DEVELOPING A SCIENCE UNIT PLAN THAT IS BOTH INTERESTING AND EFFECTIVE FOR SECONDARY SCHOOLS

A thesis submitted to the Kent State University Honors College in partial fulfillment of the requirements for General Honors

by

Margaret Quinn Evans

May, 2015
Thesis written by
Margaret Quinn Evans

Approved by

__________________________________________, Advisor

__________________________________________, Director, School of Teaching,
Learning and Curriculum Studies

Accepted by

__________________________________________, Dean, Honors College
# TABLE OF CONTENTS

LIST OF TABLES ................................................................. iv

ACKNOWLEDGEMENT ......................................................... v

CHAPTER

I. INTRODUCTION .......................................................... 1

II. READY, SET, PLAN! ....................................................... 3

Collaborative Teaching ....................................................... 3

Determining Learning Objectives ........................................ 5

Appropriate and Essential Instruction and Activities .................. 6

III. ADAPTATIONS TO LESSON PLANS ............................. 9

Accommodations for Students with Special Needs ....................... 9

IV. SAMPLE UNIT PLAN .................................................... 14

Lesson 1: Charge It Elementally! ........................................ 20

Lesson 2: How Ionic – Predicting Ionic Compound Formulas ........ 39

Lesson 3: What’s In A Name? – Naming Ionic Compounds ............. 50

Lesson 4: Coo- Coo For Covalents – Naming Covalent Compounds .... 70

Lesson 5: Reverse, Reverse! – Formula Writing From Name .......... 84

Unit Test ................................................................. 96

WORKS CITED ............................................................... 106
LIST OF TABLES

Table 1. Collaboration with Other Teachers ................................................. 4
Table 2. Categories and Examples of Accommodations ......................... 10
AKNOWLEDGMENTS

First and foremost I would like to thank Dr. Lisa Borgerding for being such a crucial part of helping me write and edit this thesis. I would also like to take the time to thank Dr. Pritha Sumraminian, Dr. Paul Sampson, and Dr. Sarah Raven for taking the time to be a part of my defense committee. I would also like to thank my Fall 2013 and Spring 2013 Supplemental Instruction Classes for being the test dummies for my lesson activities. You have all been extremely supportive and helpful throughout this process. For that, I thank you.
CHAPTER ONE: INTRODUCTION

One of the most essential events in teaching is creating effective lessons and unit plans. The process of creating these lessons can be tedious, difficult, and time-consuming. This is why many teachers ask themselves why they need to take time from their already busy schedules to create them. Aside from the fact that is part of a teacher’s job, there are many positive and necessary reasons for lesson planning.

It is one thing to write a daily lesson plan simply to meet the requirements of a supervisor or cooperating teacher, which is what a lot of pre-service teachers say they do (Richards, 2002) and another to take the time to create a good, interactive, and effective plan. The teachers who take the time to do the latter and have the skills to create these types of lessons are the ones who are the most prepared, organized, and successful in the classroom.

As students who are learning how to become teachers, the idea of creating lesson plans is constantly placed into their heads from the very first teaching course. Students are expected to write detailed plans with different templates, different sections to include, and different styles. Very rarely though, do they get a chance to talk in depth about effective practices to consider when we are writing these plans. Emerging teachers should have the opportunity to be creative, to see what works and what doesn’t work, and to try new things! Lesson planning gives these teachers, as well as more experienced teachers, a way to get creative in a structured and organized way, rather than entering the classroom without a plan, which may lead to problems during the lesson. Sitting down and thinking about the lesson in
advance is a way to resolve problems and difficulties before they arise in the classroom

(Richards, 2002)
It becomes another task entirely when teachers lesson plan for science classrooms. Science can be very difficult for students to learn and understand. There are many abstract ideas, information is constantly changing as new facts are discovered, and there is “too much to learn and understand” (Vahia, 2013). It is the teachers’ job to create lessons that will effectively drive student learning and interest in the topics. To be able to do this, teachers need to be able to find content that is significant and worthwhile (that also fits within the content standards for the specific state), encourage collaboration and active learning among students, be certain that the content and activities are appropriate for the level of the students’ knowledge, keep a pace that maximizes student learning and understanding, and be able to have the lesson reflect careful planning and organization (Tweed, 2009). Science, more than any other subject, should be demonstrated in the classroom with hands-on learning activities. Rather than giving students notes to copy, teachers should give them experiences. As Benjamin Franklin once said “tell me and I forget. Teach me and I remember. Involve me and I learn.”

This paper investigates helpful hints and suggestions for new, and veteran, teachers to keep in mind while lesson planning for science instruction. In addition to the paper, a sample unit plan on the topic of ionic and covalent bonds has been included and will be referenced in the paper for examples.
CHAPTER TWO: READY, SET, PLAN!

Let’s set the stage. It is a week before your students’ first day in their new high school science class. It is one of the most exciting and stressful times of the year. Teachers haven’t received classroom schedules from administration quite yet, but are ready to start planning for the school year. Where is an effective and logical starting point? It is one of the most stressful times of the year. New teachers, especially, have so many questions and very few answers when they are just starting out.

COLLABORATIVE TEACHING

The first step in planning units and individual lessons should be to look at the schools’ curriculum and connect with other teachers in the same subject or grade level. One of the greatest resources new teachers can have will be returning, veteran teachers in the district. They have, more than likely, tried different activities or labs for each lesson (some successful, some not so successful). Being able to connect with other teachers builds a support system in which gaining insight and assistance comes naturally with troublesome topics. This allows returning staff members to ease the staff turnover strain by providing systematic professional assistance to beginners and by socializing newcomers, and veteran teachers, to values, traditions, and other resources available at the district (Inger, 1993). In addition to building a support system, there has been research, which shows that teachers who have worked together see improvements in student achievement, behavior, and attitude (Inger, 1993).
An article titled “Teachers as collaborative professionals” posted by Dick Weindling of the Association of Teachers and Lecturers provides a lot of questions that were given to teachers and other community members about collaborative teaching. The chart below (Table 1) is in response to a question that was delivered via survey (Weindling, 2005). The question read, “To do my job as a teacher more effectively I also need to work closely with:” The overwhelming majority of primary and secondary teachers strongly agreed that to be more effective teachers they need to work closely with other teachers in their school. There was only a total of 0.9 percent of primary teachers and 1.0 percent of secondary teachers that either don’t know or disagree with the posed question.

Table 1: COLLABORATION WITH OTHER TEACHERS

<table>
<thead>
<tr>
<th>Other teachers in my school</th>
<th>STRONGLY AGREE</th>
<th>AGREE</th>
<th>DON’T KNOW</th>
<th>DISAGREE</th>
<th>STRONGLY DISAGREE</th>
<th>MEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>78.8</td>
<td>20.3</td>
<td>0.0</td>
<td>0.9</td>
<td>0.0</td>
<td>4.77</td>
</tr>
<tr>
<td>Secondary</td>
<td>75.3</td>
<td>23.7</td>
<td>0.5</td>
<td>0.0</td>
<td>0.5</td>
<td>4.73</td>
</tr>
</tbody>
</table>

School type differences are not significant

Table 1 shows that primary and secondary school teachers believe that working with other teachers is a very important part of being able to teach more effectively. In addition to this survey, research conducted by Susan Moore Johnson and Susan Kardos titled “On their own and presumed expert: New teachers’ experience with their colleagues,” found that collaboration between new and veteran teachers improves teacher retention and satisfaction.
An integrated professional culture allows the new teachers’ needs to be recognized and all teachers share the responsibility for student success.

DETERMINING LEARNING OBJECTIVES

Now that good connections with other teachers in the school have been established, it is time to start planning lessons. To start planning a lesson, it is essential to look at the school’s curriculum and the state’s standards (make sure these stay in line with each other). This is something that veteran teachers will be able to guide new teachers with. When teachers are beginning to develop lessons and unit plans they should start by determining the major learning outcomes that students will take away (again seeking assistance from other teachers may provide insight). Having a goal is essential for planning good and effective lessons. It allows teachers, as well as the students, to know what they will be learning as the topic progresses. Without clearly defined learning outcomes, students may become confused at what they are supposed to focus on and get lost in the material.

According to an article found on the Gavilan College website “Writing Measurable Learning Outcomes” (Osters, 2003) objectives are brief, clear statements that describe the desired learning outcomes of instruction. Effective objectives should have the following characteristics.

1. Objectives have measurable learning outcomes.
2. Objectives should select appropriate assessment methods.
3. Objectives should use simple action verbs.
4. Objectives should be specific.
5. Objectives should not join more than one outcome.
These objectives should remain in line with the specific state’s standards. Ohio’s New Learning Standards for Science have content statements, content elaborations, and much more built into each grade topic. It is important to not simply take exactly what they have written (the majority of the time they are not simple statements), but take the ideas and make them into objectives so that students know exactly what is expected of them by the end of the lesson. For example, a good objective would read: by the end of this lesson students will be able to name different types of compounds.

The sample unit includes lesson objectives (in each lesson) directly under the standards and summary of sections. All lesson plans, based on what a teacher prefers, look different. However, in each lesson it is imperative to clearly state the objectives. In the classroom, these objectives can be posted on a white board, chalkboard, or an objective board. An objective board allows students to know exactly what is expected of them as they are working through a lesson. It also allows teachers to remain on task and check for understanding on the right material.

APPROPRIATE AND ESSENTIAL INSTRUCTION AND ACTIVITIES

Teachers today are extremely lucky to have the resources available to them: Internet, magazines, Pinterest, and thousands upon thousands of books dedicated to lesson ideas. However, with the extensive amounts of ideas out there, it is important to be able to recognize activities that students will equally enjoy and learn from. Being able to engage students and have them enjoy every single activity or lesson is almost impossible and teachers cannot use an activity just for activity sake. It must have a purpose.
Planning lesson activities must follow guidelines. First, activities must connect to the objectives of the lesson. If the lesson covers a broad topic and can only be tied to the lesson loosely, it is not going to be a good activity for the objective in discussion. That is not to say that it would not be good at a later time, but it is not connected to current material well enough to be used effectively. Second, it is never a good idea to use an activity just to have an activity. What this means is that there is some material that cannot be presented any way except using a traditional lecture format. This is not a bad thing and can be the best tool to deliver certain information to students. Teachers now can, however, put a spin on traditional lecture and present information in the form of a PowerPoint or an incomplete outline format. Many adjustments can be made in this aspect to make the normal lecture format more involved and interactive.

Finally, lesson plan activities should be appropriate for the grade level that it will be implemented in. It is typical to find a seemingly good idea or activity and want to use it in the classroom, but it is either too low or too high for the grade level. When this happens, it is okay to chalk it up as a missed opportunity and continue searching for new activities, but it is also a good idea to collaborate with other teachers (this is where collaborative learning can be extremely useful) to see how the activity can be modified to meet the grade level it is to be used in.

As a note, it is also important that activities do not take away from student learning. While teachers are making the change to more interactive and inquiry based learning, it is essential that students understand the content that is embedded into the activities. Teachers cannot rely completely on activities to teach students material. If this were true, we wouldn’t need teachers anymore. Students could simply go to school and have someone give them the
directions to a game or activity and hope they learn everything they need to. There must be a reason to use particular activities in a lesson to make it effective.

Throughout the example unit plan, activities have been included to support the various lessons. For example, in lesson 5, the activity is titled “Flyswatter.” It is an interactive way for students to practice finding formulas for given compounds. This activity could have been given in a worksheet format, but allowing students to get competitive brings a new feel to the classroom. Taking normally dry material and creating a fun way to present it allows students to connect and understand it more effectively. This activity can be adapted to almost any content and any subject. Teachers can change the formulas for vocabulary words, images, etc. Rather than having students simply memorizing flashcards or using drill worksheets over and over, getting students up and actively learning can work very effectively. According to a study done at the University of Washington active learning in science leads to increased examination performance and a 55% increase in failure rates under traditional lecturing (Freeman, 2014).
CHAPTER THREE: ADAPTATIONS TO LESSON PLANS

In the perfect world, all students would learn at the same pace and would all be on the same page at the same time. However, we do not live in a perfect world and not all students learn the same. As educators, we must prepare our lessons for all types of learners. Many classrooms and school districts are leaning towards or have already shifted to an inclusive type of classroom. This is where differently abled students are not isolated in the special education classroom all day, but are integrated into the classrooms with their fellow classmates.

While the inclusion vision continues to grow, this means that general education teachers and special education teachers are becoming more and more collaborative in the classroom setting. Many school districts have intervention specialists that integrate themselves into the general education teachers’ classrooms (much like the students themselves) by helping to adapt lessons to each student with disability’s individualized education plan or better known as an IEP. These IEPs are developed with each individual student in mind and are designed to best help the student learn the material the most effective way for that particular student.

ACCOMMODATIONS FOR STUDENTS WITH SPECIAL NEEDS

It is crucial to point out that while we are adjusting lessons for students with special needs, we do not give these students an unfair advantage over the other students in the classroom. The accommodations are made to “level the playing field” said Dr. Sheldon.
Horowitz and content should not be altered in any way for the given assignment. The National Center for Learning Disabilities breaks down possible accommodations into six categories: presentation, response, setting, timing, test scheduling, and other (ncld.org). The table below (Table 2) lists examples under each of the six categories. It is important for teachers to make sure that students with special needs are being assessed, like any other student, to see what they know without being hindered by their disability.

**Table 2: CATEGORIES AND EXAMPLES OF ACCOMMODATIONS**

<table>
<thead>
<tr>
<th><strong>Presentation</strong></th>
<th><strong>Response</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provide an audio tape</td>
<td>• Allow verbal responses</td>
</tr>
<tr>
<td>• Use large print</td>
<td>• Allow answers to be dictated to a scribe</td>
</tr>
<tr>
<td>• Reduce number of items per page</td>
<td>• Allow use of tape recorder</td>
</tr>
<tr>
<td>• Provide a designated reader</td>
<td>• Permit responses to be given via computer</td>
</tr>
<tr>
<td>• Present instructions orally and written</td>
<td>• Permit answers to be recorded directly into test booklet.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Setting</strong></th>
<th><strong>Timing</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provide preferential seating</td>
<td>• Allow frequent breaks</td>
</tr>
<tr>
<td>• Provide special lighting or acoustics</td>
<td>• Extend allotted time for a test</td>
</tr>
<tr>
<td>• Provide space with minimal</td>
<td></td>
</tr>
<tr>
<td>distractions</td>
<td>Test Scheduling</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>• Administer test in small group setting</td>
<td>• Administer test in several timed sessions or over several days</td>
</tr>
<tr>
<td>• Administer test in private room</td>
<td>• Allow subtests to be taken in a different order</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In addition to these examples of accommodations, it is crucial to get to know and understand students with special needs in a classroom. In a discussion with two intervention specialists during my student teaching experience it was brought to light that each student, even if he or she has the same special need as someone else, is in fact different. What works for one student may not work for another student. This is why it is crucial to get to know students in the classroom and see what works the best in each case. While reading an IEP is extremely important, they are very lengthy and can only shed so much light on the actual student. It can help to begin to understand how to best help the student achieve success, but it cannot help to understand the student’s personality.

For specific student accommodations it is imperative to have a close working relationship with the intervention specialist assigned to the student, previous teachers to communicate what has worked in the past, family members of the student, and any doctors or
guidance counselors that are listed in the student’s IEP. The student’s best interest should be what all of the individuals should be working towards. With so many people working to achieve one goal, lines can get blurred and the goal may be lost. All individuals must remember that everyone is working towards what is best for student.

Four out of five lessons in the sample unit plan include a PowerPoint presentation, which serves as a visual for students. Built into the PowerPoint slides are practice problems for students to work on at different parts of the lecture. This strategy breaks up the lecture so that students with trouble keeping on task for long periods of time can focus better. In addition to this feature, lessons 2, 3, and 4 include incomplete outlines that can assist students who may need visual or written accommodations. As discussed earlier, teachers must communicate with intervention specialists to best accommodate lessons to specific or particular student needs.
CHAPTER FOUR: SAMPLE UNIT

The creation of this unit plan was based on research studies conducted on the best ways to present information in ways that will keep students attention. Lecturing has been the predominant mode of instruction since universities were founded over 900 years ago (Brockliss, 1996). Based on research completed students are 1.5 times more likely to fail under traditional lecture style classes rather than classrooms that make use of active learning techniques (Freeman, 2014). The study took two classes, both taught by the same teacher, with one class being taught by traditional lectures and the second making use of active learning strategies. One important statistic showed that students in the active learning classroom received six percentage points higher than students in the traditional lecture classroom on an identical test. Simply by making the classroom environment more engaging students can retain more of the lesson than when they are passively listening to a lecture. In the sample unit, there are multiple activities that will reinforce student learning and keep their attention through active learning strategies.

Based on research conducted in an organic chemistry class by Donald Paulson at California State University in Los Angeles, Paulson explained that “despite this interest in new teaching methods, the majority of college science classes are still taught in a predominantly lecture format” (Paulson, 1999). He continued to explain that teachers fear they will lose control of the classroom by using new strategies such as active learning, and cooperative learning. While others were skeptical of the new techniques, Paulson incorporated cooperative learning and active learning into his chemistry classes and he said, “the results have been astounding” (Paulson, 1999). His students were able to enjoy and participate in more in-depth discussions about chemistry.
The activities chosen have been shown to be effective through multiple sample lessons given to students in Fundamentals of Chemistry Supplemental Instruction sessions at Kent State University. Supplemental Instruction is a program that different universities utilize across the country. It requires Supplemental Instruction Leaders to have at least a 3.0 GPA, to have taken and received an A or A- in the course they will be involved with, and to have a desire to help other students succeed. This program allows for students to learn using different activities and methods of studying. Through this program the students in the Fundamentals of Chemistry course at Kent State have the opportunity to attend sessions that are provided. It is through this program (in which I was involved for six semesters) that these activities included in the sample unit were tested. Student feedback was given at the end of the semester in the form of an anonymous survey. The responses showed that students benefitted from the activities because they were given different ways of seeing the same material. The activities engaged the students’, which in turn kept their attention and forced them to think about information in a different way.

In the classroom setting, before this unit, students would have learned the history behind the periodic table, elements, compounds, ions, and basics of ionic and covalent bonds. The sample unit builds on students’ prior knowledge of these components. Upon completion of this unit, students should have a solid foundation of how chemical formulas are written and how to name different compounds.
<table>
<thead>
<tr>
<th>Day</th>
<th>Lesson Essential Question</th>
<th>Standard Addressed</th>
<th>Purpose</th>
<th>Activity/Strategies</th>
<th>Summary</th>
</tr>
</thead>
</table>
| Monday  | How do we find the charge of specific ions?                  | Using the periodic table, formulas of ionic compounds containing specific elements can be predicted. | Provide students with knowledge of charges of different elements on the periodic table in preparation for writing and recognizing chemical formulas. | -PowerPoint  
-Incomplete outline | Work with students through the PowerPoint and incomplete outline. Make sure to give examples on the board/overhead for understanding.                                                                 |
| Tuesday | How do we find the charge of specific ions?                  | Using the periodic table, formulas of ionic compounds containing specific elements can be predicted. | Provide students with knowledge of charges of different elements on the periodic table in preparation for writing and recognizing chemical formulas. | -Color-coded periodic table  
-ATOMS bingo               | Complete color-coding the periodic table. Play ATOMS bingo game to check for understanding of finding charges of ions. Make sure to give examples on the board/overhead for understanding. |
| Wednesday | How can we predict the chemical formula just from the charges of elements? | Using the periodic table, formulas of ionic compounds containing specific elements can be predicted. | Students will learn how to connect cations and anions to make ionic compounds. This is important in the naming process that will follow. | -Worksheet  
-PowerPoint  
-Note taking | Students will learn the drop charge method for predicting ionic formulas by utilizing a worksheet an interactive activity. |
<table>
<thead>
<tr>
<th>Day</th>
<th>Lesson Essential Question</th>
<th>Standard Addressed</th>
<th>Purpose</th>
<th>Activity/Strategies</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thursday</td>
<td>Using the periodic table, formulas of ionic compounds containing specific elements can be predicted.</td>
<td>Students will learn how to connect cations and anions to make ionic compounds. This is important in the naming process that will follow</td>
<td>-Worksheet</td>
<td>Students will practice predicting ionic formulas by completing the worksheet and the completing the notecard shuffle activity.</td>
</tr>
<tr>
<td></td>
<td>How can we predict the chemical formula just from the charges of elements?</td>
<td></td>
<td></td>
<td>-Notecard Shuffle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How can we name different ionic compounds?</td>
<td>Given the formula, a compound can be named using conventional systems that include Greek prefixes and Roman numerals where appropriate.</td>
<td>Students will learn how to name different ionic compounds given the formula.</td>
<td>-PowerPoint -Outline</td>
<td>Students will complete their outlines with the PowerPoint.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>How can we name different ionic compounds?</td>
<td>Given the formula, a compound can be named using conventional systems that include Greek prefixes and Roman numerals where appropriate.</td>
<td>Students will learn how to name different ionic compounds given the formula.</td>
<td>-Creating a step by step guide</td>
<td>Students will create their own steps, in groups of 2-3, for naming ionic compounds and give examples.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Monday</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>How can we name different ionic compounds?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summary</td>
<td>Activity/Strategies</td>
<td>Purpose</td>
<td>Standard Addressed</td>
<td>Lesson Essential Question</td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>---------------------</td>
<td>---------</td>
<td>-------------------</td>
<td>--------------------------</td>
<td></td>
</tr>
<tr>
<td>Students will complete their outlines with the PowerPoint. After, students will create their own steps, in groups, for naming covalent compounds and give examples. Much like with ionic compounds, students will create their own steps, in groups of 2-3, for naming covalent compounds and give examples. Walkthrough the guide adding important points. The students will complete a worksheet independently.</td>
<td>-PowerPoint -Outline</td>
<td>Students will learn how to name different ionic compounds given the formula. Students will learn how to name different covalent compounds given the formula. Students will have knowledge of compounds they need to learn how to do the opposite of what they have been doing. They will write the formulas from the compound name.</td>
<td>Given the formula, a compound can be named using conventional systems that include Greek prefixes and Roman numerals where appropriate. Given the formula, a compound can be named using conventional systems that include Greek prefixes and Roman numerals where appropriate. Given the name of an ionic or covalent substance, formulas can be written.</td>
<td>How can we name different ionic compounds? How can we name different covalent compounds? How can we find the chemical formula from the name of a compound?</td>
<td></td>
</tr>
</tbody>
</table>

<p>| Tuesday | Wednesday | Thursday |</p>
<table>
<thead>
<tr>
<th>Day</th>
<th>Lesson Essential Question</th>
<th>Standard Addressed</th>
<th>Purpose</th>
<th>Activity/Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friday</td>
<td>How can we find the chemical formula from a name of a compound?</td>
<td>(All standards from this unit)</td>
<td>Students will have the entire class period to work on the unit test.</td>
<td>-Flyswatter</td>
</tr>
<tr>
<td>Monday</td>
<td>Review</td>
<td>(All standards from this unit)</td>
<td>Students will have two days to work on various activities to prepare for the unit exam.</td>
<td>-Stations</td>
</tr>
<tr>
<td>Tuesday</td>
<td>Review</td>
<td>(All standards from this unit)</td>
<td>Students will have two days to work on various activities to prepare for the unit exam.</td>
<td>-Stations</td>
</tr>
<tr>
<td>Wednesday</td>
<td>Evaluation</td>
<td>(All standards from this unit)</td>
<td>Students will have two days to work on various activities to prepare for the unit exam.</td>
<td>-Unit test</td>
</tr>
</tbody>
</table>

Summary:
The students will go over the worksheet and then be broken into groups for the flyswatter activity. Students will have two days to work on various activities to prepare for the unit exam. Students will have the entire class period to work on the unit test.
LESSON 1: CHARGE IT ELEMENTALLY!

The introductory lesson for this unit is focused on introducing students to the periodic table. This is a table that any chemistry class should be familiar with to some degree. A 12th grade chemistry class should begin to look at it more in depth and be able to recognize similarities and differences between elements in the rows and columns, understand the trend of charges of ions, recognize where cations and anions are, and use the periodic table to predict which elements will be used to create ionic and covalent compounds.

During the first day of the lesson, students will listen and actively learn with an interactive PowerPoint presentation. The PowerPoint is designed to keep students attention by being coupled with an incomplete outline. In addition to the outline, the PowerPoint itself is interactive and should be used as a guide. For example, on the sixth slide, key points about cations are listed. The teacher should insert comments on why cations want to lose electrons to add context to student learning. Instead of simply giving notes, it is designed to ask a question or bring up a broad point without giving the answer. This set up will allow for a discussion to introduce students’ prior ideas or knowledge about the subject. It is a good way to informally assess what level the students are at. In opposition to the informal assessment, students will complete a matrix activity (activity 1.1 in the incomplete outline) in groups at the end of the PowerPoint lecture. Depending on the length and depth of the discussion students may or may not have time to complete the activity in class. This can then be given for homework and discussed the following day.

The second day of lesson one will be more exciting for the students. To begin, there should be a quick (2-3 minutes) informal review of the terms and information discussed the previous day. A review at the beginning of a class is good to remind students of material that
is important for the assessment at the end of the unit. Students will then begin to work on their color-coded periodic table in pairs. It is essential to complete one to two rows with the students so that they know exactly what is expected of them. Making a bullet point list on the board of things to include on their tables will also deter students from repetitively asking what to include. This periodic table will not only help students in this unit, but in many other units and many other chemistry classes. It is a great visual to aid in student learning. A sample color-coded periodic table has been included in the sample lesson to show one way it can be completed.

The periodic tables should only take approximately half of the class. The other half of the class should be spent playing “ATOMS” which is chemistry version of “BINGO.” Included in the lesson are a sample “ATOMS” game board, playing pieces, and a teacher guide to the game. It is important to note that during the first three rounds of play students are permitted to use their color-coded periodic table. This will allow students to be introduced to the game. After the third round, students should put away their color-coded periodic tables and only use a blank periodic table to aid them in the game. Not only is this a great way to check for understanding and get students excited and involved in learning, but also this game can be revisited before the unit assessment to review material. “ATOMS” can also be modified as material progresses through the unit and be used as a more cumulative review game.
Lesson Title: Charge it Elementally!

Grade Level: 12th Grade  
Subject: Chemistry
Prepared by: Ms. Evans

### Overview & Purpose:
The purpose of the lesson is to provide students with knowledge in charges of different elements on the periodic table in preparation for writing and recognizing chemical formulas.

### Ohio Science Standards Addressed:
Using the periodic table, formulas of ionic compounds containing specific elements can be predicted.

### Teacher Guide | Student Guide | Materials Required | Additional Resources
---|---|---|---
**Objectives:**
(Skills that will be learned)
- Understand trend of charges on periodic table
- Similarities between rows/columns
- Define cation
- Define anion
- Define ionic
- Define covalent
- Recognize the trend of charges on periodic table
- Understand similarities of elements based on the periodic table
- Understand differences of elements based on the periodic table

- Students are expected to already have fundamental knowledge of which side of the periodic table holds metals and which holds nonmetals

- **Materials Required:**
  - Blank periodic table
  - Crayons/Colored pencils
  - Incomplete outline
  - Bingo Cards/Pieces
  - PowerPoint

- **Additional Resources:**
  - As teacher, have filled answer key to periodic table
  - Have “treat” for winners of ATOMS
  - Use Outline as a guide for discussion during the lesson

**Information:**
(Information needed for understanding of topic)
- Definition of ionic/covalent bonds
- Definition of cation/anion
- Understanding on nonmetal/metal

**Verification:**
(Checking for student understanding)
- Make sure to fill in first two elements on periodic table with the students
- Write definitions on the board so that students can fill in their incomplete outlines

- Answering questions/asking questions

**Activity:**
(Independent activity to reinforce lesson)
- Charge ATOMS! (Chemistry BINGO)
- Charges will be on the ATOMS board and elements will be drawn.
- Play a few rounds so students all get a chance to win a treat

- Allowed to use color-coded periodic cheat-sheet for the first 3 rounds. Then, students are to put away cheat sheet and have blank period table.

**Summary:**
Work with the students through the PowerPoint to fill in the incomplete outline before you begin the periodic table. Make sure to give examples on the board/overhead so that they see what they are to be doing.

**Notes for Substitute:**
Make sure students are remaining on task. They are permitted to work on groups to finish their color-coded periodic tables unless they get out of control. For ATOMS—when student wins they may call the elements in ATOM and are then required to check answers if someone wins—then rotate.
Charge it Elementally!

Unit 13: Lesson 1

Ionic vs. Covalent

What type of elements combine to form ionic compounds?
- Metals or Transition Metals and Nonmetals

What type of elements combine to form covalent compounds?
- Nonmetals
What groups contain metals?

Metals: Group 1A, 2A, and 3A *excluding Hydrogen & Boron

What groups contain nonmetals?

Nonmetals: Group 5A, 6A, 7A, 8A (non reactive) and Hydrogen
Valence Electron Review

- What is a valence electron?
  - Electrons in the outermost shell of an element

- What is the pattern for valence electrons on the periodic table?
  - An element will have the same number of valence electrons as the group number
    - Ex: Group 1A = 1 valence electron, Group 7A = 7 valence electrons
  - The exception is transition metals (they will vary)

- How many valence electrons for the following elements?
  - Lithium - 1
  - Oxygen - 6

Finding Charges of Cations

- What is a cation?
  - Metals (Groups 1A, 2A, 3A)
  - Positive charge (1+, 2+, 3+)
  - Elements lose electrons to become cations
    - Loss of an electron (negative) makes element positive

- What is the charge associated with each group?
  - Hint: look at valence electron number (elements will lose electrons to have a full outer shell)
    - 1A: 1 valence electron (lose 1 electron) = 1+
    - 2A: 2 valence electrons (lose 2 electrons) = 2+
    - 3A: 3 valence electrons (lose 3 electrons) = 3+
Finding Charges of Anions

What is an anion?
- Nonmetals (Groups 5A, 6A, 7A)
- Negative charge (1-, 2-, 3-)
- Elements gain electrons to become anions
  - Gain of an electron (negative) makes element negative

What is the charge associated with each group?
- Hint: look at valence electron number (elements will gain electrons to have a full outer shell)
  - 5A: 5 valence electron (gain 3 electron) = 3-
  - 6A: 6 valence electrons (gain 2 electrons) = 2-
  - 7A: 7 valence electrons (gain 1 electrons) = 1-

Practice Time!

Directions: On page 4 of your lesson outline, you will find activity 1.1. Using your periodic tables find the charge for each of the cations and anions listed.
Charge it Elementally!

Name: ___________________________________________ Date: ____________

Directions: Complete this outline as we complete the lesson in class. The questions will follow the order topics will be discussed. This worksheet will be part of your notebook/binder check.

1. Ionic compounds contain __________ or ___________ ____________ and _____________. Covalent compounds contain only _____________.

2. Metals are located, generally, on the ________________ side of the periodic table, transition metals are located, generally, in the ________________ of the periodic table, and nonmetals are located, generally, on the ________________ side of the periodic table.

3. List the group numbers for metals.

4. List the group numbers for transition metals.

5. List the group numbers for nonmetals.
6. ____________electrons are located in the outermost shell of an atom. Atoms want to have a full outermost shell to become stable, which consists of ____________electrons.

7. What is the pattern on the periodic table for finding the number of valence electrons an element will have? (Hint: look at group number)

8. How many valence electrons do the following elements have?
   a. Lithium -
   b. Oxygen -

9. Metals tend to ____________electrons to have a full outermost shell and nonmetals tend to ____________electrons to have a full outermost shell.

10. A ____________ has a positive charge and an ____________ has a negative charge.

11. In number 6, what term corresponds with metals and which corresponds with nonmetals?
12. List the charge for the following groups:

<table>
<thead>
<tr>
<th>Group</th>
<th>Charge Associated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td></td>
</tr>
<tr>
<td>2A</td>
<td></td>
</tr>
<tr>
<td>3A</td>
<td></td>
</tr>
<tr>
<td>4A</td>
<td>Variable</td>
</tr>
<tr>
<td>5A</td>
<td></td>
</tr>
<tr>
<td>6A</td>
<td></td>
</tr>
<tr>
<td>7A</td>
<td></td>
</tr>
<tr>
<td>8A</td>
<td></td>
</tr>
<tr>
<td>1B-8B</td>
<td></td>
</tr>
</tbody>
</table>

13. What is the trend that you notice, regarding charges, across the periodic table?
**Activity 1.1**

**Directions:** Using the periodic table, decide if the element is a metal or nonmetal, whether it will gain or lose electrons, if a cation or anion is formed, and what the charge associated with it will be.

<table>
<thead>
<tr>
<th>Element</th>
<th>Metal/Nonmetal</th>
<th>Gain/Lose Electrons</th>
<th>Cation/Anion</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Li</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>Br</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Charge it Elementally!

Name: __________ KEY! __________________________ Date: ______________

Directions: Complete this outline as we complete the lesson in class. The questions will follow the order topics will be discussed. This worksheet will be part of your notebook/binder check.

1. Ionic compounds contain _____ metals or ____ transition _____ metals ______ and ____ nonmetals _____. Covalent compounds contain only ____ nonmetals _____.

2. Metals are located, generally, on the _____ right ______ side of the periodic table, transition metals are located, generally, in the _____ middle ______ of the periodic table, and nonmetals are located, generally, on the _____ left ______ side of the periodic table.

3. List the group numbers for metals.

   1A, 2A, 3A (1,2,13)
   *exclude Hydrogen & Boron

4. List the group numbers for transition metals.

   1B - 8B (3-12)

5. List the group numbers for nonmetals.

   5A, 6A, 7A, 8A (non-reactive)
   (15-18)
6. ____ valence _______ electrons are located in the outermost shell of an atom. Atoms want to have a full outermost shell, which consists of ____ 8 ____ electrons.

*(teacher note: talk to students about duet rule w/ H & He and metals losing electrons)*

7. What is the pattern on the periodic table for finding the number of valence electrons an element will have? (Hint: look at group number)

**metals** – same as group number (ex: 3A = 3 valence electrons)

**nonmetals** – same as group number (ex: 7A – 7 valence electrons)

8. How many valence electrons do the following elements have?
   a. Lithium - 1
   b. Oxygen - 6

9. Metals tend to ____ lose _______ electrons to have a full outermost shell and nonmetals tend to ____ gain ____ electrons to have a full outermost shell.

10. A ____ cation _____ has a positive charge and an ____ anion ____ has a negative charge.

11. In number 6, what term corresponds with metals and which corresponds with nonmetals?

   *Metal- cation*
   *Nonmetal - anion*
12. List the charge for the following groups:

<table>
<thead>
<tr>
<th>Group</th>
<th>Charge Associated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>1+</td>
</tr>
<tr>
<td>2A</td>
<td>2+</td>
</tr>
<tr>
<td>3A</td>
<td>3+</td>
</tr>
<tr>
<td>4A</td>
<td>Variable</td>
</tr>
<tr>
<td>5A</td>
<td>3-</td>
</tr>
<tr>
<td>6A</td>
<td>2-</td>
</tr>
<tr>
<td>7A</td>
<td>1-</td>
</tr>
<tr>
<td>8A</td>
<td>0</td>
</tr>
<tr>
<td>1B-8B</td>
<td>Variable</td>
</tr>
</tbody>
</table>

13. What is the trend that you notice, regarding charges, across the periodic table?

*Metals (cations) – same as group number and positive (ex: 3A = 3+)*

*Nonmetals (anions) – 8-group number and negative (ex: 6A = 8-6 = 2-)*

*Exception: transition metals vary*
**Activity 1.1**

**Directions:** Using the periodic table, decide if the element is a metal or nonmetal, whether it will gain or lose electrons, if a cation or anion is formed, and what the charge associated with it will be.

<table>
<thead>
<tr>
<th>Element</th>
<th>Metal/Nonmetal</th>
<th>Gain/Lose Electrons</th>
<th>Cation/Anion</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>M</td>
<td>Lose</td>
<td>Cation</td>
<td>2+</td>
</tr>
<tr>
<td>S</td>
<td>N</td>
<td>Gain</td>
<td>Anion</td>
<td>2-</td>
</tr>
<tr>
<td>Li</td>
<td>M</td>
<td>Lose</td>
<td>Cation</td>
<td>1+</td>
</tr>
<tr>
<td>Mg</td>
<td>M</td>
<td>Lose</td>
<td>Cation</td>
<td>2+</td>
</tr>
<tr>
<td>Br</td>
<td>N</td>
<td>Gain</td>
<td>Anion</td>
<td>1-</td>
</tr>
<tr>
<td>N</td>
<td>N</td>
<td>Gain</td>
<td>Anion</td>
<td>3-</td>
</tr>
</tbody>
</table>
The Periodic Table of the Elements

<table>
<thead>
<tr>
<th>1</th>
<th>H</th>
<th>Hydrogen</th>
<th>1.00794</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>He</td>
<td>Helium</td>
<td>4.003</td>
</tr>
<tr>
<td>3</td>
<td>Li</td>
<td>Lithium</td>
<td>6.941</td>
</tr>
<tr>
<td>4</td>
<td>Be</td>
<td>Beryllium</td>
<td>9.0122252</td>
</tr>
<tr>
<td>5</td>
<td>B</td>
<td>Boron</td>
<td>10.811</td>
</tr>
<tr>
<td>6</td>
<td>C</td>
<td>Carbon</td>
<td>12.011</td>
</tr>
<tr>
<td>7</td>
<td>N</td>
<td>Nitrogen</td>
<td>14.00674</td>
</tr>
<tr>
<td>8</td>
<td>O</td>
<td>Oxygen</td>
<td>15.9994</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>Fluorine</td>
<td>18.9984032</td>
</tr>
<tr>
<td>10</td>
<td>Ne</td>
<td>Neon</td>
<td>20.1797</td>
</tr>
</tbody>
</table>

| 11 | Na | Sodium   | 22.989770|
| 12 | Mg | Magnesium| 24.3050  |
| 13 | Al | Aluminum | 26.981538|
| 14 | Si | Silicon  | 28.0855  |
| 15 | P  | Phosphorus| 30.973761|
| 16 | S  | Sulfur   | 32.066  |
| 17 | Cl | Chlorine | 35.4527  |
| 18 | Ar | Argon    | 39.948   |

| 19 | K  | Potassium| 39.0983  |
| 20 | Ca | Calcium  | 40.078   |
| 21 | Sc | Scandium | 44.955910|
| 22 | Ti | Titanium | 47.867   |
| 23 | V  | Vanadium | 50.9415  |
| 24 | Cr | Chromium | 52.000  |
| 25 | Mn | Manganese| 54.938049|
| 26 | Fe | Iron     | 55.845   |
| 27 | Co | Cobalt   | 58.933200|
| 28 | Ni | Nickel   | 58.6934  |
| 29 | Cu | Copper   | 63.546   |
| 30 | Zn | Zinc     | 65.39    |
| 31 | Ga | Gallium  | 69.723   |
| 32 | Ge | Germanium| 72.64    |
| 33 | As | Arsenic  | 74.92160 |
| 34 | Se | Selenium | 78.96   |
| 35 | Br | Bromine  | 79.904   |
| 36 | Kr | Krypton  | 83.80    |

| 37 | Rb | Rubidium | 85.4678  |
| 38 | Sr | Strontium| 87.62    |
| 39 | Y  | Yttrium  | 88.90585 |
| 40 | Zr | Zircon   | 91.224   |
| 41 | Nb | Niobium  | 92.90638|
| 42 | Mo | Molybdenum| 92.90638|
| 43 | Tc | Technetium| 98.8       |
| 44 | Ru | Ruthenium| 101.07   |
| 45 | Rh | Rhodium  | 102.90550|
| 46 | Pd | Palladium| 106.42   |
| 47 | Ag | Silver   | 107.8682 |
| 48 | Cd | Cadmium  | 112.411  |
| 49 | In | Indium   | 114.82   |
| 50 | Sn | Tin      | 118.71   |
| 51 | Sb | Antimony | 121.76   |
| 52 | Te | Tellurium| 127.60   |
| 53 | I  | Iodine   | 126.90447|
| 54 | Xe | Xenon    | 131.30   |

| 55 | Cs | Cesium   | 132.90545|
| 56 | Ba | Barium   | 137.327  |
| 57 | La | Lanthanum| 138.9055 |
| 58 | Ce | Cerium   | 140.116  |
| 59 | Pr | Praseodymium| 140.90765|
| 60 | Nd | Neodymium| 144.24   |
| 61 | Pm | Promethium| 145      |
| 62 | Sm | Samarium| 150.36   |
| 63 | Eu | Europium | 151.964  |
| 64 | Gd | Gadolinium| 157.25   |
| 65 | Tb | Terbium  | 158.92534|
| 66 | Dy | Dysprosium| 162.50   |
| 67 | Ho | Holmium  | 164.93902|
| 68 | Er | Erbium   | 167.26   |
| 69 | Tm | Thulium  | 168.93421|
| 70 | Yb | Ytterbium| 173.04   |
| 71 | Lu | Lutetium | 174.967  |

| 72 | Th | Thorium  | 232.0381 |
| 73 | Pa | Protactinium| 231.03588|
| 74 | U  | Uranium  | 238.0289 |
| 75 | Np | Neptunium| 237      |
| 76 | Pu | Plutonium| 244      |
| 77 | Am | Americium| 243      |
| 78 | Cm | Curium   | 247      |
| 79 | Bk | Bismuth  | 247      |
| 80 | Cf | Californium| 252      |
| 81 | Es | Einsteinium| 252      |
| 82 | Fm | Fermium  | 257      |
| 83 | Md | Mendeleevium| 258      |
| 84 | No | Nihonium | 259      |
| 85 | Lr | Lawrencium| 262      |
1. Make sure all students have one ATOMS playing card and playing pieces.
2. Place element pieces into a hat/basket that will be chosen during the activity.
3. In the first round, the teacher will pull from the hat/basket. Students will be allowed to use their color-coded periodic table in this round.
4. When an element name is called, students will need to write the element on a piece of paper with its charge.
5. Once the charge is discovered, students will look at their playing cards to see if they have a charge that matches. If they do, they will put a playing piece over the charge. (If there is more than one charge, a student may only cover ONE. There are other elements with the same charge.)
6. The play continues until a student has ATOMS.
7. The student who calls ATOMS will give the element and its charge. If it is correct that student will get a “treat” and will pull elements for the next round.
8. Round two and three (same as round one)
9. In round four, students will no longer be able to use their color-coded period tables, but will be able to use a blank periodic table.
10. Play will continue until 5 minutes before the end of class for clean up.
11. All playing pieces will go into a zip-lock bag and playing cards will be collected.

*Treats may be candy, bonus points, etc. Teacher may choose
<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>T</th>
<th>O</th>
<th>M</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>2+</td>
<td>2-</td>
<td>3-</td>
<td>1-</td>
<td>1+</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>3+</td>
<td>Transition Metal</td>
<td>2-</td>
<td>3-</td>
<td></td>
</tr>
<tr>
<td>2-</td>
<td>1-</td>
<td>ATOMS</td>
<td>1+</td>
<td>1-</td>
<td></td>
</tr>
<tr>
<td>3+</td>
<td>3-</td>
<td>1+</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1-</td>
<td>Transition Metal</td>
<td>0</td>
<td>3+</td>
<td>2-</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>T</th>
<th>O</th>
<th>M</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2-</td>
<td>Transition Metal</td>
<td>1-</td>
<td>3-</td>
<td></td>
</tr>
<tr>
<td>1-</td>
<td>3+</td>
<td>0</td>
<td>2-</td>
<td>Transition Metal</td>
<td></td>
</tr>
<tr>
<td>2-</td>
<td>0</td>
<td>ATOMS</td>
<td>1+</td>
<td>1-</td>
<td></td>
</tr>
<tr>
<td>3+</td>
<td>2-</td>
<td>1+</td>
<td>Transition Metal</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1+</td>
<td>2+</td>
<td>0</td>
<td>0</td>
<td>2-</td>
<td></td>
</tr>
</tbody>
</table>
LESSON 2: HOW IONIC! – PREDICTING IONIC COMPOUND FORMULAS

This lesson will begin to build on students’ knowledge of ionic compounds and relative charges associated with each element. While the material is not so heavy in this lesson, it is still a very crucial part of the unit. This lesson is when students will begin to make the connection between cations and anions to form ionic compounds, utilize the crisscross method for predicting formulas, and understand how to write ionic formulas based on a series of steps.

The first day of this lesson will again begin with an interactive PowerPoint. This time, however, students should not be given an incomplete outline to work with. If there are students in the classroom with vision impairments or difficulty writing, though, they should be given an outline to remove potential learning barriers. Students who are preparing to continue their education at a college or university will need to learn essential note-taking skills. By alternating note-taking strategies, students can become more familiar with what is important to write down while at the same time taking good, comprehensive notes.

Predicting ionic formulas is a problem-based learning content area. The most effective way for students to learn the crisscross method is by seeing and completing several practice problems. Upon completion of the PowerPoint the teacher should work through several examples with the students to make sure they have a basic understanding before allowing them to begin working on the “Drop that Charge!” worksheet. When class is going over the example problems, they should be writing them in their notes so that they can refer to these if they need assistance on the worksheet that will be assigned for homework. As the teacher, it is important to notice if students are struggling through the example problems and need more assistance. When there is a clear divide in the class of students who understand
the material and students who do not, it is a good strategy to mix the two when completing group work. This will allow students who understand the material to assist the students who are struggling.

The second day of this lesson will begin with reviewing the previous nights homework, the “Drop that Charge!” worksheet. Rather than simply asking for the answers it can be beneficial to have volunteers come up to the board and show their work. Allowing students to come to the board to show their work serves two purposes. First, it allows the teacher to check for understanding and any common errors students are making. Second, it promotes student involvement and acts as a visual for the other students to check their own work.

The remainder of the second day should be fun for the students. Notecard shuffle is an activity that will test the students on essential skills for creating chemical formulas. They will need to be able to determine if an element is a metal or nonmetal, if the element can form a cation or anion, and the charge of the element. With this information students will be required to make as many compounds as possible in their group. To deter students from simply guessing, each correct compound is worth one point and each incorrect compound is worth negative one point. The lesson includes an answer key with all of the possible combinations. It is also important that when the activity is completed the class has a discussion of why any incorrect answers were wrong so that the same mistakes will not be made on the unit assessment.
Lesson Title: How Ionic! – Predicting Ionic Compound Formulas

Grade Level: 12th Grade  Subject: Chemistry  Prepared by: Maggie Evans

Overview & Purpose: In this lesson, students will learn how connect cations and anions to make ionic compounds. This is important so that students can correctly name ionic compounds.  Ohio Science Standards Addressed: Using the periodic table, formulas of ionic compounds containing specific elements can be predicted.

<table>
<thead>
<tr>
<th>Teacher Guide</th>
<th>Student Guide</th>
<th>Materials Required</th>
<th>Additional Resources</th>
</tr>
</thead>
</table>
| Objectives:   | -Connect cations and anions to make ionic formulas  
-Utilize criss-cross method  
-Understand different transition metals charges | -Write ionic formula’s  
-Creat ionic formula’s | -“Drop that Charge” Worksheet  
-Notecard Shuffle  
-PowerPoint |
| Information:  | -Understanding of element charges  
-Difference between cation/anions  
-Crisscross (drop charge) method for combining elements to make compounds | -Students are expected to have mastered how to know what charge an element has in its neutral state  
-Foundation of cation/anion | -Board work examples for dropping the charge method  
-Answers for notecard shuffle |
| Verification: | -After showing students a few examples have them complete the worksheet on their own, walk around for help.  
-During activity, be available for help | -Students should be asking questions and answering questions  
-In activity, students should be writing down any/all ionic formulas that can be made | |
| Activity:     | -Create Notecard Shuffle cards before class  
-Break students into groups of 4  
-Make sure they record their answers (DO NOT PUT CHARGES ON CARDS) | -Students should find as many possible combinations of cations/anions.  
-When a combination is found, they must write down the correct formula (correct charges on cation/anion, too) | |
| Summary:      | Students will learn the drop charge/crisscross method for predicting ionic formulas by utilizing a worksheet and an interactive notecard shuffle activity. Students are expected to take notes from PP. | Notes for Substitute: Students have learned how to find the charges of different ions. The first group that finishes, with the most answers correct, will get 5 bonus points on their section exam. | |

Drop that Charge!

Unit 13: Lesson 2

Let’s Review!

- What type of charge does a cation have? Positive
- What type of charge does an anion have? Negative
- What types of elements make cations? Metals and Transition Metals
- What types of elements make anions? Nonmetals
Predicting Ionic Formulas

What forms an ionic compound?
- Metals (or Transition Metals) and Nonmetals
- Cations and Anions

How can we predict the formula?
- Drop Charge method

Drop Charge Method

What is the drop charge method?
- Crisscrossing the charges of a cation and anion to get the ionic formula.

Steps:
1. Find the symbol and the charge of each element from the periodic table.
2. Write the elements with their charges next to each other (cation first, anions second).
3. Draw arrows from charge of one element to bottom of the other element (arrows should crisscross).
4. Write the number at the end of the arrow. (Numbers should be on opposite element on bottom, now).
5. This will be the formula for the compound.
Example

- Sodium and Chlorine
  1. Sodium (Na and 1+), Chlorine (Cl and 1-)
  2. Na\(^+\) Cl\(^-\)
  3. Na\(^+\) Cl\(^-\)
  4. Na\(_2\)Cl\(_2\)  * If numbers are the same you can omit them
  5. NaCl
**Board work examples for predicting ionic formulas – Teachers Guide!**

**Directions:** Use these as examples on the board after PowerPoint to help students understand the crisscross/drop charge method for predicting ionic formulas. Make sure to discuss the Transition Metals!

<table>
<thead>
<tr>
<th></th>
<th>NaCl</th>
<th>LiF</th>
<th>MgBr₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na⁺</td>
<td>Cl⁻</td>
<td>Li⁺</td>
<td>Br⁻</td>
</tr>
<tr>
<td>NaCl</td>
<td>LiF</td>
<td>MgBr₂</td>
<td></td>
</tr>
<tr>
<td>K₃P</td>
<td>MgO</td>
<td>BeN</td>
<td></td>
</tr>
<tr>
<td>K⁺</td>
<td>P³⁺</td>
<td>Mg²⁺</td>
<td>Be²⁺ N³⁻</td>
</tr>
<tr>
<td>K₃P</td>
<td>MgO</td>
<td>Be₃N₂</td>
<td></td>
</tr>
</tbody>
</table>

**Purpose Question:** Why aren’t we focusing on transition metals?

*Charge of transition metals vary therefore has to be given (we will discuss these types of metals in a later lesson.*
Drop that Charge!

**Directions:** Determine the symbol and charge for each ion in the following. Show the crisscross method for predicting the formula for ionic compounds in the following pairs. Once you have shown the dropping of charges, write the predicted ionic formula for each.

<table>
<thead>
<tr>
<th>Sodium and Chlorine</th>
<th>Beryllium and Fluorine</th>
<th>Potassium and Oxygen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lithium and Sulfur</th>
<th>Calcium and Nitrogen</th>
<th>Barium and Bromine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rubidium and Phosphorous</th>
<th>Potassium and Bromine</th>
<th>Aluminum and Iodine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Drop that Charge!

**Directions:** Determine the symbol and charge for each ion in the following. Show the crisscross method for predicting the formula for ionic compounds in the following pairs. Once you have shown the dropping of charges, write the predicted ionic formula for each.

<table>
<thead>
<tr>
<th>Sodium and Chlorine</th>
<th>Beryllium and Fluorine</th>
<th>Potassium and Oxygen</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaCl</td>
<td>BeF₂</td>
<td>K₂O</td>
</tr>
<tr>
<td>Lithium and Sulfur</td>
<td>Calcium and Nitrogen</td>
<td>Barium and Bromine</td>
</tr>
<tr>
<td>Li₂S</td>
<td>Ca₃N₂</td>
<td>BaBr₂</td>
</tr>
<tr>
<td>Rubidium and Phosphorous</td>
<td>Potassium and Bromine</td>
<td>Aluminum and Iodine</td>
</tr>
<tr>
<td>Rb₃P</td>
<td>KBr</td>
<td>AI₃</td>
</tr>
</tbody>
</table>
Notecard Shuffle Guide

**Purpose:** For students to understand which elements can combine to create ionic compounds.

1. Before the lesson, write element symbols from group 1, 2, 3, 5, 6, and 7 on notecards. There should be enough notecards for as many groups as you will have in your class. Each group will receive the same notecards. DO NOT INCLUDE CHARGES ON CARDS!
2. Break the class into teams and have them sit in different areas of the room.
3. Pass out notecard sets to each group and tell them not to start until you tell them to.
4. The groups will be expected to:
   a. Determine if the element is a metal or nonmetal
   b. Determine if the element is a cation or anion
   c. Determine the charge of the element
   d. Make as many combinations of elements that make compounds as possible.
5. Groups will write down all of the possible compounds that they find.
6. Incorrect answers are minus 1 point; correct answers are worth 1 point.
7. The group with the highest score at the end wins!
Notecard Shuffle Answer Key

- Each correct answer is worth 1 point. Each incorrect answer is minus 1 point.

1. Na$_3$N
2. Na$_3$P
3. Na$_2$O
4. Na$_2$S
5. NaF
6. NaBr
7. K$_3$N
8. K$_3$P
9. K$_2$O
10. K$_2$S
11. KF
12. KBr
13. Be$_3$N$_2$
14. Be$_3$P$_2$
15. BeO
16. BeS
17. BeF$_2$
18. BeBr$_2$
19. Mg$_3$N$_2$
20. Mg$_3$P$_2$
21. MgO
22. MgS
23. MgF$_2$
24. MgBr$_2$
25. AlN
26. AlP
27. Al$_2$O$_3$
28. Al$_2$S$_3$
29. AlF$_3$
30. AlBr$_3$
LESSON 3: WHAT’S IN A NAME? – NAMING IONIC COMPOUNDS

Now that students understand how to predict formulas and understand how to find charges of different ions, it is time to learn how to name ionic compounds. To successfully name ionic compounds, students must first know how to name specific anions and cations. Again, an interactive PowerPoint was created to promote student involvement and attention. Also, an incomplete outline has been created for students to follow along and complete various practice problems throughout the lecture. This lesson can get very tricky for students because of the different types of elements that are present: cations, anions, transition metals, and polyatomic ions. With all of the material in this lesson, it is important to move through each portion slowly and completely.

Seeing information multiple times in different ways is an important strategy for students to learn material. This lesson (activity 3.1) will allow students to create their own guides, “Ionic Compounds for Dummies”, for naming ionic compounds. Every person has a different way of thinking things through because every brain is different. Rather than giving a set of steps, allowing students to create their own will let them think the material through the way that makes the most sense to them. The teacher should ask students to present their guides to the class the following day. This allows for students to hear the different methods their classmates have come up with that they may not have considered. It also insures that rather than simply memorizing facts students understand the methodology.

After the groups have presented their naming guides, students will complete activity 3.2 in their incomplete outlines. This assignment will tie together the lesson and allow students to show their knowledge on the material. The teacher should collect the assignment and then go over the answers as a class. Going over material before the assignment is
collected will allow students to change their answers. This will not be a good assessment of where students stand with the material. Another option could be to allow students to trade papers and grade each other’s work and then collect it for completion points. Either way, this will allow the teacher to see where students are struggling and adjust lessons according to what may need to be covered in more depth before the unit assessment.

Due to the amount of papers and notes students will be taking in this unit, it is a good idea to spot check students. Teachers can do this by having a binder or notebook check at the end of each lesson or in the middle of the unit (after lesson 3). Having this check will require students to be responsible for their notes and incomplete outlines. With any unit that is heavy with notes and new material it is important to make sure students are not missing sections of notes. Missing sections of notes could be detrimental in a unit that builds on previous material through each lesson. Even spot checking certain questions or portions of a particular outline or activity can make students accountable for everything they are doing inside and outside of the class.
**Lesson Title:** What's in a Name? – Naming Ionic Compounds

**Grade Level:** 12th Grade  
**Subject:** Chemistry  
**Prepared by:** Maggie Evans

<table>
<thead>
<tr>
<th><strong>Overview &amp; Purpose:</strong> In this lesson, students will learn how to name different ionic compounds given the formula.</th>
<th><strong>Ohio Science Standards Addressed:</strong> Given the formula, a compound can be named using conventional systems that include Greek prefixes and Roman numerals where appropriate.</th>
</tr>
</thead>
</table>

### Teacher Guide

| **Objectives:**  
*(Skills that will be learned)* | **Information:**  
*(Information needed for understanding of topic)* | **Verification:**  
*(Checking for student understanding)* | **Activity:**  
*(Independent activity to reinforce lesson)* | **Summary:**  
Students will follow along taking notes and completing checkpoint questions presented in the PowerPoint. Then, students are expected to create their own steps and own examples in pairs. |
|---|---|---|---|---|
| - Name cations  
- Name ionic compounds from the chemical formula.  
- Name formulas with transition metals | - Understanding of the cation/anion naming system  
- Steps for naming ionic compounds  
- Naming PowerPoint | - In each section of the PowerPoint there will be questions for checking for understanding the students will complete. | - After the PowerPoint, students are expected to write their own steps for finding the name of an ionic compound.  
- Must include 3 examples |  |

### Student Guide

| **Teacher Guide** | **Materials Required:**  
*“What’s in a Name” PowerPoint*  
*Lesson Guide*  
*“Ionic Compounds for Dummies” example* | **Additional Resources:**  
May use periodic table and notes for activity |
|---|---|---|
| - Name anions  
- Name formulas with polyatomic ions  
- Understand naming ionic compounds steps | - Students will need basic knowledge of how to identify an ionic compound and what is the cation/anion from the formula |  |

### Teacher Notes

**Notes for Substitute:** Students must work in pairs for the creation assignment. They will need to have “ionic compound for dummies” steps. Show them the example if they are struggling with what to do. Write instructions on the board.
What’s in a Name?
Unit 13: Lesson 3 – Naming Ionic Compounds

The Basics

- How do we name cations?
  - Element name + ion
    - Ex: Mg$^{2+}$ - Magnesium ion

- Now you try:
  1. Li$^+$ - Lithium ion
  2. Al$^{3+}$ - Aluminum ion
The Basics

How do we name an anion?
- Element name – ending + ide
  - Ex: F⁻ - Fluorine – ine + ide = fluoride
  - Ex: O²⁻ - Oxygen – gen + ide = oxide

Now you try:
1. N³⁻ nitride
2. Br⁻ bromide
3. Cl⁻ chloride

Transition Metals

We know that we have to be given the charge of the transition metal.
- Remind me why?

What is different when naming transition metals?
- We will use ROMAN NUMERALS to indicate which ion we are referring to. (I, II, or III)
  - Ex: Copper comes in two general forms Cu⁺ and Cu²⁺. To differentiate between the two ions we will call Cu⁺ Copper(I) ion and Cu²⁺ Copper(II) ion.

*Note: Transition metals are cations, so we use the same general naming system as we do for cations, but add a roman numeral.
Try a few!

- $\text{Hg}^{2+}$
  - Mercury(II) ion
- $\text{Co}^{3+}$
  - Cobalt (III) ion
- $\text{Mn}^{2+}$
  - Manganese(II) ion

Polyatomic Ions

What are polyatomic ions?
- Ions with more than one element in them.
- Can be cations or anions

You will be responsible for memorizing 5 polyatomic ions.
- $\text{NH}_4^+$ - Ammonium
- $\text{OH}^-$ - Hydroxide
- $\text{NO}_3^-$ - Nitrate
- $\text{SO}_4^{2-}$ - Sulfate
- $\text{PO}_4^{3-}$ - Phosphate

*Note: The names NEVER change for polyatomic ions!
Crash Course in Formula Writing w/ Polyatomic Ions

- When writing polyatomic ions within formulas, make sure the polyatomic is never separated.
- You will use parenthesis for this.
- Still use crisscross/drop charge method

Ex: Magnesium and Nitrate

\[
\text{Mg}^{2+} \text{NO}_3^{-}
\]

\[
\text{Mg(NO}_3\text{)}_2
\]

*the parenthesis will separate the polyatomic ion from getting confused with the dropped charge. It reads that there are 2 ions of nitrate

---

Naming Ionic Compounds

- We know that ionic compounds are cation plus anions.
- We also know how to name cations and anions.

Now we want to know how we put the two names together to name ionic compounds?
- Brainstorm: How do we name ionic compounds?
Putting it Together

Naming Ionic Compounds
- Cation name – ion + anion name
- Ex: MgCl₂ –
  - magnesium ion – ion + chloride
  - magnesium chloride

Notes:
- Do not worry about numbers for ionic compounds; they DO NOT effect the naming process. (unless it is a transition metal)
- Make sure to recognize if the compound contains a transition metal or polyatomic ion.

Let’s Try Some Together!

- Li₂O
  - lithium oxide

- NH₄Br
  - ammonium bromide

- CuF₃
  - copper(II) fluoride

- Ca(OH)₂
  - calcium hydroxide
Directions: Starting on page 4 of your lesson guide, complete activity 3.1 and 3.2. You may work with a partner, that is GROUPS OF 2 (not 3 or 4). We will go over an example before you begin activity 3.1.
What’s in a Name? Guide

Name: _______________________________ Date: _______________________________

Directions: Complete this guide as you listen to the two-part lesson on naming Ionic and Covalent compounds. The topics are in order of the lesson so that you can follow along easily. **This guide will be part of your notebook check!**

1. To name cations we take the ________________ name plus ________.

2. Name the following cations:
   a. Li⁺ _______________________________
   b. Al³⁺ _______________________________

3. What is the general formula for naming anions?

4. Name the following anions:
   a. N³⁻ _______________________________
   b. Br⁻ _______________________________
   c. Cl⁻ _______________________________

5. Why are the charges of transition metals always given to us?

6. To differentiate between which form of a transition metal ion we are referring to, we use ________________ ________________ when we name them.
7. Name the following transition metals:
   a. Hg$^{2+}$ ____________________________
   b. Co$^{3+}$ ____________________________
   c. Mn$^{\text{+}}$ ____________________________

8. In the space below brainstorm ideas of how ionic compounds are named!

9. We remove __________ from the cation name when combining it with the _______ name to make the ionic compound name.

10. Write the general formula for writing the name for an ionic compound.

11. True or False: We have to account for the numbers when naming ionic compounds.

12. True or False: Only the cation name is capitalized when naming ionic compounds.
13. What are polyatomic ions?

14. True or False: Polyatomic ions are only anions.

15. What are the 5 polyatomic ions you are responsible for in this class?

16. True or False: Polyatomic ions names never change when combining to form compounds.

17. Name the following ionic compounds:
   a. Li$_2$O ______________________________
   b. NH$_4$Br ___________________________
   c. CuF$_2$ _____________________________
   d. Ca(OH)$_2$ __________________________
Activity 3.1

Directions: In your groups, come up with “Ionic Compound for Dummies” steps for naming ionic equations. Make sure to mention: cations, anions, transition metals, and polyatomic ions. Include everything I would need if I had never learned this material before. I am a “dummy”!
**Activity 3.2**

**Directions:** Complete the following table with a partner. Indicate what the element/elements is/are: cation, anion, or ionic compound. Give the name of the ion or compound that is given. Answer the questions that follow the table!

<table>
<thead>
<tr>
<th>Given</th>
<th>Cation/Anion/Ionic Compound/ TM/ Polyatomic</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Mg(NO₃)₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2  Ba²⁺</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3  N³⁻</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4  CuO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5  AlF₃</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6  PO₄³⁻</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7  Co²⁺</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Will number 3 and 6 create an ionic compound? Why or why not?

2. Will number 2 and 6 create an ionic compound? Why or why not?

3. What is the charge of the cation and anion in the compound of number 4? How do you know?
What’s in a Name? Guide

Name: ____________ Key! ____________ Date: ____________

Directions: Complete this guide as you listen to the two-part lesson on naming Ionic and Covalent compounds. The topics are in order of the lesson so that you can follow along easily. This guide will be part of your notebook check!

1. To name cations we take the ____________ element ____________ name plus ____________ ion ____________.

2. Name the following cations:
   a. Li⁺ ____________ Lithium ion ____________
   b. Al³⁺ ____________ Aluminum ion ____________

3. What is the general formula for naming anions?
   
   Element – ending + ide

4. Name the following anions:
   a. N³⁻ ____________ nitride ____________
   b. Br⁻ ____________ bromide ____________
   c. Cl⁻ ____________ chloride ____________

5. Why are the charges of transition metals always given to us?

   Because their charges vary. We cannot know which one we are talking about otherwise.

6. To differentiate between which form of a transition metal ion we are referring to, we use ____________ Roman ____________ numerals ____________ when we name them.
7. Name the following transition metals:
   d. Hg$^{2+}$ ______ mercury (II) ion _____________
   e. Co$^{3+}$ _____ cobalt (III) ion ______________
   f. Mn$^{+}$ _____ manganese (I) ion ______________

8. In the space below brainstorm ideas of how ionic compounds are named!

   (answers will vary)

9. We remove _________ion____ from the cation name when combining it with the _______anion____ name to make the ionic compound name.

10. Write the general formula for writing the name for an ionic compound.

   \[ \text{Cation name – ion + anion name} \]

11. True or False: We have to account for the numbers when naming ionic compounds.

12. True or False: Only the cation name is capitalized when naming ionic compounds.
13. What are polyatomic ions?

Ions with more than one element (cation or anion)

14. True or False: Polyatomic ions are only anions. Mostly, but not all.

15. What are the 5 polyatomic ions you are responsible for in this class?

- Sulfate $SO_4^{2-}$
- Ammonium $NH_4^+$
- Phosphate $PO_4^{3-}$
- Nitrate $NO_3^-$
- Hydroxide $OH^-$

16. True or False: Polyatomic ions names never change when combining to form compounds.

17. Name the following ionic compounds:

a. Li$_2$O ___ Lithium oxide __________________________

b. NH$_4$Br ___ Ammonium bromide ______________________

c. CuF$_2$ ___ Copper (II) fluoride _______________________

d. Ca(OH)$_2$ ___ Calcium hydroxide ______________________
Activity 3.1

Directions: In your groups, come up with “Ionic Compound for Dummies” steps for naming ionic equations. Make sure to mention: cations, anions, transition metals, and polyatomic ions. Include everything I would need if I had never learned this material before. I am a “dummy”!

(answers will vary – completion points)

see example if necessary
### Activity 3.2

**Directions:** Complete the following table with a partner. Indicate what the element/elements is/are: cation, anion, or ionic compound. Give the name of the ion or compound that is given. Answer the questions that follow the table!

<table>
<thead>
<tr>
<th>Given</th>
<th>Cation/Anion/Ionic Compound/ TM/ Polyatomic</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Mg(NO₃)₂</td>
<td>IC</td>
<td>Magnesium nitrate</td>
</tr>
<tr>
<td>2 Ba²⁺</td>
<td>C</td>
<td>Barium ion</td>
</tr>
<tr>
<td>3 N³⁻</td>
<td>A</td>
<td>Nitride</td>
</tr>
<tr>
<td>4 CuO</td>
<td>IC</td>
<td>Copper (II) oxide</td>
</tr>
<tr>
<td>5 AlF₃</td>
<td>IC</td>
<td>Aluminum fluoride</td>
</tr>
<tr>
<td>6 PO₄³⁻</td>
<td>P</td>
<td>Phosphate</td>
</tr>
<tr>
<td>7 Co²⁺</td>
<td>TM</td>
<td>Cobalt (II) ion</td>
</tr>
</tbody>
</table>

1. Will number 3 and 6 create an ionic compound? Why or why not?

   *No – they are both anions. It must be a cation + anion*

2. Will number 2 and 6 create an ionic compound? Why or why not?

   *Yes – one is a cation and one is an anion*

3. What is the charge of the cation and anion in the compound of number 4? How do you know?

   *Cu²⁺ and O²⁻ even though Cu is a TM, we know O has a 2- charge from the periodic table therefore Cu must be 2+ to give the given formula.*
“Ionic Compounds for Dummies” Example

**Directions:** If students are struggling, show them this example to give them some ideas!

1. Decide if the compound you are looking at is actually an ionic compound.
   a. Is there a cation and an anion?

2. Decide what the cation is and what the anion is.

3. Name the cation.
   a. Is it a metal, transition metal, or polyatomic?
      i. Metal - normal element name
      ii. Transition metal - element name + charge in roman numeral
      iii. Polyatomic – polyatomic name

4. Name the anion.
   a. Is it a nonmetal or a polyatomic?
      i. Nonmetal – element – ending + ide
      ii. Polyatomic – polyatomic name

5. The cation name comes first, then the anion.
   a. Make sure only the cation name is capitalized

Viola! You have named the ionic compound!!!
LESSON 4: COO-COO FOR COVALENTS – NAMING COVALENT COMPOUNDS

This lesson is very similar to naming ionic compounds. Class will begin the lesson with a PowerPoint presentation. Students are also given an incomplete outline so that they can follow along writing down relevant and important information. Due to the fact that covalent and ionic compounds are very similar, the lesson starts with explaining the differences between the types of compounds. Beginning with making this distinction can prevent students from getting confused throughout the lesson. The outline in this section uses a variety of questions such as fill in the blank, true or false, charts, and short answer. A variety of questions allow students to train their brains into thinking in different ways.

Students will complete a set of steps for covalent compound naming much like they did for ionic compound naming. Having these steps is good for students who are just starting to learn chemistry. They will be able to follow the guidelines while they are studying until they are familiar with the process and can name different compounds without the guide. The guides will be useful for activity 4.2. The activity requires students to use their knowledge to name the various compounds in the table.
# Lesson Title: What’s In a Name? – Naming Ionic Compounds

**Grade Level:** 12th Grade  
**Subject:** Chemistry  
**Prepared by:** Maggie Evans

<table>
<thead>
<tr>
<th>Overview &amp; Purpose:</th>
<th>Ohio Science Standards Addressed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>In this lesson, students will learn how to name different ionic compounds given the formula.</td>
<td>Given the formula, a compound can be named using conventional systems that include Greek prefixes and Roman numerals where appropriate.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Teacher Guide</strong></th>
<th><strong>Student Guide</strong></th>
<th><strong>Materials Required:</strong></th>
</tr>
</thead>
</table>
| **Objectives:**  
*Skills that will be learned*  
- Name cations  
- Name ionic compounds from the chemical formula.  
- Name formulas with transition metals | - Name anions  
- Name formulas with polyatomic ions  
- Understand naming ionic compounds steps |  
*What’s In a Name* PowerPoint  
Lesson Guide  
*Ionic Compounds for Dummies* example |

| **Information:**  
*Information needed for understanding of topic*  
- Understanding of the cation/anion naming system  
- Steps for naming ionic compounds  
- Naming PowerPoint | - Students will need basic knowledge of how to identify an ionic compound and what is the cation/anion from the formula |  
**Verification:**  
*Checking for student understanding*  
- In each section of the PowerPoint there will be questions for checking for understanding the students will complete. | - Students will take notes based on the PowerPoint  
- Students will answer the check point questions on the worksheet provided |  
**Activity:**  
*Independent activity to reinforce lesson*  
- After the PowerPoint, students are expected to write their own steps for finding the name of an ionic compound.  
- Must include 3 examples | - Working in pairs  
- Create "in your own words" steps for ionic naming  
- Create 3 problems with answer key |  
**Summary:** Students will follow along taking notes and completing checkpoint questions presented in the PowerPoint. Then, students are expected to create their own steps and own examples in pairs. | **Notes for Substitute:** Students must work in pairs for the creation assignment. They will need to have "ionic compound for dummies" steps. Show them the example if they are struggling with what to do. Write instructions on the board. |
What’s Different?

What is the difference between naming ionic compounds and covalent compounds?

- Ionic Compounds do not take the numbers in the formula into consideration while naming.
  - Strictly cation and anion name.
  - Metal and Nonmetals
- Covalent Compounds use prefixes to account for the numbers in the formula when naming!
  - No cations and anions
  - Nonmetals only!
So What are Prefixes?

- What do prefixes represent?
  - The number of atoms of each element in a covalent compound.
- Where are they located in the name of a covalent compound?
  - BEFORE each element name in the compound.

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>mono</td>
<td>1</td>
</tr>
<tr>
<td>di</td>
<td>2</td>
</tr>
<tr>
<td>tri</td>
<td>3</td>
</tr>
<tr>
<td>tetra</td>
<td>4</td>
</tr>
<tr>
<td>penta</td>
<td>5</td>
</tr>
<tr>
<td>hexa</td>
<td>6</td>
</tr>
<tr>
<td>hepta</td>
<td>7</td>
</tr>
<tr>
<td>octa</td>
<td>8</td>
</tr>
<tr>
<td>nona</td>
<td>9</td>
</tr>
<tr>
<td>deca</td>
<td>10</td>
</tr>
</tbody>
</table>

Naming Covalent Compounds

- Remember, covalent compounds only have NONMETALS.
  - There are no cations and anions.
- How will we name them, then?
  - General formula:
    
```
    (prefix)_1 Element Name + (prefix)_2 Element name
    ```
  - *note: First element is named by periodic table name. Second element is named as if it were an anion (name - ending + ide)
Examples

CO
- Element 1: Carbon (one)
- Element 2: Oxygen (one)
- Name: carbon monoxide

$\textbf{N}_2\textbf{O}_3$
- Element 1: Nitrogen (2)
- Element 2: Oxygen (3)
- Name: dinitrogen trioxide

*Notice: If prefix of first element is mono, it can be omitted, but the second must be included. ONLY FOR MONO!

*Notice: NO capitalization at all in covalent naming!

*Note: Final “o” on mono is dropped when used with oxygen.

Let’s Practice!

Directions: On page 3-4 of your lesson outline, we will be working with partners to complete activity 4.1 and 4.2! These are very similar to the activities we did for the ionic compounds lesson! Follow the directions in the handout.
Coo-Coo For Covalents Outline

Name: ______________________________  Date: __________________

Directions: Follow through this guide as we complete the lesson in class. Make sure you are paying attention; the answers will be talked about! This will be part of your notebook/binder check!

1. What is the main difference when naming ionic vs. covalent compounds?

2. Fill in the prefixes chart:

<table>
<thead>
<tr>
<th>Number of atoms</th>
<th>Prefix</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

3. True or False: Prefixes used in covalent compounds represent the number of atoms of each element in the compound.

4. When naming covalent compounds, the name of the first element is the name found on the ________________ ____________. The second element is named the same way ____________ are named in ionic compounds. Both names include a prefix that is placed ____________ the name of each.
5. Write the general formula for naming covalent compounds.

6. When can the prefix “mono” be omitted?

7. When is the final “o” on “mono” dropped?

8. Write the name for the following covalent compounds:

   a. CO- ________________________________

   b. N₂O₃ - ________________________________
Activity 4.1

Directions: In your groups, come up with “Covalent Compound for Dummies” steps for naming ionic equations. Make sure to mention: prefixes, exceptions of mono, similarity to anion naming, and any other relevant information. Include everything I would need if I had never learned this material before. I am a “dummy”!
**Activity 4.2**

**Directions:** Complete the following table with a partner. Give the name of the covalent compounds listed!

<table>
<thead>
<tr>
<th>Compound</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CF₄</td>
<td></td>
</tr>
<tr>
<td>2 P₂O₅</td>
<td></td>
</tr>
<tr>
<td>3 SiO₂</td>
<td></td>
</tr>
<tr>
<td>4 PBr₃</td>
<td></td>
</tr>
<tr>
<td>5 IO₂</td>
<td></td>
</tr>
<tr>
<td>6 P₄Se₃</td>
<td></td>
</tr>
<tr>
<td>7 SN</td>
<td></td>
</tr>
<tr>
<td>8 CO₂</td>
<td></td>
</tr>
<tr>
<td>9 H₂O</td>
<td></td>
</tr>
</tbody>
</table>
Coo-Coo For Covalents Outline

**Name:** KEY!  
**Date:**

**Directions:** Follow through this guide as we complete the lesson in class. Make sure you are paying attention; the answers will be talked about! This will be part of your notebook/binder check!

1. What is the main difference when naming ionic vs. covalent compounds?

   *The use of prefixes and covalent compounds don’t have cations/anions*

2. Fill in the prefixes chart:

<table>
<thead>
<tr>
<th>Number 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>

3. **True** or False: Prefixes used in covalent compounds represent the number of atoms of each element in the compound.

4. When naming covalent compounds, the name of the first element is the name found on the __________ periodic ________ table ______. The second element is named the same way __ anions ______ are named in ionic compounds. Both names include a prefix that is placed ______ before the name of each.
5. Write the general formula for naming covalent compounds.

\[(\text{prefix}) \ 1^{st} \text{ element} + (\text{prefix}) \ 2^{nd} \text{ element}\]

\[\text{(off periodic table)} \quad \text{(like anion)}\]

6. When can the prefix “mono” be omitted?

If it is on the 1\textsuperscript{st} element

7. When is the final “o” on “mono” dropped?

With oxygen – correct: monoxide

Incorrect: monooxide

8. Write the name for the following covalent compounds:

a. CO- \underline{carbon monoxide} 

b. N\textsubscript{2}O\textsubscript{3} \underline{dinitrogen trioxide}
Activity 4.1

Directions: In your groups, come up with “Covalent Compound for Dummies” steps for naming ionic equations. Make sure to mention: prefixes, exceptions of mono, similarity to anion naming, and any other relevant information. Include everything I would need if I had never learned this material before. I am a “dummy”!

(answers will vary – completion points)

see example if necessary
### Activity 4.2

**Directions:** Complete the following table with a partner. Give the name of the covalent compounds listed!

<table>
<thead>
<tr>
<th>Compound</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CF₄</td>
</tr>
<tr>
<td>2</td>
<td>P₂O₅</td>
</tr>
<tr>
<td>3</td>
<td>SiO₂</td>
</tr>
<tr>
<td>4</td>
<td>PBr₃</td>
</tr>
<tr>
<td>5</td>
<td>IO₂</td>
</tr>
<tr>
<td>6</td>
<td>P₄Se₃</td>
</tr>
<tr>
<td>7</td>
<td>SN</td>
</tr>
<tr>
<td>8</td>
<td>CO₂</td>
</tr>
<tr>
<td>9</td>
<td>H₂O</td>
</tr>
</tbody>
</table>

1. Carbon tetrafluoride
2. Diphosphorus pentoxide
3. Silicon dioxide
4. Phosphorus tribromide
5. Iodine dioxide
6. Tetraphosphorus triselenide
7. Sulfur mononitride
8. Carbon dioxide
9. Dinitrogen monoxide (water)
“Covalent Compounds for Dummies” Example

**Directions:** If students are struggling, show them this example to give them some ideas!

1. Decide if the compound you are looking at is actually a covalent compound.
   a. Is there a nonmetal + a nonmetal?
2. Name the first element.
   a. How many of the specific element is there?
      i. Find the correct prefix to associate with that number.
   b. Use the name off of the periodic table.
3. Name the second element
   a. How many of the specific element is there?
      i. Find the correct prefix to associate with that number.
   b. Use the naming method for anions for the general name.
      i. Element – ending + ide
4. Put the two names together!
5. Viola! You have named the covalent compound!!!

**Important notes:**
- NO capitalization for covalent compounds.
- When using mono:
  1. Do not use mono for first element, ever.
  2. Drop final “o” when used with oxygen
     ex: monoxide not monooxide
LESSON 5: REVERSE, REVERSE! – FORMULA WRITING FROM COMPOUND NAME

The final lesson in this unit is taking all of the information students have learned in lessons one through four and doing the reverse process. Prior to this point, students should have mastered naming compounds from the given formulas. Now, students will write the formulas from the compound name.

It is important for students to be exposed to different teaching styles. This lesson still makes use of an incomplete outline, but students are required to pay close attention to the teacher’s lecture and examples that are given. Even though there is not a PowerPoint associated with the lesson, it is still very interactive and keeping students on task since they are responsible for filling in their outlines. The outline is set up in a step-by-step manner so that is also serves as a guide for students to refer to as they are completing practice problems.

After the lecture, students will be directed to complete the formula writing worksheet. There may be enough time for students to complete the worksheet in class, but if there is not they should complete it for homework. If it is completed for homework, it should be gone over the next day so that students can check their work.

The activity in this section of the unit brings out student’s competitive nature and allows them to have a little bit of fun while they are still learning. Flyswatter is a game that requires students to understand the material, but ties in the group work aspect to help students who are still struggling. The game is also designed to get students up and out of their seats instead of sitting down constantly. The rules sheet and a list of possible compounds to use are provided in the lesson materials.
**Lesson Title:** Reverse! Reverse! – Formula Writing from Compound Name

**Grade Level:** 12th Grade  
**Subject:** Chemistry  
**Prepared by:** Maggie Evans

| **Overview & Purpose:** Now students have knowledge of naming compounds, they will learn how to do the opposite: write the formulas from the name. | **Ohio Science Standards Addressed:** Given the name of an ionic or covalent substance, formulas can be written. |

<table>
<thead>
<tr>
<th><strong>Teacher Guide</strong></th>
<th><strong>Student Guide</strong></th>
<th><strong>Materials Required:</strong></th>
</tr>
</thead>
</table>
| **Objectives:**  
*(Skills that will be learned)* | - Write chemical formula from compound name  
- Understand steps for writing chemical formula’s. | - Must understand what a name represents  
- Understanding of general structure of chemical formula  
- Need the knowledge of what an ionic vs. covalent is. |
| **Information:**  
*(Information needed for understanding of topic)* | - Students must understand how names of ionic and covalent compounds are formed.  
- General structure of formula writing | |
| **Verification:**  
*(Checking for student understanding)* | - Practice problems  
- Worksheet  
- Activity | - Asking questions when they are unsure of topics.  
- Non-verbal clues |
| **Activity:**  
*(Independent activity to reinforce lesson)* | - Flyswatter game  
- Students will be expected to understand the lesson to successfully complete the activity. | - Students will be broken into 2 groups and be expected to work together to find the correct answer. |
| **Summary:** Go through the guide with students and have them take additional notes, as needed. After, the students will complete a worksheet independently. Once this has been reviewed, the flyswatter game will begin. | | Additional Resources: |
| | **Notes for Substitute:** The guide will take you through all the steps students will need. They are to work INDEPENDENTLY on their worksheets. Have them count off by 2’s to break the class in half. This will be their groups for the flyswatter activity.
Finding the Chemical Formula from Compound Name

Name: ___________ Date: ______

**Step 1:** Decide if the compound is ionic or covalent.

- Ionic:

- Covalent:

**Step 2:** Recognize if there is a transition metal or polyatomic in the compound.

- If there is a transition metal – remember the charge is the Roman numeral following the element.
- If there is a polyatomic – remember the formula and charge
  - Phosphate
  - Ammonium
  - Hydroxide
  - Nitrate
  - Sulfate
**Step 3:** Find the chemical symbol for each element.
- Find the element on the periodic table

**Step 4:** Find the number of each element in the compound
- Ionic compounds (remember to look at charge)
  - Regular compounds
    - Example:
  - Transition metals
    - Example:
  - Polyatomic ions
    - Example:
- Covalent compounds (Look at prefixes)
  - Mono-
  - Di-
  - Tri-
  - Tetra-
  - Penta-
  - Hexa-
  - Hepta-
  - Octa-
  - Nona-
  - Deca-
Step 5: Put everything together

- Element order from name is the order for the formula, too.
  - Example:

- Make sure numbers of each element is a subscript
  - Example:
Finding the Chemical Formula from Compound Name

Name: _______________ KEY! ___________________________ Date: __________

**Step 1:** Decide if the compound is ionic or covalent.
- Ionic: *metal + nonmetal (cation + anion)*
- Covalent: *nonmetal + nonmetal*

**Step 2:** Recognize if there is a transition metal or polyatomic in the compound.
- If there is a transition metal – remember the charge is the Roman numeral following the element. *only cations – ex: mercury (II)*
- If there is a polyatomic – remember the formula and charge
  - Phosphate
    \[ PO_4^{3-} \]
  - Ammonium
    \[ NH_4^+ \]
  - Hydroxide
    \[ OH^- \]
  - Nitrate
    \[ NO_3^- \]
  - Sulfate
    \[ SO_4^{2-} \]
Step 3: Find the chemical symbol for each element.

- Find the element on the periodic table
  
  *memorize polyatomics since they aren’t one periodic table*

  Ex: calcium – Ca  
  Fluorine = fluoride – F

Step 4: Find the number of each element in the compound

- Ionic compounds (remember to look at charge) *use drop charge method
  
  o Regular compounds – look at charge on periodic table
    - Example: sodium chloride

  o Transition metals – look at roman numeral
    - Example: mercury (I) sulfide

  o Polyatomic ions – remember polyatomics
    - Example: sodium phosphate

- Covalent compounds (Look at prefixes)
  
  - Mono- 1
  - Di- 2
  - Tri- 3
  - Tetra- 4 *ex: dinitrogen trioxide*
  - Penta- 5
  - Hexa- 6
  - Hepta- 7
  - Octa- 8
  - Nona- 9
  - Deca- 10
Step 5: Put everything together

- Element order from name is the order for the formula, too.
  - Example: sodium oxide
    \[ \text{Na}^+ \text{O}^{2-} \]

- Make sure numbers of each element is a subscript
  - Example: sodium oxide
    \[ \text{Na}_2\text{O} \]

*other examples: copper (II) oxide and ammonium phosphate
**Formula Writing**

**Name:** __________________________  **Date:** __________

**Directions:** Write the formulas for the following compounds. First, decide if the compound is ionic or covalent. **Pay attention to transition metals and polyatomics!**

<table>
<thead>
<tr>
<th>Name</th>
<th>Ionic/Covalent</th>
<th>Special Characteristics</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sodium fluoride</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 dinitrogen tetroxide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Beryllium sulfate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Cobalt(IV) oxide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 silicon disulfide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Magnesium hydroxide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Iron(II) chloride</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Aluminum nitrate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Ammonium phosphate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Tin(III) bromide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 carbon monoxide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Iodine trichloride</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Formula Writing

**Name:** __KEY!__  
**Date:** ____________

### Directions: Write the formulas for the following compounds. First, decide if the compound is ionic or covalent. **Pay attention to transition metals and polyatomics!**

<table>
<thead>
<tr>
<th>Name</th>
<th>Ionic/Covalent</th>
<th>Special Characteristics</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sodium fluoride</td>
<td>I</td>
<td>Na⁺ F⁻</td>
<td>NaF</td>
</tr>
<tr>
<td>2 dinitrogen tetroxide</td>
<td>C</td>
<td>N=2 O=4</td>
<td>N₂O₄</td>
</tr>
<tr>
<td>3 Beryllium sulfate</td>
<td>I</td>
<td>(polyatomic) Be²⁺ SO₄²⁻</td>
<td>BeSO₄</td>
</tr>
<tr>
<td>4 Cobalt(IV) oxide</td>
<td>I</td>
<td>(transition metal) Co⁴⁺ O²⁻ *reduce charges</td>
<td>Co₂O</td>
</tr>
<tr>
<td>5 silicon disulfide</td>
<td>C</td>
<td>Si=1 S=2</td>
<td>SiS₂</td>
</tr>
<tr>
<td>6 Magnesium hydroxide</td>
<td>I</td>
<td>(polyatomic) Mg²⁺ OH⁻</td>
<td>Mg(OH)₂</td>
</tr>
<tr>
<td>7 Iron(II) chloride</td>
<td>I</td>
<td>(transition metal) Fe²⁺ Cl⁻</td>
<td>FeCl₂</td>
</tr>
<tr>
<td>8 Aluminum nitrate</td>
<td>I</td>
<td>(polyatomic) Al³⁺ NO₃⁻</td>
<td>Al(NO₃)₃</td>
</tr>
<tr>
<td>9 Ammonium phosphate</td>
<td>I</td>
<td>(polyatomic) NH₄⁺ PO₄³⁺</td>
<td>(NH₄)₃PO₄</td>
</tr>
<tr>
<td>10 Tin(III) bromide</td>
<td>I</td>
<td>(transition metal) Sn³⁺ Br⁻</td>
<td>SnBr₃</td>
</tr>
<tr>
<td>11 carbon monoxide</td>
<td>C</td>
<td>C=1 O=1 *drop final o on mono</td>
<td>CO</td>
</tr>
<tr>
<td>12 Iodine trichloride</td>
<td>C</td>
<td>I=1 Cl=3</td>
<td>ICl₃</td>
</tr>
</tbody>
</table>
Flyswatter Directions

1. While students are working on the worksheet, use the compounds from the list below to begin preparing for the activity.

2. Write the formulas for those compounds on the board, as well as a few incorrect formulas.

3. Students will break off into 2 groups.
   a. Let them choose their group names!

4. When students are ready explain their responsibilities:
   a. Each round, groups will designate 1 representative to be the flyswatter.
   b. All students are required to find the formula for the compound given, but only the flyswatter can swat the correct answer on the board.

5. When the groups have designated their first flyswatter, the two students will take the flyswatter and prepare for their compound.

6. Choose a compound from the list and write the name on the sideboard, or project it so that everyone can see.

7. The first student to swat the correct answer will receive 1 point for the team.
   a. Incorrect answers are not worth anything, but the other team will get a chance to swat the correct answer.

8. If both students swat the incorrect answer, the round becomes open to the groups.
   (This is why it is important for groups to find the formula as well)
   a. For this, the first group to raise their hand will get the chance to go first.

9. Play continues until all the correct answers are swatted!

*Notes: Make sure to use different colored markers and circle each formula on the board so that they are easier to read.
List of compounds and their formulas to use:

1. sodium fluoride  
   NaF

2. lithium sulfide  
   Li$_2$S

3. calcium bromide  
   CaBr$_2$

4. strontium iodide  
   SrI$_2$

5. potassium oxide  
   K$_2$O

6. magnesium nitride  
   Mg$_3$N$_2$

7. aluminum sulfide  
   Al$_2$S$_3$

8. lithium bromide  
   LiBr

9. sodium oxide  
   Na$_2$O

10. aluminum phosphate  
    AlPO$_4$

11. beryllium sulfate  
    BeSO$_4$

12. ammonium fluoride  
    NH$_4$F

13. sodium nitrate  
    NaNO$_3$

14. strontium sulfate  
    SrSO$_4$

15. aluminum hydroxide  
    Al(OH)$_3$

16. lithium phosphate  
    Li$_3$PO$_4$

17. ammonium phosphate  
    (NH$_4$)$_3$PO$_4$

18. iron (II) chloride  
    FeCl$_2$

19. iron (III) chloride  
    FeCl$_3$

20. chromium (III) oxide  
    Cr$_2$O$_3$

21. mercury (II) sulfide  
    HgS

22. tin (II) hydroxide  
    Sn(OH)$_2$
Ms. Evans – 12th Grade Chemistry - Unit 13 Test (100 Possible Points)

Name: ___________________________ Period: _______ Date: _______

Directions: Follow the directions for each section of the test. Make sure you read the questions completely and answer the questions fully. Write any answers to multiple-choice questions on the line! Make sure all handwriting is legible. You will have the entire class period to complete the test! Good Luck!

**Part One Multiple-Choice:** Answer the multiple-choice questions that follow. Write the letter on the line next to the question. **(1 point each)**

1. _____ What is the charge of a magnesium ion?
   a. 2+
   b. 1-
   c. 1+
   d. 2-

2. _____ What is the charge of fluoride?
   a. 2+
   b. 1-
   c. 1+
   d. 2-

3. _____ What is the charge of phosphate?
   a. 1-
   b. 3-
   c. 2+
   d. 2-

4. _____ What type of charge do cations have?
   a. Negative
   b. Neutral
   c. Positive
   d. a and c

5. _____ What is the easiest way to find the charge of an ion from the periodic table?
   a. It is the same as the row number
   b. It is the same as the group number
   c. It is the same as the proton number
   d. It is the same as the atomic number
Part Two Matching: Match the following terms from column one to column two. You may use lines to connect them, or write the number/letter associated next to the matching terms. (2 points each)

1. Cation  
   a. Two or more atoms creating one compound
2. Anion  
   b. Used in naming covalent compounds
3. Polyatomic Ion  
   c. Two nonmetals forming a compound
4. Transition Metal  
   d. A metal and a nonmetal forming a compound
5. Covalent  
6. Ionic  
7. Prefixes  
   e. A positively charged element
   f. A negatively charged element
   g. Elements that have different charges associated with it

Part Three Naming: Given the chemical formula, for each of the following: First, indicate if it is an ionic or covalent compound. Then, name the compound according to the rules for that compound. (3 points each)

<table>
<thead>
<tr>
<th></th>
<th>Formula</th>
<th>Type of Compound</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NaCl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>BeSO₄</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SiS₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>CO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>ICl₃</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(Part 3 Continued)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Mg(OH)$_2$</td>
</tr>
<tr>
<td>7</td>
<td>Al(NO$_3$)$_3$</td>
</tr>
<tr>
<td>8</td>
<td>Co$_2$O$_3$</td>
</tr>
<tr>
<td>9</td>
<td>SnBr$_3$</td>
</tr>
<tr>
<td>10</td>
<td>MgO</td>
</tr>
</tbody>
</table>

Part 4 Writing Formulas: Given the name of the compound, for the following: First, indicate if it is an ionic or covalent compound. Then, write the compound according to the rules for that compound. (3 points each)

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Type of Compound</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Iron(II) chloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Cobalt (IV) oxide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>dinitrogen tetroxide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Ammonium phosphate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Chromium (III) sulfide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Potassium hydroxide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Lithium iodide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Sodium nitrate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Part 4 Continued)
Part 5 Short Answer: Answer the following questions to the best of your ability. Answer the question fully!

1. Pretend that I have never named a compound before. Choose a type of compound, ionic or covalent, and describe to me steps I would follow to name that type of compound. Make sure to mention if there are different types of each compound, or if there are exceptions to the rules! (11 points)
2. Explain the trends in the periodic table of the following items: metals, nonmetals, transition metals, charges of cations, and charges of anions. You may use visual aids if you choose! (10 points)

*Bonus:* Give the steps for finding the name of the other type of compound in short answer question 1. If you chose covalent, you must now give steps for ionic. If you chose ionic, you must now give steps for covalent. (6 possible points)
Part One Multiple-Choice: Answer the multiple-choice questions that follow. Write the letter on the line next to the question. (1 point each)

1. ____ What is the charge of a magnesium ion?
   a. 2+
   b. 1-
   c. 1+
   d. 2-

2. ____ What is the charge of fluoride?
   a. 2+
   b. 1-
   c. 1+
   d. 2-

3. ____ What is the charge of phosphate?
   a. 1-
   b. 3-
   c. 2+
   d. 2-

4. ____ What type of charge do cations have?
   a. Negative
   b. Neutral
   c. Positive
   d. a and c

5. ____ What is the easiest way to find the charge of an ion from the periodic table?
   a. It is the same as the row number
   b. **It is the same as the group number**
   c. It is the same as the proton number
   d. It is the same as the atomic number
**Part Two Matching:** Match the following terms from column one to column two. You may use lines to connect them, or write the number/letter associated next to the matching terms. (2 points each)

8. Cation E  
9. Anion F  
10. Polyatomic Ion A  
11. Transition Metal G  
12. Covalent C  
13. Ionic D  
14. Prefixes B  

h. Two or more atoms creating one compound  
i. Used in naming covalent compounds  
j. Two nonmetals forming a compound  
k. A metal and a nonmetal forming a compound  
l. A positively charged element  
m. A negatively charged element  
n. Elements that have different charges associated with it

**Part Three Naming:** Given the chemical formula, for each of the following: First, indicate if it is an ionic or covalent compound. Then, name the compound according to the rules for that compound. (3 points each)

<table>
<thead>
<tr>
<th>Formula</th>
<th>Type of Compound</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaCl</td>
<td>I</td>
<td>Sodium chloride</td>
</tr>
<tr>
<td>BeSO₄</td>
<td>I</td>
<td>Beryllium sulfate</td>
</tr>
<tr>
<td>SiS₂</td>
<td>C</td>
<td>Silicon disulfide</td>
</tr>
<tr>
<td>CO</td>
<td>C</td>
<td>Carbon monoxide</td>
</tr>
<tr>
<td>ICl₃</td>
<td>C</td>
<td>Iodine trichloride</td>
</tr>
</tbody>
</table>
### Part 3 Continued

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Type of Compound</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Mg(OH)$_2$</td>
<td>$I$</td>
<td>Magnesium hydroxide</td>
</tr>
<tr>
<td>7</td>
<td>Al(NO$_3$)$_3$</td>
<td>$I$</td>
<td>Aluminum nitrate</td>
</tr>
<tr>
<td>8</td>
<td>Co$_2$O$_3$</td>
<td>$I$</td>
<td>Cobalt (III) oxide</td>
</tr>
<tr>
<td>9</td>
<td>SnBr$_3$</td>
<td>$I$</td>
<td>Tin (III) bromide</td>
</tr>
<tr>
<td>10</td>
<td>MgO</td>
<td>$C$</td>
<td>Magnesium oxide</td>
</tr>
</tbody>
</table>

### Part 4 Writing Formulas

Given the name of the compound, for the following: First, indicate if it is an ionic or covalent compound. Then, write the compound according to the rules for that compound. *(3 points each)*

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Type of Compound</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Iron(II) chloride</td>
<td>$I$</td>
<td>FeCl$_2$</td>
</tr>
<tr>
<td>2</td>
<td>Cobalt (IV) oxide</td>
<td>$I$</td>
<td>CoO$_2$</td>
</tr>
<tr>
<td>3</td>
<td>dinitrogen tetraoxide</td>
<td>$C$</td>
<td>N$_2$O$_4$</td>
</tr>
<tr>
<td>4</td>
<td>Ammonium phosphate</td>
<td>$I$</td>
<td>AlPO$_4$</td>
</tr>
<tr>
<td>5</td>
<td>Chromium (III) sulfide</td>
<td>$I$</td>
<td>Cr$_2$S$_3$</td>
</tr>
<tr>
<td>6</td>
<td>Potassium hydroxide</td>
<td>$I$</td>
<td>KOH</td>
</tr>
<tr>
<td>7</td>
<td>Lithium iodide</td>
<td>$I$</td>
<td>LiI</td>
</tr>
<tr>
<td>8</td>
<td>Sodium nitrate</td>
<td>$I$</td>
<td>NaNO$_3$</td>
</tr>
</tbody>
</table>

### Part 4 Continued
Part 5 Short Answer: Answer the following questions to the best of your ability. Answer the question fully!

1. Pretend that I have never named a compound before. Choose a type of compound, ionic or covalent, and describe to me steps I would follow to name that type of compound. Make sure to mention if there are different types of each compound, or if there are exceptions to the rules! (11 points)

(answers vary)

_Ionic_
- cations
- anions
- transition metal
- polyatomics

_Covalent_
- prefixes
- 1\(^{st}\) element
- 2\(^{nd}\) element
2. Explain the trends in the periodic table of the following items: metals, nonmetals, transition metals, charges of cations, and charges of anions. You may use visual aids if you choose! (10 points)

*Bonus: Give the steps for finding the name of the other type of compound in short answer question 1. If you chose covalent, you must now give steps for ionic. If you chose ionic, you must now give steps for covalent. (6 possible points)

*look at question 1 from part 4
WORKS CITED


