## Progression in understanding systems concepts

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.

- 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.
- 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.
- 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.

## **Resource List**

- A flax bush ecosystem
- A native bush ecosystem

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