Systems

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1. Easter Island
    - A closed system
    - Once a paradise
    - Tragedy of the commons
    - Time delay
    - Exponential devastation
    - Population crash
    - Used as a model of the current state of the planet
2. Positive Feedback Loop
    - **Runaway Cycle** — A change in the system (input) causes the output to increase, which causes more input
3. Negative Feedback Loop
    - A change in input creates an output which causes the input to decrease
    - Homeostasis (balance)
    - Ex. As pollution becomes less of a problem, it will bother fewer people, which means regulations on pollution will become less stringent
4. Time Delays
    - Typical for environmental systems
    - Do not see/feel the consequences until it is too late
    - Ex. Smoking — Years of smoking may lead to cancer, which makes it too late to quit

5. Synergistic Interactions

    - When two processes create a stronger effect together than the sum of their individual parts
    - Ex. Smog — Heat and UV radiation from the sun combine with car emissions and create a toxic substance worse than either alone

6. Organic Compounds

    - Contain Carbon
        - Exception: CO_2
    - Hydrocarbons — Fossil fuels (methane)
    - Chlorinated Hydrocarbons — DDT
    - Chlorofluorocarbons (CFCs) — Freon

7. pH

    - Percent Hydronium
    - Logarithmic scale from 0 (strong acid, more H^+ ions) to 14 (Strong base, more OH^- ions), with 7 being neutral

8. Quality Matter

    - High quality matter is easily used by man in terms of creating a product
    - Low quality matter is difficult to obtain or to convert into usable objects

9. Energy

    - The ability to do work and transfer heat
    - Kinetic Energy — Motion
    - Potential Energy — Stored energy

10. Law of Conservation of Matter

    - Matter can not be created nor destroyed
        - Matter is changed either physically or chemically, but still present
    - We will never run out of matter, only matter in easily used forms

11. Matter Breaks Down

    - Concentration — How much is there?
    - Persistence — How long will it last?

- Degradable — Via physical, chemical, or biological
  - Slowly degradable — (plastics, DDT (takes decades))
  - Nondegradable — Elements like lead and mercury never break down

12. Nuclear Changes

- Radioactive change (decay) is another possible change to matter
- Natural radioactive decay
  - Nuclear Fission — Splitting of atoms
    - Typically a large mass isotope (U-235)
    - When neutrons are shot at nucleus, the nucleus splits, releasing energy, and more neutrons
    - Creates chain reaction
    - Used in power generation (nuclear power plants)
  - Nuclear Fusion
    - Two light-speed nuclei are slammed together at high speed
    - Fusing produces new nucleus and release energy
    - Typically isotopes of hydrogen are used
    - Occurs inside a hydrogen bomb

13. First Law of Thermodynamics

- Also called the "law of conservation of energy"
- Energy is neither created nor destroyed but may be converted from one form to another
- Energy in = Energy out

14. Second Law of Thermodynamics

- When energy changes form, some energy is degraded into lower quality energy
- In other words, heat is lost to the surrounding environment in all energy conversions or transfers (entropy)