

## > Variation of EMF with temperature:-

↳ The electromotive force produced by a thermocouple increases with temperature until it reaches maximum, then begins to decrease and returns to zero as the temperature of the hot junction continues to increase while the cold junction is kept at 0°C.

## ■ Biomedical Sensors

↳ Working:

- It is a sensor which combines a bioelement with a physiochemical transducer to create an electronic signal proportional to a specific analyte.

↳ Tropism Sensors:

- Tropism refers to way plants grow in response to environmental stimuli, light, gravity, moisture etc.
- It occurs due to differential growth, causing it to curve towards or away from the stimulus.
- A positive tropism means the organ grows towards the stimulus, and negative tropism for the opposite.

## > Phototropism :-

- Refers to plant's growth response to directional light.
- Results in positive growth towards the light source.
- Occurs due to faster growth of cells on the shaded side.
- Stem curves towards light.

## > Gravitropism :-

- Refers to plant's growth response to gravity.
- Rootcap, a small organ at the root tip is essential for gravitropism.
- Gravitropism increases likelihood of roots finding water, minerals and stems and leaves better capturing light for photosynthesis.

## > Thigmotropism :-

- Refers to plant's growth response to touch.
- Tendrils are specialized organs that exhibit this response through coiling.
- Common on twining plants such as morning glory and bindweed.

## > Hydrotropism & Heliotropism :-

- **Hydrotropism** Refers to root growth in response to **soil moisture**.
- Root cap is the site of **moisture perception**.
- **Heliotropism**: Solar tracking of Plants organs to the sun's position.
- **Compass** plants in desert orient their leaves parallel to sun's rays to minimize **desiccation**.

## ↳ Environmental sensing in Animals (sharks):

- They have strong sense of smell through **sensory folds** in nasal passage.
- Pickup on electrical fields generated by other animals via **Ampullae of Lorenzini**.
- **Electromagnetic** sense helps locate in low light / murky water.

## ↳ Micro-electromechanical system (MEMS) :-

- It is a process technology for creating integrated mechanical and electrical system / device
- Found in applications such as **automotive, medical, electronic, communication and defense**.
- **Examples**: Air bag Sensor, inkjet printer head, blood pressure sensors, optical switches etc.
- **Advantages**: interdisciplinary nature, smaller size, cost effective and micromachining techniques.

## ↳ Nano-electromechanical system (NEMS) :-

- Made out of **electrochemical devices**.
- **Characteristics**: high fundamental frequency, low energy dissipation, low active mass, high force and mass sensitivity, low power consumption.
- Silicon is widely used for build NEMS, but its **Limitation** in **strength and flexibility** make it less favourable.

- Used in fields like : force sensing, chemical sensing, biological sensing, and ultra-high frequency resonators.
- Carbon nanotubes and nanowires are promising building blocks for the next generation for NEMS.

### ↳ Non-Destructive Testing (NDT) Sensors :

- They are specialised sensors for inspecting material/object properties without damaging it.
- Techniques : ultrasound, radio graphy, eddy current testing.
- Benefits : reduces risk of structural failure, increase equipment lifespan, improve component reliability.
- Industries : Aerospace, petrochemical, manufacturing etc.