There are many accounts of successfully adapting a college chemistry class to a nontraditional lecture format. However, there are fewer accounts of performing this transition in undergraduate organic chemistry. Speculation is that many do not attempt this undertaking due to the vast amount of material that is covered, the emphasis placed on student performance in this class, and/or the professor not wanting to alter a format that has become comfortable. If a method could be developed for building a flipped organic classroom then perhaps the shift of learning responsibility to the student would create a better experience in a class that already has a terrible reputation. Hopefully this approach would begin to develop study habits that would benefit students in medical, pharmacy, or other graduate schools.

In preparing to flip the organic chemistry sequence, I tried to determine several key aspects that were deemed crucial for the change to be successful. There needed to be a simple and efficient method for delivering the material and a method for assessing pre-lecture study habits. When the students came to lecture, novel methods for engagement needed to be in place. Finally, I wanted to develop unique methods for evaluating the students’ mastery of the material.

In addition to the Desire2Learn course management system currently used at our institution a secondary website was constructed that housed all of the student materials. This was done simply as a backup in the event D2L was not accessible. Students were supplied with interactive notes prior to attending lecture. The material was supplied as an entire unit instead of on a day-to-day basis. It was decided to provide the material in PDF format to the students due to the universal recognition of the format. It was determined however, that students who utilize a tablet for note taking benefited from the PDF format. These files were easily uploaded to a variety of note taking apps, manipulated inside the app, and then stored or exported to cloud storage. The notes were an expanded version of the traditional lecture notes used in the past. Sentences and ideas were more complete so students could better follow, but they were concise and only began to paint the entire picture. The notes were also interactive. Embedded inside the text students would find links to tutorial videos accessed from Khan Academy or created in house. Students were also provided links to interactive websites and practice exercises created using SoftChalk. These assignments tested the ability of students to apply material that was just read. Students received instant feedback as to whether they had mastered the concept or not and were also able to rework problem sets as practice. All of this was aimed at providing the students a means for coming to class with a basic foundation of what they needed to know. GoClass, an online learning platform that allows instructors to create lessons and push the material out to students, was used as a quizzing feature to gauge how effectively students were studying prior to attending lecture.

At this point the students should be equipped with a basic understanding of the content. Upon entering the classroom the students are provided with a mini-lecture. This consisted of 10-15 minutes of review, overview, and covering the most crucial
Students were also allowed to ask questions concerning the material or quizzes. Lecture would then shift to an interactive and student driven time. One main complaint in past courses was a lack of practice. Therefore, this interactive time heavily utilized the problems at the end of the chapter, focusing on critical thinking and multi-concept questions. The manner in which the problems were worked varied. There were times when students were placed into groups and given a specific problem. The group was charged with developing a solution and was also responsible for defending it. The groups would work on an iPad and AppleTV was used to project the group’s work for the class to view. Other times students would volunteer to answer the question, either in part or in whole. Many times the instructor would initiate a solution and require the students to finish it. As the number of reactions the students had been exposed to increased, one favorite activity was to propose a multi-step synthesis. Groups would present their reaction pathway and the class could decide the most plausible pathway. No matter the method of practice, the instructor constantly addressed aspects from the notes as they appeared in the problems being worked. Upon completion of these in-class activities, students would have two sets of study material, and hopefully these problems would reinforce the concepts discussed in the notes.

Students were also required to answer a verbal response question. As many of these students are preparing for admission interviews to various graduate schools, being able to answer difficult questions on the fly is important. Students were provided a list of topics and sample questions that could be asked. Each student would then schedule a time with the professor for his/her question. To accommodate the approximately 50 students, office hours and down time in laboratory were used for this activity. All responses were video recorded and made available to the individual student. Factors such as conciseness, quickly getting to the main point, proper interview posture and etiquette, etc. were stressed. Each student was required to critique him/herself in terms of the factors above. Initially questions were answered in one or two sentences, but as the students became more comfortable with this process, the response became more of a conversation between the professor and student. Student responses indicated that this was a unique, somewhat stressful, but overall beneficial exercise.

Students were evaluated using an in-class exam consisting of multiple choice and open response questions. This format was consistent with that used before transition to a flipped classroom. Class averages of traditional classes and flipped classes from different semesters were compared. Although these reflect different groups of students, the difficulty of the exams were comparable. In all cases students in the flipped class had higher averages. Shown below is a graph of the final letter grades from traditional lectures compared to those from the flipped classes.
For the most part the overall attitude was positive and students felt the flipped class was beneficial. Students also indicated that in order to be successful a high degree of responsibility was required. One possible reason for some students indicating the tradition lecture was preferred may be a lack of responsibility and initiative in studying and staying ahead.

Here is my final project video showing the methods used in flipping my organic chemistry class.