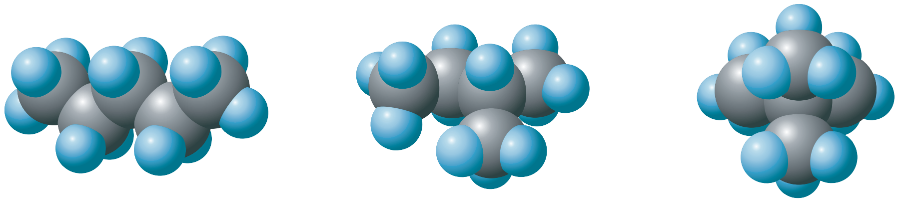


(a) Pentane
Boiling point = 36.1°C
Density = 0.626 g/mL

(b) Isopentane
Boiling point = 27.8°C
Density = 0.620 g/mL

(c) Neopentane
Boiling point = 9.5°C
Density = 0.614 g/mL

Figure 12.4 Space-filling models for the three isomeric C_5H_{12} alkanes: (a) pentane, (b) isopentane, and (c) neopentane.

Constitutional isomers are also frequently called *structural isomers.* The general characteristics of such isomers, independent of which name is used, are the same molecular formula and different structural formulas.

Figure 12.4 shows space-filling models for the three isometric C_5 alkanes. Note how neopentane, the most branched isomer, has the most compact, most spherical three-dimensional shape.

The number of possible alkane isomers increases dramatically with increasing numbers of carbon atoms in the alkane, as shown in Table 12.1. Such isomerism is one of the major reasons for the existence of so many organic compounds.

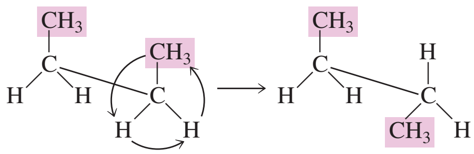
TABLE 12.1
Number of Isomers Possible for Alkanes of Various Carbon Chain Lengths

Molecular Formula	Possible Number of Isomers
CH_4	1
C_2H_6	1
C_3H_8	1
C_4H_{10}	2
C_5H_{12}	3
C_6H_{14}	5
C_7H_{16}	9
C_8H_{18}	18
C_9H_{20}	35
$C_{10}H_{22}$	75
$C_{15}H_{32}$	4,347
$C_{20}H_{42}$	336,319
$C_{25}H_{52}$	36,797,588
$C_{30}H_{62}$	4,111,846,763

Several different types of isomerism exist. The alkane isomerism examples discussed in this section are examples of *constitutional isomerism.* **Constitutional isomers** *are isomers that differ in the connectivity of atoms, that is, in the order in which atoms are attached to each other within molecules.* We will see shortly (Section 12.14) and in later chapters that other types of isomers are also possible, even among compounds whose atoms are connected in the same order. In the biochemistry portion of the text, where carbohydrates, lipids, and proteins are considered, we will find that different isomers elucidate different responses within the human body. Often, when many isomers are possible with the same molecular formula, only one isomer will be physiologically active.

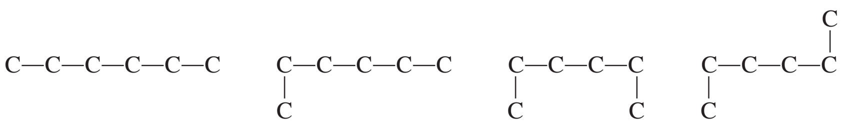
12.7 CONFORMATIONS OF ALKANES

Rotation about carbon–carbon single bonds is an important property of alkane molecules. Two groups of atoms in an alkane connected by a carbon–carbon single bond can rotate with respect to one another around that bond, much as a wheel rotates around an axle.



As a result of rotation around single bonds, alkane molecules (except for methane) can exist in infinite numbers of orientations, or conformations. A **conformation** *is the specific three-dimensional arrangement of atoms in an organic molecule at a given instant that results from rotations about carbon–carbon single bonds.*

The following skeletal formulas represent four different conformations for a continuous-chain six-carbon alkane molecule.



All four skeletal formulas represent the same molecule; that is, they are different conformations of the same molecule. In all four cases, a continuous chain of six carbon atoms is present. In all except the first case, the chain is "bent," but bends do not disrupt the continuity of the chain.