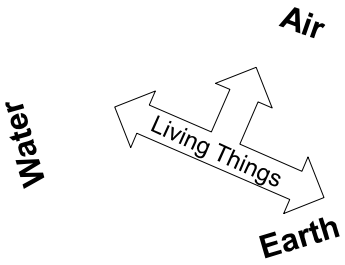
Forces in Nature

Feedback loops



1

Earth's Systems

- Geosphere
  - All rocks and minerals on or under the surface in solid or molten form.
- Hydrosphere
  - Water that is on the surface of earth, underground, and in the air.
- Atmosphere
  - The envelope of gases surrounding the earth.
- Biosphere
  - All living organisms on the planet.

2

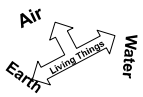
System Interaction

- A network of relationships among parts, elements, or components
  - They interact with and influence one another
  - They exchange energy, matter, or information
- Systems receive inputs of energy, matter, or information
  - They process these inputs and produce outputs

3

Feedback Loops

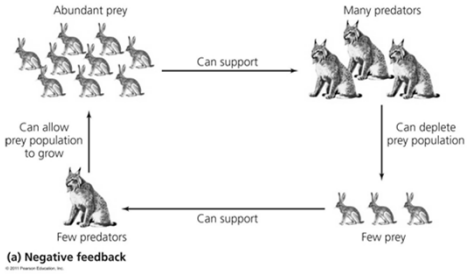
- A circular process in which a system's output serves as input to that same system
- Two types
  - Positive
  - Negative
- These do not mean good or bad.



4

Negative Feedback Loop

- Output from a system moving in one direction acts as input
  - That moves the system in the other direction
- Input and output neutralize one another
  - Stabilizes the system
  - Example:

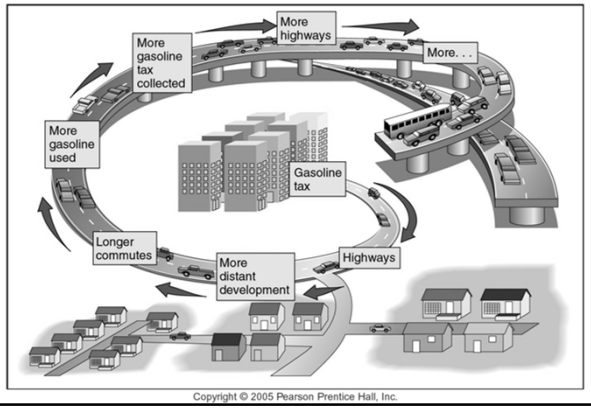


- Most systems in nature

5

Positive feedback loop

- Instead of stabilizing a system, it drives it further toward one extreme or another
- Rare in nature, but is common in natural systems altered by humans
- Example:



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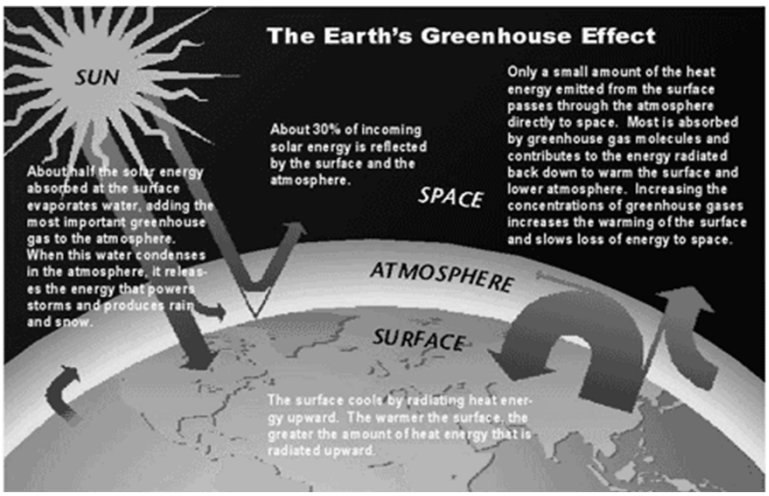
6

Feedback Loops in Context

Global warming hypothesizes that the average temperature of Earth is increasing. During analysis, scientists have identified possible positive **and** negative feedback loops to explain atmospheric climate change.

7

Radiation and Reflection



8

Positive or Negative?

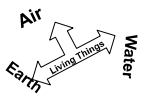
- The warming of the oceans causes dissolved CO_2 to bubble out into the atmosphere. This atmospheric CO_2 helps to trap heat near the earth. This trapped heat continues to warm the ocean.

Positive

9

Positive or Negative?

- Warmer water temperatures cause greater water evaporation, which increases the formations of clouds. A lot of water vapor in the air also traps heat inside the atmosphere.



Positive

10

Positive or Negative?

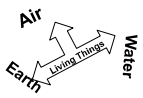
- The increased cloud cover from example 2 might also act to reflect sunlight back into space, preventing it from entering our atmosphere. This might cool the earth.

Negative

11

Positive or Negative?

- Sunlight striking the earth is absorbed by dark colors and reflected by light colors. The polar ice caps act like huge mirrors, reflecting sunlight back into space. Warmer water temperatures are melting these ice caps and decreasing these big “mirrors,” leaving dark water behind.



Positive

12

Positive or Negative?

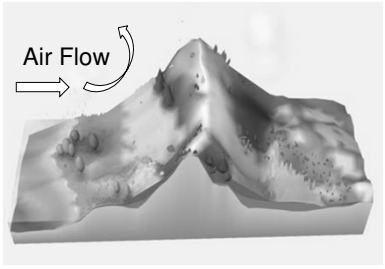
- Warmer temperatures cause greater water evaporation, which falls to earth as precipitation. Therefore global warming may cause increased snow fall in the polar regions, leading to increased ice formation.

Negative

13

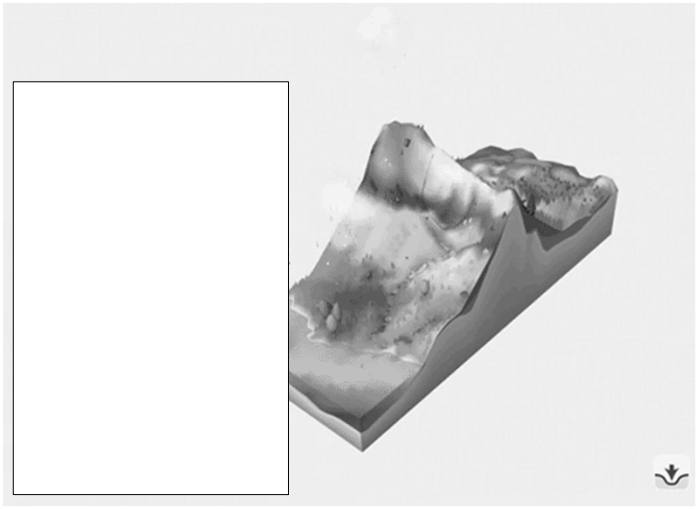
Geologic Processes and Feedback Loops

- Mountain ranges
  - Cause air to lift upwards causing the air to cool
  - This lessens the amount of water the air can hold and causes it to rain on that side of the mountain.
  - What effect does this have?



14

Geologic Processes and Feedback Loops



15

Geologic Processes and Feedback Loops

- Lack of moisture on far side of mountain
- Erosion on nearside of mountain
- Smaller mountain
- More moisture on far side of mountain
- Less air flowing up.
- Less rain
- Less erosion

Positive or Negative?

16