Reading for Activity 3.2
Same Molecules but Different Representations

Scientists develop and use molecular models for a variety of reasons. One reason is that molecular models help scientists visualize the shapes of molecules and how those molecules behave. Although a chemical formula tells which atoms a molecule is made up of, a chemical formula does not provide information about the shape of the molecule. It is important to be able to visualize the shape of a molecule because a molecule's shape determines some of its properties

This reading discusses two types of molecular models, which you have already explored in class. One is called a *space-filling model* and the other is called a *ball-and-stick model*. The different ways these models represent molecules emphasize different things.

Space-filling Model

Atoms have a dense positive nucleus that is surrounded by electrons, which form a spherically shaped cloud around the nucleus. Thus, spheres are used to represent atoms in three-dimensional molecular models.

When the atoms interact to form a molecule, their electron clouds overlap (See Figure 1a). Space-filling models represent the space taken up by the electron clouds of atoms. Figure 1b shows a space-filling model of a molecule consisting of the same two atoms. The center-to-center distances between the atoms are proportional to the distances between actual atomic nuclei.

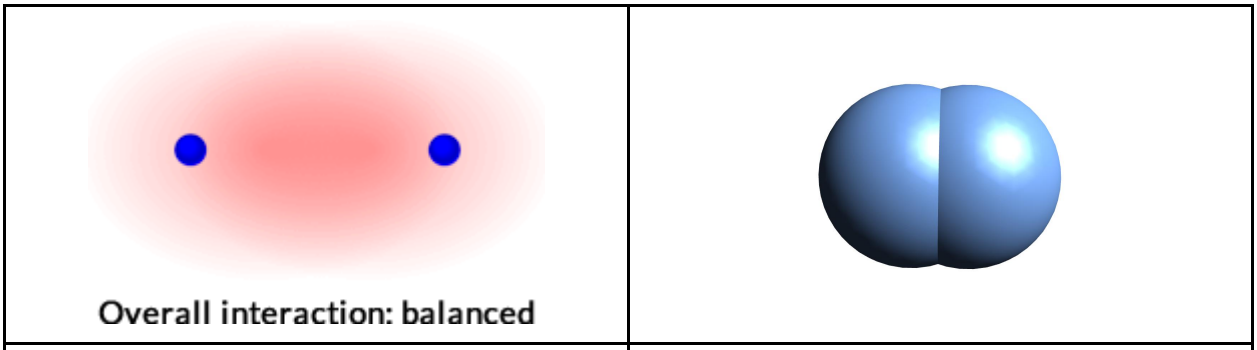

Figure 1a: Electron-cloud overlap of two atoms interacting to form a molecule.

Figure 1b: Space-filling model of a molecule containing two atoms.

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You can also see that in a space-filling model, the spheres overlap where atoms are connected. Why do you think the spheres overlap? What do you think the overlapped part of each sphere represents? In class, you learned that when atoms get close to each other, the nucleus of one atom attracts the electrons of the other atom, and when the electrons are shared between atoms, a bond is formed. In a space-filling model, the overlapping parts of the spheres show where chemical bonds are formed in a molecule when electrons are shared.

Ball-and-stick Model

Scientists also use ball-and-stick models to show how the atoms in a molecule are connected to each other. As in the space-filling model, the ball-and-stick model shows the three-dimensional shape of molecules by using a sphere to represent an atom. However, unlike the space-filling model, the ball-and-stick model uses a stick to show where two spheres are connected.The stick represents a chemical bond between atoms.

The representation below (Figure 2) is a ball-and-stick model of a molecule containing two atoms. The chemical bond is represented by the stick between the spheres. However, it is important to know that these sticks are only representations—they are not real. In class, you learned about the chemical bonds that hold atoms together. The electrostatic interactions between atoms due to charged subatomic particles pull them together, and they stay together at the distance where the forces between them are balanced. There are no physical objects, such as sticks, linking the atoms together.

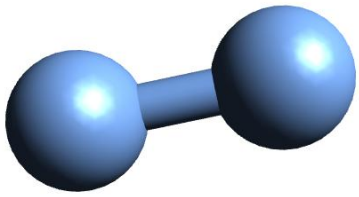

Figure 2: Ball-and-stick model of molecule containing two atoms.

Although the space-filling models are more accurate, for more complex molecules, ball-and-stick models can make it easier to see all of the components of the molecule. . Figures 2a and 2b compare the space-filling and ball-and-stick models of ethanol. While all of the atoms of the molecule are visible in the ball-and-stick model,

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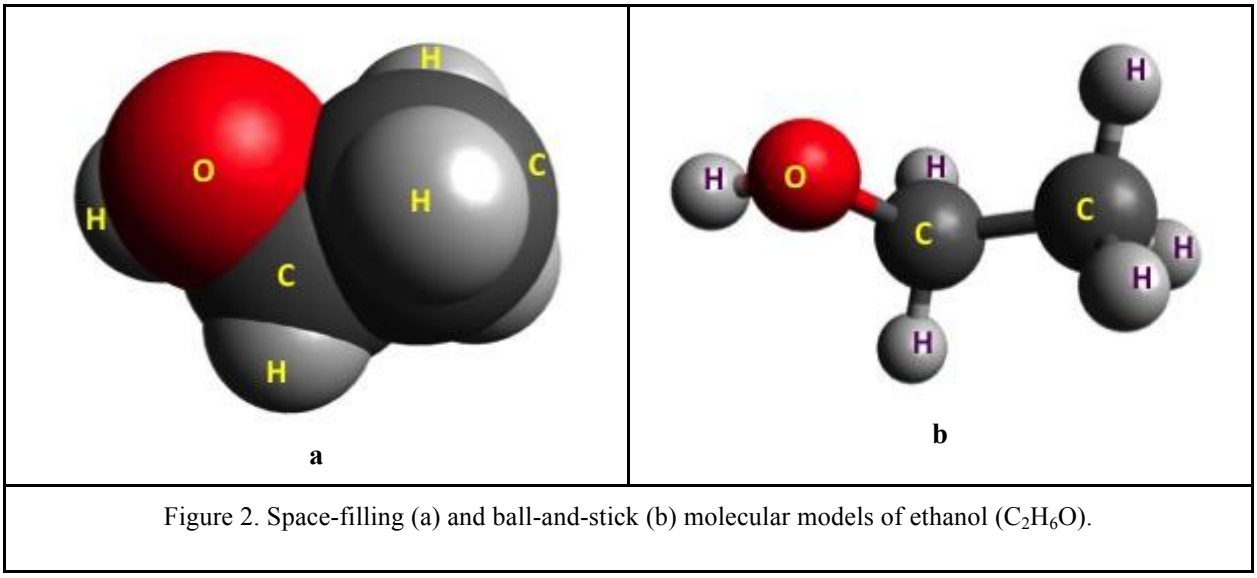

a **b**

Figure 2. Space-filling (a) and ball-and-stick (b) molecular models of ethanol (C_2H_6O).

What components of molecules are represented in each type of model? What components are missing from each type of model?

	Components represented	**Components missing**
space-filling		
ball-and-stick		

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