



**Module:** Material Structure  
**Focus:** Crystal Packing  
**Duration:** 43 minute period



- Objectives:**
1. Students will be able to illustrate that a material's performance is connected to its structure.
  2. Students will be able to list, construct and diagram three crystalline packing arrangements.
  3. Students will be able to compare and contrast simple cubic, face centered cubic (FCC), hexagonal closest packing (HCP) and body centered cubic.

**Materials:**

- Styrofoam Balls (20)
- Smaller Styrofoam Ball
- Round Toothpicks (16)

- Procedures:**
1. Review notes on crystal packing.
  2. Students will perform a lab on crystal packing.

**Assignment:** 1. Complete lab write up.

**Assessment:** 1. Laboratory Experiments, Classroom Participation, Quizzes & Test.

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**Teacher Notes:**

After a short review of crystal packing, have the students take 4 Styrofoam balls and attach them using toothpick so that they form a diamond shape. Have the students repeat this procedure again. Have the students line up one structure directly atop of the other structure. This represents a simple cubic arrangement. Have the students diagram their structures and pick one atom in the crystal and determine the number of atoms it touches directly (coordination number).

Have the students take apart their structures and reassemble seventeen balls into the following arrangements; 1-3 balls in a triangle, 2-7 balls in an arrangement with a center ball surrounded by the remaining six. Have the students place one of their 7 ball arrangements as a base. Place the 3 ball arrangement so that it rests in the spaces between the balls in the base. Place the other 7 ball arrangement on top of the 3 ball arrangement so that each ball is aligned with its corresponding ball in the base. This represents a HCP arrangement. Have the students diagram their structures and pick one atom in the crystal and determine the number of atoms it touches directly (coordination number).

Have the students take apart their structures and reassemble twenty balls into the following arrangements; 2-3 balls in a triangle, 2-7 balls in an arrangement with a center ball surrounded by the remaining six. Have the students place one of their 7 ball arrangements as a base. Place the 3 ball arrangement so that it rests in the spaces between the balls in the base. Place the other 3 ball arrangement on top of the first 3 ball arrangement so that it does not line up with each previous layer. Place the other 7 ball arrangement on top of the 3 ball arrangement so that each ball is aligned with its corresponding ball in the base. This represents a FCC arrangement. Have the students diagram their structures and pick one atom in the crystal and determine the number of atoms it touches directly (coordination number).

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Have the students take apart their structures and reassemble twenty balls into the following arrangements; have the students take 8 Styrofoam balls and attach them using toothpick so that they form 2 -4 ball diamond shape arrangements. Have the students place 1-4 ball arrangement on their table. Place a smaller Styrofoam ball so that it rest directly in the center of the diamond. Place the other 4 ball arrangement on to of the smaller Styrofoam ball so that the top and bottom layers line up. This represents a BCC arrangement. Have the students diagram their structures and pick one atom in the crystal and determine the number of atoms it touches directly (coordination number).

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