INVESTIGATION 2

PURPOSE

To construct portions of extended three-dimensional solids; to identify unit cells and determine the number of atoms in each cell; to determine the coordination number (number of nearest neighbors) in each of several different structures; to relate structure to some physical properties.

INTRODUCTION

A crystalline structure consists of a repeating arrangement of atoms, molecules, or ions. In this experiment we will use the ICE Solid-State Model Kit. You will study some of the ways that the building blocks of matter can be packed to form some typical crystals as well as two specific arrangements that are unique to the wire that you researched in Investigation 1.

A useful way of describing the basic pattern of an extended structure is to imagine a three-dimensional, six-sided figure having parallel faces that encloses only a portion of the interior of the extended structure. A cube is the simplest of these "unit cells" and will be used in this investigation. If the proper unit cell is selected, then when it is moved along any of its edges by a distance equal to the length of that edge, it should generate an identical unit cell. Repetition of this process will generate the entire structure of the crystal.

PROCEDURE

PART 1: General Considerations.

Determine how many larger spheres you can pack around a marked sphere in the same plane. It may be easier to hold the spheres in the palm of your hand while doing this. If all the spheres are the same size does the coordination number depend on size? What if the central sphere is smaller? Larger ? Check your predictions.

PART 2:

This part of the investigation requires that teams work together, using the Solid State Model Kits or following alternate procedures outlined by your instructor. Each team will build one of the following structures. All teams will then compare and contrast their structures and together answer questions.

Team A: Following the instructions in the kit, assemble the Simple Cubic Structure.
Team B: Following the instructions in the kit, assemble the Body Centered Cubic Structure.
Team C: Following the instructions in the kit, assemble the CsCl Structure with the Cl atoms at the corners.
Team D: Following the instructions in the kit, assemble the CsCl Structure with the Cs atoms at the corners.
Team E: Following the instructions in the kit, assemble the Austenite Structure.
Team F: Following the instructions in the kit, assemble the Martensite Structure.

FOLLOW-UP QUESTIONS

1. For each structure complete the table below, indicating HOW MANY SPHERES LIE WITH THEIR CENTERS AT THE _____OF THE UNIT CELL.

Structure	Corners	Edges	Faces	Inside
A				
B				
C				
D				
E				
F				

2. With how many other unit cells are the spheres at the _____of the cell shared?
   a) corners_____cells b) edges_____cells c) faces_____cells

3. What fraction of each sphere lying with their center at the ____is part of that cell?
   a) corner _____ b) edge _____ c) face _____

4. For each structure complete the table below, indicating HOW MANY TOTAL SPHERES OCCUPY EACH SITE.

Structure	Corners	Edges	Faces	Inside	Total in Cell
A					
B					
C					
D					
E					
F					

5. Compare the models of austenite and martensite.

   a) What packing arrangement is used in the austenite structure?

   b) How is the austenite structure altered to yield the martensite structure?

   c) Compare the number of spheres per unit cell for each structure. How does the density of martensite compare to that of austenite?

   d) From what you have learned about these structures, which do you think would be the more flexible low temperature phase of the wire in Investigation 1? Explain.