**Earth System Notes: Open vs. Closed System**

**Open System**

* Open System – a system in which both \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are exchanged with the surroundings.
* Example:
  + Human Body
  + Take in \_\_\_\_\_\_\_\_\_\_\_ and air (O2)
  + Breathe out \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Closed System**

* **Closed System** – a system in which\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, but not matter, is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with the surroundings.
* Example:
  + Watch
  + Self contained
  + All kinds of interacting parts with little or no interaction with environment

**Earth is a Closed System**

* Energy in the form of solar radiation passes from the Sun, through the atmosphere to the surface. The Earth in turn emits radiation back out to space across the system boundary. Hence, energy passes across the Earth's system boundary, but not mass, making it a Closed system.

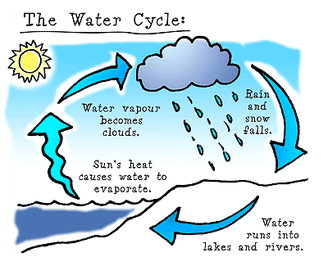
**Earth as a Closed System**

* Earth itself is a closed system
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_is possible exception, but it is man made.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is another possible exception.

**Interactions of Four Spheres**

* Four spheres are open systems
* Matter and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are constantly exchanged between the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ via:
  + Chemical reactions, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, radiation (light and heat), growth and decay of organisms
* Matter and energy move between spheres in order to complete certain cycles in Earth’s system
  + **Cycles**: Energy, water, nitrogen, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and rock cycles

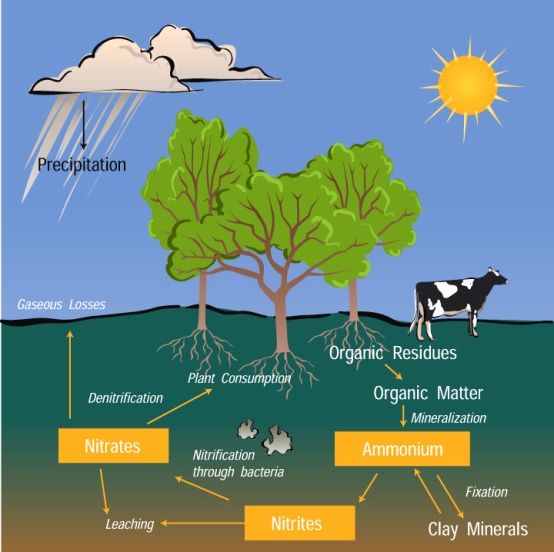
**Water Cycle**

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**Carbon Cycle**

* Like the water cycle, we also have a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ where carbon is moving from sphere to sphere.
* How does carbon return to the atmosphere?
  1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  2. Decay
  3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Nitrogen Cycle**

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