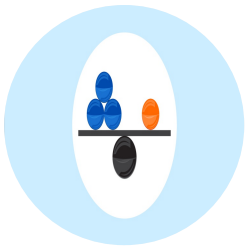

Balancing Act, Part 2

Stoichiometry_Grams to Grams

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Grade Level	10th – 12th Grade	**Time Frame**	115 min
Subject	Science	**Duration**	2-3 days
Course	Chemistry		

Essential Question

How can stoichiometry calculations help us understand the relationship between reactants and products in a chemical reaction?

Summary

This is part 2 of a 3-part lesson. In this lesson, students will reflect on the purpose and significance of stoichiometry in understanding the quantitative aspects of a chemical reaction. This lesson encourages students to think about how stoichiometry calculations can provide insights into the relative amounts of reactants consumed and products formed, as well as the stoichiometric ratios between them. Additionally, it encourages students to consider how stoichiometry can be applied to real-world scenarios, such as determining the number of reactants needed for a desired outcome. Before this lesson, students should be able to read a periodic table in order to calculate the molecular/molar weight of an element/compound. Students should also know how to balance equations and know how to calculate mole to mole ratios before completing this lesson.

Snapshot

Engage

Students use the I Notice, I Wonder strategy to formulate what's needed to create a bouncy ball.

Explore

Students make predictions and develop their own bouncy balls.

Explain

Students watch a video on how to do gram to gram conversions in stoichiometry.

Extend

Students apply and demonstrate their understanding of how to convert grams to grams.

Evaluate

Students explain their understanding of gram-to-gram conversion using the My Favorite Mistake strategy.

Standards

Oklahoma Academic Standards (Chemistry)

CH.PS1.7 : Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
CH.PS1.7.1: The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.

Attachments

- Bouncy Ball Instructions—Grams to Grams.docx
- Bouncy Ball Instructions—Grams to Grams.pdf
- I Notice, I Wonder—Grams to Grams.docx
- I Notice, I Wonder—Grams to Grams.pdf
- Lesson Slides—Grams-to-Grams.pptx
- Stoichiometry Grams to Grams Notes (Student Copy)—Grams to Grams.docx
- Stoichiometry Grams to Grams Notes (Student Copy)—Grams to Grams.pdf
- Stoichiometry Grams to Grams Notes (Teacher Copy)—Grams to Grams.docx
- Stoichiometry Grams to Grams Notes (Teacher Copy)—Grams to Grams.pdf
- Stoichiometry Race Gram to Gram Conversions (Student Copy)—Grams to Grams.docx
- Stoichiometry Race Gram to Gram Conversions (Student Copy)—Grams to Grams.pdf
- Stoichiometry Race Gram to Gram Conversions (Teacher Copy)—Grams to Grams.docx
- Stoichiometry Race Gram to Gram Conversions (Teacher Copy)—Grams to Grams.pdf
- Stoichiometry Race Question Slips—Grams to Grams.docx
- Stoichiometry Race Question Slips—Grams to Grams.pdf
- Stoichiometry Steps Poster—Grams to Grams.docx
- Stoichiometry Steps Poster—Grams to Grams.pdf

Materials

- Lesson Slides (attached)
- I Notice, I Wonder handout (attached; one per student)
- Bouncy Ball Instructions handout (attached; one per student)
- Stoichiometry: Grams to Grams Notes (attached; one per student)
- Stoichiometry Race Handout (attached; one per student)
- Question Slips handout (attached; one per group)
- My Favorite Mistake Handout (attached; one per student)
- Stoichiometry: Grams to Grams Notes (Teacher's Copy) (attached; optional)
- Stoichiometry Race Steps handout (attached; recommend to print in color and laminate; 3-4 copies)
- 1 tablespoon of borax [found in the laundry section of the grocery store] (one per student)
- 1/2 cup or warm water (one per student)
- 1 bottle of glue (one per group)
- 1 tablespoon of cornstarch (one per student)
- Measuring teaspoon/tablespoon set (1/4 tsp, 1/2 tsp, 1 tsp, & 1 tbsp)
- Box of food coloring (one-two per class; optional)
- Meter Stick (one per group)
- iPad/Phone camera (one per group)
- Whiteboard (one per student)
- Dry erase markers (one per student)
- Craft Sticks (one per group)
- Bowls (two per group)
- Masking tape (one per group of students)

- Calculator (one per group/student; optional)
- Periodic table (one per group)
- Green, Red, and Yellow cups (one set per group)

5 minutes

Engage

This is part 2 of a three-part series. Consider teaching Part 1, Balancing Act 1: Stoichiometry—Moles to Moles.

Teacher's Note: Setting up for the lesson

Before the lesson, print the attached **I Notice, I Wonder** handout. Create 2-3 bouncy balls using the following instructions. Consider creating 2-3 additional sets in case any get destroyed throughout the day. Store each bouncy ball in a sealed bag to help prevent them from drying out. If the stored balls start to flatten over time, soak them in the warm borax solution for about 5 minutes and reroll the balls. If students are storing the balls to be used in the following class, be sure to have them label their bags with their name and the amount of glue used.

Prep Note for Stoichiometry Race: To save time during the Extend for your classes, consider creating the 2x4 tables on the floor with tape in advance. (See **slide 17** for an example.) Create one for the front of the room for the modeling activity at the end of the Explain. Be sure to make them large enough that a student can stand or sit in each square. Make sure groups are spread out in the room.

Print and hang up 3-4 Stoichiometry Steps posters around the room for students to reference during the Extend activity, recommendation size for posters is 24x36. If unable to make poster, consider providing a copy in your students' learning management system or print the handout for them to reference.

Print and cut the 3 questions from the attached **Question Slips** handout for the Extend activity.

Use the attached **Lesson Slides** to follow along with the lesson. Begin with **slide 3.** Briefly read aloud the essential question: *How can stoichiometry calculations help us understand the relationship between reactants and products in a chemical reaction?* Next, move to **slide 4** and share the objectives with your students to the extent you feel necessary.

Display **slide 5** and Introduce students to the I Notice, I Wonder instructional strategy and how it can help them observe and reflect on their experiences. Remind them that observations are factual statements about what they see, while wonders are questions or curiosities they have about the phenomena they observe. Explain to the students that they will be using the I Notice, I Wonder strategy to observe and reflect on the ball. Gather the students in a comfortable viewing area where they can all easily see the ball in motion.

Bounce the ball in front of the students and ask them to observe the ball silently. Pass around a ball or two for students to closely examine. You may encourage them to pay attention to consider its feel, height, speed, chemical makeup, and any other relevant details they notice about the ball. Remind them to record any observation and questions that come to mind.

After bouncing the ball, facilitate a class discussion based on the "I Notice, I Wonder" statements. Encourage students to share their observations and questions. Guide the discussion to explore possible explanations for their wonders and to deepen their understanding of what the ball was made of that contributed to its ability to bounce.

40 minutes

Explore

Teacher's Note: Setting up for the lesson

Before the lesson, print the attached **Bouncy Ball** handout. Line out butcher paper or plastic table cloth for students to bounce their balls. Cover tables as well to protect from stains from the food coloring if used. Place the materials needed for this activity at each station for each group.

Display **slide 6**. Organize students into groups of 3-4 and pass out the **Bouncy Ball Instructions** handout. Give students time to collect materials. Inform students that they are going to make their own bouncy ball but the glue amount will be missing. Have students collect all the supplies they need.

Have students follow the directions on the handout. Once students have shaped their bouncy ball, have each group member drop it from the same height (top of meter stick) onto a hard surface, the floor, to test its bounce.

Teacher's Note

Remind students to only release, not throw down, their bouncy balls.

Have students test and record their bounce from the bottom of the ball. Have the group compare scores and the student with the highest score is the winner. Have the winner from their group test their ball against the winners of the other group(s). Have students continue to compete until you have one winner. Have the winner share out the amount of glue they used. Students only need to record the top four highest bounces on the Round 2 Whole Class chart in the Bouncy Ball Instructions handout. Afterwards, direct students to complete the analysis questions individually or as a group.

Display **slide 7** and discuss with the class how the borax and glue react together. Inform students that the correct amount of glue is 6 teaspoon or 2 tablespoons.

Teacher's Note

Consider mixing students with different skill levels and backgrounds to encourage collaboration and shared learning. Walk around the room, monitor students, and assist as needed.

If time allows, let students create a new bouncy ball with the correct measurement of glue.

This is a good place to stop for day 1.

20 minutes

Explain

Display **slide 8** and pass out the **Stoichiometry: Grams to Grams Notes** handout. Review what stoichiometry is with the class.

Teacher's Note

If you did not teach Balancing Act, Part 1, consider unhiding **slide 9-12** to review vocabulary and how to balance an equation.

Display **slide 13** and go over the steps needed to solve a stoichiometry problem from grams to grams.

Display **slide 14** and review the setup for grams-to-grams conversions. This slide is animated to review each step in the table.

Display **slide 15** and inform the students they will complete a problem while watching the video. Show ketzbook's Stoichiometry Tricks video and have students work through the problem with the video. Ensure that the video is easily accessible and can be viewed without any issues. After watching the video, allocate time for reflection and discussion of misconceptions.

Embedded video
https://youtube.com/watch?v=-1xfnq8yGk8

Teacher's Note

Unhide **slide 16** if students need more scaffolding on how to convert grams to grams. Providing a visual representation can help students gain a better understanding of the flow of conversion.

Display **slide 17** to review an example problem as a whole class for the next activity. Using a 2x4 table that you've created on the floor in the front of the classroom (either in advance or now), choose seven volunteers to come up to the front of the room and hand each a dry erase board and marker. Each student will represent a specific element or compound and units in the chemical equation. Display **slides 18 - 25** as you complete each step. On their whiteboards, have students write what they represent in the problem and then stand in the corresponding place in the table. While walking through the problem as a class, have the students complete the problem on their handout.

The sample problem: If 14 grams of H_2 and excess O_2 react to produce water, how many grams of H_2O are produced?

First, students must balance out the equation.

___H_2 +____ O_2 ->___ H_2O

Answer: 2 H_2 + 1 O_2 -> 2 H_2O

Slide 18: One student writes "14 g H_2" (provided from the problem) and stands in the first space of the table.

Slide 19: The student for the next step writes "2.02 g H_2" (molar mass of hydrogen) on their board and steps into the next space of the table. Continue the process with slides 20-25.

As students work through the reaction and cancel out with another student's element or compound with units, they sit down to indicate that they have completed their part in the reaction. For example, in the problem mentioned above, since they both are “g H_2“, they cancel each other out and both take a seat. Once seated, they cross out the units g H_2 but not the numbers on their white board. Then the next person will be “1 mol H_2 “ step into the next space. The group continues working together until all students have canceled out, are seated, and have reached grams of H_2O. At the final step, students solve across the table to determine the mass of H_2O produced, focusing on just the numbers and units they have left in their equation set up.

Teacher's Note

This is a great time to use questions to help check for understanding. Consider having students not in the table answer where each student volunteer should go and what they should have on their board.

Answer to Practice Problem

$$\frac{14\ g\ H_2}{} \quad \frac{1\ mol\ H_2}{2.02\ g\ H_2} \quad \frac{2\ mol\ H_2O}{2\ mol\ H_2} \quad \frac{18.02\ g\ H_2O}{1\ mol\ H_2O} = 124.89\ g\ H_2O$$

40 minutes

Extend

Display **slide 26.** Inform students it is now their turn to work in groups using tables around the room that they can create now or that you could have premade beforehand. They will race other groups to solve all three problems correctly. Divide students into groups of five-seven (or no more than eight) and ensure each student has a whiteboard and a marker to perform calculations and keep track of their progress. Provide each student with the attached **Stoichiometry Race Grams- to-Grams** handout. Then assign a 2x4 table to each group.

Display **slide 27** and go over the directions for the race. Instruct students to assign themselves a position. Once they have solved the problem, they should check their work as a team to ensure accuracy. When they are confident in their answer, they can change their cup color to green to be checked by the teacher. Once they have completed question 1 correctly and have it recorded on their handout, give them question 2. Repeat with question 3.

The first group to complete all three problems correctly wins.

Display **slide 28** and go over what each color of cup represents**.** Inform students that as they are working that they will use the cups to display the following:

- Green - We are done.
- Yellow - We are working.
- Red - We need assistance.

Everyone should start with a yellow cup on the top of their stack. Provide each group with a stack of green, yellow, and red cups, calculator, and periodic table. Pass out question 1 from the **Question Slips** handout; have students keep it face down until the race begins. Once students are ready, give the signal for the race to begin.

Teacher's Note

Note areas of disagreement or key points and identify any misconceptions.

If you have smaller groups you can inform students to put a white board in the squares for “1 mole A” and the “1 mole B” sections (step 3 & 6) of the table since they are constant. Just be sure that students switch out the A and B for the proper element/compound they are using.

Based on the time allotted, decide on how many questions you want students to complete in the race. It is important that the Evaluate is done on the same day as the race.

10 minutes

Evaluate

Display **slide 29.** Remind the students about the My Favorite Mistake strategy and how it can help them improve their problem-solving skills. Have each group reflect on the three problems from the Stoichiometry Race on the back of their Stoichiometry Race handout. In their groups, give them 2 minutes to identify one area where they repeatedly made mistakes and had to go back and correct. Have them discuss the following prompts:

- What mistake did your group make?
- Why did you guys make it?
- What can you do differently in the future to keep from making that mistake?

Have each group share with the class.

Teacher's Note

Reinforce the importance of learning from mistakes and encourage students to apply the “My Favorite Mistake" strategy to future problem-solving tasks.

Next, consider teaching Balancing Act, Part 3: Stoichiometry—Percent Yields.

Resources

- Foundation, C.-12. (n.d.). 12 foundation. CK. https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/12.1/primary/lesson/everyday-stoichiometry-chem/
- Foundation, C.-12. (n.d.-a). 12 foundation. CK. https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/10.4/primary/lesson/conversions-between-moles-and-mass-chem/
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- K20 Center. (n.d.). I Notice, I Wonder. Strategies. https://learn.k20center.ou.edu/strategy/180
- K20 Center. (n.d.). My Favorite Mistake. Strategies. https://learn.k20center.ou.edu/strategy/115
- Malia. (2022a, April 20). *How to make bouncy balls*. The stem laboratory. https://thestemlaboratory.com/how-to-make-bouncy-balls/
- YouTube. (2017a, March 26). *Stoichiometry tricks*. Video. YouTube. https://www.youtube.com/watch?v=-1xfnq8yGk8