

# Nanotechnology Research Experience for Teachers

Rice University

Summer 2010



## Hydrogels

<b>Subject</b>	IPC
<b>Grade Levels</b>	9 <sup>th</sup> and 10 <sup>th</sup>
<b>Essential Question</b>	What is the relationship between viscosity and density in hydrogels?
<b>Science Objectives</b>	<ul style="list-style-type: none"><li>• Students will make hydrogels of different concentrations</li><li>• Student will observe and measure the speed of a metal ball as it moves through different hydrogels.</li><li>• Students will determine the viscosity and the density of the different gels and how they relate to each other.</li></ul>
<b>Math Objectives</b>	<ul style="list-style-type: none"><li>• Plot, read and interpret graphs.</li><li>• Determine velocity and acceleration by calculating slope (gradient)</li></ul>

## LESSON ACTIVITIES

<b>Engage</b>	<p>Ask students to look at the texture of different hydrogel concentrations and predict which one will be more viscous and which will have more density. Have students explain the reasons for their predictions.</p> <p>Give students a bottle of ketchup and ask them to predict which of the hydrogels will be more viscous and dense than the ketchup.</p> <p>Have students write down or /glue the procedure paper in their science journals.</p>
<b>Explore</b>	<p>Students will prepare the hydrogels themselves and measure viscosity and density.</p> <p>Students will record their observations in organized tables.</p>
<b>Explain</b>	<p>The teacher will lead discussions on viscosity and density, and the movement of the ball as it falls through the gels. How the speed of the dropping ball relates to and density and viscosity</p> <p>Students should provide a data-supported explanation for how the alginate particles in the hydrogels are arranged to affect the movement of the ball through the gels.</p>
<b>Elaborate</b>	<p>Have students use the information learned in “Explain” above to predict what effect temperature will have on the density and viscosity and why?</p>
<b>Evaluate</b>	<p>Have students write up a lab report and answer questions based on lab observations and measurements.</p>
<b>Materials</b>	<p>Water, sodium alginate, viscosity tubes, stopwatch magnet and metal balls.</p>

**Assessment Products**      Research (product) on use of hydrogels in medicine.  
Lab report  
Lab related questions

## INFORMATION FOR TEACHERS

**Standards**      TEKS 6C, Analyze chemical and physical properties of matter using viscosity and density

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**Prior Student Learning**      Properties of solid, liquid and gas, bonding covalent and ionic bonds

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**Lesson Sequence**      Physical and chemical properties of matter

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**Adaptations for Special Learners**

1. High achievers will compare and contrast Newtonian and non-Newtonian fluids.
2. ELL/SEN students make posters and presentations on particle structure in solids, liquids and gases.

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**Extensions**      Have students hypothesize how their results would have been different if they had used a coin/paper clips instead of the metal balls for this activity.

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**Resources**      Viscosity tubes from NASCO, alginic acid sodium salt (A2158) from Sigma Aldrich, [www.JCE.DivCHEM.org](http://www.JCE.DivCHEM.org) .vol 82 No.7 July2005. Journal of chemical Education.

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## STUDENT ACTIVITY: VISCOSITY LAB.

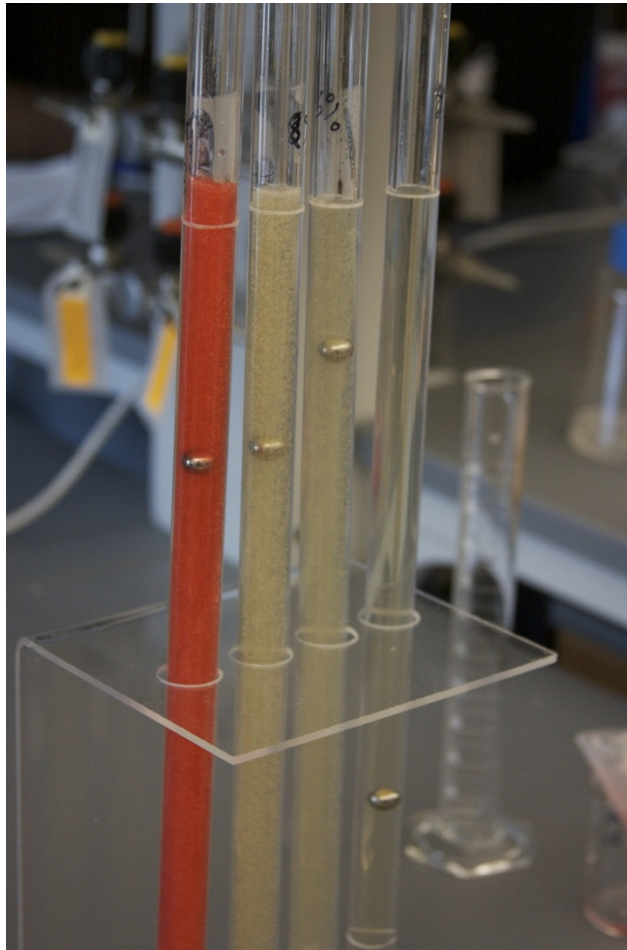
**Essential Question** To determine the physical properties of hydrogels using viscosity and density.

- Explore**
1. Students will do paper activity on powers of Ten.  
Earth---- leaf----cell---- DNA.
  2. Students will take measurements of the diameter of M&Ms in millimeters and convert the units into nanometers.

- Materials**
1. Sodium alginate, water, viscosity tubes, stopwatch, metal balls, and a magnet.
  2. Students will prepare 3%, 5%, 7% and 9% sodium alginate gels.
  3. Measure equal volumes of the gels into the viscosity tubes.
  4. Make sure all the gels are at the same levels in the tubes.
  5. Copy the chart into student science journal.
  6. Place the metal ball at the surface of the each gel and measure the time it takes for the balls to drop to the bottom of the tube using a stopwatch.
  7. Repeat step#6 above for all the different gels.
  8. Record your reading on the chart below.

Table of Results:

Gels	Depth/cm	Time/sec	Velocity/cm/sec	Mass/g	Density/g/ml
1					
2					
3					
4					



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***Explain/Product***

1. Students will write a lab report
2. Students will plot a graph of time Vs type of gel.
3. Students will calculate the speed of the metal ball as it moves through the gel.
4. Students should be able to use correct axis (dependent and independent variable)

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***Elaborate***

Students will use the lab report to make a prediction on the effect of temperature on the gels  
Student will also predict what the effect will be if paperclips are used instead of metal balls or if pennies are used instead of the metal balls.

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***Evaluate/Test, rubric, skill,***

Lab report  
Correct drawing of graph  
Correct deductions made from the table of results and the graphs  
Good reasoning on the effect of temperature  
Good reasoning on the use of pennies/paperclip instead of metal balls.

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