CHEMISTRY 5E MODEL LESSON

Teacher: Heather Yarbrough	**Expected Length of Lesson:** 2-3 days (45-60 min lessons)	**Lesson Topic:** Percent composition	**Unit:** Chemical composition/reactions

Targeted Content Standards/ Element: (Include the entire standard)	**SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions.** c. Use mathematics and computational thinking to apply concepts of the mole and Avogadro's number to conceptualize and calculate • percent composition (this one addressed in lesson) • empirical/molecular formulas • mass, moles, and molecules relationships • molar volumes of gases
Targeted Literacy Skills or Standards: (include as many as your lesson incorporates)	**L11-12RST3**: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. **L11-12WHST1**: Write arguments focused on discipline-specific content. a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Provide a concluding statement or section that follows from or supports the argument presented. **L11-12WHST4:** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
Inquiry Question (or what you would like the students answer)?	How do you determine the percent composition of a substance in a mixture or chemical formula?
Key Vocabulary: Words important for understanding content and skills (ex: Tier 2 and 3 words)	percent composition mole molar mass

Learning Targets (I-Can Statements) ***At the end of the week, what will students know and what will students be able to do?	**<u>Foundational:</u>** ● I can differentiate between an element and a compound. ● I can explain that elements bonded together create molecular compounds. **<u>Mastery:</u>** ● I can determine part and whole of a substance and calculate a percent by using the formula: part/whole x 100. ● I can calculate percent composition of by mass given the masses of elements in a compound by completing a popcorn lab. ● I can calculate percent composition by mass given the formula or name of a compound by completing the "Person to Percent" activity. ● I can determine the number of grams in 1 mole of a element by looking at the Periodic Table of the Elements. ● In a compound, I can determine the numbers of atoms of each element and calculate the mass by multiplying the number of atoms by the number of grams in 1 mole. ● I can calculate the molar mass of a compound by adding the masses of the elements in the compound. **<u>Extension:</u>** ● I can determine empirical formulas from percent composition.
ENGAGE Describe how the teacher will capture students' interest. What kind of questions should the students ask themselves after the engagement?	● Prepare bags with 15-20 small edible items in them. Possible items to include are: popcorn, M&Ms, pretzels, peanuts (if no allergies exist), sunflower seeds, candy corn, etc. Decide how many of each item you will place in the bags (i.e. 5 pretzels, 3 pieces of popcorn, 3 M&Ms, 6 candy corn). ● Put the students in pairs and give them 1 bag per group. Tell them you have made your own version of "Chex Mix" for a gathering you will be having at your house. The guests that are coming really have a sweet tooth so you want to make sure your Chex Mix will meet their expectations. Tell them you would prefer if your mixture was at least 80% sweet so you have given them a sample of your Chex Mix and you need feedback on whether it will meet that criteria. Make sure to designate what constitutes a "sweet" item. ● Students will examine the sample. Have them talk it out in their pairs and determine if the host and guests will be satisfied. Give them happy face and sad face cards and have each pair hold up the card that they think will best represent the host/guests. Allow students to defend their position and prove it with calculations. ● Introduce percent composition by showing the students the proper way to calculate part/whole x 100. ○ Example: If the bag had the amounts shown above and M&Ms and candy corn are considered sweet, you would have 9 sweet items (3 M&Ms and 6 candy corn). This is

	the "part. The whole is the total number of items in the bag, 17. So, 9/17 = .529. Now multiply that by 100 = 52.9%. Thus, the host/guests would not be pleased.
EXPLORE Describe what hands-on/minds-on activities students will be doing. List "big idea" conceptual questions the teacher will use to encourage and/or focus students' exploration	● See Explain #1 ● Put students in groups of 3 for the "Person to Percent" activity. Give each group a card with a different compound containing 3 elements (such as $C_6H_{12}O_6$ OR $Ba(OH)_2$). ○ Each student assumes the role of one of the elements and will use the periodic table to calculate their individual mass. ○ The group will then calculate the total molar mass. ○ Each student will calculate his percent composition. ○ Students will self-check their answers by making sure all 3 percentages equal up to 100. ● Swap formulas with another group and repeat. Once a group has completed 5 compounds, the teacher will check that they have completed all 5 and send them to an area where the answers are for a 2nd checkpoint. ● Next, have students determine the percent of water in the Popcorn Percent Composition Lab (see the sheet attached).
EXPLAIN Student explanations should precede introduction of terms or explanations by the teacher. What questions, resources, or strategies will the teacher use to help students connect their exploration to the concept under examination? List higher order thinking questions which teachers will use to solicit *student* explanations and help them to justify their explanations. Describe how the teacher will clarify the content or skill.	**Explain #1** ● Before starting the Explore activity, go through a few examples of how to calculate percent composition by mass given the formula or name of a compound. For example, Quartz has the chemical formula SiO_2. What is the percentage composition of each element this compound? ○ The mass of Si is 28 and the mass of 1 oxygen is 16 but since there are 2 atoms of oxygen (O_2), you multiply 2 x 16 = 32 ○ The total molar mass (or whole) is 28 + 32 = 60. ○ To find the percent composition of Si, take the mass of Si (part) and divide by the molar mass of the compound (whole) and then multiply by 100. ■ 28/60 = 46.6 x 100 = 46.6% ○ Repeat for O_2. ■ 32/60 = 53.3 x 100 = 53.3% **Explain #2** ● Students will answer questions on the lab sheet as the teacher monitors. After the lab, the teacher will give each student a list of the mastery learning targets and have the students self-assess their understanding of each target. The teacher will pair up students who don't feel confident with students who do feel confident and allow for peer tutoring.

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ELABORATE

Describe how students will develop a more sophisticated understanding of the concept.

What vocabulary will be introduced and how will it connect to students' observations?

How will students make real-life connections?

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- Nabisco, the maker of the Oreo, has developed a new Oreo that they claim has DOUBLE the amount of creamy filling of a regular Oreo. Think about how you could put their claims to the test.
    - Let students carry out their experiment and collect actual data OR give them the data below to calculate and form a conclusion.

<table>
<tr><th></th><th>Regular Oreo</th><th>Double Stuffed Oreo</th></tr>
<tr><td>Mass of entire cookie</td><td>11.3 g</td><td>14.5 g</td></tr>
<tr><td>Mass of creamy filling</td><td>7.26 g</td><td>10.46 g</td></tr>
<tr><td>Mass of wafers</td><td>4.04 g</td><td>4.04 g</td></tr>
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- Students will pretend they are food critics and will write a review of the new Double Stuffed Oreo for the food section in the local newspaper. The review should include:
    - An opening sentence that states Nabisco's claim and whether you back this claim or dispute it
    - Step by step process of the experiment you conducted
    - Your percent composition calculations that support/don't support the claim
    - A concluding statement

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EVALUATE

How will students be evaluated THROUGHOUT the lesson?

How will students demonstrate that they have mastered the learning target(s)?

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- Pair discussions and happy/sad face cards
- Percent to Person activity; 2 self-checks
- Popcorn Percent Composition Lab
- Learning targets self-assess and peer tutoring
- Oreo Cookie newspaper review & rubric

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"Person to Percent"

Glucose $C_6H_{12}O_6$	Copper (II) sulfate $CuSO_4$
Sodium carbonate Na_2CO_3	Chloroplatinic acid H_2PtCl_6
Lithium nitrate $LiNO_3$	Hexafluorosilicic acid H_2SiF_6
Ammonium chloride NH_4Cl	Potassium Bromate $KBrO_3$
Barium hydroxide $Ba(OH)_2$	Nicotine $C_{10}H_{14}N_2$

POPCORN LAB: PERCENT COMPOSITION

Objectives:

- Find the percent of water in popcorn
- Calculate the percent composition of popcorn and chemical compounds

Introduction:

1. In today's lab, you'll be cooking popcorn in the microwave. Microwaves work by exciting water molecules so that they rub together and get hot. When popcorn is heated, the water trapped inside the kernel expands until the skin of the kernel explodes and steam is released. After the steam escapes, predict what happens to the mass of the popcorn bag?.

2. You should already know alot about percent. Today you'll be figuring out some percentages for compounds and mixtures. You can always find percent by using the following formula:

$$\frac{Part}{Whole} * 100 = Percent$$

Let's try it:

a. You get a 5 out of 10 on a quiz.
   i. What is your "part"?

   ii. What is your "whole"?

   iii. What percent did you get on the quiz?

b. Water is made of 16g of oxygen and 2g of hydrogen, for a total of 18g.
   i. What is the percent oxygen?

   ii. What is the percent hydrogen?

   iii. Add your percentages – if it's not 100% you have done something wrong!

MATERIALS: balance, microwave, bag of microwave popcorn, calculator

PROCEDURES:

1. Take the popcorn out of the plastic wrapper and place on the scale. Record the mass in the table below to the appropriate significant figure.
2. Cook the popcorn in the microwave: listen to your popcorn carefully so you don't burn the popcorn.
3. Open the bag and let the steam escape. (This is the water that was trapped in the kernel.)
4. Place the bag of cooked popcorn on the scale and record the mass to the appropriate significant figure in the table below.
5. Calculate the mass of water by finding the difference between the mass of the popped popcorn and the mass of the unpopped kernels. Record in the table below.

DATA TABLE:

Mass of unpopped popcorn	
Mass of popped popcorn	-
Mass of water	=
Percent of water in popcorn	

Calculate the percentage of water in the popcorn thinking about the part/whole x 100 formula.

Percent water in popcorn = _____ X 100 = [ ]

CONCLUSION/ANALYSIS:

1. Knowing the percent of water that was in your popcorn, calculate the percent of popcorn.

2. Take the mass of the popcorn **BEFORE** popping and find the number of moles in the popcorn. Note: 1 mole popcorn = 79g.

3. Take the mass of the popcorn **AFTER** popping and find the number of moles in the popcorn.

4. Did you use the mass of the unpopped popcorn or the mass of the popped popcorn as your "whole" value? Explain why.

PRACTICE PERCENT COMPOSITION PROBLEMS:

REMEMBER: There are 2 ways to calculate percent composition.

If actual sample masses are given, use them.

$$\frac{\text{Actual mass of element}}{\text{Total mass of compound}} \times 100$$

If no masses are given, use the formula to calculate molar mass, and % composition from there.

$$\frac{\text{Mass of element in 1 mole compound}}{\text{Molar mass of compound}} \times 100$$

1. Calculate the percent composition of water, when there is 45.87g of H_2 and 187.67g of O_2.

2. What is the percent composition of all elements in magnesium sulfate, $MgSO_4$?

3. What is the percent composition of all elements in sodium bromide, NaBr?