Science Learning Packet
CHEM A: Ionic Bonding Packet

science learning activities for SPS students during the COVID-19 school closure.

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Due to the COVID-19 closure, teachers were asked to provide packets of home activities. This is not intended to take the place of regular classroom instruction but will help supplement student learning and provide opportunities for student learning while they are absent from school. Assignments are not required or graded. Because of the unprecedented nature of this health crisis and the District’s swift closure, some home activities may not be accessible.

If you have difficulty accessing the material or have any questions, please contact your student’s teacher.
INTRODUCTION: Take Home Unit – Conductivity and Ionic Bonding

Often you will hear the warning not to bring any electronics near water or you'll get electrocuted. You may have been told not to go swimming in a thunder storm. We've learned before that electricity is the flow of electrons through wires, but what is happening in water? What could cause the electricity to travel? The Conductivity and Ionic Bonding unit will focus on these ideas to guide you to an understanding of different types of bonds between atoms and how this relates to conductivity.

Throughout this unit, you will complete a group of activities in order to explain the phenomenon of a young woman getting electrocuted in the bath tub while using her phone. You'll be able to model what is happening in the water and you'll be able to explain the requirements that must have been met.

Why should you do this?
Conductivity and different types of bonds is a HUGE part of chemistry. This unit will build your understanding for Chem B as well as Biology. There are 4 state standards within this unit that all students are supposed to understand in order to move forward in science.

How can you do the labs?
2.2 can be completed using two paper clips and a battery. If you do not have these materials, there is a data table that has already been completed for you to use to complete the assignment. Although playing with electricity is more fun!
2.5 you can use any small object to represent electrons (rice, beads, etc) and you just need cups to represent atoms
2.7 uses Java which a lot of phones and computers do not support. If you can not open the phet, an alternative video is linked at the bottom of the page for you to complete the assignment.

What if I don’t have internet access and can only complete the physical packet?
If you are completing the physical packet, there are only two assignments that will be difficult to complete (2.7 and 2.8) as they require videos/simulations. You can skip these and check in with your teacher via phone call in order to learn the material. You can also use the SIR Part 2 to learn any missed information.

What resources do I have to be successful?
All the materials you need are on this OneNote. Some quizzes or check ins will be posted on Schoology, so be sure to check there as well. Your teachers are still available to you and will communicate in means that work for them and you.

Use the timeline below to keep track and learn as much as you can within the time you have away from the school building.
Week 1: 2.1, 2.2, 2.3a - be sure you understand the rules for conductivity and solubility

Week 2: 2.3b, 2.4, 2.5 - be sure you understand the different types of bonds and their properties. Specifically the atoms that make them up. Be sure you understand ionic bonds in detail.

Week 3: 2.6, SIR PART 1 - this week is the finalization of many of the key points from the unit. The focus should be understanding all the content so far and checking in with your teacher to understand.

Week 4: 2.7, 2.8, start SIR PART 2 - be sure to be able to model how ions behave in water. Be sure you understand the importance of charge.

Week 5: Finish SIR PART 2 and 2.9 Final Explanation

2.1a Electrocution Article

Tuesday, April 7, 2020
4:50 AM

Texas teen was electrocuted by her cellphone while taking a bath, her family says

By Katie Mettler
July 12, 2017 at 2:50 a.m. PDT

It wasn’t abnormal for 14-year-old Madison Coe, a lover of band and basketball, to shut herself in the bathroom and soak in the tub.

That’s what she had been doing late Saturday night at her father’s New Mexico home, according to family, when he knocked on the door and said it was time to get out. “Okay,” Madison reportedly said.

But 20 minutes passed and the teen never emerged, so Logan Coe called out once again. This time, he got no response.

He entered the bathroom and found Madison unresponsive in the water and her Samsung Edge Plus phone plugged into an outlet in the wall, Madison’s mother, Angela O’Guinn-Downs, told People magazine. The cellphone had fallen into the bathtub, family told local news in Lovington, N.M., and the girl had a burn mark on her hand.
Coe, an EMT, tried to revive her, as did medical professionals who transported her to the hospital, where Madison was pronounced dead. The medical examiner has yet to rule on official cause of death, but authorities said in a news release that “initial evidence shows signs consistent with electrocution.” Lovington police confirmed that a cellphone, a charging cord and an extension cord were found by the bathtub, reported the Associated Press. The U.S. Consumer Product Safety Commission told USA Today that it is investigating the incident.

“There was a burn mark on her hand, the hand that would have grabbed the phone,” Madison’s grandmother, Donna O’Guinn, told KCBD-TV. “And that was just very obvious that that’s what had happened.”

Madison’s stepmother, Felisha Owens, told KRQE News 13 that the girl was only doing what she had done many times before — sitting in the bathtub, phone plugged in, “playing our games.”

“I did it, she did it,” Owens said through tears.

But the tragedy has made her realize the dangers.

“The bathroom is a place for showers and personal time and your phones don’t belong in the bathroom,” she told KRQE News 13. Electricity and water do not mix. All it takes is a drop.”

Madison had just graduated from the eighth grade at Terra Vista Middle School in Lubbock, Tex., reported KCBD-TV. She was spending the summer in New Mexico with her father before starting her freshman year of high school in Houston.

“It is with heavy hearts that Frenship ISD mourns the loss of Madison Coe,” officials from the school district said in a statement to KCBD-TV. “We wish to share our heartfelt sympathy with her family and friends as we carry the burden of this tragedy together.”

In Texas, Madison played basketball and was first chair tuba in the school band.

“Not many girls play the tuba, but Maddy nailed it,” Owens, the girl’s stepmother, told KRQE.

Madison’s grandmother, O’Guinn, said the teen was her “shining star” and “has a special place” in her heart. She was smart and a good student, O’Guinn said.

“She was such a bright, vibrant, very intelligent, loving, caring young lady,” Madison’s mother told People magazine. “She had such a huge heart. Always willing to help others.”

Reports of the girl’s death have sparked family, friends and strangers to share a social media post warning other parents and children about the dangers of mixing electronics and water.
“Please please let her voice be heard and protect and educate your children on the fatal dangers of electrocution,” the social media post states, according to the Lubbock Avalanche-Journal.

“This is such a tragedy that doesn’t need to happen to anyone else,” Madison’s grandmother told KCBD-TV. “And we want something good to come out of this as awareness of not using your cellphone in the bathroom as it is plugged in and charging.”

2.1b Electrocution Phenomenon Questions

Read 2.1a Electrocution Article before completing this assignment

Directions: Use drawings and words to explain what you think could have happened to cause electrocution in the bathtub. Your drawing must include zoom bubbles to show what is happening at the molecular and atomic levels.

1. Explain each snapshot here:

Before Cell phone is dropped sitting in bath

Once exposed wires hit the bath water
2. **Unanswered Questions:** What information do you still need? What might be happening at the molecular and atomic levels that you can’t see or explain yet?

3. Go onto schoology and add your ideas to the Class Discussion

### 2.2 Conductivity of Substances

**Purpose:** Use evidence to evaluate different substances and whether they conduct electricity

**Materials (if you want to try some of the lab on your own)**
- Two paper clips unfolded without plastic coating
- Tape (preferably black electrical tape)
- D Battery (you can use AA, but it won’t be as obvious)
- Multiple cups
- Salt
- Sugar
- Aluminum Foil
- Wax
• A penny (copper)

**NOTE:** If you do not have the materials to conduct the lab, don't worry! Data has been filled out at the bottom of this page.

**Pre-Lab Questions**

1. Do you think that water conducts electricity?

2. Do you think the bath water in Madison's tub was pure water? If not, what else could have been in the bath water?

**Evidence of conductivity:**

**Video 1: Does pure water conduct electricity?**

[Water Conductivity Experiment](#)

1. Does pure water conduct electricity? Explain your answer

2. Does water with salt (sodium chloride) conduct electricity? Explain your answer

3. What evidence is used in the video to show that conductivity is happening?
Video 2: Other evidence of conducting

If you want to test some conductivity at home, you probably don't have wires or a light bulb that conduct well enough to light up. This means we need another piece of evidence that shows conductivity is happening. Watch the video below.

Electrolysis of Copper(II)Chloride

4. What evidence shows that conductivity is happening in this video even though there is no lightbulb?

5. Does Copper (II) chloride conduct electricity when dissolved in water?

Preparing for the lab:
6. Re-write the definitions of these words in your own language:
   a. Dissolve: to become completely incorporated into a liquid. Completely break down and spread out within a liquid.
      Reworded in your own words:

   b. Conductivity: the ability of a substance to pass charged particles through it.
      Reworded in your own words:

   c. Soluble: a property of a substance that means it is able to dissolve
      Reworded in your own words:

7. On the data table below, fill in the PREDICTIONS for each substance you will test
Test Substances | Prediction | Prediction | Prediction |
---|---|---|---|
Conduct as a solid (when not dissolved in water) | Able to Dissolve (Soluble)? | Will it make the water conduct once you put it in the water? |
Yes/No | Yes/No | Yes/No |
Al (s), Aluminum Foil
C₁₂H₂₂O₁₁ (s), sucrose (sugar)
NaCl (s), sodium chloride (salt)
SiO₂ (s), silicon dioxide (sand)
C₂₀H₄₂ (s), paraffin (wax)
Cu (s), copper

Procedure for testing substances:
NOTE: Be very careful that your dry substances stay dry. You may want two conductivity meters - one that stays dry and one that gets wet and rinsed between each trial

Step 1: Build your conductivity meter. First tape the paperclips to each end of the battery. To test if electricity is flowing, touch the two ends of the paper clips together - you should feel them get warm (do not hold too long!).

Step 2: Test your solid substances
A. Put the two ends of the paper clip on the solid substance
B. Wait a few moments to feel if the paper clips get warm
C. If they warm up, then you would mark "yes" under "Conduct when not dissolved"
D. If they do not warm up, you would mark "no"

Step 3: Testing Solubility
A. Get 5 glasses of water
B. For the powder substances, place about half a spoonful into the water.
C. For the penny, wax, and Aluminum Foil, place them in the water
D. Stir each cup of water for about a minute
E. Observe whether most of the substance has seemed to disappear
F. If most the substance disappeared, you would mark "Yes" on "Able to Dissolve (Soluble)"
G. If it seems that the substance is still there, you would mark "No"
H. DO NOT DUMP OUT THE WATER OR REMOVE THE SUBSTANCE

Step 4: Testing if the water now conducts
A. For each cup, you will place your paperclips into the water and observe
B. Be sure to rinse between each cup.
C. Make sure the paper clips are near the bottom of the water, but NOT touching the substance. You are testing to see if the water now conducts.
D. Look closely at the wires as you hold them in each cup.
E. If there are bubbles being produced on one wire, mark "Yes" for "Does it make the water conduct".
F. If it doesn't seem like there are any bubbles or anything happening, mark "No".

Data:

<table>
<thead>
<tr>
<th>Test Substances</th>
<th>Test Results</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conduct when not dissolved?</td>
<td>Able to Dissolve (Soluble)?</td>
<td>Does it make the water conduct?</td>
</tr>
<tr>
<td>EXAMPLE: H₂O (l), water</td>
<td>No</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>EXAMPLE: CuSO₄ (aq), copper (II) chloride</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>EXAMPLE: C₂H₅O (l), ethanol</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>EXAMPLE: CaCl₂ (aq), calcium chloride</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>EXAMPLE: SiO₂ (s), silicon dioxide (sand)</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Al (s), Aluminum Foil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C₁₂H₂₂O₁₁ (s), sucrose (sugar)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>NaCl (s), sodium chloride (salt)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C₂₀H₄₂ (s), paraffin (wax)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu (s), copper</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Analysis of Data:

8. Look at the chemical equations for each substance.
   a. Which substances are made of ONLY METAL Atoms?
   b. Which substances are made of ONLY NONMETAL Atoms?
   c. Which substances have both METAL AND NONMETAL Atoms?

9. Use the data to organize the substances into groups:
   a. Which substances were soluble: ____________________________
i. GROUP A (soluble and conducts): Which of the soluble group conducted electricity? 
_____________

ii. GROUP B (soluble and does NOT conduct): Which of the soluble group did not conduct electricity? 
_____________

b. Which substances were NOT soluble: 
_____________

i. GROUP C (not soluble and conducts): Which of the not soluble group conducted electricity? 
_____________

ii. GROUP D (not soluble and does NOT conduct): Which of the not soluble group did not conduct electricity? 
_________

c. Re-write the groups. Be sure no substance is in two groups:
   i. GROUP A (soluble and conducts):

   ii. Group B (soluble, but doesn't conduct):

   iii. Group C (not soluble, but conducts):

   iv. Group D (not soluble, and doesn't conduct):

10. What patterns do you see in your data? Find at least 4 patterns.

11. Substances that will make the water conduct are made of:
   a. Metal atoms only
   b. Metal and Nonmetal atoms
   c. Nonmetal atoms only

12. Substances that will conduct, but do NOT dissolve are made of:
   a. Metal atoms only
   b. Metal and Nonmetal atoms
   c. Nonmetal atoms only

13. Substances that may be soluble, but will NOT conduct either as a solid or when dissolved are made of:
   a. Metal atoms only
   b. Metal and Nonmetal atoms
   c. Nonmetal atoms only

14. Predict whether isopropanol, C₃H₇O (l), will conduct electricity. State your reasoning.

Making Sense
15. If it is dangerous to take a bath with a blow dryer, what must also be true about the water in the bathtub?
   a. There must be only metal atoms within the water
   b. There must be metal and nonmetal atoms within the water
   c. There must be only nonmetal atoms within the water

16. Explain your answer to the previous question

17. Bathtubs are hot. This means they make people sweat. Within our sweat we have salt (NaCl). Based on this lab, what do you know about NaCl?

### Filled out data:

<table>
<thead>
<tr>
<th>Test Substances</th>
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<tbody>
<tr>
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<td>No</td>
</tr>
<tr>
<td>Cu (s), copper</td>
<td>Yes</td>
</tr>
</tbody>
</table>
2.3a Bonding Initial Ideas

Purpose: To investigate the four types of chemical bonding found in different substances and relate chemical bonding to their physical properties

NOTE: You will need physical cards with different substances to complete the tables of this assignment. If you do not have the cards, you can still complete the readings and analysis questions.

Initial Ideas Data Table (without looking at the reading)

Try to sort the cards based on similarities. When you have 4 groups, assign them to the bond types below. Do not look at the reading yet! This is initial ideas.

Note: This is an initial ideas sort based on patterns. The names of the different groups may not mean anything to you and that is ok! Just pick a column to write the cards in.

<table>
<thead>
<tr>
<th>Group 1: Ionic</th>
<th>Group 2: Network Covalent</th>
<th>Group 3: Metallic</th>
<th>Group 4: Molecular Covalent</th>
</tr>
</thead>
<tbody>
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</table>
Purpose: To investigate the four types of chemical bonding found in different substances and relate chemical bonding to their physical properties

1. Use the reading to fill in the properties of each bond type below. *The reading is below the analysis questions.*

Each sphere in the model represents 1 atom. The gray shaded area represents places where the negatively charged valence electrons might be found within each type of chemical bond.
Properties should be: Hardness (1), Solubility (2), Conductivity (3), the atoms that make it up (4)

<table>
<thead>
<tr>
<th>Model 1: Ionic</th>
<th>Model 2: Molecular Covalent</th>
</tr>
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<tbody>
<tr>
<td>Properties:</td>
<td>Properties:</td>
</tr>
<tr>
<td>1.</td>
<td>1.</td>
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<tr>
<td>2.</td>
<td>2.</td>
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<tr>
<td>3.</td>
<td>3.</td>
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<tr>
<td>4.</td>
<td>4.</td>
</tr>
<tr>
<td>![Ionic Diagram]</td>
<td>![Molecular Covalent Diagram]</td>
</tr>
<tr>
<td>Metal atoms lose their valence electrons to form cations while non-metal atoms gain valence electrons to form anions.</td>
<td>Valence electrons are shared between some atoms. This creates small stable units (molecules) within the substance.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 3: Metallic</th>
<th>Model 4: Network Covalent</th>
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<tbody>
<tr>
<td>Properties:</td>
<td>Properties:</td>
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<td>1.</td>
<td>1.</td>
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<tr>
<td>2.</td>
<td>2.</td>
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<tr>
<td>3.</td>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
<td>4.</td>
</tr>
<tr>
<td>![Metallic Diagram]</td>
<td>![Network Covalent Diagram]</td>
</tr>
<tr>
<td>Valence electrons are delocalized and are able to move freely throughout the substance like a “sea” of electrons.</td>
<td>Valence electrons connect atoms with each other in all directions, like a grid or network.</td>
</tr>
</tbody>
</table>

**Analysis Questions**
Final Sort Data Table (after the reading)

Simple steps to identifying the bond:

1. Identify the atoms within the substance (metals, nonmetals, both metals and nonmetals, metalloid)
2. If there is no metalloid, you've identified the bond! Just look at if it is only metals, only nonmetals, or metal and nonmetal.
3. If there is a metalloid, look at the properties and take your best guess!

Now use the cards in 2.3a and re-sort them correctly!

<table>
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</tbody>
</table>

1. What do the shaded areas in the illustration of the four models of chemical bonding attempt to show?

2. Name the type of bonding for each substance described below:
   a. A substance made entirely of metal atoms. _______________________________
   
   2. A substance made entirely of non-metal atoms and is an extremely hard solid. ______________
   
   c. A substance made of both metal and nonmetal atoms. _______________________________
   
   d. A substance made entirely of non-metal atoms and is found as a gas in nature. ______________
3. Which type of chemical bonding can be found in molecules that are solids, liquids, and gases at room temperature?

4. Look at the four drawings of the types of bonds. Imagine drawing lines between the atoms. If you don’t hit any gray with your drawn line, it is easy to separate the atoms. The gray areas are areas where there is an extreme amount of force between the atoms. How does the drawing for the network covalent bonding model explain the incredible hardness of a diamond?

5. Both sugar and salt dissolve in water, but they are bonded differently. Use the models for Molecular Covalent and Ionic Bonding, respectively, to explain how these two substances might be different once they dissolve.

6. Which type of chemical bonding would you predict for the following substances? (g) = gas, (s) = solid, (l) = liquid
   a. Cl₂ (g) chlorine ________________________________
   b. Zn (s) zinc ________________________________
   c. C₃H₈ (l) propane ________________________________
   d. Si (s) silicon ________________________________
   e. KI (s) potassium iodide ________________________________
   f. CO₂ (g) carbon dioxide ________________________________
   g. CaCO₃ (s) calcium carbonate ________________________________

Making Sense
7. Go back to 2.2 Conductivity of Substances Lab. For each Group you identified, what type of bond do you now know they had?
   a. Group A:
   b. Group B:
   c. Group C:
   d. Group D:

8. Why do ionic compounds conduct electricity when they are dissolved in water but not as solids?

9. What type of chemical must have been in Madison's bath water (ionic, covalent, metallic)? Explain your reasoning.

Bonding Reading (use this to fill in the properties for each bond):
You have already been introduced to ionic compounds. These all have ionic bonding in which metal atoms transfer valence electrons to nonmetal atoms. The resulting oppositely charged ions are strongly attracted to each other. This attraction is what holds the ions together.

In **covalent bonding**, the nucleus of one atom is attracted to the valence electrons of another atom. Unlike ionic bonding, one atom does not transfer an electron to the other. Instead both atoms *share* the valence electrons between them.

Covalent bonding can happen in two different ways. In molecular covalent bonding, the atoms bond to form individual clusters called **molecules**, such as the methane molecule shown here.

In network covalent bonding, the valence electrons are shared between atoms but form a highly regular extended network, creating a very durable structure. Diamond consists of carbon atoms that are covalently bonded in a network.

In a metal, the valence electrons are distributed throughout the substance in what is sometimes called a “sea” of electrons. The valence electrons are free to move throughout the substance. The atoms are bonded by the attraction between the positively charged atoms and the negatively charged “sea” of electrons.

### 3 Relating Bonds and Properties

Some properties of substances, such as solubility and conductivity, are directly related to the type of bonds the atoms in the substances have. Therefore, it is possible to match the bonding with the physical properties observed in different substances. Examine what happens to each type of substance when it is struck by a hypothetical hammer.
Notice that the hardest substance is a solid with network covalent bonding. This is because bonding in these substances is in an organized network.

Bonding can also help to explain the properties of dissolving and conductivity. Examine the illustration below representing dissolving. Water is represented by the lighter blue areas. Ionic solids and molecular covalent substances dissolve in water. Metallic solids and network covalent solids do
Conduction requires the movement of a charged particle, either an ion or an electron. Metals conduct electricity because the valence electrons are free to move throughout the solid. Ionic compounds that have been dissolved in water conduct electricity because the cations and anions are free to move in the solution. Network covalent solids and molecular covalent substances do not conduct electricity. The charge cannot move in these substances because the electrons are “stuck” between the atoms and are not available to move.

The periodic table is a valuable tool in figuring out bonding. You can use the table to determine if the elements in a compound are metals, nonmetals, or both.

- Ionic compounds, such as salts, are made from metal and nonmetal elements.
- Metallic compounds, such as brass, are made only of metal atoms.
- Network covalent compounds, such as diamonds, and molecular covalent compounds, such as methane, are made from nonmetals.
Introduction:
From the first unit, you learned that atoms within the same GROUP (or column) have the same number of valence electrons. You also learned that the last group (Noble Gasses) are non-reactive because they have a FULL VALENCE SHELL.

*Remember that "valence" is just a fancy word for "outer".*

Remember that each energy shell around the atom can hold 8 electrons except for the first which holds 2. See Argon's Bohr model to the right as reference.

It is very easy to determine the number of valence electrons without drawing a Bohr model every time. Remember that you can use the periodic table and just count the columns!

The Transition Metals (middle area) do not follow these rules and using the shell model for electrons doesn't really work. Therefore we don't usually use them in this simplified bonding model.
1. Practice using your periodic table to determine the number of valence electrons for each element below. You should get to the point where this is very easy to do. Have a family member or friend test you!

<table>
<thead>
<tr>
<th>Element</th>
<th>Valence Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
</tr>
<tr>
<td>Ar</td>
<td></td>
</tr>
<tr>
<td>Al</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td></td>
</tr>
<tr>
<td>Mg</td>
<td></td>
</tr>
</tbody>
</table>

Use the video below to review valence electrons and the octet rule

The Octet Rule

Valence electrons are important because if they don't have a full valence shell, they will either STEAL, GIVE, or SHARE electrons to get a full shell. For this unit, we will be focusing on Ionic Bonding (stealing/giving). Next unit will focus on Covalent Bonding (sharing).
For example, Lithium has 3 electrons. The innermost shell gets filled up with 2 electrons, then the 3rd electron will go on the valence shell. (see the diagram on the right)

Lithium can do two things to achieve a full valence shell.
  - Give up 1 electron- this would change its valence shell to the innermost
  - Gain 7 electrons- this would fill the second shell

2. In nature, most reactions happen based on the lowest energy option. Do you think it would require less energy for Lithium to give up ONE electron or try to steal SEVEN electrons?

3. You most likely realized that losing one electron would require way less energy than trying to gain seven. Therefore when lithium forms a bond, it will GIVE UP its electron to have a full shell. This is a feature of many metal elements. Looking at the periodic table, which elements would need only ONE MORE electron to have full valence shells?

4. Test yourself by stating whether the atoms below would STEAL or GIVE electrons to get full shells. We are going to discuss SHARING in the next unit, so you can ignore that for now. The first element is done for you.

<table>
<thead>
<tr>
<th>Element</th>
<th>Number of Valence Electrons</th>
<th>Is it a Metal or Nonmetal?</th>
<th>Will this element steal or give electrons?</th>
<th>Number of electrons stolen/given to get a full shell (8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li</td>
<td>1</td>
<td>Metal</td>
<td>Give</td>
<td>1 (The 1st shell is full when there are 2 electrons)</td>
</tr>
<tr>
<td>K</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cl</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Al</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Br</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Se</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Be</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. For those elements you said would give up electrons, remember that we only count shells that have electrons. So, the outermost shell with electrons becomes the valence shell. Look at the image to the right. Identify 2 differences you notice between the Lithium atom before and after it has lost an electron.

6. Atoms that have gained or lost electrons now have a charge. This means we call them IONS instead of atoms. Ion just means "atom with a charge." What charge does the Lithium Ion have now that it has a full shell? Explain.

7. Looking at the periodic table. What charge would you expect a Beryllium Ion to have?
   a. +1
   b. +2
   c. +3
   d. -1
   e. -2
   f. -3

8. Explain your answer to the previous question:

9. When Oxygen forms an ion, it gains 2 electrons. This would bring its valence shell to 8 (full). Which atoms would give up 2 electrons to have full valence shells?

10. Match the atoms below. The atoms on the left give up electrons. The atoms on the right steal electrons. Use the periodic table and their valence electrons to figure out which atoms would pair with each other to form a bond. Use the draw tool to connect the correct atoms.

<table>
<thead>
<tr>
<th>Give Up</th>
<th>Steal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithium (Li)</td>
<td>Phosphorus (P)</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>Fluorine (F)</td>
</tr>
<tr>
<td>Aluminum (Al)</td>
<td>Oxygen (O)</td>
</tr>
</tbody>
</table>
Multiple ions in a single bond

11. Sometimes, one ion isn't enough to fill another's shell. For example, Oxygen needs 2 electrons in order to fill its valence shell. If it were to bond with Lithium, how many electrons could Lithium give up? Remember, once it has a full shell it will NOT give up any more.

12. Because Lithium will only give up one valence electron, Oxygen would still be missing one electron. How many Lithium atoms must bond with Oxygen to fill its shell completely?

2.5 Modeling Ionic Bonding

For this activity, you will need the following materials:
1. 35 small objects to represent valence electrons (grains of rice, small pieces of paper, beads, etc)
2. 8 things to represent atoms (circles of paper, cups, pieces of fabric, etc)
3. 8 pieces of paper labelled "OUTER SHELL FULL"

Introduction:
You will be using your materials to model what happens to the electrons when an ionic bond is formed. Be sure to pay attention to the number of electrons.

**NOTE:** In the directions CUPS will represent atoms and RICE GRAINS will represent electrons, but you can use whatever you have.

Pre-Lab Practice
1. In this lab, you will ONLY be modeling valence electrons. You are ignoring all other electrons. To practice identifying valence electrons, fill in the table below:

<table>
<thead>
<tr>
<th>Atom</th>
<th>Atomic Number</th>
<th>Metal/Nonmetal</th>
<th>Number of Electrons total</th>
<th>Number of VALENCE electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cl</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. According to the rules from 2.4 about stealing or giving electrons, which atoms in the previous question would GIVE UP electrons? Explain your answer.

3. Which atoms would STEAL electrons? Explain your answer.

4. Looking at the number of electrons each atom needs to steal or give up, which of the choices below are possible pairs that would form (choose all that apply):
   a. Na and Mg
   b. Na and Cl
   c. Na and O
   d. Mg and Cl
   e. Mg and O
   f. Cl and O

Guided Lab:
5. Use the your materials to create each of the atoms from the table in question 1. Remember you are ONLY SHOWING VALENCE ELECTRONS. Put all other grains of rice away. You should have four cups like the ones shown below:
6. Remember that bonds will form in the easiest (lowest energy) way possible. This means if an atom has 2 electrons to give, it will try to give them both to the same atom. Move grains of rice so each cup has either EIGHT or ZERO grains of rice. Pay attention to which grains of rice you move where. Which atoms gave and stole from each other? We call this ionic bonding.

7. Which atoms would now have a POSTIVE charge? Which would now be NEGATIVE?

8. The cups that had 1 or 2 grains of rice are now empty. This doesn’t mean that the atoms don’t have any electrons, it means that their valence shell is now empty but the next shell down is full and becomes the valence shell! Put a piece of paper in each of the empty cups that says "OUTER SHELL FULL." For the two cups that now have 8 electrons, also put in a piece of paper to each cup that says "OUTER SHELL FULL."

Trying it on your own - 1 to 1 ratio
9. Using the grains of rice and cups, complete the table below and build these atoms. Label each cup with the atom symbol and take a picture of your atoms. Remember the rice is only represents the VALENCE electrons.

<table>
<thead>
<tr>
<th>Atom</th>
<th>Metal/Nonmetal</th>
<th>Valence Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Li</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10. Following the bonding procedure in step 6, bond each atom, so it has a full valence shell. Remember to put the piece of paper in to show that they have FULL OUTER SHELLS. You might find it helpful to separate them by metal and nonmetal.

Which atoms formed bonds? Take a picture.

11. Did your cups representing METALS end up empty or full? Did you cups representing NONMETALS end up empty or full?

12. Would an empty cup have a positive or negative charge? Would a full cup have a positive or negative charge?

13. Draw or take a picture of your before and after and paste it here:

14. Would the atoms in the before picture be called "ions"? Why/why not?

Trying it on your own - 2 to 1 ratio

15. Sometimes in order to fill the outer shell an atom will be forced to steal electrons from more than one atom. Build the atoms below:

<table>
<thead>
<tr>
<th>Atom</th>
<th>Metal/Nonmetal</th>
<th>Valence Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ca</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Br</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
16. Now try bonding each atom so that all of them have full shells. Remember an atom will keep giving or stealing until it has EIGHT or ZERO. Do not put the piece of paper labelled "FULL OUTER SHELL" in the cup until it has 8 or 0 in the cup.
   a. Which atom needed more than one atom to have a full shell?

2. How many Lithium atoms would Nitrogen need in order to have a full shell?

Practicing your ionic bonding:
Use this game to practice creating bonds between atoms. Then answer the analysis questions [https://www.brainpop.com/games/collisionsionicbonding/?topic_id=](https://www.brainpop.com/games/collisionsionicbonding/?topic_id=)

17. How did the game represent valence electrons?
   a. Dots
   b. Rings
   c. Whole Atoms
   d. Highlighted areas
   e. Letters
   f. Connections between atoms
   g. "X"

18. Use one of the atoms from the game to explain your answer to the previous question.

19. What color does the game use for METALS?

20. What color does the game use for NONMETALS?

21. Draw or explain one of the bonds that required more than 2 atoms

\[
\text{M}_9\text{Na}_{g} \text{Cl}_10
\]
2.6a BASIC Naming Types of Bonds

Part 1: Monatomic Ions

Ions are atoms that have either lost or gained electrons. While atoms are neutral, ions are charged particles.

A loss of electrons results in a positive ion or cation (pronounced “cat-eye-on”). A gain of electrons results in a negative ion or anion (pronounced “an-eye-on”).

Although ions and elements have similar chemical symbols, they are entirely different substances with different physical properties.


A. Monatomic Ions

In order to determine the charge of monatomic ions, you can use the periodic table as a guide:

<table>
<thead>
<tr>
<th>Group # (Column)</th>
<th>Ion Charge</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>These elements <strong>lose one</strong> electron to form <strong>+1</strong> ions.</td>
<td>Na⁺, Li⁺, K⁺</td>
</tr>
<tr>
<td>2</td>
<td>These elements <strong>lose two</strong> electrons to form <strong>+2</strong> ions.</td>
<td>Mg²⁺, Ca²⁺, Ba²⁺</td>
</tr>
<tr>
<td>Groups 3-12</td>
<td>The elements in groups 3-12 are called transition metals. These elements always lose electrons to form <strong>positive</strong> ions (cations) but their charges vary. For example, iron can form a +2 or a +3 ion. <em>In cases like these, you must be told which ion to use.</em></td>
<td>Fe²⁺, Fe³⁺</td>
</tr>
<tr>
<td>13</td>
<td>These elements <strong>lose three</strong> electrons to form <strong>+3</strong> ion.</td>
<td>Al³⁺</td>
</tr>
<tr>
<td>14</td>
<td>The charges on these ions vary. Carbon and silicon do not form ions. For the rest of the group, you must be given the charge.</td>
<td>Sn²⁺, Pb²⁺</td>
</tr>
<tr>
<td>15</td>
<td>These elements <strong>gain three</strong> electrons and form <strong>−3</strong> ions.</td>
<td>N⁻³, P⁻³</td>
</tr>
<tr>
<td>16</td>
<td>These elements <strong>gain two</strong> electrons to form <strong>−2</strong> ions.</td>
<td>O⁻², S⁻²</td>
</tr>
<tr>
<td>17</td>
<td>These elements <strong>gain one</strong> electron to form <strong>−1</strong> ions.</td>
<td>F⁻, Cl⁻, Br⁻, I⁻</td>
</tr>
<tr>
<td>18</td>
<td>These atoms do NOT form ions. Their charge is always <strong>zero</strong>.</td>
<td>He, Ne, Ar, Kr</td>
</tr>
</tbody>
</table>
Naming Ions (Nomenclature):
Simple **cations** are named by saying the element and adding the word “ion.”
\nNa\(^+\) is called “sodium ion”
Mg\(^{2+}\) is called “magnesium ion”

Simple **anions** are named by dropping the ending off the element name and adding “ide.”
F\(^-\) is called “fluoride”
O\(^{2-}\) is called “oxide”
N\(^{3-}\) is called “nitride”

Note: the charge of a monatomic **anion** is equal to the group number minus 18.

**Nomenclature Worksheet 1: Monatomic Ions**

*Use a periodic table to complete the table below:*

<table>
<thead>
<tr>
<th>Element Name</th>
<th>Element Symbol</th>
<th>Ion Name</th>
<th>Ion Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. sodium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. bromine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. magnesium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. chlorine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. oxygen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. boron</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. lithium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. neon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. phosphorus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. aluminum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. calcium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. iodine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. nitrogen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. cesium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. sulfur</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. fluorine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. potassium</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part 2: Simple Binary Ionic Compounds

Ionic compounds are compounds formed by the combination of a cation and a anion. (Think: “metal plus nonmetal”). Ionic compounds are more commonly known as “salts.” Binary ionic compounds are compounds containing only two elements, as demonstrated in the examples below.

When writing formulas for ionic compounds, we use subscripts to indicate how many of each atom is contained in the compound. Remember that even though ions have charges, ionic compounds must be neutral. Therefore, the charges on the cation and the anion must cancel each other out. In other words, the net charge of an ionic compound equals zero.

**Example 1:**

For a salt containing sodium ion, Na\(^+\), and chloride, Cl\(^-\), the ratio is one to one. The positive charge on the sodium ion cancels out the negative charge on the chloride. 

\[ (+1) + (-1) = 0 \]

Therefore, the formula for the salt is NaCl. (The actual formula is Na\(_1\)Cl\(_1\), but chemists omit subscripts of 1).

**Example 2:**

For a salt containing calcium ion, Ca\(^{2+}\), and chloride, Cl\(^-\), the ratio can’t be one to one.

\[ (+2) + (-1) = +1 \]

Remember that ionic compounds must be neutral. In order to yield a neutral compound, two chlorides must bond to the calcium ion:

\[ (+2) + 2(-1) = 0 \]

So, the formula for this salt is CaCl\(_2\).

**Nomenclature:**
When naming ionic compounds, simply write the *element name* of the metal followed by the *ion name* of the nonmetal. (Remember: the metal ion (cation) is always written first!)

NaCl is called “sodium chloride,” and CaCl₂ is called “calcium chloride.”

**Nomenclature Worksheet 2:**  
**Simple Binary Ionic Compounds**

*Please complete the following table:*

<table>
<thead>
<tr>
<th>Name of Ionic Compound</th>
<th>Formula of Ionic Compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sodium bromide</td>
<td>K₂O</td>
</tr>
<tr>
<td>2. Calcium chloride</td>
<td>MgI₂</td>
</tr>
<tr>
<td>3. Magnesium sulfide</td>
<td>AlCl₃</td>
</tr>
<tr>
<td>4. Aluminum oxide</td>
<td>CaBr₂</td>
</tr>
<tr>
<td>5. Lithium phosphide</td>
<td>Na₃N</td>
</tr>
<tr>
<td>6. Cesium nitride</td>
<td>LiF</td>
</tr>
<tr>
<td>7. Potassium iodide</td>
<td>Ba₃P₂</td>
</tr>
<tr>
<td>8. Barium fluoride</td>
<td>Cs₂S</td>
</tr>
<tr>
<td>9. Rubidium nitride</td>
<td>SrF₂</td>
</tr>
<tr>
<td>10. Barium oxide</td>
<td></td>
</tr>
</tbody>
</table>
Part 3: Polyatomic Ions

Video Instructions: Naming Compounds with Polyatomic Ions

Polyatomic ions contain two or more different atoms (polyatomic means “many atoms”). Here are some common examples:

a. **ammonium ion, NH₄⁺** (the only positive polyatomic ion you need to know)

b. **“ATE” ions:** contain an atom bonded to several oxygen atoms:

   Nitrate = NO₃⁻  Phosphate = PO₄³⁻  Sulfate = SO₄²⁻
   Carbonate = CO₃²⁻  Acetate = CH₃CO₂⁻  Chlorate = ClO₃⁻

c. **“ITE” ions:** remove one oxygen from the “ATE” ion and keep the same charge:

   Nitrite = NO₂⁻  Phosphite = PO₃³⁻  Sulfite = SO₃²⁻
   Chlorite = ClO₂⁻
Other common complex ions:

Hydroxide = OH⁻  
Cyanide = CN⁻

Ionic Compounds Containing Polyatomic Ions

As you've already learned, ionic compounds are formed by the combination of a positive ion (cation) and a negative ion (anion). This is the same when dealing simple ions or complex ions. Be careful to note, however, that complex ions are grouped together and should not be separated. In other words, don’t ever separate the sulfate ion, SO₄²⁻ into sulfur and oxygen. If it's written as a group, keep it as a group!

Since complex ions come in groups, things can get tricky when using subscripts. As a result, we use parentheses to separate the ion from the subscript:

If we need two sulfates in a compound, we write: (SO₄)₂.  
If we need three nitrates in a compound, we write: (NO₃)₃.

And, just as before, the net charge of the compound must be zero. For a salt containing sodium ion, Na⁺, and nitrate, NO₃⁻, the ratio would be 1:1 since the positive and negative charges cancel out. Therefore, the formula is NaNO₃ and is called sodium nitrate. (Note: no parentheses are necessary here).

For a salt containing calcium ion, Ca²⁺, and nitrate, NO₃⁻, the ratio must be 1:2 (one calcium ion for every two nitrates). So, the formula would be Ca(NO₃)₂.

Nomenclature Worksheet 3: Ionic Compounds Containing Polyatomic Ions

Please complete the following table:

<table>
<thead>
<tr>
<th>Name of Ionic Compound</th>
<th>Formula of Ionic Compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sodium chromate</td>
<td></td>
</tr>
<tr>
<td>2. Calcium carbonate</td>
<td></td>
</tr>
<tr>
<td>3. Magnesium nitrate</td>
<td></td>
</tr>
<tr>
<td>4. Aluminum sulfate</td>
<td></td>
</tr>
<tr>
<td>5. Lithium phosphate</td>
<td></td>
</tr>
<tr>
<td>6. Ammonium chloride</td>
<td></td>
</tr>
</tbody>
</table>
Part 4: Ionic Compounds Containing Transition Metals

The transition metals are the elements located in the middle of the periodic table (in groups 312. Unlike the group 1A and 2A metal ions, the charges of transition metal ions are not easily determined by their location on the periodic table. Many of them have more than one charge (also known as an oxidation state). There are eight transition metals that you should highlight on your periodic table:

Co, Cr, Cu, Fe, Mn, Hg, Sn, and Pb

Each of these elements form more than one ion and therefore must be labeled accordingly. For example, iron forms two ions: Fe^{2+} and Fe^{3+}. We call these ions “iron (II) ion” and “iron (III) ion” respectively. (See “Table of Transition Metal Ions”).

When naming any ion from the elements listed above, you MUST include a Roman numeral in parentheses following the name of the ion. The this roman numeral is equal to the charge on the ion. We don’t include the “+” because all metal ions are positive. Here are two more examples:

Pb^{4+} = “lead (IV) ion”  Cr^{3+} = “chromium (III) ion”
Similarly, when naming a compound containing one of these transition metals, you must include the Roman numeral as well. “Iron Chloride” isn’t specific enough since the compound could contain either iron (II) or iron (III) ion. You must specify the charge on the iron.

Iron (II) chloride contains the Fe\(^{2+}\) ion. When combined with chloride, Cl\(^{-}\), we know the formula must be FeCl\(_2\).

Iron (III) chloride contains the Fe\(^{3+}\) ion. This time, three chlorides are required to form a neutral compound. Therefore, the formula is FeCl\(_3\).

**By looking at the formula of an ionic compound, we can determine the charge (oxidation state) of the metal.**

**Example:** Write the name of Co\(_2\)O\(_3\)

1. Recognize that Co, cobalt, is a transition metal. This means that you must include a Roman numeral after its name. So, the basic name will be Cobalt (__) Oxide.
2. To find the charge on cobalt, use oxide as a key. Oxide has a charge of –2 so three oxides will have a charge of –6.
3. What balances a –6 charge? A +6 charge! So, the positive half of the compound must equal +6.
4. Since there are two cobalt ions, the charge is split between them. So, each one has a +3 charge. Therefore, we are using the Co\(^{3+}\) ion and the compound is called cobalt (III) oxide.

Remember that anions (negative ions) always have a definite charge. When dealing with compounds containing transition metals, *look to the anion first*. Determine the charge of the anion and then solve to figure out the charge of the cation.

When dealing with metals other than the transition metals, you don’t need Roman numerals. In other words, calcium ion, Ca\(^{2+}\) is always +2. Don’t call CaCl\(_2\) “calcium (II) chloride.” Its name is “calcium chloride.”

---

**Nomenclature Worksheet 4:**

**Ionic Compounds Containing Transition Metals**

*Please complete the following table:*

<table>
<thead>
<tr>
<th>Name of Ionic Compound</th>
<th>Formula of Ionic Compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Copper (II) sulfate</td>
<td></td>
</tr>
<tr>
<td>2. Copper (I) oxide</td>
<td></td>
</tr>
</tbody>
</table>
3. Chromium (III) cyanide
4. Cobalt (II) hydroxide
5. Silver bromide
6. Zinc nitrate
7. Iron (III) acetate
8. Lead (IV) sulfate
9. FeCl₂
10. PbSO₃
11. Co₂(CO₃)₃
12. AgNO₃
13. Zn(CN)₂
14. CuClO₃
15. Cr(OH)₃
16. Hg₂O

Nomenclature Worksheet 5: Ionic Compounds Summary

<table>
<thead>
<tr>
<th>Name the following compounds:</th>
<th>Name:</th>
<th>Give the formula for each compound:</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CaF₂</td>
<td>23. sodium fluoride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Na₂O</td>
<td>24. potassium sulfide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. BaS</td>
<td>25. calcium carbonate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. CuSO₄</td>
<td>26. magnesium hydroxide</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Fe₂O₃</td>
<td>27. zinc nitrate</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>HgCl₂</td>
<td>28. silver acetate</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>AgNO₃</td>
<td>29. copper (II) oxide</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>MgCO₃</td>
<td>30. iron (III) chloride</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>KC₂H₃O₂</td>
<td>31. barium chromate</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>K₂Cr₂O₇</td>
<td>32. aluminum oxide</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Al(OH)₃</td>
<td>33. lead (II) sulfate</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>PbBr₂</td>
<td>34. tin (IV) oxalate</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>ZnSO₃</td>
<td>35. calcium phosphate</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>NaHCO₃</td>
<td>36. lithium permanganate</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>NH₄Cl</td>
<td>37. mercury (I) nitrate</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Li₃PO₄</td>
<td>38. radium sulfite</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>SnCl₂</td>
<td>39. chromium (III) chloride</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Al(NO₂)₃</td>
<td>40. ammonium sulfide</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Rb₂CrO₄</td>
<td>41. copper (II) acetate</td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>KMnO₄</td>
<td>42. calcium bicarbonate</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>CuCl</td>
<td>43. tin (II) oxide</td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>FeSO₄</td>
<td>44. silver sulfite</td>
<td></td>
</tr>
</tbody>
</table>
Part 5: Naming Binary Covalent Compounds

Binary covalent compounds come from the combination of two nonmetals (or a nonmetal and a metalloid). These compounds do not involve ions; as a result, they have a slightly different naming system. Chemists use prefixes to indicate the number of atoms in each compound. The prefixes are listed in the table below:

<table>
<thead>
<tr>
<th># of Atoms</th>
<th>Prefix</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mono</td>
</tr>
<tr>
<td>2</td>
<td>Di</td>
</tr>
<tr>
<td>3</td>
<td>Tri</td>
</tr>
<tr>
<td>4</td>
<td>Tetra</td>
</tr>
<tr>
<td>5</td>
<td>Penta</td>
</tr>
<tr>
<td>6</td>
<td>Hexa</td>
</tr>
<tr>
<td>7</td>
<td>Hepta</td>
</tr>
<tr>
<td>8</td>
<td>Octa</td>
</tr>
<tr>
<td>9</td>
<td>Nona</td>
</tr>
<tr>
<td>10</td>
<td>Deca</td>
</tr>
</tbody>
</table>

When naming binary covalent compounds, the first element name is given followed by the second element with an “ide” ending. The first element gets a prefix when there is more than one atom in the compound.* The second element ALWAYS gets a prefix. Here are some examples:

<table>
<thead>
<tr>
<th>Compound</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO*</td>
<td>Nitrogen Monoxide</td>
</tr>
<tr>
<td>N₂O</td>
<td>Dinitrogen Monoxide</td>
</tr>
<tr>
<td>NO₂⁺</td>
<td>Nitrogen Dioxide</td>
</tr>
<tr>
<td>N₂O₃</td>
<td>Dinitrogen Trioxide</td>
</tr>
<tr>
<td>N₂O₄</td>
<td>Dinitrogen Tetraoxide</td>
</tr>
<tr>
<td>N₂O₅</td>
<td>Dinitrogen Pentaoxide</td>
</tr>
</tbody>
</table>
* Notice that the prefix “mono” is omitted in these cases

Prefixes are necessary when naming covalent compounds because the atoms can combine in any whole number ratio. N₂O, for example, cannot simply be called “nitrogen oxide,” because there are several other compounds that contain nitrogen and oxygen. We must specify that there are two nitrogen atoms bonded to a single oxygen atom.

When dealing with ionic compounds, there is only one way for a cation and anion to combine to form a neutral compound. As a result, there is no need to use prefixes. This is why CaCl₂ is called “calcium chloride,” rather than “calcium dichloride.”

Nomenclature Worksheet 6:
Binary Covalent Compounds

Please complete the following table:

<table>
<thead>
<tr>
<th>Name of Covalent Compound</th>
<th>Formula of Covalent Compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. carbon dioxide</td>
<td></td>
</tr>
<tr>
<td>2. phosphorus triiodide</td>
<td></td>
</tr>
<tr>
<td>3. sulfur dichloride</td>
<td></td>
</tr>
<tr>
<td>4. nitrogen trifluoride</td>
<td></td>
</tr>
<tr>
<td>5. dioxygen difluoride</td>
<td></td>
</tr>
<tr>
<td>6. N₂F₄</td>
<td></td>
</tr>
<tr>
<td>7. SCl₄</td>
<td></td>
</tr>
<tr>
<td>8. ClF₃</td>
<td></td>
</tr>
<tr>
<td>9. SiO₂</td>
<td></td>
</tr>
<tr>
<td>10. P₄O₁₀</td>
<td></td>
</tr>
</tbody>
</table>

Determine whether the following compounds are covalent or ionic and give them their proper names.

1. Ba(NO₃)₂
2. CO
Shortcut for Formula Determination:

Use the following method when asked to determine the formula of an ionic compound:

1. Write the two ions with their charges (metal first).
2. Ignoring the + or – charges, “crisscross” the numbers and make them subscripts.
3. Then, rewrite the formula, dropping the charges.

(See Examples Below)

Example 1:
Write the formula for calcium chloride:

1. Write the two ions with their charges (metal first).

Ca\(^{2+}\)   Cl\(^{-}\)

2. Ignoring the + or – charges, “crisscross” the numbers and make them subscripts:

Ca\(^{2+}\)   Cl\(^{-}\)

3. Then, rewrite the formula, dropping the charges. In this case, the formula is:

CaCl\(_2\).

Example 2:
Write the formula for magnesium oxide:
1. Write the two ions with their charges (metal first).
   \[ \text{Mg}^{2+} \quad \text{O}^{2-} \]

2. Ignoring the + or – charges, “crisscross” the numbers and make them subscripts:
   \[ \text{Mg}^{2+} \quad \text{O}^{2-} \]

3. Then, rewrite the formula, dropping the charges. The rewritten formula is: \( \text{Mg}_2\text{O}_2 \). **Note:** Since the subscripts for the anion and cation are the same, the formula reduces to \( \text{Mg}_1\text{O}_1 \).

   Therefore, the correct formula is written as: \( \text{MgO} \).
1.1 Scientists’ Ideas Reading

After completing lessons 1-4, read the following. Think about how the ideas relate to the evidence you have collected.

Metals can conduct electricity as solids and liquids. Substances that contain metals and nonmetals only conduct when they are dissolved.

Elements on the periodic table can be divided into metals, metalloids, and nonmetals. Metals are elements that tend to more easily lose their electrons. Nonmetals are elements that more strongly hold onto their electrons and more easily gain extra electrons. Metalloids can sometimes behave as metals, and sometimes as nonmetals.

The periodic table is well organized in terms of metals and nonmetals. Metals are mostly on the left side of the periodic table (hydrogen being the one exception). Metals also include some elements not commonly thought of as metals, like sodium and calcium. The periodic table to the right shows the division of the elements on it.

Substances made of only metal atoms conducted when they were solid but did not cause water to conduct when they were placed in the water. Metallic bonds conduct as a solid, but do not dissolve and do not cause water to conduct. Substances made of a metal and a nonmetal did not conduct as solids but caused water to conduct when they were placed in the water and dissolved. Substances made of only nonmetals did not conduct as solids and did not cause water to conduct whether they dissolved or not.

Substances have various abilities to conduct electricity as solids or when dissolved due to the different types of bonds formed between the atoms of the substance.
There are four models of chemical bonding determined by the distribution of electrons within the bond. The four models include ionic, network covalent, metallic, and molecular covalent.

The type of bonding in a substance affects the properties of that substance: ionic, metallic, molecular covalent, and network covalent.

Moving from left to right across the periodic table, the atoms have an increasing number of protons. This increases the force with which they hold onto their valence electrons. Metals are elements that have a relatively weak hold on their electrons, so they are likely to lose electrons. Nonmetals have a relatively strong hold on their electrons and so are more likely to gain electrons. Metalloids usually behave different ways around metals and nonmetals because they are right in the middle in terms of relative strength of attraction between valence electrons and nucleus.

**Ionic bonds** are usually made of a metal and a nonmetal. Metal atoms donate their valence electrons and become positively charged. Nonmetal atoms accept valence electrons and become negatively charged. The positive metal ion and negative nonmetal ion attract and form an ionic bond.

**Metallic bonds** are composed of only metal atoms which are trying to get rid of their valence electrons. Without other atoms to accept these unwanted electrons, the metal atoms share their electrons communally in a “sea of electrons.” Pictured to the right are the metallic bonded substances.

**Covalent bonds** are usually made of all nonmetals, so they hold onto electrons relatively equally. Electrons are shared between atoms. **Network covalent substances** share electrons tightly with multiple atoms near them, creating an interlocking grid. **Molecular covalent substances** share their electrons with only a few atoms, creating groups of atoms called molecules.
The type of bonding determines the properties of the substance.

Ionic bonding, composed of a positive metal ion and negative nonmetal ion, makes the substance very likely to dissolve because the charged particles are attracted to the charged parts of water molecules. **Ionic substances** are hard, but also very brittle because a slight shift can cause similarly charged ions to become close to each other and make it break apart. Ionic that have ionic bonds conduct when they are dissolved in a solution.

**Metallic substances** are malleable and bendable because their electrons can shift around, and that holds the substance together as the atoms shift. Metals do not dissolve because the electrons are always in the middle and hold the atoms together. Substances that have metallic bonds conduct as solids.

**Molecular covalent substances** are usually very soft or liquids or gases because the molecules want to move freely. They dissolve relatively easily because the molecules spread apart in a substance like water.

**Network covalent substances** are hard and very strong because the atoms are connected in many ways and do not shift easily. They do not dissolve because the atoms do not want to come apart. Conductivity of a substance is determined by bonding of atoms. Ionic bonds do not conduct as a solid but can dissolve and cause water to conduct when they are dissolved in water. Network covalent substances do not conduct, do not dissolve, and do not cause the water to conduct. Molecular covalent substances do not conduct, they do dissolve, but they do not cause water to conduct when dissolved.

Knowing the different properties of different substances, we can look at those properties and determine what type of bonding is in those substances. Something that is very hard, brittle, and dissolves could easily be inferred to be ionic. Something that is a bendable solid that will not dissolve could easily be inferred to be metallic. Something that is an extremely hard solid that is not malleable or bendable and does not dissolve is probably a network covalent. And something that is extremely soft as a solid or is a liquid or gas and dissolves is probably molecular covalent.
Ionic bonds are formed by the transfer of electrons and occur in predictable ratios based on the number of valence electrons.

The most important types of bonds for this unit are the ionic bonds. In ionic bonds, some atoms lose valence electrons and other atoms gain valence electrons. This makes them charged ions. The ions are then attracted to each other because one ion is positively charged and the other is negatively charged. The ratio between positive metals and negative nonmetals of ionic substances is predictable because they are combined to produce a substance that is net neutral.

For example, in lithium fluoride, the lithium atom will donate 1 electron to fluorine. Lithium will become a 1+ lithium ion and fluorine will accept the single electron and become a 1- fluoride ion. Collectively, the charges of these ions balance leaving a neutrally bonded substance. The chemical formula for lithium fluoride is written LiF. Since only one atom of lithium and of fluorine are required, no subscripts are used to indicate multiple atoms.

In the case of lithium oxide, two lithium atoms will donate 1 electron each to oxygen. Each lithium will become a 1+ lithium ion and oxygen will accept the two electrons and become a 2- oxide ion. Collectively, the charges of these ions balance leaving a neutrally bonded substance. The chemical formula for lithium oxide is written Li₂O. Since two atoms of lithium are required, the subscript “2” is used after Li and none are used after O.

Respond to the following questions individually in your lab notebook:

1. A friend says to you that sodium is not a metal because it is table salt. How would you respond?
2. How do electrons behave differently in ionic bonds and metallic bonds?
3. A mystery substance conducts electricity and you are able to bend it with your bare hands. What kind of bond do you think it has? Why?
4. A friend tests the conductivity of magnesium chloride (MgCl₂) and notes that it does not conduct electricity. They suggest that it has a network covalent bond, because it is pretty hard as a solid. What test might you suggest they perform and why?
5. Write the chemical formulas for following ionic compounds:
   a. Calcium Fluoride
   b. Barium Sulfide
   c. Magnesium Iodide
Respond to the following questions individually in your lab notebook:

1. A friend says to you that sodium is not a metal because it is table salt. How would you respond?

2. How do electrons behave differently in ionic bonds and metallic bonds?

3. A mystery substance conducts electricity and you are able to bend it with your bare hands. What kind of bond do you think it has? Why?

4. A friend tests the conductivity of magnesium chloride (MgCl₂) and notes that it does not conduct electricity. They suggest that it has a network covalent bond, because it is pretty hard as a solid. What test might you suggest they perform and why?

5. Write the chemical formulas for following ionic compounds:
   a. Calcium Fluoride
   b. Barium Sulfide
   c. Magnesium Iodide

2.7 Solubility Phet
Tuesday, January 7, 2020
5:52 AM

Sugar and salt are both white crystalline solids commonly found in the home. This exercise allows you to investigate how these compounds might be distinguished from each other.

This simulation may be downloaded from the PhET website at http://phet.colorado.edu/en/simulation/sugar-and-salt-solutions.

If you can not download/use java, please see the video at the bottom of this page.

Purpose: in this experiment, you will explore the behavior of sugar and salt in water and attempt to classify these substances into categories.
**Procedure**

*Part I: Open Exploration*

1. Open the “Sugar and Salt Solutions” PhET simulation. Take five minutes to explore the functions available. Share with a partner at least two interesting items that you discovered. Record these discoveries in the space provided.

   *One interesting thing I discovered is that...*

   *Another interesting thing is...*

*Part II: Macro (First Tab)*

2. Make the light bulb glow. Record your observations in Table 1.

   **Table 1. Macro Exploration**

<table>
<thead>
<tr>
<th>Compound</th>
<th>What Happens to the Light Bulb? (Glow/Does not glow)</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Make the light bulb glow as brightly as possible. Explain your procedure.

   *To make the light bulb glow brightly, I...(describe what you changed)...*

4. Explore what happens to the sugar and salt solutions with the evaporation slider. Describe what happens during the evaporation process for a solution.

   *When I increase the evaporation slider, the solution...*

5. Using Table 2, classify sugar and salt as either an electrolyte or a nonelectrolyte:

   **Table 2. Electrolyte/Nonelectrolyte Reference**
<table>
<thead>
<tr>
<th>Substance</th>
<th>When Added to Water</th>
<th>What Happens to the Light Bulb?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrolyte</td>
<td>Conducts electricity</td>
<td>Glows</td>
</tr>
<tr>
<td>Nonelectrolyte</td>
<td>Does not conduct electricity</td>
<td>Does not glow</td>
</tr>
</tbody>
</table>

a. **Sugar is a(n)...**

b. **Salt is a(n)...**

*Part III: Water (Third Tab)*

6. What happens as you add sugar or salt to water? Fill in Table 3 with what you find.

**Table 3. Water Exploration**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Electrolyte or Nonelectrolyte?</th>
<th>Drawing</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. Using the observations made with salt in water and sugar in water; propose one possible explanation for the light bulb glowing under the “Macro” tab.

*The light bulb glows because when salt is put it water it…*

*The light bulb does not glow because when sugar is put it water it…*

*Extension*

*Remember from our previous lessons that ionic is when a metal and nonmetal comes together.*

*Part IV: Micro (Second Tab)*
8. What happens when other compounds are added to water? Fill in Table B with what you discover. Fill in the PREDICTION column before you test each substance.

**Table B. Micro Exploration**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Break Apart or Stay Together?</th>
<th>Break Apart or Stay Together?</th>
<th>Electrolyte or Nonelectrolyte?</th>
<th>Ionic ?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prediction</strong></td>
<td><strong>Observation</strong></td>
<td>****</td>
<td>****</td>
<td>****</td>
</tr>
<tr>
<td>Salt (NaCl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar (C_{12}H_{22}O_{11})</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium chloride (Ca_{2}Cl )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium nitrate (NaNO_{3})</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucose (C_{6}H_{12}O_{6})</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. On the picture below, draw what happens to salt when it is placed into water.
10. Electricity is the "movement of charged particles." What do you think is happening for an electric current to happen?

**If you couldn't download Java, please watch the video below.**
If you want to get more out of this, watch the video on MUTE so you can analyze what is happening.

[sugar and salts PHET](https://phet.colorado.edu/sims/sugar-and-salts)
2.8 Electrolysis of Copper II Chloride
Tuesday, January 7, 2020
5:53 AM

**Observations**
Observe closely what is happening in this video. Within the water is copper (II) chloride. As the electricity is turned on, notice what happens to the wires. You do NOT need sound for either video.

Video 1: Starting
[Electrolysis of Copper(II)Chloride](#)
Video 2: After a while (NOTE: The wires are reversed in this video)

Close up on a copper chloride electrolysis

**Electrolysis:** The separating of a compound using electricity

1. What did you see happen to wires?
2. What does this evidence tell us about copper and chlorine dissolved in water? (Note: Cl₂ is a gas at room temperature, and Cu is a solid)

3. Which wire must have been positively charged? Negatively? Hint: think about the ions in the water.

Video 3 (watch with sound):
Electrolysis of copper(II)chloride

4. Were your ideas in question 3 correct based on the third video?
5. For copper to bond with other copper atoms, it must start as a neutral atom. What must copper gain when it hits the wire in order to be neutral again (think about what it gave to chlorine)?

6. **Electricity is defined as the “movement of charged particles.”** What type of charged particles are moving in the water?

7. What type of charged particles are moving in metal wires?

8. What must be happening when a positive ion (cation) touches a negative wire?

9. What must be happening when a negative ion (anion) touches a positive wire?

Video 4: Electrolysis explanation (checking your answers)

*What Is Electrolysis | Reactions | Chemistry | FuseSchool*
10. Based on the video, were your answers to questions 8 and 9 correct?
11. What did you learn from the video?

SIR PART 2: Solubility and Conductivity
Friday, April 3, 2020
5:13 AM

<<I.2 SIR (1).docx>>

<<I.2 SIR (1).docx.pdf>>
I.2 Scientists’ Ideas Reading

After completing lessons 5-6, read the following. Think about how the ideas relate to the evidence you have collected.

Many ionic compounds are soluble in water, dissociating into positive and negative ions.

Ionic and covalent substances dissolve differently. When ionic substances dissolve, they separate into ions. Molecular covalent substances separate into their molecules, but not charged ions.

When molecular covalent substances dissolve, they do so because their molecules spread out into the water (or whatever substance they are dissolving in). With sugar, for example, it is made of C_{12}H_{22}O_{11} molecules, meaning each molecule has 12 carbon atoms, 22 hydrogen atoms, and 11 oxygen atoms bonded together. In a solid, those molecules hold together loosely as shown in the picture to the right. When added to water, the molecules separate from each other and spread out into the water as seen in the illustration below. The sugar appears to disappear because the molecules are spread so far apart, you can’t see them.

Molecular covalent substances follow this pattern, where the water can cause the molecules to spread apart but does not separate the molecules. The important point is that sucrose is always still in the formula of C_{12}H_{22}O_{11} wherever it is in the solution. It does not separate into carbon, hydrogen, or oxygen.

When ionic substances dissolve in water, they separate out into different ions. For example, sodium chloride is composed of sodium and chloride ions and has a formula of NaCl. As a solid, the sodium and chloride ions hold together very tightly. When sodium chloride dissolves in water, it separates out, not into NaCl molecules, but into Na^+ ions and Cl^- ions.

Ionic substances follow this pattern. When they dissolve, the ions separate from each other. There are always cations (positive ions) and anions (negative ions) floating freely in the water. The more thoroughly the substances dissolve, the more ions there are floating freely.
These differences between the ways ionic and covalent substances dissolve helps to explain the conductivity of ionic substances when dissolved.

The presence of ions in solution allows the solution to conduct electricity.

2.5b.

Electricity is the flow of charged particles. For a substance to conduct electricity, charged particles must be free to move within the substance. In solid metals, such as copper, negatively charged electrons shared between the metal atoms can flow between atoms allowing the metal to conduct electricity. When ionic compounds are dissolved in a liquid, the charged ions (the cations and anions) flow freely through allowing the solution to conduct electricity.

The conductivity of ionic solutions is different from the conductivity of metals. In solution, charged ions move, not electrons. Rather than having just the negative charged electrons move in solution, the cations and the anions are moving.

2.6.

In solution, positive ions are attracted to the negative electrode of a conductivity tester and negative ions are attracted to the positive electrode of a conductivity tester.

Electrolysis is the process of running an electric current through a salt solution, which is an ionic compound dissolved in a liquid. In this process the positive and negative ions of the ionic compound will separate from each other in the solution.

To introduce an electric current, a power source such as a battery is connected to a positive electrode and negative electrode which are then placed into the solution. When the circuit is complete, the positively charged ions (cations) in the solution move towards the negatively charged electrode (cathode). And the negatively charged ions (anions) move towards the positively charged electrode (anode). When we did this lab, we ran a current through a solution of copper (II) chloride (CuCl₂). At a macroscopic level, we observed the copper solid forming on the negative electrode (cathode) and chlorine gas forming bubbles at the positive electrode (anode).
This means that the cathode is contributing a bunch of electrons into the solution. Instead of moving through the solution, the electrons attract the positive cations to the cathode. Those electrons can join the positive copper ions and make those copper ions turn neutral. When they turn neutral, they are no longer able to stay dissolved, so the neutral copper starts to form.

The anode is trying to absorb electrons, so it is very positively charged. The negative anions are attracted to this terminal. Since they have extra electrons, they sacrifice their extra electrons to become neutral. Those electrons go into the anode, and the anions become neutral, so they start to come out of solution, and we see neutral chlorine gas form.

However, electron movement is involved because the cathode contributes electrons to the solution, and the cations absorb them and become neutral. At the anode, the anions give up their electrons to become neutral and the anode absorbs them in. At the cathode, the electrons are flowing out, and at the anode the electrons are flowing in.

Respond to the following questions \textit{individually} in your lab notebook:

1. Draw pictures showing how potassium chloride dissolves in water. Include water as a particle.
2. Draw pictures showing how ethanol \([\text{C}_2\text{H}_6\text{O}]\) dissolves in water. Include water as a particle.
3. Explain the differences of what happens when you try to run an electric current through potassium chloride and ethanol.
4. A friend states that, “Electricity is the movement of electrons.” Do you agree or disagree with this statement? Explain why or why not.
Respond to the following questions individually in your lab notebook:

1. Draw pictures showing how potassium chloride dissolves in water. Include water as a particle.

2. Draw pictures showing how ethanol (C₂H₆O) dissolves in water. Include water as a particle.

3. Explain the differences of what happens when you try to run an electric current through potassium chloride and ethanol.

4. A friend states that, “Electricity is the movement of electrons.” Do you agree or disagree with this statement? Explain why or why not.

2.9 Electrocution Final Explanation
Tuesday, January 7, 2020
5:56 AM

Throughout this unit, you explored the properties of different types of substances. You learned about the different bond types and focused specifically on ionic bonding. You were exploring these properties in order to explain what could have happened to cause Madison to be electrocuted in the tub.

Before submitting your final explanation, answer these questions to help you prepare.

1. Can pure water conduct electricity (review 2.2)? Could Madison's bath water have been pure water?

2. How are valence electrons important to understanding ionic bonding?

3. What substance must have been in the bath water?

4. What "charged particles" would be moving to cause her to get electrocuted?

5. Why would a positive and negative wire sticking in the water be important?

Now try to explain each snapshot again:

| Before Cell phone is dropped sitting in bath | Once exposed wires hit the bath water |
Explanation of what is in the water and cell phone (include particles & charge):

Explanation of how electricity is flowing in the water to Madison (include particles & charge):

Learning Tracking Tool - Ionic Bonding and Conductivity
Monday, January 6, 2020
6:16 AM

What could have happened to cause electrocution of Madison in the bathtub?

<table>
<thead>
<tr>
<th>Assess: Am I with understanding?</th>
<th>Questions I still have?</th>
<th>did we figure out? Organize key information and with a description and/or</th>
<th>Your learning be used to explain the phenomenon?</th>
<th>did we do? The activity so you remember when you look</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
In an article about getting shocked in the bath tub, we were presented with our first question: What happened to electrocution of the tub?

We read out that there are main groups of substances based on their conduct and/or current possibilities for conductivity are:

- Conductors
- Insulators
- Semiconductors

We learned that the group that was the bath water must have been charged by charging your phone and using it in the bathtub, making it possible to be shocked by touching your body. We explored how the conductors and/or insulators are stolen or shared between atoms when different substances meet. We read about the Octet rule: how atoms will (give/steal) valence electrons and become (positive/negative).

We were asked to answer the question: Can you understand the phenomenon? Ready to start testing to get more information - don't tell me any yet.
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do we form ionic bonds?</td>
<td>By valence electrons moving in ionic bonds, we can name ionic bonds. From this, we can use the charge to identify atoms and their positions, which can be metal/nonmetal.</td>
</tr>
<tr>
<td>How do we indicate about present in bonds?</td>
<td>All atoms will transfer (valence) electrons and (positive/negative) charges, enabling the formation of ionic bonds.</td>
</tr>
<tr>
<td>We can see a phet that modeled substances dissolved in water.</td>
<td>The difference between dissolving and how sugar dissolves, are the atoms charged or uncharged?</td>
</tr>
<tr>
<td>The movement of the charged particles must have been Madison's bath water?</td>
<td>'Electricity' must have been the movement of negatively charged particles.</td>
</tr>
<tr>
<td>The difference between dissolved and how sugar dissolves, are the atoms charged or uncharged?</td>
<td>Here, we see gather around the movement of the charged particles. The wires are added to the phet to create a loose connection like the one above, be dangerous in water? What would the ionic charges in your water do?</td>
</tr>
<tr>
<td>Electrolysis of Chloride - dissolved in water, wires are added?</td>
<td>The chloride was dissolved over time to two left in an ionic solution.</td>
</tr>
<tr>
<td>You see gather around you?</td>
<td>You see gather around you?</td>
</tr>
<tr>
<td>They travel to different</td>
<td>You see gather around they travel to different ions in the water.</td>
</tr>
</tbody>
</table>
Madison got electrocuted in the bathtub. Be sure to explain the importance of substances in the water, and how electricity was flowing.