UNIT 6
STOICHIOMETRY
TEACHER NOTES

PREVIEW

Created by: IT'S NOT ROCKET SCIENCE®

Included by Folder:

1- Implementation

- Read First (this document) with **14** pages of teacher notes for how to implement this curriculum
  - Includes links to YouTube video lectures for each set of PowerPoint notes on ***page 16***
- NGSS Alignment Overview
- Unit Plans for 50-minute and 90-minute (block) pacing, CP and Honors, + editable versions
- Distance Learning Tips
- RADAR Signs
- Reference Sheet – Unit 6
- Periodic Tables – 6 versions
- How to Write a Great Study Guide resource

2-Packets

- Two 47-page packets, differentiated for CP and Honors, with all student handouts for the entire unit including:
  - Cornell note outlines, activities, labs, and practice
- Additional versions of the packets with Fill-in-the-blank notes and completely filled in notes
- Packet answer keys
- 4-page guide to accessing and using the **paperless digital version** of the packets through Google Drive™

3-Notes

- Concept 1 Notes: Meet the Mole – 30 slide ppt
- Concept 2 Notes: Intro. to Stoichiometry– 16 slide ppt
- Concept 3 Notes: Limiting Reactants – 14 slide ppt

All ppts have editable text and are fully animated in presenter mode*

4-Activities

- 30 Magnitude of a Mole Activity Cards + editable version
- Inquiry Lab Activity data table Excel spreadsheet
- 8 Stoichiometry Review Stations + editable version

5-Assessments

- Stoichiometry Quiz – CP and Honors
- Unit 6 Test CP– Versions A and B *(matching rearranged)*
- Unit 6 Test HONORS – Versions A and B *(matching rearranged)*

All assessments come with an editable version and a detailed answer key

Supplemental Resources

- Additional practice handouts on the following topics:
  - Dimensional Analysis
  - Scientific Notation
- Answer keys

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Teacher Notes:

Overview:

This unit is designed to be everything you need to teach a stoichiometry unit in a high school chemistry 1 course. Content covered includes: molar mass, Avogadro's number, empirical and molecular formulas, percent composition, stoichiometric calculations, limiting reactants, and percent yield. This product includes PowerPoint notes *(with corresponding lecture videos),* a packet of student handouts for all activities, labs, and practice, and summative assessments including 1 quiz and 1 unit test. The teacher implementation notes provide suggestions for differentiating the unit for CP *(college prep, or on-grade level)* classes and Honors *(advanced)* classes. The unit test is provided in both CP and Honors versions. The student packet also comes in a paperless digital version that can be used in Google Drive™ and/or Microsoft OneDrive™.

Packet instead of Interactive Notebook:

I started creating packets for my students over ten years ago, and I love them so much more than interactive notebooks. While interactive notebooks are great resources that work for many teachers, I have found the packet strategy to be a more appropriate tool for using in the secondary classroom setting with my students. I love using the packet for many reasons:

1. I only have to make copies **one time** each unit instead of copying handouts every day. Even though it takes some time to copy the packets for each student, it saves so much time on a day to day basis. *(Also I've often recruited seniors to be my "Teacher's Aide" and have trained them to copy all of my packets for me. I haven't seen a copier in YEARS and it's glorious!)* You can also now go **DIGITAL** and **PAPERLESS** with the Google Drive™ version of the packet, if you prefer!
2. It puts responsibility back on the students to maintain their chemistry binder with their packet, while also aiding them in practicing organization skills. It has been incredibly effective for my lower level students especially. Even though it is a lot of papers to receive at once, I can watch them put it in their binder and leave it there, rather than having to hang on to numerous individual papers passed out each day. It has really eliminated the need for a textbook too, so students really only have to remember to bring ONE thing to class – their binder with their packet!
3. It makes it so easy to be absent last minute. If you or your child gets sick, sub plans are a breeze. You don't have to send your teacher neighbor to make copies for you – because your students already have everything they need. You just have to tell the sub which pages the students need to work on for the day. It was especially helpful for my long-term substitute when I was on maternity leave!
4. The structure of the packet provides a more helpful method than interactive notebooks in preparing students for college – which should be one of our goals as high school teachers. The packet helps students learn how to structure notes *(one of the reasons why I love teaching them how to write Cornell notes)* and how to stay organized.
5. They are a time saver in so many ways – no more time wasted regularly passing out handouts or having to cut and paste things into a notebook.
6. Students do a better job keeping up with returned graded work because every page is numbered, so they can put graded assignments right back into the packet where it came from, setting them up to more likely refer back to graded work as they study.
7. You no longer need a filing cabinet – you can keep all of your curriculum and keys organized into easy to grab binders! See picture on ***page 16.***

You can read more about **my love of packets here**!

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Teacher Notes:

In short...

The best statistical evidence I have in support of why I love the packet strategy so much is that I had a **96% pass rate** on my state's standardized End-of-Course Biology exam for non-Honors students and a **100% pass rate** for Honors students, using this same strategy in my Biology 1 course. This was at a South Carolina public school with over 50% of the students being below the poverty line. My average score on the EOC *(all 200+ students combined that I taught during my time there)* was a 90%. I believe this success is due to multiple factors, but I attribute a lot of it to the packet-based curriculum I have designed. Honestly, I could go on and on about the packet as an organizational resource and why I love it so much, but I think you will find that you feel the same if you choose to test it out!

Next Generation Science Standard Alignment:

When writing each of my chemistry units, I tried to incorporate as many different states' chemistry standards as possible, while most importantly keeping the content within the scope of the NGSS style. While NGSS doesn't have specific standards for chemistry *(just the high school physical science standards that are part chemistry, part physics)*, there are many DCIs, science & engineering practices, and crosscutting concepts that align with my chemistry curriculum. This unit covers content related to the following standard:

- **HS-PS1-7**: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

*You can find more information about NGSS alignment in the **"NGSS Alignment"** guide in the **Implementation folder.***

Prior Knowledge:

This is the **sixth unit** I would teach in chemistry 1, and the first one after coming back from winter break for our second semester. At this point in the year, I would expect students to have prior knowledge on topics covered in my Intro. to Chemistry unit *(including measurement, experimental design, scientific notation, dimensional analysis, properties and classification of matter)*, my The Atom unit *(including atomic theory, structure, isotopes, an introduction to the periodic table, and nuclear chemistry)*, my Electrons unit *(including electrons and the electromagnetic spectrum, electron configurations, Bohr models, Lewis structures, and periodic trends)*, my Chemical Bonds unit *(including naming and writing formulas for ionic and covalent bonds, metallic bonds, molecular geometry, and intermolecular forces)*, and my Chemical Reactions unit *(including writing, balancing, and classifying chemical reactions, predicting products, and chemical equilibrium)*. If that is NOT the case for your students, keep that in mind as you move forward with this unit, as you may need to provide further support for them to be successful with the content. Some additional practice handouts have been included in the ***Supplemental Resources folder*** if you need to review dimensional analysis and scientific notation more at the start of the unit.

When to use:

This is designed to be the sixth unit in your chemistry 1 course. I believe the resources I have provided in this product are everything you need to teach a unit on stoichiometry. ***However***, if you know that your students don't have the prior knowledge mentioned above, or if you teach through a concept and realize your students want to go deeper or may need more support, you may need to make some additions for your students. Every class is different and some will need more support than others – and that is totally okay! You can easily add pages manually prior to copying the packet for your class.

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Teacher Notes:

Assessment:

I did not include point values on any of the handouts in the packet in order to provide you the freedom to grade things how you desire. On the next few pages I am going to provide you an overview of **my** grading strategy for you to reference. Feel free to adopt this or do entirely your own thing. It is completely up to you!

After much research and number crunching over the years, this is the simplest and most accurate grading technique that I have come up with. I divide my gradebook into two simple categories: **MAJOR** grades and **MINOR** grades. Within each category, different assessments are worth different amounts of points based on length, depth, and complexity. Below I will give you an idea of what goes into each category.

Major Grades = 60% of the student's overall grade

- **Tests** = **100 pts**
  - Unit 6 has 1 test, which would count as a 100 pt major grade.
- **Quizzes** = **25 pts**
  - Unit 6 has 1 quiz, which would count as a 25 pt major grade.
- **Projects** = **100 pts**
  - None in this unit.

Minor Grades = 40% of the student's overall grade

- **Activities/Labs/Practice** = **10-100 pts**
  - The amount of points I give students is **completely dependent** on the length and depth of the activity. I also do not grade many of the in-class assignments the students do, because there are so many of them! Instead, we would just go over them as a class. If I did want to assign a grade, I often just circle the class and do a spot check grade for completion before drawing names and going over as a class. For instance, in this unit, I would not collect and grade:
    - Lab Activity: Stoichiometry with S'mores
    - Stations: Stoichiometry Review
    - ALL of the practice handouts (could be **10 pts each** for completion)
  - Now for the things I might grade for accuracy – in general, an activity that lasts only half of a 50-minute class period would usually only be worth about 25 pts. An activity that lasts a full class period or two is usually worth about 50 pts, and an activity that takes more than two class periods to complete would be worth 100 pts. For instance, in this unit I would collect and grade for accuracy:
    - Lab Activity: Homemade Hot Chocolate for **25 pts**
    - Activity: Magnitude of a Mole for **25 pts**
    - Inquiry Lab Activity: Percent Composition for **50 pts** *(give a LOT of grace with this though if you do grade it because it is an inquiry activity!)*
    - Lab: Homemade Chalk for **50 pts**

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Teacher Notes:

Assessment (continued):

Minor Grades = 40% of the student's overall grade

- **Daily Quizzes/Bell Ringers** = **5 pts per day**, usually totaling **25 pts for the week** *(if there is one every day)*
  - This is something I have fallen in love with doing, but not every teacher does which is why I do not include my daily quizzes/bell ringers with this product *(if you would like to purchase for this unit, you can find them in my store. They are $5 per unit or cheaper as a bundle.)*
  - I call my bell ringers "Prime Times" because I believe that the first 5 minutes of class is the most important time of the day. I love that my students are in a routine and come in ready to work as soon as they get to my room because they know they will have a Prime Time.
  - If you would like to know more about how I implement these, again, check them out in my store! The gist is that students have 3-5 questions a day on the board when they come in. They use the same sheet of paper each day to write their answers on. I give them 5 minutes at the start of class to answer the questions, then they pass them over and I collect them and grade each day. They count for 5 pts a day. At the end of the week I add up the points based on how many we did and give them a score for the week.
  - **I grade these for accuracy but I allow students to use their notes.** This way I ensure students are writing good notes, keeping up when they are absent, and getting the basics of what we covered the day before. I also like it because I go over the answers as soon as I collect them so I know if the majority of students are getting what we did the day before so I can address issues before we move on to new material. It is my favorite way to check in with each student **DAILY** to know where they are with the material!!

- **Homework** = **Concept Study Guides** = **10 pts each**
  - I like to avoid assigning homework as much as I can (you can read why here!) However, most students don't know how to study, so I like to help to provide them with the skills to make their own study guides that they can use for years to come. Here is how I do this:
    - I divide each unit into 3-6 concepts (Note: This unit has 3 concepts.) Students make a study guide for each concept and turn them in at different points throughout the unit to be graded for 10 pts each. I return them **within a day** so they can have them to study for their unit tests.
    - For their study guide they must **answer all objectives**, **complete any practice problems**, and **define all vocabulary** on the first page of the packet. They do not have to write anything for the *italicized objectives*, as those represent skills that would be hard to show mastery of on paper, however they do need to be able to do ALL of the objectives on the assessment.
  - All summative assessments provided in this product and future products are aligned with the objectives and vocabulary outlined on the front page(s) of each packet, making this an effective resource to base their study guides off of.
  - I do allow them some freedom in this. Some students like to type these, some hand write them. I also encourage students to make them as **visual** as possible. *They shouldn't write their study guides in paragraph form.* I encourage them to make Venn diagrams, tables, and other charts to make their study guides visually appealing – and something they would actually like to study from. I do not show them examples of how to do this, because I want them to find their own method that works best for them!
    - For instance, a lot of students make flashcards, flipcharts, or use Quizlet (an online flashcard making tool) for the vocabulary portion. This is great, but I do make them turn these in with their study guide so I can check them. For Quizlet, students just print them out and staple to the back of their objectives.
    - To provide guidance for students as they make their first study guide, see the **"How to Write a GREAT Study Guide"** document in the **Implementation** folder.
  - I find these especially useful because so much of this course builds upon itself, and I want to encourage my students to really learn material for the long-term, and not just cram it in the night before a test. If students make good study guides, they will be incredibly useful resources for them to reference throughout the year as they review for future tests. It will also be a valuable skill for them to have if they move on to higher education.

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Teacher Notes:

Materials:

- Hole-punched copies of the packet for each student to put in their binders *(or distributed digital paperless packets to students via Google Drive™ or Microsoft OneDrive™)* (can be found in the **Packets** folder)
- Copies of the Periodic Table Foldout for students to put together and keep in their binders (can be found in the **Implementation** folder)
- Copies of Reference Sheet – Unit 6 (can be found in the **Implementation** folder)
- Copies of quizzes and tests (can be found in the **Assessments** folder)
- Ability to project and use PowerPoints
- Access to technology for activities where students will need to conduct research
- *(optional)* I recommend a class set of calculators students can use, as needed
- Printed *(and I prefer laminated so that they hold up each year – you won't regret it!!)* copies of the following (can be found in the **Activities** folder):
  - Stations: Stoichiometry Review
    - 1 set = 8 stations
      - *I'd have 2-3 copies of each station card for bigger classes so that students don't get bunched up*
- For the **Lab Activity: Homemade Hot Chocolate**:
  - Measuring instruments: tablespoon, teaspoon, dropper, 1 cup
  - Hot chocolate ingredients: unsweetened cocoa powder, sugar, milk, vanilla extract, salt, large marshmallows, and mini candy canes
    - Consider purchasing a non-dairy milk option (like oat milk) for students with dairy allergies!
  - Spoons for stirring
  - Hot plates
  - Oven mitts
  - Metal camping cups
    - I recommend ordering 6 of **these** on Amazon and reusing each year.
  - Disposable insulating cups (like to-go coffee cups) for drinking the finished product out of
- For the **Activity: Magnitude of a Mole**:
  - 1 poster board for every 2 students (each student needs ½ a board to make a mini-poster)
  - Coloring utensils
- For the **Inquiry Lab Activity: Percent Composition**:
  - Regular Oreos (1 per student)
  - Double Stuf Oreos (1 per student)
  - Digital scales
  - Weigh boat/paper

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Teacher Notes:

Materials (cont.):

- For the **Lab Activity: Stoichiometry with S'mores**:
  - Safety goggles
  - Option 1 = Regular Sized S'mores
    - Ziploc bag for each student with graham cracker squares, regular sized marshmallows, and pieces of Hershey's chocolate. You decide how many to give each student, but I recommend that all bags are assembled the same so that their answers to the lab are easier to check for accuracy. They need a minimum of 2 graham cracker squares, 1 marshmallow, and 1 piece of chocolate (I consider 1 row from the bar with 3 parts 1 full piece of chocolate) in order to make 1 s'more. I would give more than that so they can determine which ingredient is limiting.
    - Bunsen burner and clean roasting sticks for roasting the marshmallows over the flame
    - Alternatively, they can microwave their s'mores 20-30 seconds if you have access to a microwave and don't want to use lab equipment.
  - Option 2 = Mini S'mores
    - Ziploc bag for each student with honey teddy grahams, mini marshmallows, and chocolate chips. This version makes much smaller s'mores (still with the 2:1:1 ratio of ingredients) BUT it is nice because you can give them way more ingredients so they have to think a little harder to determine the limiting reactant.
    - Tea lights and toothpicks for roasting! I love this mini version because if the marshmallows melt on the tea lights, it is no big deal because you can toss them! You can get a giant pack for a decent price here.
- For the **Lab: Homemade Chalk**:
  - Safety goggles and disposable gloves
    - Note: Both reactants can irritate the skin so if students touch their skin, they need to wash with soap and water, in addition to wearing goggles and disposable gloves. Both products can be poured down the drain at the end of the lab!
  - Distilled water *(enough for ~100 mL per lab group)*
  - Solid calcium chloride *(enough for 2.77 g per lab group – the 500 g bottle linked is enough for ~175 students or lab groups, with a little wiggle room)*
  - Solid sodium carbonate *(enough for 2.65 g per lab group)*
  - Graduated cylinders
  - Digital scale
  - Weigh boat/paper
  - Stirring rod
  - 50-mL or 100-mL *beakers (3 per lab group)*
  - Funnel
  - Filter paper
  - *(optional, but helpful)* Squirt bottle with distilled water
  - 125-mL Erlenmeyer flask *(1 per lab group)*

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Teacher Notes:

Implementation:

Over the next few pages I will be providing commentary for how to implement this unit, based on the **unit plans** included in the **Implementation** folder. Be sure to have a copy of the unit plan open or printed out as you read through this so that it makes the most sense.

For this unit, I use the exact same resources for both my CP *(on grade level)* and Honors *(advanced)* students. The main difference is that the Honors summative assessments are more challenging than the CP.

For general implementation, I give CP students a lot more support and guidance as I teach them, and the Honors students are expected to work more independently. If there are any other differences between implementation for both levels, I will include those in the notes. Also, check out the **NGSS Alignment** document in this folder for tips on how to teach through this unit using NGSS phenomena.

The student packet is provided for Honors and CP levels. There are also three formats for each packet – the originals, ones with completely filled in notes, and ones with fill-in-the-blank notes. There are also paperless digital versions of EVERY derivation of the packet, which can be accessed using the PDF of instructions in the **Packets** folder.

A quick note on stoichiometry before we dive in: I know this unit is intimidating for a lot of students. You NEED to build confidence in them that they CAN do this. All stoichiometry is just fancy Algebra!! That is IT!! Especially if they remember learning scientific notation and dimensional analysis at the beginning of the year, they will be set up to start strong in this unit. If not, I definitely recommend using the extra practice in the supplemental resources folder. The hot chocolate lab activity will hopefully refresh their memories as well.

For all of the practice handouts, I try to write the same types of problems back to back. So every two problems are done similarly, just with different numbers/values. This allows you to assign only odds, and then students who need extra practice can also do the evens in tutoring after school or on their own. You can also do ALL of the odds as a class and then have students do evens on their own or with a partner. Totally your call! I just wanted you aware of how I structured these purposefully before you start. Most activities and practice handouts also have a "challenge problem" at the end. These are not to be skipped!! I WANT students to do this, as I think it is great logic practice to see if they can logically take it to the next step before explicitly being taught what is next in our "fancy Algebra" skills. If these overwhelm your CP students more than they inspire them, you can have them skip them.

You'll notice this unit has more instructional resources with edible components than I have ever done before. It is up to you if you want to allow them to actually eat the materials afterwards or not. You can also designate certain lab equipment for these labs only year after year. You can try to do these in the cafeteria, also, if allowed. My hope was that all of these activities would make learning stoichiometry a little sweeter (pun intended).

Lastly, please use the unit plans and these notes as a ***guideline*** for your class. Teaching and plans have to be flexible and be able to be adjusted based on students' needs. This unit is written to take **16 days**, but you can cut out some of the activities, have them do some of the practice at home (I built in time for all of it to be in class), or use the YouTube lecture videos (links on ***page 16***) to do a flipped classroom style if you need to squeeze it into a shorter period of time. Editable versions of unit plans are provided for that exact reason!

Note: *All implementation notes below are based off a 50-minute class period. A 90-minute block unit plan is provided in the* ***Implementation*** *folder for reference.*

- Day 1: ***Prior to class, make sure to have all supplies needed for the homemade hot chocolate lab activity.*** Distribute packets to students from the **Packets** folder. This has all of the handouts they will need for the entire unit! You can pick from the original, filled in

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Teacher Notes:

- Day 1 (cont.): notes, and fill-in-the-blank notes options provided. Start with the Lab Activity: Homemade Hot Chocolate. The purpose of this lab activity is to review scientific notation and dimensional analysis before jumping into this unit. The timing of this falls right after winter break for me, so the hot chocolate feels extra fun this time of year. This is a variation of the fudge lab the students did in **Unit 1: Introduction to Chemistry**, so they should have a general idea of what to do. Make sure to have purchased and prepped all ingredients in advance. See notes below for how MUCH you will need of each ingredient and material. I would have students do the calculations in class so you can walk around and help those that need a refresher. I would have CP only do the main 5 and honors do all 7 *(but as always, your call! You know your students best)*. Once they get all 5 (or 7) correct and checked off, I sign their paper and they can start making their hot chocolate. If you don't have hot plates or Bunsen burners, you can just have them microwave their milk for 1 min, then add ingredients, stir, and microwave another 30 seconds. Students without all of their checks will need to make corrections. The second time they come around if their answer is still incorrect, I will look more closely at their work and try to offer advice if I see something off. I help the students struggling with corrections by pointing out if they did the standard notation wrong or if they are missing a conversion factor or something like that. The students that make their hot chocolate first have to clean their tools for the next students, and then can sit with their hot chocolate and work on the reflection questions. Again, it is a little bit of a juggling act to have students working at different paces but I like it to be staggered this way so I don't need as much equipment and can better help students who need it. If you prefer all the students to work at the same pace, you can use the extra practice in the **Supplemental Resources** folder for those who finish first to do while you wait on all students to finish the calculations. If students need all of class time to do this *(because you have to review SN and DA before starting)*, then just make sure they are all signed off by the end of class so you can start class tomorrow by them making their cup of hot chocolate before starting Concept 1 Notes.
  - **1 cup** – for students to measure out milk
  - **1 teaspoon** – for students to measure out cocoa powder
  - **1 tablespoon** – for students to measure out sugar
  - **1 dropper** – for students to measure out vanilla extract
  - **Spoons or stirring rods** (that aren't used for chemicals) for each group to mix their hot chocolate
  - **Metal/aluminum/tin cups** for heating – I have this 6 pack from Amazon. Students just had to clean out their cups when they were finished for the next student to use!
  - **Hot plates** – due to limited resources, I typically only had 2-3 set up in a "heating station" area at a time, and since students had a staggered start this wasn't an issue! Alternatively, you can have students heat their milk in a microwave with microwave safe cups
  - **Milk** – 1 [illegible] cup [illegible] gal [illegible] for very [illegible] you have
  - **Cocoa** [illegible] is e[illegible] for 45 [illegible]
  - **Sugar** – [illegible] enough [illegible]
  - **Salt** – I k[illegible] salt s[illegible] a v[illegible] fin[illegible] need more than 1 container because each partnership is only using 1 pinch!
  - **Vanilla extract** – one bottle is enough for 25 students
  - **Large marshmallows** – [illegible] enough for [illegible]
  - **Mini candy canes** – just need enough for 1 per student

PREVIEW
More Teacher Notes in the actual product

Course: Chemistry		
Unit 6 Stoichiometry		
Learning Objectives	**Determination of Evidence**	**Alignment**
Student will be able to… - Explain the relationship between the following terms: mole, Avogadro's number, and molar mass. Include what each is used for. - Differentiate between the empirical and molecular formula of a compound and explain how it applies differently to ionic vs. covalent compounds. - Use Avogadro's number to convert from moles to atoms or molecules, and vice versa. - Determine the formula or molar mass of an element or a compound. - Find the percent composition of a compound and use percent composition to determine the empirical and molecular formulas for an unknown compound. - Explain the significance of the mole ratio in stoichiometric calculations. - Be able to calculate the amount of moles or mass of a reactant or product when given the amount of moles or mass for another reactant or product (meaning you can do all types of stoichiometry calculations, including mol to mol, mol to g, g to mol, and g to g). - Be able to apply naming rules to write chemical formulas from compounds. - Be able to balance and classify reactions. - Explain why the amount of product formed from a reaction is always determined by the limiting reactant. - Differentiate between actual and theoretical yields. - Be able to determine the limiting and excess reactant when given starting amounts of reactants. - Be able to determine the amount left unused from an excess reactant. - Be able to determine how much product can be made when given the amount of moles or masses of the reactants. - Be able to calculate percent yield when given the actual yield and quantity of a reactant.	*The following assessments will provide evidence of student learning:* Classwork: - Lab Activity: Homemade Hot Chocolate - Activity: Magnitude of a Mole - Practice: Molar Mass of Elements - Practice: Molar Mass of Compounds - Inquiry Lab Activity: Percent Composition - Practice: Percent Composition - Practice: Determining Formulas - Practice: Stoichiometry - Lab Activity: Stoichiometry with S'mores - Practice: Limiting Reactants - Practice: Percent Yield - Lab: Homemade Chalk - Stations: Stoichiometry Review Homework: - Concepts 1-3 Study Guides Quizzes/Tests: - Quiz: Stoichiometry - Unit 6 Test: Concepts 1-3	*Next Generation Science Standards by NSTA:* HS-PS1-7 *See "NGSS Alignment" document for further detail.*

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Unit Plans (+ EDITABLE VERSIONS)

for both CP and Honors

Includes 50-MINUTE and 90-MINUTE pacing

Day	Learning Objectives	Methods/Activities	Assessments	Homework	Standards
1	Review of Dimensional Analysis and Scientific Notation	-Lab Activity: Homemade Hot Chocolate p.2-4	-Lab Activity: Homemade Hot Chocolate p.2-4		HS-PS1-7
2	The Mole Molar Mass	-Start Concept 1 Notes p.5-6 (slides 1-11) -Practice: Molar Mass of Elements p.12-13, go over after	-Informal questioning and discussion -Practice: Molar Mass of Elements p.12-13		HS-PS1-7
3	The Mole Molar Mass	-Go over p.12-13 if you didn't yesterday -Activity: Magnitude of a Mole p.11	-Activity: Magnitude of a Mole p.11		HS-PS1-7
4	Molar Mass	-More Concept 1 Notes p.6-7 (slides 12-17) -Practice: Molar Mass of Compounds p.14-15, go over after	-Informal questioning and discussion -Practice: Molar Mass of Compounds p.14-15, go over after		HS-PS1-7
5	Percent Composition	-Inquiry Lab Activity: Percent Composition p.16-18	-Inquiry Lab Activity: Percent Composition p.16-18		HS-PS1-7
6	Percent Composition	-Wrap up p.16-18 lab, if needed -More Concept 1 Notes p.8-9 (slides 19-23) -Practice: Percent Composition p.19, go over after	-Informal questioning and discussion -Practice: Percent Composition p.19		HS-PS1-7
7	Empirical and Molecular Formulas	-Go over p.19 if you didn't yesterday -Finish Concept 1 Notes p.9-10 (slides 24-30) -Practice: Determining Formulas p.20-21, go over after	-Informal questioning and discussion -Practice: Determining Formulas p.20-21	-Concept 1 study guide	HS-PS1-7
8	Stoichiometry	-Collect Concept 1 study guide -Concept 2 Notes p.22-26 (slides 1-16) -Work on Concept 2 Study Guide, if time	-Concept 1 SG -Informal questioning and discussion		HS-PS1-7
9	Stoichiometry	-Practice: Stoichiometry p.27-29, go over after -Work on Concept 2 Study Guide, if time	-Practice: Stoichiometry p.27-29	-Concept 2 study guide	HS-PS1-7
10	Stoichiometry	-Collect Concept 2 study guide -Lab Activity: Stoichiometry with S'mores p.30-31	-Concept 2 SG -Lab Activity: Stoichiometry with S'mores p.30-31	-Study for quiz tomorrow	HS-PS1-7

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47-page CP Packet with all student handouts for the entire unit.

Unit Topic: Stoichiometry

Essential Question: How can chemical reactions be described quantitatively?

Concept 1:
Meet the Mole

Objectives:

1. Explain the relationship between the following terms: mole, Avogadro's number, and molar mass. Include what each is used for.
2. Differentiate between the empirical and molecular formula of a compound and explain how it applies differently to ionic vs. covalent compounds.
3. *Use Avogadro's number to convert from moles to atoms or molecules, and vice versa.*
4. *Determine the formula or molar mass of an element or a compound.*
5. *Find the percent composition of a compound and use percent composition to determine the empirical and molecular formulas for an unknown compound.*

Practice:

6. How many molecules are in 2.00 mol of CO_2?
7. What is the mass, in grams, of 7.18 mol of calcium carbonate?
8. How many moles are in 50.99 g of ammonium chloride?
9. Determine the empirical formula for a compound that is 53.70% iron and 46.30% sulfur.
10. Consider a compound that is 54.5% carbon, 9.1% hydrogen, and 36.4% oxygen. If its molar mass is 88 g/mol, what are its empirical and molecular formulas?

Vocabulary:

Mole
Avogadro's number
Molar mass
Conversion factor
Formula mass
Percent composition

Concept 2:
Introduction to Stoichiometry

Objectives:

1. Explain the significance of the mole ratio in stoichiometric calculations.
2. *Be able to calculate the amount of moles or mass of a reactant or product when given the amount of moles or mass for another reactant or product (meaning you can do all types of stoichiometry calculations, including mol to mol, mol to g, g to mol, and g to g).*

Practice:

3. Determine how many grams of hydrogen are needed to produce 28.65 g of ammonia in the following reaction: $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
4. Write the balanced equation for the double displacement reaction that occurs between sodium phosphate and magnesium chloride. Then determine how many grams of each product can be made from 10.00 g of magnesium chloride.

Vocabulary:

Stoichiometry
Mole ratio

Concept 3:
Limiting Reactants

Objectives:

1. Explain why the amount of product formed from a reaction is always determined by the limiting reactant.
2. Differentiate between actual and theoretical yields.
3. *Be able to determine the limiting and excess reactant when given starting amounts of reactants.*
4. *Be able to determine the amount left unused from an excess reactant.*
5. *Be able to determine how much product can be made when given the amount of moles or masses of the reactants.*
6. *Be able to calculate percent yield when given the actual yield and quantity of a reactant.*

Practice:

7. Answer the following questions about this reaction: $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$
   a. Identify the limiting reactant if you begin with 0.345 mol Na and 0.678 mol H_2O.
   b. How much of the excess reactant, in grams, will be leftover?
   c. How much of each product, in grams, will be formed?
8. Write the balanced equation for the decomposition reaction of solid potassium chlorate into solid potassium chloride and oxygen gas.
   a. Find the theoretical yield of oxygen gas if you start with 15.32 g of potassium chlorate.
   b. Calculate the percent yield if 5.75 g are actually produced in lab.

Vocabulary:

Limiting reactant
Excess reactant
Actual yield
Theoretical yield
Percent yield

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The first page of the packet splits the unit into 3 concepts: meet the mole, introduction to stoichiometry, and limiting reactants. Each concept is broken down into objectives, practice, and vocabulary that students will use to create study guides from. An editable version of this cover page is included for you to customize for your class!

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47-page Honors Packet with all student handouts for the entire unit.

Unit Topic: Stoichiometry Honors

Essential Question: How can chemical reactions be described quantitatively?

Concept 1:
Meet the Mole

Objectives:

1. Explain the relationship between the following terms: mole, Avogadro's number, and molar mass. Include what each is used for.
2. Differentiate between the empirical and molecular formula of a compound and explain how it applies differently to ionic vs. covalent compounds.
3. *Use Avogadro's number to convert from moles to atoms or molecules, and vice versa.*
4. *Determine the formula or molar mass of an element or a compound.*
5. *Find the percent composition of a compound and use percent composition to determine the empirical and molecular formulas for an unknown compound.*

Practice:

6. How many molecules are in 2.00 mol of CO_2?
7. What is the mass, in grams, of 7.18 mol of calcium carbonate?
8. How many moles are in 50.99 g of ammonium chloride?
9. Ethanol, C_2H_5OH is 52.2% carbon, by mass. How many grams of carbon would you expect to find in 110.0 g of ethanol?
10. Determine the empirical formula for a compound that is 53.70% iron and 46.30% sulfur.
11. Consider a compound that is 54.5% carbon, 9.1% hydrogen, and 36.4% oxygen. If its molar mass is 88 g/mol, what are its empirical and molecular formulas?

Vocabulary:

Mole
Avogadro's number
Molar mass
Conversion factor
Formula mass
Percent composition

Concept 2:
Introduction to Stoichiometry

Objectives:

1. Explain the significance of the mole ratio in stoichiometric calculations.
2. *Be able to calculate the amount of moles or mass of a reactant or product when given the amount of moles or mass for another reactant or product (meaning you can do all types of stoichiometry calculations, including mol to mol, mol to g, g to mol, and g to g).*

Practice:

3. Determine how many grams of hydrogen are needed to produce 28.65 g of ammonia in the following reaction: $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
4. Write the balanced equation for the double displacement reaction that occurs between sodium phosphate and magnesium chloride. Then determine how many grams of each product can be made from 10.00 g of magnesium chloride.

Vocabulary:

Stoichiometry
Mole ratio

Concept 3:
Limiting Reactants

Objectives:

1. Explain why the amount of product formed from a reaction is always determined by the limiting reactant.
2. Differentiate between actual and theoretical yields.
3. *Be able to determine the limiting and excess reactant when given starting amounts of reactants.*
4. *Be able to determine the amount left unused from an excess reactant.*
5. *Be able to determine how much product can be made when given the amount of moles or masses of the reactants.*
6. *Be able to calculate percent yield when given the actual yield and quantity of a reactant.*

Practice:

7. Answer the following questions about this reaction: $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$
   a. Identify the limiting reactant if you begin with 0.345 mol Na and 0.678 mol H_2O.
   b. How much of the excess reactant, in grams, will be leftover?
   c. How much of each product, in grams, will be formed?
8. Write the balanced equation for the decomposition reaction of solid potassium chlorate into solid potassium chloride and oxygen gas.
   a. Find the theoretical yield of oxygen gas if you start with 15.32 g of potassium chlorate.
   b. Calculate the percent yield if 5.75 g are actually produced in lab.

Vocabulary:

Limiting reactant
Excess reactant
Actual yield
Theoretical yield
Percent yield

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The majority of the instructional resources used in the CP (College Prep, or on-grade level) and Honors (advanced) student packets are the same. The unit tests are differentiated for CP and Honors.

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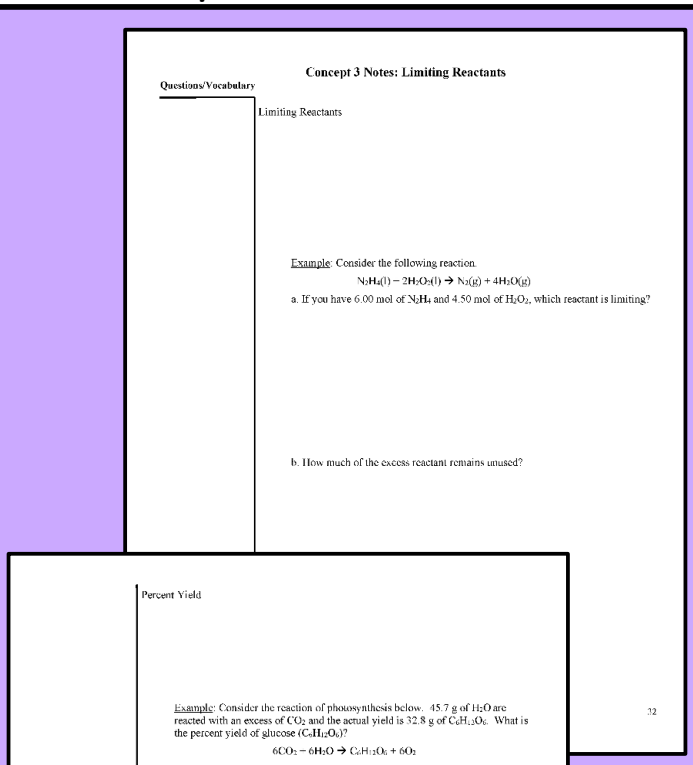
Along with activity overviews, lab investigation handouts, practice, and project guidelines, each packet also includes **Cornell note outlines** that go along with the PowerPoint lecture notes.

Sample Concept 3 Notes: Limiting Reactants **Cornell Note outline**



Concept 3 Notes: Limiting Reactants

Questions/Vocabulary

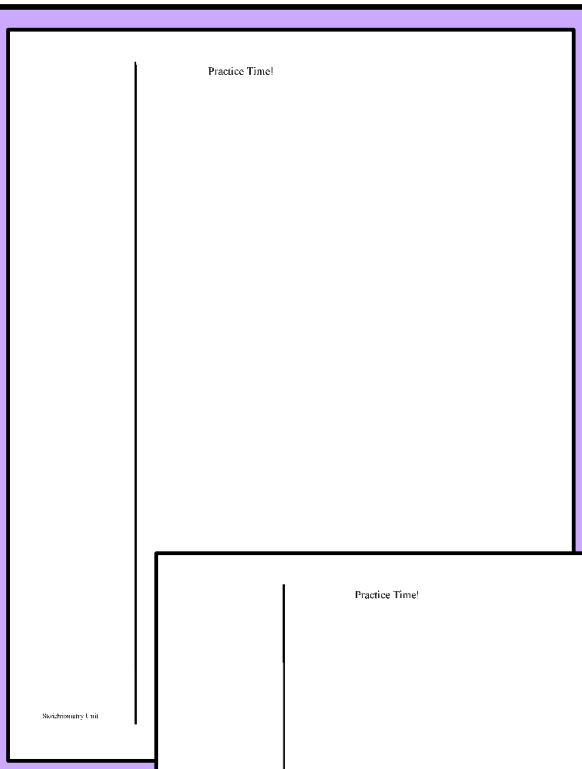
Limiting Reactants

Example: Consider the following reaction.

$N_2H_4(l) + 2H_2O_2(l) \rightarrow N_2(g) + 4H_2O(g)$

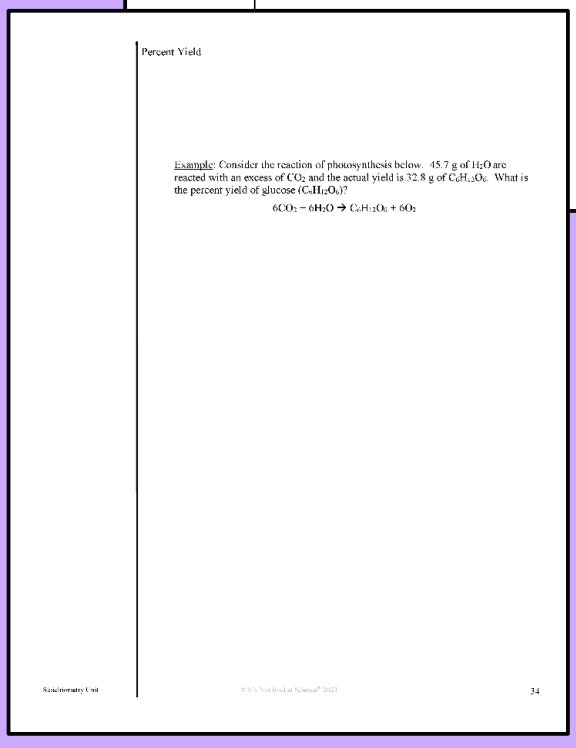
a. If you have 6.00 mol of N_2H_4 and 4.50 mol of H_2O_2, which reactant is limiting?

b. How much of the excess reactant remains unused?



Practice Time!

Stoichiometry Unit



Percent Yield

Example: Consider the reaction of photosynthesis below. 45.7 g of H_2O are reacted with an excess of CO_2 and the actual yield is 32.8 g of $C_6H_{12}O_6$. What is the percent yield of glucose ($C_6H_{12}O_6$)?

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Stoichiometry Unit

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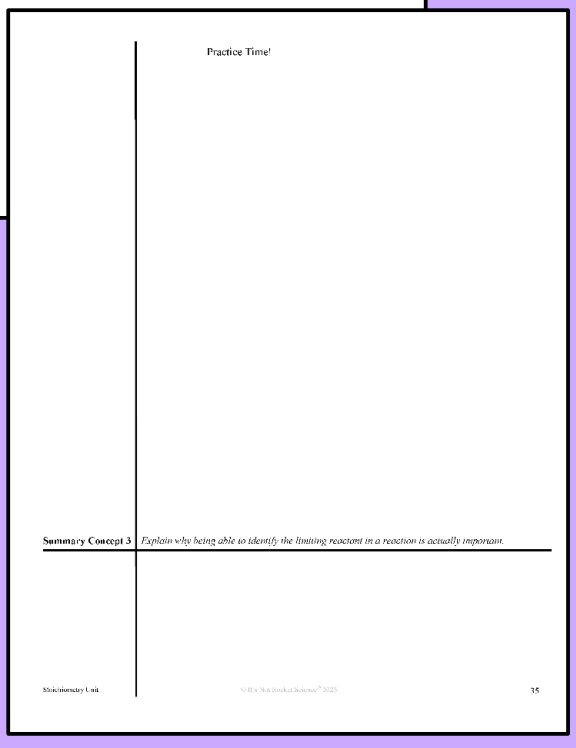

Practice Time!

Summary Concept 3 *Explain why being able to identify the limiting reactant in a reaction is actually important.*

Stoichiometry Unit

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Cornell Notes leave a margin for students to highlight terms and write questions as they go back and study their notes. Cornell Notes also leave room at the end of notes for students to summarize what they learned. The summary sections of the CP packet have questions to help them summarize.

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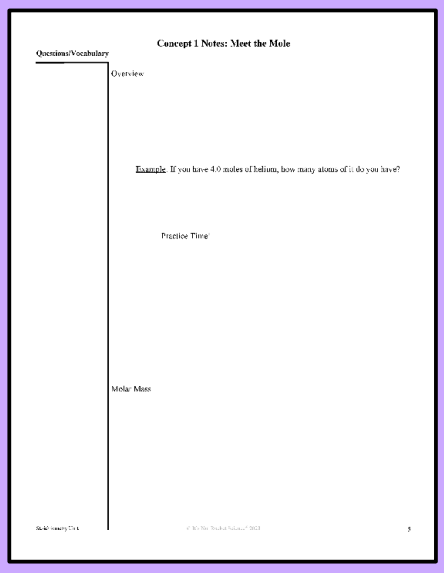
The packet comes with Cornell Note outlines in **three different formats**: original, fill-in-the-blank, and completely filled-in.

Sample ORIGINAL Cornell Note outline



Concept 1 Notes: Meet the Mole

Questions/Vocabulary

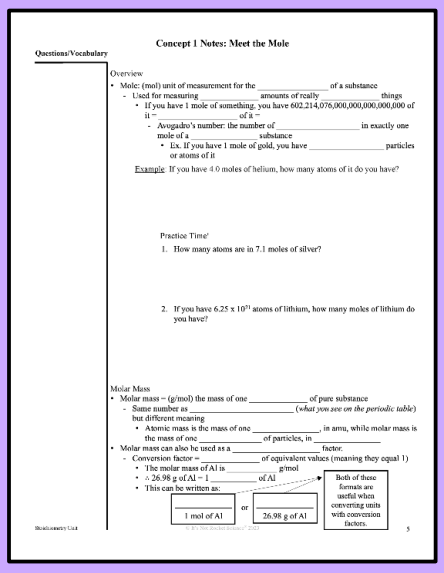
Overview

Example: If you have 4.0 moles of helium, how many atoms of it do you have?

Practice Time!

Molar Mass

Sample FITB Cornell Note outline



Concept 1 Notes: Meet the Mole

Questions/Vocabulary

Overview

- Mole: (mol) unit of measurement for the _____ of a substance
  - Used for measuring _____ amounts of really _____ things
    - If you have 1 mole of something, you have 602,214,076,000,000,000,000,000 of it = _____ of it ~
    - Avogadro's number: the number of _____ in exactly one mole of a _____ substance
      - Ex. If you have 1 mole of gold, you have _____ particles or atoms of it

Example: If you have 4.0 moles of helium, how many atoms of it do you have?

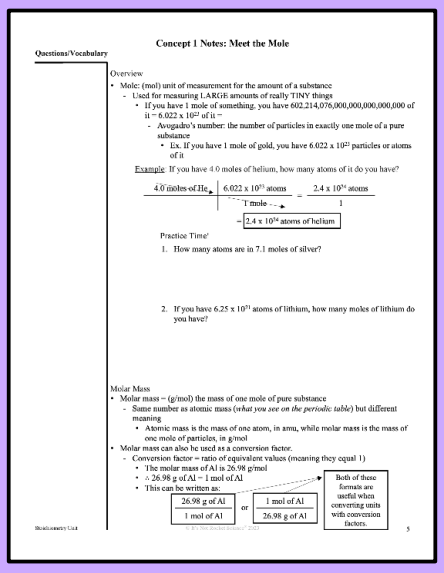
Practice Time!

1. How many atoms are in 7.1 moles of silver?
2. If you have 6.25×10^{21} atoms of lithium, how many moles of lithium do you have?

Molar Mass

- Molar mass = (g/mol) the mass of one _____ of pure substance
  - Same number as _____ (*what you see on the periodic table*) but different meaning
    - Atomic mass is the mass of one _____, in amu, while molar mass is the mass of one _____ of particles, in _____
- Molar mass can also be used as a _____ factor.
  - Conversion factor = _____ of equivalent values (meaning they equal 1)
    - The molar mass of Al is _____ g/mol
    - ∧ 26.98 g of Al = 1 _____ of Al
    - This can be written as: _____ / 1 mol of Al or 26.98 g of Al / _____ — Both of these formats are useful when converting units with conversion factors.

Sample FILLED-IN Cornell Note outline



Concept 1 Notes: Meet the Mole

Questions/Vocabulary

Overview

- Mole: (mol) unit of measurement for the amount of a substance
  - Used for measuring LARGE amounts of really TINY things
    - If you have 1 mole of something, you have 602,214,076,000,000,000,000,000 of it = 6.022×10^{23} of it ~
    - Avogadro's number: the number of particles in exactly one mole of a pure substance
      - Ex. If you have 1 mole of gold, you have 6.022×10^{23} particles or atoms of it

Example: If you have 4.0 moles of helium, how many atoms of it do you have?

$$\frac{4.0 \text{ moles of He}}{1 \text{ mole}} \left| \frac{6.022 \times 10^{23} \text{ atoms}}{} \right. = \frac{2.4 \times 10^{24} \text{ atoms}}{1}$$

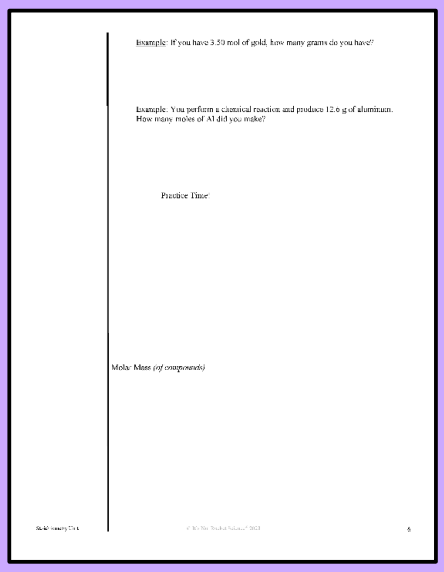
$$= \boxed{2.4 \times 10^{24} \text{ atoms of helium}}$$

Practice Time!

1. How many atoms are in 7.1 moles of silver?
2. If you have 6.25×10^{21} atoms of lithium, how many moles of lithium do you have?

Molar Mass

- Molar mass = (g/mol) the mass of one mole of pure substance
  - Same number as atomic mass (*what you see on the periodic table*) but different meaning
    - Atomic mass is the mass of one atom, in amu, while molar mass is the mass of one mole of particles, in g/mol
- Molar mass can also be used as a conversion factor.
  - Conversion factor = ratio of equivalent values (meaning they equal 1)
    - The molar mass of Al is 26.98 g/mol
    - ∧ 26.98 g of Al = 1 mol of Al
    - This can be written as: 26.98 g of Al / 1 mol of Al or 1 mol of Al / 26.98 g of Al — Both of these formats are useful when converting units with conversion factors.

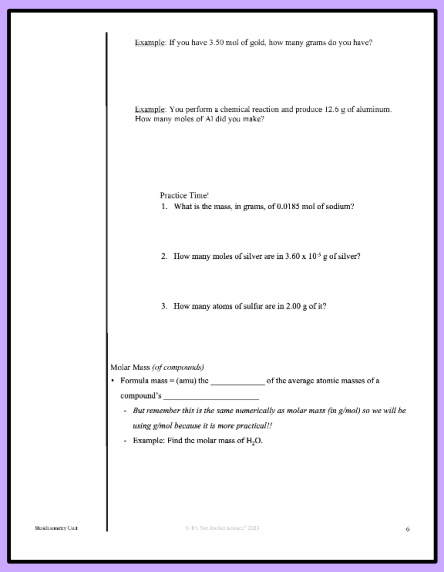


Example: If you have 3.50 mol of gold, how many grams do you have?

Example: You perform a chemical reaction and produce 12.6 g of aluminum. How many moles of Al did you make?

Practice Time!

Molar Mass *(of compounds)*



Example: If you have 3.50 mol of gold, how many grams do you have?

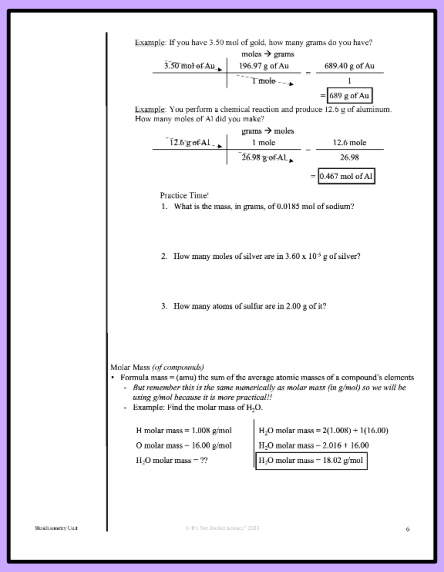
Example: You perform a chemical reaction and produce 12.6 g of aluminum. How many moles of Al did you make?

Practice Time!

1. What is the mass, in grams, of 0.0185 mol of sodium?
2. How many moles of silver are in 3.60×10^{5} g of silver?
3. How many atoms of sulfur are in 2.00 g of it?

Molar Mass *(of compounds)*

- Formula mass = (amu) the _____ of the average atomic masses of a compound's _____
  - *But remember this is the same numerically as molar mass (in g/mol) so we will be using g/mol because it is more practical!!*
  - Example: Find the molar mass of H_2O.



Example: If you have 3.50 mol of gold, how many grams do you have?

$$\frac{3.50 \text{ mol of Au}}{1 \text{ mole}} \left| \frac{196.97 \text{ g of Au}}{} \right. \quad \text{moles} \rightarrow \text{grams} = \frac{689.40 \text{ g of Au}}{1}$$

$$= \boxed{689 \text{ g of Au}}$$

Example: You perform a chemical reaction and produce 12.6 g of aluminum. How many moles of Al did you make?

$$\frac{12.6 \text{ g of Al}}{26.98 \text{ g of Al}} \left| \frac{1 \text{ mole}}{} \right. \quad \text{grams} \rightarrow \text{moles} = \frac{12.6 \text{ mole}}{26.98}$$

$$= \boxed{0.467 \text{ mol of Al}}$$

Practice Time!

1. What is the mass, in grams, of 0.0185 mol of sodium?
2. How many moles of silver are in 3.60×10^{5} g of silver?
3. How many atoms of sulfur are in 2.00 g of it?

Molar Mass *(of compounds)*

- Formula mass = (amu) the sum of the average atomic masses of a compound's elements
  - *But remember this is the same numerically as molar mass (in g/mol) so we will be using g/mol because it is more practical!!*
  - Example: Find the molar mass of H_2O.

H molar mass = 1.008 g/mol
O molar mass = 16.00 g/mol
H_2O molar mass = ??

H_2O molar mass = 2(1.008) + 1(16.00)
H_2O molar mass = 2.016 + 16.00
H_2O molar mass = 18.02 g/mol

This helps to better **differentiate** for the needs of your students!

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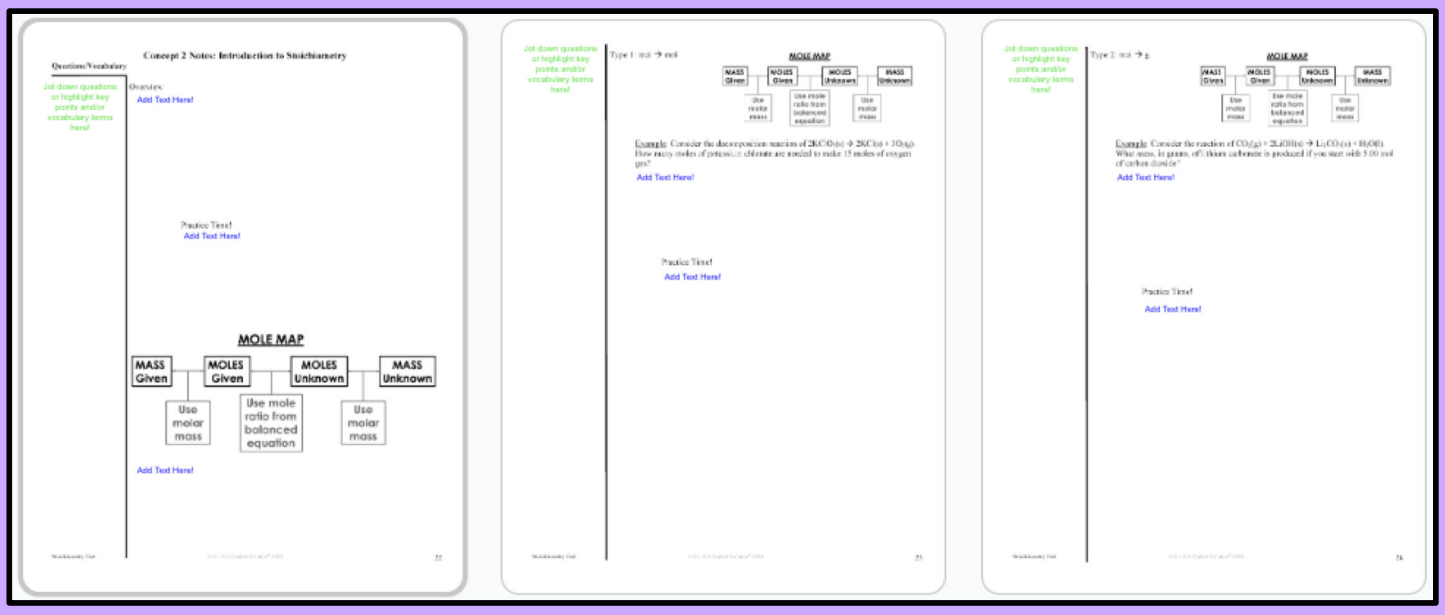
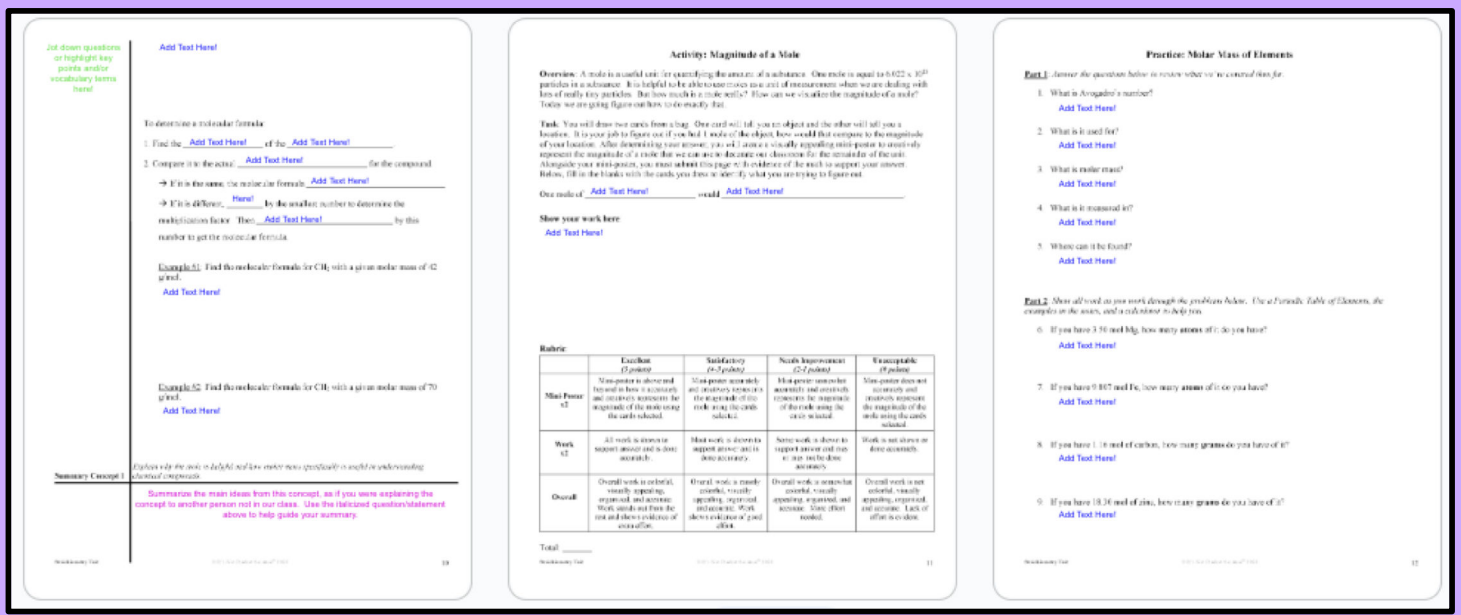
PLUS each packet is available as a printable PDF **and** in a **Paperless Digital** version that can be used in GOOGLE DRIVE or MICROSOFT ONEDRIVE





Perfect for teachers in 1:1 classrooms, looking to integrate more educational technology, or wanting to go PAPERLESS! Get all of the same content, organization, and ease of the paper packet, without all of the copies!

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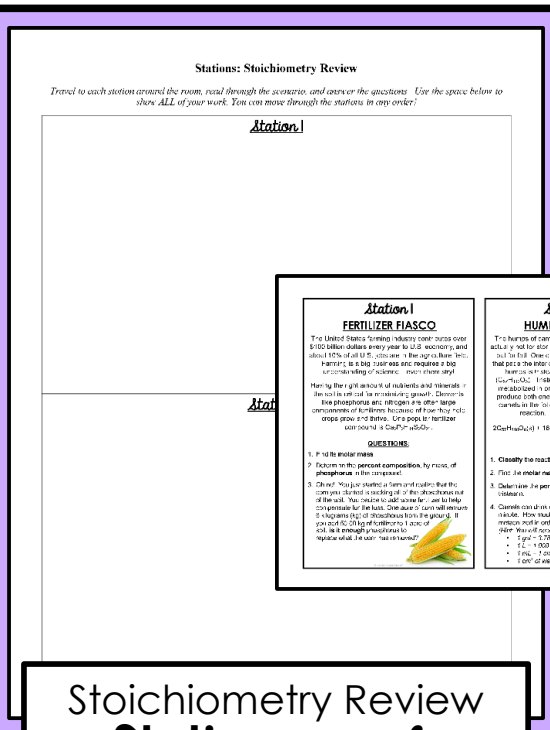
Packet includes student handouts for:

Homemade Hot Chocolate **Lab Activity**
Magnitude of a Mole **Activity**
Percent Composition **Inquiry Lab Activity**
Stoichiometry with S'mores **Lab Activity**
Homemade Chalk **Lab**
Stoichiometry Review **Stations**



Stations: Stoichiometry Review

Travel to each station around the room, read through the scenario, and answer the questions. Use the space below to show ALL of your work. You can move through the stations in any order!

Station 1

Station 1
FERTILIZER FIASCO

The United States farming industry contributes over $100 billion dollars every year to U.S. economy, and about 16% of all U.S. jobs are in the agriculture field. Farming is a big deal and requires a big understanding of science. even more so!

Having the right amount of nutrients and minerals in the soil is critical for maximizing growth. Elements like phosphorus and nitrogen are often large components of fertilizers because of how they help crops grow and thrive. One popular fertilizer compound is $Ca_3P_2O_8$.

QUESTIONS:

1. Find its **molar mass**
2. Determine the **percent composition**, by mass, of **phosphorus** in the compound.
3. Chow! You just started a farm and realize that the corn you planted is sucking all of the phosphorus out of the soil. You decide to add some fer... are to help compensate for the loss. One acre of corn will require 5 kilograms (kg) of phosphorus from the ground. If you add 50.00 kg of fertilizers, how of ... ed, is it enough? Justify your ... to replace what the corn has removed?

Station 2
HUMP HYDRATION

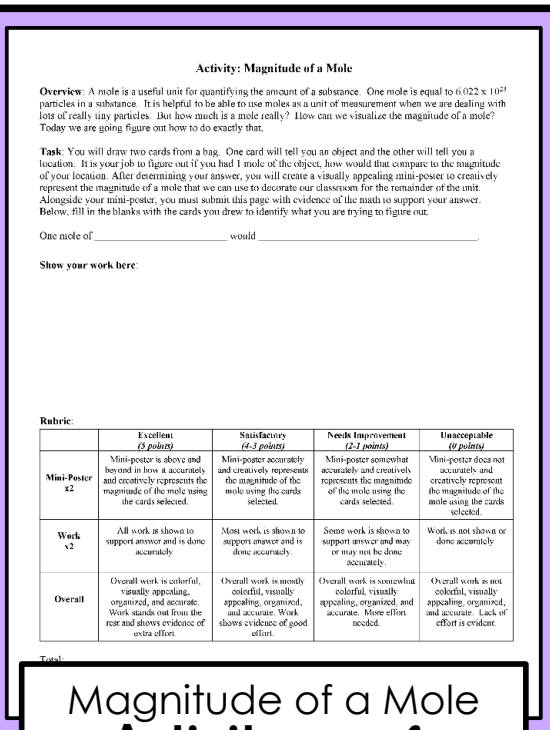
The humps of camels are actually not for storing water but for fat. One of the key that pairs the interior of the humps is an ... ide ($C_{57}H_{110}O_6$). Triolein is metabolized in order to produce both energy for camels in the following reaction.

$2C_{57}H_{110}O_6(s) + 163O_2(g) \rightarrow 114CO_2(g) + 110H_2O(l)$

QUESTIONS:

1. **Classify** the reaction above.
2. Find the **molar mass** of triolein.
3. Determine the **percent composition**, by mass, of triolein.
4. Camels can drink up to 20 gallons of water in one minute. How much fat, in grams, would need to be metabolized in order to produce that amount of water? (Hint: You will need the following conversion factors)
   - 1 gal = 3.785 L
   - 1 L = 1000 mL
   - 1 mL = 1 cm³
   - 1 cm³ of water = 1 g

Stoichiometry Review
Stations *sample*



Activity: Magnitude of a Mole

Overview: A mole is a useful unit for quantifying the amount of a substance. One mole is equal to 6.022×10^{23} particles in a substance. It is helpful to be able to use moles as a unit of measurement when we are dealing with lots of really tiny particles. But how much is a mole really? How can we visualize the magnitude of a mole? Today we are going figure out how to do exactly that.

Task: You will draw two cards from a bag. One card will tell you an object and the other will tell you a location. It is your job to figure out if you had 1 mole of the object, how would that compare to the magnitude of your location. After determining your answer, you will create a visually appealing mini-poster to creatively represent the magnitude of a mole that we can use to decorate our classroom for the remainder of the unit. Alongside your mini-poster, you must submit this page with evidence of the math to support your answer. Below, fill in the blanks with the cards you drew to identify what you are trying to figure out.

One mole of _____ would _____.

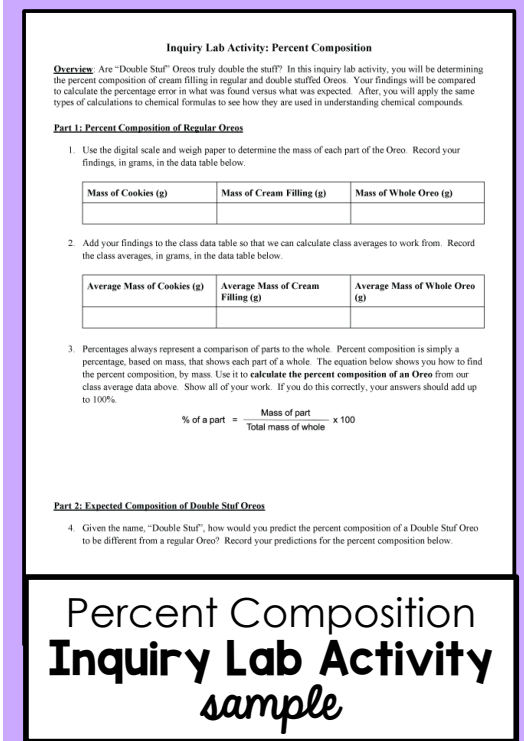
Show your work here:

Rubric:

	Excellent *(5 points)*	Satisfactory *(4-3 points)*	Needs Improvement *(2-1 points)*	Unacceptable *(0 points)*
Mini-Poster x2	Mini-poster is above and beyond in how it accurately and creatively represents the magnitude of the mole using the cards selected.	Mini-poster accurately and creatively represents the magnitude of the mole using the cards selected.	Mini-poster somewhat accurately and creatively represents the magnitude of the mole using the cards selected.	Mini-poster does not accurately and creatively represent the magnitude of the mole using the cards selected.
Work x2	All work is shown to support answer and is done accurately	Most work is shown to support answer and is done accurately.	Some work is shown to support answer and may or may not be done accurately.	Work is not shown or done accurately
Overall	Overall work is colorful, visually appealing, organized, and accurate. Work stands out from the rest and shows evidence of extra effort.	Overall work is mostly colorful, visually appealing, organized, and accurate. Work shows evidence of good effort.	Overall work is somewhat colorful, visually appealing, organized, and accurate. More effort needed.	Overall work is not colorful, visually appealing, organized, and accurate. Lack of effort is evident.

Total: _____

Magnitude of a Mole
Activity *sample*



Inquiry Lab Activity: Percent Composition

Overview: Are "Double Stuf" Oreos truly double the stuff? In this inquiry lab activity, you will be determining the percent composition of cream filling in regular and double stuffed Oreos. Your findings will be compared to calculate the percentage error in what was found versus what was expected. After, you will apply the same types of calculations to chemical formulas to see how they are used in understanding chemical compounds.

Part 1: Percent Composition of Regular Oreos

1. Use the digital scale and weigh paper to determine the mass of each part of the Oreo. Record your findings, in grams, in the data table below.

Mass of Cookies (g)	Mass of Cream Filling (g)	Mass of Whole Oreo (g)

2. Add your findings to the class data table so that we can calculate class averages to work from. Record the class averages, in grams, in the data table below.

Average Mass of Cookies (g)	Average Mass of Cream Filling (g)	Average Mass of Whole Oreo (g)

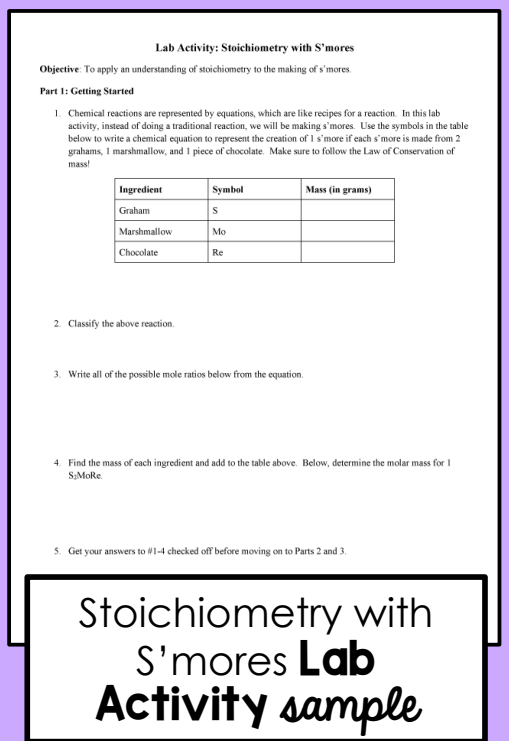
3. Percentages always represent a comparison of parts to the whole. Percent composition is simply a percentage, based on mass, that shows each part of a whole. The equation below shows you how to find the percent composition, by mass. Use it to **calculate the percent composition of an Oreo** from our class average data above. Show all of your work. If you do this correctly, your answers should add up to 100%.

$$\% \text{ of a part} = \frac{\text{Mass of part}}{\text{Total mass of whole}} \times 100$$

Part 2: Expected Composition of Double Stuf Oreos

4. Given the name, "Double Stuf", how would you predict the percent composition of a Double Stuf Oreo to be different from a regular Oreo? Record your predictions for the percent composition below.

Percent Composition
Inquiry Lab Activity
sample



Lab Activity: Stoichiometry with S'mores

Objective: To apply an understanding of stoichiometry to the making of s'mores.

Part 1: Getting Started

1. Chemical reactions are represented by equations, which are like recipes for a reaction. In this lab activity, instead of doing a traditional reaction, we will be making s'mores. Use the symbols in the table below to write a chemical equation to represent the creation of 1 s'more if each s'more is made from 2 grahams, 1 marshmallow, and 1 piece of chocolate. Make sure to follow the Law of Conservation of mass!

Ingredient	Symbol	Mass (in grams)
Graham	S	
Marshmallow	Mo	
Chocolate	Re	

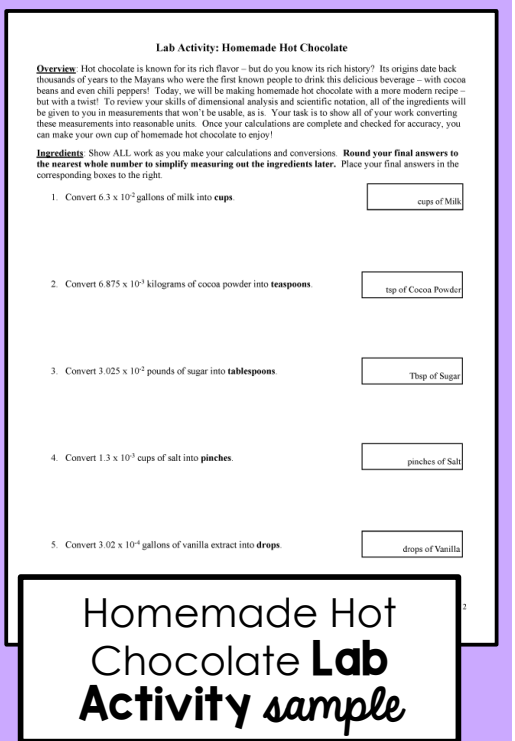
2. Classify the above reaction.

3. Write all of the possible mole ratios below from the equation.

4. Find the mass of each ingredient and add to the table above. Below, determine the molar mass for 1 S_2MoRe.

5. Get your answers to #1-4 checked off before moving on to Parts 2 and 3.

Stoichiometry with S'mores **Lab Activity** *sample*



Lab Activity: Homemade Hot Chocolate

Overview: Hot chocolate is known for its rich flavor – but do you know its rich history? Its origins date back thousands of years to the Mayans who were the first known people to drink this delicious beverage – with cocoa beans and even chili peppers! Today, we will be making homemade hot chocolate with a more modern recipe – but with a twist! To review your skills of dimensional analysis and scientific notation, all of the ingredients will be given to you in measurements that won't be usable, as is. Your task is to show all of your work converting these measurements into reasonable units. Once your calculations are complete and checked for accuracy, you can make your own cup of homemade hot chocolate to enjoy!

Ingredients. Show ALL work as you make your calculations and conversions. **Round your final answers to the nearest whole number to simplify measuring out the ingredients later.** Place your final answers in the corresponding boxes to the right.

1. Convert 6.3×10^{-2} gallons of milk into **cups**. _____ cups of Milk

2. Convert 6.875×10^{-3} kilograms of cocoa powder into **teaspoons**. _____ tsp of Cocoa Powder

3. Convert 3.025×10^{-2} pounds of sugar into **tablespoons**. _____ Tbsp of Sugar

4. Convert 1.3×10^{-3} cups of salt into **pinches**. _____ pinches of Salt

5. Convert 3.02×10^{-4} gallons of vanilla extract into **drops**. _____ drops of Vanilla

Homemade Hot Chocolate **Lab Activity** *sample*

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Also included in this unit...

15 pages of **practice**, covering:

Molar Mass of Elements

Molar Mass of Compounds

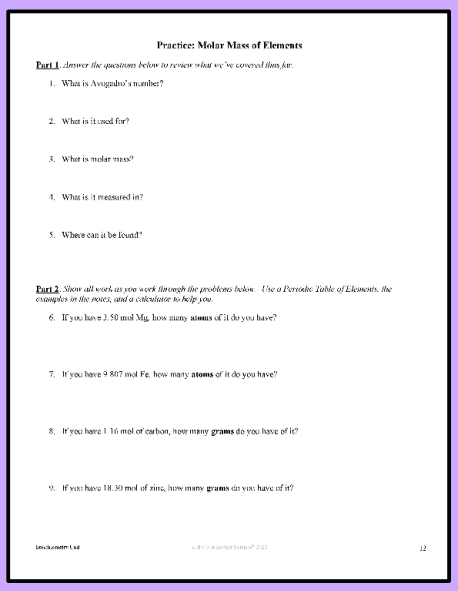
Percent Composition

Determining Formulas

Stoichiometry

Limiting Reactants

Percent Yield



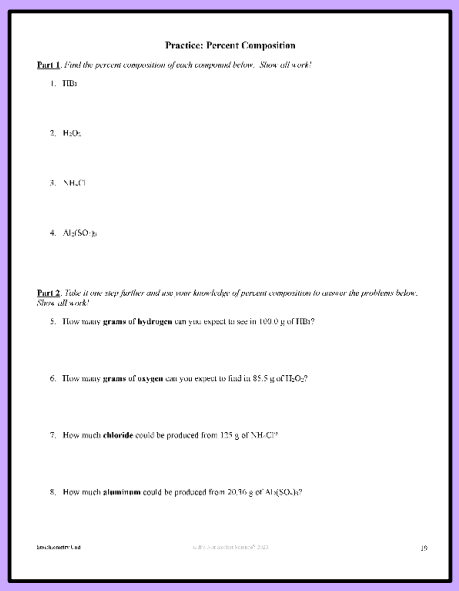
Practice: Molar Mass of Elements

Part 1: *Answer the questions below to review what we've covered thus far.*

1. What is Avogadro's number?
2. What is it used for?
3. What is molar mass?
4. What is it measured in?
5. Where can it be found?

Part 2: *Show all work as you work through the problems below. Use a Periodic Table of Elements, the examples in the notes, and a calculator to help you.*

6. If you have 2.50 mol Mg, how many **atoms** of it do you have?
7. If you have 9.807 mol Fe, how many **atoms** of it do you have?
8. If you have 1.16 mol of carbon, how many **grams** do you have of it?
9. If you have 18.30 mol of zinc, how many **grams** do you have of it?



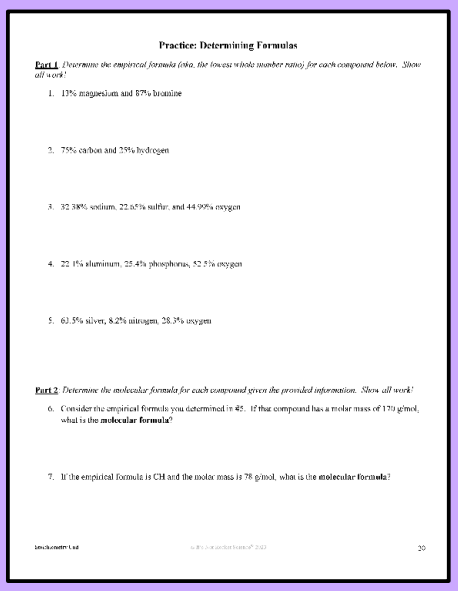
Practice: Percent Composition

Part 1: *Find the percent composition of each compound below. Show all work!*

1. HBr
2. H_2O_2
3. NH_4Cl
4. $Al_2(SO_4)_3$

Part 2: *Take it one step further and use your knowledge of percent composition to answer the problems below. Show all work!*

5. How many **grams of hydrogen** can you expect to see in 100.0 g of HBr?
6. How many **grams of oxygen** can you expect to find in 85.5 g of H_2O_2?
7. How much **chloride** could be produced from 125 g of NH_4Cl?
8. How much **aluminum** could be produced from 20.36 g of $Al_2(SO_4)_3$?



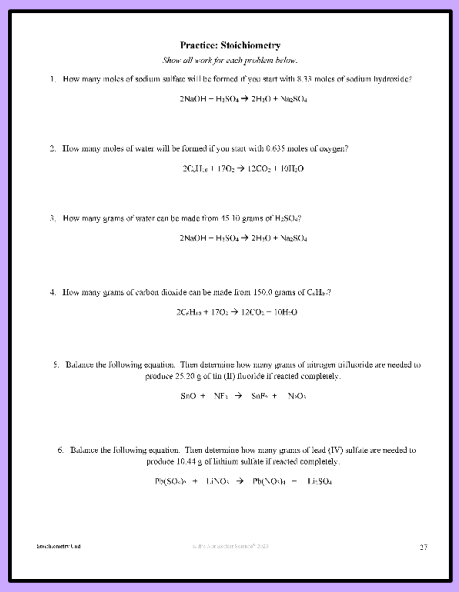
Practice: Determining Formulas

Part 1: *Determine the empirical formula (aka, the lowest whole number ratio) for each compound below. Show all work!*

1. 13% magnesium and 87% bromine
2. 75% carbon and 25% hydrogen
3. 32.38% sodium, 22.65% sulfur, and 44.99% oxygen
4. 22.1% aluminum, 25.4% phosphorus, 52.5% oxygen
5. 63.5% silver, 8.2% nitrogen, 28.3% oxygen

Part 2: *Determine the molecular formula for each compound given the provided information. Show all work!*

6. Consider the empirical formula you determined in #5. If that compound has a molar mass of 170 g/mol, what is the **molecular formula**?
7. If the empirical formula is CH and the molar mass is 78 g/mol, what is the **molecular formula**?



Practice: Stoichiometry

Show all work for each problem below.

1. How many moles of sodium sulfate will be formed if you start with 8.33 moles of sodium hydroxide?

$2NaOH + H_2SO_4 \rightarrow 2H_2O + Na_2SO_4$

2. How many moles of water will be formed if you start with 0.635 moles of oxygen?

$2C_4H_{10} + 17O_2 \rightarrow 12CO_2 + 10H_2O$

3. How many grams of water can be made from 45.10 grams of H_2SO_4?

$2NaOH + H_2SO_4 \rightarrow 2H_2O + Na_2SO_4$

4. How many grams of carbon dioxide can be made from 150.0 grams of C_2H_6?

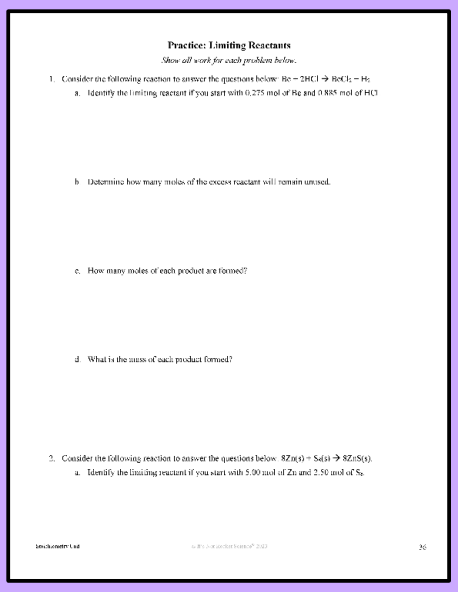
$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

5. Balance the following equation. Then determine how many grams of nitrogen trifluoride are needed to produce 25.20 g of tin (II) fluoride if reacted completely.

$SnO + NF_3 \rightarrow SnF_2 + N_2O_3$

6. Balance the following equation. Then determine how many grams of lead (IV) sulfate are needed to produce 10.44 g of lithium sulfate if reacted completely.

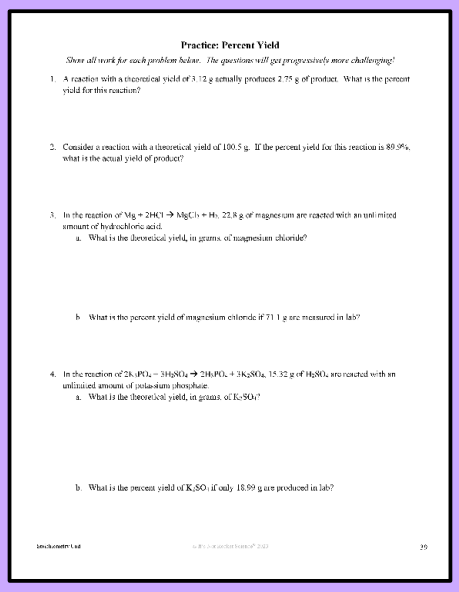
$Pb(SO_4)_2 + LiNO_3 \rightarrow Pb(NO_3)_4 + Li_2SO_4$



Practice: Limiting Reactants

Show all work for each problem below.

1. Consider the following reaction to answer the questions below: $Be + 2HCl \rightarrow BeCl_2 + H_2$
   a. Identify the limiting reactant if you start with 0.275 mol of Be and 0.885 mol of HCl
   b. Determine how many moles of the excess reactant will remain unused.
   c. How many moles of each product are formed?
   d. What is the mass of each product formed?
2. Consider the following reaction to answer the questions below: $8Zn(s) + S_8(s) \rightarrow 8ZnS(s)$.
   a. Identify the limiting reactant if you start with 5.00 mol of Zn and 2.50 mol of S_8



Practice: Percent Yield

Show all work for each problem below. The questions will get progressively more challenging!

1. A reaction with a theoretical yield of 3.12 g actually produces 2.75 g of product. What is the percent yield for this reaction?
2. Consider a reaction with a theoretical yield of 100.5 g. If the percent yield for this reaction is 89.9%, what is the actual yield of product?
3. In the reaction of $Mg + 2HCl \rightarrow MgCl_2 + H_2$, 22.8 g of magnesium are reacted with an unlimited amount of hydrochloric acid.
   a. What is the theoretical yield, in grams, of magnesium chloride?
   b. What is the percent yield of magnesium chloride if 71.1 g are measured in lab?
4. In the reaction of $2K_3PO_4 + 3H_2SO_4 \rightarrow 2H_3PO_4 + 3K_2SO_4$, 15.32 g of H_2SO_4 are reacted with an unlimited amount of potassium phosphate.
   a. What is the theoretical yield, in grams, of K_2SO_4?
   b. What is the percent yield of K_2SO_4 if only 18.99 g are produced in lab?

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3 Powerpoints of Notes

Covering **3** different concepts

60 slides, all with *editable text*

Fully animated presentations in slide show mode

Sample slides from Concept 1 Notes: Meet the Mole

Molar Mass

- **Molar mass** can also be used as a **conversion factor**.
  - **Conversion factor** = ratio of equivalent values (meaning they equal 1)
    - The molar mass of Al is 26.98 g/mol
    - ∴ 26.98 g of Al = 1 mol of Al
    - This can be written as:

$$\frac{26.98 \text{ g of Al}}{1 \text{ mol of Al}} \quad \text{or} \quad \frac{1 \text{ mol of Al}}{26.98 \text{ g of Al}}$$

Both of these formats are useful when converting units with conversion factors

Molar Mass

Of Compounds

- **Example**: How many moles are in 125 g of $KMnO_4$?

125 g of $KMnO_4$
mol of $KMnO_4$ = ?
molar mass of $KMnO_4$ = ?

Molar mass of $KMnO_4$ = 1(39.10) + 1(54.94) + 4(16.00)
Molar mass of $KMnO_4$ = 39.10 + 54.94 + 64.00
Molar mass of $KMnO_4$ = 158.04 g/mol

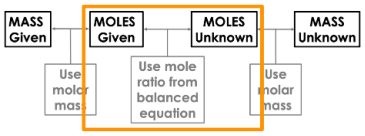
$$125 \text{ g } KMnO_4 \left| \frac{1 \text{ mol}}{158.04 \text{ g } KMnO_4} \right. = \frac{125 \text{ mol}}{158.04}$$

= **0.791 mol $KMnO_4$**

Sample slides from Concept 2 Notes: Introduction to Stoichiometry

Type 1: mol → mol

MOLE MAP



- **Example**: Consider the decomposition reaction of $2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$. How many moles of potassium chlorate are needed to make 15 moles of oxygen gas?

15 mol of O_2
mol of $KClO_3$ = ?
2 mol $KClO_3$ = 3 mol O_2

$$15 \text{ mol } O_2 \left| \frac{2 \text{ mol } KClO_3}{3 \text{ mol } O_2} \right. = \frac{30 \text{ mol } KClO_3}{3}$$

= **10 mol $KClO_3$**

Type 3: g → mol

Example: How many **moles** of **oxygen gas** will be produced from 50.78 g of carbon dioxide in the following reaction? $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

50.78 g of CO_2
mol of O_2 = ?
6 mol CO_2 = 6 mol O_2
Molar mass of CO_2 = ?

Molar mass of CO_2 = 1(12.01) + 2(16.00)
Molar mass of CO_2 = 12.01 + 32.00
Molar mass of CO_2 = 44.01 g/mol

$$50.78 \text{ g } CO_2 \left| \frac{1 \text{ mol } CO_2}{44.01 \text{ g } CO_2} \right| \frac{6 \text{ mol } O_2}{6 \text{ mol } CO_2} = \frac{304.68 \text{ mol } O_2}{264.06}$$

= **1.154 mol O_2**

Sample slides from Concept 3 Notes: Limiting Reactants

Limiting Reactants

- You can only make as much product as the reactants you have.
- Once one reactant is used up, no more product can be formed (even if you still have the other reactant!)
  - **Limiting reactant** = the **reactant** that **limits** the amount of product that can be made
    - It gets used up first, and thus can make the least amount of product
  - **Excess reactant** = the **reactant** that **isn't** completely used up in the reaction
    - Thus you will have **excess** or "**leftovers**" of this one

Limiting Reactants

How to identify limiting vs. excess

Example: Consider the following reaction.

$$N_2H_4(l) + 2H_2O_2(l) \rightarrow N_2(g) + 4H_2O(g)$$

a. If you have 6.00 mol of N_2H_4 and 4.50 mol of H_2O_2, **which reactant is limiting**?

6.00 mol of N_2H_4
4.50 mol of H_2O_2
1 mol N_2H_4 = 1 mol N_2
2 mol H_2O_2 = 1 mol N_2

$$6.00 \text{ mol } N_2H_4 \left| \frac{1 \text{ mol } N_2}{1 \text{ mol } N_2H_4} \right. = 6.00 \text{ mol } N_2$$

$$4.50 \text{ mol } H_2O_2 \left| \frac{1 \text{ mol } N_2}{2 \text{ mol } H_2O_2} \right. = 2.25 \text{ mol } N_2$$

∴ H_2O_2 is the limiting reactant

PLUS check out my **YouTube channel** for **lecture videos** that go with each set of notes!

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Assessments

Stoichiometry **Quiz**

Unit 6 **Test**

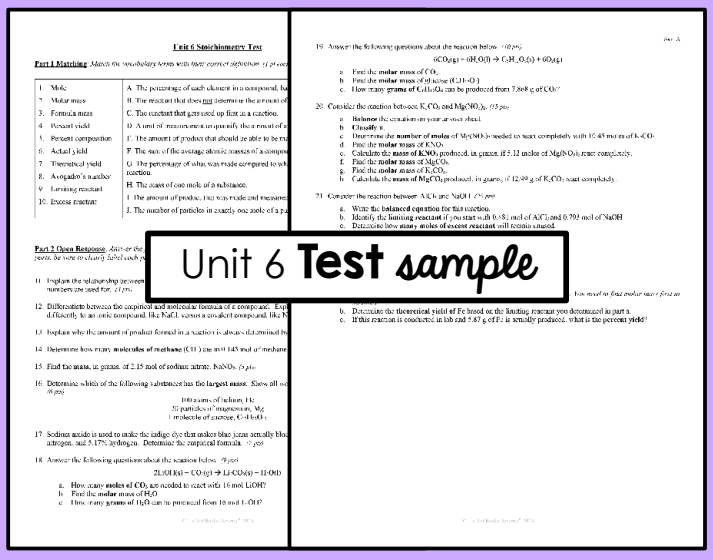
CP (College Prep, or on grade level) and Honors versions included!

A combination of matching and open response questions

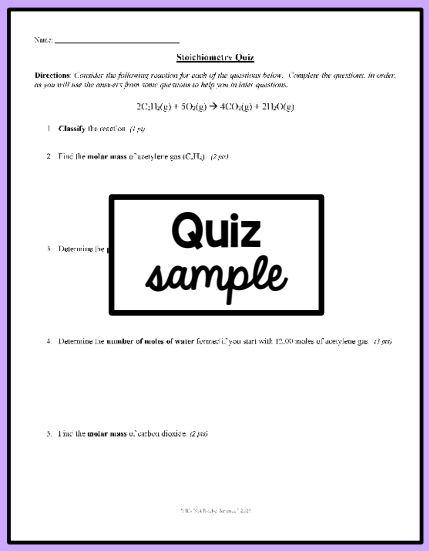
Versions A and B for all tests

(Matching are rearranged to help prevent cheating)

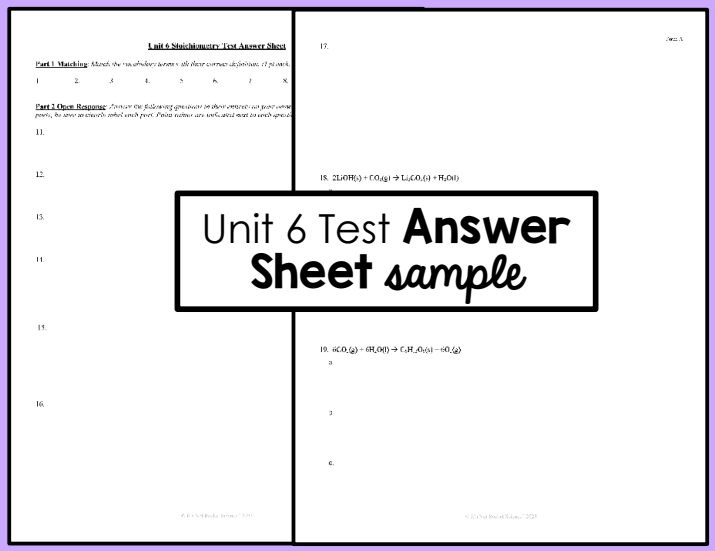
Includes 2-page answer sheet to minimize copies each year



Unit 6 **Test** *sample*



Quiz *sample*



Unit 6 Test **Answer Sheet** *sample*

Detailed **Answer Keys**

• **Editable Versions** of all assessments are included!

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NGSS Alignment Overview

Stoichiometry Unit

Essential Question: How can chemical reactions be described quantitatively?

Overall Standards Addressed:
HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Suggested Introductory Phenomena:

- **Anchoring phenomenon**: The stoichiometry required to make flameless ration heaters (FRH) in order to hear meal, ready-to-eats (MRE) is a fascinating real-world connection of stoichiometry to the military.
  - **Connects to** → Activity: Magnitude of a Mole
- **Anchoring phenomenon**: Air bags are a perfect example of the use of stoichiometry to create a life saving device. Students can research how air bags work and even make their own air bags that can be used to drop items on to (like eggs!)
- **Everyday phenomenon**: Use cars or rockets to talk about fuel needs, and how stoichiometry can be used to predict the amount of fuel needed to be able to power devices certain distances. You can also tie in hybrid cars that use electricity and do calculations with how far they can go before needing a charge (and how that distance changes based on how much they've loaded down the car. For example, Ford now makes electrically powered trucks, but if you fill the bed, you can't get very far on a charge! They can explore these ideas with stoich.)
- **Everyday phenomenon**: How the fast food industry is able to mass produce foods using a recipe could be a great example to tie in dimensional analysis in the real world, and the necessity of scaling measurements into different units!
  - **Connects to** → Lab Activity: Homemade Hot Chocolate
- **Everyday phenomenon**: Limiting reactants are a part of everyday life. Ask any adult who meal plans, or a parent who packs school lunches for their little kids – there is a constant assessing of what you have and a mental calculation of what you can make with it. Use the s'mores lab activity as an inquiry activity to introduce this concept
  - **Connects to** → Lab Activity: Stoichiometry with S'mores
- **Everyday phenomenon**: Baking sourdough using a live starter is a fun way to explore stoichiometry and tie its importance into how to make delicious fluffy bread vs. hard dense bread, if not handled properly.
- **Investigative phenomenon**: Have students investigate what would be necessary in order to make water on Mars for humans to be able to live there. They can use stoichiometry to figure out how much they would need to do it. You can show them a clip from The Martian movie where he creates water!

Curricular Connections to Standards (expanded):

Activity/Lab/Project	Science and Engineering Practices	Crosscutting Concepts
Lab Activity: Homemade Hot Chocolate	Use mathematics and computational thinking Construct explanations and design solutions	Scale, proportion, and quantity
Activity: Magnitude of a Mole	Develop and use models Use mathematics and computational thinking	Scale, proportion, and quantity Energy and matter
Inquiry Lab Activity: Percent Composition	Develop and use models Plan and carry out investigations Analyze and interpret data	Scale, proportion, and quantity Energy and matter

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When writing each of my chemistry units, I tried to incorporate as many different states' chemistry standards as possible, while most importantly keeping the content within the NGSS* style. This document organizes the various instructional methods to show alignment of the unit to the high school physical science DCIs, as well as the incorporation of science and engineering practices and crosscutting concepts. The first page is pictured here.

This document is a helpful resource for teachers who are using the Next Generation Science Standards while they teach a Chemistry 1 course.

This document also includes a list of suggested introductory phenomena. You can read more about how to use phenomena on my blog **here** or listen to my podcast episode all about it **here**.

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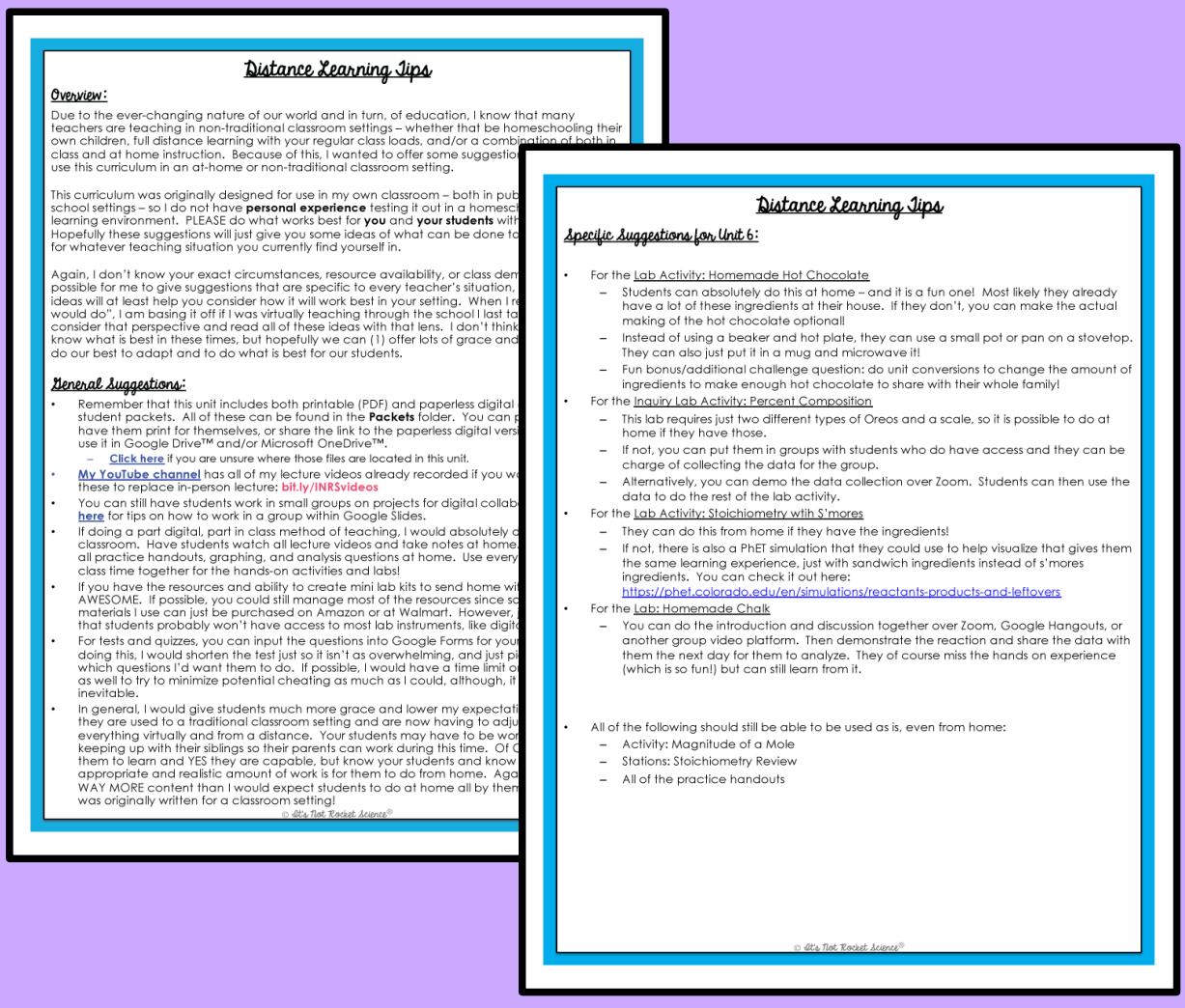
Distance Learning Tips

In light of the uncertainty of the last few years, I have included a 2-page document with tips for teaching this unit virtually. Although the unit wasn't specifically written to be taught in a distance learning or homeschool setting, many of the resources can still be used and/or adapted in some way to fit either of these two types of classrooms. The YouTube lecture videos and paperless digital version of the student packets are especially helpful for teachers who are transitioning between virtual and in-person teaching, as they help to maintain consistency and organization for the students.



Distance Learning Tips

Overview:

Due to the ever-changing nature of our world and in turn, of education, I know that many teachers are teaching in non-traditional classroom settings – whether that be homeschooling their own children, full distance learning with your regular class loads, and/or a combination of both in class and at home instruction. Because of this, I wanted to offer some suggestio use this curriculum in an at-home or non-traditional classroom setting.

This curriculum was originally designed for use in my own classroom – both in pub school settings – so I do not have **personal experience** testing it out in a homesc learning environment. PLEASE do what works best for **you** and **your students** wit Hopefully these suggestions will just give you some ideas of what can be done to for whatever teaching situation you currently find yourself in.

Again, I don't know your exact circumstances, resource availability, or class dem possible for me to give suggestions that are specific to every teacher's situation, ideas will at least help you consider how it will work best in your setting. When I r would do", I am basing it off if I was virtually teaching through the school I last ta consider that perspective and read all of these ideas with that lens. I don't think know what is best in these times, but hopefully we can (1) offer lots of grace and do our best to adapt and to do what is best for our students.

General Suggestions:

- Remember that this unit includes both printable (PDF) and paperless digital student packets. All of these can be found in the **Packets** folder. You can p have them print for themselves, or share the link to the paperless digital vers use it in Google Drive™ and/or Microsoft OneDrive™.
  - Click here if you are unsure where those files are located in this unit.
- My YouTube channel has all of my lecture videos already recorded if you w these to replace in-person lecture: bit.ly/INRSvideos
- You can still have students work in small groups on projects for digital collab here for tips on how to work in a group within Google Slides.
- If doing a part digital, part in class method of teaching, I would absolutely classroom. Have students watch all lecture videos and take notes at home all practice handouts, graphing, and analysis questions at home. Use every class time together for the hands-on activities and labs!
- If you have the resources and ability to create mini lab kits to send home wi AWESOME. If possible, you could still manage most of the resources since s materials I use can just be purchased on Amazon or at Walmart. However, that students probably won't have access to most lab instruments, like digit
- For tests and quizzes, you can input the questions into Google Forms for you doing this, I would shorten the test just so it isn't as overwhelming, and just pi which questions I'd want them to do. If possible, I would have a time limit o as well to try to minimize potential cheating as much as I could, although, it inevitable.
- In general, I would give students much more grace and lower my expectati they are used to a traditional classroom setting and are now having to adju everything virtually and from a distance. Your students may have to be wo keeping up with their siblings so their parents can work during this time. Of C them to learn and YES they are capable, but know your students and know appropriate and realistic amount of work is for them to do from home. Aga WAY MORE content than I would expect students to do at home all by them was originally written for a classroom setting!

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Distance Learning Tips

Specific Suggestions for Unit 6:

- For the Lab Activity: Homemade Hot Chocolate
  - Students can absolutely do this at home – and it is a fun one! Most likely they already have a lot of these ingredients at their house. If they don't, you can make the actual making of the hot chocolate optional!
  - Instead of using a beaker and hot plate, they can use a small pot or pan on a stovetop. They can also just put it in a mug and microwave it!
  - Fun bonus/additional challenge question: do unit conversions to change the amount of ingredients to make enough hot chocolate to share with their whole family!
- For the Inquiry Lab Activity: Percent Composition
  - This lab requires just two different types of Oreos and a scale, so it is possible to do at home if they have those.
  - If not, you can put them in groups with students who do have access and they can be charge of collecting the data for the group.
  - Alternatively, you can demo the data collection over Zoom. Students can then use the data to do the rest of the lab activity.
- For the Lab Activity: Stoichiometry wtih S'mores
  - They can do this from home if they have the ingredients!
  - If not, there is also a PhET simulation that they could use to help visualize that gives them the same learning experience, just with sandwich ingredients instead of s'mores ingredients. You can check it out here: https://phet.colorado.edu/en/simulations/reactants-products-and-leftovers
- For the Lab: Homemade Chalk
  - You can do the introduction and discussion together over Zoom, Google Hangouts, or another group video platform. Then demonstrate the reaction and share the data with them the next day for them to analyze. They of course miss the hands on experience (which is so fun!) but can still learn from it.

- All of the following should still be able to be used as is, even from home:
  - Activity: Magnitude of a Mole
  - Stations: Stoichiometry Review
  - All of the practice handouts

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Have questions?

Please do not hesitate to contact me with any questions **prior to purchasing**! Due to the nature of digital resources, this resource **cannot** be returned and refunded, so please ask before you buy! You can see the TpT refund policy here.

I respond to Q&A's as well as email at **itsnotrocketsciencestore@gmail.com**!

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THANK YOU!

I hope you find this resource to be useful to you in your classroom and that your students enjoy it as well!

WANT TO SHARE YOUR THOUGHTS?

If you enjoy this resource, PLEASE leave feedback for me! I'd love to hear specifically what you enjoyed and how you used this in your classroom so that I can continue to create resources that are beneficial to you and your students. Your encouragement and feedback mean so much to me!

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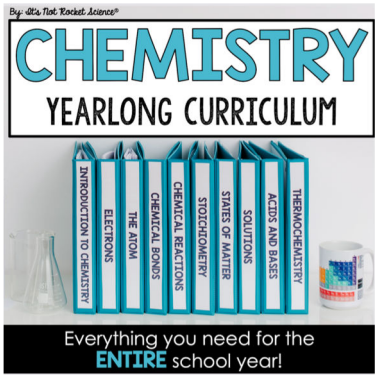

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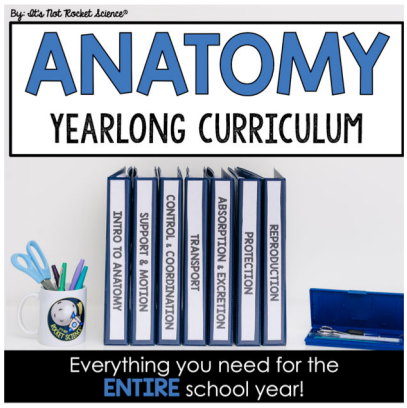

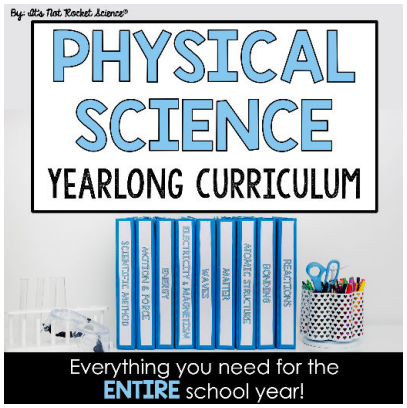

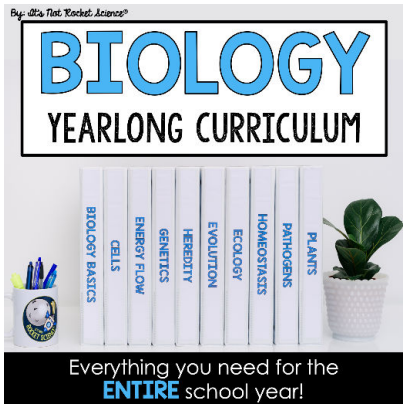
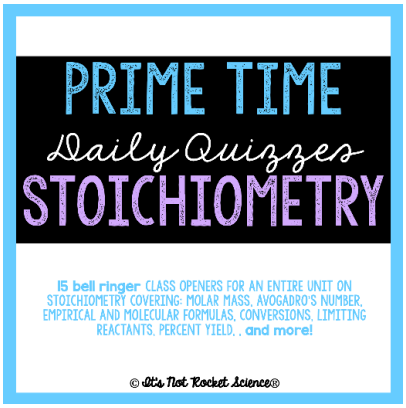
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