

Case Study

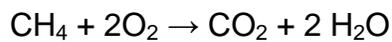
A terminal lake in California, Mono Lake, gets a build-up of salts and minerals. It is very salty and few species are able to live in it. Many birds depend on its supply of brine shrimp and alkali flies. LA decided to redirect the lake's water. This killed the food supply and repulsed the birds; the water level dropped quite low. The study shows how legislation can greatly damage or greatly improve environmental issues.

Key Ideas

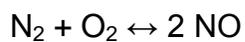
1. All environmental systems consist of matter. The components of matter are:

Mass   Atom   Element   Molecules   Compounds

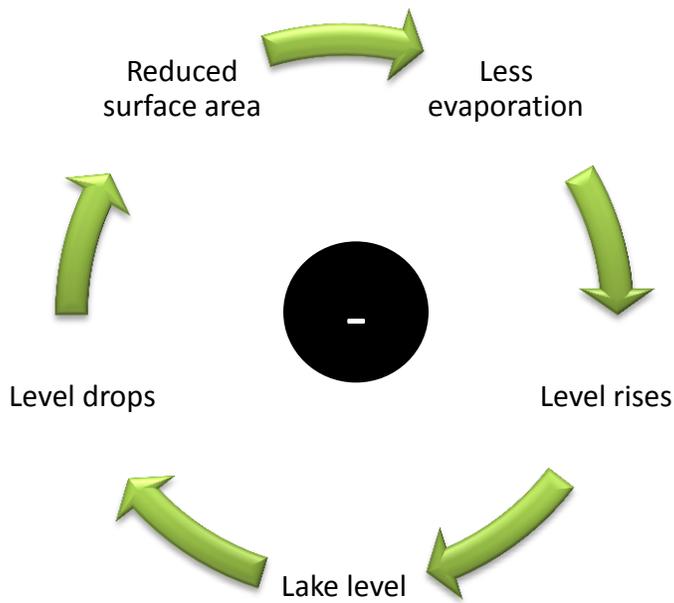
2. Chemical reactions: Bonds between atoms can change



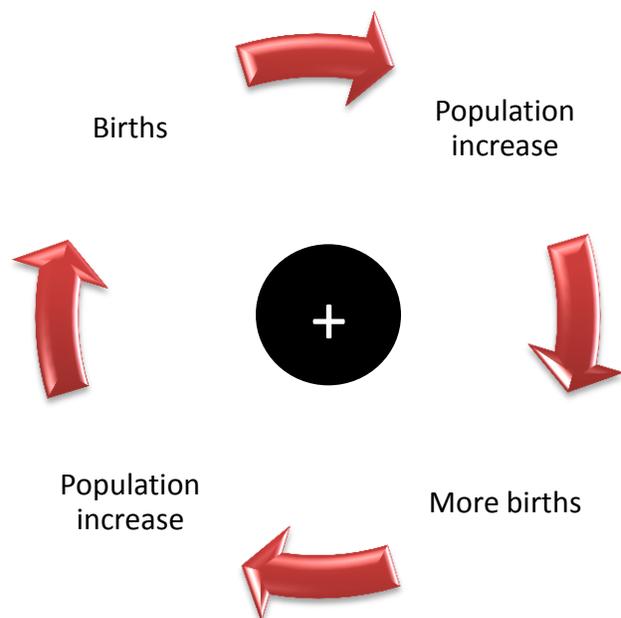
Sometimes chemical reactions can occur in either direction.



3. (a) Negative feedback loop



(b) Positive feedback loop



4. Cells are made up of four types of molecules: Carbohydrates, proteins, nucleic acids, and lipids. Since these types of molecules are rather large, they are also called macro-molecules.

5. Potential energy is the energy that is stored but has not yet been released, whereas, kinetic energy is the energy of motion.

6. The First Law of Thermodynamics says matter and energy can neither be created nor destroyed. The Second Law of Thermodynamics states that when energy is transformed, the quantity of energy remains the same, but its ability to do work diminishes.

7. The three categories of chemical bonds are covalent, ionic, and polar:

Covalent bond – Elements that do not readily gain or lose electrons form compounds by sharing electrons.

Ionic bond – Atoms transfer their charges. The resulting charge imbalance holds them together.

Hydrogen bond – A weak chemical bond that forms when hydrogen atoms that are covalently bonded to one atom are attracted to another atom on a different molecule.

### Vocabulary Words

- **Element** – A substance composed of atoms that cannot be broken down into smaller, simpler components.
- **Half-life** – The time it takes for one-half of the original radioactive parent atoms to decay.
- **DNA** – The genetic material organisms pass on to their offspring that contains the code for reproducing the components of the next generation.
- **RNA** – Translates the code stored in the DNA and allows for the synthesis of proteins.
- **Joule** – The amount of energy used when a 1-watt light bulb is turned on for 1 second.
- **Capillary action** – This happens when adhesion of water molecules to a surface is stronger than cohesion between the molecules.
- **Electromagnetic radiation** – A form of energy that includes, but is not limited to, visible light, ultraviolet light, and infrared energy, which we observe as heat.
- **Energy efficiency** – The ratio of the amount of work that is done to the total amount of energy that is introduced into the system in the first place.
- **Entropy** – The randomness that all systems move toward rather than toward order.

### Formulas

Energy is the ability to do. Power is the rate at which work is done.

$$\text{Energy} = \text{power} \times \text{time}$$

$$\text{Power} = \text{energy} \div \text{time}$$

Unit	Definition	Relationship to joules	Common uses
Calorie	Amount of energy it takes to heat 1 gram of water 1° C	1 calorie = 4.184 J	Energy expenditure and transfer in ecosystems; human food consumption
Calorie	Food calorie; always with a capital C	1 Calorie = 1,000 calories = 1 kilocalorie (kcal)	Food labels; human food consumption
British thermal unit (Btu)	Amount of energy it takes to heat 1 pound of water 1°F	1 Btu = 1,055 J	Energy transfer in air-conditioners and home and water heaters
kilowatt-hour (kWh)	Amount of energy expended by using 1 kilowatt of electricity for 1 hour	1 kWh = 3,600,000 J = 3.6 megajoules (MJ)	Energy use by electrical appliances often given in kWh per year.

### Multiple Choice Questions

1. What system constitutes a positive feedback loop?
  - (a) Evaporation in a lake
  - (b) Greenhouse gases in the atmosphere
  - (c) Increasing temperature resulting in increased decomposition
  - (d) Infectious disease

2. Which of the following macromolecules does not make up a cell?

- (a) Carbohydrates
- (b) Lipids
- (c) Nucleic acids
- (d) Proteins
- (e) Sugars

3. Which chemical bond is the least strong?

- (a) Hydrogen
- (b) Ionic
- (c) Covalent
- (d) All bonds are the same strength

Free Response Question Ideas

FRQ could ask to give examples of open and closed systems. Maybe power and energy, the laws of thermodynamics, or even potential and kinetic energy. Also, converting to different units.

Areas of Concern

- Increasing population sizes
- Disrupting environmental systems
- Creating positive feedback loops
- Energy efficiency

Yay for Us

The Everglades has shrunk greatly in size, in addition water flow and its resulting quality has been reduced. However, scientists and policy makers are utilizing a systems-based approach called The Comprehensive Everglades Restoration Plan [of 2000]. Their three focuses are: increase water flow in the Everglades, reduce incoming pollutants, and develop strategies to deal with problems in the future.

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