Online instruction has become a popular topic in recent years, especially at the collegiate level. Despite the popularity of online education, chemistry professors have been reticent to offer online courses and have only recently begun to seriously explore the possibility (Pienta, 2013). General chemistry courses are full of complex, visually stimulating material that is ideal for the online environment. In my experience, students often struggle with visualizing events that occur on the microscopic level, despite their familiarity with the macroscopic consequences. The unique affordances of an online environment provide a means to help students with this type of confusion.

 Designing this unit gave me a new appreciation for the complexities of creating an entire course. I wanted to choose a topic within chemistry that was both conceptually challenging for students and could be stimulating in an online environment. Gases represent one of the easiest topics to depict visually and with simulations despite being one of the most difficult concepts to explain mathematically. Designing a unit around this topic provides the unique opportunity to utilize different methods of instruction.

 The unit is designed to take place within a larger sequence of instruction, but can stand on its own. Material has been sequenced to gradually increase in difficulty and provide assessment and feedback at many points along this path. This structure of learning is in accordance with that described by Dirksen (2012) and provides the necessary time for skills to develop and for students to be engaged and confident in their abilities. Moderating the level of challenge ensures that students are not overwhelmed by the material. Similarly, care was taken to avoid over-stimulus and overuse of visual aids. When provided, any visual image is paired with an explanation in words to ensure that students are not mentally overloaded with material (Clark and Mayer, 2012). Additionally, videos are included with a picture-in-picture view of an instructor when explaining material. This should provide students with a personal connection to the material and instructor as opposed to an abstract notion of being taught.

 Assessing student learning is another challenge of online learning. I consider many forms of assessment in this unit. The first is what I call self-assessment on the part of the learner. There are many sample problems embedded in the unit, placed immediately after the section on which they are based. Each of these sample problems is specifically designed to enhance the material that was just covered by the student, and also includes a complete solution. Students are explicitly told to complete the problem prior to viewing the solution. In this way, they can determine where they stand after each section. Each solution has a full page description of the thought process involved in understanding each problem before providing any steps in the mathematics of the answer.

 More traditional formative assessments are incorporated as two quizzes, each of which will build upon the preceding material. These quizzes allow students to form a complete idea of where they stand in their understanding of course materials before moving on to more advanced material. Quizzes provide multiple question types. In this manner, students must utilize multiple methods of solving problems and learn the ability to think critically about chemistry. Summative assessment for the unit would take the form of a test spanning multiple units.

 Finally, an end of unit survey is made available to students. This survey allows for student feedback with regard to the unit and instruction itself. The purpose of this survey is to provide students with a sense of ownership over the material and that their feedback will be used by the instructor to design more effective and highly engaging materials in the future.

 Designing this unit has given me a new appreciation for the amount of work that will be required to design a complete online course and measure its effectiveness. It is a worthwhile effort and assembling this material has provided me with the blueprint to follow, but with a newfound respect for the diversity of instructional methods and depth of content required to be an effective means of instruction.

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