# RECYCLED WARRIORS:

## the role of plastics in society and the environment


## Abstract

Plastics are becoming increasingly ingrained in today's society of overconsumption – and subsequently, the very framework of the natural ecosystems that surround us. What happens to these plastics once they have outlived their use? Plastics, given that they were designed to be durable, do not readily break down; rather, they simply turn into smaller and smaller pieces until they are able to infiltrate the most minute of micro-ecosystems, then spread and bio-magnify as they make their way up the food chain. Moreover, they enable the mindset of consumerism, and allow for the privatization of water and the ensuing social justice issues that intertwine with the ecological impacts of plastics. Through this project, I hope to highlight these issues in a way that illuminates the intrinsic connections between humankind and the environment, contextualizing the nuances of plastics and how they impact both the planet and humankind.


## Project Objective

To create a wearable suit of armor entirely out of recycled plastics to bring attention to the abundance of plastics in our environment and the subsequent issues that arise, while also recognizing those who fight every day for environmental justice and sustainability.

## Key Concepts

***Environmental Degradation***

Because of normalized over-consumption of plastic materials, waterways are polluted (both by plastic objects and by the chemicals that leech out of them), marine life is decimated, and massive synthetic 'islands' of plastics congregate in the ocean, turning into an unmanageable mush of micro-plastics. Impacts on marine and human health are also a key concern with chemical leeching of plastics.

***Drawbacks of recycling and fossil fuel dependence***

Recycling is often used as a crutch; a way of validating the use of plastics because you can simply recycle it. However, recycling takes added energy, and produces objects of reduced value and chemical stability. In the end, the plastic bottle will someday just be another piece of trash.

***Water as a basic human right***

Water is a luxury that not all are given access to. Privatization of water and the commodifying of it as a bottled drink is only made possible through the use of its patent plastic container. Large corporations enter areas, drain (or significantly reduce) reservoirs at no cost to themselves, and sell the water for a profit.

## Materials and Processes

Plastic bottles - estimated lifespan: over 400 years

Plastic bags - 500 billion consumed world-wide ***each year***

Straws - Americans use 500 million straws per day

Processes Utilized: riveting/joining with straws, making rope out of braided plastic bags, heat-forming plastic bottles

# Recycled Warriors

*Lainey Everly*


## Total Materials Used:

Approx. 20 straws
Approx. 300 plastic bags
20 Powerade bottles
21 Gatorade bottles
2 other soft drink bottles
8 bottle caps

## Objective:

*To create a suit of armor made entirely out of recycled plastics in order to draw attention to the social and environmental implications of plastic, while also recognizing those who fight every day for environmental justice. Art is a catalyst for social change.*

"Every year, more than 500 billion plastic bags are discarded worldwide; they wave from tree branches so abundantly that South Africans have dubbed them their "national flower," and no fewer than six countries have enacted bans. Shredded packaging fouls shorelines and turns up in the stomachs of trout, albatross, and sea turtles (which mistake plastic bags for jellyfish). In the Pacific Ocean, currents feed scraps into a thousand-mile-wide gyre of synthetic jetsam."

## Choosing the material

When working with a material that is difficult to form, it becomes key to base the design of the piece off of the capabilities and properties of said material, and also to choose materials according to what you desire of the design. Depending on what you are able to acquire (types of plastic containers, bottles), your project may look a lot different than originally intended. Look at materials and try to find ways that you can creatively incorporate them. If you are looking for a specific curvature or shape, use this in determining material. If you are limited in your resources – as working with recyclables tends to be – get creative. If you are trying to achieve a flat form, find forms that already take this shape. Gatorade bottle bottoms, for example, can make for an excellent, flat, flexible surface, if you cut out and reattach the flat panels along the middle of the bottle. The key to this first step is experimentation and a very liberal use of creativity. For the rest of this paper, I will share a variety of techniques and tips that I used in completing a suit of armor made entirely out of recycled plastics.

## Forming

Hard plastic is a relatively challenging material to mold predictably. This goes for materials such as plastic drink bottles or other containers of the same material and thickness. Unless you have an exact mold of the desired shape, it will be very difficult to manipulate the material to the right fit. I used a mixture of heat and applied pressure to flatten materials, but had little success with free-forming material to an exact shape. The other thing to remember is that plastic tends to shrink inwards when heated, and will procure odd, warped, irregular pinching and stretching undulations. For a large portion of my armor, I utilized cut-outs from Powerade bottles. These cut out portions are fairly flat, but still have a slight curvature that I needed to minimize as much as possible. For this process, I used a metal block which I pressed down on top of the individual cut-out pieces. While still applying pressure, I used a

heat gun and rotated it around the piece, still pressed underneath the block. I continued this until the gap between the block and the table surface was relatively minimal, indicating that the piece had been flattened adequately. When doing this, take care to not direct the heat gun at you hand, and be equally wary when picking up the newly formed material, which may still be very hot. These things should not burn you with brief exposure, but caution is always in your best interest.

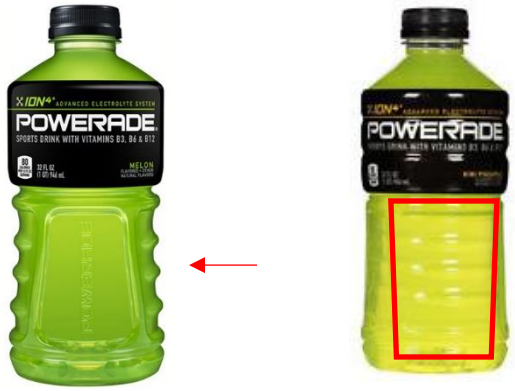



Image 001

Cut out the ribbed section, as outlined in ***Image 001***.

Then, flatten and apply pressure while evenly heating, as demonstrated below in ***Image 002-005.***


Image 002

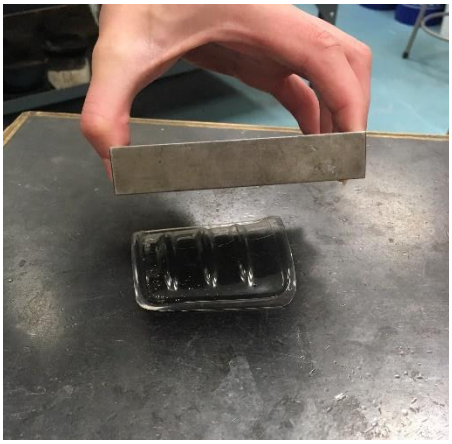


Image 003


Image 004

Image 005

This process may be repeated with bottle-bases (and works best with soft drink bottles similar to the one given in the visual example of ***Image 006-008***.

^ Image 006

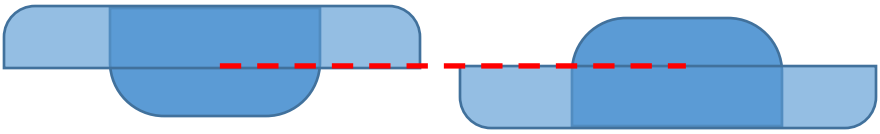
< Image 007

Cut the bottom of the bottle off where indicated in ***Image 006***. Apply heat and pressure to the piece (shown in ***Image 007***) and produce the flattened object seen in ***Image 008***.

^ Image 008

## Improvising pieces without additional forming

One surface material that I utilized in its original form is the base of bottles. While I also heat-formed some of these (as shown above), other bottle-bases work wonderfully to attach without any additional manipulation. These bottles include Powerade and Gatorade bottles, and are characterized by a flat surface on the bottom, so as to allow for a good connection point. I would simply cut off the bottom of the bottle to the extent where, if you are alternating face down and face up, the cut edges of the bases match up in the middle of the height. For a visual aid, refer below to ***Image 009***.

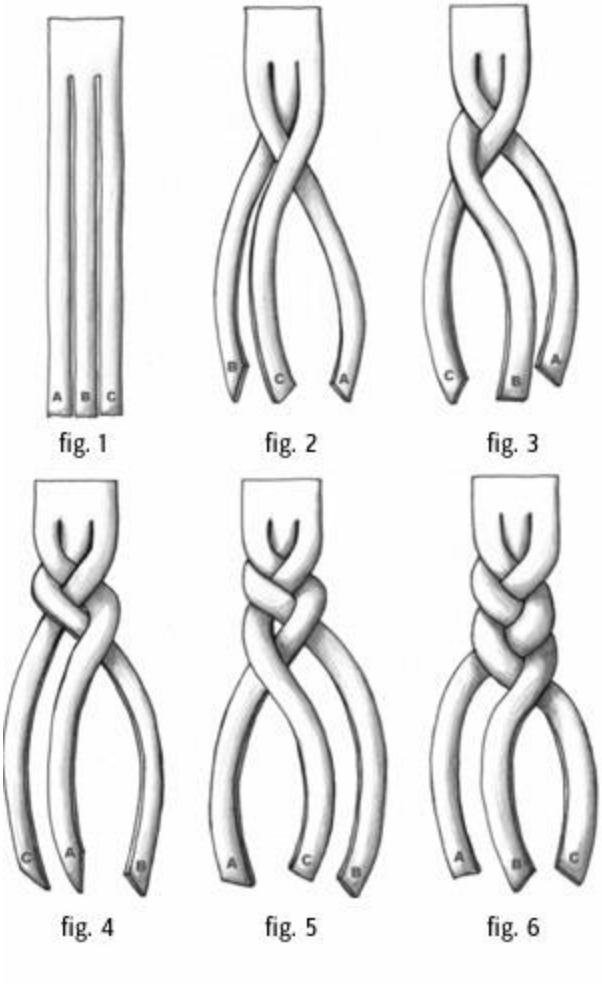


< Image 009

This form allows for the pieces to be attached in a way that is flexible, but sturdy, and does not jut out a significant amount.

## Making plastic bag rope

One of the most basic ways to hold things together is through using some form of cordage; my solution was to braid small strips of plastic bags. The end result of this is a rope that is strong and flexible, and can vary in size depending on the method and size of plastic strips. This processes is one of the more simple and straightforward of those outlined in this paper. Techniques may be altered to produce a variety of rope sizes, but the general principle remains the same. Shown below is a quick visual guide to braiding (***Image 010***).

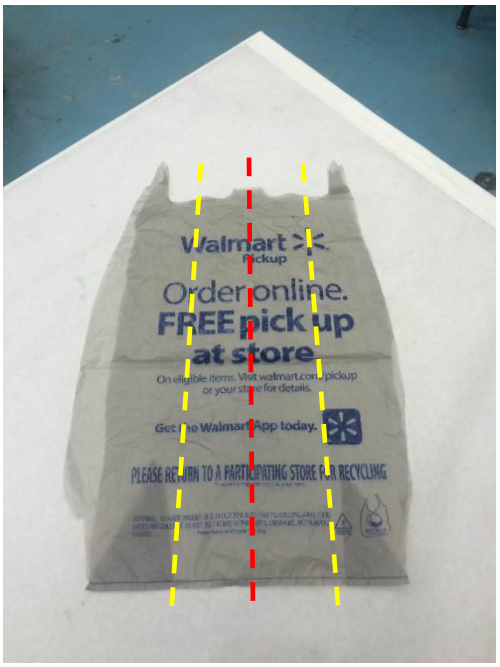



^ Image 011

For my purposes with wanting a standard rope size, I developed a system for cutting the strips and braiding them together. I cut the bags as shown in ***Image 011***, making sure to first gently flatten the bag and smooth it slightly so as to avoid the plastic folding over itself (this leads to jagged-cut strips and has a poor aesthetic effect in the finished product where the rope looks 'frayed'). Cut in the places indicated below in the following order: cut off the handle portions first (save these, as they can be used later for weaving), then cut down the middle line, then down the quarter marks. Once cut, it is a good idea to cut off the overlapping parts of the plastic, located in the center of the strips – the 'seam' of the bag. It is also good to cut off any excess plastic that may be located in this 'seam' area. Once you have your pieces cut, tie a set of three strips together on one end. Find a way to secure the end so that you are able to braid more easily. You can do this in a variety of ways, including tying the end to a secured element, such as a nail in a table, a wire-frame headboard, or a drawer handle – get creative with it! You could also clamp the knot to a table or counter-top and go from there. My personal solution to this problem was to utilize a used gelato container. While this is a very useful container for carrying around finished rope, it can also be used to secure your strips for braiding. Take the end of your bag-strips that are tied together and place it in between the lid and the container as you are screwing the lid on. Make

sure that the strips are secured, then you are free to use your thighs, knees, calves, or feet to hold onto the container as you braid. This is a great on-the-go hack for braiding materials (see ***Image 015*** and ***016***).


< Image 012




< Image 013

Once you have cut the bag handles off, cut on the middle red line, then on the yellow lines to create even strips perfect for a small cord.

< Image 014


^ Image 015

> Image 016

To finish a piece of rope, you can simply tie off your braid with a simple, tight knot. If desired, you can use a hot-knife with an X-acto blade attachment to cut off the knot, and melt the plastic together by repeatedly pressing and rolling the knife against the knot, preventing the braid from coming undone. (See ***Image 017*** below)

^ Image 017

## Riveting

Perhaps my favorite process utilized in this project, riveting with straws opened a whole new window of opportunity for joining plastic pieces. If you are looking for a way to connect materials in a way that allows them to rotate, while simultaneously holding pieces flush together, then this process will be your best bet. This process utilizes used straws to create a tube rivet, not unlike tube rivets standard in metalsmithing. For this, you will need a hot knife with a wide, flat top attachment (one such attachment is pictured in ***Image 018*** and is otherwise known as a transfer point). With the heat set on medium-high, tap the end of the straw with the flat end of the knife attachment. Make sure that you are tapping and not pressing the hot-knife to the straw for an extended period of time, because that will

simply melt and warp the straw. Also, make sure that you are tapping straight down onto the straw, in order to make sure that the rivets are not crooked (unless you need the rivet to angle a certain way.)

Let's take a step back and talk about tools. A lot of these tools and attachments used for riveting plastic can be fabricated or altered by hand. With some types of hot-knives, it is fitted to hold tapped objects. The tool that I used is called the 'Walnut Hollow Creative Versa Tool with Versa-temp variable temperature control' (shown in ***Image 019***). This particular device came with multiple tips, which was helpful for the completion of this project. This tool can be used for a variety of things, including trimming/cutting polyester-based fabrics, wood burning, cutting plastics and foam, and a variety of others. The control dial is helpful, though this can be fabricated using a dimmer dial-board implement.

I used two main tips for riveting, including a flat-topped tip called a transfer point, and a modified stamp point that I filed down to the exact same diameter of the straws that I was working with, so as to make the process go smoother and more efficiently.

^ Image 018

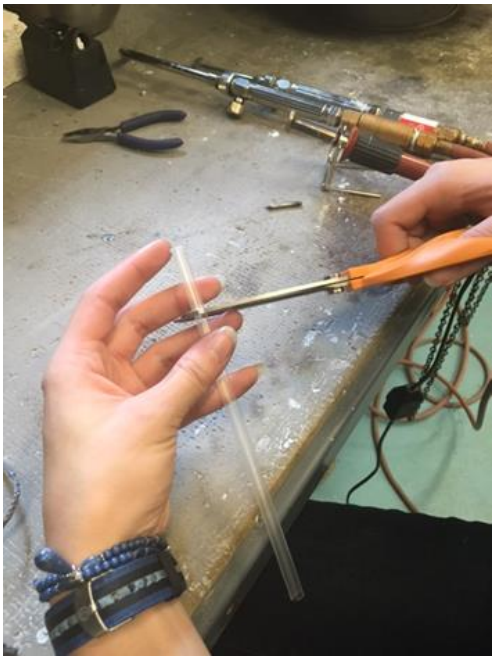
< Image 019

I would suggest, before riveting many pieces together, to pre-make the rivets. You can go about this by using the transfer point to tap down and flatten one end of a straw, then approximate how much of the straw you will need for the other end and cut it there. This part will take experimentation from person to person, as distance between materials may differ, as well as the desired size/shape of the rivet head. Cut off the straw at this point, and repeat the process with the remaining straw. I kept a

bottle of pre-made rivets handy at varying sizes, as I was utilizing different materials and had a need for this variance. Refer to ***Image 020 - 023*** for a visual aid on how to pre-make rivets.

^ Image 020

^ Image 021



^ Image 023: Pre-made rivets

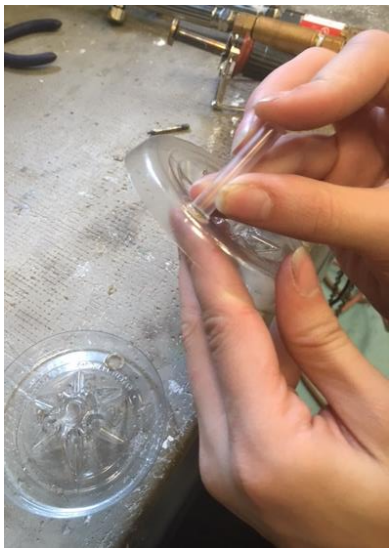
< Image 022

^ Image 024

Using the resized stamp tool/ hot-knife attachment, create a hole where you would like to place a rivet, in each piece that you would like to attach (reference Image 024, 025).

^ Image 025

If you are attaching multiple pieces together, it is in your best interest to create as many holes as possible at a time because otherwise, switching attachments and allowing time for warm-up can take up a lot of time. That being said, make sure that as you are creating holes, you are also inserting the pre-made rivets into the holes as placeholders in order to make sure that all of the pieces remain aligned (***Image 026, 027***). Once this has been done, the stamp attachment can be switched out with the transfer point, and the rivet can be tapped down and completed (***Image 029***). Always remember to allow for cool-down time when you are creating rivets, because if the pieces are pressed down while you are riveting, releasing the pressure while the rivet is still cooling will lead to a warping of the rivet.



^ Image 026

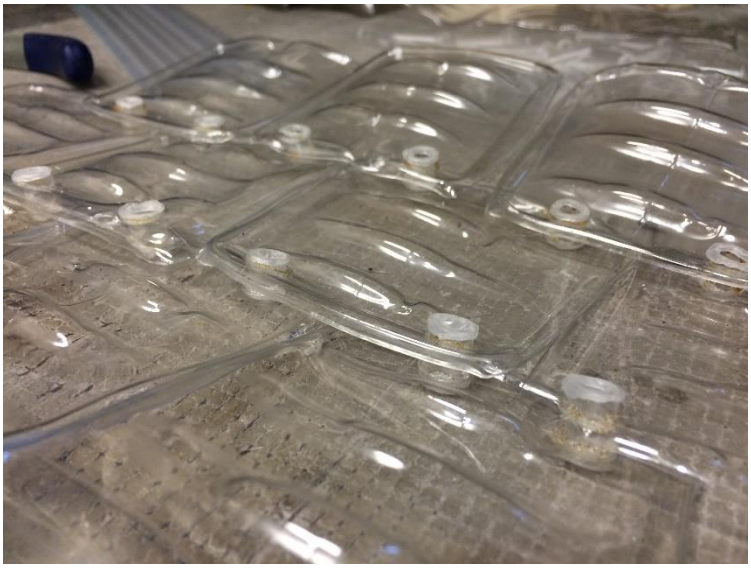
^ Image 027

^ Image 028

^ Image 029

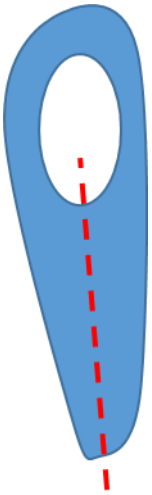
^ Image 030

^ Image 031



< Image 032
This serves as another example of what can be riveted together. It is a detail shot of my back-plate, created by riveting together flattened pieces of Powerade bottles.

## Weaving plastic bags



^ Image 033

This process took the least amount of time and yielded the greatest result for my project. To begin, I collected as many bag handles (leftover from cutting the strips for the braided rope) as I thought I might need for the piece to be 11 inches wide (in my case, this turned out to be 24 handles, however, this number can vary greatly, given how tightly you weave). I threaded a rope through all of the handles, and secured each end to something stable – I just so happened to use some lamps set up in the studio (see ***Image 034***). Next, you need to fabricate the pieces that you will weave in between the handle pieces. To do this, I cut another handle so that it was split in half, but still connected on one end (shown in ***Image 033***). I then tied one end to the braided rope holding the handles You can tie it either to the left or the right of the handles, either way works), then you begin to weave the strip in between each individual handle – I like to think of it as going under and over (see ***Image 035***). When you finish a row, simply wrap the strip around the last handle piece and continue on in the same pattern. If done correctly, It should look something like ***Image 041***.

^ Image 034

^ Image 035

You may find that you quickly run out of weaving material. The simple solution is to tie off (and double knot) the next piece onto the last and cut off excess material. This should look like ***Image 037***.

^ Image 036

^ Image 037

^ Image 038

^ Image 039
Gauntlet created by lacing the sides of the woven sheet together using plastic bag rope.

^ Image 040
Adding finishing touches along the waistline.

^ Image 041

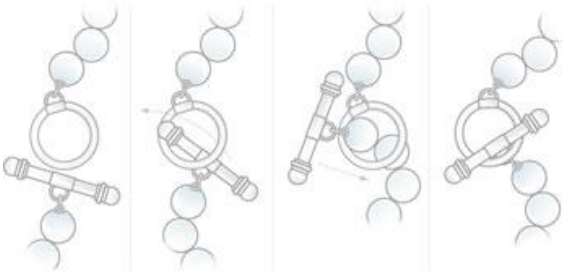
Completed woven panel

^ Image 042

You can get creative when tying off the weaving. In ***Image 042***, you can see that I have tied off the panel by splitting the single strips and tying each one to the neighboring side. I triple-knotted these and heat-treated them so that they would not come undone.

## Creating Clasps/ Connector Pieces

One of the main goals that I had for my project was that I wanted to be able to put on and take off every part of the armor by myself with minimal difficulty. This being the case, I needed to find a way to connect the chest plate and the back plate. My original idea was to lace the pieces together up the sides, but this would take more time to put on and take off, and I didn't want to have just some rope tied off at the bottom – I wanted pieces that would easily come together, with no extra calculating or maneuvering necessary. I then decided to try something akin to a T-clasp, diagramed in ***Image 043.*** The idea would be that you could pull the rope with a hard piece of rectangular-shaped plastic (the 'T' part of the clasp) through a smaller hole in the chest plate or back plate, and when the rectangle-piece was released, it would rest on the outsides of the hole, effectively holding the two plates together.



^ Image 043

For the 'T', I decided it would be best to use a more sturdy plastic than what I had used for the actual armor. I settled on bottle caps, as they were an

adequate size and were sturdy – even when cut down to such a small size. This is not the first time that I utilized bottle caps for this project – I also used a cap to make a rudimentary button to secure the skirt-portion of the armor. For creating the clasp, you simply have to determine the uniform size for your 'T', and cut it out (I simply used scissors). As is shown in the images below (***Image 044, 045***), I first cut off the sides of the cap, then cut the circle in half, leaving adequate space to cut out a small rounded-rectangular shape. 1 bottle cap yields 2 'T's. To create a hole in the center of the T, you can simply use a pointed attachment on a hot knife. This is demonstrated in ***Images 046-048***.

^ Image 044

^ Image 045

^ Image 046

^ Image 047

^ Image 048

All that's left once you have the 'T' part of the clasp is to thread it with rope and cut a hole to size in the piece which you desire to fasten. The rope should be tied off and heat-treated so as to keep it secure. The hole can then be created using the hot-knife. Refer to ***Images 049 – 054***.

^ Image 049

^ Image 050

^ Image 051

^ Image 052

^ Image 053

^ Image 054

## Final Product: