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| **Date**: October 9, 2025 |
| **Subject**: Chemistry |
| **Grade**: 12 |
| **Duration**: 80 Minutes |
| **Topic**: Forces of Attraction |
| **Subtopic:** Structure and Bonding in Crystalline solids |
| **Number of Students**: 12 [Girls: 10] [Boys: 2] |
| **General Objectives**:  *On Completion of this lesson, students will be able to*:   * Appreciate that the forces of attraction between particles influence the properties and behaviour of matter.   **Specific Objectives**:  *By the end of the lesson, students will be able to:*   1. Classify solids according to their lattice structure and type of bonding. 2. Describe the structure of I2, ice, SiO2, NaCl, Cu, graphite, and diamond. 3. Relate lattice structure and bonding to physical properties such as melting point, conductivity, hardness, and solubility. 4. Explain differences in properties among crystalline solids in terms of their structure and bonding. |
| **Key Scientific Attitudes:**  Critical thinking, communication, collaboration, cooperation, open-mindedness |
| **Content**   * ***Common solids and their structures*:**   + I2: Simple molecular   + Ice: hydrogen bonded   + SiO2: Giant molecular (covalent)   + NaCl: ionic   + Cu: Metallic   + Graphite/Diamond: Giant Atomic |
| **Instructional Sequence**  ***Engage:***   * **Purpose**: Stimulate curiosity and activate prior knowledge about different types of solids. * **Activity**: What’s the connection?   Display samples or images of iodine crystals, ice, salt, quartz, copper, graphite, and diamond.   * Ask**:**   + “Which of these substances would conduct electricity?”   + “Which one is the hardest?”   + “Which ones melt easily?” * Record students’ predictions in a two-column chart on the board: Substance vs Expected Properties. * ***Transition Question***:   “Could the internal arrangement of particles – their lattice structure – be responsible for these differences?”  ***Explore:***   * **Purpose:** Let students observe and compare physical properties to infer structural differences. * **Activity**: Group Investigation – Comparing Properties   Provide students with data cards (or a table) showing experimental or known properties for each solid:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Substance** | **M.P** | **Electrical Conductivity** | **Solubility** | **Hardness** | **Other Features** | | I2 | Low | None | Soluble in nonpolar solvents | Soft | Crystals sublime easily | | Ice | Low | None | Soluble in water | Brittle | Floats on water | | SiO2 | Very high | None | Insoluble | Very hard | Covalent network | | NaCl | High | Conducts when molten/aqueous | Soluble in water | Brittle | Ionic | | Cu | High | Good conductor | Insoluble | Malleable, ductile | Metallic bonding | | Graphite | High | Conducts | Insoluble | Soft, slippery | Layers of carbon atoms | | Diamond | Very high | None | Insoluble | Hardest known | Tetrahedral carbon lattice |   Students work in pairs to ***group solids*** that share similar properties and discuss what might be common about their ***particle arrangement*** or ***bonding***.   * ***Guiding Questions***:   + “Why is graphite soft but diamond hard if both are made of carbon?”   + “Why does NaCl conduct electricity when molten but not when solid?”   + “Why does ice float on water?”   ***Explain:***   * ***Purpose***: Formalize understanding of how bonding and lattice structure explain physical properties. * ***Teacher Input***:   Use diagrams or 3D models to show lattice structures for each solid type.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Type of Solid | Example | Nature of Particles | Type of Bonding | Structure Description | Key Physical Properties | | Simple Molecular | I2 | Molecules | Weak van der Waals | Molecules packed in lattice | Low mp/bp, non-conductor | | Hydrogen bonded | Ice | Molecules with H-bonds | Hydrogen bonds | Open hexagonal lattice | Low mp, less dense than liquid | | Giant Molecular (Covalent) | SiO2 | Atoms | Strong covalent bonds | 3D tetrahedral network | Very hard, high mp, non-conductor | | Ionic | NaCl | Ions | Ionic bonds | Alternating cations/anions | High mp, brittle, conducts when molten | | Metallic | Cu | Atoms | Metallic bonds (sea of electrons) | Closely packed lattice | Conductive, malleable, ductile | | Giant atomic | Graphite/  Diamond | Carbon atoms | Covalent bonds | Layered vs 3D tetrahedral | Graphite conducts, diamond hard |  * **Key Concept Summary:**   + The type of bonding and arrangement of particles in a crystal lattice determine its melting point, hardness, conductivity, and solubility   ***Elaborate:***   * **Purpose**: Extend learning by applying structure-property relationships to new contexts. * **Activities**:  1. ***Structure – Property Match Game:***   Provide cards showing lattice diagrams and property descriptions.  Students match each structure to the correct substance and justify their choice.   1. ***Thinking Question***:   “Why does diamond not conduct electricity, but graphite does?”  “Why does ice have a lower density than water?”  “Which type of solid would make the best electrical wire, and why?”   1. ***Mini Design Challenge***:   “If you needed a material that is both strong and conductive, which structure type would you choose? Explain”  ***Evaluate:***   * Purpose: Assess student understanding through formative and summative checks.   Formative Assessment:   * Exit Ticket / Quick Quiz:   + Name the type of lattice structure for each of the following: NaCl, SiO2, I2, Cu.   + Explain why diamond is hard while iodine crystals are soft.   + Identify one property of ice that results from hydrogen bonding.   + Predict the type of solid for a substance that is malleable and conducts electricity.   Summative Extension:  Students prepare a poster comparing any two lattice types (e.g., metallic vs ionic), including:   * Structure diagram * Bonding explanation * Physical properties and real-world uses   **Evaluation 2**:  -------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------- |