VIBRATIONS OF ATOMS

STRESS + STRAIN \rightarrow \text{response of solids to mechanical forces.}

Consider a solid rod, length L, cross-sectional area A, and apply a tensile force F along its length \( \Rightarrow \) increase in length, \( \Delta L \).

strain, \( \varepsilon = \frac{\Delta L}{L} \) \text{ (fractional change in length)}

stress, \( \sigma = \frac{F}{A} \) \text{ (force per unit area)}

Hooke's law of elasticity states that the strain is proportional to the stress:

\[ \varepsilon = \frac{1}{E} \cdot \sigma \]

where E is the Young's modulus.

**Units:**
- strain: unitless
- stress, Young's modulus: \( \text{N/m}^2 \) or \( \text{Pa} \)

**Problem 7.1, page 117.**

ELASTIC WAVES - Let's derive the wave equation!

fix one end of the rod (\( x = 0 \)) - then the displacement \( u(x) \) of a point from its unstressed position varies linearly along the rod:

\[ u(x) = \frac{du}{dx} \cdot x = \varepsilon x \]

and \( \Delta L = [u(L) - u(0)] = \varepsilon L \)

provided that stress and strain are constant along the rod.