1. One of carbon's interesting properties is its ability to form a wide variety of molecules, especially ones containing bonds linking multiple carbon atoms.
2. This element is so widely distributed throughout nature that the largest subdiscipline of chemistry, organic chemistry, is devoted to the study of carbon compounds.
3. The name organic is historical and suggests a biological origin for the substances under investigation, but this is not necessarily true.
4. In practice, most organic chemists confine themselves to compounds in which carbon is combined with a relatively small number of other elements: hydrogen, oxygen, nitrogen, sulfur, chlorine, phosphorus, and bromine.
5. Even with this restriction, over 12 million of the 23 million total known compounds are considered organic.
6. The chemical behavior (i.e., properties and reactivity) of organic compounds enables us to organize them into a relatively Small number of categories.
7. As a result, in this chapter we concentrate an only a few and stress their important roles within the functions of living things.
8. To identify a specific organic compound from among the myriad of possibilities, the compound must be named.
9. Chemists use a formal Set of nomenclature rules established by an international committee so each of the 12 million compounds can be uniquely named.
10. However, many of these compounds have been known for a long time by common names such as alcohol, sugar, and morphine.
11. When a headache strikes, even chemists do not call out for 2-(acetyloxy)-benzoic acid; they simply say "Give me some aspirin!"
12. Likewise, prescriptions specify penicillin-N rather than 6[(5-amino-5-carboxy-l-oxopentyl)amino]-3,3-dimethyl-7-oxopentyl-4-thia-l-azabicyclo[3.2.0]hepta-ne-2-carboxylic acid.
13. Mouthfuls like this are the cause of great merriment to those who like to satirize chemists. Nonetheless, chemical names are important and unambiguous to those who know the system.
14. You can rest easy because in this chapter, we will use common names in almost all cases.
15. An incredible variety of organic compounds exists because of the remarkable ability of carbon atoms to bond in multiple ways both to other carbon atoms and to atoms of other elements.
16. To better understand such possibilities, we need a few basic rules for bonding in organic molecules.
17. You used one of these in Chapter 2, the octet rule.
18. When bonded, each carbon atom has a share in eight electrons, an octet.
19. Eight electrons can be arranged to form four bonds, with a pair of shared electrons in each covalent bond.
20. The most common configurations for these four bonds around a carbon atom are (a) four single bonds, (b) two single bonds and one double bond, (c) one single bond and one triple bond, or (d) two double bonds.
21. These arrangements are illustrated in Figure 10.2.
22. Other elements exhibit different bonding behavior in organic compounds.
23. A hydrogen atom is always attached to another atom by a single covalent bond.
24. An oxygen atom typically attaches either with two single bonds (to two different atoms) or one double bond (to a single atom).
25. A nitrogen atom commonly forms three single bonds (to three different atoms), but also can form either a triple bond (to one other atom), or a single and a double bond.
26. Chemical formulas such as C4H10 indicate the kinds and numbers of atoms present in a molecule, but do not show how the atoms are arranged or connected.
27. To get that higher level of detail, structural formulas are used that show the atoms and their arrangement with respect to one another in a molecule.
28. Here is the structural formula or normal butane, or *n*-butane (C4H10), a hydrocarbon fuel used in cigarette lighters and camp stoves.
29. A drawback to writing structural formulas, at least in a textbook, is that they take up considerable space.
30. To convey the same information in a format that is easily typeset into a single line, we use condensed structural formulas where carbon-to-hydrogen bonds are not drawn out explicitly, but simply understood to be single bonds.
31. Here are condensed structural formulas for *n*-butane.
32. Note that the carbons are bonded directly to other carbon atoms, and that the hydrogen atoms do not intervene in the chain.
33. Rather, two or three hydrogens are attached　to each carbon atom, depending on its position in the molecule.
34. The same number and kinds of atoms can be arranged in different ways, helping to explain why there are so many different organic compounds.
35. Isomers are molecules with the same chemical formula (same number and kinds of atoms), but with different structures and properties.
36. You already encountered isomers in the discussion of octane, C8H18, in Chapter 4.
37. Here we illustrate isomers with C4H10.
38. One way to arrange these atoms is in a chain to form n-butane.
39. Another arrangement is possible in which the four carbon atoms are not all in a line.
40. This other isomer is known as isobutane.
41. The linear n-butane is shown for comparison, now represented in a more realistic zigzag form.
42. The chemical formulas of these two isomers are the same; the way the atoms are connected is different.
43. Note that the central carbon in isobutane has three carbons connected to it and all of the other carbons have one other carbon (and three hydrogens) connected to them.
44. Rotating this representation doesn't change how the atoms are connected.
45. Just like its linear isomer, isobutane can be written using a condensed structural formula.
46. Here, the parentheses around the CH3 groups indicate that they are attached to the carbon to their left.
47. Note that the CH3 attached to the central CH carbon atom introduces a "branch" into the molecule.
48. Figure 10.3 shows three depictions of *n*-butane and isobutane.
49. The first column shows the simple structural formula and the second a ball-and-stick model.
50. In the third column we see space-filling models that present a more realistic view of the molecular shape.
51. Only two isomers of C4H10 exist.
52. As the number of atoms in a hydrocarbon increases, so does the number of possible isomers.
53. Thus, C8H18 has 18 isomers and C10H22 has 75.
54. Given a chemical formula, no simple calculation can be performed to obtain the number of isomers.