



what counts as alive, and the ladder built to name every kind of it



Five hallmarks of life

Growth

increase in cell number and mass, from within

Reproduction

makes new individuals of the same kind

Metabolism

the sum of every chemical reaction inside the body

Cellular organisation

built of one cell or many, always cells

Consciousness

sensing the surroundings and responding to them

Growth: living vs non-living *

Living organism

- growth is **intrinsic**, cells divide and add mass from within
- indeterminate, continues through much of the life span in plants

Crystal, mountain, non-living

- growth is **extrinsic**, material is deposited layer on the outside
- stops the moment fresh material stops arriving

both can get bigger, that alone doesn't make them the same kind of growth

Reproduction isn't universal

- defined as producing progeny, **similar to** the parent, by sexual or asexual means
- worker bees, worker ants, mules and many sterile hybrids never reproduce at all, yet they are still alive
- a single individual can live out its entire life without ever reproducing once
- so reproduction alone can never be the complete test for life

Metabolism, unique but not sufficient alone

- **catabolic** reactions break molecules down and release energy, **anabolic** reactions build them up and use it
- every living cell performs metabolism as an organised, coordinated whole, no exceptions
- but isolated cell-free extracts can carry out the same biochemical reactions in a test tube
- that in-vitro reaction is metabolism without a cell around it, so metabolism by itself isn't proof of life either

no single characteristic is enough on its own: growth, reproduction, metabolism, cellular organisation and consciousness only define life **together**

