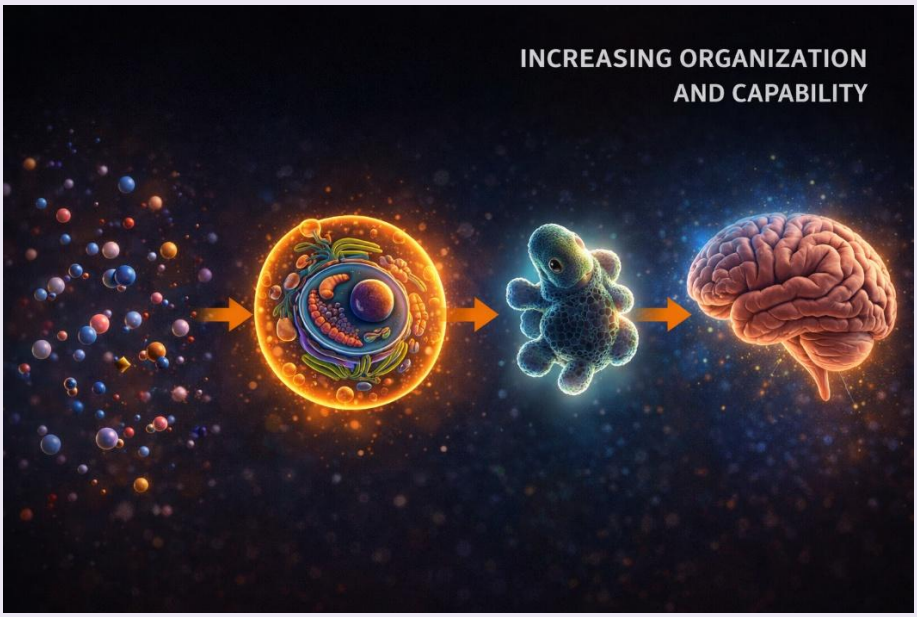
SST-13 Emergence as Constraint Regulation



In a shallow pool of water on the early Earth, simple chemicals drift and interact.
At first, nothing persists for long. Molecules combine and break apart, carried away by currents or disrupted by changing conditions. There is activity, but no stability.
Over time, something different begins to happen. Certain reactions start to reinforce themselves. Some combinations of molecules make it easier for similar reactions to occur again. These processes begin to last longer.
Later, some of these processes become enclosed within simple boundaries, holding their components together. What was once dispersed now remains localised. Reactions become more reliable.
Much later still, entirely new forms appear: cells, organisms, and eventually beings capable of thought and reflection.
At each stage, something new has emerged, not by chance alone, but because systems have become better at maintaining the conditions required for their own continuation.

Formal Description
An emergent property is a property arising from the organisation of a system that alters constraint configurations affecting system viability.
Emergent properties persist when they alter constraint configurations in ways that improve system viability.
Evolutionary development proceeds through the successive emergence of properties that enable increasingly effective constraint regulation.

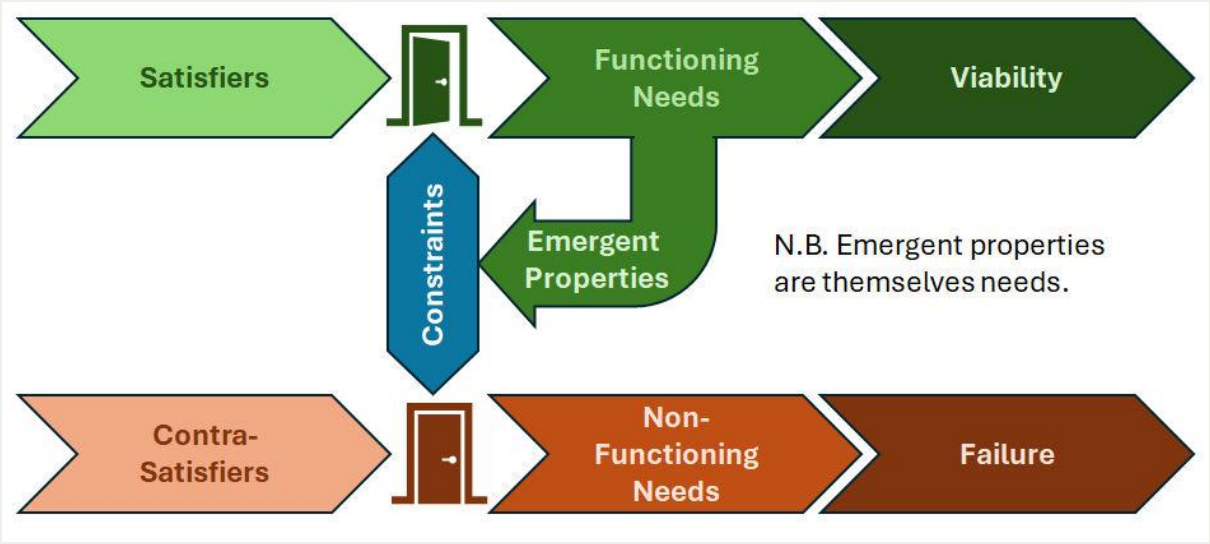
Plain English Explanation

Emergence is often described as something "new" appearing in a system, but in this framework it has a more precise meaning. An emergent property is not just something novel; it is something that changes how a system is able to regulate the conditions affecting its survival.

In earlier modules, we saw that systems depend on satisfiers and are threatened by contra-satisfiers. We also saw that constraints shape access to these. Emergence can now be understood as the process through which new forms of organisation arise that improve how these constraints are managed.

For example, when a system develops a boundary, it reduces the loss of important components. When it develops metabolic processes, it can actively acquire what it needs. When it develops a nervous system, it can respond more effectively to its environment. In each case, the system has not simply become more complex; it has become better able to regulate the conditions affecting its viability.

This provides a simple but powerful way of understanding evolution. Evolution is not just a sequence of changes in form, but a sequence of improvements in the regulation of constraints. Systems that develop new ways of improving access to satisfiers and reducing exposure to contra-satisfiers are more likely to persist, while those that do not are less likely to endure.



Example 1 (Chemical to Biological)

Autocatalytic chemical networks make certain reactions more likely to continue. This improves persistence and represents an early form of constraint regulation.

Example 2 (Biological)

The development of cell membranes allows systems to maintain internal conditions, reducing environmental disruption and enabling more reliable functioning.

Example 3 (Cognitive)

The emergence of learning allows organisms to adjust behaviour based on experience, improving their ability to respond to changing conditions.

Provenance and Links

This module draws on:

- Evolutionary theory, particularly the concept of major transitions developed by John Maynard Smith and Eörs Szathmáry, which describes how new levels of organisation emerge over time.
- Complexity theory and self-organisation, including Stuart Kauffman, who explored how autocatalytic systems can generate persistent organisation.
- Non-equilibrium thermodynamics, particularly Ilya Prigogine, which explains how organised structures can arise and persist under conditions far from equilibrium.
- General systems theory, including Ludwig von Bertalanffy, which emphasises the role of organisation in producing system-level properties.

This module integrates these perspectives by interpreting emergence as the progressive improvement of constraint regulation across evolutionary stages.

Practical Exercise

Choose one example of emergence:

- the development of life
- the evolution of the brain
- the rise of organisations or institutions

Explain:

1. What new capability emerged?
2. How did it change the system's ability to maintain itself?
3. How did it affect constraints on satisfiers or contra-satisfiers?

👉 Write a short paragraph (6–8 sentences).