

Stoichiometric Calculations: A General Chemistry Flipped Classroom Module

Instructor Notes

Overview

This activity is intended for use in a college-level first semester/quarter general chemistry course, and is designed to help students complete the following learning objectives:

- a) using mole-gram conversions and mole-mole conversions to carry out stoichiometric calculations for balanced chemical reactions;
- b) gaining appreciation for how stoichiometric calculations are used in real-world chemical reactions.

Prior to completing this activity, students will be expected to have learned how to use molar masses of elements and compounds to carry out mole-gram conversions, how to balance chemical reactions, and how to use balanced chemical reactions to carry out mole-mole conversions.

Pre-lecture Online Learning

a. Studies of previous implementations of flipped classroom modules indicate simply asking students to watch videos prior to lecture is not an effective way to ensure compliance and can result in students being unprepared for the in-class activity.¹ Therefore, instructors are encouraged to assign a pre-lecture quiz that assesses student learning from the video lecture. A pre-lecture quiz is provided as a separate file in this module, and instructors can deliver this using either the test/quiz function in their course management system or using in-class clickers to solicit answers prior to starting the in-class activity.

If instructors are interested in further increasing the interactivity and engagement of the pre-lecture videos they might consider embedding the videos in the Playposit system (<https://learn.playposit.com/learn/>). Playposit allows instructors to insert questions within the video, which then must be answered by the student before proceeding further in the video. Not only does this help increase the interactivity and engagement of the video, but since the Playposit questions can be assigned for homework and awarded points this also helps increase student compliance.

b. Pre-lecture videos for Stoichiometric Calculations (Khan Academy):

<https://www.khanacademy.org/coach/class/5741031244955648/content>

¹ He, W; Holton, A; Farkas, G; and Warschauer, M. (2016), "The effects of flipped instruction on out-of-class study time, exam performance, and student perceptions." *Learning and Instruction*, 45, 61-71.

This pre-lecture learning module is listed under the Chemistry course within the Khan Academy course list and is titled "Stoichiometry." The Stoichiometry module includes three videos, plus two optional exercises and one optional quiz.

Even though the Khan Academy provides a freely accessible set of online videos that reduces the barrier to implementing flipped classroom modules, instructors are encouraged to create their own set of videos if time permits. The author's previous experience has found students generally appreciate seeing and/or hearing their own instructor in the video, and more importantly students have less uncertainty about what specific topics are considered important by the instructor when the video is created by their own instructor. Though there are numerous ways in which faculty can create their own online videos, the author has found using the Zoom teleconferencing system screen capture function while annotating Powerpoint slides on a tablet/laptop with touch screen functionality is the most cost-effective and convenient method for creating new videos. The following link provides instructions for creating videos using the Zoom teleconferencing system:

<https://support.zoom.us/hc/en-us/articles/201362473-Local-Recording>

c. In addition to the pre-lecture videos and quizzes, instructors are encouraged to assign the associated journal articles cited in the in-class activity worksheet in order to familiarize the students with the justification for using coal to create liquid fuel. Instructors may choose to include additional questions in the pre-lecture quiz or simply review the key points from the articles in the in-class activity introduction. It is noted the author routinely assigns the entire *Science* article and the introduction to the *PNAS* article, though instructors may choose to assign different sections of the readings if that might be more appropriate for their student audience.

In-class Activity

It is recommended that students be given 2-3 days to complete the pre-lecture activities described above. As mentioned above, instructors are encouraged to assign the associated pre-lecture quiz or deliver these questions to students at the beginning of lecture using a clicker in-class response system. The in-class activity can be completed in one 50-minute or one 80-minute lecture period, depending on how the instructor chooses to implement the activity. Below is a suggested timeline.

-Clicker questions to administer pre-lecture quiz (optional; instructors may wish to administer the pre-lecture quiz online using the test feature in their course management site): 10-15 minutes

-Introduction to the activity and relevance of the assigned readings: 5 minutes

-Groups of 3-4 students work collaboratively on in-class activity worksheet, and answer questions in free response form: 20-25 minutes

-Instructor solicits answers to multiple choice versions of the worksheet questions using an in-class clicker system (optional; instructors may wish to collect the free response answers and grade them manually): 15-20 minutes

-Summary and activity wrap up: 5 minutes

If instructors choose to solicit answers to the worksheet questions using an in-class clicker system, multiple choice versions of the questions are provided in a separate Powerpoint file within this module. The answers for the multiple choice versions of the questions are provided in the answer key, which is also included as a separate Word file. If the instructor's institution does not use a campus-wide clicker response system, instructors are encouraged to consider using either the PollEverywhere system or Kahoot. PollEverywhere is free to use with less than 40 participants, and clicker questions can be embedded within Powerpoint presentations using a PollEverywhere add-in. If instructors wish to use a system with larger enrollment classes the Kahoot system is free to use with unlimited numbers of students, however questions must be administered from the Kahoot website. Both systems allow students to submit answers using a mobile phone or other device with wireless internet capabilities and allow instructors to download grade reports in the form of an Excel spreadsheet. Instructors can learn more about these in-class response systems at the following websites:

PollEverywhere: <https://www.polleverywhere.com/>

Kahoot: <https://kahoot.com/>