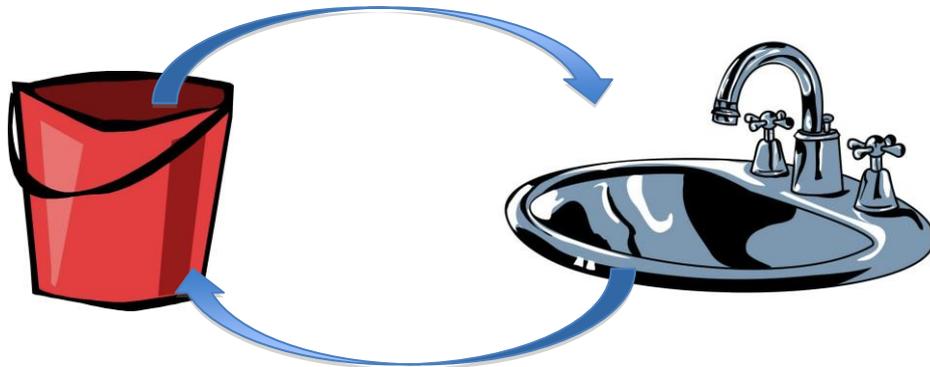
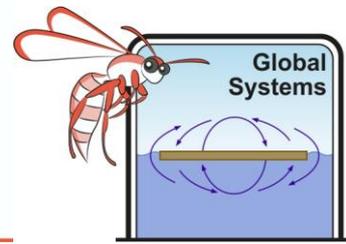


Source to Sink – Teacher Notes



Since our planet formed from a cloud of stellar dust about 4.5 billion years ago, little matter has been added or lost. Perhaps a little hydrogen has escaped from our upper atmosphere and materials from meteors have been added but most of the original atoms are still here. They have however travelled around a bit! In Year 9 Earth Science students learned how heat and gravity have moved materials within the planet to form the core, mantle, crust and atmosphere. Initial planetary differentiation took about 100 million years. Although movement still occurs within the planet, it is on a geologically slow scale.

At the surface of Earth materials move from one location to another at a much faster rate. These locations can be described as four intersecting spheres or zones:

- A **biosphere** where life occurs
- A **hydrosphere** where water is found
- A **lithosphere** of rocks and soils at the surface of the planet
- An **atmosphere** of gasses surrounding the planet

Materials can move within spheres and between spheres.

Materials per student

- A pair of compasses or a circular object such as the base of a beaker.
- A pencil

Draw a concept diagram of the four intersecting “spheres” and label each sphere.

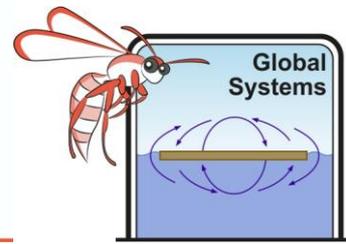
Students may prefer drawing four jigsaw pieces. This will help them realise that we are referring to zones or “spheres of influence” rather than perfect spherical volumes.

In reality, do the spheres look like this? Explain your answer **No. On Earth water does not lay within one enormous ball shape. The atmosphere lies above the solid Earth in a hollow flattened ball shape. Water can be found distributed through the atmosphere as water vapour, on the lithosphere’s surface as an ocean and within the lithosphere as ground water.**

Why do you think scientists use the word “sphere”? **Sphere or zone of influence**

In which sphere do living things exist? **Living things exist in the biosphere but depend on materials from the other three for survival.**

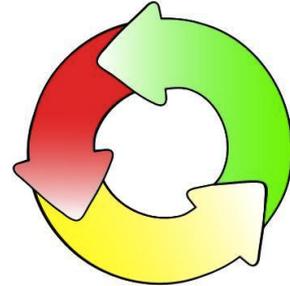
Source to Sink – Teacher Notes



When discussing matter moving from place to place in global systems, we use the terms:

Source	The original location of the material.
Reservoir or sink	The location to which the material is transferred and stored for an indefinite period of time.
Releasing agent	The process or activity which releases the material from the sink.
Forcing factor	The process that causes materials to be released at a faster rate.
Cycle	Balanced movement from sources to sinks. Over geological time inputs should equal outputs.

Of course during any cycle a sink in time will become a source when the material moves on to another sink. There must always be an overall balance between the rate of output from the source and the rate of input to the sink.



Example: Carbon dioxide

1. A jarrah tree takes in carbon dioxide from the atmosphere during photosynthesis. It can live for 140 years. When it dies and decomposes it releases carbon dioxide back into the atmosphere over 140 years. Name the sources, releasing agents and sinks.

Sources	Atmosphere and jarrah tree
Releasing agents	Photosynthesis, respiration & decomposition
Sinks	Jarrah tree and atmosphere
Time taken	140 years for each movement
Is this a balanced cycle of inputs and outputs?	Yes



Name the sources, releasing agents and sinks for carbon dioxide involved if humans burn down 40 years old jarrah trees to clear land for building houses.

Sources	Atmosphere and jarrah tree
Releasing agents	Photosynthesis, respiration & fire/combustion
Sinks	Jarrah tree and atmosphere
Forcing factor	Human action
Time taken	40 years for absorption from atmosphere but 40 years for return



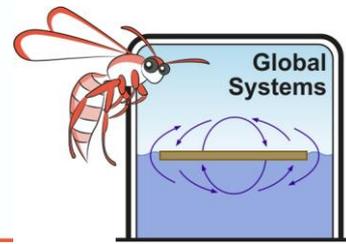
Is this a balanced cycle of inputs and outputs? Explain your answer **No. The carbon dioxide was forced from the tree 100 years too soon. There would now be more carbon dioxide in the atmosphere than there was before.**

Imbalance can be the result of natural occurrences. Iceland is an island in the middle of the North Atlantic Ocean. It lies over a mid-oceanic ridge. Massive volcanic eruptions from fissures on the sides of “Laki” volcano between June 1783 and February 1784 poured out lavas and released poisonous gasses, sulphur dioxide, fluoride and carbon dioxide that instantly killed a quarter of the island’s human population and most of the agricultural plants and animals. Many more died of starvation and fluoride poisoning over the following months.

NOTE Fluoride in small amounts strengthens bone and tooth enamel. Large amounts produce aberrant behaviour and bone deformities including some cases of gigantism.

The effects of the “Laki fires” were also felt all over Western Europe and even in North America. Dust obscured sunlight and there was a longer colder winter in the following year. The Mississippi river froze, there were terrible floods and crops died and rotted in the fields. Increased CO₂ in the atmosphere caused two years of increased temperatures and drought. Fluorine from volcanic ash c

Source to Sink – Teacher Notes



contaminated crops. People starved and the old and young died in increased numbers. It has even been suggested that this helped trigger the French Revolution. Dust from this eruption is even reported to have affected the monsoons in Burma.

What was the source in this case? **Magma in the rocks feeding Laki volcano**

What was the sink in this case? **The atmosphere**

What was the forcing factor in this case? **A volcanic eruption rapidly increasing the amount of dust and carbon dioxide in the atmosphere**

Give two instances of the negative impact from this imbalance one in the immediate area and another at a distance. **Instant death of plants and animals on Iceland and subsequent starvation of humans there. Failure of crops and starvation in Northern Europe and North America. Changed monsoons in Burma**

Interesting information



Bhutan is a small kingdom nestled in the Himalayan Mountain Range.

It is the only country in the World that is a carbon sink.

In its constitution it insists that at least 60% of its land must remain forest.

It exports hydro electricity.

The Gross National Happiness Commission is charged with reviewing government policies and allocation of resources.

Dance is the national sport.