

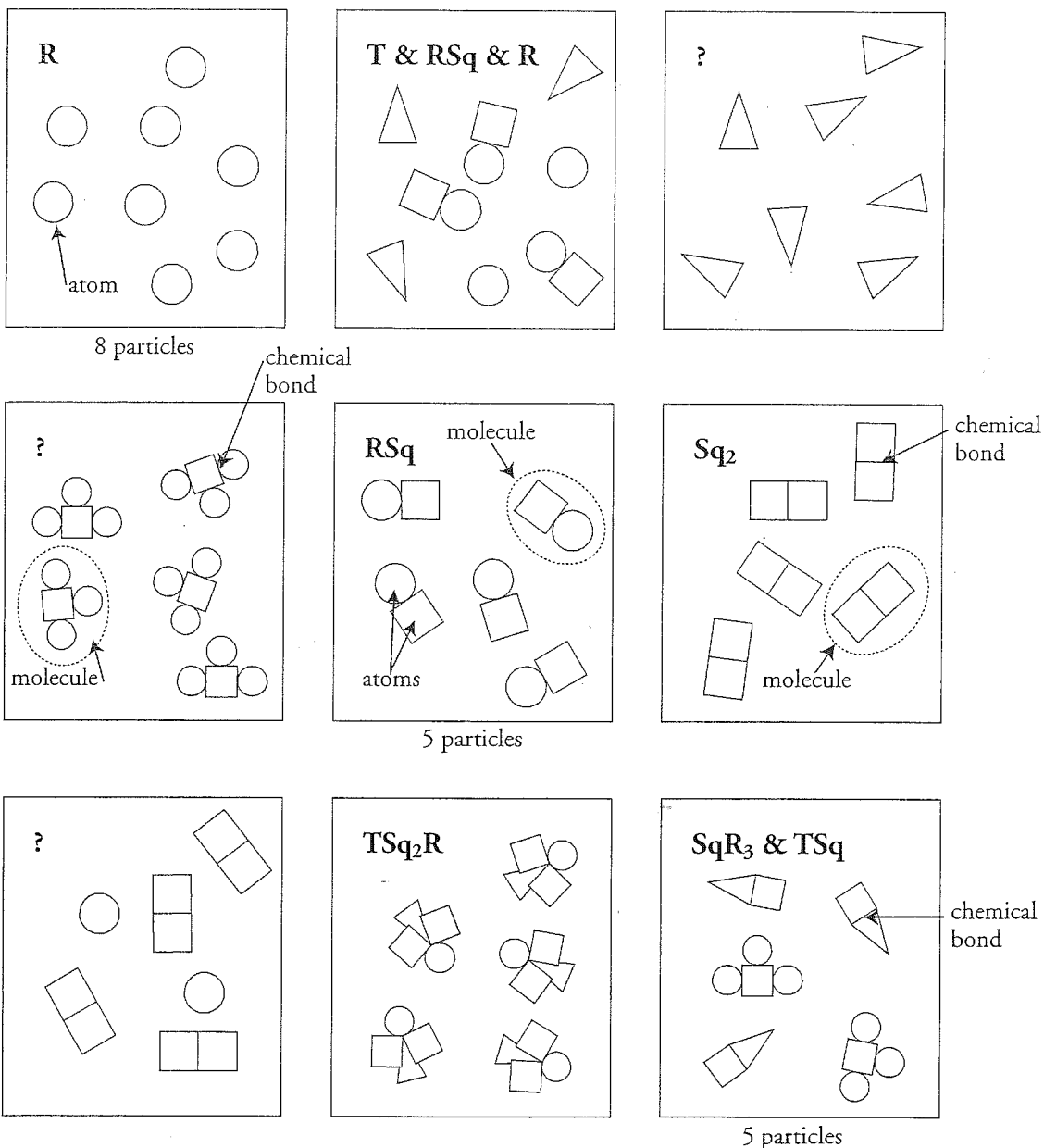
# Classification of Matter

How do atoms combine to make different types of matter?

## Why?

Look at the things in this room. They are all matter. That matter may be pure or it may be a mixture. Can you tell by looking at it? What if you looked at it under a microscope? Then could you tell? Something that looks pure may not really be pure. It depends on what type of particles an object or substance is made of. In this activity we will explore how the smallest chemical units of matter determine whether something is classified as an element, a compound, or a mixture.

## Model 1 — Atoms, Particles, and Molecules



1. Locate the circled molecule of  $\mathbf{RSq}$  in Model 1.
  - a. Find a second  $\mathbf{RSq}$  molecule and circle it.
  - b. How many atoms are in a molecule of  $\mathbf{RSq}$ ?
  
2. Find and circle a molecule of  $\mathbf{TSq}_2\mathbf{R}$  in Model 1.
  - a. How many different types of atoms are found in a molecule of  $\mathbf{TSq}_2\mathbf{R}$ ?
  - b. How many  $\mathbf{Sq}$  atoms are in a molecule of  $\mathbf{TSq}_2\mathbf{R}$ ?
  
3. Locate the drawing labeled  $\mathbf{SqR}_3$  &  $\mathbf{TSq}$  in Model 1.
  - a. How many different types of atoms are found in the sample of  $\mathbf{SqR}_3$  &  $\mathbf{TSq}$ ?
  - b. How many different types of molecules are found in the sample of  $\mathbf{SqR}_3$  &  $\mathbf{TSq}$ ?
  
4. When two atoms are touching in the drawings of Model 1, what is holding the atoms together?
  
5. As a group, discuss the following questions and record your answers:
  - a. Can a *particle* be a single atom?
  - b. Can a *particle* be a molecule?
  - c. How many particles are in the drawing representing  $\mathbf{T}$  &  $\mathbf{RSq}$  &  $\mathbf{R}$  in Model 1?
  - d. What is your group's definition of the word "particle" as it is used in chemistry?
  
6. Compare the codes listed at the top of each drawing in Model 1 with the shapes in that box.
  - a. What do the letters  $\mathbf{R}$ ,  $\mathbf{Sq}$ , and  $\mathbf{T}$  in the codes represent?
  - b. What do the small numbers (subscripts) in the codes represent?
  - c. When atoms are touching, how is that communicated in the code?
  - d. What is the common characteristic of the samples in which an ampersand (&) is used?
  - e. In Model 1 there are three drawings that are labeled with a question mark. Write codes to properly label these drawings.



7. Appoint one group member to cut apart Model 1 to separate the nine drawings. As a team, sort the drawings into two groups—one group where all the particles in the drawing are identical, and a second group in which the drawings contain more than one type of particle.

### Read This!

Matter is classified as a **pure substance** when all of the particles are identical. Matter is classified as a **mixture** if there are different types of particles present.

8. Identify which drawings from Question 7 are pure substances and which are mixtures. List the codes for the drawings in the appropriate places below.

Pure Substances		Mixtures
_____	_____	_____
_____	_____	_____
_____	_____	_____

9. How are the codes (chemical formulas) for pure substances different from those for mixtures?
10. As a team, take the set of pure substances drawings from Question 8 and sort them into two new groups, those containing only one type of atom and those with two or more types of atoms.

### Read This!

**Elements** are defined as pure substances made from only one type of atom. **Compounds** are defined as pure substances made from two or more types of atoms.

11. Identify which drawings from Question 10 are elements and which are compounds. List the codes for the drawings in the appropriate places below.

Elements		Compounds
_____		_____
_____		_____
_____		_____

12. How are the codes (chemical formulas) for elements different from those for compounds?
13. Use what you have just learned about chemical formulas to identify each of the following as an element, a compound or a mixture.
- |                  |                     |   |
|------------------|---------------------|---|
| a. $\text{Br}_2$ | b. $\text{NaHCO}_3$ | c. $\text{C}_6\text{H}_{12}\text{O}_6$ & $\text{H}_2\text{O}$ |
| d. Cu & Zn       | e. $\text{CO}_2$    | f. Al   |

14. Explain the difference between:

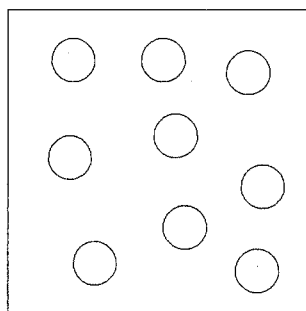
*a.* An atom and an element.

*b.* A molecule and a compound.

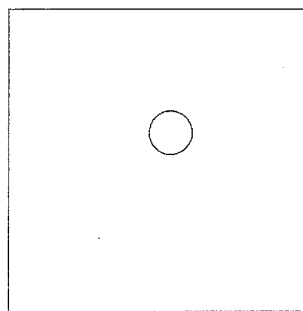


## Extension Questions

15. It is often useful to separate matter. Physical methods of separation (filtering, distillation) do not require a chemical change. In other words, no chemical bonds are broken or formed during the separation. Chemical methods of separation (decomposition, electrolysis) require a chemical change. In other words, chemical bonds are broken and/or formed during the separation.
- Is straining cooked pasta from water a physical or chemical separation?
  - Is using a fuel cell to separate water into hydrogen and oxygen a physical or chemical separation?
  - Which type(s) of matter (mixtures/compounds/elements) could be separated by physical methods?
  - Which type(s) of matter (mixtures/compounds/elements) would need to be separated by chemical methods?
16. Students in a chemistry course were asked the following question on a unit exam: "Draw a diagram representing an element using circles as atoms."
- The following diagrams represent two typical answers given by students. Which drawing is the best representation of an element? Explain.



Drawing A



Drawing B

- Imagine that the atom in Drawing B had been removed by physical separation from one of the substances in Model 1. What substances could have been the source of the atom in Drawing B?