



Systems Thinking and Matter Conservation Brief

SRI Education



Systems and Matter Conservation

What are systems?

A system is a collection of components and their interactions. A system has a defined boundary that determines what goes in and out of the system (such as matter or energy). The system is defined in a way that helps explain a particular phenomenon, make a prediction, or solve an engineering problem. Models of systems help us understand and make predictions about system behavior

What is conservation?

Conservation refers to how the total amount of certain things (such as energy and matter) do not change during the course of a process. For instance, in many processes, matter can move in and out of system or from one part of a system to another part. Matter can also change forms, such as from a solid to a liquid. However, in processes where matter is conserved, matter is neither created nor destroyed. In the elementary grade band, we tend to focus on the conservation of matter, because energy is a more challenging concept at this grade band.

How are systems and conservation related?

Conservation is a fundamental science concept that helps describe a wide range of phenomena across science and engineering. When matter is conserved, all matter flow in and out of the system must be accounted for. For instance, the amount of matter that goes into the system must be equal to the amount of matter that goes out of the system plus the amount that stays in the system. Models of systems can represent the flow of matter in and out of the system, based on properties of the system.

How are systems and conservation used in the curriculum?

It is important to note that the curriculum does not explicitly define the system boundaries for students. As curriculum designers, we believed this would have been too confusing for elementary students to directly consider system boundaries. However, the water runoff model in the curriculum defines the system as the ground surface of the school. Rainfall represents the flow of matter (water) into the system. The water absorbed by the ground is what remains in the system. The water runoff is the flow of matter out of the system.

Matter conservation dictates that all rainfall must go somewhere, and that the water cannot be created or destroyed. Therefore, using this system model, rainfall either (1) absorbs into the ground surface or (2) stays on top of the surface as runoff. This relationship gives rise to the equation **total runoff = total rainfall – total absorption**. Note that this model does not take into account water that might evaporate from the surface.