GNG1103

Engineering Design

Deliverable G

Date: March 1,2020

Team #: F08

Problem Statement

The problem statement is to create an interactive, innovative , user-friendly and cost effective VR learning experience that helps students currently enrolled in Organic Chemistry visually understand chemistry molecules in 3D

Reasons for Prototyping

1. Make a plan for the final Prototype for Design Day
2.Continue to get a deeper understanding of our final prototype
3. Reduce the risk of errors
4. Verify that it is feasible
5. Find mistakes in advance , improve them and incorporate any feedback.

Introduction

After having determined the viability of the divers representations in the former prototype the task remained to create a suitable environment in unity. Overall, the feedback from the client on our previous prototype was positive so we will go ahead with the models more or less unaltered; however, the client did stress the importance of showing reactions in solution and the randomness of collisions.

The purpose of the second prototype is to test the environment and mechanics in unity. This is on the whole a far more daunting task than the former with far greater potential for problems. Creating these elements early on also allows greater time to correct technical issues and change it to meet the needs of the client. The overall environment is styled on a laboratory and therein is a beaker whereby the user may access the reaction visualising element. This will not only create a more navigable program, as well as the feeling of a game, but will help connect the molecular level to the more familiar, observable world. We have been using solid works to design the molecules and exporting them to unity. Extended research has been made to be able to export solidworks 3D molecules into unity.

Largely the testing in this prototype will be testing the rotation of the molecules and vibration. We are trying to test a background that works. We are trying to use pictures from labs in Uottawa but if this idea doesn't work we might buy one from the Unity store.

Prototype Screenshots

Our team designed a cover image for our game in unity. This is the first image they will see when entering the game which includes a flask and the name of the game using elements from the periodic table.

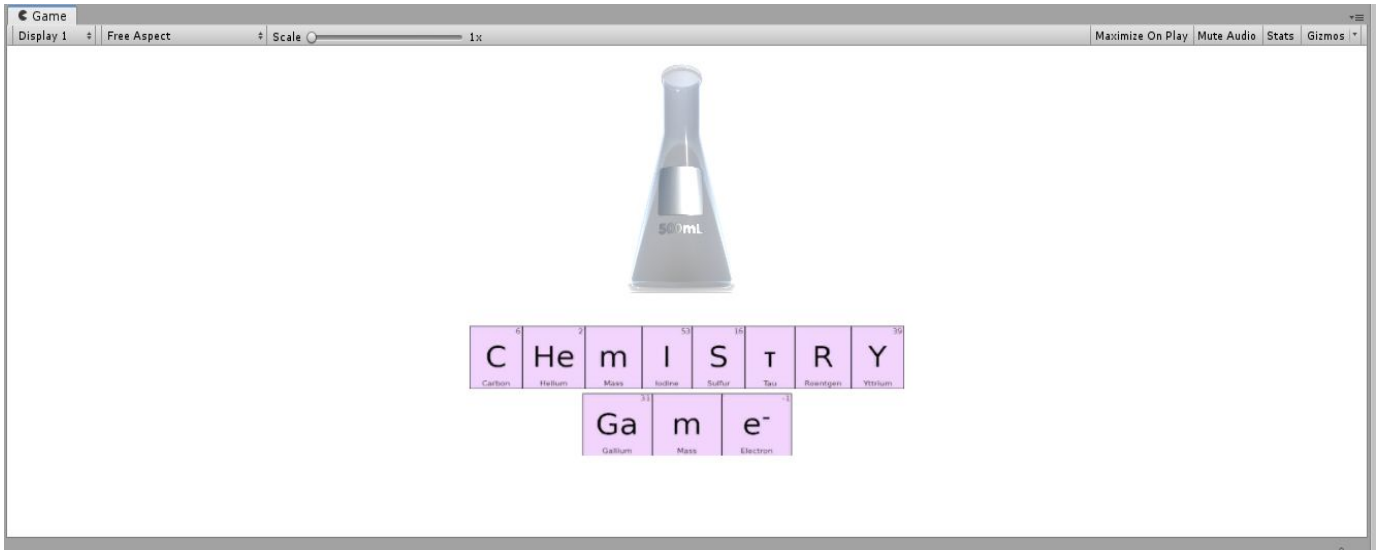

Figure 1.Cover page of the game

SolidWorks Molecules

This week we worked on creating water molecules in Solid Works. We created a 3D protonated Acetone, Water and Hydroxide in ball and stick and orbital form.

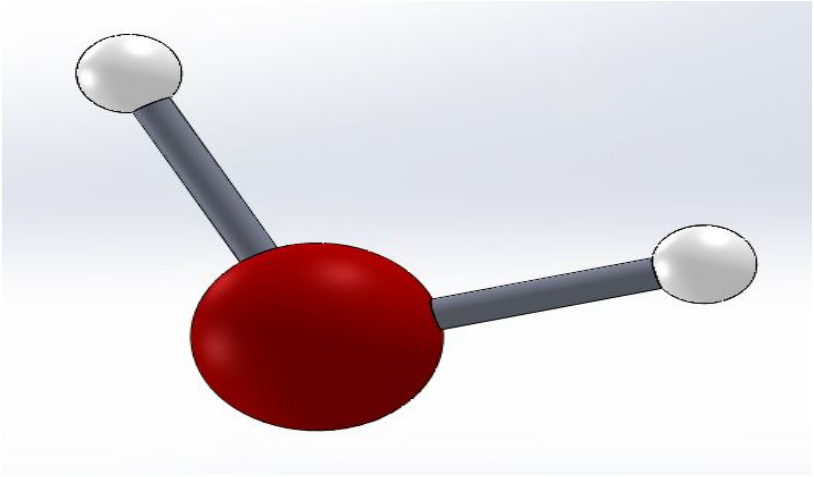

Figure2. H_2O molecule

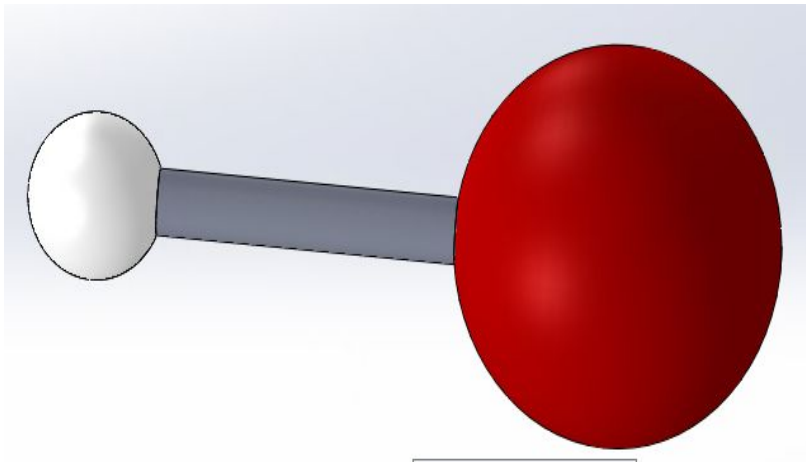

Figure 3. OH molecule

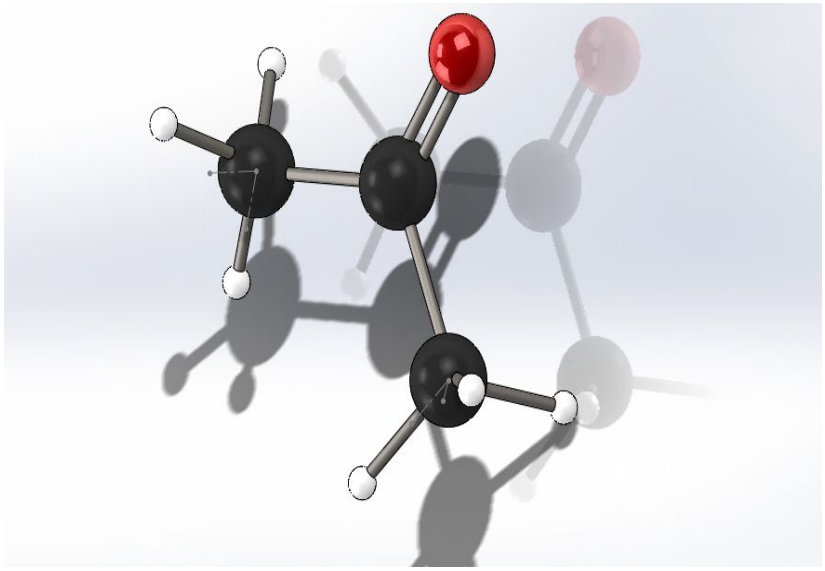

Figure 4. Acetone Molecule

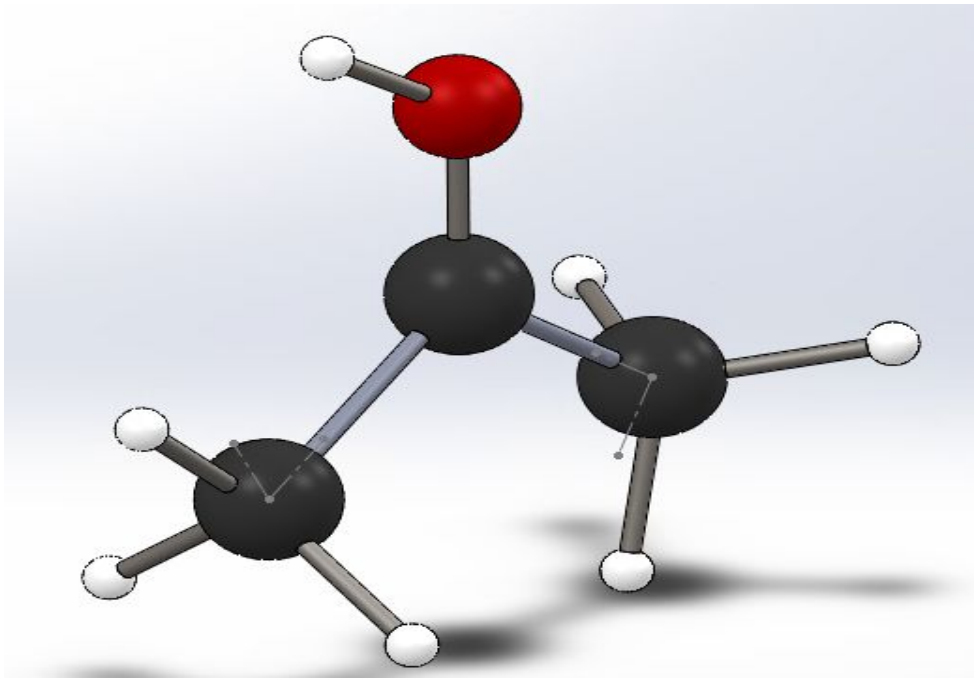

Figure 5. Protonated Acetone Molecule

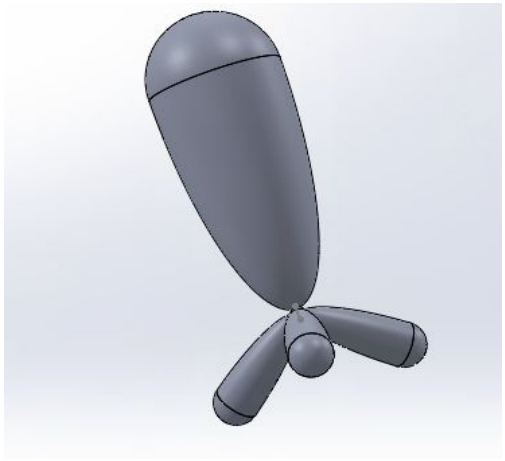

Figure 6. Orbitals Hydroxide Molecule

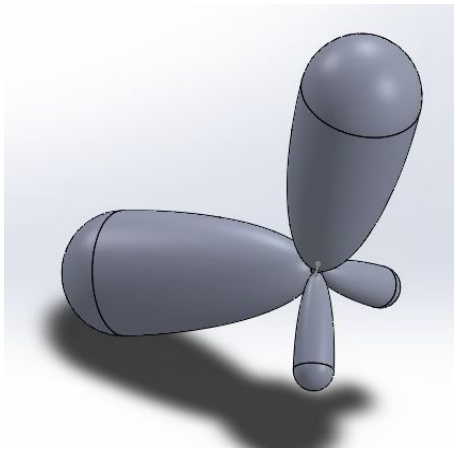

Figure 7. Orbitals H_2O molecule

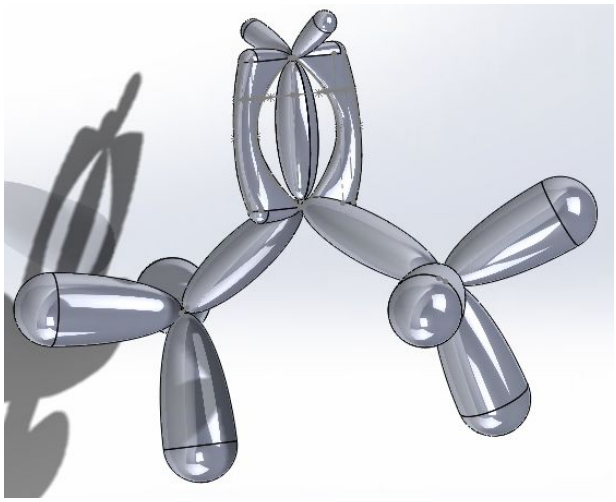

Figure 8. acetone orbitals

When the user gets into the game the first thing he will see when he approaches the Lab bench is a pop up window with the Learning Objectives. The learning Objectives for Scenario 2 are :

1) To describe the internal movement of the molecules.
2) Select the appropriate to solve a problem (orbitals,ball and stick, electrostatic)
3) Explain /identify requirements for successful collision(angle of reaction, energy)

Then they will be able to begin the activities by selecting the different Learning Objectives.

Environment and Two different Scenes

The first scene is not completely done because we needed special authorization to enter a chemistry lab in University of Ottawa to use it as the 2D background for our first scene, We asked a PhD student if she could ask her supervisor if we were authorized to take pictures of the lab to use them in the VR game; she replied by saying that she could send us pictures Monday morning. We also asked a student in another lab if he was able to send pictures of the

lab he works in, a physical chemistry lab in D'iorio. Online we were able to find pictures of a biochemistry lab in Marion hall. Before choosing a background to finish the first scene we want to see the pictures from the organic chemistry lab that the PhD student will send us. In our next group meeting we will decide on a background . Right now the lab scene consists of a lab bench we bought for $8.99 and a Flask we bought for $3.99 . The second scene will be a beaker full of molecules the user will jump into and play with reactions and the molecules.

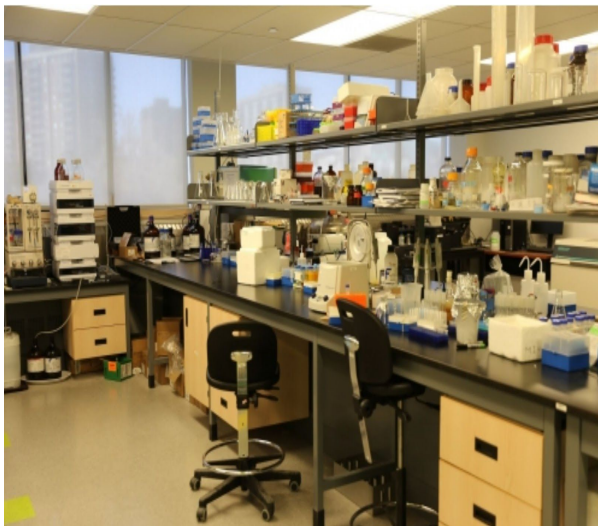

Figure 9. Biochemistry Lab in Marion Hall

Figure 10. Physical Chemistry Lab D'iorio

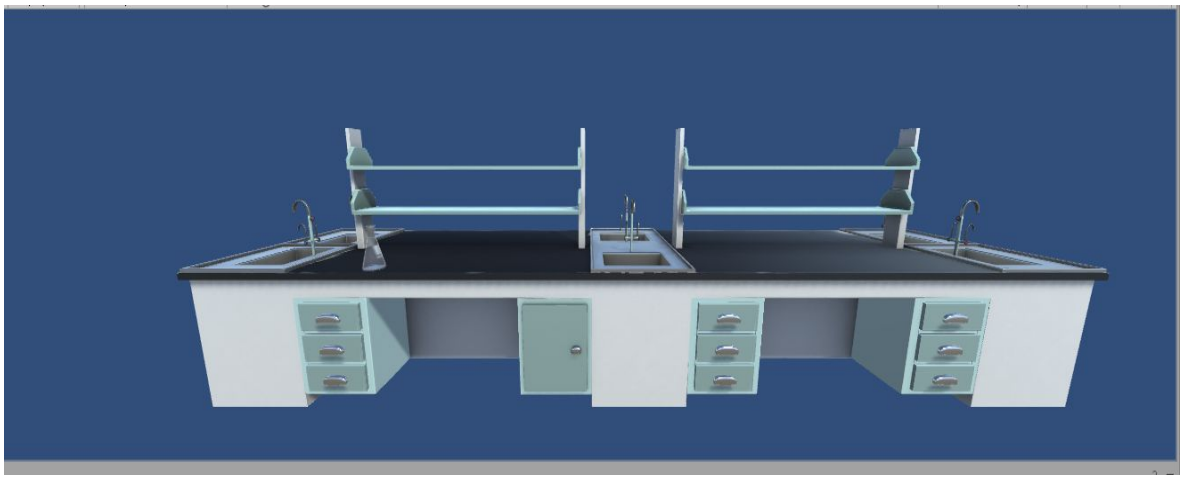

Figure 11. Lab Scene with the erlenmeyer flask where the reactions will take place

Figure 12. Beaker with solution

Figure 12. Beaker scene Front view vs. Top view

What is challenging? What do we have to continue to work on ?

After much research we are currently working on five different codes to incorporate for the final prototype. The first code is how to make things collide to show the collisions between two molecules to show an acid base reactions.The second code we worked on this week (still in progress) is to change scenes. We want to have two scenes; however, the code to change scenes in unity is complicated. The current plan is to have the user enter a lab and then proceed to another scene within the beaker. The third code will be incorporated for the last prototype and is a 2D pop-up window with multiple choice questions to assess the student learning. The last code we worked on this week (now complete) is the code for picking up the molecules and moving them. We need to continue to work on how to do an electrostatic model of the molecules. The idea of using background pictures from actual Uottawa labs is a challenge because unity is 3D and the images 2D we would have to distort them to fit them.

Cost of Prototype

We are allowed to spend 100 CAD in the unity store. We might buy a pop up quiz window which is around $29 USD. We are currently trying to find a way to create the pop up quiz without spending the money. In total till now we have spent around 18.99 CAD in unity or $12.99 USD.

Unity Asset	Cost in USD
Lab Bench	$8.99
Flask	$3.99
total	$12.99

Testing Plan

The first prototype did not resemble our last prototype, yet the second prototype is closer to our final prototype. There is still a lot of work that we must accomplish to finish our final product. But from the test that we ran in unity we saw that the models do rotate. Stopping criteria is simple; once we create a good prototype and have both positive and negative feedback will stop testing the prototype. We have two Testing Dates planned where we will test our prototype with the head set: one on March 12 and the final testing on March 18.

Feedback

During the first client meeting the client stated how it was important to address the common errors the users tend to make and explain to them why these misconceptions are untrue. The client mentioned two common errors that need to be addressed. First we need to show that collisions are a probability and that molecule movement is not random. The second common error is that molecules do not move internally. In our last client meeting we got some positive feedback but the client also asked us to address the misconception that there is only one molecule in a solution so we decided to make this more clear by creating beaker full of water and showing that there are several molecules. The client also specified that it would be good to show the differences between the pi bond and the sigma bonds.

Conclusion

We understand that in the next two weeks there is still a significant part of the project that we need to finish. Yet, we are still on schedule according to our gantt chart. It is important to add that we have modified our original plan as we learn more about organic chemistry and what is possible to make in unity with our basic knowledge of coding.We still need to work on the interactive side of the molecules and the acid base reactions.We have a plan and set codes to tackle the next step to make this a reality. The design can be seen in unity and we are able to show how the molecules rotate . We need to figure out a way to show them vibrate. We will continue to do research on how to make an object vibrate in unity.Some improvements can still be made but overall our prototype fidelity is high and we are happy with what we have accomplished till now.