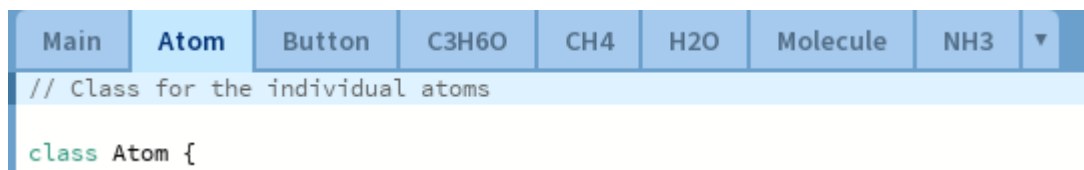


## Criterion C: Development

1. OOP
2. GUI (shapes, HUD)
3. Inheritance
4. ArrayLists
5. Libraries
6. Enhanced for loop

1. OOP stands for object oriented programming. This is where a programmer will create objects that will encapsulate methods and variables. This allows reusability of code and makes the program easier to run. In my program, I used object oriented programming in the form of creating literal objects that my program will display. The classes that I used were reused throughout the program because of the nature of chemistry and my model. This was appropriate to meet the clients needs as he wants a model with the ability to display multiple molecules. Creating a new section of code every time would not be practical so this technique was used.



This section displays all of my classes as well as the beginning of one of my classes.

*Java constructor - javatpoint* (no date) [www.javatpoint.com](http://www.javatpoint.com). Available at:  
<https://www.javatpoint.com/java-constructor> (Accessed: April 6, 2023).

2. GUI means graphical interface which is what the user sees and can interact with in my program. In my case, the user will be greeted with text screens, buttons and shapes. I used molecules and button classes to display the images and HUD(heads up interface). This was the main purpose of my program as models need a way for the user to see and interact with it for them to be important in classroom use. You can interact with the molecules

which differentiates my program from others on the internet. The client would like to be able to move the molecules as well as clear and make new ones therefore a GUI was needed.

```
void display(float x, float y, float z){
    fill(255);
    lights();
    sphereDetail(10);
    noStroke();
    pushMatrix();
    translate(x, y, z);
    rotateY(PI/2);
    atom = createShape(SPHERE,size);
    atom.setTexture(image);
    shapeMode(CENTER);
    shape(atom,0,0);
    popMatrix();
    fill(0);
}
```

This section of code displays the atom that is part of a molecule and translates it to a certain position. It also sets the texture to the sphere that is the PShape.

*Sphere()* / reference (no date) *Processing*. Available at:

[https://processing.org/reference/sphere\\_.html](https://processing.org/reference/sphere_.html) (Accessed: April 6, 2023).

*Rect()* / reference (no date) *Processing*. Available at:

[https://processing.org/reference/rect\\_.html](https://processing.org/reference/rect_.html) (Accessed: April 6, 2023).

*P3d* (no date) *Processing*. Available at: <https://processing.org/tutorials/p3d> (Accessed: April 6, 2023).

3. Inheritance is the mechanism in which one object can acquire all the properties and behaviors of a parent object. It represents the IS-A relationship and there can be many child classes to one superclass. I used this in my program as I realized that all the molecules needed to have certain properties and instead of rewriting the class for each molecule, I set up a superclass with the method and wrote it so that only the parameters would define what happens to the molecule. I used it as this makes the program run with less resources as code is not repeated unnecessarily so the client can have an easier time running it on his

computer.

```
class Molecule {
    float x1, y1, speedX, speedY, rotation;
    float speed = 5;

    Molecule(){
    }

    void moveCenter(float startX, float startY, float targetX, float targetY){
        x1 = startX;
        y1 = startY;
        location = new PVector(x1, y1);
        target = new PVector(targetX, targetY);
        rotation = atan2(location.y - target.y, location.x - target.x) / PI * 180 + random(-2, 2);
        speedX = cos(rotation/180*PI)*speed;
        speedY = sin(rotation/180*PI)*speed;
        if(PVector.dist(location, target) >= 10){
            x1 = location.x - speedX;
            y1 = location.y - speedY;
        }
    }
}
```

This section of code makes it so each molecule can find the other molecule that is placed and start moving toward it like in an animation. This is repeated throughout all the molecules as they all need the ability to move toward the target locations

*Super / Reference* (no date) *Processing*. Available at:

<https://processing.org/reference/super.html> (Accessed: April 6, 2023).

4. ArrayLists are a collection of items that can be accessed and are not static. This was important to the clients needs as molecules could be added dynamically and removed without exiting the program. This means that any combination of the molecules can be placed on the screen and removed when needed.

```
ArrayList<H2O> water = new ArrayList<H2O>();
ArrayList<CH4> methane = new ArrayList<CH4>();
ArrayList<NH3> ammonia = new ArrayList<NH3>();
ArrayList<C3H6O> acetone = new ArrayList<C3H6O>();
```

This section of code is the instantiation of the arraylists and their names as well as what they will contain.

(2023) *ArrayList (Java Platform SE 8)*. Available at:

<https://docs.oracle.com/javase/8/docs/api/java/util/ArrayList.html> (Accessed: April 6, 2023).

5. Libraries are extremely useful mechanisms for programmers as they allow the use of a library's pre-programmed methods and saves the programmer time. In my solution, I used a processing library called Peasycam. This was a library that allowed the use of a camera and simplified many of the control methods as well as had in-built GUI methods. This would suit the client's needs as he wanted to be able to look around the molecule to explain to the students how they formed in 3-D.

```
if (methane.size() == 1 && acetone.size() == 1) {  
  CH4 m1 = methane.get(0);  
  C3H6O c1 = acetone.get(0);  
  m1.moveCenter(c1.x, c1.y, m1.x, m1.y+500);  
  c1.x = m1.x1;  
  c1.y = m1.y1;  
  cam.beginHUD();  
  fill(255);  
  textSize(30);  
  text("There is a dipole induced bond between the Oxygen and Hydrogen as methane becomes a dipole due to the acetone", width-200, 0+150, 400, 300);  
  cam.endHUD();  
}
```

This section of code displays the inbuilt HUD methods that made the creation of many of the text boxes and buttons easier.

Feinberg, J. (no date) *Peasycam V302*, *peasycam*. Available at:  
<https://mrfeinberg.com/peasycam/> (Accessed: April 6, 2023).

6. An enhanced for loop is also called a for each loop. This means that for each of an object, it will loop through a collection. This was important to my program as with my arraylists of objects, I needed a way to loop through them and get the methods. This is important to the client as this allows the molecules to be displayed correctly and accurately on the screen.

```
for (C3H6O acetonepart : acetone) {  
  acetonepart.display();  
}
```

This was a simple loop that I created to display every molecule that was in the collection so whenever one was added, it would display onto the screen.

Word count: 845