The Three Questions

Answer each of the questions (numbered 1-4) below to explain how matter and energy move and change in a system. Note that matter movement is addressed at both the beginning (1) and end (4) of your explanation.

Matter Movement

Question

Where are molecules moving?

1 How do molecules move to the location of the chemical change?

4 How do molecules move away from the location of the chemical change?

Rules to Follow

All materials (solids, liquids, and gases) are made of atoms that are bonded together in molecules.

Scale: The matter movement question can be answered at the atomic-molecular, cellular, or macroscopic scale.

Evidence We Can Observe

Moving solids, liquids, and gases are made of moving molecules.

A change in mass shows that molecules are moving.

Matter Change

Question

2 How are atoms in molecules being rearranged into different molecules?

What molecules are carbon atoms in before and after the chemical change?

What other molecules are involved?

Rules to Follow

Atoms last forever in combustion and living systems.

Atoms can be rearranged to make new molecules, but not created or destroyed.

Carbon atoms are bound to other atoms in molecules.

Scale: The matter change question is always answered at the atomic-molecular scale.

Evidence We Can Observe

BTB can indicate CO_2 in the air.

Organic materials are made up of molecules containing carbon atoms:

- fuels
- foods
- living and dead plants and animals
- decomposers

Energy Change

Question

3 What is happening to energy?

What forms of energy are involved?

What energy transformations take place during the chemical change?

Rules to Follow

Energy lasts forever in combustion and living systems.

Energy can be transformed, but not created or destroyed.

C-C and C-H bonds have more stored chemical energy than C-O and H-O bonds.

Scale: The energy change question can be answered at the atomic-molecular, cellular, or macroscopic scales.

Evidence We Can Observe

We can observe indicators of different forms of energy before and after chemical changes:

- light energy
- chemical energy stored in organic materials
- motion energy
- heat energy

Carbon TIME

Carbon: Transformations in Matter and Energy
Environmental Literacy Project
Michigan State University