

# Progression in understanding systems concepts

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In this progression, we have illustrated the stages identified by Assaraf and Orion with reference to ecosystems:

### 1. Naming parts and processes

Children can name both living (e.g., specific plants and animals) and non-living (e.g., rocks, water) parts of an ecosystem. They may also name some processes such as feeding, weather activity and so on.

### 2. Identifying processes that create relationships between parts

Feeding relationships are probably the simplest beginning point – e.g., "caterpillars eat cabbage leaves" in a garden ecosystem.

### 3. Building up a framework of relationships

Food chains and webs are one type of framework. Nutrient cycles and weather cycles are others.

### 4. Making generalisations about relationships

Saying that all food chains must start with a plant is an example of a generalisation.

### 5. Understanding that some relationships can impact on other relationships

Humans can be involved in relationships directly and indirectly – e.g., when they kill caterpillars there is less food for blackbirds in the garden.

### 6. Knowing there can be hidden dimensions that affect the system

In a garden ecosystem the decomposers are mostly tiny soil animals or invisible bacteria and fungi. They are hidden but without them soil would lose its fertility.

### 7. Understanding that many systems go in cycles

Decomposers are nature's recyclers! Nutrient cycles such as the carbon cycle would stop if dead bodies could not be broken down.

### 8. Recognising that systems can change over time, sometimes slowly and sometimes quite quickly

Students who understand this may be able to predict changes and give reasons for their predictions.

## References

Assaraf, O., & Orion, N. (2005). Development of system thinking skills in the context of Earth system education. *Journal of Research in Science Teaching*, 42 (5), 518-560.

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