

main points

- The Earth is (virtually) a materially closed system but an energetically open one. In other words, energy flows in and out of the planet, but matter does not.
- The flow of energy through the Earth powers many *material cycles* in which matter is cycled through a variety of forms.
- Chemical reactions involve the *rearrangement* of atoms (although the atoms are often incorporated within molecules or ions).
- Chemical equations summarize chemical reactions, using chemical formulas to represent the reactants and products, rather than full names.
- All the atoms that appear on one side of a balanced equation must also appear on the other side. Chemical reactions, in other words, adhere to the Law of Conservation of Mass (matter).
- Real chemical reactions are more complex than the neat summaries depicted in equations. Some reactants usually remain unreacted, some side reactions generate additional minor products, and most reactions proceed through a variety of chemical intermediates which are not usually included in the equations.
- Chemical equations can be used to calculate the specific quantities of reactants and products involved in the reactions, either as masses or as moles. The general term for the process of performing such calculations is *stoichiometry*.
- In order to live in chemical harmony with the Earth, we need to learn to use materials in ways that fit into the general pattern of material cycles within our materially closed system.
- Recycling of materials is becoming an increasingly important and popular aspect of modern life and economic activity. The growth of recycling is being driven both by its economic benefits and by concern for the environment.