# Balancing Act, Part 3

## Stoichiometry--Percent Yield

Brittany Bowens, Sherry Franklin, Kelsey Willems
Published by *K20 Center*

*This work is licensed under a Creative Commons CC BY-SA 4.0 License*

| | |
|---|---|
| **Grade Level** | 10th – 12th Grade |
| **Subject** | Science |
| **Course** | Chemistry |

## Essential Question

How can we determine the efficacy of a chemical reaction using percent yield?

## Summary

In this lesson, students consider the concept of percent yield as a measure of the efficiency or effectiveness of a chemical reaction. It encourages students to think about how the theoretical yield (the amount of product calculated from stoichiometry) compares to the actual yield (the amount of product obtained in a laboratory experiment) and how percent yield is calculated using these values. Additionally, it prompts students to reflect on the factors that can affect the percent yield, such as side reactions, incomplete reactions, or loss of product during purification processes. It also encourages students to consider how stoichiometry can be applied to real-world scenarios, such as predicting product yields or determining the amount of reactant needed for a desired outcome. Students should also know how to use the gram-to-gram conversion. Consider teaching Balancing Act: Part 2 first.

## Snapshot

**Engage**

Students will participate in a Silent Ball game to calculate the efficacy of their being able to pass the ball.

**Explore**

Students select an image to analyze real-world instances in which individuals make predictions, subsequently comparing these predictions to the actual outcomes.

**Explain**

Students view a video demonstrating the process of calculating percent yield.

**Extend**

Students complete a card sort by researching and discussing career opportunities available that apply stoichiometry.

**Evaluate**

Students will demonstrate their understanding of percent yield by completing an Exit Ticket.

## 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

- Career Card Sort Solution—Balancing Act Part 3 Stoichiometry-Percent Yield.docx
- Career Card Sort Solution—Balancing Act Part 3 Stoichiometry-Percent Yield.pdf
- Career Card Sort—Balancing Act Part 3 Stoichiometry-Percent Yield - Spanish.docx
- Career Card Sort—Balancing Act Part 3 Stoichiometry-Percent Yield - Spanish.pdf
- Career Card Sort—Balancing Act Part 3 Stoichiometry-Percent Yield.docx
- Career Card Sort—Balancing Act Part 3 Stoichiometry-Percent Yield.pdf
- Career Reflection—Balancing Act Part 3 Stoichiometry-Percent Yield - Spanish.docx
- Career Reflection—Balancing Act Part 3 Stoichiometry-Percent Yield - Spanish.pdf
- Career Reflection—Balancing Act Part 3 Stoichiometry-Percent Yield.docx
- Career Reflection—Balancing Act Part 3 Stoichiometry-Percent Yield.pdf
- Lesson Slides—Balancing Act Part 3 Stoichiometry-Percent Yield.pptx
- Percent Yield Exit Ticket—Balancing Act Part 3 Stoichiometry-Percent Yield - Spanish.docx
- Percent Yield Exit Ticket—Balancing Act Part 3 Stoichiometry-Percent Yield - Spanish.pdf
- Percent Yield Exit Ticket—Balancing Act Part 3 Stoichiometry-Percent Yield.docx
- Percent Yield Exit Ticket—Balancing Act Part 3 Stoichiometry-Percent Yield.pdf
- Stoichiometry Percent Yield (Student Copy)—Balancing Act Part 3 Stoichiometry-Percent Yield - Spanish.docx
- Stoichiometry Percent Yield (Student Copy)—Balancing Act Part 3 Stoichiometry-Percent Yield - Spanish.pdf
- Stoichiometry Percent Yield (Student Copy)—Balancing Act Part 3 Stoichiometry-Percent Yield.docx
- Stoichiometry Percent Yield (Student Copy)—Balancing Act Part 3 Stoichiometry-Percent Yield.pdf
- Stoichiometry Percent Yield (Teacher Copy)—Balancing Act Part 3 Stoichiometry-Percent Yield.docx
- Stoichiometry Percent Yield (Teacher Copy)—Balancing Act Part 3 Stoichiometry-Percent Yield.pdf

## Materials

- Lesson Slides- Balancing Act Part 3: Stoichiometry_Percent Yield (attached)
- One medium-size ball (ie. beachball)
- Stoichiometry Percent Yield Notes (Student Copy) (attached; one per student)
- Stoichiometry Percent Yield Notes (Teacher Copy)
- Career Card Sort handout (attached; one per group)
- Card Sort Solutions handout (attached; one per teacher)
- Career Reflection handout (attached; cut in half; one half page per student)
- Percent Yield Exit Ticket Handout (attached; one per student)

10 minutes

# Engage

### Teacher's Note: Prior Knowledge

Make sure your students know how to use the gram-to-gram conversion. If you need to teach gram-to-gram conversion, consider teaching Balancing Act: Part 2 prior to starting this lesson.

Use the attached **Lesson Slides** to follow along with the lesson. Begin with **slide 3.** Briefly, read aloud the essential question: *How can we determine the efficacy of a chemical reaction using percent yield?* 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 game Silent Ball. Inform the students that they will pass a ball quietly around the room. Each student who drops the ball, makes a bad pass, or makes a sound is considered out and has to sit down. Let students know they cannot throw to the person next to them but must throw across the room. Before passing, ask students: *If you were to pass the ball to each student in the class, theoretically how many times should the ball get to each person without someone having to sit out?* (This number is based on how many students are in the class).

Each student has one chance to catch and throw the ball correctly. Remind students who remain in the game to continue standing after they catch and throw. Once all students have completed the round, ask them how many fair catches actually occurred. (This should be the number of students still standing.) Finally, ask students how they might go about calculating how efficient they were in playing Silent Ball? (Students should divide the actual/theoretical and then multiply by 100).

### Optional Activity

You can try another round but add a second ball to the mix for students to determine the percent yield. After completing the round, you could make the connection of how there can be more than one element/compound that has an effect on the percent yield.

### Teacher's Note

You may consider using the Playworks's Silent Ball video to help with showing the instructions for Silent Ball. You may also add a timer for students to complete the round under 3-5 minutes, depending on the size of class.

20 minutes

# Explore

**Teacher's Note: Setting Up Padlet**

Prior to starting this lesson, set up a Padlet Add the link or a QR code to **slide 6** for students to access the Padlet.

**Device Alternative**

If your school policy allows, students can use their phones to complete this activity.

Go to **slide 6** and use the Pick a Pic instructional strategy to invite students to find an image depicting situations in which people may want to measure the efficiency of an event. Instruct students to add their pictures to Padlet and add a hashtag to the picture that describes what it is about (for example, "#BasketballFreethrows"). Provide students with a laptop or tablet to find their picture. Have students scan the QR code or navigate to the link you added to the slide to access the class's Padlet. Give students 10 minutes to find and add their picture to the Padlet.

Next display **slide 7** and ask students to review their classmates' pictures. Instruct them to select a picture that hasn't been chosen by another student, add their name, and add at least two to three factors that could affect the outcome. *For example: The experience of the basketball player, the height of the basketball goal, the number of free throw attempts.*

Allow about 15 minutes for students to do so.

15 minutes

# Explain

Display **slide 8** and pass out the **Stoichiometry Percent Yield Notes** (Student Copy) handout to each student. Review the vocabulary, percent yield set up, steps for solving percent yield problems with the students on **slides 8-11**.

Display **slide 12** and inform the students they will be completing a problem on their Percent Yield Notes handout while watching the video. Show the Ketzbook's Percent Yield Made Easy: Stoichiometry Tutorial Part 4 video and have the students work throughout 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.

Ask students to think back to the Silent Ball activity and explain how the activity connects to what they just learned about percent yield. Have them identify the theoretical, actual, and percent yield in the scenario.

15 minutes

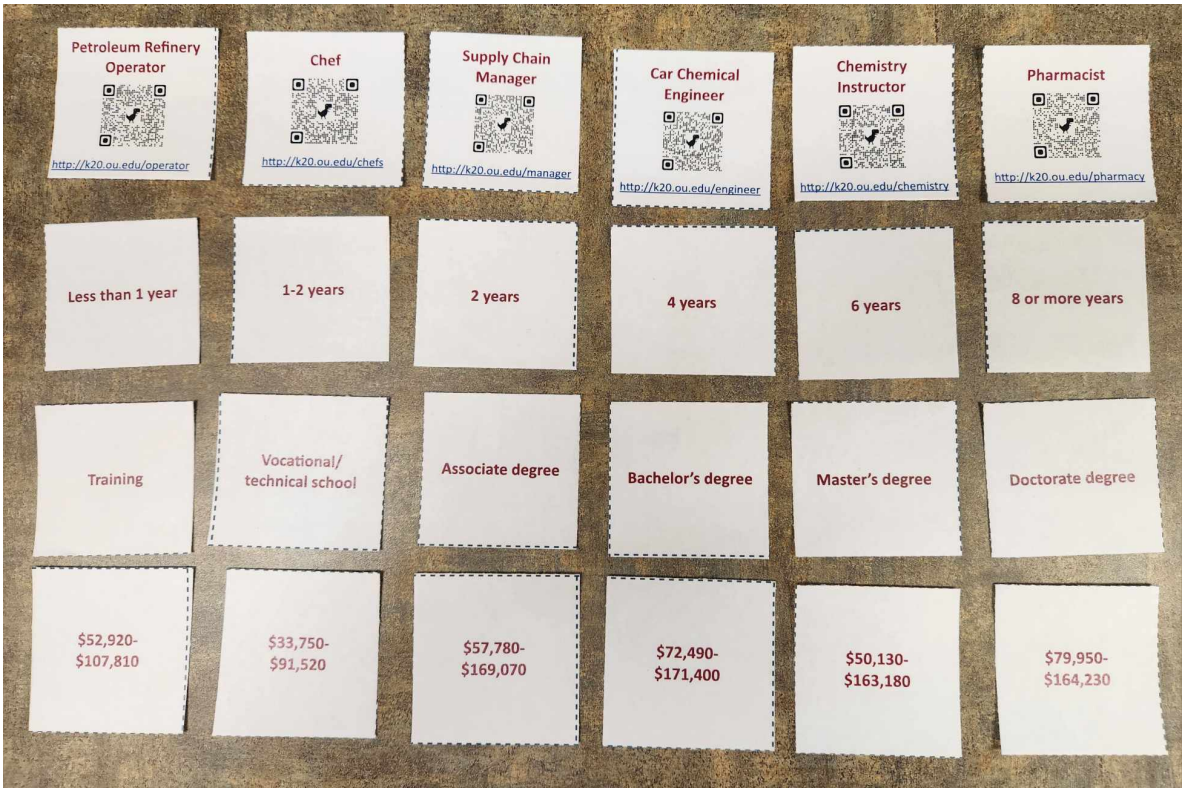
# Extend

The following activity can be used to add a career exploration element to this lesson. Prior to the activity, print the attached **Career Card Sort** handout so that there are enough for eight groups of students.

Display **slide 13** and place students into groups of 3-5 people. Pass out the Career Card Sort handout to each group. Make sure each group has a tablet or laptop to use for research. Tell students the cards have information for five careers related to percent yield. Instruct students to cut out the cards and then sort them into the following categories.

- Career Title
- Education level required
- Years of education needed
- Salary range

Tell students that the QR codes or shortened links on each of the career title cards has the information they need to complete the card sort. As each group finishes sorting, use the attached **Career Card Sort Solution** to check student work. Below is how the card sort should appear after sorting the cards:




Next, pass out the attached **Career Reflection** handout to each student. Move to **slide 14** and ask students to answer the questions on the Career Reflection handout. Students choose the career from the choices that interest them the most and what the day-to-day job description is. They then determine what post-secondary education options are available in their state to attend for that certification/degree (If one is not listed for their state, then the student can list for a neighboring/different state.)

**Teacher's Note**

In the Career Reflection handout, students can find the different postsecondary education options by clicking on the “Find Training” option in the “education” section of the websites. From there, they can enter their zip code or state to search.

For the fourth quadrant, students may choose an occupation such as an environmentalist, food chemist, supply chain manager, perfume manufacturer.

10 minutes

# Evaluate

Go to slide **15** and have students complete an Exit Ticket. Give students the **Percent Yield Exit Ticket** handout, which asks them to solve for the percent yield of the following stoichiometry problem:

Suppose you're in a chemistry lab and you want to synthesize water ($H_2O$) by reacting hydrogen gas ($H_2$) with oxygen gas ($O_2$) according to the following balanced chemical equation:

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

You have 10.0 grams of hydrogen gas ($H_2$) and 40.0 grams of oxygen gas ($O_2$). After carrying out the reaction, you find that you obtain 16.0 grams of water ($H_2O$). Calculate the percent yield of the reaction.

## Resources


- K20 Center. (2020). Bell ringers and exit tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (2020). Card sort. Strategies. https://learn.k20center.ou.edu/strategy/147
- K20 Center. (2020). Padlet. Tech Tools. https://learn.k20center.ou.edu/tech-tool/1077
- K20 Center. (2020). Pick a pic. Strategies. https://learn.k20center.ou.edu/strategy/91
- Silent Ball. Playworks. (2019, September 4). https://www.playworks.org/game-library/silent-ball/
- YouTube. (2017, March 29). Percent yield made easy: Stoichiometry tutorial part 4. YouTube. https://www.youtube.com/watch?v=_xeqkSQb0Pg