C-3.3 Explain how the types of intermolecular forces present in a compound affect the physical properties of compounds (including polarity and molecular shape).

**Revised Taxonomy Levels 2.7 B <u>Explain</u> conceptual knowledge**

**Students did not study this concept in physical science**

**It is essential for students to**

- Understand that ionic bond and covalent bond are relative terms and that most bonds that we characterize as ionic or covalent actually have a character that lies somewhere between 100% ionic and 100% covalent
  - Bonds between active metals and active nonmetals are characterized by a high degree of ionic character because electron transferred is virtually complete
    - Because ionic bonds are very strong, substances with ionic bonds usually have high melting and boiling points
  - Bonds between identical non metals (diatomic compounds) are characterized by zero percent ionic character because electrons are shared equally.
  - Bonds between other substances (such as the bond between oxygen and hydrogen) have an intermediate nature; the shared electrons are not shared equitably but spend more time with whichever atom is more electronegative.
    - The atom with the stronger attraction for electrons becomes partially negatively charged
    - The atom with the lower electronegativity value becomes partially positively charged
    - Covalent bonds that do not share the electrons equally are called polar covalent bonds
    - Covalent bonds that do share the electrons equally are called non-polar covalent bonds
    - If the polar bonds in a molecule are all alike, the polarity of the molecule as a whole depends only on the arrangement in space of the bonds (water molecules are polar due to bent structure)
    - Polar molecules are attracted to one another, but the attraction is not a chemical bond so it is broken easily. These substances usually have moderate melting and boiling points
    - Polar molecules are attracted to one another and to ionic substances as well

**Assessment**

The verb, <u>explain</u> means that the major focus of assessment should be for students to "construct a cause and effect model". In this case, assessments will ensure that students can model how intermolecular forces affect the properties of a substance. Because the indicator is written as <u>conceptual knowledge</u>, assessments should require that students understand the "interrelationships among the basic elements within a larger structure that enable them to function together." In this case, assessments must show that students can construct a cause and effect statement relating how intermolecular forces which are determined by the type of bonding within a substance, affect the properties of the substance.