



IPC: Science Course Module—Goes to the Movies!  
University of Houston

## Dissolving Rate of Sugar

<b>Type of Lesson:</b>	<u>Content with Process:</u> Focus on constructing knowledge through active learning.	
<b>IPC Content TEKS:</b>	9D	demonstrate how various factors influence solubility including temperature, pressure and the nature of the solute and the solvent.
	9E	demonstrate how factors such as particle size influence the rate of dissolving
<b>Learning Goal/ Instructional Objective:</b>	<p>Learning goal: Students investigate which factors most affect the dissolving rate of sugar.</p> <p>Instructional Objectives: Students will be able to:</p> <ol style="list-style-type: none"> <li>1. explain how changing the surface area affects the speed of dissolving</li> <li>2. discuss how temperature affects the dissolving rate</li> <li>3. observe how stirring affects the rate of sugar dissolving</li> <li>4. identify the independent variable, dependent variable and the constants in each part of the experiment</li> </ol>	
<b>Key Question:</b>	Which factor is the most effective in dissolving sugar the fastest: temperature, particle size due to surface area or stirring?	
<b>Related Process TEKS:</b>	<b>(1) Scientific processes.</b> The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices	The student is expected to: (A) demonstrate safe practices during field and laboratory investigations; and  (B) make wise choices in the use and conservation of <a href="#">resources</a> and the disposal or recycling of <a href="#">materials</a> .
	<b>(2) Scientific processes.</b> The student uses scientific methods during field and laboratory investigations.	The student is expected to: (A) plan and implement experimental procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;  (B) collect data and make measurements with precision;  (C) organize, analyze, evaluate, make inferences, and predict trends from data; and  (D) communicate valid conclusions.
	<b>(3) Scientific processes.</b> The student uses critical thinking and scientific	The student is expected to: (A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence



	problem solving to make informed decisions.	<p>and information;</p> <p>(B) draw inferences based on data related to promotional materials for products and services;</p> <p>(C) evaluate the impact of research on scientific thought, society, and the environment;</p> <p>(D) describe connections between physics and chemistry and future careers; and</p> <p>(E) Research and describe the history of physics, chemistry, and contributions of scientists.</p>
<b>To the Teacher:</b>	<p><b>INTRODUCTION:</b></p> <p>Students conduct a variety of simple investigations to determine which factors most affect the dissolving rate of sugar. After the various investigations, they draw conclusions from the data they collected. The data should indicate the warmer water, crushed particles, and stirred solutions will dissolve faster. The water temperature and stirring are common answers among the students. You might have to have brief math lesson to review surface area. As the surface area increases, the ability to dissolve the sugar faster. The water needs to come in contact with the sugar to dissolve faster. The smaller particles expose more surface area allowing more water to come in contact with the sugar.</p> <p>Check the glassware for cracks before students use them on the hot plate. If a beaker has a crack, it might break further and cause damage. Remind students to use heat resistant gloves to remove the hot beakers from the hot plate. The directions tell them to remove the beaker from the heat before placing the sugar in the water. If the sugar is placed in the beaker on the hot plate, the sugar will cook and create a strong odor.</p>	
<b>Multiple Intelligences:</b>	<i>Logical-Mathematical Intelligence</i>	Consists of the ability to detect patterns, reason deductively and think logically. This intelligence is most often associated with scientific and mathematical thinking.
	<i>Linguistic Intelligence</i>	Involves having a mastery of language. This intelligence includes the ability to effectively manipulate language to express oneself rhetorically or poetically. It also allows one to use language as a means to remember information.
	<i>Interpersonal Intelligence</i>	Includes interpersonal feelings and intentions of others.
	<i>Intrapersonal Intelligence</i>	Intrapersonal intelligence--the ability to understand one's own feelings and motivations.

### Materials:

- goggles
- 50-mL graduated cylinder
- 250-mL beaker
- hot plate
- alcohol thermometer
- heat resistant gloves
  - stop watch (2 if possible)
- apron
- triple beam balance
- water
- 6 sugar cubes
- stirring rod/spoon
- 2 clear cups or 100 mL beakers

### SAFETY NOTE:



**Wear goggles and aprons for the entire lab. Use heat resistant gloves to handle hot glassware. Inspect all glassware for cracks. Be careful of the hot plate cord and the electrical outlet. See Texas Science Safety Manual for lab and investigation guidelines:**

[http://www.tenet.edu/teks/science/safety/safety\\_manual.html](http://www.tenet.edu/teks/science/safety/safety_manual.html)



**Engagement:** Discuss stomach remedies and how to speed up the time so that the medicine works faster in your stomach.

## Explore:

### Procedure

1. Safety goggles and laboratory aprons should be worn throughout this experiment.
2. Obtain laboratory materials. **READ THE LAB COMPLETELY THROUGH BEFORE BEGINNING.**
3. Measure 50 mL of water and place in a 100 mL beaker. Make sure there are no cracks or chips in the glass before you place the beaker on the hot plate and turn it to high. Bring to a boil. Continue reading as the water warms. Measure 50 mL of water and place in a 100 mL beaker of water. This will be your cold water sample.
4. On one paper towel, carefully crush a sugar cube and label it A. Repeat the process for cube 2 labeling it B. Measure the mass of the sugar cubes separately and record the results in the appropriate data table in your journal.
5. Once the water reaches the boiling point, use heat resistant gloves to carefully remove the beaker and set on the table. Do not add the sugar when the water is on the hot plate.
6. Place the crushed sugar sample A in the hot water and time how long it takes for the sugar to completely dissolve using a stop watch. Do not shake or stir the solution. Record your observations in your data table in your journal.



HOT



COLD –  
NOT STIRRED



COLD –  
STIRRED

7. Rinse out all cups and prepare for the next set. Read the data tables for Sets 2 – 4 and conduct the investigations needed to complete the data tables.
8. Once you are completely finished, **WASH** each beaker out and dry.
9. Carefully return all materials to materials area, make sure your hot plate is unplugged, and return goggles and folded apron. Wipe off your work area so it is clean of sugar and water.

## Explain:

### DATA/OBSERVATIONS:

COPY THE FOLLOWING DATA TABLES BELOW IN YOUR JOURNAL TO COMPLETE AS YOU WORK.

SET 1	Cup	Sugar Sample	Water Conditions	Mass (g)	Time (min.)
	A	<i>Crushed</i>	Hot		<i>faster</i>
	B	Crushed	Cold		

SET 2	Cup	Sugar Sample	Water Conditions	Mass (g)	Time (min.)
	C	Cube	Hot		<i>faster</i>
	D	Cube	Cold		

SET 3	Cup	Sugar Sample	Water Conditions	Mass (g)	Time (min.)
	E	Cube	Hot, stirred		<i>faster</i>
	F	Cube	Hot, NOT stirred		

SET 4	Cup	Sugar Sample	Water Conditions	Mass (g)	Time (min.)
	G	Crushed	Cold, stirred		<i>faster</i>
	H	Crushed	Cold, NOT stirred		

### ANALYSIS/CONCLUSIONS: (Record in your journal.)

1. Did you change the same factors in each set? yes Complete the data table below identifying the independent variable in each set.

Set	Independent Variable
1	Temperature
2	<i>Temperature</i>
3	<i>Stirred</i>
4	<i>Stirred</i>

2. Were all the dependent variables the same? yes Complete the data table below identifying the dependent variable for each set.

Set	Dependent Variable
1	Time
2	<i>Time</i>



3	<b>Time</b>
4	<b>Time</b>

3. Complete the data table below identifying the constants for each set.

<b>Set</b>	<b>Constants</b>
1	<b>Solute, particle size, amount of water, not stirred</b>
2	<b><i>Solute, particle size, amount of water, not stirred</i></b>
3	<b><i>Solute, temperature, particle size, amount of water</i></b>
4	<b><i>Solute, temperature, particle size, amount of water</i></b>

4. How does the particle size affect the rate at which sugar dissolves in water? *The smaller the particle the faster it dissolves.*
5. How does temperature affect the rate at which sugar dissolves in water? *The higher the temperature, the faster the sugar dissolves.*
6. How does stirring affect the rate at which sugar dissolves in water? *Stirring causes the particles to move faster and break up faster causing the sugar to dissolve faster.*
7. If you wanted to dissolve a substance faster, what should you do? *Heat the water, stir the solution, and crush the solute.*
8. If you wanted to dissolve a larger amount of substance, say 10 sugar cubes, what should you do to dissolve the sugar faster? *Heat the water, stir the solution, and crush the solute.*

### Elaborate:

- Based on lab observations, investigate the effect of surface area and particle size on starting a fire with wood.
- Find out examples of how cooking uses the observations on the effect of particle size (surface area), and stirring on the rate of dissolving AND solubility affected by temperature, pressure and the nature of the solute and solvent.
- Apply all of the lab observations to crystal growing.

### Evaluate:

Students evaluate and analyze data and observations. Based on data and observations, students complete questions and relate their observations to real life experiences

Grading Rubric:

<b>POINTS</b>	<b>Scientific Accuracy</b>	<b>Reasoning</b>	<b>Communication</b>	<b>Collaboration</b>
<b>4</b>	All data was collected accurately.	Conclusions were correctly reached using accurate data and other observations.	Data was displayed properly with correct units. All questions were answered clearly and with detail.	Team worked well together. All team members contributed and discussed lab results in detail.
<b>3</b>	Most data was collected accurately.	Most conclusions were correctly reached using accurate data and other observations.	Most data was displayed properly with most units correct. Most questions were answered clearly and with detail.	Team worked fairly well together. Most team members contributed and there was some discussion of lab results.
<b>2</b>	Some data was collected accurately.	Based on accurate data and observations, conclusions were incorrectly reached.	Some data was displayed properly with some correct units. Some questions were answered clearly with some detail.	Team did not always work well together. Some team members worked together and there was little discussion of lab results.



<b>1</b>	Data was inaccurate	Conclusions were incorrect.	Data was improperly displayed with incorrect units. Few questions were answered clearly with little detail.	Team worked poorly together. Team members did not help each other or discuss the lab results.	
	Subtotal: ____	Subtotal: ____	Subtotal: ____	Subtotal: ____	<b>TOTAL:</b> ____/16pts

**References/Resources/Websites:**

- [http://www.chemistry.co.nz/crystals\\_defined.htm](http://www.chemistry.co.nz/crystals_defined.htm)
- [http://uk.geocities.com/magoos\\_universe/crystals.htm](http://uk.geocities.com/magoos_universe/crystals.htm)
- <http://www.sdnhm.org/kids/minerals/grow-crystal.html> (San Diego Natural History Museum)
- <http://webphysics.davidson.edu/alumni/MiLee/JLab/crystallography>
- [http://www.phschool.com/science/science\\_news/chemistry/properties\\_matter.html](http://www.phschool.com/science/science_news/chemistry/properties_matter.html)

**The following site contains teacher resource lessons:**

<http://visualclutter.com/Links/Science>

**The following sites contain information about growing crystals in unusual gravity conditions:**

- [http://science.nasa.gov/headlines/y2001/ast11dec\\_1.htm](http://science.nasa.gov/headlines/y2001/ast11dec_1.htm) (crystals in outer space)
- <http://www.mos.org/cst/article/77/3.html> (growing crystals in near zero gravity)

**The following sites contain information about many I.P.C. topics including chemistry and crystals:**

- [http://www.thinkquest.org/library/cat\\_show.html?cat\\_id=36](http://www.thinkquest.org/library/cat_show.html?cat_id=36)
- <http://www.sciencenews.org>
- [http://www.phschool.com/science/science\\_news/chemistry/properties\\_matter.html](http://www.phschool.com/science/science_news/chemistry/properties_matter.html)

**Properties of Matter:**

**The following sites contain information about chemistry especially matter and crystals:**

- [http://www.phschool.com/science/science\\_news/chemistry/properties\\_matter.html](http://www.phschool.com/science/science_news/chemistry/properties_matter.html)
- <http://www.chem4kids.com>
- <http://www.school-for-champions.com/science.htm>
- [http://www.thinkquest.org/library/cat\\_show.html?cat\\_id=36](http://www.thinkquest.org/library/cat_show.html?cat_id=36)
- <http://school.discovery.com/lessonplans/physics.html>

