

Requirements for Life

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Life: What is it?

- Things with the ability to reproduce AND the ability to evolve and adapt
- Why both of these?
- Flames can spread or “reproduce”, but they aren’t alive
- Crystals (i.e. salt) can also spread or grow, but they aren’t alive either
- Only living things evolve – meaning develop adaptations to their environment that improve their ability to continue

Implications

- **Need: an energy source**
 - **Something to power the “doing” of things**
 - **Including reproduction**
- **Need: means of reproduction**
 - **Access to material components of life**
 - **Way of passing on the information about the structure of life (“genetic code”)**

Energy Source

- **Want something easy to make, easy to store, capable of making things happen in a “typical” environment**
- **Options:**
 - **Nuclear energy? (Requires 10,000,000K and high pressure)**
 - **Solar energy? (Hard to store light)**
 - **Thermal energy? (tends to “leak” out; hard to store)**
 - **Kinetic energy? (hard to store)**
 - **Chemical energy? Works!!**

Genetic Code

- **Need lots of ability for variation in the code (especially if adaptation/evolution are important)**
- **Need ways of “writing” and “reading” code**
- **Likely solution: chemical coding (like DNA)**
- **Need large/complex chemical molecules**

- **What element is really good at making complex chemical molecules?**

Medium of Life

- **Solids?** Chemical reactions are very slow in most solids
- **Gas?** Chemicals are often (not always) easily dispersed in air/gas
- **Liquid?** Chemical reactions can proceed quickly, while density of reacting materials stays high

Solvent

- **Chemical that can break apart solids into liquid phase**
- **Chemical that can separate and mix apart many complex structures into the liquid phase**
- **What is the best solvent known in the world?**
- **(Not molecular acid)**



Summary

- **Need energy source and reproductive code**
- **Likely energy source: chemical energy**
- **Reproductive code: likely chemical, and requires complex molecules/chains**
- **A little weaker: May have a preference for liquid phase?**
- **Probably need a powerful solvent**

- **At the risk of seeming Earth-centric: carbon does a great job of storing chemical energy and forming complex molecules suitable for reproduction; water is a GREAT solvent**