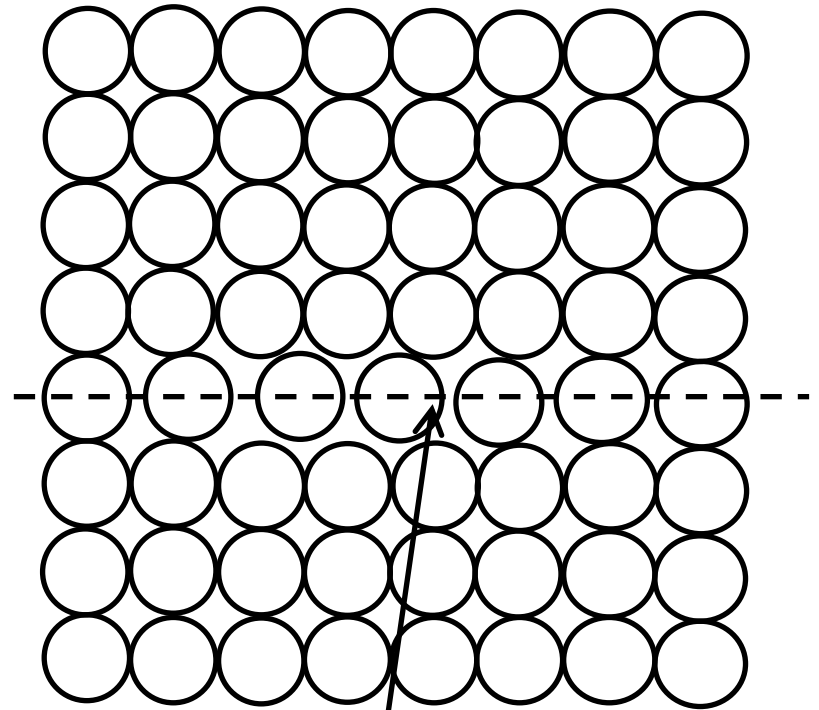


Fig. 3.30: Lattice defect



Vacancy



Dislocation

Fig. 3.31: Stress concentration

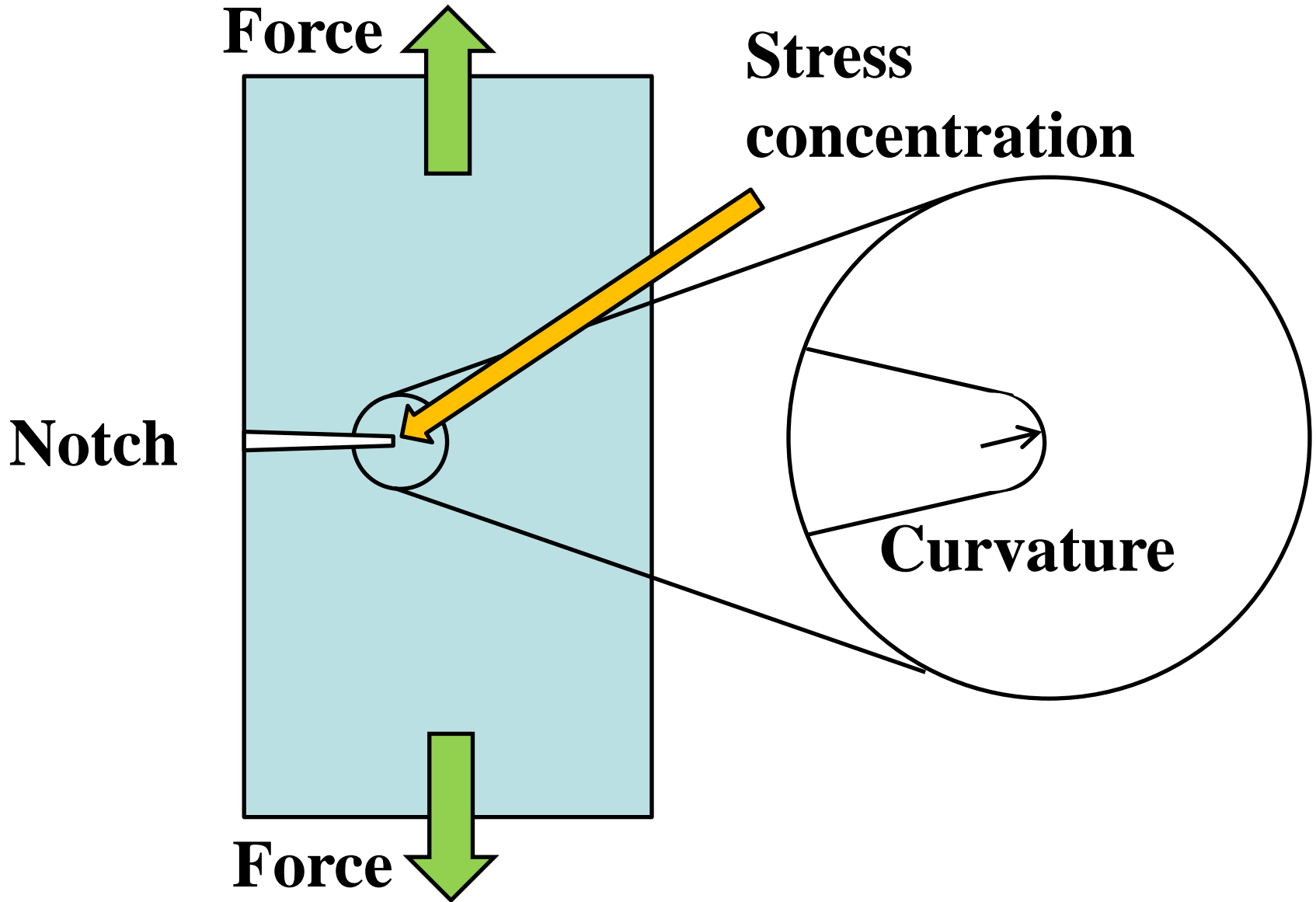
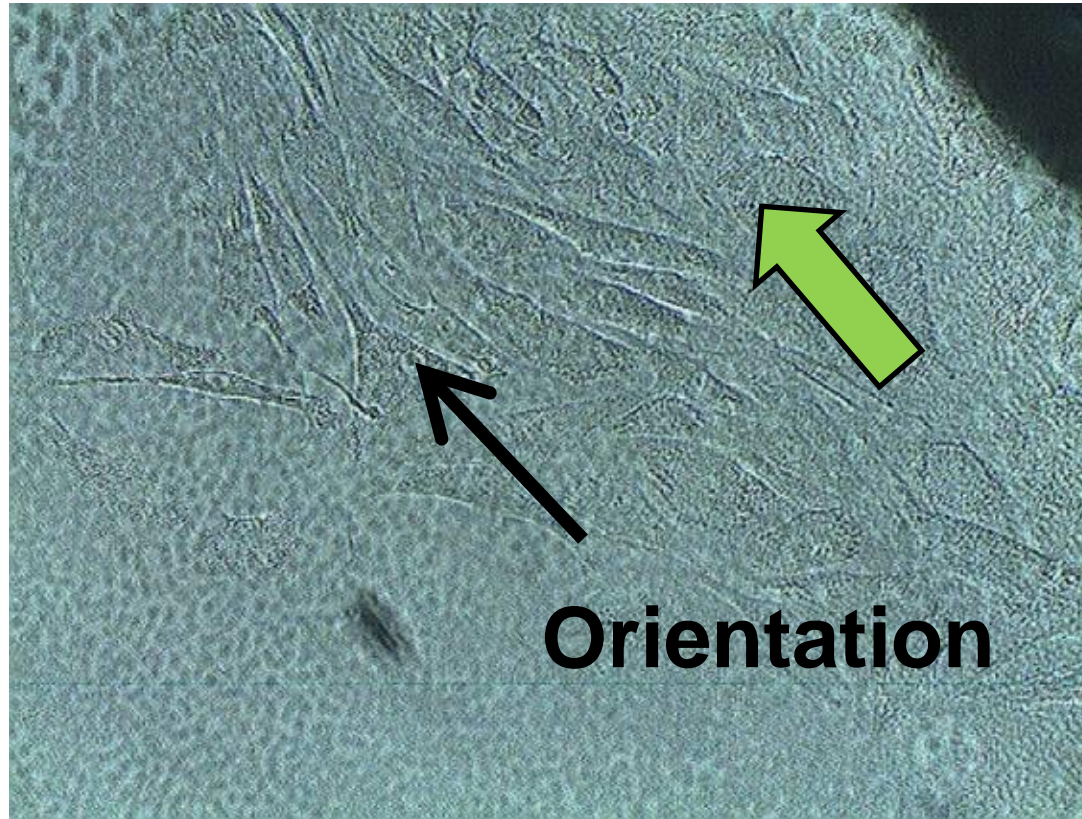


Fig. 3.32(a): Orientation of endothelial cells



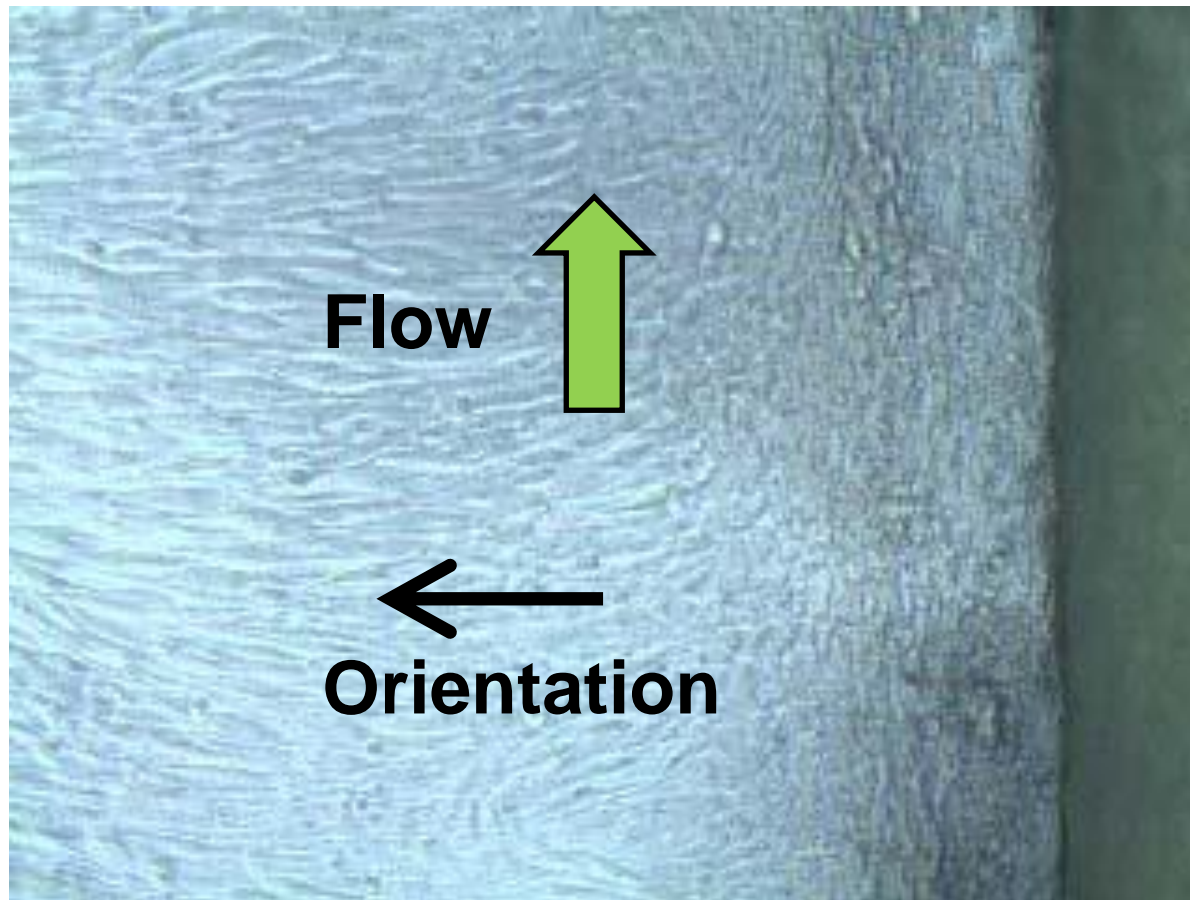
Orientation

Flow



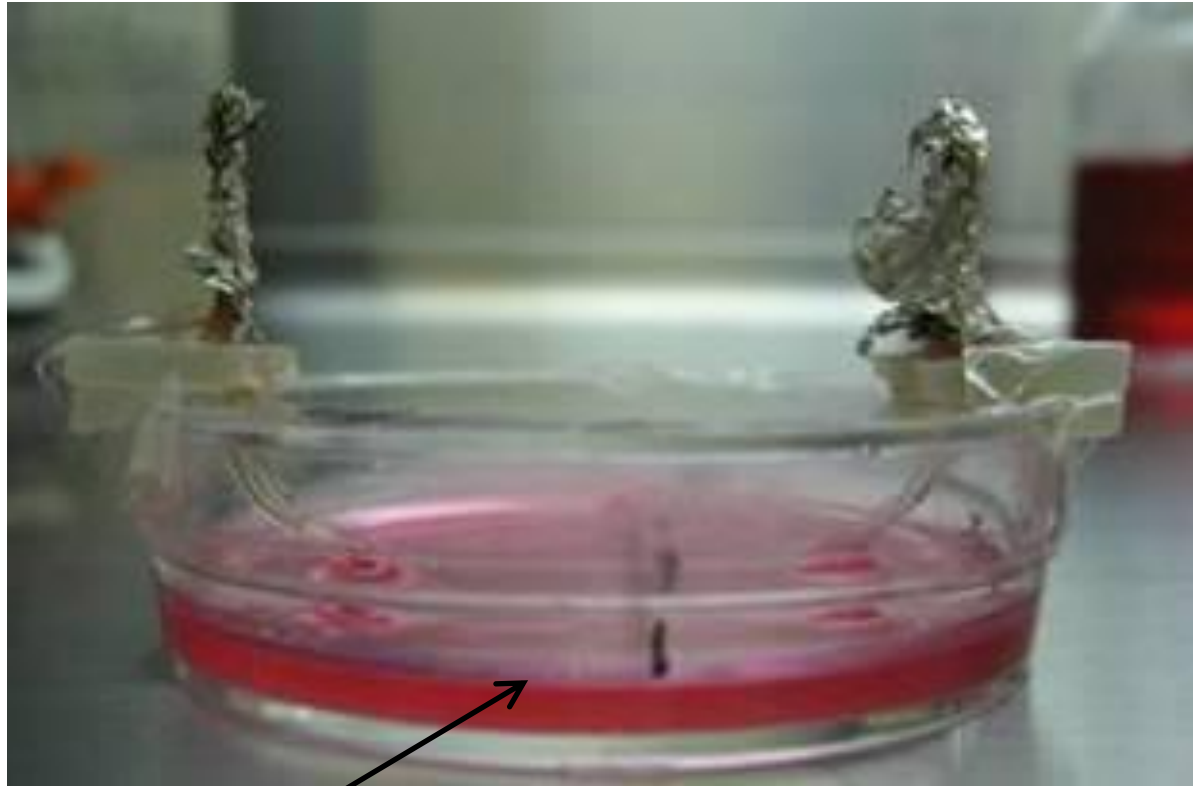
0.1 mm

Fig. 3.32(b): Orientation of C2C12



0.1 mm

Fig. 3.33: Electrodes



Cell culture

10 mm

Fig. 3.34: Force applied on laryngoscope

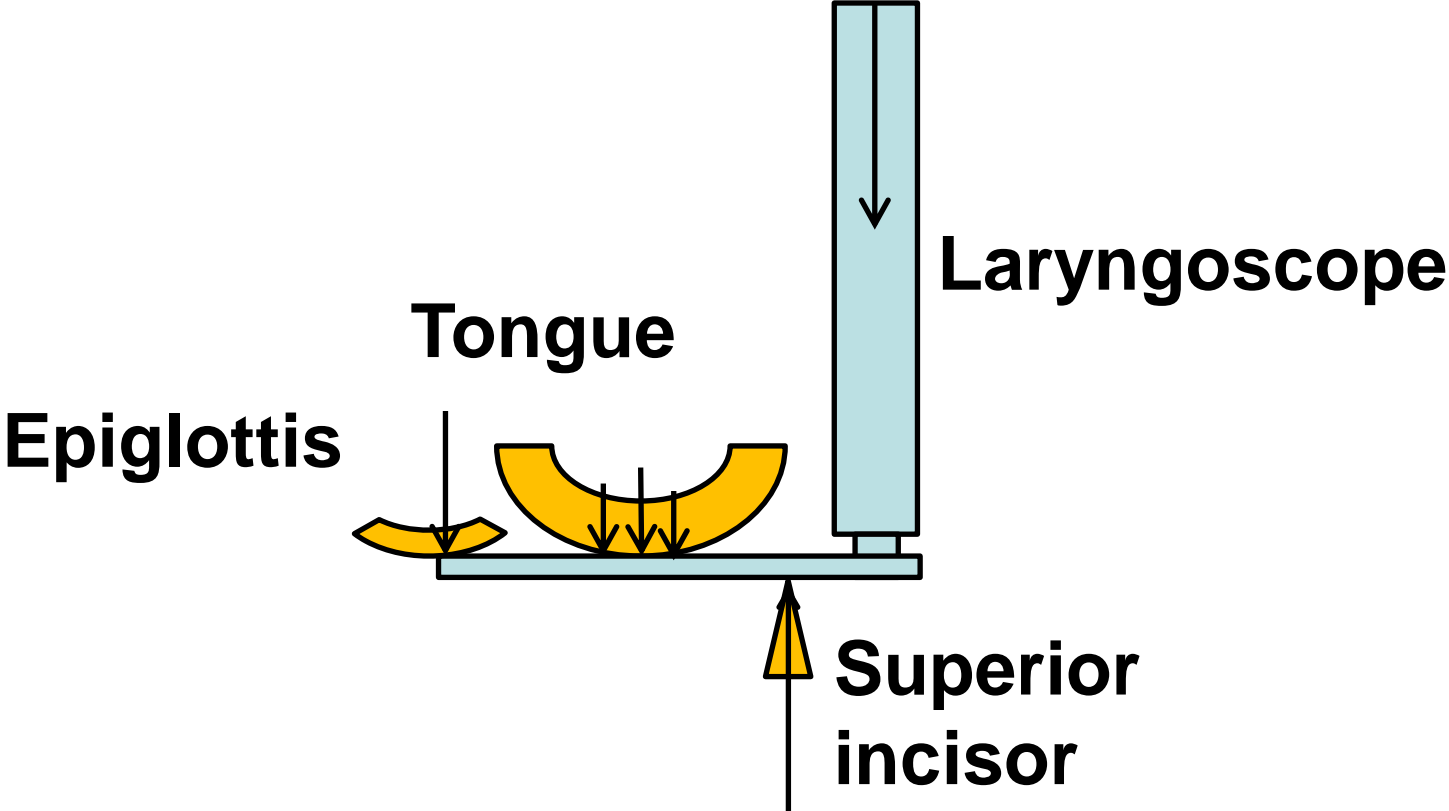


Fig. 3.35: Phantom

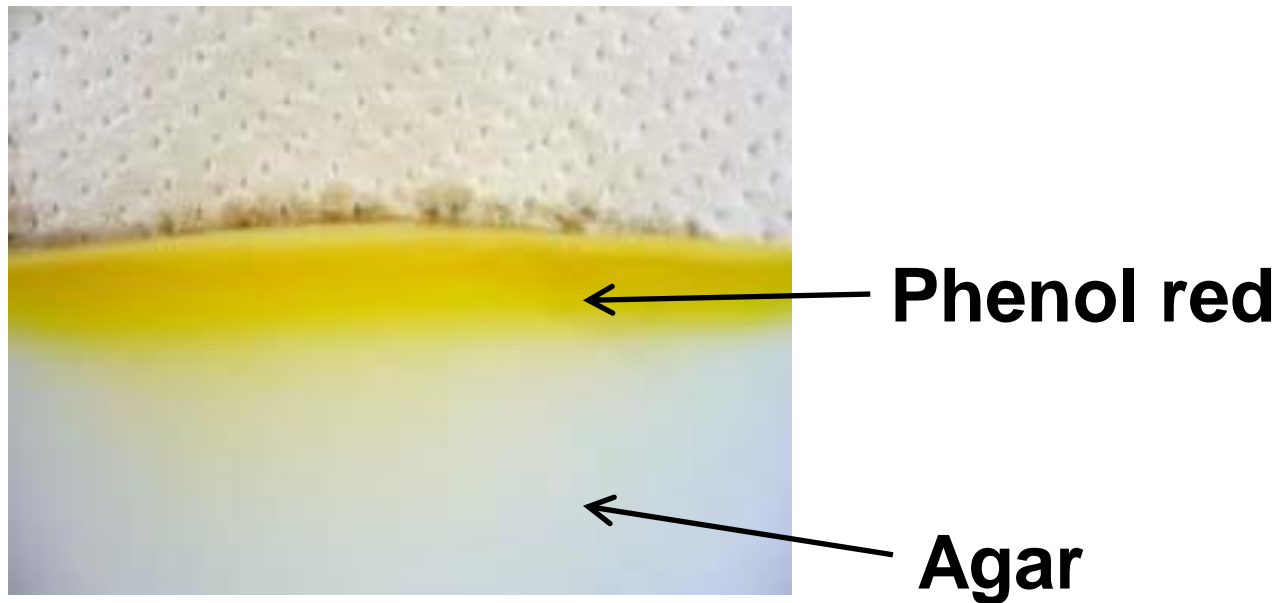


(a) Copper sulfate aqueous solution



(b) MRI (magnetic resonance image)

Fig. 3.36: Penetration of phenol-red into agar



Q. 3.3 Fig. 3.37: Face-centered cubic unit lattice

