1.2 DEVELOPING A MODEL OF THE ATOM

ACTIVITY 1.2.1 DEVELOPING A MODEL OF A BLACK BOX

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(e) When investigating the contents of an actual black box, there are a number of physical, sensory observations that can be carried out. For each manipulation of the black box, we can use our senses of touch, vision, hearing, smell, and taste to give us a clue about the contents, and some ideas for a theoretical description or general statement that may characterize the nature of the contents of the box. We are unable to carry out such observations of the nature of the atom, as the atom is too small to touch, see, hear, smell, or taste.

PRACTICE

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Understanding Concepts

1. (a) A theory is based on non-observable ideas. A law is based on observations.
   (b) Empirical knowledge is observable, and theoretical knowledge is not.
2. Scientists use models — mental or physical representations of theoretical concepts — to help describe and explore their ideas.
3. The law of conservation of mass requires that all matter in a reaction be measured, in this case not just the solids (and liquids) in the unburned wood and the ashes. The missing matter could be accounted for if we were to measure the mass of the escaped gaseous products of combustion and the particulates in the smoke.
4. Changing models of the atom:
   - Democritus's model of the atom (third or fourth century B.C.)

     Different atoms are of different sizes, have regular geometric shapes, and are in constant motion. There are empty spaces between atoms.
   - Thomson's model of the atom (1897)
     Negatively charged electrons are distributed inside the atom, which is a positively charged sphere consisting mostly of empty space.
   - Rutherford's model of the atom (1911)
     The atom contains a positively charged core, the nucleus, that is surrounded by a predominantly empty space containing negative electrons.
   - Chadwick's model of the atom (1932)
     The atom is composed of a nucleus, containing protons and neutrons, and a number of electrons equal to the number of protons. An atom is electrically neutral.
5. (a) nucleus: the small, positively charged centre of the atom
   (b) proton: a positively charged subatomic particle found in the nucleus of the atom
   (c) electron: a negatively charged subatomic particle found around the nucleus
   (d) neutron: an uncharged subatomic particle in the nucleus of the atom
6. Cathode ray tubes can be found in some radios, televisions, and computer monitors.

