Origins of ELSI:

the Earth-Life Science Institute to study the Origin of Earth & Origins of Life

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Institute for Advanced Study, Princeton

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The 3 BIG questions:

- **the Origin of the Universe** **Kavli-IPMU (2007)**
- **the Origin of Life** **ELSI (2012)**
- **the Origin of Intelligence** **??? (2017 ?)**

The 3 BIG questions:

- **the Origin of the Universe** Kavli-IPMU (2007)
- **the Origin of Life** ELSI (2012)
- **the Origin of being able to ask: what is**

the Origin of the Universe
the Origin of Life
the Origin of being able to ask: what is

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Cooking recipe for ELSI:

How to study the Origin of Earth & Origins of Life ?

- Take a building
- Add geologists & biologists
- Stir
- Add some astronomers and chemists
- Stir more (regularly add catalysts: coffee)
- Sprinkle in some physicists, mathematicians, etc.
  [including some secret ingredients]
- Cook until done (occasionally add solvents: alcohol)

ELSI: Earth-Life Science Institute

	Earth	Life
Earth	Geology	Biology
Universe	Planetology	Universal Biology

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ELSI Satellite: Harvard Origins of Life Initiative
(Jack Szostak)

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ELSI Satellite: Institute For Advanced Study, Princeton
(Program in Interdisciplinary Studies)

Mathematics	Natural Science
History	Social Science

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System Science: *resilience*

Making reliable systems from unreliable parts

robustness, maintenance

in Nature, and in Culture

The success of science rest on:

- Reductionism -- look for building blocks
- Complexity -- look for emergent features

Quarks, gluons, electrons

Protons, neutrons, electrons

Atomic nuclei, electrons

Atoms

Molecules

Quarks, gluons, electrons

Protons, neutrons, electrons

Atomic nuclei, electrons

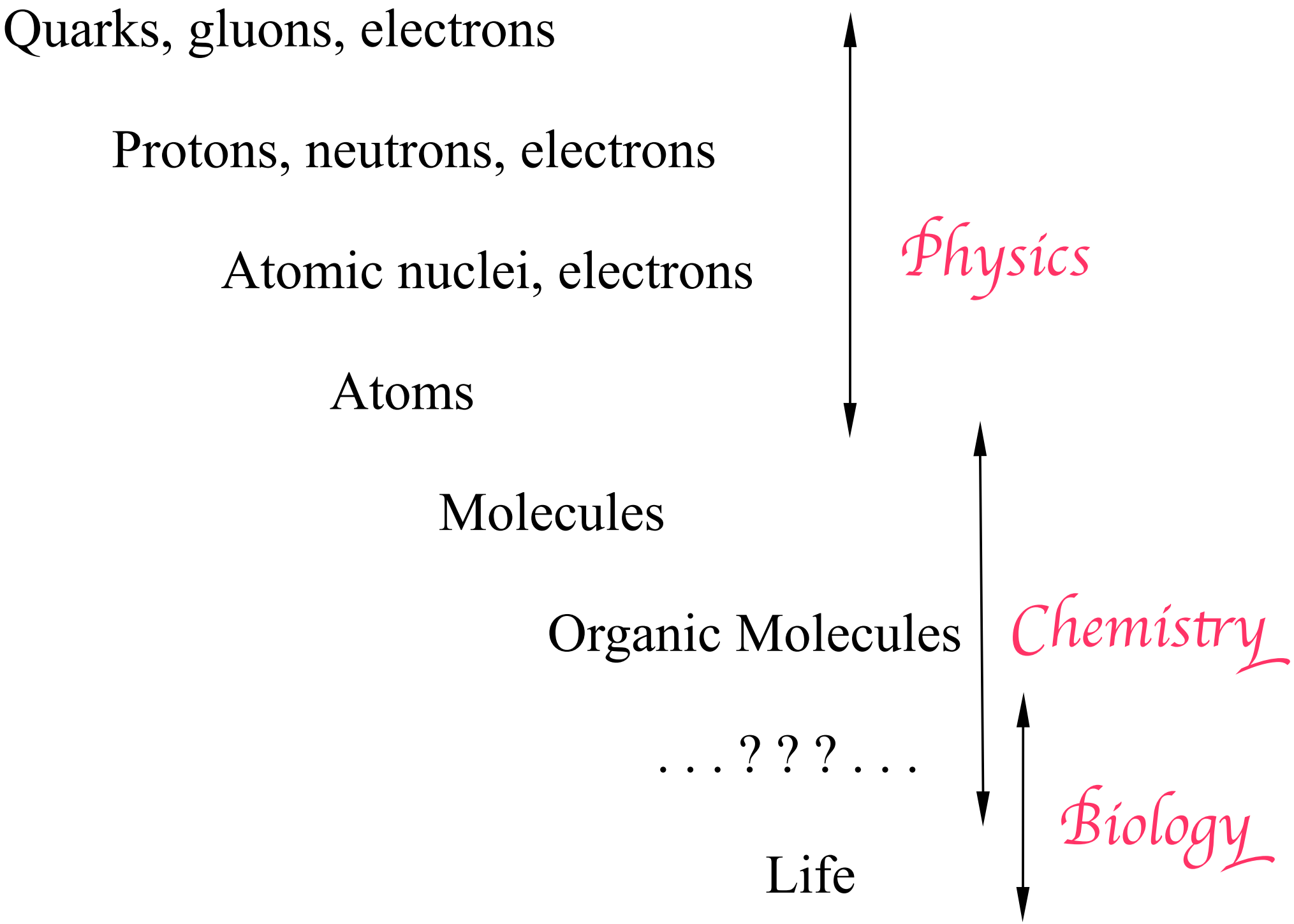
Atoms

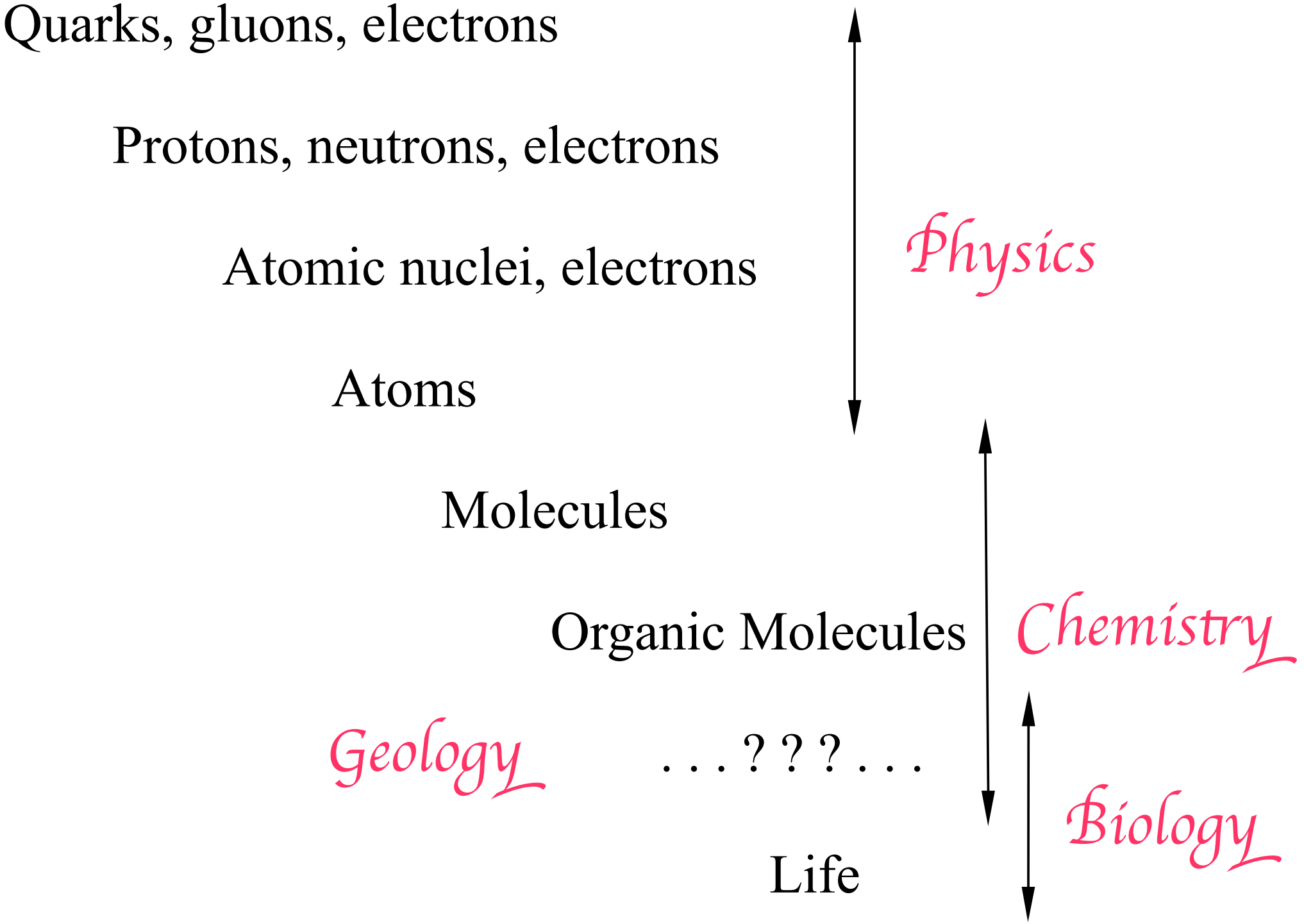
Molecules

Organic Molecules

. . . ? ? ? . . .

Life


Quarks, gluons, electrons
Protons, neutrons, electrons
Atomic nuclei, electrons
Atoms
Molecules
Organic Molecules
. . . ? ? ? . . .
Life
Physics
Chemistry
Biology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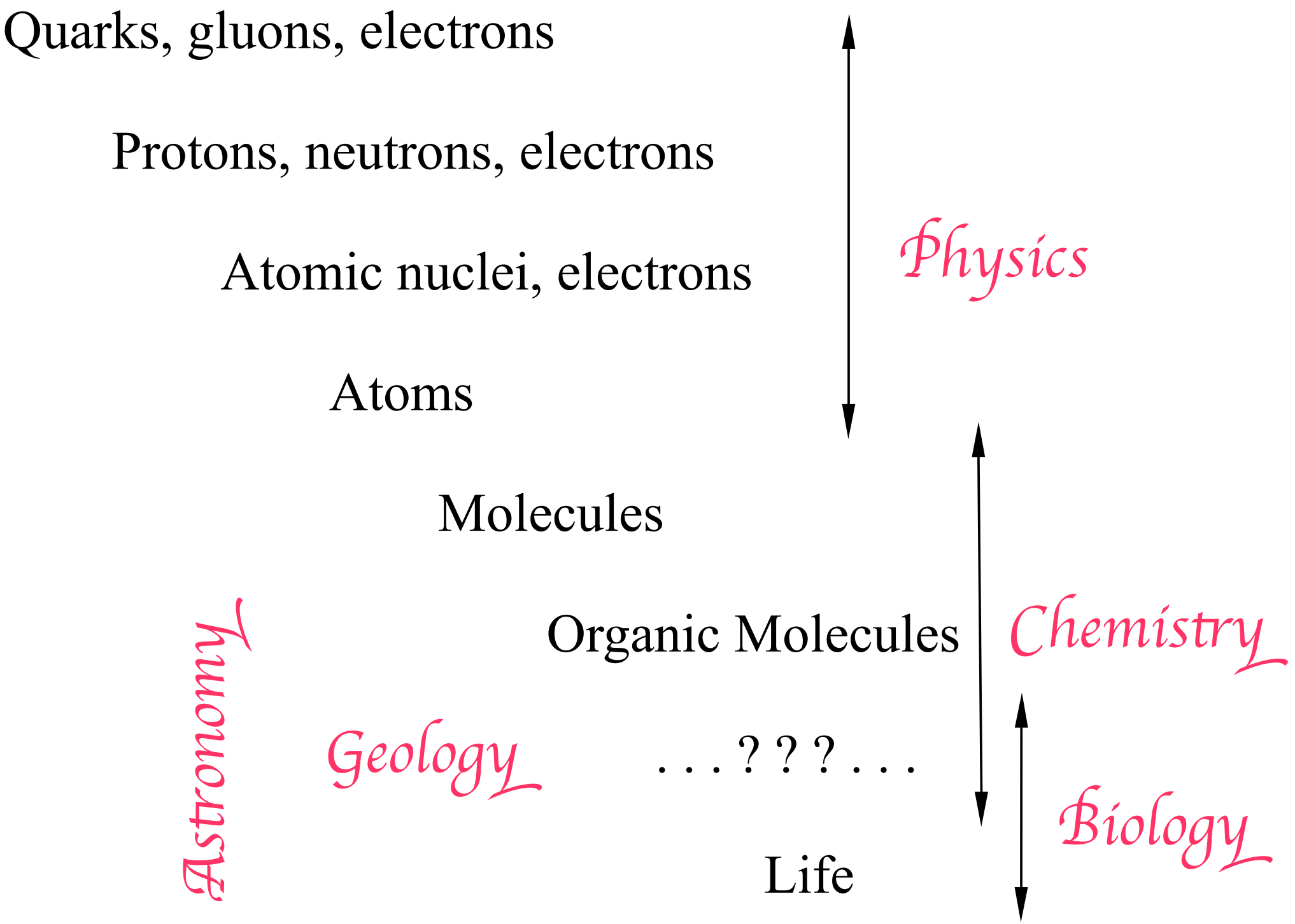
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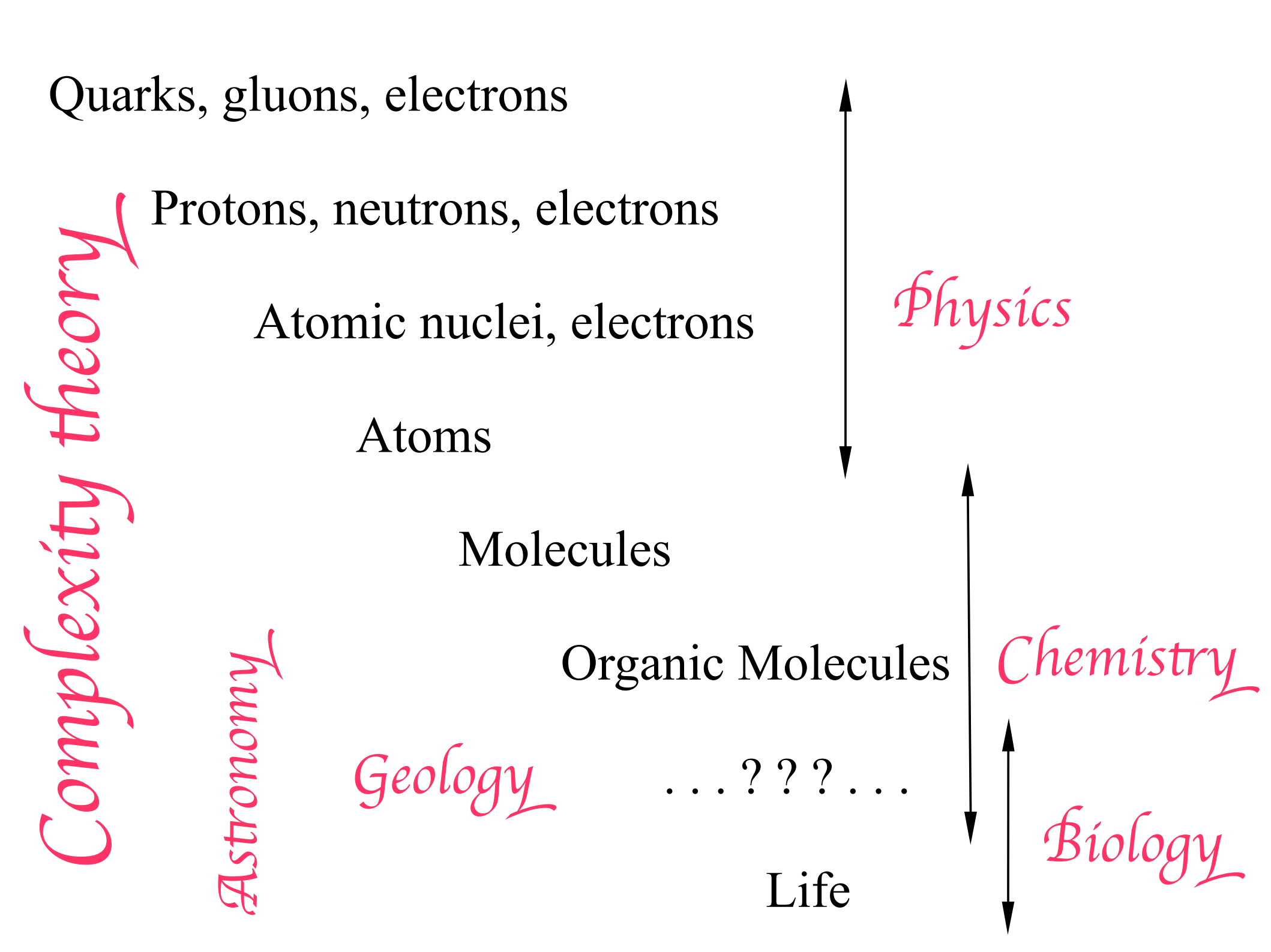
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Life
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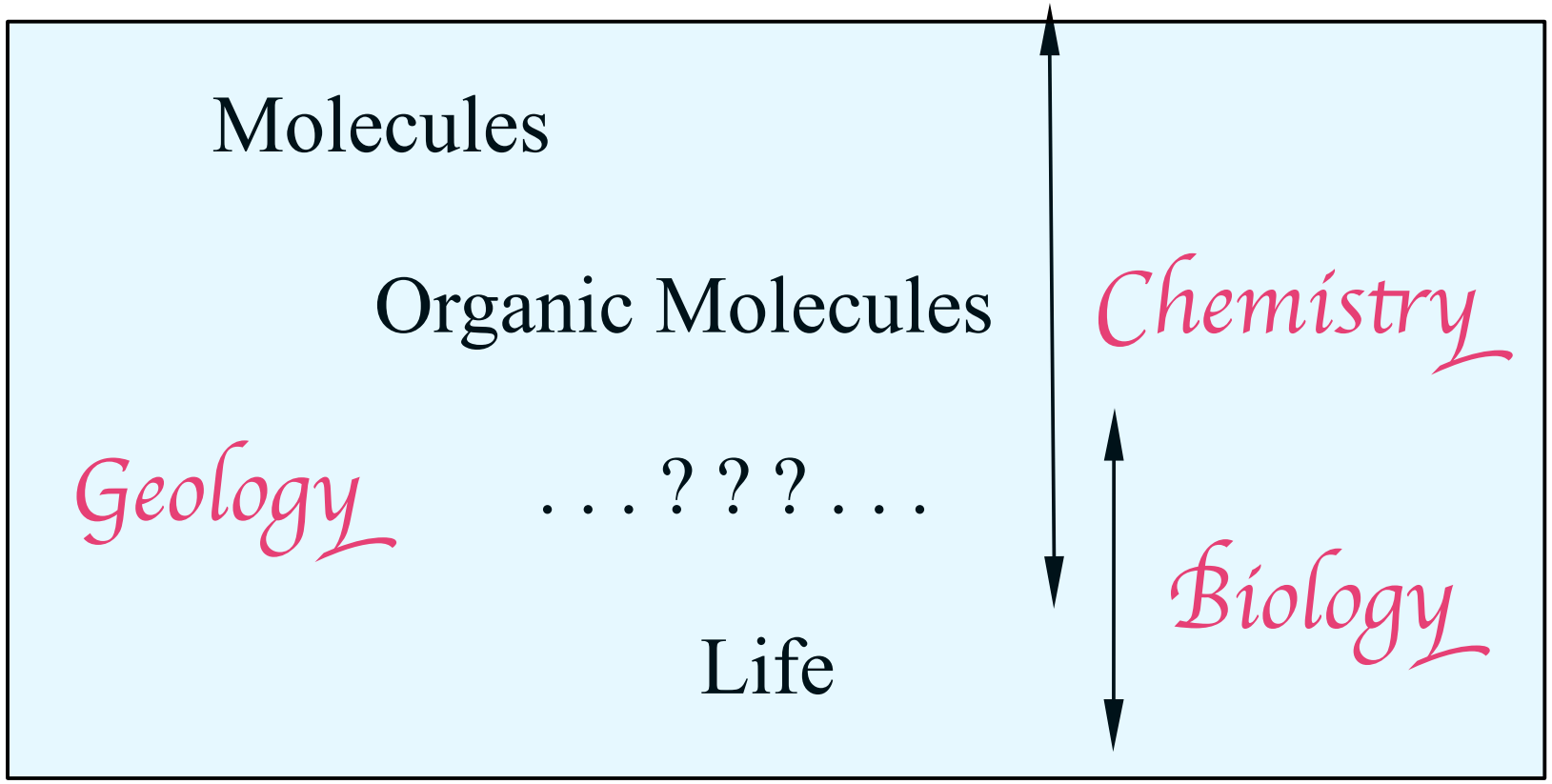
Geology
Astronomy
Complexity theory

But . . . this picture is misleading: the question marks are presented on the level of *structure*



. . . whereas the answers must surely be found in terms of *process*

The success of science rest on:

- Reductionism -- look for building blocks
- Complexity -- look for emergent features

Quarks, gluons, electrons

Protons, neutrons, electrons

Atomic nuclei, electrons

Atoms

Molecules

Quarks: elementary particles (as far as we know)

Protons: we cannot liberate the quarks !

Atomic nuclei: we can transmute (nuclear energy)

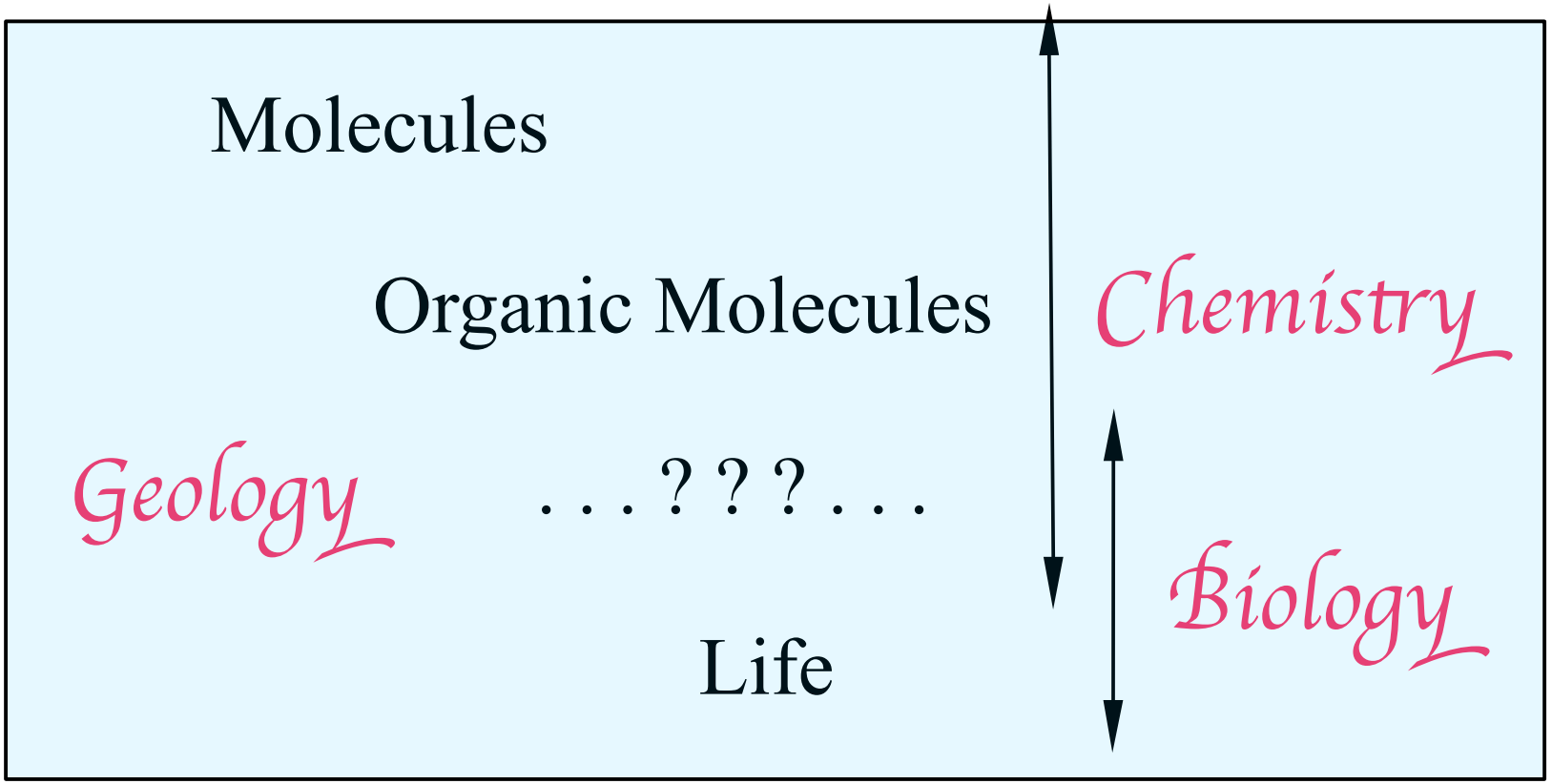
Atoms: we can strip electrons (in a candle)

Molecules: we can rearrange (chemistry!)

The more complex, the more brittle, so . . .

molecules that are more and more complex are unlikely to survive in a natural environment

So . . . how come nature could add further complexity ???



The trick is the invention of repair, maintenance, resilience.

Make many copies, tinker, let most fail but keep the best:
this is evolution, and evolution produced resilience.

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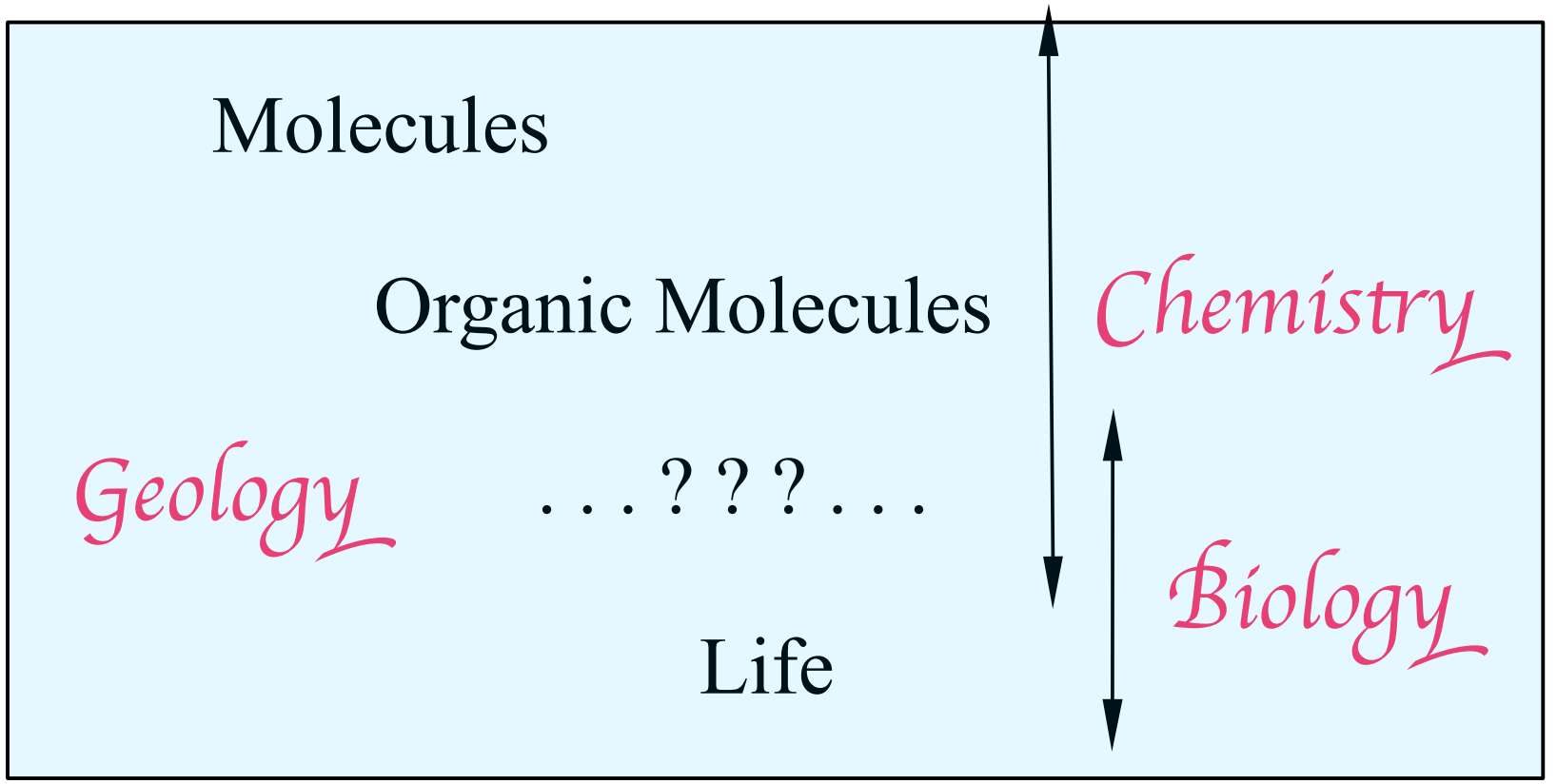
The question marks presented on the level of *structure*



require answers in terms of
process and *resilience*

ELSI homework
2012-2022-...