Connected Chemistry

Solutions Unit

Lesson 2: Dissolving and Dissociation

Student's Lesson at a Glance

Lesson Summary

In this two-day lesson, students observe the teacher's demonstration that not all homogeneous mixtures or solutions are the same. Students use computer simulations to simulate both soluble and insoluble substances in water. From this interaction, students classify these mixtures into different categories. By using the simulations, students can differentiate between a molecular and ionic compound. In the final activity, students use a model kit to simulate dissociation with water and sodium chloride.

SWBAT (Students Will Be Able To)

- Define dissolution and dissociation
- Distinguish between dissolving and dissociating
- Differentiate among solutions, suspensions, and colloids
- Explain that soluble ionic compounds dissociate into cations and anions when placed in water
- Explain that soluble molecular compounds dissolve into individual molecules when placed in water, but do not dissociate into ions

Essential Vocabulary

Keep a list of all important words from this lesson. This list, in addition to the lists from other lessons, will make studying easier and improve scientific communication skills. The essential vocabulary from the unit is in bold. Additional words that will expand your scientific vocabulary are in italics.

The Connected Chemistry Curriculum © 2018, University of Illinois at Chicago

Connected Chemistry Reminder

- Many questions will ask you "what you think" or "to make predictions." The only answer that is wrong is the answer that is left blank.
- Prefixes and suffixes on words can help you discover the meaning of a word.
- Use the vocabulary section and note section to take good notes so that studying for tests and quizzes will be easier.
- Supporting claims with evidence is not only a skill that scientists use, but a skill that will help you in other classes and everyday life.
- Draw a key when you are sketching. Symbolic keys can help you and others decode your sketches at a later time.

Notes

Homework

Upcoming Quizzes/ Tests

The Connected Chemistry Curriculum © 2018, University of Illinois at Chicago

This page has been left blank.
Please turn to the next page.

The Connected Chemistry Curriculum © 2018, University of Illinois at Chicago

Activity 1: Connecting

A **mixture** is a combination of two or more substances that are not chemically bonded and do not exist in fixed proportions to each other. Not all mixtures are the same. On the table, your teacher has three bottles of water and containers with equal amounts of sand and two unknown white crystallized substances (labeled #1 and #2). Your teacher is going to add the sand to one of the bottles of water, crystal substance #1 to a second bottle, and crystal substance #2 to the last bottle. After adding the sand and crystallized substances to the water, your teacher will shake them up.

1. Look at the glass of soda. What do you observe about the liquid in the bottle?

____

____

2. Look at the picture and the two bottles of unshaken Italian salad dressing in middle. What do you observe about the substance in the bottle?

____

____

3. Would you classify soda and Italian dressing as mixtures?

____

____

4. How are soda and Italian dressing different?

____

____

The Connected Chemistry Curriculum © 2018, University of Illinois at Chicago

5. Describe what you see in the bottle with the sand and water.

6. Describe what you see in the bottle with the crystal substance #1 and water.

7. Describe what you see in the bottle with crystal substance #2 and water.

8. What makes the sand and water mixture different from the other two mixtures?

Recall, that the prefix *hetero* means "different." A mixture that forms and separates into layers is called a **heterogeneous mixture**. A mixture that does not separate into layers, but evenly distributes the solute in the solvent is called a **homogeneous mixture**.

9. Crystal substance #1 and crystal substance #2 both formed homogeneous mixtures. Do you think the homogeneous mixtures formed in exactly the same way? *Support your claim with evidence.*

To create a solution, a solute is combined with a solvent, such as water. Solutions can be produced by one of two distinct processes. In the first process, a solute **dissolves**. Dissolving is when a compound breaks apart into isolated particles. The second process is when a substance **dissociates**. Dissociation is when an ionic compound dissolves and breaks apart into constituent ions.

10. Two of the mixtures above created a solution. Do you think the two solutions were created as a result of dissolution, dissociation, or a combination of the two? *Support your claim with evidence.*

Activity 2: Solubility Demonstration

Demonstration

Use Simulation 2, Set 6

- *Your teacher has a container with cooking oil and water in it.*
  Sketch a macroscopic view of the mixture.

Sketch a macroscopic view of oil and water	Describe your drawing

- *Your teacher will start a simulation of this mixture on the submicroscopic level.*
- *Your teacher will add additional water then add the pentane, a substance similar to cooking oil. Sketch a submicroscopic view of the mixture and record your observations.*

Sketch Submicroscopic View of Mixture	Sketch One Molecule of Water	Sketch One Molecule of Pentane
Key		
Observations		

The Connected Chemistry Curriculum © 2018, University of Illinois at Chicago

11. How would you classify a mixture of oil and water? Please explain.

12. Can a mixture of oil and water be considered a solution? *Support your claim with evidence.*

13. Use the stir feature on the simulation to mix the pentane and water. What will happen to the mixture after stirring is stopped? How does this connect with what you saw in the beaker of cooking oil and water?

Activity 3: Solubility Simulation

Part 1

Use Simulation 2, Set 1-7

Your teacher has seven containers at the front of the classroom that contain the following mixtures:

- Water and sodium chloride
- Water and sand
- Water and glycerol
- Water and calcium chloride
- Water and acetic acid
- Water and pentane
- Water and sodium bicarbonate

Sketch what each of the mixtures look like on a macroscopic level.

Using the simulation, create each mixture that is requested. Pull the water slider all the way to the right before adding to the simulation. Create a submicroscopic sketch of each of the mixtures. Include a key.

Mixture	Sketch a Macroscopic View of the Mixture	Sketch a Submicroscopic View of the Mixture	Observations of the Submicroscopic View
1. Water + Table Salt ($NaCl$)			
2. Water + Sand (Silicon Dioxide, SiO_2)			
Water + Glycerol ($C_3H_8O_3$)			
4. Water + Calcium chloride ($CaCl_2$)			

The Connected Chemistry Curriculum © 2018, University of Illinois at Chicago

Mixture	Sketch a Macroscopic View of the Mixture	Sketch a Submicroscopic View of the Mixture	Observations of the Submicroscopic View
5. Water + Acetic Acid (CH_3COOH)			
6. Water + Pentane (C_5H_{12})			
7. Water + Baking Soda ($NaHCO_3$)			
Key			

13. Looking at the seven mixtures you made, which ones can you classify as solutions? *Provide evidence to support your claim.*

From this list, create two categories of mixtures. Classify the seven mixtures into the two categories you created.

NaCl and water

Sand and water

Pentane and water

Sodium bicarbonate and water

Acetic acid and water

$CaCl_2$ and water

Glycerol and water

Category	1__________________	2 __________________
Mixtures		

14. Which of the seven mixtures were aqueous solutions? *Explain your answer.*

15. In the computer simulation, how does a solid compare to an aqueous solution?

16. Are the solids in the computer simulation (e.g., sand, sodium chloride) an accurate representation of how a solid would look in the real world? *Support your claim with evidence.*

Part 2

Use Simulation 2 Set 7

Re-examine the seven solutions at the front of the room.

17. Ignoring the labels and just looking at the containers on the macroscopic level, are you able to distinguish between the mixtures?

18. In both the sodium chloride and calcium chloride simulations, there were gray halos around the particles. What do the halos represent?

Recall that **compounds** contain atoms of multiple elements. There are two types of compounds: **molecular compounds** and **ionic compounds**. It is important to remember the differences between these types of compounds because ionic compounds and molecular compounds behave differently when they form solutions. Ionic compounds break apart by **dissociating** into charged particles called ions. Molecular compounds break apart by **dissolving** into individual molecules, but they do not break apart into charged particles or into individual atoms. Considering the three simulations of sodium chloride, glycerol and calcium chloride again, classify the compounds based on the information you just read in the paragraph above.

19. Is sodium chloride an ionic compound or a molecular compound? *Support your claim with evidence.*

20. Is glycerol an ionic compound or a molecular compound? *Support your claim with evidence.*

21. Is calcium chloride an ionic or a molecular compound? *Support your claim with evidence.*

22. Is baking soda an ionic compound or a molecular compound? *Support your claim with evidence.*

23. What two differences can you identify when comparing calcium chloride and sodium chloride to baking soda?

The Connected Chemistry Curriculum © 2018, University of Illinois at Chicago

Part 3

Look back at the sketches of the five solutions you completed in Part 1. Using this knowledge, classify the five solutions as dissociations or dissolutions.

24. Is combining calcium chloride and water an example of a solution made through dissolution or dissociation? *Support your claim with evidence.*

____

____

25. Which of the five solutions include ionic compounds that dissociate? *Support your claim with evidence.*

____

____

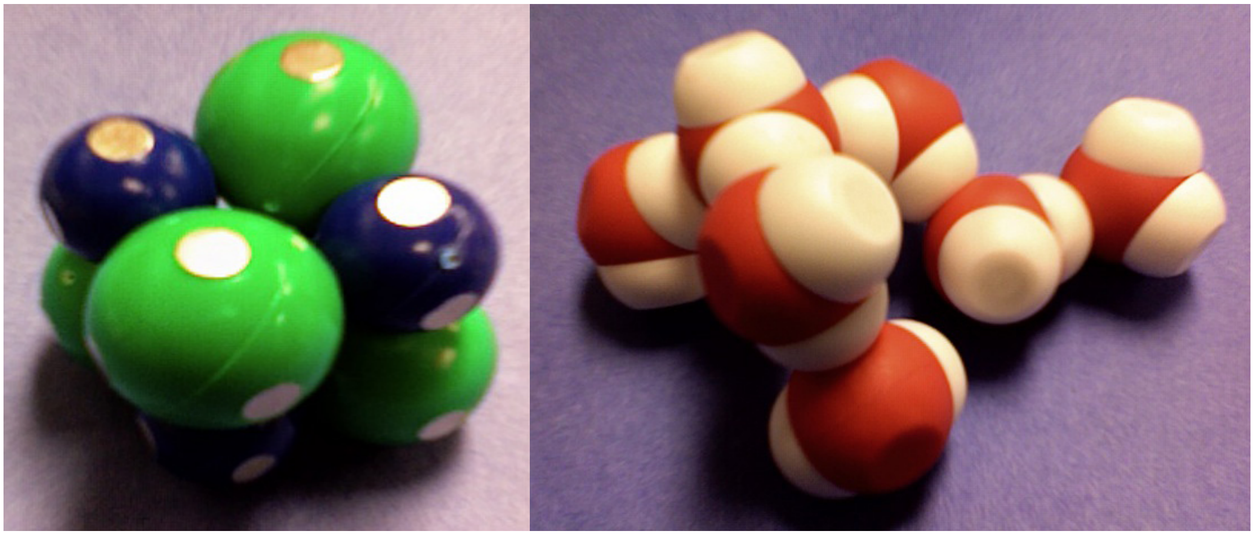
26. Which of the five solutions include molecular compounds that dissolve? *Support your claim with evidence.*

____

____

Activity 4: Modeling Dissociation

The mixture of sodium chloride and water in the computer simulations can be represented with physical models. In your hand "mix" the NaCl (s) and H_2O (l) physical models.



Sketch the model after "mixing"	Observations
Key	

27. If there are attractions between the model atoms, describe which atoms are attracted to each other.

28. How does water, a polar substance, facilitate the dissociation of substances?

29. If you used a physical model of a pentane molecule, would you be able to create the same outcome as you did with the sodium chloride and water? *Support your claim with evidence.*

30. What does the physical model allow you to experience in the dissociation of sodium chloride in water that the computer simulations do not allow?

31. What is the limitation of using physical models to represent dissociation?

32. Instead of ions having halos as they do in the simulation, how is charge of the ion represented in the physical model?

Lesson Reflection Question

33. Create a Venn diagram that shows the similarities and differences between dissociation and dissolution.