



## GST 09 – Entities and Boundaries

### Formal Description

An entity is any identifiable portion of physical reality, including objects, fields, relationships, and events.

A boundary is a demarcation that separates an entity from what is not the entity. Boundaries may be sharp or diffuse and may be defined by material discontinuities, energetic gradients, or structural distinctions. Boundaries may also be continuous, forming a single connected demarcation, or discontinuous, comprising multiple separated regions treated as belonging to the same entity.

An entity exists as a distinguishable unit only by virtue of its boundary, which defines its relationship to its environment.

### Plain English Explanation

If everything exists in space-time, the next question is: what counts as a “thing”? In systems theory, any identifiable “thing” is called an entity. An entity can take many forms. It might be a physical object, like a chair; a living organism, like a tree; a process, such as a storm; or even a distributed configuration, such as an ecosystem. In each case, we are identifying something as a distinct part of reality.

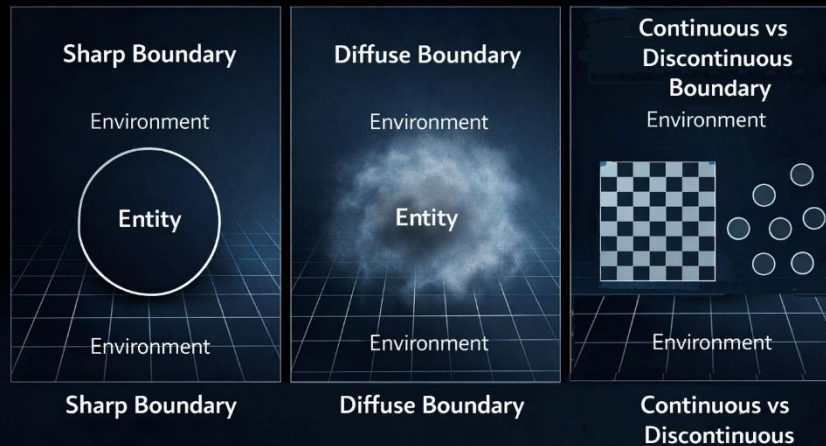
To do this, we rely on boundaries. A boundary is what allows us to distinguish an entity from what is not part of it — to say “this is the entity” and “that is its environment.” Sometimes boundaries are very clear, such as the surface of a ball or the walls of a container. In other cases, they are less precise, such as the edge of a forest, the boundary of a cloud, or the limits of a country. Even when boundaries are not sharp, they still exist in some form, often as gradual transitions or differences rather than abrupt edges.

Boundaries can also differ in another important way. Some are continuous, forming a single, unbroken edge or surface, such as the boundary of a chessboard. Others are discontinuous, consisting of separate parts that are nevertheless treated as belonging together. A chess set, for example, consists of individual pieces that are physically separate but collectively form a single entity when considered as a set. This shows that boundaries do not always have to be a single connected surface; they can also be defined by grouping together multiple distinct elements.

Boundaries are fundamental because without them we would not be able to identify or study anything as a separate entity. They allow us to distinguish entities from their environment, determine what belongs to a system, and understand how different systems interact. In this sense, boundaries are essential to all of systems theory.



## Types of Boundaries



### Example 1 – A Cell

A biological cell has a membrane that separates it from its surroundings. This membrane controls what enters and leaves the cell.

👉 This is a sharp, continuous boundary.

### Example 2 – A Cloud

A cloud does not have a sharp edge. Instead, it gradually blends into the surrounding air.

👉 This is a diffuse, continuous boundary.

### Example 3 – A Chess Set

A chess set consists of multiple individual pieces that are physically separate but are treated as a single entity when considered as a set.

👉 This is a discontinuous boundary.

### Example 4 – A Country

A country may have clearly defined borders on a map, but in reality these borders may be:

- physically marked (e.g. fences, rivers), or
- socially agreed and enforced

👉 This may involve sharp or diffuse boundaries, and in some cases elements of discontinuity (e.g. overseas territories).

### Provenance and Links

This module draws on foundational concepts from systems theory, biology, and the philosophy of science concerning the identification of entities and the role of boundaries in distinguishing systems from their environment.

The concept of an entity as a distinguishable part of reality aligns with the general systems perspective developed by Ludwig von Bertalanffy, in which systems are understood as organised wholes composed of interrelated components. Central to this perspective is the distinction between a system and its environment, which is made possible through the identification of boundaries.



In biological and ecological sciences, boundaries are often diffuse rather than sharply defined. Organisms, ecosystems, and atmospheric systems exhibit gradual transitions rather than clear-cut edges, reflecting continuous variation in physical and functional properties. This understanding is consistent with modern ecology and complexity science, where systems are frequently characterised by fuzzy or permeable boundaries.

The distinction between continuous and discontinuous boundaries relates to the treatment of collections of entities as unified wholes. This connects to broader concepts in systems theory and mathematics concerning sets, aggregation, and levels of organisation, where physically separate components may be considered as a single entity depending on the analytical perspective.

Within General Systems Theory, boundaries are fundamental because they enable the identification of entities, the distinction between systems and environments, and the analysis of interactions between systems. They therefore provide a necessary basis for subsequent concepts including systems, inputs and outputs, and system behaviour.

### **Practical Exercise**

Choose two different entities from your everyday experience.

For each one:

1. Describe the entity
2. Identify its boundary
3. Classify the boundary as:
  - sharp or diffuse
  - continuous or discontinuous
4. Reflect:
  - Does the type of boundary affect how easy it is to define or study the entity?

👉 Write a short paragraph for each example.