Balancing Act, Part 1

Stoichiometry_ Mole to Mole Ratio

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Grade Level	10th – 12th Grade	**Time Frame**	105
Subject	Science	**Duration**	2-3 days
Course	Chemistry		

Essential Question

How can the balanced chemical equation be used to determine the mole-to-mole ratio between reactants and products?

Summary

This is part 1 of a 3 part lesson. In this lesson, students learn the role of the balanced chemical equation in establishing the stoichiometric relationship between different substances involved in a chemical reaction. This lesson encourages students to reflect on how the coefficients in the balanced equation can be used as conversion factors to relate the moles of reactants to the moles of products, allowing for quantitative analysis and calculations in stoichiometry. 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 have an understanding of what a mole represents.

Snapshot

Engage

Students use lotion to determine the importance of having proportional ingredients for a usable product.

Explore

Students organize and decide reactants and products for various scenarios.

Explain

Students watch a video on how to determine the ratio of elements for products.

Extend

Students apply their understanding of how to convert moles of one element/compound to another.

Evaluate

Students demonstrate their understanding of mole to mole 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

- I Notice, I Wonder—Mole to Mole Ratio - Spanish.docx
- I Notice, I Wonder—Mole to Mole Ratio - Spanish.pdf
- I Notice, I Wonder—Mole to Mole Ratio.docx
- I Notice, I Wonder—Mole to Mole Ratio.pdf
- Lesson Slides—Mole to Mole Ratio.pptx
- Mole to Mole Conversion Practice (TEACHER COPY)—Mole to Mole Ratio.docx
- Mole to Mole Conversion Practice (TEACHER COPY)—Mole to Mole Ratio.pdf
- Mole to Mole Conversion Practice—Mole to Mole Ratio - Spanish.docx
- Mole to Mole Conversion Practice—Mole to Mole Ratio - Spanish.pdf
- Mole to Mole Conversion Practice—Mole to Mole Ratio.docx
- Mole to Mole Conversion Practice—Mole to Mole Ratio.pdf
- Mole-y Chalk Art—Mole to Mole Ratio - Spanish.docx
- Mole-y Chalk Art—Mole to Mole Ratio - Spanish.pdf
- Mole-y Chalk Art—Mole to Mole Ratio.docx
- Mole-y Chalk Art—Mole to Mole Ratio.pdf
- My Favorite Mistake Handout—Mole to Mole Ratio - Spanish.docx
- My Favorite Mistake Handout—Mole to Mole Ratio - Spanish.pdf
- My Favorite Mistake Handout—Mole to Mole Ratio.docx
- My Favorite Mistake Handout—Mole to Mole Ratio.pdf
- Stoichiometry Mole to Mole Conversion Notes (TEACHER COPY)—Mole to Mole Ratio.docx
- Stoichiometry Mole to Mole Conversion Notes (TEACHER COPY)—Mole to Mole Ratio.pdf
- Stoichiometry Mole to Mole Conversion Notes—Mole to Mole Ratio - Spanish.docx
- Stoichiometry Mole to Mole Conversion Notes—Mole to Mole Ratio - Spanish.pdf
- Stoichiometry Mole to Mole Conversion Notes—Mole to Mole Ratio.docx
- Stoichiometry Mole to Mole Conversion Notes—Mole to Mole Ratio.pdf

Materials

- Lesson Slides (attached)
- Mole-y Art handout (attached; one per student)
- I Notice, I Wonder handout (attached; one per student)
- Stoichiometry Mole to Mole Notes handout (attached; one per student)
- Stoichiometry Mole to Mole Notes (TEACHER COPY) handout (attached; optional)
- Mole to Mole Conversion Practice handout (attached; one per student)
- Mole to Mole Conversion Practice (TEACHER COPY) handout (attached; optional)
- My Favorite Mistake handout (attached; one per student)
- 3 hypoallergenic bottles of lotion (The recommend size is 8oz., but you can use whatever size you want. Be sure to adjust amounts of water added in first two bottles)
- Scale or triple beam balance (one per group)
- Red, green, and yellow cups or red, green and yellow construction papers to make cones (one set per group)
- Colored Pencils
- Chalk

- Black Butcher Paper (optional)
- Dry Erase Pocket Sleeves (optional)
- Dry Erase Markers (optional)

10 minutes

Engage

Teacher's Note: Setting Up for the Lesson & Allergies

Before the lesson, obtain three bottles of lotion. Label each bottle A, B, and C. Add 3 tablespoons of water to bottle A and add 5 tablespoons of water to bottle B. Shake well. Leave bottle C as a control with no additional water. If you like, you can find bottles with a screw on cap for larger openings at your local dollar store. If there is too much lotion in the bottle, you can remove 3 tablespoons of lotion from each bottle before adding the appropriate amount of water to each bottle. For larger class sizes, you may consider having 3-5 sets of the lotion bottles throughout the room or to pass down each row.

Pay attention to the ingredients in the lotion. Check to see if any students in your class have a skin or food allergy before completing the activity.

Use the attached **Lesson Slides** to follow along with the lesson. Begin with **slide 3.** Briefly, read aloud the essential question: How can the balanced chemical equation be used to determine the mole-to-mole ratio between reactants and products? Then, 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 explain how it can help them observe and reflect on their experiences. Pass out the attached **I Notice, I Wonder** handout to each student. Provide the three lotion samples with different water concentrations to the students. Make sure each student has access to all three samples. Instruct students to apply each sample of lotion to the same area of their skin (arm or back of hand.) Encourage them to leave space on their skin between each sample to avoid mixing them.

Display **slide 6** and ask them to record their observations and reflections on each bottle. Give the students a few minutes to complete this task.

Student Sample Responses:

- I notice that sample A (the 3 Tbsp. of water) lotion feels greasy on my skin.
- I notice that sample B (the 5 Tbsp. of water) lotion feels cooler on my skin than sample A lotion.
- I wonder if sample C (control) lotion will feel the coolest.
- I notice that sample C lotion absorbs quickly into my skin.
- I wonder if sample A lotion will take longer to absorb than sample B lotion.

Once students have completed their observations and reflections, have them share their observations with the class. Encourage students to discuss their findings and draw conclusions. Inform students (if they haven't yet discovered on their own) that each bottle has a different concentration of water. Highlight the importance of having a balance of the right ingredients (reactants) for creating a desired product.

Optional

If you don't want to use lotion, you may consider preparing three samples of mashed potatoes with different amounts of salt (no salt, one tablespoon of salt, & two tablespoons of salt) for students to try and make their notices and wonders.

40 minutes

Explore

Organize students into groups of 3-4 and pass out the attached **Mole-y Art** handout. Inform students that today they are going to create artwork and determine the amount of moles used to produce their artwork. Provide each group with a stack of a green, yellow, and red cups. Have each group stack the three cups and put the yellow cup on top of the stack.

Display **slide 7** and instruct students that they will work as a team to complete the pre-work section. Display **slide 8** and inform students that as they are working through the pre-work to use the cups to indicate one of the following:

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

After everyone has completed the pre-work, ask students to spend 2-3 minutes brainstorming what they are going to draw and how they will execute it. Review the responses to the pre-work as a class.

Next, move to **slide 9** and provide each group with a large piece of black butcher paper or go outside on the sidewalk. Have have them sketch their artwork. Each group member should weigh their chalk and add their individual contributions to the artwork. Inform students they have 15 minutes to complete their artwork and that it must take up at least half of their paper. If working in the classroom, use the timer on the slide to help students keep track of time.

Embedded video

https://youtube.com/watch?v=m3zT2IxZQaw

After completing the artwork, have students return to the handout. They will reweigh their chalk and record it in the table. Next, students will need to calculate the mass of chalk used. Students will then move to complete the data analysis questions. Feel free to use the cups to check for student understanding.

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 students work on paper, consider using the Gallery Walk instructional strategy to allow them to view each others' work.

15 minutes

Explain

Display **slide 10** and pass out the **Stoichiometry Mole to Mole Conversion Notes** handout. Go over the following important terms and information on **slides 11-14**:

- Stoichiometry
- Reactants
- Products
- Balanced Equation
- Coefficient
- Moles
- Molecular Mass

Display **slide 15** and go over the steps needed to solve a stoichiometry problem from moles to moles. Next, move to **slide 16** to inform students that they will practice the steps by solving the problem used in the video Stoichiometry Made Easy: Stoichiometry Tutorial Part 1 by ketzbook. After watching the video, allocate time for reflection and discussion of misconceptions.

Embedded video

https://youtube.com/watch?v=Gle1bPAZsgg

Teacher's Note

A **Stoichiometry Mole to Mole Conversion Notes (Teacher's Copy)** handout is attached for you to use if needed.

30 minutes

Extend

Display **slide 17.** Place students into groups of 3-4. Provide students with the attached **Mole to Mole Conversion Practice** handout and colored pencils to represent each element. Instruct students that they will first use the colored pencils to assign a color to each element. Next, students will balance out the chemical formula. After balancing, students will use the colored pencils to check their balanced equation by indicating how many colors of each element are available in the reactants and the products. Once students have balanced out the formula, have them move to convert moles to moles in the question that follows.

Optional

You could choose to use skittles or M&Ms instead of color pencils for smaller class sizes.

For bigger classes or to decrease the amount of prints, you may consider placing students into groups, provide the handout in a pocket sleeve, and have students use a dry erase marker to work through the problem.

Teacher's Note

Note areas of disagreement and key points. Clarify any misconceptions.

You are welcome to use your own equations from your resources to do this activity or to add additional questions.

A **Mole to Mole Conversion Practice (Teacher's Copy)** handout is attached for you to use if needed.

After you have collected and checked the handouts, return to students to use as a future study tool.

10 minutes

Evaluate

Display **slide 18.** Introduce the My Favorite Mistake instructional strategy and how it can help them improve their problem-solving skills to help build their understanding. Pass out the attached **My Favorite Mistake** handout.

Explain to students that the slide displays a problem with a mistake. Ask students to answer the following three prompts on their handout:

- What were two things that were done well?
- Where is the mistake?
- What should be done differently?

Encourage students to show all their work and have students turn in their responses after completion.

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.

If time permits, once all handouts have been turned in unhide **slide 19 and 20** to show students the answer to My Favorite Mistake and walk through the problem with the students.

Optional Activity

Another play on this strategy that you might consider is to have students work in pairs or small groups to solve 1-3 stoichiometry problems that each have different mistakes. Using the My Favorite Mistake strategy, encourage them to discuss and solve where the mistakes lie and how to correct it. Encourage students to show their work in identifying the mistake and how to correctly finish-out the problem.

Next, consider teaching Balancing Act, Part 2: Stoichiometry_Grams to Grams.

Resources

- K20 Center. (n.d.). Gallery walk / carousel. Strategies. https://learn.k20center.ou.edu/strategy/118
- 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
- YouTube. (2016b, December 14). Stoichiometry made easy: Stoichiometry tutorial part 1. YouTube. https://www.youtube.com/watch?v=Gle1bPAZsgg