Order

Evolutionary adaptation

Response to the environment

Reproduction

Growth and development

Regulation

Energy processing
The biosphere

Ecosystems

Tissues

Organs and organ systems

Communities

Organelles

Cells

Populations

Atoms

Molecules

Organs and organ systems

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Animals eat leaves and fruit from the tree.

Leaves take in carbon dioxide from the air and release oxygen.

Sunlight

Leaves absorb light energy from the sun.

CO₂

O₂

Cycling of chemical nutrients

Leaves fall to the ground and are decomposed by organisms that return minerals to the soil.

Water and minerals in the soil are taken up by the tree through its roots.

Animals eat leaves and fruit from the tree.

Water and minerals in the soil are taken up by the tree through its roots.
Heat

Producers absorb light energy and transform it into chemical energy.

Chemical energy in food is transferred from plants to consumers.

(a) Energy flow from sunlight to producers to consumers

Chemical energy

An animal's muscle cells convert chemical energy from food to kinetic energy, the energy of motion.

(b) Using energy to do work

When energy is used to do work, some energy is converted to thermal energy, which is lost as heat.

A plant's cells use chemical energy to do work such as growing new leaves.
(a) Wings

(b) Wing bones
Eukaryotic cell

- Membrane
- Cytoplasm
- Membrane-enclosed organelles
- DNA (throughout nucleus)
- Nucleus (membrane-enclosed)

Prokaryotic cell

- Membrane
- DNA (no nucleus)
Sperm cell

Nuclei containing DNA

Egg cell

Fertilized egg with DNA from both parents

Embryo’s cells with copies of inherited DNA

Offspring with traits inherited from both parents
Excess D *blocks* a step.

(a) Negative feedback

Excess Z *stimulates* a step.

(b) Positive feedback
**Species**

*Ursus americanus*  
(American black bear)

**Genus**

*Ursus*

**Family**

*Ursidae*

**Order**

*Carnivora*

**Class**

*Mammalia*

**Phylum**

*Chordata*

**Kingdom**

*Animalia*

**Domain**

*Eukarya*
(a) Domain Bacteria

(b) Domain Archaea

(c) Domain Eukarya

Kingdom Plantae

Kingdom Animalia

Kingdom Fungi

Protists
Cilia of Paramecium

Cross section of a cilium, as viewed with an electron microscope

Cilia of windpipe cells
Population with varied inherited traits

Elimination of individuals with certain traits

Reproduction of survivors

Increasing frequency of traits that enhance survival and reproductive success
Observations

Question

Hypothesis #1: Dead batteries
Prediction: Replacing batteries will fix problem
Test of prediction
Test falsifies hypothesis

Hypothesis #2: Burnt-out bulb
Prediction: Replacing bulb will fix problem
Test of prediction
Test does not falsify hypothesis