

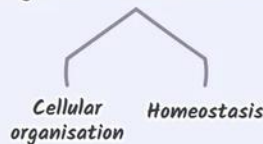
the traits that make something alive, and the tools built to study the variety of it



Characteristics of Living Organisms

- **metabolism** : catabolism breaks molecules down for energy, anabolism builds new ones; every cell runs both together
- **growth and development** : a well orchestrated process from birth, not a sand mound simply getting bigger
- **ageing** : growth and development don't run forever; molecules, organs and systems lose effective working
- **reproduction** : sexual or asexual, produces a young one like the parent, keeping the race continuing
- **death** : once the body loses its capacity for metabolism, the organism dies, not immortal
- **responsiveness (irritability)** : every living being responds to thermal, chemical or biological change around it
- beyond the six traits, two more are treated as defining hallmarks of life
- **cellular organisation** : every living thing is built of one cell or many, never zero
- **homeostasis** : the ability to keep internal conditions steady while the surroundings change

Beyond the six traits



the two further hallmarks of life, beyond the six traits already listed

Growth, Living or Non-living

Living organism

- growth comes from within, cells divide and add mass intrinsically
- is the outcome of coordinated metabolism, not deposition

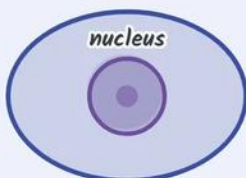
Sand mound, boulder

- gets bigger only by material piling up from outside
- this is not growth in the biological sense, and these are not living beings

the textbook makes this comparison directly: a growing sand mound is not, by that fact alone, alive

Each Trait, Why It Fails Alone *

Metabolism



plasma membrane
in vitro test tube reactions run real chemistry outside any cell: metabolism alone is not enough

Growth

a sand mound or boulder also gets bigger, but only from outside deposition, not from within

Reproduction

mules and sterile worker bees never reproduce, yet both are undeniably living

Responsiveness

brain dead patient on life support: metabolism runs, but no self consciousness or independent homeostasis, so debated