Holding it all together– Draft 1.1 December 2002
Intermolecular Forces
Alexi

Objective: To use knowledge of molecular shape and polarity to recognize the interaction between molecules (intermolecular forces). Use investigative laboratory experience to interpret evaporations at the molecular level. The correlation between the strength of intermolecular forces and the rate of evaporation/magnitude of the temperature change during evaporation is also established.

Target student audience: YR. 1, GENERAL CHEMISTRY

ChemSense user level: Intermediate

ChemSense tools used: DRAWING

Specialized tools needed: Filter paper square/gauze, with rubber band for support; Medium test tubes; Test tube rack; Thermometers; Graph paper; Cyclohexane; Ethanol; 2-Propanol; Toluene; Water

Classroom implementation

Time: long period or equivalent short periods (2 /45-55 minute periods)
Student grouping: pairs
Activity Type: DRAWING; investigative laboratory experiment

Chemistry concepts in activity (linked to CA standards & ChemSense 5 themes):

Standard 2d- Students know the atoms and molecules in liquids move in random pattern relative to one another because of the intermolecular forces are too weak to hold the atoms or molecules in a solid form.

Standard 2f- Students know how to predict the shape of simple molecules and their polarity from Lewis dot structures.

Standard 2g- Students know how electronegativity relates to bond formation.

Standard 2h- Students know how to identify solids and liquids held together by Van der Waals forces or hydrogen bonding and relate these forces to volatility and boiling/ melting point temperatures.

Prerequisite chemistry concepts: Molecular geometry; Molecular polarity; States of matter; Chemical properties (boiling point, evaporation, melting point, etc)

Inquiry skills (linked to NSES):

Design and conduct scientific investigations (NSES).

Identify questions and concepts that guide scientific investigations (NSES).

Formulate and revise scientific explanations and models using logic and evidence (NSES).

ACTIVITY Summary:

1. ChemCatalyst- Use ChemSense to make prediction of how the molecules of water will interact according to observed molecular polarity.
2. Concept introduction- Introduction to types of intermolecular forces.
3. ChemRxn- Use ChemSense to
4. Laboratory experiment- Compare the evaporation rate by measuring the temperature against time for two different liquids.
5. Post lab- Use results from experiment to answer exercise questions.
6. ChemSynthesis- Use ChemSense to represent answers from exercise questions and extension question.

Sources: Integrated Science program- University High School: Evaporation Rate and Molecular polarity lab.

Application: Understanding of intermolecular forces applies directly to principles of solubility and properties of solids, liquids, and gasses.

Activity:

1. ChemCatalyst- Cut, copy and move the water molecules in a way that represents the predicted interaction found between the molecules. Students use their knowledge of molecular polarity and electrostatic interactions to predict the interactions found between a number of molecules.

2. Concept Introduction- Teacher-led discussion about the types of intermolecular forces; Dipole-Dipole (hydrogen bonding) and Dispersion forces. Students are introduced to these concepts for the first time.

3. ChemRxn- After being introduced to the types of IMF, students will use their newfound knowledge to represent the interactions visually with ChemSense.

4. Laboratory experiment- By using a thermometer with a wick to absorb liquids, students obtain temperature readings over 15 minutes. Each group of two will take readings of two liquids, and the class results will be collected to make conclusions (see laboratory instructions).

5. Post Lab- In groups, students answer the questions from the lab exercise questions (see laboratory instructions).

6. ChemSynthesis- Show how various molecules form intermolecular forces between the individual molecules. After comparing the intermolecular forces that occur in differing types of molecules, determine which has the higher boiling point and why this is so. Represent a visual answer to the questions, 'why is CO_2 a gas at room temperature while I_2 is a solid.'

7. Check in- after publishing all answers to questions, prepare evaluations of other students' representations.

Rubric:

Level:	**Defining characteristics:**
Insufficient mastery	Does not show correct representations of IMF. Lacks the distinction in the differences between dipole-dipole and dispersion forces.
Basic mastery	Representations of IMF are correct, but some part of the model lacks deeper understanding of the forces. Strength or size of molecules is not taken into account.
Exemplary mastery	Proper representations of IMF are shown with proper dipoles vs. dipole moments demonstrated. In some way the strength of the IMF are represented clearly. Size of molecules and size of dipole moments are taken into account.