

Mono Lake was saved from destruction... The **Mono Lake Committee (1941-present day)** works with the Stream Scientists and DWP to monitor streamflow and water temperatures, track groundwater levels, and support on-the-ground restoration activities, including planting trees and pulling invasive weeds.

**Mono Lake:**  
**(terminal lake)**

**Result of humans re-directing/closing off water flow to/from bodies of water (no outlet).**

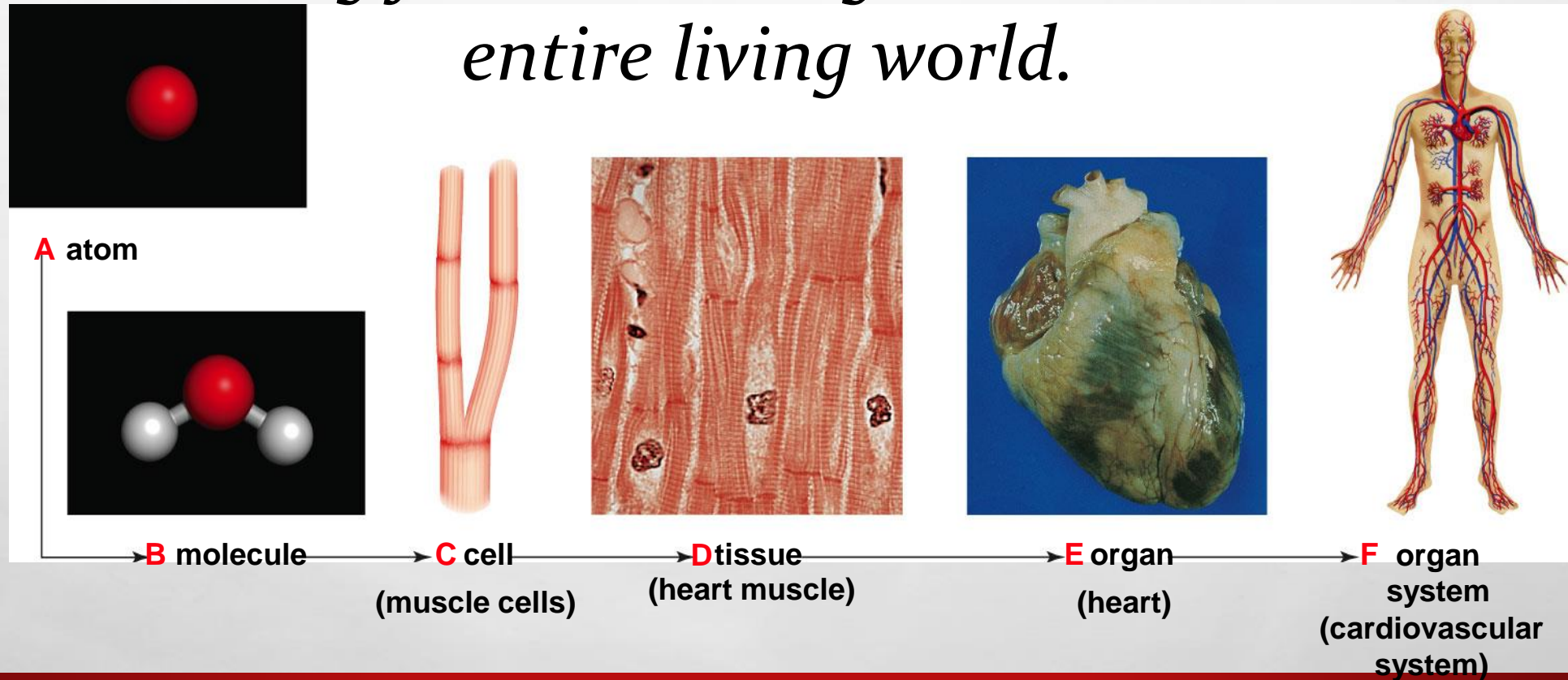
**Over time, evaporation has caused a buildup of salt concentration (Tufa Towers – salt and minerals wash into from streams), resulting in 2.5x saltier (denser than ocean water) and 80x more alkaline (pH = 10) than oceans, little to no marine life can survive its water (California's Dead Sea – one of the oldest lake in N. America – over a mil yrs. old ).**

Chapter 2

Environmental Systems

# Life's Organization:

*Nature is organized on many levels, starting from nonliving materials to the entire living world.*





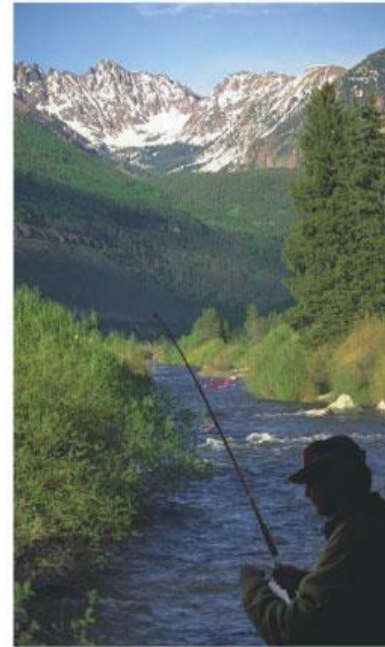
organism  
(human)



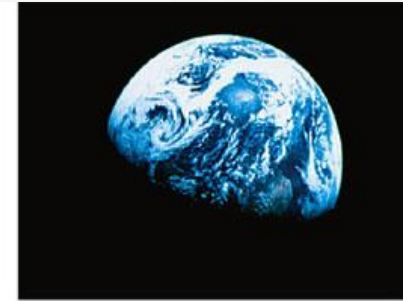
population **H**



community **I**



**J**ecosystem



**K** the biosphere

**G**

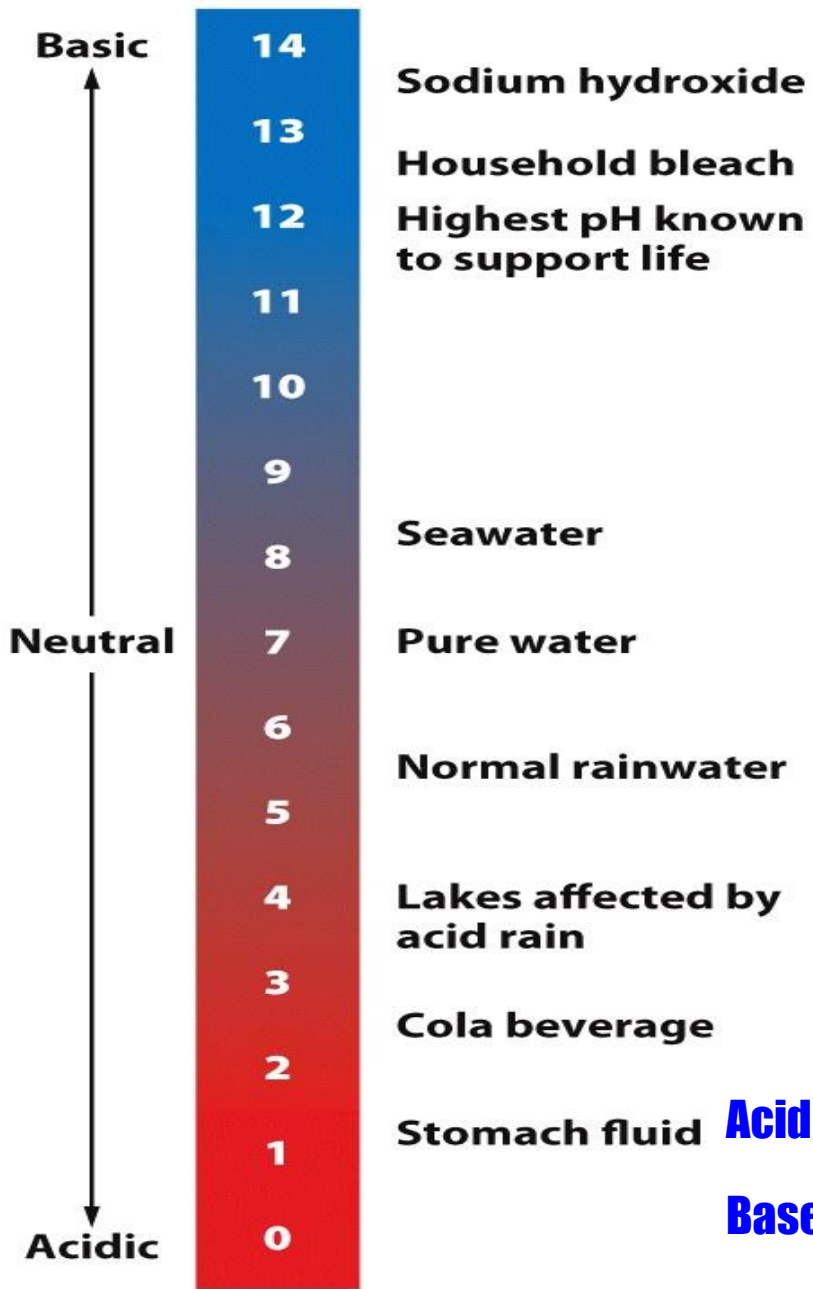


Super small to super large!!!!

# NULL HYPOTHESIS EXAMPLES

THE NULL HYPOTHESIS ASSUMES THERE IS NO RELATIONSHIP BETWEEN TWO VARIABLES AND THAT CONTROLLING ONE VARIABLE HAS NO EFFECT ON THE OTHER.





**pH-** a way to indicate the strength of acids and bases.  
*(Acid – closer to 0, stronger)*  
*(Base – closer to 14, stronger)*

**0-6.9 Acidic**

**Measured in log of 10....**

**Ex. pH of 4 is 100x the concentration of hydrogen ions than a pH of 6.**

**7 Neutral**

**pH of 8 is 1000x the concentration of 11**

*(equal hydronium to hydroxide ions)*

**7.1 – 14 Basic**

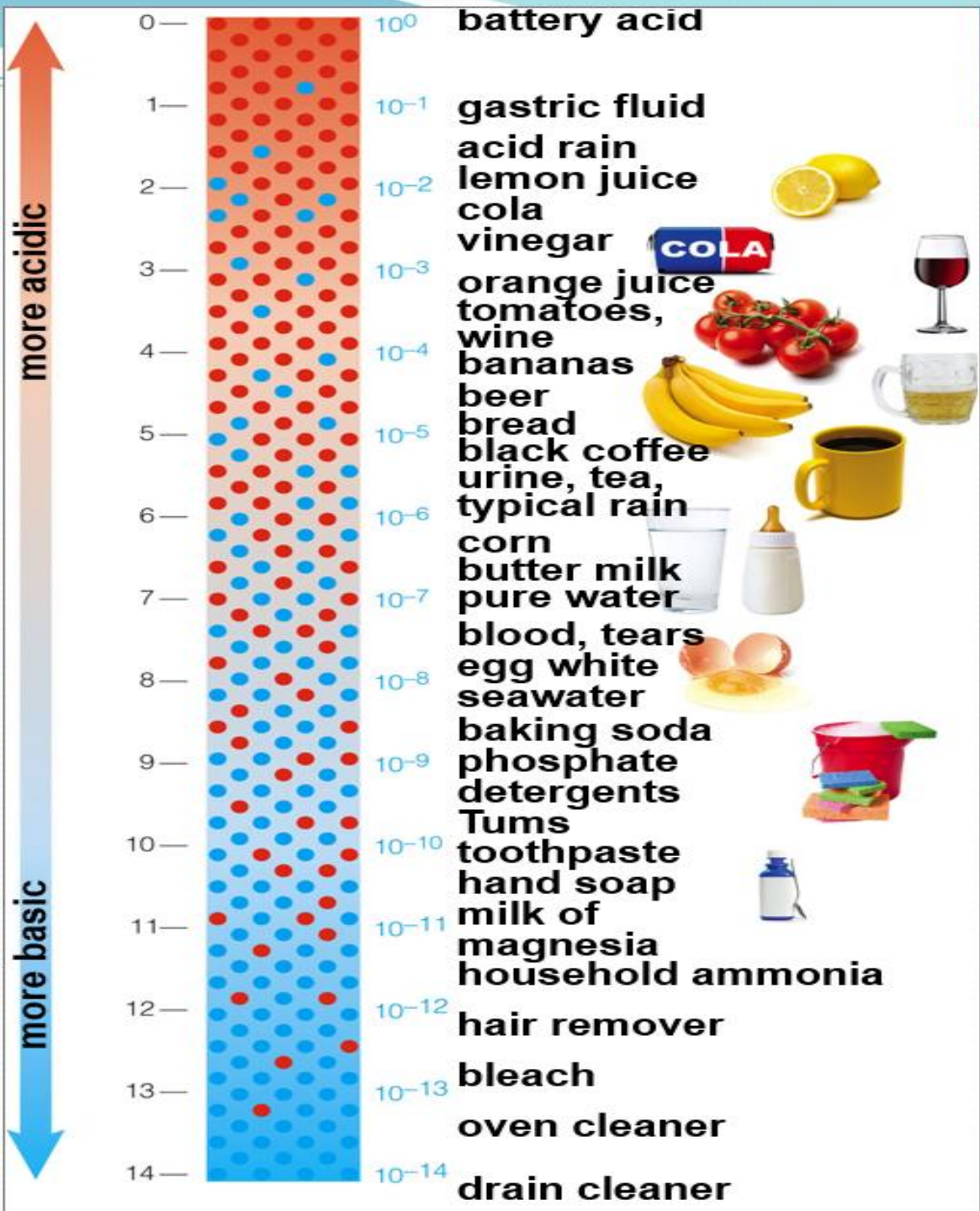
**Acid:** donates H<sup>+</sup>; acidic solutions

**Base:** accepts H<sup>+</sup>; basic solutions

**Salt:** releases ions other than H<sup>+</sup> and OH<sup>-</sup>

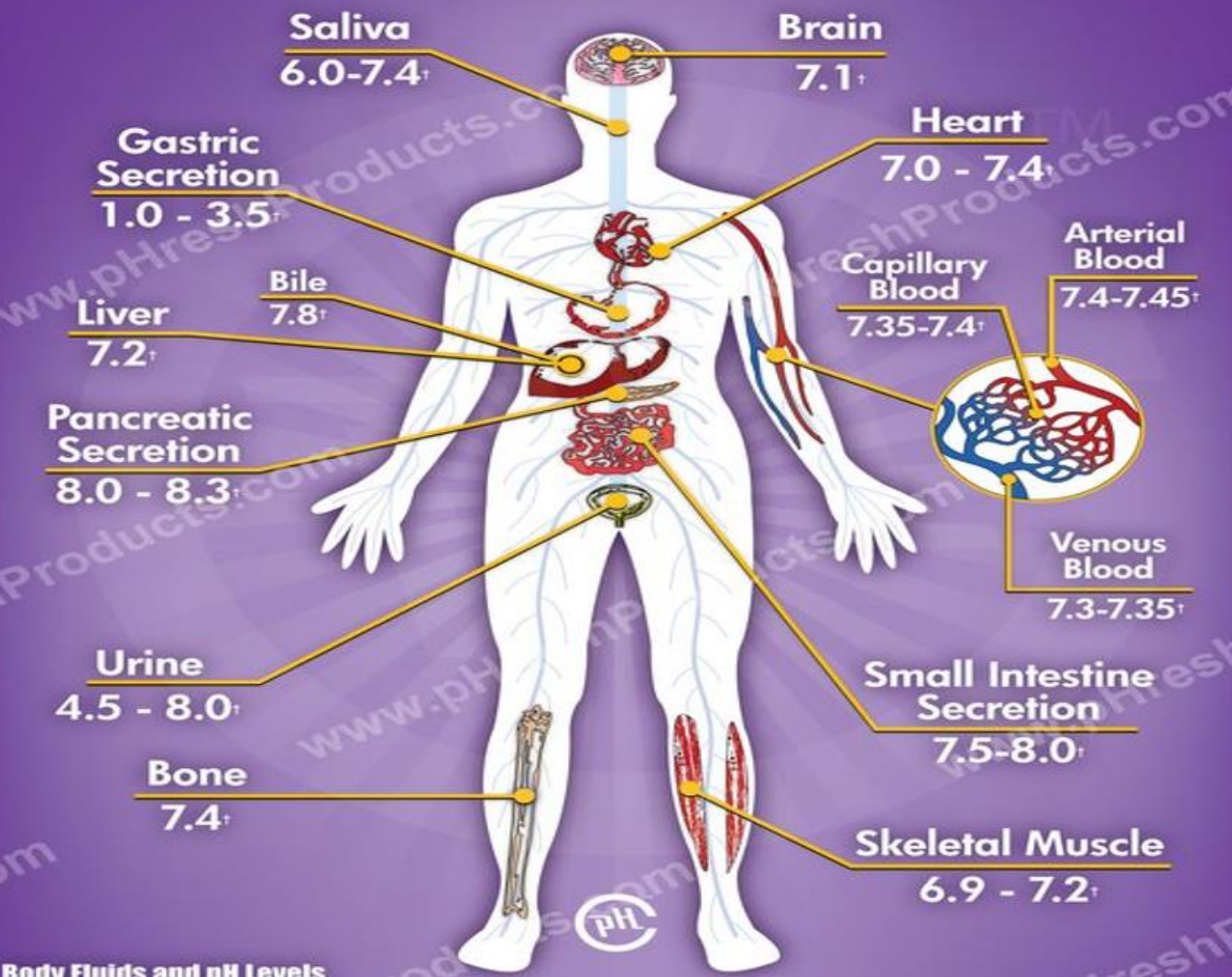
**Neutralization reaction = Acid + Base → Salt + water**

Figure 2.8  
 Environmental Science



# pH Values of the Human Body

Fluids in the human body function to provide digestion, lubrication, nutrient and oxygen transportation, and protection. To perform these functions, the acid levels must be varied to match the bodily function. Overall levels of acidity or alkalinity are measured on a pH scale and must be carefully controlled in each body fluid.\*



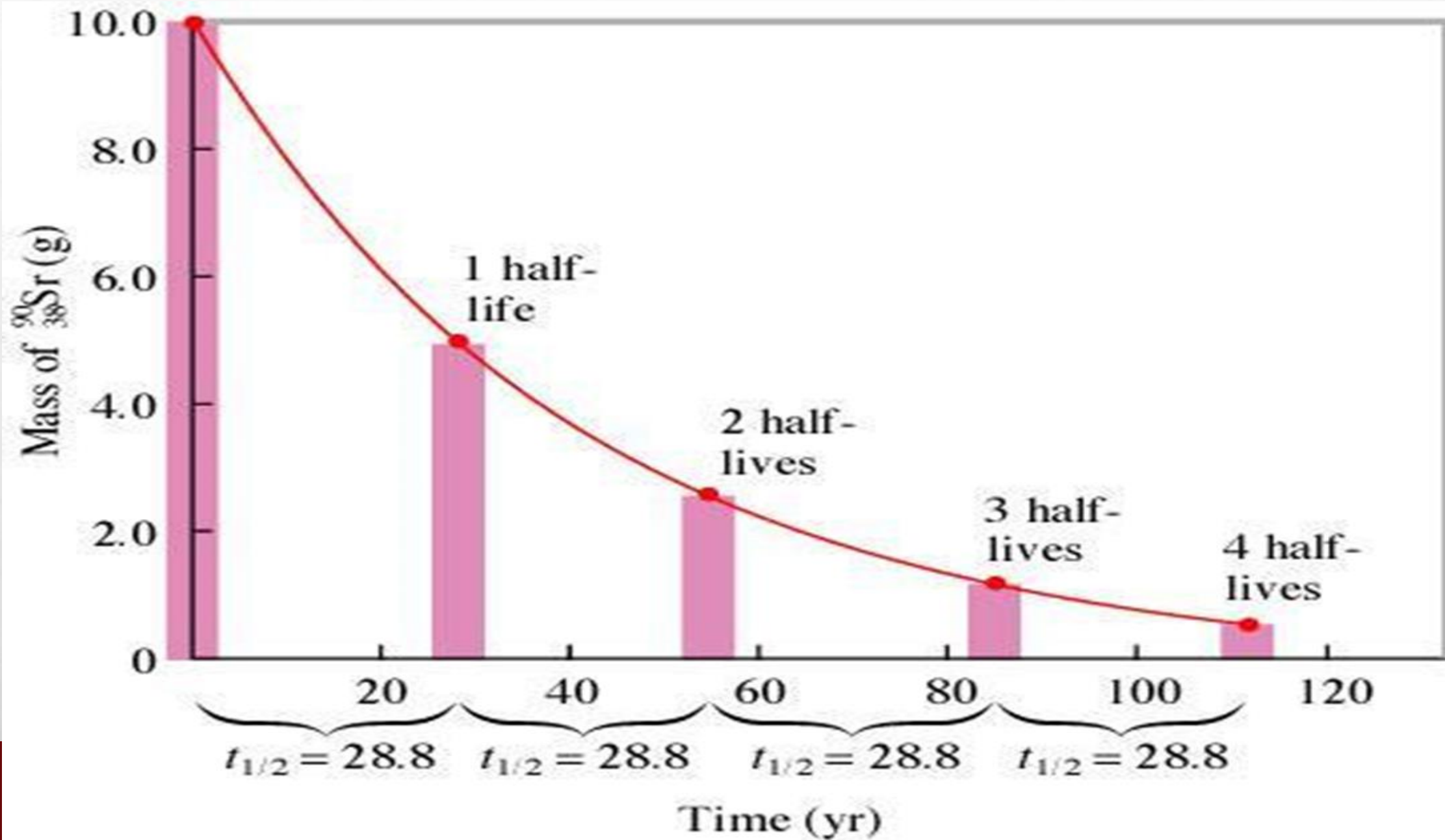
## Body Fluids and pH Levels

Saliva, blood and spinal fluid all have a pH of about 7.4. This near neutral level prevents tissue damage that may be caused by levels at either end of the pH scale. Proton pumps that regulate the hydrogen ions in the stomach keep the pH between 1.5 and 3.5. This highly acidic fluid breaks down food and allows digestion to continue. Alterations in any of these systems can lead to serious medical conditions. For example, a pH imbalance in the mouth leads to tooth decay, and alterations in the blood can lead to breathing difficulties. When stomach acid gets beyond the protective sphincter in the esophagus, heart burn and a sour taste may be experienced. The burning sensation is caused by acidic damage to the tissue in the esophagus, and continued acidity may lead to irreversible changes and cancer.\*

- **Radioactive decay**- the spontaneous release of material from the nucleus of an unstable isotope.
- **Half-life**- the time it takes for one-half of the original radioactive parent atoms to decay.
  - Some elements that undergo radioactive decay emit harmful radiation.
  - Knowledge of the half-life allows scientists to determine the length of time that a radioactive element may be dangerous.

(EX). DEPLETED NUCLEAR FUEL IN AIR GENERATED BY NUCLEAR POWER PLANT  
(PERIOD OF TIME THAT PEOPLE & ENVIRONMENT MUST BE PROTECTED FROM THE  
EFFECTS/EMISSIONS)

*\*\*\*IF A RADIOACTIVE ISOTOPE HAS A HALF LIFE OF 10,000YRS... WHICH MEANS THAT 10,000YRS FROM TODAY A SAMPLE WILL BE HALF AS RADIOACTIVE, ANOTHER 10,000YRS WILL BE  $\frac{1}{4}$  RADIOACTIVE AND SO FORTH*





# HALF-LIFE...

**1. Total years =  $X \times n$**

**$X$  = # of half-lives based on fraction of decay**

**$n$  = set # of years for  $\frac{1}{2}$  of the element to decay**

**\*\*\*the element loses half of its radioactivity every  $n$  years.**

**2. Amt. remaining = (original amt.)  $\times (.5^X)$**

**$X$  = half lives**

# Radioactivity - half life

- How long (in yrs) will it take 10g of Uranium to decay 1/8 OF ITS ORIGINAL SUBSTANCE IF IT HAS A HALF LIFE OF 10,000YRS?

present	1/2	1/4	1/8
1. 10G	--- 5G	--- 2.5G	--- 1.25G
	1 half life	2 half life	3 half life

$$X \times N = \text{TOTAL YEARS}$$

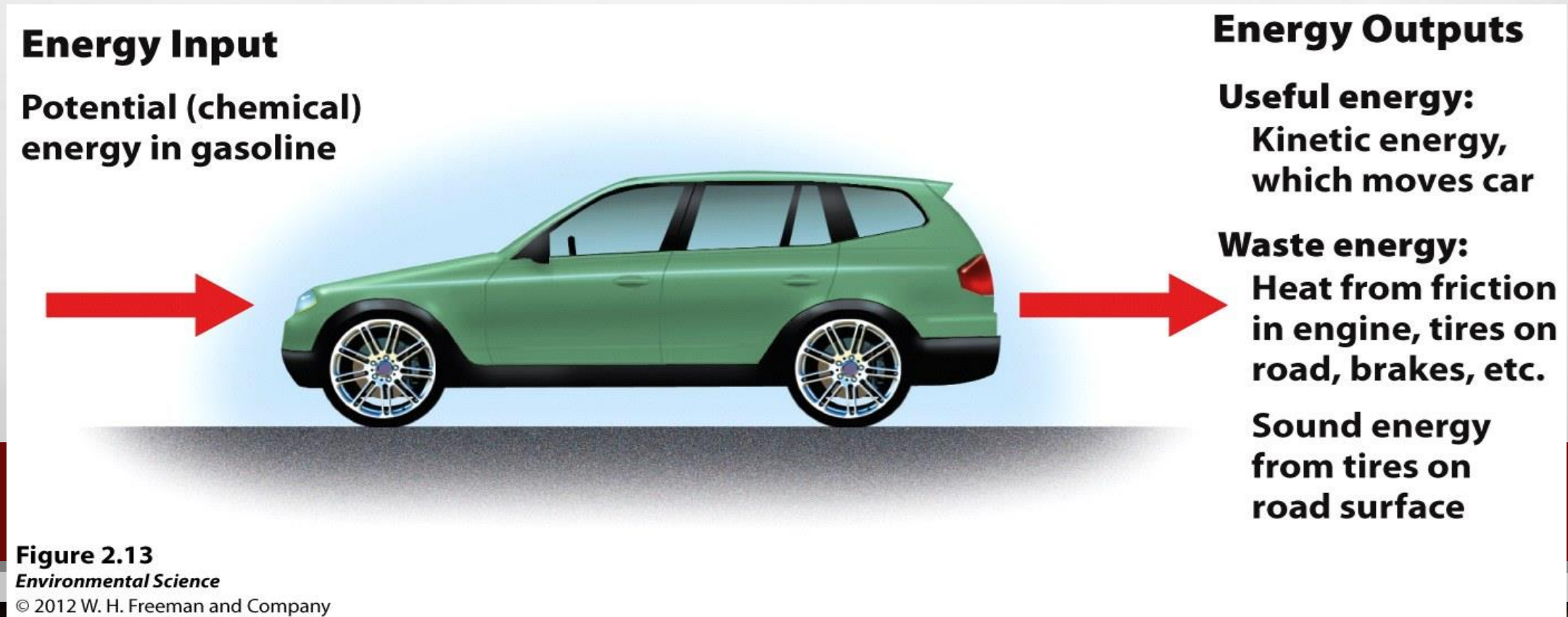
2. 3 half lives x 10,000yrs = 30,000yrs to degrade 10g U

**1. You have 450g of a radioactive substance. It has a half-life of 285 years. After 1,625 year, what mass remains??**

**2. Strontium-90 is a radioactive waste product from nuclear reactors. It has a half-life of 33 years. How many years will it take for a quantity of strontium-90 to decay 1/16 of its original mass???**

# First law of thermodynamics

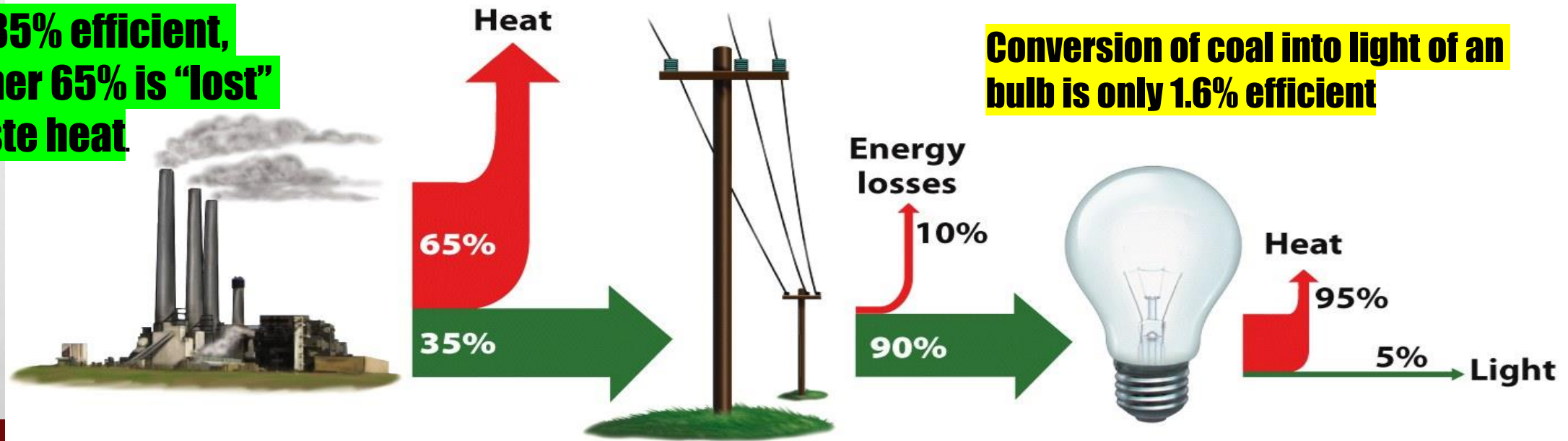
- Energy is neither created or destroyed, changed form.
- You can't get something from nothing.
- ORGANISM NEEDS USABLE ENERGY BY "EATING" – SUN/FOOD



# Second law of thermodynamics

- When energy is transformed, the quantity of energy remains the same, but its ability to do work diminishes (**SOME ENERGY IS CONVERTED INTO A LESS USABLE FORM, SUCH AS WASTE HEAT...NOT USEFUL TO DO WORK**).

**1st step: 35% efficient, the other 65% is "lost" as waste heat**



**Calculation:  $(35\%) \times (90\%) \times (5\%) = 1.6\%$  efficiency**

**Figure 2.15**

*Environmental Science*

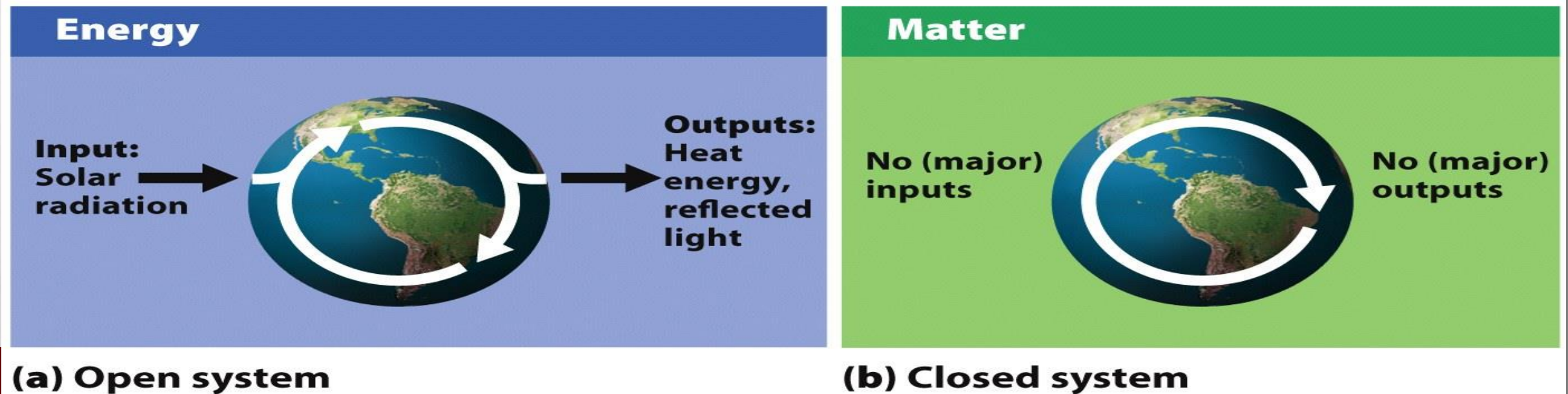
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# Second law of thermodynamics

- **ENERGY EFFICIENCY**- THE RATIO OF THE AMOUNT OF WORK THAT IS DONE TO THE TOTAL AMOUNT OF ENERGY THAT IS INTRODUCED INTO THE SYSTEM
- **Energy quality**- the ease with which an energy source can be used for work.
- **Entropy**- all systems **move toward randomness** rather than toward order.
  - This randomness is always increasing in a system, unless new energy from the outside of the system is added to create order.
  - **ALL LIVING THINGS WORK AGAINST ENTROPY BY USING ENERGY TO MAINTAIN ORDER.**
  - **ALL SYSTEMS MOVE TOWARD INCREASED ENTROPY**

# SYSTEM ANALYSIS SHOWS HOW MATTER AND ENERGY FLOW IN THE ENVIRONMENT

- Open system- exchanges of matter or energy occur across system boundaries.
- Closed system- matter and energy exchanges across system boundaries do not occur.



**(a) Open system**

**(b) Closed system**

Figure 2.18  
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**Earth is an open system due to energy (sun), but closed system due to matter (very little matter enters/leaves Earth) ...mono lake has both inputs and outputs**

## Steady States

- **Negative feedback loops-** when a system responds to change by returning to its original state, or at least by decreasing the rate at which the change is occurring. (*prey vs. predator*)
- **Positive feedback loops-** when a system responds to change by increasing the rate at which the change is occurring (*TRIGGERING CHANGE IN A FORWARD DIRECTION, INTENSIFYING*)



**NEGATIVE FEEDBACK LOOP:** Negative feedback loops *reduce* the effects of climate change.

**Ex. Increased cloudiness reflects more incoming solar radiation**

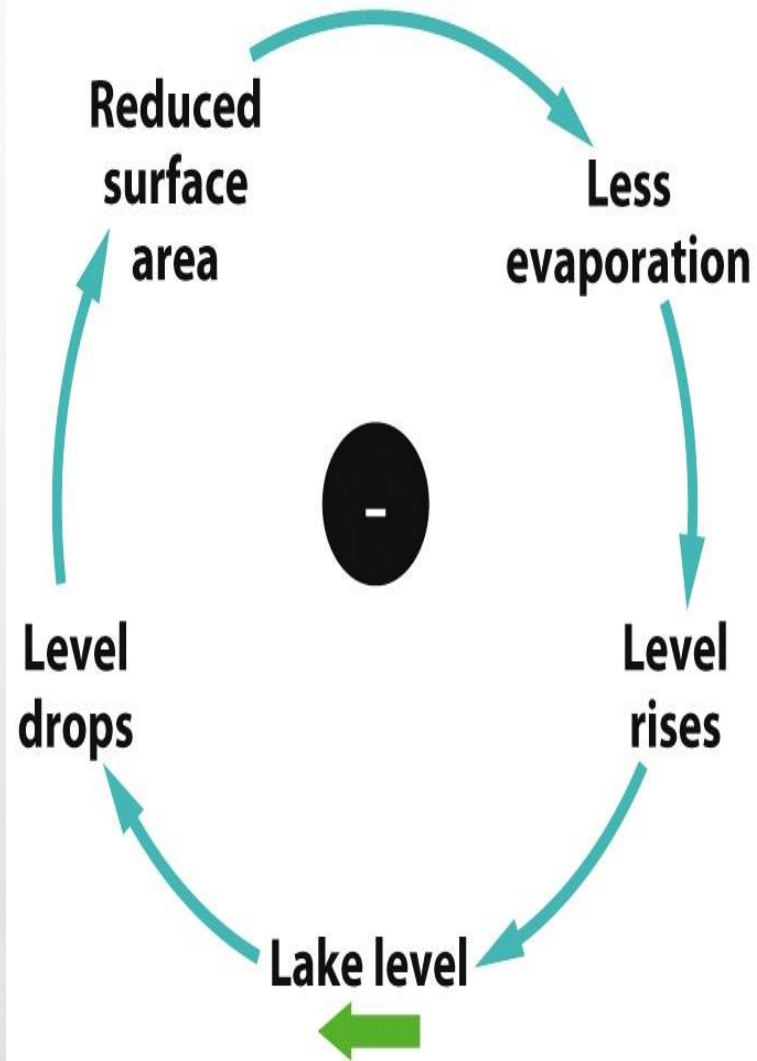
As ice sheets melt, this could increase cloudiness with more water vapor in the atmosphere. Because clouds reflect 1/3 of incoming solar radiation, there would be less heat absorption on Earth's surface.

**• POSITIVE FEEDBACK LOOP:** In a positive feedback loop, an initial warming triggers a feedback to amplify the effects warming.

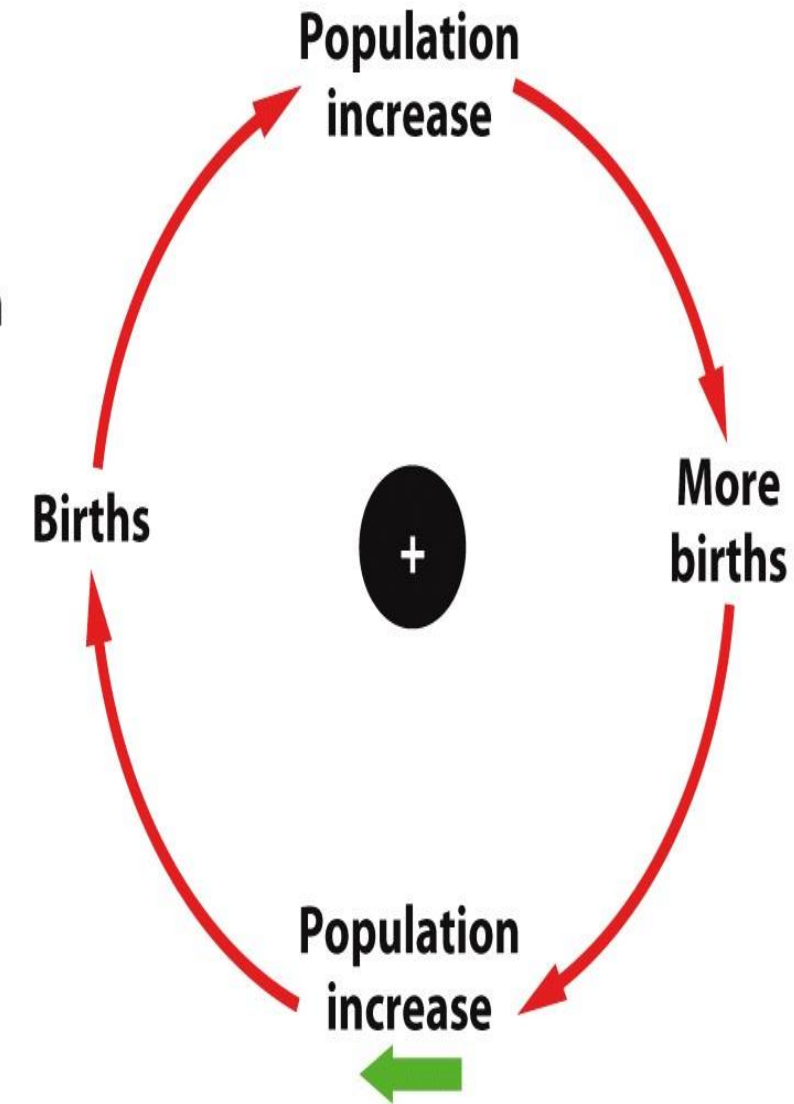
**Ex. Sea level rise**

As the planet warms, ocean waters expand. Rising sea levels hit coastal cities the hardest. But another result will trigger further glacier calving.

If you increase water volume, this could cause further chunks of ice to outpour into the oceans



**(a) Negative feedback loop**



**(b) Positive feedback loop**

Figure 2.21

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# NATURAL SYSTEMS CHANGE ACROSS SPACE AND OVER TIME

Anthropogenic (humans) change in an environmental system is often very visible positive or negative...change in rivers (redirect water sources), air that has been polluted (automobile &/or greenhouse gas emissions), sprawling (taking over wild areas for civilizations), deforestation/fragmentation &/or overhunted/overharvesting to extinction, creating habitat for species to thrive

Throughout Earth's history, **small natural changes have had large effects on complex systems**, but **human activities have increased** both the **PACE** and the **INTENSITY** of these natural environmental changes (ex. Mono Lake).