

**Research Experiences for Teachers (RET)  
Center for Pre-College Programs  
New Jersey Institute of Technology**

**MODULE TEMPLATE**

**MODULE TOPIC:**

Formulation of solution and inter-particle relations.

**LIST OF LESSONS:**

Investigate the lowering of the freezing point by the addition of solute to a pure solvent.

Investigate the factors responsible for rate of dissolution.

**BACKGROUND INFORMATION:**

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**Lesson #1**  
**Investigate the Lowering of the Freezing Point**

**LESSON TOPIC:**

Investigate the lowering of freezing point by the addition of solute to a pure solvent.

**STANDARD(S) & INDICATOR(S):**

5.1.12.A.1 Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations.

5.2.12.A.2. Account for the differences in the physical properties of solids and liquids.

5.2.12.A.5. Describe the process by which solutes dissolve in solvents.

**OBJECTIVE(S):** Students will be able to:

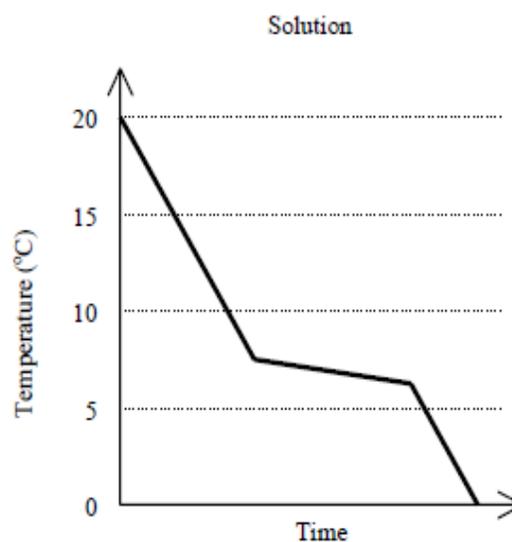
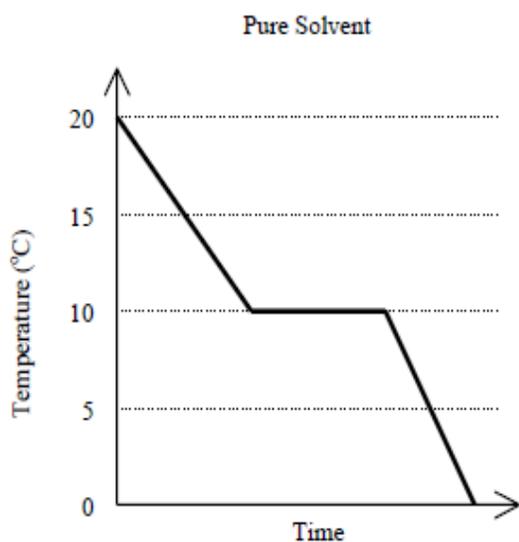
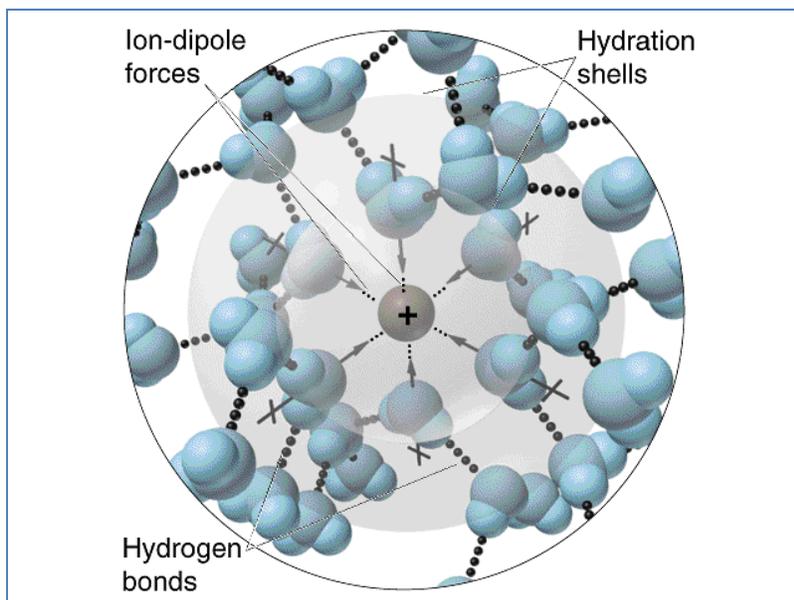
- Calculate the mass of solute to be added to the given volume of solvent to achieve desired concentration of solution.
- Evaluate the molar mass of unknown solute by calculating the depression in the freezing point.

**BACKGROUND INFORMATION:**

Have you ever wondered?

- How antifreeze lowers the freezing point of water in the cooling systems of automobiles?
- Why the salt is spread on the streets before snow?

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**CLASSROOM ACTIVITY DESCRIPTION (LABORATORY/EXERCISES/PROBLEMS)**  
**including detailed procedures:**

Students will calculate the mass of solute to be added to the given volume of solvent to achieve desired concentration of solution. Students use weighing scale for mass and graduated cylinder for volume and apply equations to achieve the required mass to create a solution.

Students:

- Measure correct mass, volume of both the solute and solvent, measure temperature.

Lesson Plan Template

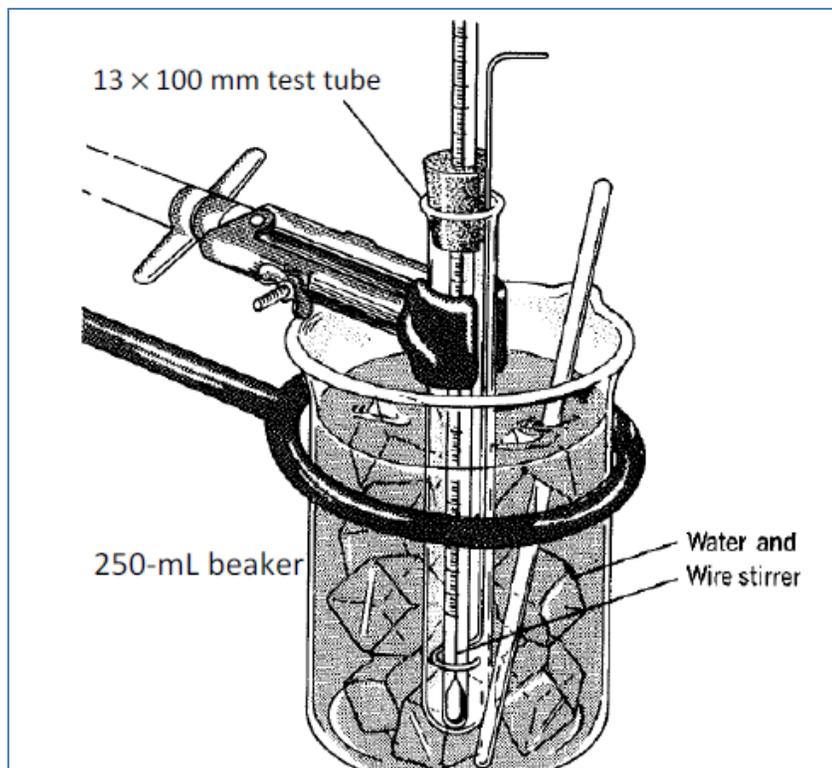
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- Perform two similar activities for comparative studies between the pure solvent and the solution.
- Perform the experiment, correctly apply the equation to evaluate molar mass, graph their results, measure percent error and answer post lab questions.



**PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:**

- Students synthesize a lab report to show the data calculations for mass, reflect the comparison in the graph and apply this property of solution to measure the molar mass of the solute required to achieve the desired depression or vice-versa.
- After performing the lab students should be able to calculate the value of van't hoff factor.
- Students respond to post lab questions.

This material is based upon work supported by the National Science Foundation under Grant Nos. EEC-0908889

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**Factors Responsible for Rate of Dissolution**

**LESSON TOPIC:**

Investigate the factors responsible for rate of dissolution.

**STANDARD(S) & INDICATOR(S):**

5.1.12.A.1 Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations.

5.2.12.A.2. Account for the differences in the physical properties of solids and liquids.

5.2.12.A.5. Describe the process by which solutes dissolve in solvents.

**OBJECTIVE(S):** Students will be able to:

- Investigate the effect of concentration, particle size and temperature on the rate of dissolution.
- Compare the time of reaction in different situations like the change in concentration of reactants and temperature of the reaction.
- Investigate the best conditions for a faster process.

**MATERIALS:**

**BACKGROUND INFORMATION:**

Students will be able to investigate factors effecting the rate(speed) of reaction.

The rate of a reaction increases if:

- the temperature is increased
- the concentration of a dissolved reactant is increased
- solid reactants are broken into smaller pieces
- a catalyst is used

Starch turns dark blue in the presence of  $I_2$  molecules. The color change time of the reactions at various concentrations and different temperature is investigated to compare the rate of reaction. Students will be able to modify their experiments in future to speed up or slow down the process.

**CLASSROOM ACTIVITY DESCRIPTION (LABORATORY/EXERCISES/PROBLEMS) including detailed procedures:**

Students will completely dissolve a solute and will be able to infer the difference between the time taken to dissolve a larger versus a smaller size solute, a high and low temperature medium.

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Student will predict the three factors responsible for a higher rate of dissolution by using the graphical representation and comparing the time for complete dissolution.

### **PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:**

- Students predict the three factors responsible for a higher rate of dissolution by using the graphical representation and comparing the time for complete dissolution.
- Students synthesize a lab report using scientific procedure including a written conclusion.
- Students respond to post lab questions.
- Students implement the results of their observations to control the rate of most of reactions.

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