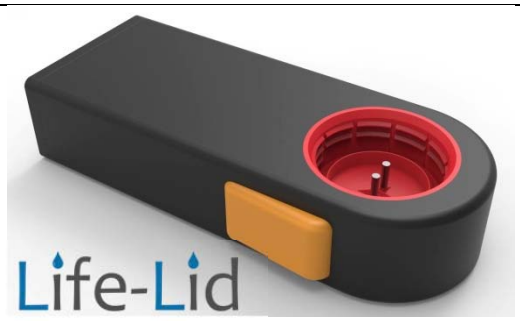
Project:	***Life Lid***	
Project Team:	*Tara Hennessy, Stephen Dingley, Tim Pugh, Alex Service*	
Contact:	*Tara Hennessy*	

Abstract: *please insert a short (250 word) abstract which explains your concept and how you would envisage it being implemented.*

Life Lid is a pocket sized device which produces chlorine from salt and water. The device has a bottle cap fitting allowing it to easily screw onto any standard bottle. The salt water solution is put into the bottle and when the device is turned on the current starts to turn the solution to chlorine. This chlorine could be used to purify drinking water. Life-Lid was created with the aim of combating the current water crisis happening in Nepal. Our goal is to provide cleaner drinking water to the Nepalese. Currently 80% of people have access to dirty drinking water. The water sources contain a number of contaminants that are causing life threatening illnesses to the Nepalese whom consume them. 44,000 children are dying from water borne illnesses every year.

How does it work?

The user dissolves 3g of salt in 20ml of water in a bottle and screws the Life Lid on. The bottle is then placed with the Life Lid on the bottom and turned on for 2 minutes. After 2 minutes the chlorine is made. The user then puts the chlorine solution into 2 litres of water the solution. After 30 minutes all harmful bacteria is killed and the water is safe to drink.

What's the science behind it?

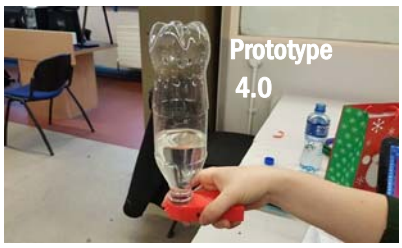
Life-Lid uses electrolysis to convert the salt water solution into Chlorine. Electricity (9V) is sent through an anode and a cathode (Graphite Probes). The electric current separates the elements of sodium chloride and H2O allowing them to collect as a new compound of sodium hypochlorite.

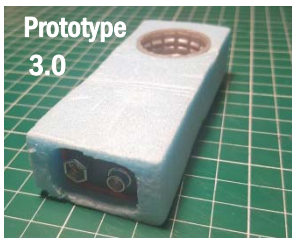
Program Theme: *Please select the program theme under which your project / concept is being submitted by placing an "X" in the appropriate column. (note you can select more than one thematic area)*

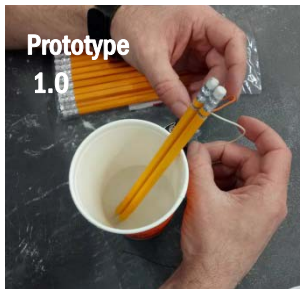
13. Climate Resilient Infrastructure	
14. Self Supply Water and Sanitation	**X**
15. Community Participatory Health	
16. On and Off (Micro) Grid Energy Systems	
17. Food Security	
18. Applying Big Data in the Community	

In the following sections you are asked to provide a concise description of your concept and how it would work in practice (Maximum 5 pages). You can insert tables, graphs, photos, drawings to illustrate your concept as appropriate.

Life-Lid

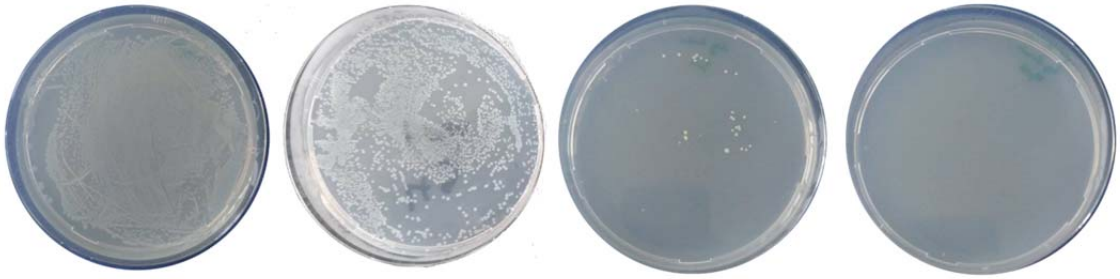




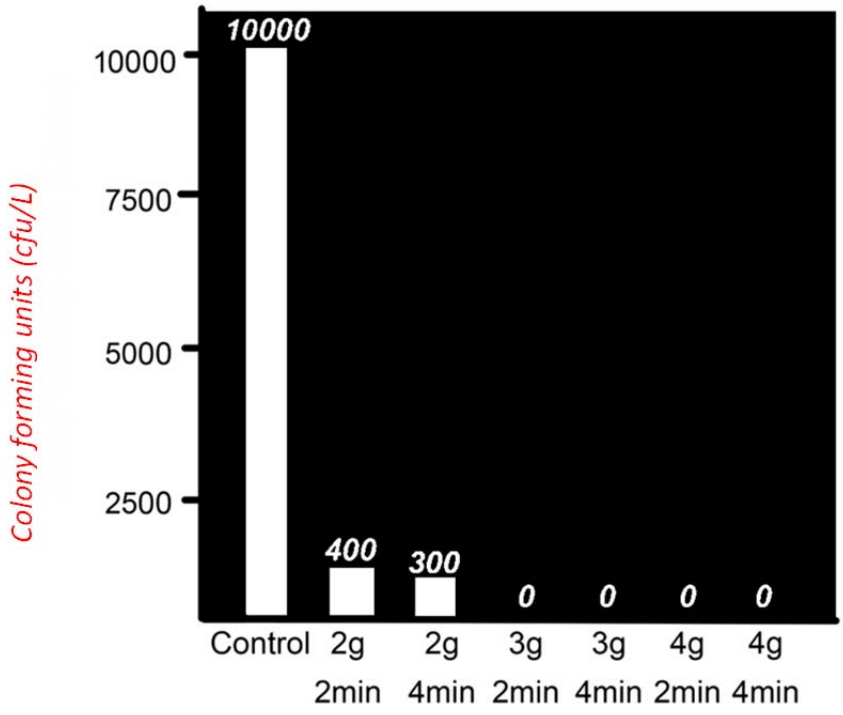


An initial prototype 1.0 was made to test the process; once the experiment was complete we tested to see if chlorine was present. The results show a very high concentration of chlorine, too high for consumption. After these results it was decided to construct a better prototype for testing, prototype 2.0. It was made minimally using whatever would suffice. We used a 7up bottle and cap before it was blow moulded, two HB pencils, a 9V battery and some basic electronics such as a resistor, an LED and a switch. Now a model was made, scientific calculations could be achieved.

With the help of microbiologist, Julie Ann Naughton in DIT Kevin Street, prototype 2.0 was able to undergo numerous tests on its effectiveness of killing harmful bacteria. Water was spiked with a concentration of Ecoli and pseudomonas, both of which are found in Nepal's ground water. The bacteria were grown on agar dishes at 37 degrees. Chlorine was made in the prototype using different concentration of salt and water and the bacteria were exposed to the solution. Results showed that if solution of 3g grams of salt was dissolved in 20ml of water for 2 minutes, enough chlorine was produced to eliminate 100% of bacteria after just 30 minutes. This was compared to our control which showed 10000 cfu/l when exposed to no chlorine (See results on graph and images) The white spots are colonies of bacteria, on the last dish no white spots can be seen meaning all bacteria has been removed.



Control	4 grams, 1 minute	2 grams, 2 minutes	3 grams, 2 minutes
0% killed	**50% killed**	**90% killed**	**100% killed**



Salt (g) : Time(Min) Concentration

Further testing took place with Anna Reid in DIT Bolton Street's water labs. A chemical called DPD (diethyl paraphenylene diamine) was added to a sample of Life-Lid's Chlorine and inserted into a spectrophotometer to read the amount of free and total chlorine present. 2.5mg/l of total chlorine needs to be added to the contaminated water in order to kill all micro-organisms. 2.0mg/l to kill bugs presence and 0.5mg/l of free chlorine to kill any future contamination. Our sample contained 2.14mg of total chlorine and 1.93mg of free chlorine when added to 2 litres of water. This is enough to kill all bacteria and abides by EPA's drinking water regulations of 4mg/l.

Now the development of prototype 3.0 began, this prototype was made with high density blue foam and was primarily used as a guide for our 3D printed prototype, prototype 4.0. The foam model allowed us to see sized dimensions the housing had to be to fit all components inside. Once these numbers were achieved prototype 4.0 was constructed.

Prototype 4.0 housing was built on a computer using solid works and printed using the uni-maker 3D printer in DIT Bolton street. All the electronic components were then carefully housed inside the device.

There are only a few basic parts inside the device to make it function. For the electrolysis reaction to happen there

needs be an anode and a cathode. For this, we are using a 9V battery (Anode) and two graphite probes (Cathode). Components used in electrolysis, undergo an electrochemical reaction that causes corrosion, this means that components decay, and need to be replaced over time. To combat decay, a lesser quality material (sacrificial Anode) is used to protect more important parts (Cathode) from decay. In our device, the 9V battery will be the sacrificial Anode, leaving the graphite probes safe from decay, so they will not need replacing.

For user feedback, an 18mA LED light has been added to show that the device is active. This is connected between the graphite probes along with a 10kΩ Resister to prevent it from burning out with the higher voltage from the 9V battery. A switch has also been added to toggle the power on/off.

The lifespan of the battery, using the recommended two minute operation time can be used 750 to 840 times before needing to be changed.

In the coming months we hope to develop our concept even further. In prototype 5.0 we plan to add a 3g salt measure and to eliminate the LED light. The device would last 24 times as long with no LED and also reduces the cost of manufacture. Another water issue in Nepal is the arsenic which is found in water in the Terai region in particular. According to Patrick Cox of Geo Life, iron oxide or common rust has the ability to remove arsenic from water through adsorption. In future development we are looking at incorporating iron nails into our design to reduce arsenic levels in the water. (COX, Patrick, 2008)

In terms of how it would be used in Nepal, Life Lid could be used amongst a family or even two families to purify their water. The family would have to source, a plastic bottle for making the chlorine in, some salt, and water. Once these resources are gathered they can begin purifying the water. (See images below)

Objective (What you are planning to do):

Describe your overall idea / concept and approach. Identify the alternative options considered during the design process and a justification for the selected technology, approach and/or process.

b) *Describe your overall idea / concept and approach*

Our overall idea centered around making the people of nepal more independent and to try produce a product in which people would be able to make their own clean drinking water. We kept independence at the heart of our design journey so we always had the single family in mind when designing the product. We wanted to produce a product or system which could produce a minimum of 8.8 litres of clean drinking water a day providing enough clean drinking water for a minimum of a family of four. We wanted to ensure the ease of use so people who have spent their lives with minimum techonology would be able to use our product with ease, we wanted to make peoples lives easier not harder. We wanted to if possible use materials which could be sourced locally to minimise costs and to make sure as many people as possible would be able to have the benefit of using our product.

So LifeLid is using very simple techonology, such as using a normal 9 V battery and grafitie probes which can be found in the standard pencil and an on and off button. The process is kept extremely simple to try and minimise the risks of failure. The product will be shipped ready to use as it is very small this will keep the price low to both product and to transport. The battery will be the heaviest part and this can be either provided or sourced locally, this is something in which we will research as the project moves forward.

The user will collect water from the locality , this water is usually dirty containing bacteria and other micro organisims which can cause harm to humans. The user will pour 20 mls of the water into a standard coca cola bottle (or similar) and use the small grove in LIfeLid to measure 3g of salt and make a solution with these two. The bottle will be connected into the product and turned upside down so the probes are submerged within the solution. The user will then turn on lifeLid and count for 120 seconds. In this time chlorine is forming within the bottle. When 120 seconds has been reached the user can take the solution and pour it into 2 litres of dirty water, wait 30 minutes and then this water is ready for consumption. This process and measurements has been scientifically tested with a number of micro bacterias proving that the water is safe for consumption and meets the WHO standards.

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How it works: b) *Identify the alternative options considered during the design process and a justification for the selected technology, approach and/or process.*

Throughout the process we had many other ideas and brought a few to testing. We began with filters both with and without charcoal. Both of these filters were proven successful as they reduced the turbidity of the water by a large amount but the water was still proven to be dangerous as the filters were not affecting the presence of microbacteria. We wanted to provide a complete solution and filtering systems were already on the market. We would essentially be solving a minor problem with an already distributed solution and this is not our aim as we wanted to solve a problem that the people of Nepal have with an innovative and useful solution. This was when we moved on to work with chlorine and because chlorine is known to clean water we wanted to provide a sustainable, safe and effective way for the people who need it most to have access to it. By using a simple method of production while also having a compact and intuative product LifeLid will make a real difference to the people who really need it.

Background (Why you are doing it): *Key questions to address in this section include the following:*

What problem are you trying to solve?

From our intial research we found that there was a massive water problem within Nepal and we wanted to target that problem as clean water is a basic human right and so many children were falling ill. Throughout Nepal most people collect their own water and this normally comes from the rain or ground water, both of these sources contain infectious micro organisims which can be extremely harmful so through this project we wanted to help small families have an easy but also effective way of collecting clean water.

Is the solution already available (product / service/ knowledge)?

Currently the only solution on the market like the LifeLid is a camping accessory which uses chlorine to clean water in a similar way. This product is targeted at hobbiest campers and costs over 100$ to buy. It uses a more complicated and expensive system to give the same result. LifeLid takes the complication away and provides proven results in the simpliest way possible ensuring that people of all walks of life and of various ages will be able to use the simple process to produce the end product – clean drinking water.

What makes your idea different?

Lifelid is different because from the beginning the end user was always at the center. All of the components for Lifelid are replaceable with very little knowledge needed in electronics as there are very few parts and each part is found in Nepal meaning replacement parts can be found and used. This will allow the user to take complete control of the product meaning they can have control of the availabilty of clean drinking water for them and their families.

Expected Results (who wants them and how will they use them)

Once Lifelid reaches the end user it will be used daily. Each day a member of the family will collect the water which they will need for that day, which is estimated at 8.8 litres for a family of four. They will then use this product to produce enough chlorine to clean their water for the day. This will give the family the independence to survive off the grid. They will use the small 3g indent in the product to measure out the exact amount of salt needed to create enough chlorine which will be needed to clean 2L of water, these measurements can be multiplied to treat higher quantities of water. The expected result of the production of Lifelid is the major decrease in water bourne illness in the people of Nepal and will decrease the illness and death rate across the country. Lifelid will be used by families ensuring enough clean water is available for all.

Lifelid is ready for market. Our team currently has a fully functioning prototype of our study and a longlasting product. All the components which will need to be replaced in years to come have been designed for ease of maintanance. Our prototype has been scientifically tested and shows to be fully working, killing all bacteria within an extreme case of micro organisim infestation. Full Computer Aided Design models and drawings have been created. Lifelid with the help of Where There is No Engineer can be in the hands of the end user, the people who really need it before the end of the year. Our prototype has been 3D printed, this would not be the most effective production method for the increased quantities. With investment from the programe Lifelid will be injection molded from moulds which will be created from the current CAD 3D model which we have.

To ensure that the product solves the problem, which we know it can in the most effective way, we need to source the batteries more locally which will ensure smaller shipping costs as well as creating both the packaging and instructions which will accompany the product with the help someone who speaks napli to ensure the end user is not confused.

Although LifeLid will kill all microbacteria which was present during our lab tests for its most effective use the water in the area in which LifeLid will be distributed would be tested to find out what microrganism are found in the local water. This would allow us to ensure that lifelid will be able to kill 100% of the bacteria found. We have carried out all the tests in. Dublin both spiking samples with strong bacteria colonies as well as getting water samples from nepal itself and have found that the LifeLid has been sucessful in cleaning both. However we do realise that the water in different regions vary and for the most sucessful use, each region would be tested.

Community Participation

Outline briefly how you would envisage the community could participate in the various stages of your concept from design through to final implementation.

Our team will hopefully gain insightful feedback on our final design before Lifelid goes into production just to ensure that the final product is something in which the people of Nepal can really use and find extremely helpful. Once into production the explanation of the use of Lifelid can be carried out by the communities in Nepal. We will gain help in sourcing replacement batteries from the commuinties. We would also need the help from the commuinities of Nepal in the distribution of Lifelid. The light nature of the final product lends itself majorly to easy distribution throughout the harsh landscape and tough terrain which is found in Nepal, meaning Lifelid will reach the small communities who live away from the main infrastructure which in reality are they people who will find the most value in the use of the product.