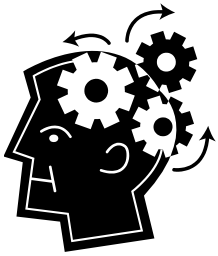
Systems Thinking Overview



A **System** is a set of variables or parts that interact with each other. Examples of natural systems are forests and the solar system; designed systems are airports or schools. Systems behave according to the relationships that the parts have with each other. Complex systems are challenging to understand, and their future behavior is difficult to predict.

Systems Thinking is a form of critical thinking that helps learners understand complex, dynamic systems. It includes identifying the boundaries and parts of a system, the relationships between those parts, and how the system behaves over time. Typically we try to simplify complexity into direct or linear relationships. However, systems thinking enables learners to practice seeing indirect effects, feedback loops, cycles, delays, and potentially surprising outcomes, such as exponential growth.

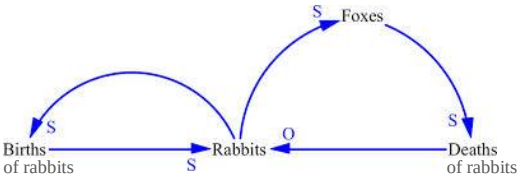
Why Incorporate Systems Thinking?

- To promote problem solving and critical thinking skills
- To address new performance-based expectations in the NGSS and Common Core
- To develop future leaders capable of addressing complex global issues

Tools for Systems Thinking

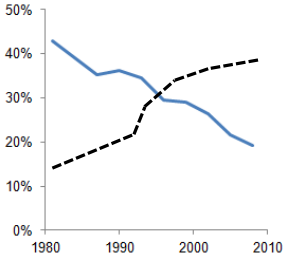
Causal Loop Diagram

This diagram shows feedback loops in a predator/prey relationship. The S's indicate a relationship that has the same direction (if one increases so does the other). The O's represent an opposite relationship. More complex diagrams help to show not only the direct connections, but indirect connections as well.



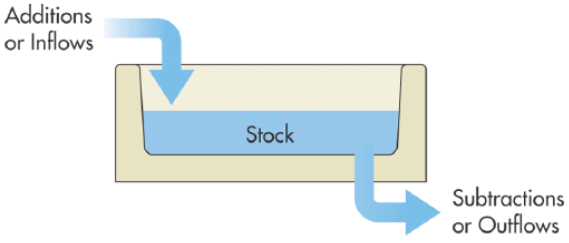
Behavior Over Time Graph

The behavior over time graph demonstrates trends and patterns in a system. This helps to show short term and long term impacts and possible effects of delay.



Stock-Flow Diagram

A stock-flow diagram illustrates inputs and outputs of a system, usually indicating rate or volume. An example could be the amount of carbon that is added to and removed from the atmosphere.



Computer Simulation Model

Computer models help learners visualize long term impacts from many variables. The example below shows potential sea level rise in the southeastern United States. Models simulate known direct and indirect impacts to a system over time to reveal unexpected outcomes.