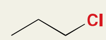
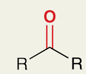
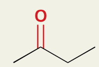
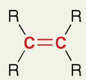
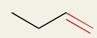
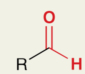
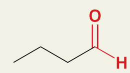
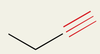
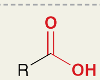
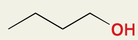
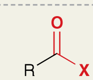
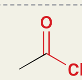
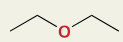
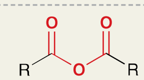
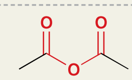
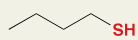
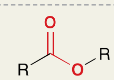
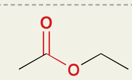
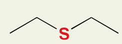
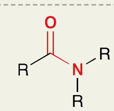
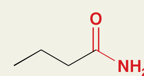
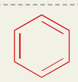
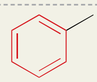
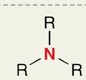
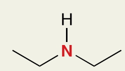
The physical and chemical properties of every organic compound are determined by the functional groups present in the compound. Therefore, the classification of organic compounds is based on their functional groups. For example, an *alkene* is a compound that exhibits a carbon-carbon double bond, while an *alcohol* is a compound that exhibits an OH group (Table 2.1). Many of the chapters in this book are organized by functional group. Table 2.1 provides a list of common functional groups and the corresponding chapters in which they appear. In organic chemistry, the letter "R" is used to represent a generic carbon chain, such as a —CH_3 group. In some cases, R might represent a hydrogen atom (R = H).

TABLE 2.1 EXAMPLES OF COMMON FUNCTIONAL GROUPS

FUNCTIONAL GROUP*	CLASSIFICATION	EXAMPLE	CHAPTER	FUNCTIONAL GROUP*	CLASSIFICATION	EXAMPLE	CHAPTER
R—X (X=Cl, Br, or I)	Alkyl halide		7		Ketone		19
	Alkene		7, 8		Aldehyde		19
R—C≡C—R	Alkyne		9		Carboxylic acid		20
R—OH	Alcohol		12		Acyl halide		20
R—O—R	Ether		13		Anhydride		20
R—SH	Thiol		13		Ester		20
R—S—R	Sulfide		13		Amide		20
	Aromatic (or arene)		17, 18		Amine		22

* The "R" refers to the remainder of the compound, usually a carbon chain.

WorldLinks | Fragrances and Perfumes

Rose fragrance is a complex mixture of organic compounds, including alcohols, alkenes, and esters.

It's certainly good advice to "stop and smell the roses" as you go through life. Such a pause benefits your mental health by providing an opportunity for reflection. Smelling roses might also increase our appreciation for organic chemistry, because organic molecules are responsible for most of the odors we encounter each day! Fragrances can have a tremendous impact on our minds and bodies. They can increase our appetite, or they can turn our stomach and make us sick. A certain odor might evoke images of a holiday or a favorite meal, or cause you to recall a childhood memory. In each case, a molecule or, more likely, a complex mixture of molecules is interacting with odor receptors in your nose and sending powerful signals to your brain. In response, an emotional reaction might be triggered, or perhaps your mouth will start watering!

Throughout history, humans have devised many practical purposes for fragrances: perfumes conceal body odors, essential oils provide relaxing aromatherapy, and pleasant-smelling soaps and shampoos are appealing to use. Plague doctors in the 1600s theorized that miasmas, or the smell of decomposition, was the cause of the spread of the Black Death. To protect themselves while treating the sick, they would place aromatic herbs and flowers in the beaks of their masks to combat the odors of disease and decay.

Fragrant materials filled the beaks of masks worn by plague doctors.

A tablet showing one of the world's first chemists as she prepares perfume.

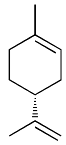
From the ancient Middle East, we find the earliest record of a chemist—on a tablet dating from 1200 BC. A woman named Tapputi was a perfume maker who used a distillation process to isolate fragrant essential oils, much like a modern-day perfume chemist might. Chemists have been making perfume for at least 3,000 years, and ancient perfumers had to rely on fragrances derived from natural sources. Plants were used, but also materials obtained from animals, such as ambergris from sperm whales, extracts from the anal glands of civet cats, and secretions isolated from male musk deer. It seems that certain organic molecules that are used by animals to mark their territory are also effective for humans trying to attract a mate! The modern fragrance industry was born in the late 1800s, when the first synthetic fragrances were produced. With the tools of organic synthesis at their disposal, chemists can produce affordable aromas, design novel fragrances, and develop alternatives to products harvested from animal sources. Fragrances are not only used to make perfumes and colognes (and air fresheners and scented candles…), but they are also added to many personal care and household products.

Perfumes use natural and/or synthetic fragrances.

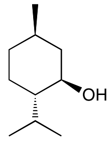
Odors contribute to the flavor of foods.

Flavors are very closely tied to fragrances. The molecule limonene not only gives lemons their characteristic odor, but contributes to the flavor of lemons as well. You have likely had the experience of not being able to taste your food when you have a stuffy nose. This is evidence of the intertwined relationship between our senses of smell and taste.

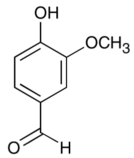
A selection of fragrant molecules is given below. As you can see, a wide variety of functional groups are represented. How many functional groups can you identify? Quiz yourself or discuss the structures with your study group, and then visit Chapter 2 of the Student Solutions Manual to see if you found them all.



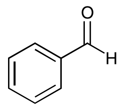
Limonene (lemons)



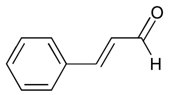
Menthol (mint)



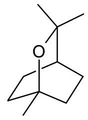
Vanillin (vanilla)



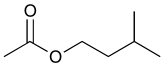
Benzaldehyde (cherry)



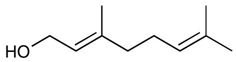
trans-Cinnamaldehyde (cinnamon)



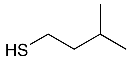
1,8-Cineole (eucalyptus)



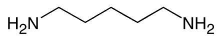
Isopentyl acetate (banana)



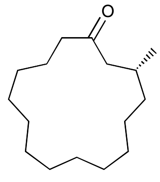
Geraniol (rose)



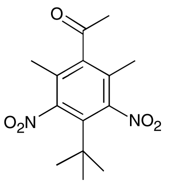
3-Methyl-1-butanethiol (skunk spray)



Cadaverine (decomposed tissue)



Muscone (musk deer glands)



Musk ketone (synthetic musk)