

Fish Tank Design Portfolio



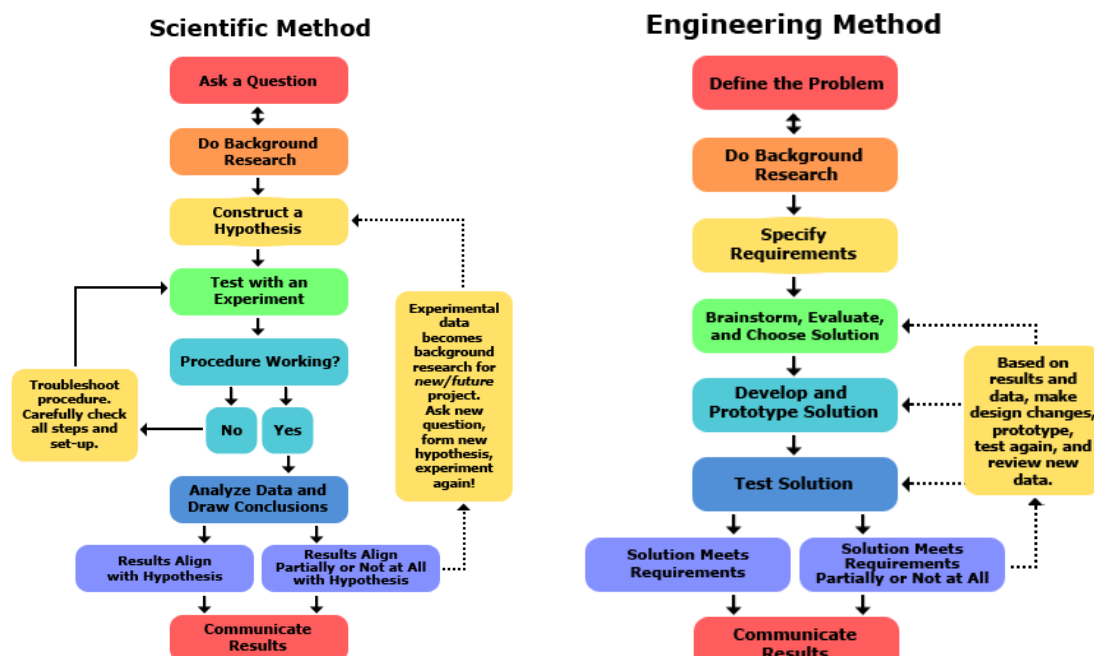
Comparing the scientific method and the Engineering Design Process:

Scientists and engineers use 2 different processes called the scientific method and the engineering design process.

The scientific method is used primarily by scientist but can also be used by engineers in some instances. The scientific method is used to make testable explanations and predictions in science. The steps of the scientific method go as follows: asking a question, doing background research, creating a hypothesis, designing experiments, analysing results and drawing conclusions, and communicating results.

The engineering design process is a bit different and used by mostly engineers but also some scientists like computer scientists. The engineering design process helps to create solutions to problems. The engineering design process is done by defining the problem, doing background research, specifying requirements, creating solutions and determining the best one, building a prototype, testing and redesigning the model, and communicating results.

The scientific method is similar to the engineering design process in some ways such as both methods having to do background research and also communicating results, however the scientific method is more on developing scientific concepts whereas the engineering design process is on creating/inventing the physical aspect.



Pictures: ("Comparing the Engineering Design Process and the Scientific Method", 2017)

Zebrafish in research background:

Zebrafish (*Danio rerio*) are small tropical freshwater fish which belongs to the minnow family (Cyprinidae). Zebrafish are prominent in the aquarium trade and are now also being used as an animal model for research. The natural habitat of zebrafish is in slow-moving streams and rivers, ponds, and also rice paddies India and Burma.

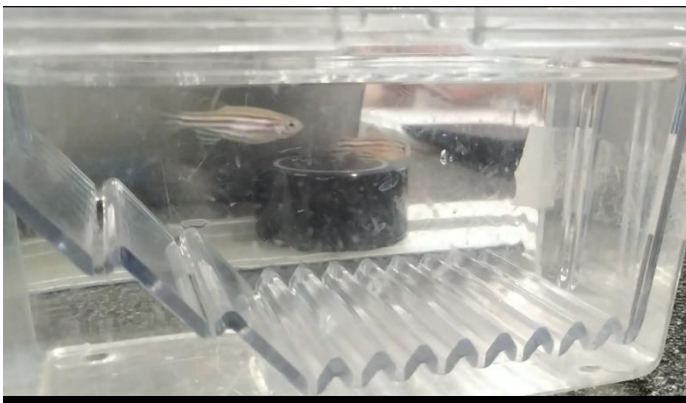
The behaviour of zebrafish during breeding starts of by the female and male chasing each other. This is done because the female must determine whether the male is suitable to be the mate by testing his speed and agility in swimming. After the female has decided that the male is an appropriate mate, they will begin to breed when the lights come on (imitating dawn) as the light triggers their breeding.

Zebrafish are used in research to help investigate the genetic cause of human diseases. There are many benefits for using zebrafish in research for human diseases. Although zebrafish and humans appear to be extremely different, 70% of human genes are found in zebrafish ("Why use the zebrafish in research?", 2014). 84% of genes associated with human diseases also have a zebrafish counterpart (Burke, 2016). This makes it easy to research most human diseases as they can also be found in zebrafish. There are many more benefits that makes them good animal models such as cheap price, fast reproduction, small size, external embryos, and same major organs as humans. Zebrafish are used by many science researchers around the world including in Monash University.



Zebrafish breeding tanks:

Currently, Monash University is using these breeding tanks to breed zebrafish.



Approximate tank dimensions: 14cm(L) x 9cm(W) x 7cm(H)

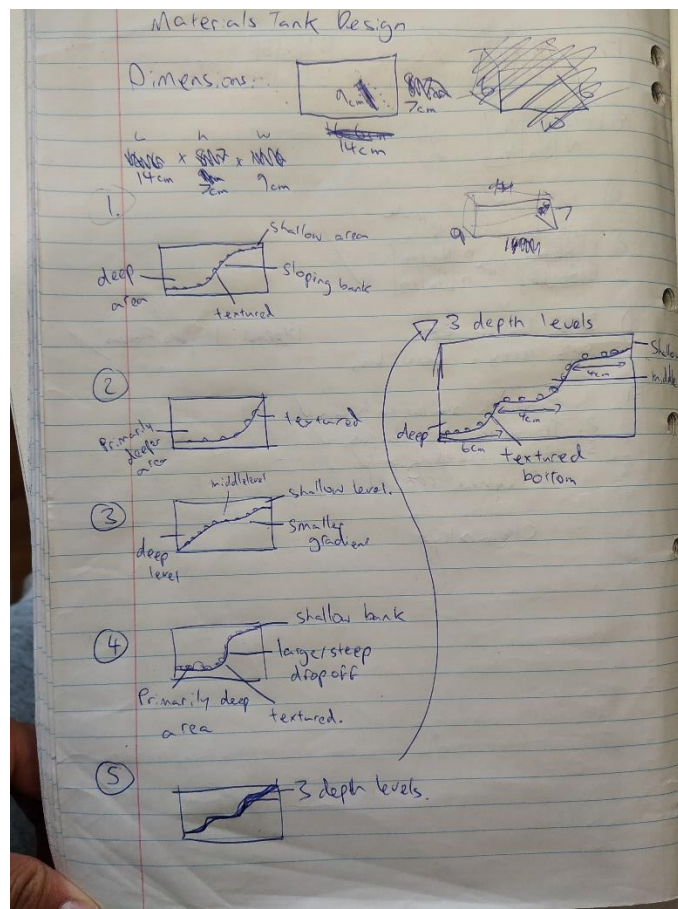
These tanks work by having an insert placed in the tank which separates the adult zebrafish from the eggs when they are laid. There are small holes/slits in the insert which allows the eggs to fall through and down into the bottom of the tank. This is so the parents don't eat their eggs. There is also a slope on one side of the tank insert, this is used to imitate their natural habitat and have an area where the zebrafish can corner each other to breed. The tanks are also transparent to help light go through to trigger breeding as well as to make observation easy.

The Problem we are aiming to solve:

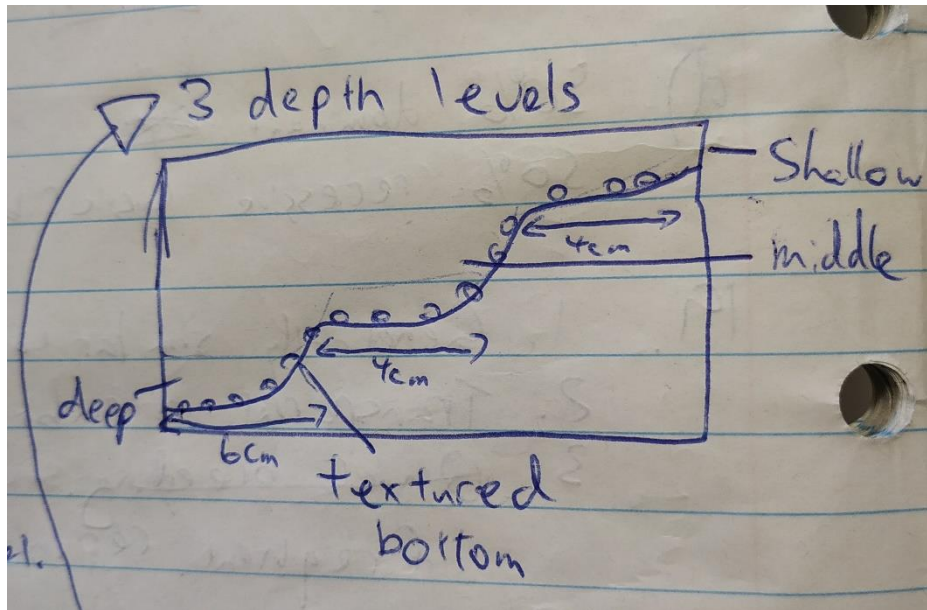
At the moment, researchers at Monash University wants to change their old breeding tanks to a new and updated design. There is actually a commercial breeding tank out in the market that is optimal for zebrafish breeding however it is too large for the needs of Monash University researchers. What the researchers want in their new and updated breeding tanks is to have breeding tanks that have a higher breeding rate from the zebrafish, as well as being in a smaller tank. They need this because their current tanks are not having that good breeding success and the commercial tanks that are available comes in a size that is too big.

Initial design:

Hand drawn sketches of the new breeding tank design ideas:



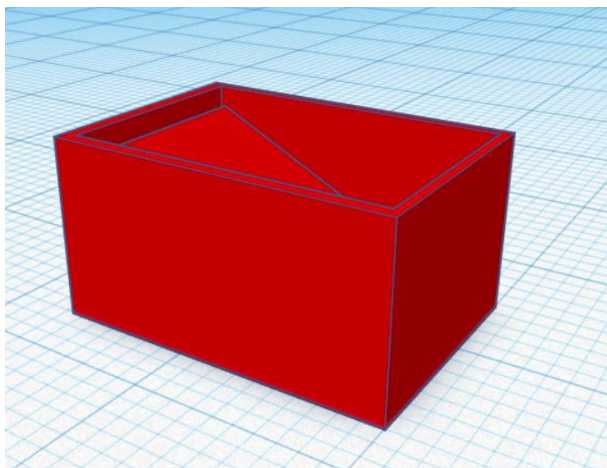
The design that was settled on was design 5.



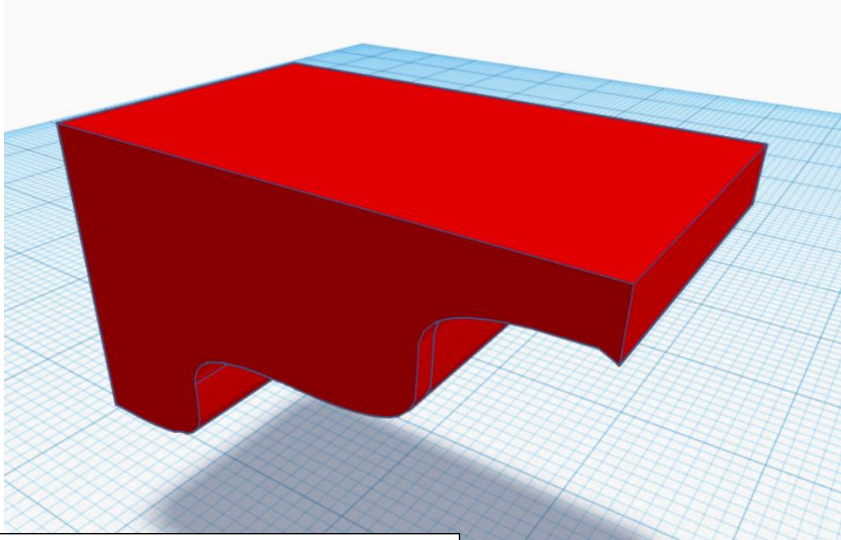
There are quite a few changes that has been made to the breeding tank. In this 3-depth level design, there are 2 slopes, resulting in three different depths; deep, middle, and shallow. Having three different depth levels will help to imitate the zebrafish's natural habitat more as in the wild the water depth levels are not consistent. This is different from the original breeding tank as the original breeding tank is flat most of the way and then there is a steep slope which does imitate their natural habitat very well. Having 3 depths/ 2 slopes also makes the gradient of the rise in depth not as steep as the original breeding tank. This also helps to imitate their natural habitat. Another change that has been made to the breeding tank design is that the bottom of the insert would now have texture. This texture is in the form of small balls embedded in the insert bottom. The textured bottom would help the zebrafish to be more comfortable in the tank they can rub their bodies along it which gives them a sense of security. It would also imitate the natural rocks, pebbles, and other debris that is found in their natural habitat. This is better than the original habitat which does not have any texture on the bottom which could make the zebrafish stressed as it is very artificial to them and not what they would experience in the wild.

CAD Design:

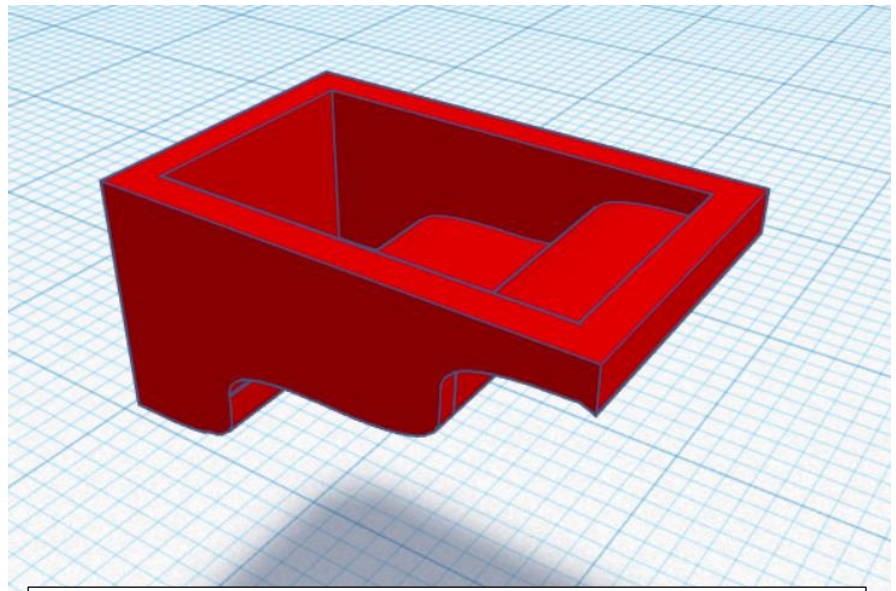
This is the design process that the tanks went through as it was being created on tinker cad.



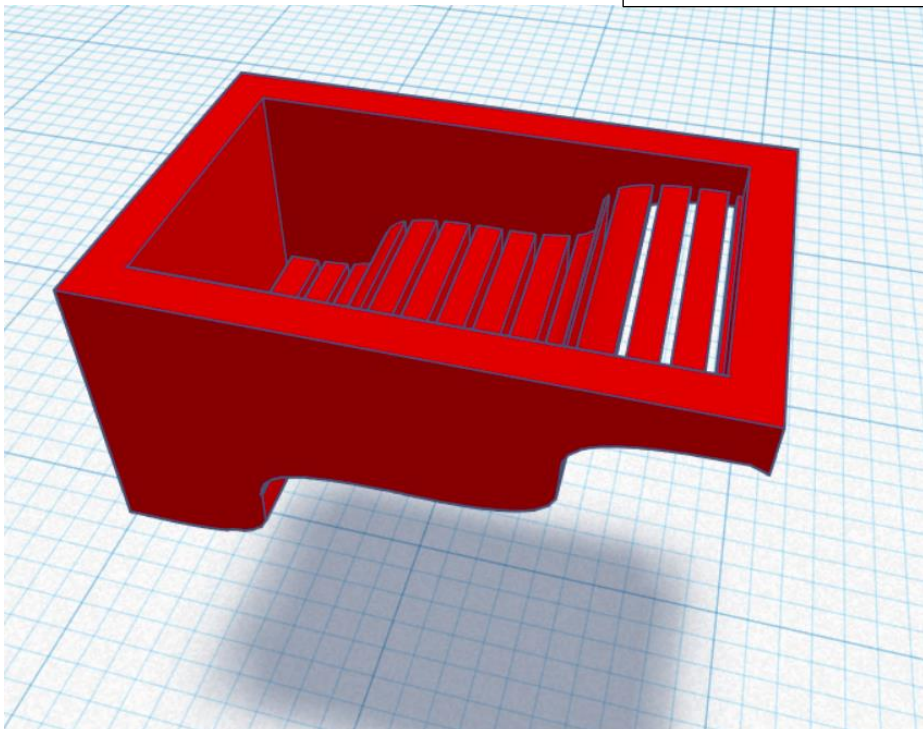
I started off with this design when I first started to play around with CAD designs. This is the design that was given feedback on.



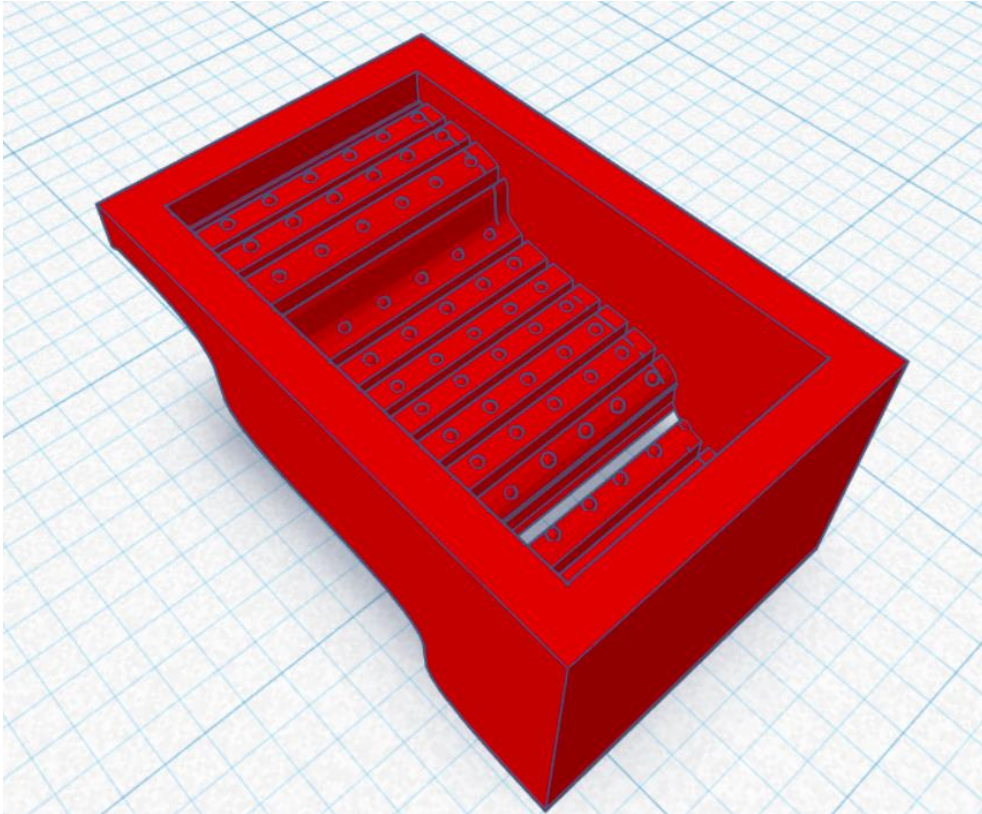
Made the shape of the fish tank insert



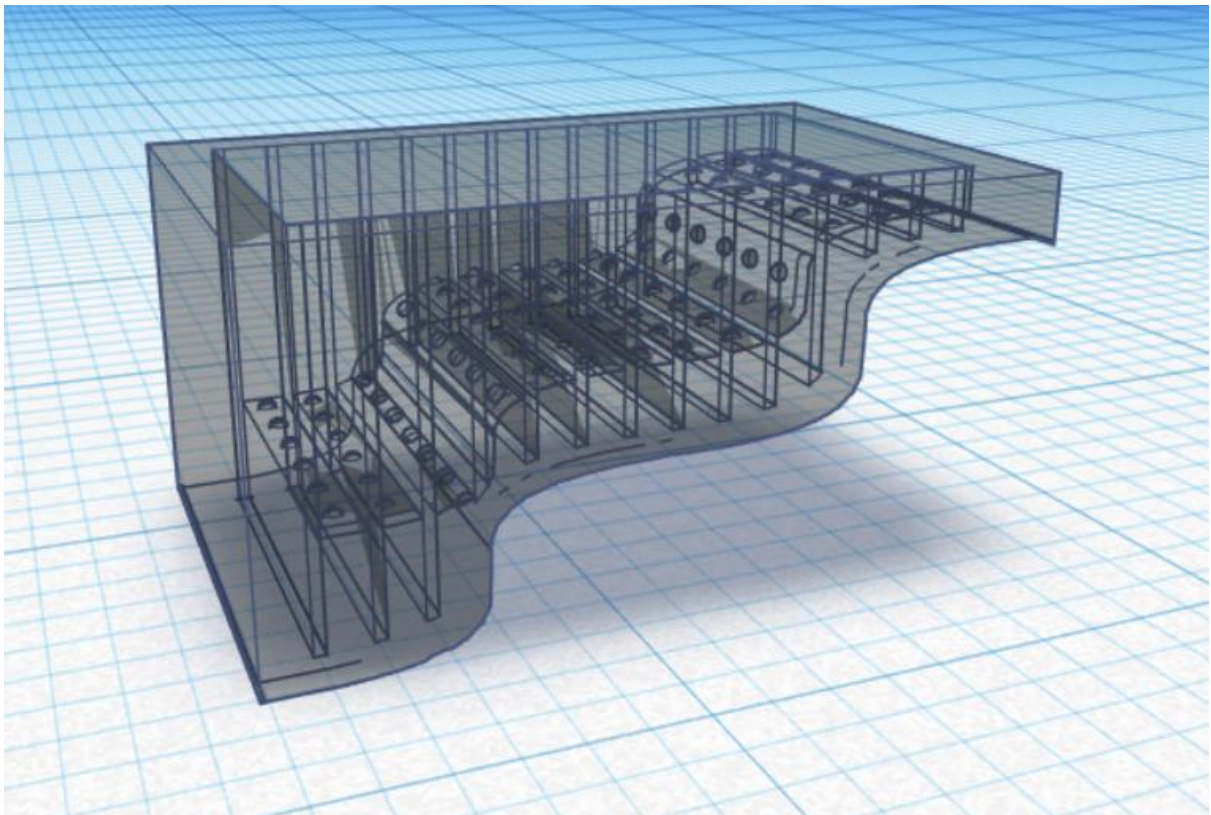
Removed the inner portion.



Added slots in the bottom for eggs to fall through



Bumps were added as texture for the floor. This is to imitate the Zebrafish's Natural habitat



Finalized tank design. It has been made transparent for easy visualization.

Improving the design:

A peer critique session was done in class to improve each other's tanks. The stage in which the tank was in when this critique session happened was the very first stage (first picture). This is because there were difficulties making the curves using tinker cad that was later solved with help from Andrew.

The reviewers in this group were Jimmy, Andrew, and Dasindu.

Reviewer Questions	Response
<i>Am I going to finish</i>	<i>I am going to try and finish on time</i>
<i>Are the bumps on the floor going to be symmetrical</i>	<i>Yes, because the fish would not notice that they are symmetrical.</i>
<i>Would it be holes or slots</i>	<i>Slots as it would allow more eggs to fall through and save material.</i>
<i>Why did I choose that design</i>	<i>Because in Nature there are different depth levels and I am trying to imitate that here.</i>
<i>How steep are the slopes going to be</i>	<i>Not that steep because there are 3 levels</i>

Feedback	Response to feedback:
Round off edges	I will round of all sharp edges, however I think the edges of the box will not have to be rounded off as it does not pose a threat to the fish.
Get rid of the gap	The gap has been fixed, it was a mistake that I had not noticed.
Make the floor go with the curves	The floor has now been fixed to go with the curves.
Make it transparent	This has been done so it can be visualized better.
Add holes or slots	Slots have been added for the fish eggs to fall through.

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Materials Science and Engineering: Fish Tank Design Portfolio

After receiving the feedback, I had some help from Andrew to make the curves of the base of the insert. Then I did everything else whilst paying close attention to the feedback. The gap had been fixed and the floor had been made to go with the curves. It was also made transparent during various stages of the design process in order to better visualize the tank. Slots were chosen over holes as it would allow more eggs to fall through and use less materials.

References:

Source 1 - Science Buddies. (2017, August 09). Comparing the Engineering Design Process and the Scientific Method. Retrieved April 27, 2019, from <https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-compare-scientific-method>

Source 2 - Why use the zebrafish in research? (2014, November 17). Retrieved April 27, 2019, from <https://www.yourgenome.org/facts/why-use-the-zebrafish-in-research>

Source 3 – Burke, E. (2016, October 14). Why Use Zebrafish to Study Human Diseases? Retrieved April 27, 2019, from <https://irp.nih.gov/blog/post/2016/08/why-use-zebrafish-to-study-human-diseases>

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