**First Proposal**

**Step one**

1. What is the title of your investigation?

Effect of volume on the sinking speed of sphere.

1. What is your research question? Remember your research question should state clearly your Independent and dependent variable.

How does the volume of a sphere affect its sinking speed in liquid?

1. What is your hypothesis?

As the volume of the sphere increases, the sinking speed increases.

1. Make a list with you independent, dependent and controlled variables, and describe how you are going to measure them.

Independent variables: the volume of the sphere

Dependent variable: the speed at which the sphere falls

Controlled variables: the viscosity of the liquid, the density of the sphere, the distance the sphere travels, the temperature of the water, the initial velocity of the sphere, the air pressure.

Volume: the sphere will be made from Blu tack, the volume will be calculated by the method of displacement.

The sinking speed (average speed): a measuring cylinder will be filled with water, and the sphere will be released under water at a certain height. The speed can be calculated by the formula v=s/t, where s is the distance the sphere travels and t is the time taken.

Alternatively, a video will also be taken in case of inaccurate measurement. Also, the video can be analyzed in Tracker afterwards if possible.

**Step two**

1. **What are the materials you will need? Is there any material you cannot get by yourself?**

Blu tack, balance, water, measuring cylinder (as tall as possible), timer, camera (phone)

1. **What challenges are you expecting to face? What are you going to do to overcome them?**

It will be hard to make a sphere out of Blu Tack, as well as measure the radius of it to calculate the volume and keep the density constant. Alternatively, I am going to weigh the Blu Tack I am going to use first, and then measure the volume of the sphere by the method of displacement. The density can then be calculated also.

Second, it will be hard for me to measure the time it takes accurately because of reaction time. To deal with that, I plan to take a video while doing the experiment, so that I can analyze it afterwards also.

Third, the difference in average speed might not be significant. To solve this, I have several ways: I can add some liquid that has higher density than water, and make the density of the liquid as close as that of the sphere (but can not exceed the density of the sphere), so that the speed will be slower and thus larger difference; also I can use a measuring cylinder as tall as possible so the speed difference can be enlarged; finally I can also make the difference of volume between spheres larger, so the difference of speed will also get larger.

1. **What precision are you expecting for your raw (measured) data? How many significant figures will it have? What will be the uncertainty?**

It will not be very precise, but the precision should be enough for a convincing conclusion;

For the volume, the data should have at least two sig figs, and the uncertainty will be random; for the time and distance travelled, the data collected should both have three sig figs, and the uncertainty might come from random errors as well as reaction time since I have to time it.

1. **What calculation are you going to do with your raw data? (if any)**

I need to calculate the density of each sphere in order to make sure the density stays the same throughout the experiment.

I also need to calculate the average speed of the sphere, or if possible, the acceleration as well.

Finally, I need to find the relationship between volume and speed.

1. **What will be your final graph? How do you expect it to look like? What will be you trendline (linear, quadratic, ...)?**

The first graph, which is the relationship between volume and speed are expected to be linear;

The second graph, if possible, will describe the relationship between the time and velocity for a single sphere, and that is expected to be almost quadratic.

1. **What sources/references have you consulted so far? Have you been keeping a record and building your bibliography for the assignment?**

None, only class notes.

**Second proposal**

**Step one**

1. What is the title of your investigation?

The relationship between surface tension and viscosity of saline water

1. What is your research question? Remember your research question should state clearly your Independent and dependent variable.

What is the relationship between surface tension and viscosity of saline water?

1. What is your hypothesis?

The two variables of saline’s surface tension increases as the viscosity increases.

1. Make a list with you independent, dependent and controlled variables, and describe how you are going to measure them.

Independent variables: the viscosity of water (by changing the concentration of salt in water)

Dependent variable: the surface tension of water

Controlled variables: the temperature of water, the volume of water, the shape of container

To measure the surface tension of water, I will use a dropper to drop a drop of water on a glass dish, and then compare the diameter of the drops to determine the relative surface tension; to measure the viscosity of water, I would let a sphere falling through the water in a beaker and measure the time it takes each time for the ball to travel a certain distance.

**Step two**

1. What are the materials you will need? Is there any material you cannot get by yourself?
2. What challenges are you expecting to face? What are you going to do to overcome them?
3. What precision are you expecting for your raw (measured) data? How many significant figures will it have? What will be the uncertainty?
4. What calculation are you going to do with your raw data? (if any)
5. What will be your final graph? How do you expect it to look like? What will be you trendline (linear, quadratic,...)?
6. What sources/references have you consulted so far? Have you been keeping a record and building your bibliography for the assignment?

~~The effect of viscosity on the pitch of a glass~~

~~1. What is the title of your investigation?~~

~~The effect of liquid’s viscosity on the its resonance frequency~~

~~2. What is your research question? Remember your research question should state clearly your Independent and dependent variable.~~

~~How can the viscosity of a liquid affect its resonance frequency in a glass?~~

~~3. What is your hypothesis?~~

~~the resonance frequency decreases as the viscosity of the liquid increases.~~

~~4. Make a list with you independent, dependent and controlled variables, and describe how you are going to measure them.~~

~~Independent variables: the viscosity of water (by changing the concentration of salt in water)~~

~~Dependent variable: the resonance frequency of the glass~~

~~Controlled variables: the temperature of water, the mass of water, the shape of container, the way of hitting the glass to create the resonance~~

~~To measure the viscosity, I will let a ball fall through a certain distance in the liquid and determine the relative velocity by comparing the time it takes for the ball in different liquids; also, a pitch detector on my phone will be used to measure the resonance frequency.~~