

MYP PERSONAL PROJECT

Creating a Sustainable Jewel from Upcycled E-Waste; an Application of Circular Economy

PLANNING

• Learning Goal

My learning goal is to learn what is the circular economy and then apply its principles by learning how to make a sustainable, gold jewel from upcycled e-waste. To achieve this goal, I will also learn how to extract gold from the discarded technology. My aim is to produce a jewel from previously mined gold that alternatively would have gone to waste, or would have been produced by mined gold, thus saving energy costs and environmental impact. By reusing precious metals from an alternative source, I will give life to the components of the discarded devices and produce an environmental-neutral product.

• Global Context

I chose the global context of “Globalisation and Sustainability” because it is directly related to my learning and product goal¹. In particular, I chose to inquire into the impact of decision-making on humankind and the environment because I will be exploring how the decision of transitioning to a circular economy can contribute to minimise waste and reduce the impact on the environment. Researching the internet on reliable websites, such as the European Parliament and United Nations websites, I learned that the European Commission adopted the new circular economy action plan (CEAP) in March 2020 and it is one of the main building blocks of the European Green Deal, Europe’s new agenda for sustainable growth². Circularity is also a key concept embedded within the United Nations Sustainable Development Goals, as captured in SDG12, which aims to promote resource and energy efficiency in order to reduce economic and environmental costs.³

• Personal Interest

Being born in Milan, the famous fashion capital, has certainly contributed to my passion for the world of fashion.⁴ I am creative and ever since I was a child I enjoyed designing clothes and accessories for my dolls. However, I am aware that today, as fast fashion accelerates, more ends up in a bin. The same happens with discarded technology, or e-waste, which ends up in landfills and is toxic. According to a 2019 UN report, 50 million tons of e-waste is produced every year!⁵ When I was in Grade 9, I was introduced to the world of upcycling when working for a fascinating project for Digital Design: “Upcycled Buildings”. I remember that I was totally captivated by the Upcycling Pavilion created for a popular architecture show in Latin America: a striking red pavillion made from 5,000 recycled Coca-Cola crates. The inspiration for the pavilion came from concern over the amount of waste produced by typical pavilions coupled with a desire to keep costs down. This led me to strongly believe that upcycling should be the new norm; finding wealth in our waste has to be the future. I was recently talking to my father (an economist whose ‘startup’ assesses the eco-sustainability of companies) about upcycling and my concern about the Earth’s finite

¹ In Process Journal 9, p.7, 15/8/21.

² “Circular Economy: definition, importance and benefits.”

<https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefit>

³ “The 17 Goals.” <https://sdgs.un.org/goals>. Notes in Process Journal 3, p.7, 29/7/21.

⁴ In Process Journal 9, p.7, 15/8/21.

⁵ “UN report: Time to seize opportunity, tackle challenge of e-waste.” www.unep.org

resources and he introduced me to the concept of 'circular economy' and how it aims to lengthen the life of an object and turn waste into a resource. He explained that it is a move beyond the linear 'take-make-waste' model of production and consumption to one that regenerates and aims for 'zero-waste' production. My father underlined that 'circularity' is a global goal; a political, economic, environmental goal on everybody's agenda in the world of sustainability.⁶ I felt engaged and curious to learn more about it. So, he suggested that I explore the website of the Ellen MacArthur Foundation; a leading organisation in the circular economy industry. As I visited the website, I came up with these words: *"If we could build an economy that would use things, rather than use them up, we could build a future that really could work in the long term"* (Dame Ellen MacArthur)⁷.

That's when I became inspired and determined to use my creativity, my love of fashion, my interest in upcycling and the circular economy, to create a sustainable jewel made from e-waste; my personal attempt to create beauty while drawing more attention to the challenge of e-waste and the value that a circular economy has for our common future.

• **Intended Product**

Through my learning goal I intend to gain the skills that will enable me to design and create a sustainable pair of circular-shaped, gold earrings made from discarded electronic material. The circular shape of the earrings intends to capture the 'circularity' concept. I will name the earrings "CircleUP" to encompass the idea of 'circularity' and 'upcycling'. In addition, I intend to accompany my product with a set of photographs taken during the entire transformation process, from e-waste to earrings. This will enable my audience to gain a better understanding of the whole project. Earrings have always been my favourite jewel. These earrings ally my ambition to design and create a fashion item with my desire to do it in a 'beautiful' way.

• **Product Success Criteria**

Having settled my goal, I needed to think about the success criteria for my product. So, I analysed⁸ a set of existing sustainable jewels made from e-waste⁹ and then designed the following success criteria for my product.

Product Success Criteria	Details & Test Method
Form: 1. My product will be a pair of sustainable gold earrings.	It is important that I create my jewel responsibly, making sure that it has minimum environmental impact. I will measure this through a questionnaire that I will give to a test group of viewers.
2. The earrings must be made of salvaged gold from upcycled e-waste.	I want to make sure that my earrings are created using gold that would have gone to waste. I will ask the goldsmith to verify the gold that I extract.
3. The earrings will be circular shaped.	I want my earrings to reflect the concept of 'circularity'; a key solution for sustainable growth. I will measure this through a questionnaire that I will give to a test group of viewers.

⁶ In Process Journal 4, p. 7, 30/7/21, "Notes taken during informal conversation with dad - expert on circular economy"

⁷ "Circular Economy." <https://www.ellenmacarthurfoundation.org/>

⁸ In Process Journal 25, p. 5, 10/9/21, "Table Analysing Existing Products."

⁹ Notes in Process Journal 6, p.7. 1/8/21. AuTerra. <https://auterra.co.za/>; Lylie's <https://lylies.com/>

4. The skills that I will need to learn are: a) how to extract gold from e- waste. b) how to make a handcrafted gold jewel	a) I will take detailed notes during my selected video tutorial so that I can carry out the gold extraction procedure in the most effective, efficient, safe and eco-friendly way. b) With the guidance of the goldsmith, I will learn the goldsmithing skills by actually making my jewel in a real-life situation. To test my skills, I want to make sure that while I carry out the gold extraction procedure and while I make my earrings at the lab, I will take photographs and then make a video with voice-over to illustrate and explain how I carried out these tasks.
5. I will create one pair of earrings. Each earring will have a diameter of 8 mm.	After my preliminary research, I was able to set realistic goals for what I could create within my time frame, with the skills that I have and with the amount of material that I can expect to collect. One pair of earrings will be challenging but achievable. The earrings will be small because I will have a limited amount of gold available. I will test the size by measuring with a ruler.
6. To disassemble the devices and for the gold extraction procedure, I will use the following equipment and tools: pliers; screwdriver set; scissors; 1 pyrex beaker (1000 ml); 2 glass containers; paper coffee filters; 1 funnel; 1 graduated cylinder; muriatic acid (300 ml); hydrogen peroxide 10 Vol. (300 ml); rubber gloves; eye goggles; apron; recycling bin; plastic tank.	After watching the video tutorial, I was able to set out the equipment list. Equipment for making the jewel will be available at the goldsmith's lab. I will verify this from product packaging.
7. I will follow these steps to assemble my project: i. disassemble e-waste ii. extract gold from e-waste iii. make the earrings at the lab using the salvaged gold iv. appropriately recycle leftover materials at a recycling center	It is important that I complete each step before going on to the next one. I will need to be organised and must manage my time well. I will verify this through photographic evidence of the transformation process from e-waste to earrings. I will also make a video with voice-over where I will explain all the steps.
<u>Function:</u> 8. I will create a gold jewel without exploiting the environment.	There is an urgent need to protect our environment. Therefore, I want to make my earrings sustainably. I will: utilise gold that alternatively would have gone to waste; reduce e-waste by reusing its components; save scarce, raw materials by not using newly mined gold; recycle all leftover materials so that they can be repurposed. I will measure this through a questionnaire that I will give to a test group of viewers.
<u>Audience:</u> 9. The earrings and photographs of the transformation process from e-waste to earrings, will be viewed by my peers and teachers at school and by my family.	I want to make sure that my audience will understand how my jewel was made and that I created it respecting our environment. I will measure this through a questionnaire that I will give to a test group of viewers.
<u>Cost:</u> 10. The project will cost maximum 50 Euros	Considering the equipment I need and the photographs that will accompany it, I believe that this is a realistic budget. I will try to keep costs down wherever possible. I will measure this by making a list of all items I buy with their cost and by collecting receipts.

• Plan for Achieving My Product

To achieve my product and its associated criteria, it was crucial to have a solid action plan to keep me on track and give me a clear direction. First, I wrote down all the tasks I needed to accomplish and put them in chronological order. Then, I created a table showing all the tasks I needed to carry out, what I needed to do to complete them, when they had to be completed, the people involved and the progress I made. In this way I could understand at a glance what I needed to do to achieve my product goal efficiently and effectively.

DATES	TASK	TO DO	PEOPLE	PROGRESS
1 July-20 Oct	Ongoing learning about circular economy	Research: - On Google: "Basic principles of circular economy" - Newspaper articles - Check source reliability - Make study notes - Informal conversation with expert	Dad (economist & sustainability expert)	- Done - Done - Done - Done - Done
1 July-9 Oct	Sourcing e-waste	Spread the word - family, friends	Grandad (electronics hobbyist)	Done
15 July-28 July	Planning interview with expert	- Fix formal appointment with dad for interview - Prepare questions for interview	Dad	- Done - Done
29 July	Interview with expert	- Ask questions - Take notes of answers	Dad	- Done - Done
30 July-10 Oct	Learning how to extract gold from e-waste	Research video tutorials: - On Google: (in English) "How to extract gold from e-waste" (in Italian) "Come estrarre l'oro dai componenti elettronici" - Select a reliable tutorial - Take detailed notes of equipment & method		- Done - Done - Done
31 July-17 Sept	Finding a goldsmith to work with	- Ask family for contacts - Contact goldsmith to fix an appointment - Plan 2 appointments (for lesson & workshop) - Note dates, time, address	Master Goldsmith	- Done 17/9 Contact - Done 2/10 Lesson 16/10 Lab - Done - Done
1 Aug-1 Oct	Learning how to make a handcrafted gold jewel (Part 1)	Research: - On Google: "Guide to jewellery production" - Check source reliability - Make study notes		- Done - Done - Done
20 Aug-31 Aug	Sketching earring	Research: - On Google: "Existing sustainable earrings made from e-waste" - Make table: Analysing Existing Products - Get ideas from magazines, shops - Sketch (shape: circular)		- Done - Done - Done - Done

3 Sept-18 Sept	Obtaining all equipment	• Make a list • Check what available at home • Buy the rest (NB: budget)	Grandad (tools)	• Done • Done • Done
18 Sept-9 Oct	Disassembling electronic devices	• Plan 3 sessions • Make arrangements with grandad • Take photographs • Prepare recycling bin	Grandad	18/9 Done 25/9 Done 9/10 Done • Done • Done
2 Oct	Learning how to make a handcrafted gold jewel (Part 2)	• One-to-one lesson with goldsmith • Take notes	Master Goldsmith	10 am • Done • Done
11 Oct-14 Oct	Extracting gold from devices	• Make appointment with grandad for supervision • <u>Day 1</u>: Dissolving (outside on balcony) • <u>Day 2</u>: Filtration (have container to collect leftover acid solution & recycling bin) • <u>Day 3 & 4</u>: Gold residue left to dry on filter • Take photographs/video	Grandad	• Done 11/10 - 4 p.m. 12/10 - 4 p.m. • Done 12/10 - 14/10 • Done • Done
16 Oct	Making the earrings at goldsmith's lab	• Bring filter paper with gold residue to lab • Take photographs	Master Goldsmith & Sara	9 a.m. - 3 p.m. • Done • Done
25 Oct	Recycling leftover material at WEEE center	Research nearest WEEE center. (in Italian: RAEE) • On Google: "Riciclo rifiuti elettronici Milano" • Check opening times, address • Make arrangements with an adult to drive me there • Bring acid solution in container and leftover materials in a recycling bin • Take photographs/video	Grandma	• Done AMSA center Ple. delle Milizie 1/1 • Done 12 noon • Done • Done • Done
26 Oct-6 Nov	Planning captions & photos to demonstrate transformation process from e-waste to earring	• Select 12 photos to illustrate main stages • Write captions • Plan layout of photos • Plan font/size of title and captions • Make a collage of the photos • Print collage in colour on A4 paper • Go to stationary shop to print A3 copy		• Done • Done • Done • Done • Done • Done • Done

APPLYING SKILLS

• Achieving the Learning Goal - ATL Skill: Research

My learning goal encompassed learning about the circular economy, as well as learning how to make a jewel and how to extract gold from e-waste. Therefore, I had to do a considerable amount of research. I used a wide variety of sources, as may be seen in my bibliography. For example, I gathered information from primary sources (an interview with an expert in sustainability; a one-to-one lesson and a workshop with a master goldsmith); print sources (books, newspapers); digital sources (websites, videos). However,

before using information from a source, I needed to check its reliability. To do this, I used a model that evaluates five criteria: author, origin, objectivity, quality, quantity and each criterion is given a rating. This evaluation enabled me to identify the sources that would be most appropriate to help me achieve my goal.

Source 4: "Circular Economy." *Ellen MacArthur Foundation*. <https://www.ellenmacarthurfoundation.org/>

Criteria	Rating	Descriptor
A Author	4	Written by a well-known reputable organization. Many professionals contributed to creating this source.
	3	Author is highly professional in this field of study. Author is from or backed by a well-trusted organization.
	2	Author is knowledgeable/reputable, bases the source on his/her own experiences as well as others'.
	1	Author is stated but is unreliable. Source is eliminated.
	0	Does not meet any of the above. Source is immediately eliminated.
B Origin	3	Published in professional/well-known/reputable media
	2	Published in trustworthy media
	1	Posted in a well-known or editable media where anybody can post. Source is almost always eliminated.
	0	Does not meet any of the above. Source is immediately eliminated.
C Objectivity	3	Non-biased with appropriate reasoning and opinions for both pros and cons.
	2	Mostly biased but basing the opinion on a wide variety of reasons.
	1	Completely biased with a narrow scope of points.
	0	Confusing/unclear objectivity. Source is immediately eliminated.
D Quality	3	Highly professional, convincing source.
	2	Convincing details with understandable reasoning.
	1	Somewhat relevant to the subject. Not reasonable enough to qualify as a convincing source.
	0	Irrelevant information presented. Source is eliminated.
E Quantity	2	Appropriate amount of information to clearly state the opinion and facts with detailed reasoning.
	1	Too much or too little.

Excerpt from Source Reliability Evaluation

To learn about the circular economy, I researched the websites of well established organisations, such as the Ellen MacArthur Foundation and the European Parliament. I first skimmed through the information to build understanding and then made study notes by summarising the main points, underlining and putting important information in bold (*excerpt on next page*). This method enabled me to grasp and assimilate the information. In order to learn the chemical procedure for extracting gold from e-waste, I researched the internet for video tutorials because I wanted to learn by watching how it is done and seeing the equipment required and how it is used. After viewing several videos, I selected five videos that were reliable and clear and made a list of their links in order to have them handy. Then, I watched them again, listened attentively and took detailed notes. This enabled me to compare the methods used and select the most achievable one for me (*excerpt on p.8 of the report*). To learn how to make jewellery, I did a preliminary internet research to gain a basic knowledge about the topic before meeting with the goldsmith for my first lesson. A search on Google for "Handmade Jewellery Production", led me to a blog by Dauvit Alexander, jeweller and teacher at the School of Jewellery at Birmingham City University. It contained a lot of useful information and subject-specific terms, so I skimmed through it and then took notes, underlined fundamental points and put the terminology in bold to help me learn.

Circular economy (C E) is:

- Model of production + consumption involves: sharing, reusing, repairing, refurbishing and recycling existing materials + products, long as possible. -> life cycle of products extended
- Aims: reducing waste to a minimum. When product reaches end of its life, its materials kept within the economy when possible. So be productively used again and again -> creates further value.
- In C E products + materials they contain= highly valued. A change from traditional, linear economic model based on take-make-use throw away pattern.
- Also, part of this model is "planned obsolescence": when product designed to have limited lifespan (encourage consumers to buy it again). European Parliament called for measures to tackle this practice.

Why need to switch to a circular economy:

- World population GROWING.
- Therefore: so is demand for raw materials BUT supply crucial raw materials LIMITED.
- Also: extracting + using raw materials -> major impact on environment. Also, increases energy consumption + CO2 emissions.
- Smarter use raw materials can lower CO2 emissions.

Benefits:

- Waste prevention, ecodesign + re-use can: save EU companies money; reduce tot. annual greenhouse gas emissions

Materials:

- Economy uses raw materials extracted domestically or imported. In C E raw materials come from virgin OR secondary sources

Product design

- Contribute to longer product lifespan + a more C E, thanks to eco-design + repair-friendly design.

Product use

- To prolong + optimise product use: shift from ownership of products to their usage (via rental, sharing or subscription models) should be considered.

Excerpt from my Study Notes on Circular Economy (From Process Journal 10, p.7, 16/8/21)

2. Alexander, Dauvit. "Guide to Jewellery Production."

<https://make.works/blog/guide-to-jewellery>

- Many techniques are used: e.g. ultra- traditional cutting of metal using a saw; soldering; lost-wax casting
- Designer understands: potentials + pitfalls of specific jewellery materials + how jewellery works in relation to body
- Cutting and forming metal

Cutting of metal into elements/ units which can then be formed into jewellery item. Done with piercing saw but laser-cutting= option.

Forming: shaping of metal. Can be done by: hammering, bending, raising over a stake, sinking, die-forming OR many other processes

- Soldering

Joining of metal using heat. Most usual way: gas-torch. Increasingly: laser-welding + TIG welding uses in jewellery studio.

- Casting

Using wax models to create moulds-then filled with molten metal. This proce allows: to rapidly produce multiple units OR to produce units which otherwise impossible. Waxes may be: carved by hand by specialist wax carvers OR by digital milling. Jewellers cast their own work BUT many prefer to use specialist casting companies.

Excellent for information about the processes required to manufacture a jewel and to learn subject-specific terminology

Excerpt from my Study Notes on Jewellery Production (From Process Journal 14, p. 6, 21/8/21)

Equipment:

- E-waste
- Muriatic acid 250 ml
- Hydrogen peroxide 10 vol. 250 ml
- Paper coffee filters
- Spray bottle
- Funnel
- Measuring cylinder
- Containers: 2 glass; 2 plastic; 1 pyrex beaker (1000 ml)
- Pliers
- Screwdriver set
- Protection gear: eye goggles, mask with filter, acid resistant rubber gloves, apron

Method:

1. Using pliers, cut off the gold connectors from the circuit boards
2. Collect them in a plastic container
3. Prepare a mixture of 50% muriatic acid and 50% hydrogen peroxide 10 vol in the following way:
4. Pour 250 ml muriatic acid in a measuring cylinder. Then pour it into a small container
5. Pour 250 ml hydrogen peroxide 10 vol. into a measuring cylinder. Then pour it into the container together with the muriatic acid
6. Pour the mixture into the container with the gold connectors making sure that the connectors are completely covered by the solution (eventually, add more solution using same proportion)
7. Allow to rest for at least 4 hours to allow the gold to detach (the longer the better).
8. After this time the parts that were covered with gold will be clean and gold flakes will be floating.
9. For those parts that are not completely clean, sprinkle with water using a spray bottle
10. Filter in the following way:
11. Place a coffee filter paper inside a funnel
12. Place the funnel over a glass container
13. Carefully pour the solution
14. Using a spray bottle, sprinkle some water on the gold powder residue in order to have it all close together and not spread out.
15. Allow filter to dry. The gold will detach.
16. Allow gold to dry

Excerpt from my Notes on the Video Tutorial I Selected (From Process Journal 28, p. 5, 5/10/21)

• **Achieving the Learning Goal - ATL Skill: Communication**

Once I acquired a basic knowledge about circular economy and jewellery making, I wanted to deepen my knowledge by interviewing an expert in each field. The circular economy expert was my father, so it was simple to fix an appointment. The master goldsmith was a family contact, so I telephoned her to arrange an appointment. After presenting myself and my project, we established a suitable date, time and place for the interview. I immediately noted the details of the appointment on a sticky note which I kept handy (*photo on p.10 of the report*). The knowledge acquired through my research enabled me to prepare good questions before the interview with the circular economy expert. Interviewing and interacting with him was particularly valuable because the input from his personal experience extended my knowledge and also made my learning more meaningful. My one-to-one lesson with the master goldsmith gave me the unique opportunity to talk about the art of making handmade jewellery with an expert. In order to make our interaction more effective, I immediately sought to establish rapport with her. We communicated in Italian and I learned many new concepts. For example, after an overview of the techniques used to make handcrafted jewellery, the lesson became more technical, with a focus on learning the maths of how to measure the specific weight of gold and the amount needed in relation to the size of an object, as well as learning how to prepare alloys. Throughout the lesson I actively listened, took care not to interrupt and took detailed notes (*excerpt on next page*). At home, I revised my notes by highlighting important points and wrote a

glossary of the terms I learned (in *Process Journal* 30,p.5,8/10/21). My research and interaction with the experts, enabled me to achieve my learning goal. I then felt prepared to transfer my knowledge, understanding and skills to create my product.

Interview with Circular Economy Expert (JS)

1. **CS: What are the basic principles of circular economy in simple terms?**

JS: Circular economy models: identify the by-products of the production of one firm/company that can be used as raw materials for the production of OTHER goods and products at ANOTHER COMPANY/FIRM

2. **CS: What is the aim of a circular economy?**

JS: The primary aim of the circular economy is that of reducing waste by identifying what can be reused (e.g. waste for someone can be raw material to someone else, hence giving longer life to all materials)

3. **CS: What are the benefits of implementing a circular economy?**

JS: Main benefits: planet because: reduces exploitation of Earth and its resources; reduces waste & consequently pollution; reduces cost of production; creates more sustainable chains globally.

4. **CS: What are the challenges /disadvantages of the circular economy?**

JS: No REAL disadvantages. There are CHALLENGES at implementing the circular economy model because it is difficult to identify and consolidate the supply chain models of a circular system. At times circular supply chain can be more unreliable than a classic non circular supply chain

5. **CS: Is there waste in a circular economy?**

JS: Yes, you can NEVER GET TO 'ZERO' WASTE (very difficult). But, having a circular economy aims to reduce as much as possible waste so as to maximise the life. Therefore, gives value to all products and resources as well as production waste

6. **CS: Does recycling e-waste contribute to a circular economy?**

JS: With a proliferation of technological devices, e-waste is an ever-growing challenge for the global ecosystem. Globally, there are many initiatives that try to mitigate e-waste that range from extending the life of electronic devices to implementing end of life circular models on certain part of technological devices. There are still challenges ahead, in optimising e-waste whether through recycling, circularity or other environmentally-mitigating waste-disposal techniques but, circular aspects are definitely one of the biggest pillars in the waste optimisation strategy for e-waste.

Excerpt from my Notes Taken During the Lesson with the Goldsmith (From Process Journal 26, p.5, 2/10/21)

Handwritten calculations for a circular economy project, showing the calculation of volume and weight of a gold ring.

CALCOLI (1^a draft):

diameter (cerchio/circle) = $\phi \rightarrow 8 \text{ mm}$

$A = \pi \cdot r^2$

$A = 16\pi = 50,24 \text{ mm}^2$

$V = A \cdot sp \text{ (surface area)}$

$V = 50,24 \cdot 0,5 = 25,12 \text{ mm}^3$

$\rightarrow \text{in cm} = 1000$

$V = 0,025 \text{ cm}^3$

$P = V \cdot \rho_s \rightarrow \text{peso oro}$

$\phi \cdot r \cdot 0 = \rho_s = 19,45$

$\hookrightarrow \text{grandezza}$

cm^3

$P = 0,025 \text{ cm}^3 \times 19,25 \frac{\text{gr}}{\text{cm}^3} = 0,48125 \text{ gr}$

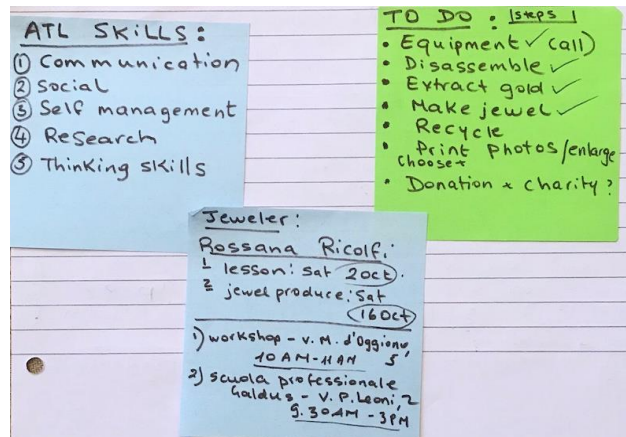
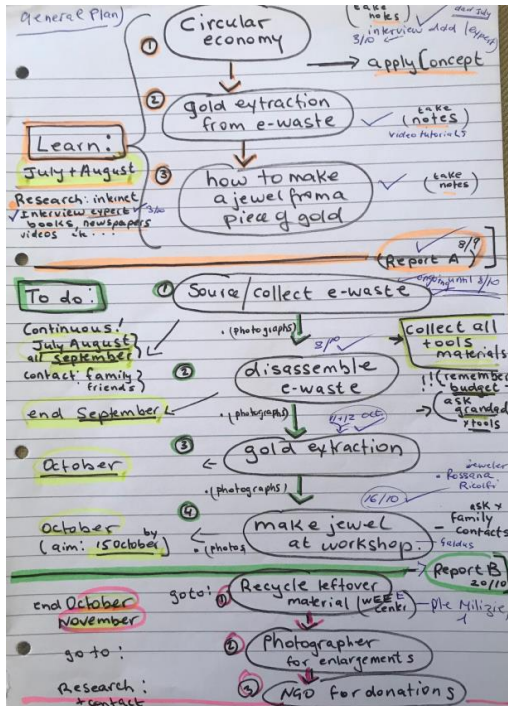
$\text{peso} \times 2 \text{ (orecchini = coppia)}$

- Achieving the Product Goal - ATL skill: Self Management**

Following my research, I realised that creating my product was challenging because I had to accomplish a sequence of complex tasks that were unfamiliar to me. From the sourcing of e-waste, to disassembling the devices, to extracting the gold contained inside them, to creating a pair of earrings from the gold retrieved, to closing the 'circular loop' by recycling leftover materials at a recycling area. I had to complete each step before going on to the next one. So, I had to be well organised and needed to manage my time well during the entire creation process. In order to be successful and avoid missing out anything, I took paper and pen

and created a visual diagram of the entire process with comments and reminders and placed it on the wall in front of my desk.

Moreover, to help me keep focus, I wrote a concise list of 'to do' tasks on a sticky note which I placed on my desk. This really worked well because it immediately made me feel calm, in control and confident; the entire process seemed less overwhelming. This is an example of how I used my self-management skills to achieve my goal.



Visual Overview of the Whole Project
(From Process Journal 41, p.3, 21/10/21)

Sticky Notes: 'To Do' Tasks; Appointments; ATL Skills Reminder
(From Process Journal 40, p.4, 20/10/21)

• **Achieving the Product Goal - ATL skill: Thinking (Creative and Critical)**

I had to think creatively when I realised that I had not collected a sufficient amount of discarded technology in the time I had scheduled. I had asked family and friends for devices they wanted to throw away. Now, I had to think of an alternative way and decided to look for spare parts (e.g. circuit boards). To do this, I thought of asking my grandfather, who is an electronics hobbyist, to collaborate with me. This turned out to be a good solution to my problem as he had saved many circuit boards from his old devices. We also went to a computer repair technician with whom my grandfather was well acquainted and he too collaborated by giving us some circuit boards that he was going to discard. Now that I had a good amount of e-waste, I was ready to go on to the next steps. However, when I was collecting the equipment for the gold extraction experiment, I came up with another obstacle. One of the chemicals required was nitric acid, which I thought I could get at the chemist, but I was wrong. This acid is not for sale for non-professional use. I went to several chemists but always got the same negative answer. However, I didn't give up and to solve this problem, I critically analysed the video tutorials to capture any detail that would enable me to achieve my goal without using nitric acid. In one of the videos, ["Come estrarre l'oro"] I observed that by using the gold

connectors on the edge of the circuit boards, rather than mixing up all the disassembled parts together, the gold could be separated using a mixture of muriatic acid and hydrogen peroxide. These are available at any supermarket and are also safer, cheaper and more eco-friendly. So, I cut up all the connectors and completed my experiment successfully. After the dissolution stage, gold specks were floating in the solution and after the filtering stage, gold collected as a residue on the paper filter. When it was dry, I was ready to take the gold to the goldsmith's workshop to make my product. While I was creating my earrings at the workshop, I had to overcome another problem. As I was "hammering" my gold disc to flatten it, the gold was hardening too fast. Therefore, I had to apply heat to soften it by using a gas torch. To do this, I had to move from the "hammering" area. Although the "gas torch" area was nearby, I noticed that those few moments were sufficient to harden the gold back again. After several unsuccessful trials, I needed to find a solution. So, I thought to myself, "What if I bring the torch to the "hammering" area?" I knew that this was an unusual procedure, but I thought that this would be a good solution and decided to ask the goldsmith if I could do this. She agreed and thanks to this creative solution, I was able to go ahead and achieved my product goal. In my video with voice-over I demonstrate the entire process.

- **Achieving the Product Goal - ATL skill: Social (Collaboration)**

An example of how I used my social skills was at the goldsmith's lab, where I collaborated with Sara, one of the senior students, to create my earrings. I had no previous jewellery making experience, so during the entire creation process (which lasted six hours), I carefully followed her instructions, listened to her advice and asked for help when I needed. I encouraged her contribution and learned from her corrections. Although, I had never met Sara before, we got along well. Thanks to this collaborative environment, I was able to successfully achieve my product goal and enjoyed this fantastic experience!

(Process Journal 60, p.2, 15/11/21)

REFLECTING

- **Reflection: the impact of my project on my learning**

When I started my project, I was aware of the urgent need to reduce pressure on the environment and had prior knowledge about upcycling. I also knew that our technological society causes an increasing amount of e-waste which contains precious, finite metals. This is what ignited my ambition to create a sustainable jewel from previously mined gold that alternatively would have gone to waste. To achieve my goal, I first wanted to learn more about upcycling and global e-waste management and then learn the technique for extracting gold from e-waste as well as the techniques for making handcrafted jewellery. I thought to learn everything through traditional research. However, when I was still at the initial phase of my project, I had the opportunity of talking to a sustainability expert about my project. This greatly extended my knowledge because he introduced me to the concept of circular economy and I learned that it is a political, economic and environmental goal on everybody's agenda in the world of sustainability and, therefore, is closely linked to my global context. I was also surprised to learn that my project is an application of circular economy because upcycling e-waste is the 'end of life' stage of the circular loop and by recycling the leftover materials I close the circular loop. Consequently, I was stimulated to learn about circular economy and add value to my project. So, I did extensive research on the internet and on newspapers and later interviewed the expert to develop a better grasp of the principles. What I realised is that acquiring information first hand

from an expert's personal experience was the most valuable source for research. By talking it out with him, the complex topic of circular economy became simple, understandable and interesting. This was further confirmed when I had my lesson with the master goldsmith. I had researched information about jewellery making on the internet and on an insightful book [Fettolini, L.] but never came across all the important technical data that she taught me. Thanks to the goldsmith's experience and passion, I was able to understand and learn the information rapidly, thoroughly and pleasantly. Moreover, thanks to her guidance at the lab, I was able to put theory into practice and acquire the skills to make my jewel. Therefore, I learned that interaction with an expert is the best form of research and that learning is enhanced through action in real-world situations. Thanks to my project, I have grown as a learner and have greatly extended my knowledge, my understanding and my skills. I also became a better student because I learned to think of strategies to help me persevere throughout my long and challenging project and complete it in time. For example, I realised that I am a visual learner. I benefitted from using pen and paper to summarise my tasks and using sticky notes with reminders to keep focus and avoid stress. Now, I am aware that these apparently simple strategies were key to help me manage my work and will apply them in the future as a student and in my career. Finally, working on my project **also had a positive impact on me as a person** as it changed the disposable mindset I grew up with. I also feel proud of my accomplishment as I was able to create a beautiful object in a 'beautiful' way; my small contribution towards our common future.

• Product Evaluation

My product

My product was a pair of sustainable gold earrings. The gold that I used to make my earrings was extracted from upcycled e-waste, which meets my goal. The earrings are circular-shaped to capture the 'circularity' concept and I named them "CircleUP" to encompass the idea of 'circularity' and 'upcycling'. My final product was accompanied by a collage of 12 coloured photographs demonstrating the entire transformation process from e-waste to earrings, thus enabling me to share it with my audience. While working on my earrings, I regularly referred to my criteria so I could make sure that I fulfilled them successfully. I used the global context as inspiration to use my creativity and love of fashion to design and produce a handcrafted gold jewel made from e-waste; my personal attempt to create beauty while drawing more attention to the problem of resource depletion, the challenge of rapid e-waste generation and the value that a circular economy has for sustainable growth.

Product Success Criteria: Single Point Rubric

Areas of Strength	Product Success Criteria	Areas for Development
I achieved my product goal and was pleased to have used my creativity and skills to design and produce a gold jewel with a low environmental impact.	<u>Form:</u> My product will be a pair of sustainable gold earrings.	
This was a challenging goal, as I had to learn the gold extraction procedure. So, I was particularly pleased to have successfully achieved this criterion – as confirmed by the respondents of my survey- and	The earrings must be made of salvaged gold from upcycled e-waste	

to have saved precious resources.		
All the responses from my survey confirmed that I achieved this criterion. This was important because my choice to give a circular shape to my earrings was not casual as I wanted to reflect the concept of 'circularity' and its key role in the path towards sustainable growth, which is linked to my global context.	The earrings will be circular shaped.	
a) I had no prior knowledge about the chemistry of gold extraction and wasn't sure to succeed. However, after analysing several video tutorials, I was confident that it was achievable and (as a risk-taker) was determined to try. I was extremely pleased that the careful selection of the most appropriate and reliable tutorial, my detailed note-taking of the procedure and the methodical preparation of all the equipment, contributed effectively to this criterion.	The skills that I will need to learn are: a) how to extract gold from e- waste; b) how to make a handcrafted gold jewel.	b) I fulfilled this criterion and, considering that it was my first attempt at jewellery making, I was proud that my earrings turned out well. This was also confirmed by the goldsmith who guided my work. She observed that to improve, I should practice using the handsaw in order to cut the metal with more precision. I learned that making jewellery by hand requires great arm and hand control and finger dexterity, as well as patience and concentration. In the future, I intend to take more lessons to improve my skills.
	I will create one pair of earrings. Each earring will have a diameter of 8 mm.	I successfully created one pair of earrings. Although I had taken accurate measurements, using a compass and ruler, the diameter of each earring is slightly different: one is 8 mm (which satisfies the criterion), the other is 7mm. This is because I need to improve my cutting skills.
Sourcing e-waste was challenging because I needed to have sufficient material by the end of September in order to complete all the steps of my project on time. Thanks to the collaboration of family and friends (and my perseverance), I was able to collect a sufficient amount of e-waste (mostly laptops and discarded circuit boards). I was lucky to find most of the other equipment at home, thus keeping costs down, and purchased what was missing at the supermarket.	To disassemble the devices and for the gold extraction process, I will use the following equipment and tools: discarded electronic devices, pliers; screwdriver set; scissors; 1 pyrex beaker (1000 ml); 2 glass containers; paper coffee filters; 1 funnel; 1 graduated cylinder; muriatic acid (300 ml); hydrogen peroxide 10 vol. (300 ml); rubber gloves; mask with filter; eye goggles; apron; recycling bin; plastic tank.	
My method of using pen and paper to create a detailed visual diagram of all the steps, as well as sticky notes with reminders, helped me manage my time and contributed effectively to	I will follow these steps to assemble my project: i. disassemble e-waste ii. extract gold from e-waste iii. make the earrings at the lab using the salvaged gold	

this criterion.	iv. recycle leftover materials at a recycling center	
I was pleased that all the responses from my survey confirmed that the production of my earrings satisfies circular economy principles such as, reducing waste and reducing the use of scarce raw materials. Upcycling e-waste and using salvaged gold from e-waste to create my jewel has contributed effectively to this criterion	Function: I will create a gold jewel without exploiting the environment.	
	Audience: The earrings and photographs showing the transformation process from e-waste to earrings, will be viewed by my peers and teachers at school and by my family.	I was pleased with the responses to my survey as most of the viewers of my earrings and the accompanying photographs, understood all the steps involved in the creation of my earrings. However, I hope to show the project 'live' to a wider audience (subject to Covid 19 restrictions) so I can talk about it, thus increasing awareness about the beauty and importance of creating a jewel sustainably. For this purpose I also created a video with voice over, where I explain what I have done.
I was pleased that I was able to spend much less (8.98 Euros), than my budget. To reduce costs, I looked for equipment available at home and at my grandparents'. The gold extraction procedure that I finally selected required less equipment than the ones I had initially considered. Making a collage of 12 photographs, to demonstrate the transformation process, rather than single large-sized photographs, as I had initially planned, was cheaper and more effective.	Cost: The project will cost maximum 50 Euros	

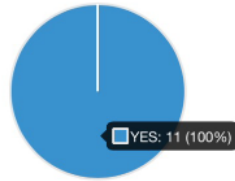
Overall Evaluation: I think that I created a successful and meaningful product. Considering that I had no prior knowledge and experience in handmade jewellery making, I am particularly pleased with the outcome of my earrings. This has motivated me to seek to improve my skills in the future. Thanks to my project, I had the opportunity of seeing with my own eyes how many precious metals are inside our electronic devices and, sadly, how they are wasted when they are discarded. Therefore, I think that my product is successful also because it is sustainable. I was able to create a 'zero waste' pair of gold earrings and feel proud to have met my goal. My evaluation is also based on the results of a survey that I sent out to my peers regarding my product's success criteria.

Excerpt from my Survey (From Process Journal 64, p.1, 22/11/21)

6. Circular economy aims to protect the environment by reducing waste.
Has my product satisfied this principle?

[More Details](#)

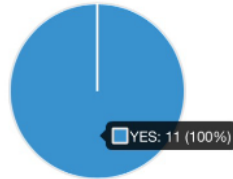
● YES	11
● NO	0
● SOMEWHAT	0



7. Circular economy aims to protect the environment by reducing the use of scarce raw materials.
Has my product satisfied this principle?

[More Details](#)

● YES	11
● NO	0
● SOMEWHAT	0

**MY PRODUCT** (From Process Journal 56, p.2, 31/10/21)**TRANSFORMATION PROCESS: from E-waste to Earrings**

Process Journal 59 pg. 2, 15/11/2021



1.a. Disassembling:
opening laptop



1.b. Disassembling:
cutting out components



1.c. Disassembling:
inside laptop



1.d. Disassembling:
detaching gold connectors



2.a. Extracting Gold:
dissolving



2.b. Extracting Gold:
filtration



2.c. Extracting Gold:
gold residue on filter



3.a. Jewellery Making:
gold smelting



3.b. Jewellery Making:
cutting gold disc with handsaw



3.c. Jewellery Making:
cutting & shaping



4. Finished product:
sustainable gold earrings



5. Recycling leftover materials

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