

Lesson #1 Title: What is a solution?

Targeted Grade Level: High School Chemistry

New York State Science Learning Standards: **NGSS Standard:** HS-PS1-10. Use evidence to support claims regarding the formation, properties and behaviors of solutions at bulk scales. [Clarification Statement: Examples of physical properties could include colligative properties, degree of saturation, physical behavior of solutions, solvation process and **conductivity**. Examples of solution types could include solid-liquid, liquid-liquid, and gas-liquid solutions. Concentrations can be quantitatively expressed in ppm, molarity, and percent by mass]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
<p>SEP: Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science. ♣ Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS1-10)</p>	<p>DCI: PS1.A: Structure and Properties of Matter ♣ (NYSED) Solutions possess characteristic properties that can be described qualitatively and quantitatively. (HS-PS1- 10)</p>	<p>CCC: Patterns ♣ Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-10)</p>

Rational: I am going to use these lessons to study the conductivity of ionic vs covalent solutions. Students have a tough time understanding why ionic solutions conduct electricity. It is something that the students will accept but sometimes cannot visualize what is going on. I am going to use modeling to help them understand why ionic solutions conduct electricity. I am also going to have the students investigate what type of solutions conduct electricity. The idea behind this is if the students design their own experiment and uncover the information on their own, they will have a better chance of remembering the material.

Unit Objective: Students will be able to use evidence to generate a claim as to which type of solution will be able to light a light bulb.

**Student Learning Objectives**

Students will be able to model a solution and define what a solution is.

**Materials:** Computers for edpuzzle, light bulb with conductor, salt water in beaker

**Prior knowledge needed:** Ionic compounds, aqueous solutions

**Engaging phenomena:** ionic solution and light bulb

<b>Lesson Section</b>	<b>Teacher and Student Activities</b>	<b>Key Questions</b>
Engage	Using a lightbulb and conductor, I will take a beaker with liquid in it get the light bulb to light. (salt water)	Why did it light? Is this water? What could it be?
Explore	Students will try to model what they think a solution is.  Student Work: <b>Pre-assessment:</b> 1) When you hear the word solution, what do you think of?  2) Model what you think an ionic solution is on the organizer on the next page. <i>Differentiation and UDL: guidelines for models on model sheet. Some students struggle on where to start when creating a model. They will use the suggestions to help collect their ideas and transfer them into a model.</i>	

		Solution model sheet
	<p>Name:</p> <p>Suggestions of possible things to include when making any models:</p> <ul style="list-style-type: none"> <li>-pieces of the phenomenon like the plate, markers, liquid, etc.</li> <li>-particles/molecules</li> <li>-before/after pictures</li> <li>-Small scale vs. large scale</li> <li>-particle movement</li> <li>-prediction of repeating the phenomenon</li> <li>-prediction if the phenomenon continues</li> </ul>	<p>Drawing of your model:</p>
Explain	<p>After they create their first models, we will come together and talk about the key components of a solution.</p> <ul style="list-style-type: none"> <li>-solute</li> <li>-solvent</li> <li>-homogeneous</li> <li>-heterogeneous</li> </ul>	<p>What solutions do you know about?</p>
Elaborate	<p>Students will give each other feedback on their models following the post modeling protocol:</p> <p>Peer feedback- give your model to another student.</p> <p>Peers: Provide feedback on your partners model in a different color. Be sure to be specific and constructive. When you are done give back the model to your partners.</p> <p>Modeler: Make the changes to your feedback from your partner in a different color.</p>	

Evaluate	Students will watch an edpuzzle on “What is a solution?” They will be asked to write down a definition of a solution on a separate piece of paper and bring it into class.
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Lesson # 2 Title: Planning an Investigation  
 Targeted Grade Level: High School Chemistry

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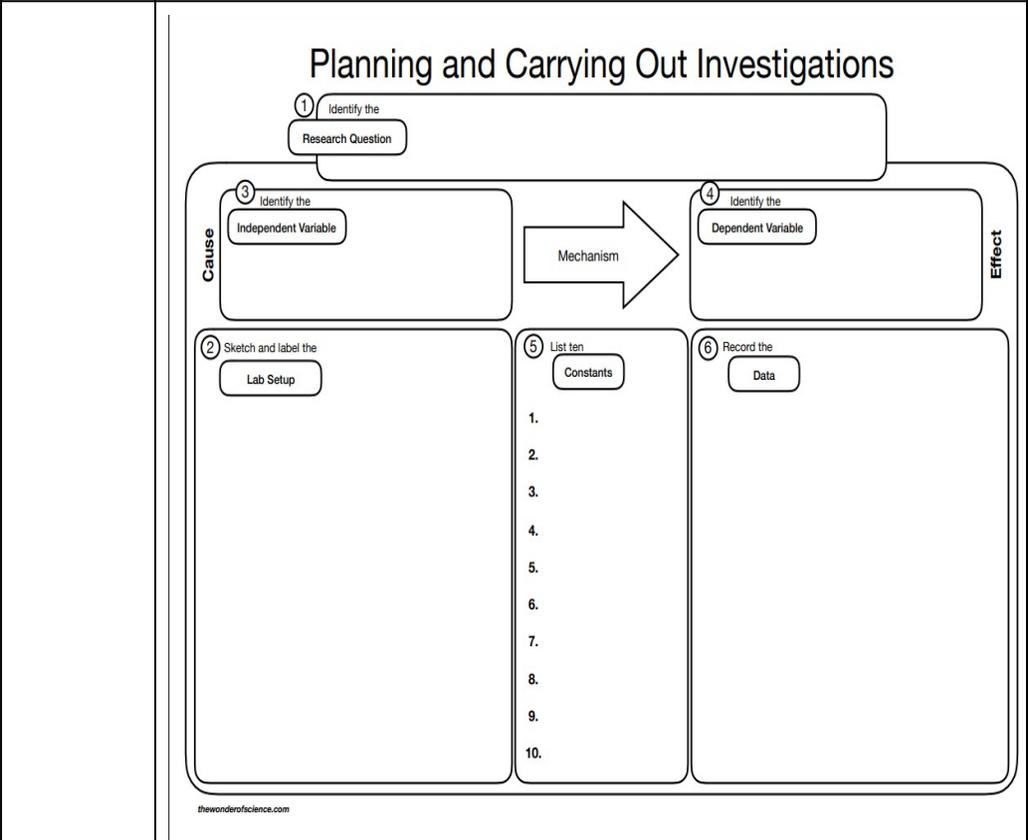
### Student Learning Objectives

Students will be able to design an investigation that answers the guiding question.

**Materials:** Planning and Carrying out investigation graphic organizer.

**Prior knowledge needed:** Definition of a solution

Lesson Section	Teacher and Student Activities	Key Questions and Connections to NGSS
Engage	<p>First the students will come to a consensus as to what the definition of a solution is and write it on the board.</p> <p>The students will be asked the following guided question: <b>Which type of solutions conduct electricity?</b></p>	
Explore	<p>The students will be asked to design an investigate to discover which type of solutions will conduct electricity.</p> <p>The students will be assigned groups and lab tables on flipidty (<i>I will make the groups before hand to great heterogenous groups to meet the needs of my students</i>) and will complete the following graphic organizer to plan and carry out their investigation:</p>	



Reference: Anderson, P. Planning and Carrying out Investigations Graphic Organizer. Retrieved from <https://thewonderofscience.com/documents>

Explain	After they make their first draft of their investigation, we will come together as a class to have a group discussion and share their ideas. This will help other group add key components to their investigation.
Elaborate	After the students will be able to use the computer to research any other material that they might be missing to carry out an investigation like this (Ideal they will see that they will need some sort of volt meter) But the students will be told they can't google the answer to the question!
Evaluate	<p>Students will hand in their investigation graphic organizers so I can collect their supplies.</p> <p>Final assignment/homework: Fill out google form on group etiquette. <i>Not all groups are stellar so I use a google form for students to reflect on how their groups worked, what some strengths and weaknesses are etc. It helps open up</i></p>

	<p><i>communication among group members because the students come up with a thoughtful way on how to make the group work better together. Also, some of my students are ENL and cannot communicate with their peers effectively so this allows me to intervein when necessary.</i></p>	
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Lesson # 3 Title: Carrying out an Investigation  
 Targeted Grade Level: High School Chemistry

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Unit Objective: Students will be able to use evidence to generate a claim as to which type of solution will be able to light a light bulb.

#### Student Learning Objectives

Students will carry out an investigation to determine which solutions conducts electricity.  
 Students will make a claim and support it with evidence to reason which solution will conduct electricity.

**Materials:** Their graphic organizer, the lab material they have requested. (beakers, volt meters, ionic solutions, covalent solutions, water, etc)

**Prior knowledge needed:** Definition of a solution

Lesson Section	Teacher and Student Activities	Key Questions and Connections to NGSS
Engage	Students will watch a short video to review claim evidence and reasoning.  <a href="https://www.youtube.com/watch?v=WQTsue0IKBk">https://www.youtube.com/watch?v=WQTsue0IKBk</a>	What was the little girls claim, evidence and reason?
Explore	The students will carryout their investigation to see which solution conducts electricity.	<b>What is different about your solutions?</b>
Explain	Once the students have completed their labs, they will fill out the	

	<p>following CER worksheet based on their investigation.</p> <p style="text-align: center;">Claim-Evidence-Reasoning Worksheet</p> <p>Name _____ Date _____</p> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; border-radius: 15px; padding: 10px; width: 45%;"> <p><b>I. Data:</b> Use this space below to record the data collected in the lab.</p> </div> <div style="text-align: center;">  </div> </div> <div style="border: 1px solid black; border-radius: 15px; padding: 10px; width: 45%; margin-top: 10px;"> <p><b>II. Claim:</b> Write your claim here:</p> </div> <div style="border: 1px solid black; border-radius: 15px; padding: 10px; width: 45%; margin-top: 10px;"> <p><b>III. Evidence:</b> Write down evidence collected in during your investigation to support your claim.</p> </div> <div style="border: 1px solid black; border-radius: 15px; padding: 10px; width: 45%; margin-top: 10px;"> <p><b>IV. Reasoning (Connect your evidence to the claim)</b> Explain, with your evidence, your reasoning...why you chose either the claim or counter claim.</p> </div>	
Elaborate	The class will make a class data table and come to a consensus as to which solution will conduct electricity.	
Evaluate	<p>Students will hand in their CER sheets for evaluation.</p> <p>Exit ticket: Why did the ionic solution conduct electricity while the covalent solution did not?</p>	

Lesson # 4 Title: **Model Revision and Final assessment**  
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<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts:</b>
SEP: Engaging in Argument from	DCI: PS1.A: Structure and	CCC: Patterns ♣ Different

<p>Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science. ♣ Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS1-10)</p>	<p>Properties of Matter ♣ (NYSED) Solutions possess characteristic properties that can be described qualitatively and quantitatively. (HS-PS1- 10)</p>	<p>patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-10)</p>
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Unit Rational: I am going to use these lessons to look at the conductivity of ionic vs covalent solutions. Students have a tough time understanding why ionic solutions conduct electricity. It is something that the students will accept but sometimes cannot visualize what is going on. I am going to use modeling to help them understand why ionic solutions conduct electricity. I am also going to have the students investigate what type of solutions conduct electricity. The idea behind this is if the students design their own experiment and uncover the information on their own, they will have a better chance of remembering the material.

**Student Learning Objectives**

Students will be able to revise their original models and explain why ionic solutions conduct electricity

**Materials:** CER Sheet, Post-its, tablets/chromebooks

Lesson Section	Teacher and Student Activities	Key Questions and Connections to NGSS
Engage	The groups will write their claims on the board. The students will then rank which claim was the strongest uses post-it notes.	



**Reflection:** I really am excited about this lesson. I wrote this lesson after I did my solutions unit this year and with all the videos I used they still struggled with what a solution is. The use of models hopefully will really help the students understand the material on a deeper level. Also, as a teacher I can see their growth with the material from the beginning of unit to the end of the unit by looking at their first model and their second model. Also, for my students that struggle with written explanations, they can also use models to show that understand. In the assessment, they will have to explain what they illustrated in their model and that can help them synthesize a stronger explanation. In addition to the models, allowing the students to plan and carry out their own investigation can allow students to discover the answer to the questions on their own and have a deeper understanding of the material.