resource depletion and recycling

synthesis and use of materials

physical properties

9-12

The development of new materials and the increased use of existing materials by a growing human population have led to the removal of resources from the environment much more rapidly than they can be replaced by natural processes. Disposal of

Waste management includes considerations of quantity, safety, degradability, and cost. It requires social and technological innovations, because waste-disposal problems are political and economic as well as technical.

Increased knowledge of the properties of particular molecular structures helps in the design and synthesis of new materials for special purposes.

Groups of atoms and molecules can form structures that can be measured in billionths of a meter. The properties of structures at this scale (known as the nanoscale) and materials composed of such structures, can be very different than the

At very low temperatures, some materials become superconductors and offer no resistance to the flow of electrons.

Semiconducting materials differ greatly in how well they conduct electrons, depending on the exact composition of the material.

Objects made up of a small number of atoms may exhibit different properties than macroscopic objects made up of the same kinds of atoms.

6-8

The wasteful or unnecessary use of natural resources can limit their availability for other purposes. Restoring depleted soil, forests, or fishing grounds can be difficult and costly.

Some materials, such as plastics, are synthesized in chemical reactions that link atoms together in long chains. Plastics can be designed to have a variety of different properties for a variety of uses.

A substance has characteristic properties such as density, a boiling point, and solubility, all of which are independent of the amount of the substance and can be used to identify it.

Efforts to find replacements for existing materials are driven by an interest in finding materials that are cheaper to obtain or produce or that have more desirable properties.

The benefits of Earth's resources -- such as fresh water, air, soil and trees -- can be reduced by deliberately or inadvertently polluting them. The atmosphere, the oceans, and the land have a limited capacity to absorb and recycle waste

Atoms may link together in well-defined molecules, or may be packed together in crystal patterns. Different arrangements of atoms into groups compose all substances and determine the characteristic properties of

Recycling materials and the development of substitutes for those materials can reduce the rate of depletion of resources but may also be costly. Some materials are not easily recycled.

The choice of materials for a job depends on their properties.

Some material resources are very rare and some exist in great quantities. The ability to obtain and process resources depends on where they are located and the form they are in. As resources are depleted, they may become more difficult to

Materials vary in how they respond to electric currents, magnetic forces, and visible light or other electromagnetic waves.

3-5

Sometimes it is possible to use the materials from discarded products to make new products, but materials differ widely in the ease with which they can be recycled.

Humans have produced a wide variety of materials, such as steel, plastic, and nylon, that do not appear in nature.

All materials have certain physical properties, such as strength, hardness, flexibility, durability, resistance to water and fire, and ease of conducting heat.

Discarded products contribute to the problem of waste disposal.

Naturally occurring materials such as wood, clay, cotton, and animal skins may be processed to change their properties.

K-2

Some objects can be used over again.

Some kinds of materials are better than others for making any particular thing. Materials that are better in some ways, such as stronger or cheaper, may be worse in other ways, such as heavier or harder to cut.

Objects can be described in terms of their properties. Some properties, such as hardness and flexibility, depend upon what material the object is made of, and some properties, such as size and shape, do not.