NAME:_____

DATE: _____ PERIOD: _____

MODELING MATTER

PICTURES IN THE MIND

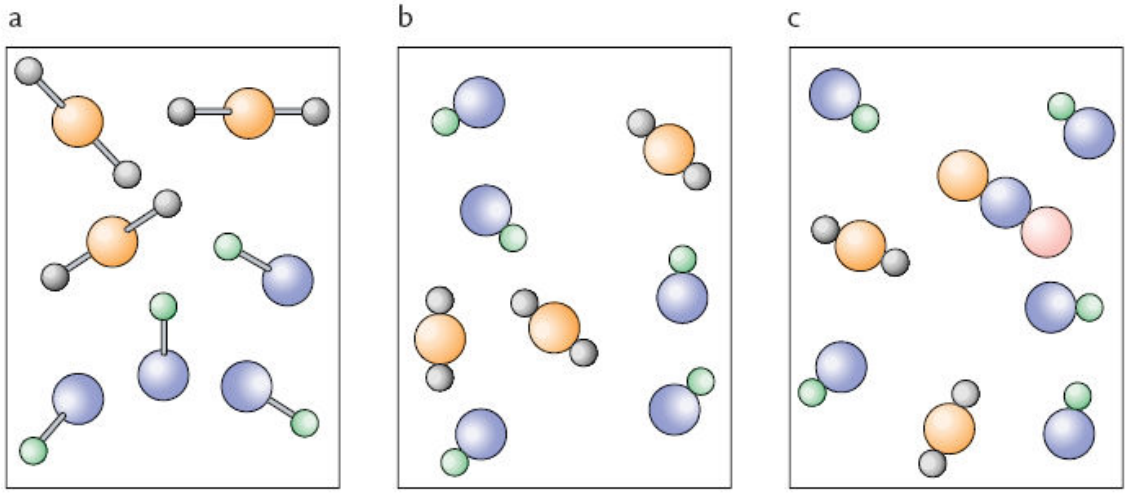
You live in a macroscopic world—a world filled with large-scale, readily observed things. As you experience the properties and behavior of bulk materials, you probably give little thought to the particulate world of atoms and molecules. If you wrap leftover cake in aluminum foil, it is unlikely that you think about how the individual aluminum atoms are arranged in the wrapping material. It is also unlikely that you consider what the mixture of molecules that make up air looks like as you breathe. And you seldom wonder about the behavior of atoms and molecules when you see water boiling or iron nails rusting.

Having a sense of how individual atoms and molecules might look and behave in elements, compounds, and mixtures can help you explain everyday phenomena. This activity will give you practice in observing, interpreting, evaluating, and creating visual models of matter at the particulate level.

To introduce you to these visualizations, consider this example: Suppose you want to draw a model of a homogeneous mixture of two gaseous compounds. You know that a homogeneous mixture is uniform throughout, so the two compounds should be intermingled and evenly distributed. You also know that compounds are composed of atoms of two or more different elements linked together by chemical bonds. Suppose a molecule of one of the compounds contains two different atoms. To represent this molecule, you could draw two differently shaded or labeled circles to denote atoms of the two elements and a line connecting the atoms to denote a bond.

Suppose the other compound is composed of molecules that each contain three atoms, and that two of the atoms are of the same element. You now need to choose the order in which the atoms should be connected: the unique atom (Y) could be in the middle, X–Y–X, or on the end, X–X–Y. As long as you draw this imaginary compound in the same way every time, it does not matter which way you do it for this activity. However, the way in which atoms are connected in real compounds does, in fact, make a difference; X–Y–X is a different molecule from X–X–Y.

Examine the three models (a, b, and c) in the illustration. Which best represents a homogeneous mixture of the two compounds just described?



You are correct if you said that b is the best visual model. The two types of molecules are uniformly mixed, and the atoms are shaded to indicate that they represent different elements. In a, the mixture is not homogeneous because the molecules are not uniformly mixed. Model c contains three different compounds instead of two. Notice that in a, bonded atoms in each molecule are connected by lines. In b and c, bonded atoms just touch each other. Both representations are used by chemists; either one is acceptable in this activity.

Now it is your turn to create and evaluate various visual models of matter.

1. Draw a model of a homogeneous mixture composed of three different gaseous elements. Describe the key features of your drawing.

Key:
Gaseous element 1:

Gaseous element 2:

Gaseous element 3:

Description of key features of the drawing:

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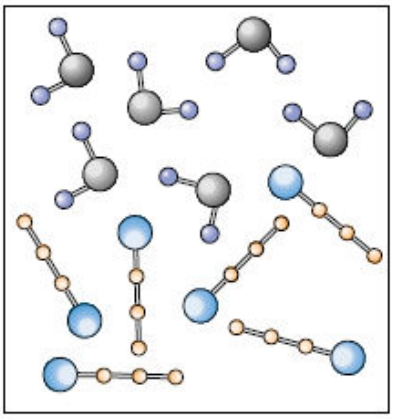
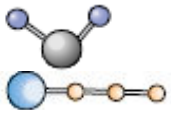
2. Refer to the diagram below when answering the following questions.



What type of matter are the following pictures? Be sure to tell how many different types of atoms and the number of atoms.



Is the mixture in the model above heterogeneous or homogeneous? Explain your answer.

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3. Draw a model of each of the following samples of matter. Write a description of key features of each model.

a. a mixture of gaseous elements X and Z

Description of key features:

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b. a two-atom compound of X and Z

Description of key features:

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c. a solution composed of a solvent that is a two-atom compound of L and R, and a solute that is a compound composed of two atoms of D and one atom of T

Description of key features:

_____

_____

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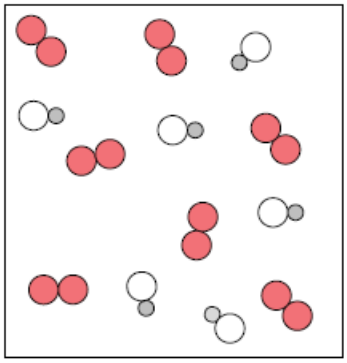
4. The element iodine (I) has a greater density in the solid state than in the gaseous state. Draw models that depict and account for this difference at the atomic level. Iodine exists as a two-atom molecule.

Solid State

Gaseous State

5. A student in a chemistry class at Riverwood High School was asked to draw a model of a mixture composed of an element and a compound. Comment on the usefulness of the student's drawing.



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