



THE BURDEN of Plastic Generation

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Lund University MA 2019



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The Burden of Plastic Generation
-Educational serial comic matching with modular eco toy figure
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Degree Project for Master of Fine Arts in Design
Main Field of Study Industrial Design
Lund University, School of Industrial Design
Department of Design Sciences

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2019

ISBN: LUT-DVIDE/ EX--19/50442-SE

thanks to

Claus-Christian Eckhardt

Per Liljeqvist

Olof Kolte

All instructors in the workshop

Precious Plastic Malmo

And all the private contributors
involved in this project.

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Abstract

Plastic pollution is not a new thing, not a new thing at all. Actually, concern about plastic had been growing date back to 1960s, almost 60 years ago, when the plastic debris in the ocean was first observed, but now the global plastic production is still increasing, as well as the amount of the plastic waste that enters the ocean every year. I knew about plastic pollution since I was a kid -people talked about it, and it was also on the textbook from school, but just like many other kids, I didn't really care, not until I saw those pictures of seabirds and marine life that are hurt or killed by plastic pieces, which shocked me and make me realize how bad the situation really is. Therefore, I felt the obligation to do something about it, to send out the message to more people, especially the younger ones, to help them see it through earlier, not like me, and deeper, and be a part of the solution, which might not be perfect, and takes a lot of time, but it has to start now, one step after another. So my master degree project is my attempt to be one of the tiny little steps of our solution to plastic pollution.

In this report, I will share my research about micro-plastic, treatments for plastic waste, the alternative of plastic, recycling system and its lies, the market of plastic toy and its influence, as well as some existing attempt of the eco-toy and educational toy. Also, I will talk about how my perspective changed throughout my research process and what changed my mind. It also documented my visit to precious plastic Malmo and my interview of some young parents about their kids' toys, in additional, a history study about the progress of some similar environmental problems. Then, I will show you the ideation process of my educational serial comic about plastic pollution and the modular eco-toy figure concept and how I developed them. In the end, it is the document of the result of my work and the discussion as well as the reference.

This project is against plastic pollution, not the material itself.

Introduction

In 1856, the first man-made plastic, Parkesine (nitrocellulose), was invented by Alexander Parkes, in Birmingham, England.

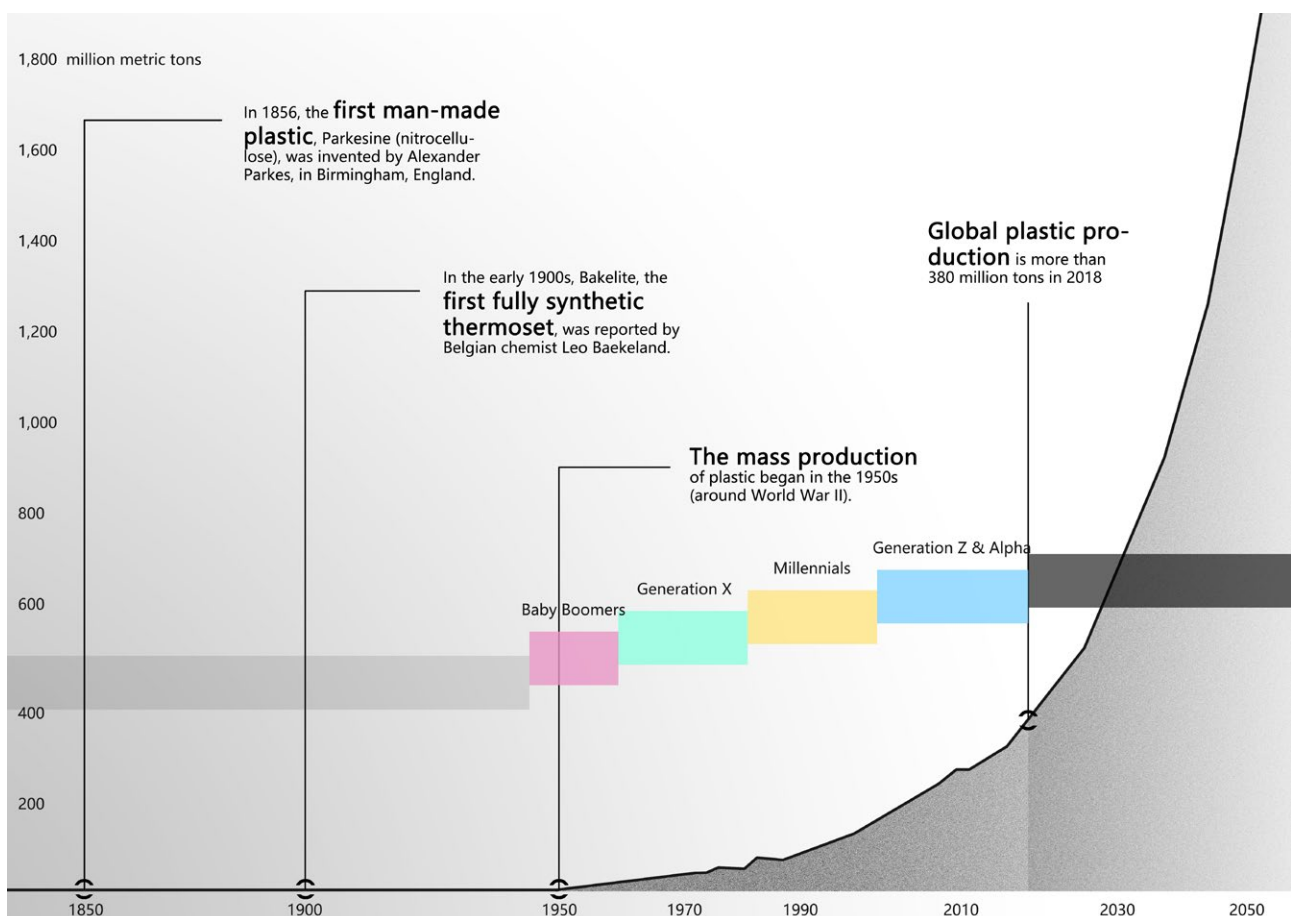
In the early 1900s, Bakelite, the first fully synthetic thermoset, was reported by Belgian chemist Leo Baekeland.

After World War I, improvements in chemical technology led to an explosion in new forms of plastics.

The mass production of plastic began in the 1940s and 1950s (around World War II).

If we say our last generation (Generation X, birth years ranging from 1960s to 1980s) were still born in an adaptation period of the new surge of plastic, experienced the transition between natural materials and plastic in their lives, then our generation (Millennials, birth years ranging from 1980s to 2000s) and those next to come (Generation Z and Generation Alpha) were born with plastic. It's no exaggeration to say we are "the plastic generations". We were exposed to various plastic products at the very beginning of our lives, and perhaps, nothing will change till the day we die. And that's why, plastic is in our norm, which is also a horrible thing that we don't feel anything wrong using plastic or even though we there is a problem we can't resist it. Because most of our last generation didn't realize the seriousness of the plastic pollution in time to include this matter into their early-stage parenting. But luckily, we still have some awaken. For example, Boyan Slat, 24, the founder of The Ocean Cleanup, devoted himself to rid the world's oceans of plastic using advanced technologies. He once quoted in his speech "that's for our children to worry about" as people's common response to the environmental issues, and he said here he is. Similarly, Greta Thunberg (born 2003), a Swedish schoolgirl, started a campaign called "Fridays For Future" to protest against the lack of action on climate change, which is one of the environmental effects of plastic pollution. Concern about plastic had been posed date back to 1960s, almost 60 years ago, when the plastic debris in the ocean was first observed, but the global plastic production is still increasing nowadays (more than 300 million tons per year), as well as the amount of the plastic waste that we dumped in the oceans every year (8 million tons). Why is that? How to deal with this complex systematic problem? I'm not sure yet, but still, I felt the burden of "the plastic generations", I felt the obligation to do something, at least spread out what I learned and how I think to avoid the same ignorance.

Focusing on plastic pollution, I devoted my master thesis project to, hopefully, develop a minor step toward the great solution. Besides of my innovative work, my research is a essential part of this project as well. The purpose of this project is to spread the truth of plastic pollution, and lead people, especially children to rethink plastic. This project is also a self-changing journey of mine. It changed the way I see this environmental problem, it changed the way I see this material, it changed the way I design.



The big deal

We produce more than 300 million tons of plastic every year, 50% of which is single-use. Of all the plastic waste we produced since the beginning, only 9% was recycled, 12% was burnt, and the other 79% is still sticking around somewhere. Around 8 million tons of plastic will end up in the ocean each year.

Effects on animals

Because it's everywhere, marine animals and birds and many other creatures keep getting trapped in plastic and swallowing it. Living organisms can be harmed either by mechanical effects, such as entanglement in plastic objects or problems related to the ingestion of plastic waste, or through exposure to chemicals within plastics that interfere with their physiology. Humans are also affected by plastic pollution, such as through the disruption of various hormonal mechanisms. The presence of plastics, particularly microplastics, within the food chain is increasing. In the 1960s microplastics were observed in the guts of seabirds, and since then have been found in increasing concentrations. The long-term effects of plastic in the food chain are poorly understood.

Climate change

Plastics are generally made from petroleum. If the plastic is incinerated, it increases carbon emissions; if it is placed in a landfill, it becomes a carbon sink although biodegradable plastics have caused methane emissions. In 2019 a new report "Plastic and Climate" was published. According to the report, plastic will contribute Greenhouse gases in the equivalent of 850 million tons of Carbon dioxide (CO₂) to the atmosphere in 2019. In the current trend, annual emissions will grow to 1.34 billion tons by 2030. By 2050 plastic could emit 56 billion tons of Greenhouse gas emissions, as much as 14 percent of the earth's remaining carbon budget.

Production of plastics

Production of plastics from crude oil requires 62 to 108 MJ/Kg (taking into account the average efficiency of US utility stations of 35%). Producing silicon and semiconductors for modern electronic equipment is even more energy-consuming: 230 to 235 MJ/Kg of silicon, and about 3,000 MJ/Kg of semiconductors. This is much higher than the energy needed to produce many other materials, e.g. iron (from iron ore) requires 20-25 MJ/Kg of energy, glass (from sand, etc.) 18 - 35 MJ/Kg, steel (from iron) 20 - 50 MJ/Kg, paper (from timber) 25 - 50 MJ/Kg.

Ocean plastic

How does plastic end up in the ocean?

80% of the ocean plastic originates from land, the majority of them enter the ocean through rivers. The trash from landfills, streets, and beaches are carried away by natural force and reach the oceans or rivers. Or in some regions, people just dump their trash directly into the water system due to poor garbage disposal infrastructure. In fact, 90% of all plastic waste that enters the sea through the river comes from just 10 rivers in Asia and Africa. The Yangtze River alone contributes 1.5 million tons of plastic waste each year. Other sources of ocean plastic include the fishing industry and transportation through the sea and so on. The waste travels to the with the gyre and will eventually reach the center of the gyre where it collects. During they journey they will break up into much smaller bits as they are eroded by sunlight, saltwater, currents, and waves. These pieces of plastic have rough, pitted surfaces. And more than 50% of marine debris, including plastic, will sink.

Micro-plastic

Micro-plastic is pieces smaller than 5 millimeters, 51 trillion of them are floating around our ocean and easily eaten by all kinds of marine life. They will travel up the food chain and finally get to our bodies. And micro-plastic might carry chemicals with toxicity that were used in plastic production like BPA and DEHP, which will cause serious health issues when they are accumulated. 8 out of 10 babies and almost all adults have measurable amounts of phthalates, a common plastic additive in their bodies. And 93% of people have BPA in their urine.

The Great Pacific Garbage Patch

The great Pacific garbage patch is a gyre of marine debris particles in the north-central Pacific Ocean. The collection of plastic and floating trash, which comes primarily from countries in Asia, lies halfway between Hawaii and California and extends over an indeterminate area of widely varying range, depending on the degree of characterized by exceptionally high relative pelagic concentrations of plastic, chemical sludge, and other debris that have been trapped by the currents of the North Pacific Gyre. Despite the common public image of islands of floating rubbish, its low density (4 particles per cubic meter) prevents detection by satellite imagery, or even by casual boaters or divers in the area. It consists primarily of an increase in suspended, often microscopic, particles in the upper water column.

Our options for plastic waste nowadays

Rethink

--To refuse and reduce using plastic. Not only required the awareness of individuals, but also need the moral conscience of the industry, with the help of legislation.

Recycle

--Quality will degrade and the contaminant will concentrate during the repeating recycling process. Also tends to encourage plastic usage.

Reuse

--Limited usage

Reconfiguration

--Using plastic waste as a raw material without changing with heat, limited usage currently.

Biodegradable, bioplastic

--Biodegradable plastic does not break down very efficiently in natural environments (extremely low in ocean and landfill).

--Bioplastics are plastics derived from renewable biomass sources, such as vegetable fats and oils, corn starch, straw, woodchips, food waste, etc. Not all bioplastics are biodegradable nor biodegrade more readily than commodity fossil-fuel derived plastics.

Incineration

--"Waste-to-energy", generates toxic gas, not sustainable, low efficiency to convert into electricity.

Thermal cracking

--"Waste-to-energy", high investment.

Pyrolysis

--"Waste-to-fuel", generates harmful gas.

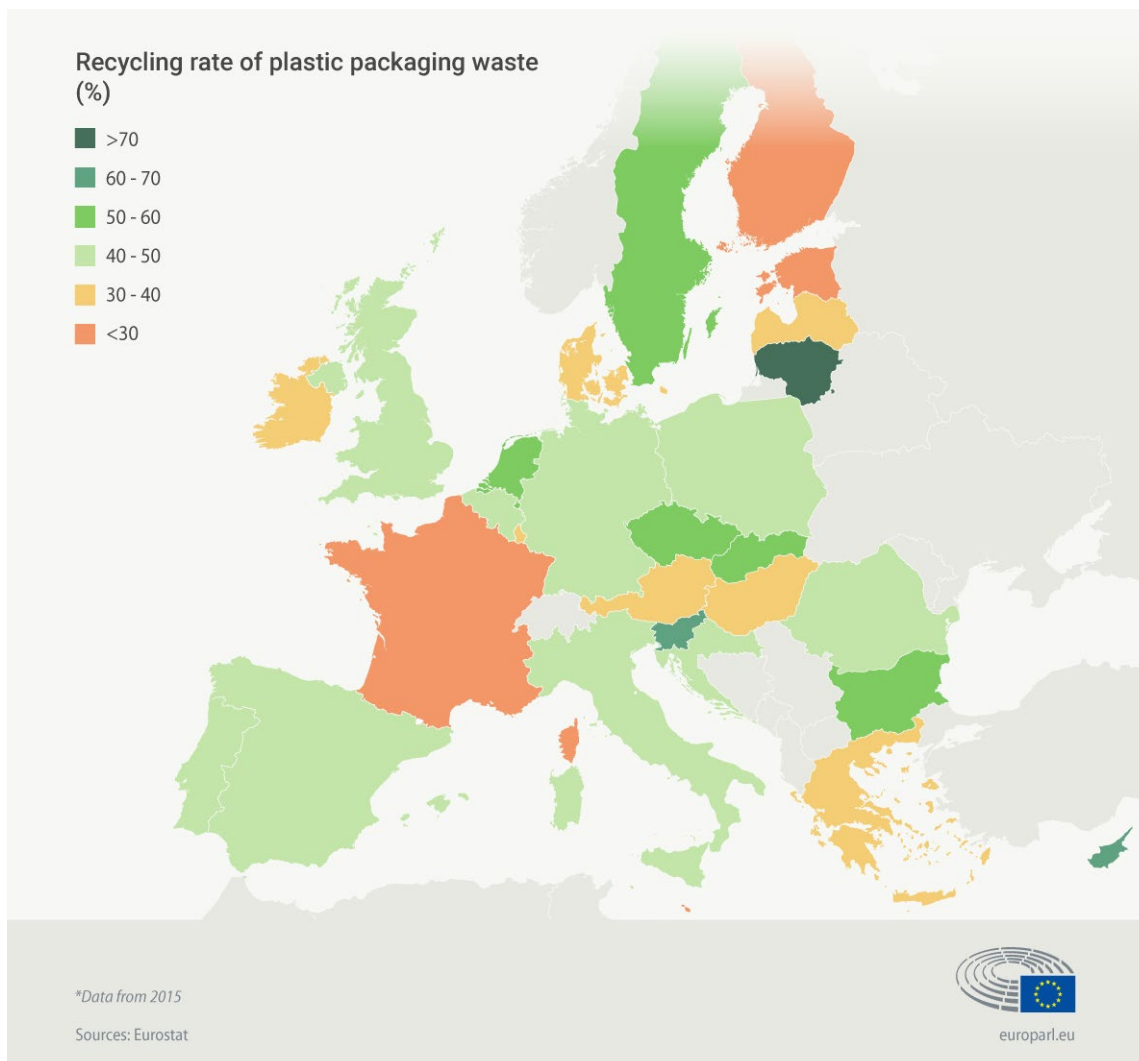
Pyrogenesis

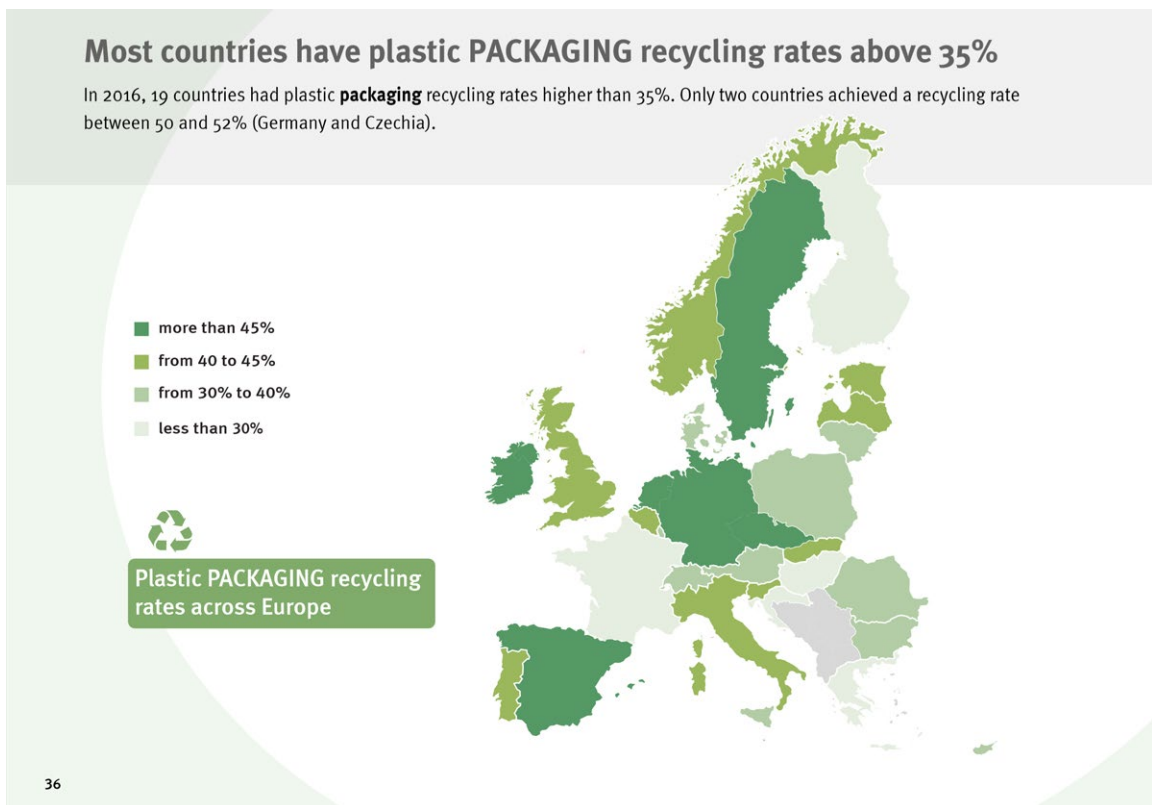
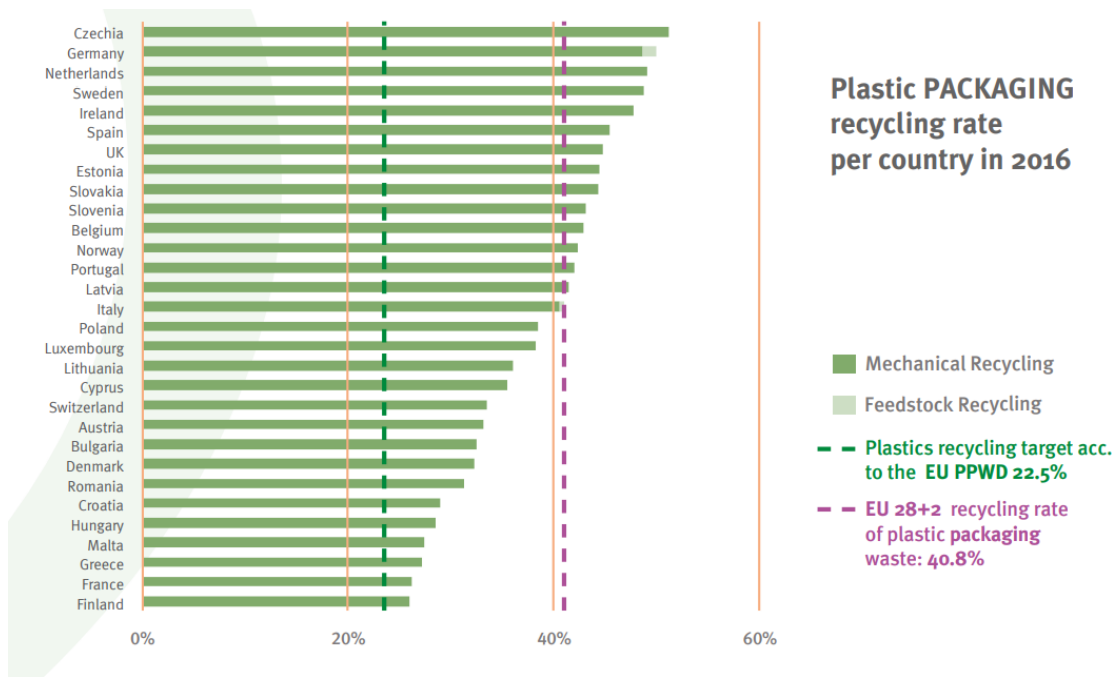
--Vaporizes the waste, not a self-sustaining system, difficult to scale up.

The truth of recycling

Less than 10% of the plastic we ever produced all the time has been recycled.

Mechanical recycling is the only widely adopted technology for large-scale treatment of plastic solid waste. The main steps are the removal of organic residue through washing, followed by shredding, melting, and remolding of the polymer, which is often blended with virgin plastic of the same type to produce a material with suitable properties for manufacturing. Presorting of plastics before recycling is costly and time-intensive, recycling requires large amounts of energy and often leads to low-quality polymers, and current technologies cannot be applied to many polymeric materials. Only two types of plastic can be recovered and recycled with mechanical processes: poly(ethylene terephthalate) (PET) and polyethylenes, which represent 9 and 37% of the annual plastic produced, respectively.





When you search for the statistic of plastic recycling you can find a lot of charts and data. However, when you looked into these charts and numbers, you will find out that they do not match, or even tell a completely different story. Why is that? So I try to dig deeper and realize that every country has different standards about recycling.

The Swedish recycling & the British/Australian recycling

Turns out, for example, in Sweden, the government counts incineration as a part of recycling, so-called "waste-to-energy" recycling. In fact, 70% of the plastic waste in Sweden were sent to the incineration facilities, which became a successful business that they even import waste from other countries. Differ from conventional recycling, incineration is burning the waste turns them into energy without any pre-sorting, no wonder the government can claim they recycle 99% of plastic waste every year. But it also faces many problems, like the generation of greenhouse gas, the material could not be recovered again, the low efficiency with high investment and so on. Most importantly, the majority of the energy they generated -about 90%- goes to the heating system of all over Sweden, which will stop during summer, and the facilities will stop processing the waste as well. If only use incineration to generate electricity, the energy efficiency in the plant would be much lower than the heating, so the whole "waste-to-energy" system is not suitable for any other countries that don't need the heating facility.

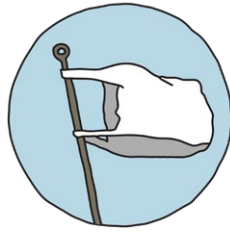
While in the UK, they rarely have recycling plant in their homeland, since nobody wants to get involved in this "dirty business" which is costly and low benefit. And their recycling rate is based on the amount of plastic waste they exported to other countries that will process them like China, Malaysia, and Poland. As for where did that plastic eventually end up, or have they ever been recycled, nobody knows, and nobody cares as well. Because once the cargo was sent away, their "recycle" job is over. However, reports show that the quality of this kind of exported waste are generally low, which means they are not only plastic but include a lot of pollutants and other materials. While buyers like China they only expect the waste that has been sorted. So most of those plastic waste that has claimed to be recycled are still piled up somewhere, can not and will not be recycled. The same issues have also been reported in Australia. As China stricted its regulation against plastic waste trading in 2018, more and more plastic scraps have nowhere to go, stuck in Hongkong or be transported to other developing countries in Asia illegally.

Recycling, giving the hope to people for a promising second life of plastic waste, they believe and put it in their recycle bin, which however inevitably ends up in landfills or the oceans. More people deserve to know the truth and strive for a better solution.





A visit to precious plastic



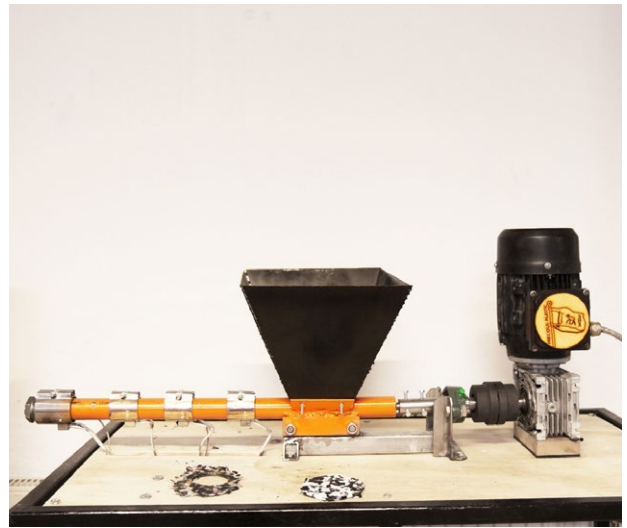
PRECIOUS
PLASTIC

Precious Plastic is a global community founded by Dave Hakkens in 2013, trying to boost plastic recycling worldwide on a small scale locally, as a solution to plastic pollution. They share knowledge, techniques, and tools online to recycle plastic waste into something valuable.

It's a very eyes-catching exciting operation. So, I went to visit one of their branch stations in Malmo. Daniel showed me the machine they made, the progress they have so far, and their plans.

We both agree that recycle should be the last solution. They try more to focus on the education of children, to show them the possibility of turning plastic trash into valuable things. They are cooperating with local schools to teach the kids how to use plastic trash to make handicrafts, such as jewelry and home decoration.

Even though I'm not sure if guiding kids to handicraft with plastic is the right thing, but I am optimistic that it will help raise the awareness of this problem of the next generation.



The last resort of plastic: recycle

"End-of-pipe" solution, means methods used to remove already formed contaminants from a stream of air, water, waste, product or similar. These techniques are called "end-of-pipe" as they are normally implemented as a last stage of a process before the stream is disposed of or delivered.

Recycling is an "end-of-pipe" solution, which should be the last measure to take after rethink, refuse, reduce and reuse. The amount of plastic that we can really recycle so far is extremely unequal to the amount we produce. In fact, the amount of plastic we've produced is already much more than we actually need. If we let this keep happening, even though we eventually find a way to recycle all types of plastic perfectly in the future, but what for? They just become an excessive burden for our environment. Plus recycling creates an illusion to people that we can continue our dependency on plastic. Blindly rely on recycling will just lead to more serious pollution.

As for the idea of recycling on a small scale locally, to turn plastic waste into valuable stuff, it is interesting and has a good starting point. But it seems like expediency after all. It is pointless to keep recycling plastic into something we don't really need after a while. Of course, we can easily melt down plastic waste and make something out of it, like cups, bowls, decoration, jewelry or even furniture, we can fill our homes with all kinds of plastic products, but is that really what we want? The fact is, we need way fewer plastic products than we thought in our lives. We throw away loads of plastic waste every day because most of them are single-use packaging. Besides that, the other high-quality plastic goods we use usually last for a long period that we simply don't need too many of them or replace them too often. In other words, we always produce more plastic waste than we actually need in our daily lives. That's why only keep recycling can't make up the unbalance.

Therefore, instead of focusing on this type of pointless recycling, we need to convince people into rethinking plastic, control the pollutant from the source.



History study:

How problems like these been solved in history?

"Learning from the history", as one always say, in a complicated case like plastic pollution, a study about similar cases in the past might give unexpected input. That's why I chose these two cases: asbestos and DDT.

Asbestos

People have used asbestos for thousands of years to create flexible objects, such as napkins, that resist fire. In the modern era, companies began producing asbestos consumer goods on an industrial scale. Now people recognize the health hazard that asbestos poses, and it is banned or strictly regulated around the world.

Asbestos use dates back at least 4,500 years when the inhabitants of the Lake Juojarvi region in East Finland strengthened earthenware pots and cooking utensils with the asbestos mineral anthophyllite.

The large-scale asbestos industry began in the mid-19th century.

The use of asbestos became increasingly widespread towards the end of the 19th century, when its diverse applications included fire-retardant coatings, concrete, bricks, pipes and fireplace cement, heat-, fire-, and acid-resistant gaskets, pipe insulation, ceiling insulation, fireproof drywall, flooring, roofing, lawn furniture, and drywall joint compound. In 2011 it was reported that over 50% of UK houses still contained asbestos, despite a ban on asbestos products some years earlier. In 1899, Montague Murray noted the negative health effects of asbestos. The first documented death related to asbestos was in 1906.

In the early 1900s, researchers began to notice a large number of early deaths and lung problems in asbestos-mining towns. The first diagnosis of asbestosis was made in the UK in 1924.

Approximately 100,000 people in the United States have died, or are terminally ill, from asbestos exposure related to shipbuilding.

The United States government and asbestos industry have been criticized for not acting quickly enough to inform the public of dangers and to reduce public exposure. In the late 1970s, court documents proved that asbestos industry officials knew of asbestos dangers since the 1930s and had concealed them from the public.

Asbestos was widely banned by most of the countries in the western world started from around the 1980s.

The United States remains one of the few developed countries to not ban asbestos which is legal and still widely used in such commonly used products as clothing, pipeline wraps, vinyl floor tiles, millboards, cement pipes, disk brake pads, gaskets, and roof coatings.

Substitutes for asbestos in construction now including fiberglass, mineral wool, glass wool and so on.

All types of asbestos fibers are known to cause serious health hazards in humans. Amosite and crocidolite are considered the most hazardous asbestos fiber types; however, chrysotile asbestos has also produced tumors in animals and is a recognized cause of asbestosis and malignant mesothelioma in humans, and mesothelioma has been observed in people who were occupationally exposed to chrysotile, family members of the occupationally exposed, and residents who lived close to asbestos factories and mines.

The similar things between asbestos and plastic are that they are both incredible material in a way. Asbestos has desirable physical properties such as sound absorption, average tensile strength, affordability, and resistance to fire, heat, and electricity. And plastic generally has the advantages of low cost, ease of manufacture, versatility, and imperviousness to water. That's the reason they were both widely used in multitude industries. Asbestos was used to be, or perhaps still, everywhere, just like plastic. They were in clothing, building, furniture, vehicle, and various types of equipment. When the concern about its health impact was first brought up, the asbestos industry denied the danger and convinced the public that it's safe to use in the right way. Until more and more workers in related industries died and the stakeholders of the asbestos industry could not cover it up, then more investigation proved its negative health effects which finally led to the strict regulation or the ban of this material. From this case, we can learn that only when the public can see the real damage -people's death- the material did then they really realize the seriousness of this problem and the necessity of a ban to this material. The health impact of asbestos was discovered since the early 1900s but it took 80 years or even more for the majority of the world to take action to control this pollution. Substitutes for asbestos were developed long before its phase-out. For example, fiberglass was invented in 1880 and its mass production started at the 1930s when is about the same time that people realize the harm of asbestos products, but still not until 50 years later that fiberglass started to widely replace asbestos in related industries. Even now some countries haven't completely banned the usage and production of this material, including the US, Russia, and China which are the top three countries in the world with asbestos mineral resources. We may assume that it's the stakeholders of the asbestos industry that slow down the regulation of this pollution. But in the case of plastic, things are more complicated. First of all, plastic is much more commonly used in our life than asbestos, so the scale of industry and the network of the stakeholders are much more complex. Besides the material itself is not as harmful as asbestos that will cause a fatal impact on the human body. No wonder it's been 60 years since the concern of plastic pollution was brought up and still, it has not been completely controlled now.



DDT

DDT was first synthesized in 1874.

From 1950 to 1980, DDT was extensively used in agriculture -more than 40,000 tonnes each year worldwide -and it has been estimated that a total of 1.8 million tonnes have been produced globally since the 1940s.

As its production and use increased, public response was mixed. At the same time that DDT was hailed as part of the "world of tomorrow," concerns were expressed about its potential to kill harmless and beneficial insects (particularly pollinators), birds, fish, and eventually humans. The issue of toxicity was complicated, partly because DDT's effects varied from species to species, and partly because consecutive exposures could accumulate, causing damage comparable to large doses.

In 1957 The New York Times reported an unsuccessful struggle to restrict DDT use in Nassau County, New York, and the issue came to the attention of the popular naturalist-author Rachel Carson. William Shawn, an editor of The New Yorker, urged her to write a piece on the subject, which developed into her 1962 book *Silent Spring*. The book argued that pesticides, including DDT, were poisoning both wildlife and the environment and were endangering human health. *Silent Spring* was a best seller, and public reaction to it launched the modern environmental movement in the United States.

Despite the worldwide ban, DDT is still being used in a few regions, especially in the third world, to fight against malaria, because of its low cost.

DDT is a persistent organic pollutant that is readily adsorbed to soils and sediments, which can act both as sinks and as long-term sources of exposure affecting organisms. Depending on conditions, its soil half-life can range from 22 days to 30 years. Routes of loss and degradation include runoff, volatilization, photolysis and aerobic and anaerobic biodegradation. Due to hydrophobic properties, in aquatic ecosystems DDT and its metabolites are absorbed by aquatic organisms and adsorbed on suspended particles, leaving little DDT dissolved in the water (however, its half-life in aquatic environments is listed by the National Pesticide Information Center as 150 years). Its breakdown products and metabolites, DDE and DDD, are also persistent and have similar chemical and physical properties. DDT and its breakdown products are transported from warmer areas to the Arctic by the phenomenon of global distillation, where they then accumulate in the region's food web.

Because of its lipophilic properties, DDT can bioaccumulate, especially in predatory birds. DDT is toxic to a wide range of living organisms, including marine animals such as crayfish, daphnids, sea shrimp and many species of fish. DDT, DDE, and DDD magnify through the food chain, with apex predators such as raptor birds concentrating more chemicals than other animals in the same environment. They are stored mainly in body fat. DDT and DDE are resistant to metabolism; in humans, their half-lives are 6 and up to 10 years, respectively. In the United States, these chemicals were detected in almost all human blood samples tested by the Centers for Disease Control in 2005, though their levels have sharply declined since most uses were banned. Estimated dietary intake has declined, although FDA food tests commonly detect it.

Despite being banned for many years, in 2018 research showed that DDT residues are still present in European soils and Spanish rivers.

While DDT has an identical way of polluting the ecosystem as micro-plastic. It can accumulate in creatures' body and magnify through the food chain, and finally get into the human's body. And it is resistant to metabolism so it will stay in our body for years. DDT is toxic to a wide range of living organisms, including marine animals and birds. The application of DDT started from the early 1900s and reached its peak from the 1950s to the 1980s. While in 1962, a book written by Rachel Carson, called *Silent Spring*, played an important role in opposing the using of DDT and eventually led to the ban of its agricultural use in the USA in 1972. And this book also launched the modern environmental movement in the United States. This shows how important is it to raise public awareness when dealing with environmental problems. 60 years ago, a book can do it, what about now? While media have changed a lot nowadays, and movies and TV shows might have a bigger influence than books. And we do have some great documentaries and TV shows focusing on plastic pollution in recent years, such as *Plastic Ocean*, and *The Blue Planet*. They are doing a significant job in spreading the message. I can imagine they awaken the awareness of grow-ups, but what about the kids? Can they relate? Can they comprehend the information they received? Could there be a more suitable media to send this message to the next generation? These questions worthy of our consideration.

It is a long fight, and there is simply no "one perfect solution" for this kind of problem, what it takes is hundreds of thousands of small steps, one after another. And I think, among all of them, the key is to show people its impact directly, which is hard because we can't see the microplastic, we can't prove they have direct impact on us yet; we can't tell animals are suffering from plastic, in facts, we don't even see or care wild animals that much; and we don't notice how bad our world are drowned by plastic already, especially in developed country, everybody put the plastic waste in recycling bin, and they are carried away, sent to another part of the world, everything seems nice and clean, no problem at all. That's why we need more people to see through it, keep it in their minds, and be really scared of it. That's how we start and maybe to win the fight.



Next generation: Be aware

Plastic waste can stay for hundreds of years, this is destined to be a long battle, which may last for generations. Therefore, this is our job to integrate this concern into their education in the early stage. Based on my own experience, that I also learned about it from school when I was a kid but I wasn't really related to it and didn't really concern about it, I think only bring this up in the textbook is not enough, neither is introducing them the recycle system. We should guide the young generation to rethink plastic (refuse and reduce), especially when they are born in a world that is full of this material, which may blind them from the existing problem. Besides instill the concern of plastic pollution in their mind, more importantly, is to cultivate their habit and behavior into a more eco way. However, what is the most effective way to achieve these goals? In my opinion, except for including it in their formal education, integrate it in their playtime will also be significant. Learning while playing, when there's more fun, kids will be more willing to accept it and pay more attention as well. In addition, try to provide them a more eco living environment to grow up is essential, like using less plastic products in daily life but instead, introducing more products made of natural materials. Forming an eco-lifestyle in their early stage will make a huge difference in their future life.

Drown by plastic: Toys market research and its influence

When talking about kids, we have to talk about toys. This is one of the kinds of products that they spend most of their time with. However, the toy industry is obsessed with plastic. Most of the toys today are made out of plastic. A photographer works for National Geographic, Gabriele Galimberti, is doing a project called "Toy Stories", which is about kids around the world and their toys. Kids from every corner of the world, ranging from the US, Australia, Sweden, Italy to China, Thailand, Botswana, Zambia, ages from 3 to 6, boys and girls, most of their toys are all plastic. Totally 53 photos, in 41 countries, I don't think it's a coincidence or personal preference of the photographer, this is the facts of the toy industry nowadays.



I think it's a worrying thing. Just like our unhealthy dependence on our cellphones right now, we all know it's bad, and we certainly don't want our kids to have this problem. But kids tend to own a cellphone younger and younger. And when they love to play with their phones and you just indulge them to do it all the time, what do you think would happen? Same in the case of plastic products, if most of the things they use and play with are plastic, very naturally, it will become their norm and comfort zone. Think about ourselves, how many things we own, we use, we consume in our daily lives are plastic? If you really count it you will realize, that's much much more than we thought, basically everything. Why didn't we notice it? Because it's our norm.

Existing educational toys and eco-toys



Toys' product life

The product life of toys is extremely short compare to other products. It's not because they are easily broken, but because of their growing speed. The ages range of the target group of an adult's product could be 10 years or even 20 years, while for kids, the age range has to be subdivided into 1 to 3 years or even months. And they learn so fast, and lose their interest so fast as well, that they constantly demand new stuff to fulfill their growing needs. While the short product life means a large amount of waste if they did not enter the second-hand market. Which makes toys one of the biggest contributors to plastic crisis right after single-use plastic packaging.

An interview with a mother with a two-year-old daughter

Q: What kind of toys does she usually play with?

A: Mostly is a set of educational toy that comes with a matching book. It is kind of a publication I subscribed to. There will be different toys every month along with the monthly issue in different themes.

Q: What kinds of educational toys are there?

A: For example, building blocks, to train the flexibility of her finger; a fake microphone, so that she can sing; some poems and songs are also included in the books; and a toy mob to let her exercise and cultivate her responsibility of cleaning. Basically everything. You know, a single toy can't fulfill all the needs of a kid, they will lose their interest quite soon. It's good to have a couple more so she can switch.

Q: In all these aspects, which one do you value the most?

A: I hope she can develop well in all aspects of course. But at this age, I think the body coordination ability is most important. When she grows older, like 4-7, I think LEGO would be a good choice, for her creativity, but I prefer she does more outdoors activities rather than playing with toys then.

Q: Who made the choice of buying this kind of toys?

A: Me. It's still too young for her to make the choice. She generally likes everything at this age, especially dolls. Actually, kids like this don't care if it's educational or not, fun is all that matters.

Q: Did you ever have consideration of the material of the toys?

A: Yes. The building blocks she has are made out of rice. And other plastic toys should not have BPA. It's very important that it's easy to clean up. I've seen some wooden toys, but I guess wooden toys are easy to grow mold, especially in moist areas. And there are very few natural material toys in the market, most of them are plastic. Plastic toys tend to last longer I think.

Q: How long do you think the product life of a toy can be?

A: It's hard to say. About a month I think, if she plays it every day. Then she will get bored. But sometime she will turn back after a while.

Q: Have you ever received old toys from other people instead of buying them? Do you have any plans on how to deal with the idle toys?

A: No, I haven't received any old toys from others. And for now, I kept all her toys so far. I think I can leave them to my next child if there's a next one (laugh). Otherwise, I think I will sell them online or donate them to the kids from poverty areas.



Age group and early education

I did some research about early education, try to target an appropriate age group and learn about their interests and behavior. Below is some related information I sorted out from a guidebook of early education for children from 3 to 6 years old.

3~4 years old:

1. Like to ask grow-ups to tell them stories and read them books.
2. Can understand images and can tell what is happening in the picture.
3. Can understand the text that matching with an illustration.
4. Can sense and discover the soft, hard, smooth and rough properties of objects and materials.
5. Can follow basic rules with a reminder.

4~5 years old:

1. Like to read the books they like repeatedly, and tell the story they learned to others.
2. Can tell the story based on the information from a comic.
3. Will have emotional reactions according to the story.
4. Should be told to save the food, water, and electricity.
5. Should be encouraged to explore objects and materials.
6. Can gather information through simple research.
7. Can sense and discover the properties or uses of common materials.

5~6 years old:

1. Can read a book intently.
2. Can guess the development of the story based on part of the plot or the clues of the pictures, or even complete a story by themselves.
3. Will have their own opinion on the story, and can discuss the content with others.
4. Should be told to care about our environment and save resource.
5. Will be emotionally related to their exploration.
6. Can do a simple analysis of the information they gain from research.
7. A preliminary understanding of the close relationship between people's lives and the natural environment, knowing to respect and cherish life and protect the environment.

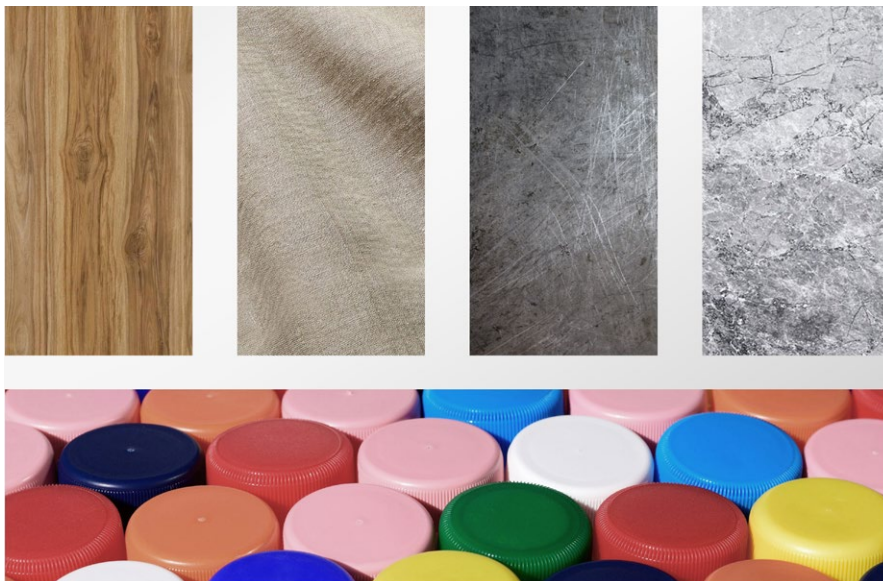
Based on their reading, understanding and thinking ability, and in order to match the content they are taught, I decided to set the target age group at 4~6 years old.

Ideation

So, I decided to make an educational comic matching with a set of modular eco-toy figure. Aiming to tell the story about plastic in a fun and metaphor way, and encourage them to play with and get along with different natural materials, by doing so, guide them to rethink plastic.

Educational serial comic

The concept of the comic is to characterize different materials, including conventional natural materials and of course plastic. Put them into a fantasy world where they have their own species and their own society. The story will focus on their adventure and how they face the unexpected plastic crisis. As for the choice of material, I chose 4 kinds of traditional material we use the most, wood, metal, stone and textile.



Is plastic all bad? Possible side effect on children

Despite the huge pollution they caused, plastics are critical to modern life. Plastics made possible the development of computers, cell phones, and most of the lifesaving advances of modern medicine. Lightweight and good for insulation, plastics help save fossil fuels used in heating and transportation. Perhaps most important, inexpensive plastics raised the standard of living and made material abundance more readily available. Without plastics, many possessions that we take for granted might be out of reach for all but the richest Americans. Replacing natural materials with plastic has made many of our possessions cheaper, lighter, safer, and stronger.

I don't think plastic is a bad material, actually, it's incredible in some way. The environment tragedy is due to our loss of control of the usage of plastic. For example, some high-quality plastic products that can be used for a lifelong time or even pass on generations should be encouraged, while those single-use unnecessary plastic packaging are the things that should be banned.

Therefore, as a story based on facts, the right message should be sent. The characters' development should stay critical. For instance, even the villain characters should not be evil for the sake of evil, instead, they might have their pity side, which requires a deeper character development.

It's important to avoid causing an inappropriate impact on children, which is a violation of the original intention. Again, this project is against plastic pollution, not the material itself.

Story telling based on facts

The setting of the story is based on facts, reflecting the real problems happening in real life. Here are some examples of story setting and their representation in real life:

The unexpected bloom: The invention of the first plastic 160 years ago started a new age in the world. The explosion of new types of the plastic following by its mass production and application make this material rapidly replace conventional material and take most of their market.

The undefeatable army: Plastic has incredible durability and flexibility thanks to their molecular structure. And certain types of them can be melted down and molded again to have a second or dozens of lives.

Polly in control: The widely use of this material and our dependency on it results in our lost control of plastic. They are everywhere in our lives, they become something we can't avoid. So much so that even they have already caused huge problems in our environment, we can't do much about it.

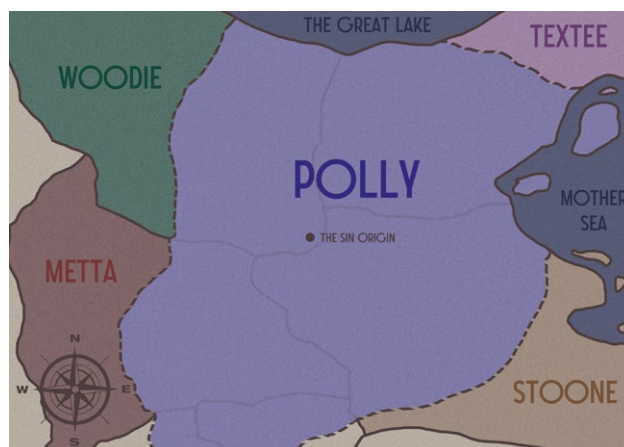
Micropolly crisis: Micro-plastic is already inside the body of every creature in every corner in the world, carrying mixed chemicals with potential health effects. Their existence in the food chain is hardly noticed and almost impossible to avoid.

Story outline

North to the Great Lake, East to the Mother Sea, the fantasy world was ruled by 4 main nations together: Woodie, Metta, Stoone, and Textee, with dozens of many other small nations as well. Peace has been maintained for hundreds of years. Communication and trading between nations are encouraged and supported.

All is fine until the unexpected bloom started at the sin origin. The Polly family was born and start growing at an unbelievable speed about 160 years ago. With their rapid expansion of the population, they started invading other nations. Wherever their undefeatable army goes, wherever was ruined. After continuously step back, the 4 old nation called on a united army to fight against the Polly together. But still failed after a hard battle, with most of their land's been taken.

Now, even though some small scale of resistance still happening from time to time, the Polly has basically taken control and still expanding. And a micropolly crisis is coming quietly.



Modular eco toy figure

The idea of the modular toy figure is to provide children blocks of different natural materials to build their own toy figures, originate from the 4 main characters in the comic. The materials include those 4 categories, wood, metal, stone, and traditional textile, and more could be added. The modular design of the construction and the blocks should allow random combinations between different materials.



Be in touch with the nature

The concept of letting children play with a variety of natural materials is to show them the wonder of nature, subtly instill them the awareness of being environmentally friendly, cultivate their sympathy to nature, at the same time, give them a break from plastic products. What's more, they can learn from it, about the properties of different materials.

Creativity

Creativity is one of the most important things that we should cultivate to our children at a very early stage. As a modular toy, it provides the chance for kids to develop their creativity. By choosing different materials blocks, playing with different combinations, they can create their own figures. And dozens of possibilities will make their interest last longer.

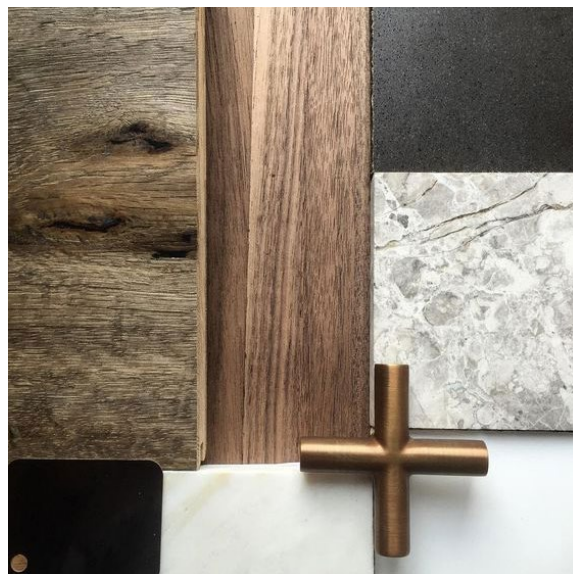
Advantages and disadvantages of natural material comparing to plastic

Plastic dominated the toy industry for a reason. For example, they are cheap, they are easy to manufacture into complex form and shape texture, they are easy to clean and can last longer, not to mention they are colorful. We all know that kids love colorful things! But plastic toys also have problems like aging, they become brittle and start fading. Also, parents need to be very careful about certain chemicals that commonly used in the plastic products, which should not be in a toy for children.

Natural material can be very colorful too! Only wood itself has a considerable amount of different color and texture, from red to dark brown, from white to gray-green. Not to mention materials from other categories.

Differ from plastic's aging, natural materials like wood, stone might show more charm with time goes by. Plastic products will become less valuable with abrasion while a little defect, on the opposite, will give eco-products a sense of history, maintain or even increase their value. All these features, allow eco-toys to be shared and passed to another family for a second life, which would be less possible in the case of plastic.

Plastic can be easily melted and molded into any specific complicated form, while the processing of conventional material is way harder. A detailed figure is cool but also it's well defined, which means it will limit people's imagination. On the contrary, a relatively simple abstract toy can give plenty of room for kids' free imagination, which is very beneficial for their creativity development.



What does eco mean besides eco material? Sharing and passing

What does eco-toy mean besides using eco materials? I think it also should communicate an eco-lifestyle to the kids through the playing process. For example, instead of continuously buying new figures, the kids can create and build new characters themselves by the existing modular components, in which way also encourage creativity.

In addition, because of the relatively short product-life of toys -kids are tend to lose their interest of one toy easily after a certain period of time even though it was once their favorite, the possibility for sharing or passing these toys should be considered, in order to lengthen the product-life and reduce the production-consumption. How to encourage sharing and passing, how to make secondhand toys more acceptable are the key issues here.

Matching with the comic: Knowing your toy

Learn from my interview, combining the toy to a storybook or a comic might help increase the kids' interest in this toy. With the character development and the story around it, it becomes more interesting than only a random figure itself. It can open the imagination of the kids, and therefore can make them pay more attention to it and also potentially make the product-life of the toy longer.



The existence of this kind of product in the market shows that it's already a successful business model. And it's worthy to learn from it.

The P Age: the script

The P Age

Chapter 1 Micropolly

Scene 1

“Sometimes, I rather be in here...” Looking at the dilapidated scene outside the bars, Simen said.

“No...” said Yeo.

“What do you mean no? Look at this, totally a mess! It’s not the pretty world it used to be anymore. Do you still have the desire to escape under this circumstance?”

“Yes...”

“Hum..I don’t understand you Yeo..well but I guess I didn’t understand you all the time.. since..you know.. you don’t talk too much..”

“No...”

“But that’s good, people used to said I talk too much. So we are perfect to each other! Right? Buddy!!”

“...”

[crunch, crunch, crunch] *footsteps sound*

“Sounds like we will have a new buddy today!” said Simen excitingly.

footstep sound gets closer

The new prisoner was put in the cell across the aisle, a chubby woodmate with a headphone on.

“Hello mate! How are you feeling? Still hanging in there? How you end up here? Don’t worry! We got you! Right Yeo?” Simen continuously said.

“You talked too much.” said the new prisoner.

“Oh yeah! He can speak!” Simen yelled excitingly.

“...” Yeo & new mate.

“You have no idea how long I’ve been waiting for someone like you!”

“Someone like me?”

“Yes! Someone like you that can say at least ...1 2 3 4...7 words!! Anyway, my name is Simen, from the great Stoone nation as you can tell, and this is Yeo, well..at least that’s how I called him because he can only say ‘yes’ and ‘no’ ..” Try to reach out his hand while talking.

“ok..I’m Ale. Nice to meet you.” Reaching out his arm as well but couldn’t touch Simen’s hand because it’s too short.

“...” Yeo quietly shook Ale’s hand easily with a long arm.

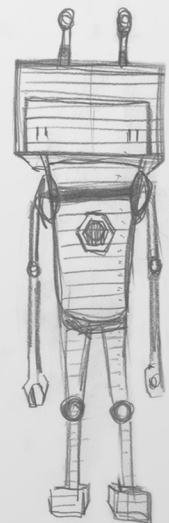
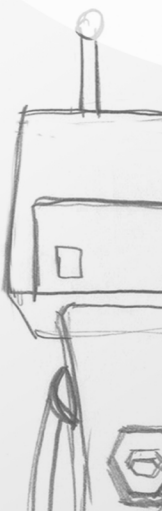
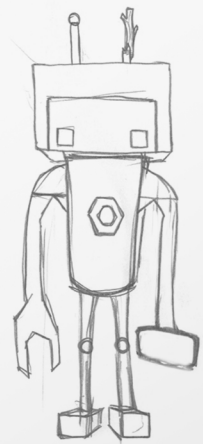
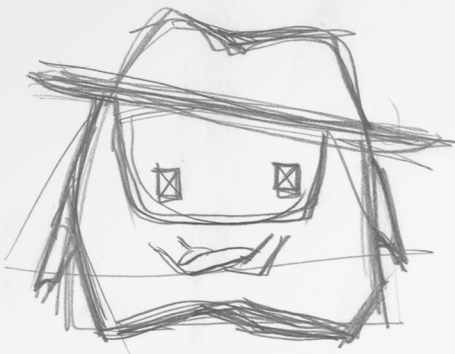
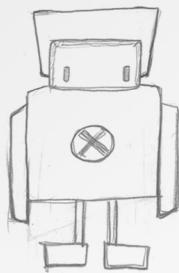
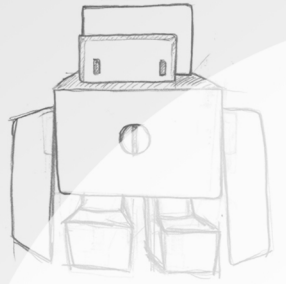
“Wait..Wait..Wait!! That’s not fair!!” Simen turned back and heartbroken at the corner.



First
sketch

round
ching





S
sketch

Considering the toys are matching with this comic, the figures should be based on the characters as well. Therefore, I decided to keep the characters in simple shapes that are possible to be manufactured using natural materials. So in the second round, I developed more ideas I like from the first attempt, added more details based on their personalities, and background story.

Second round Designing and sculpturing



FINAL ADJ

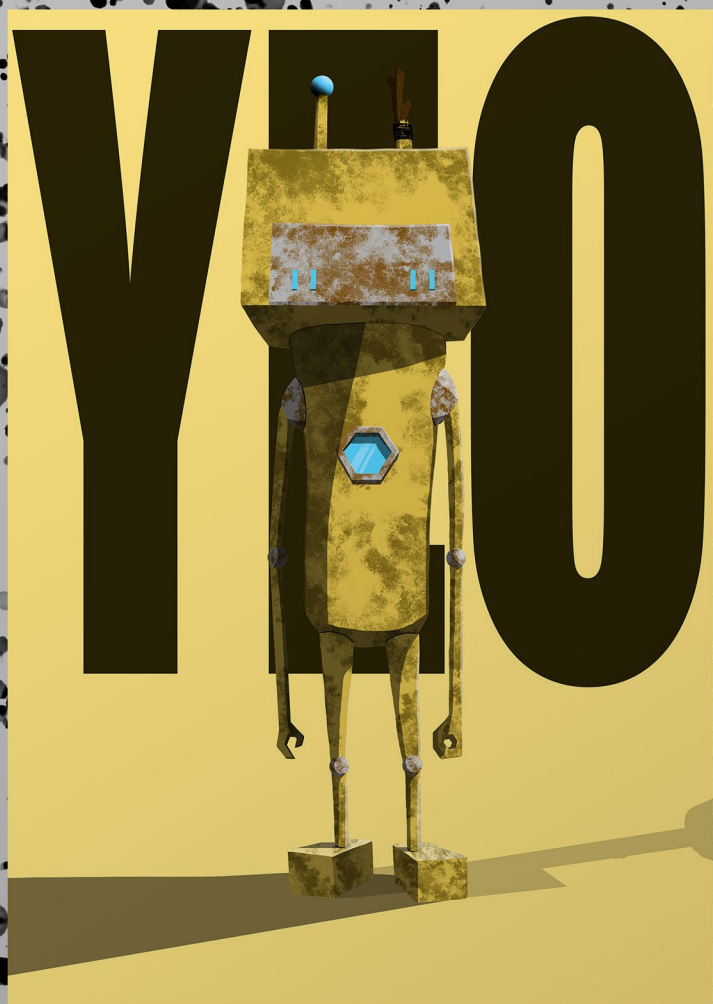
SIMEN



AME



USTMENT



SIMMONS



Simen

Stoone nation, cement

A young scholar from stoone nation, were captured when the Polly army invaded without any resistance..

Always wearing a hat try to make up his height. Short arms and move slowly but knows a lot. Longing for others` recognition, so talks a lot, but an awkward joke maker. Always being meant but actually kind inside.

Ale

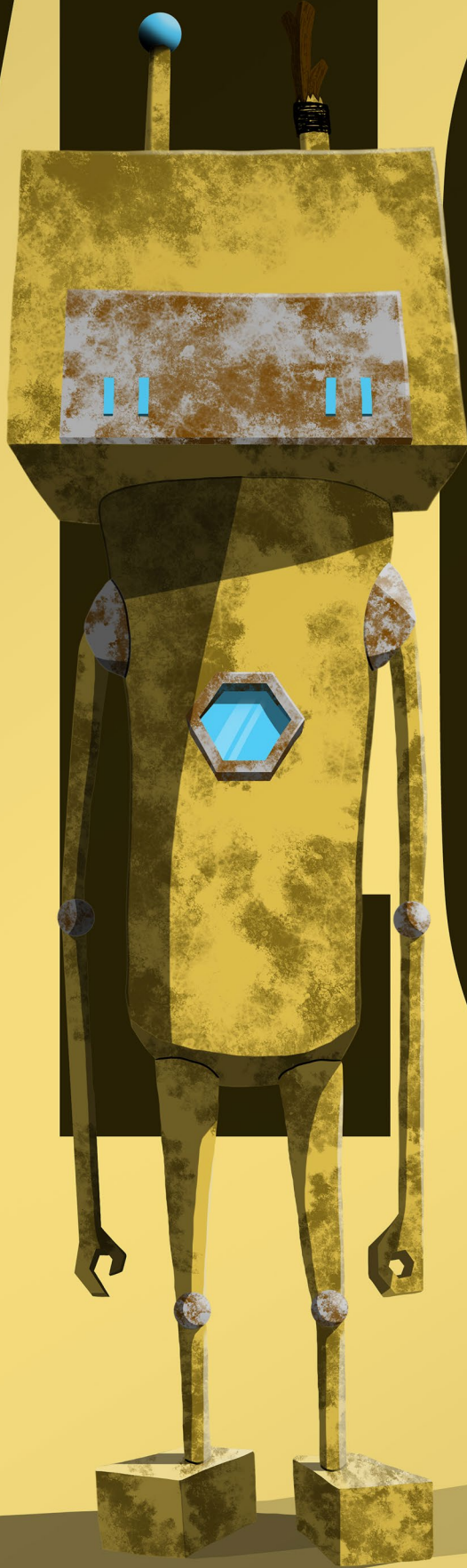
Woodie nation, alder

An ordinary soldier of Woodie nation, survived the United War against the Polly, but lost one of left ear. That`s the reason why he always wearing an earphone hiding his ear defection. When wandering after the war, he picked up a piece of fabric at their ruined temple, which he wear later as a sumo clothing.

Chubby and weighty, gentle and humble normally, but dominating when he gets angry, which rarely happen.



W



O

Yeo

Metta nation, brass

Son of King Aurum of Metta nation, real name is Brazz, but during the fight with Polly army, one of his aerial was broken, lost most of his language ability, "yes" and "no" are the only two words left that he can say. Captured and sent to the prison after the battle, where he met Simen, who named him "Yeo" .

Brave and a good fighter. Always gets all the jobs done quietly. Getting rusty after staying in the prison for a long time. Simen stuck a branch on his broken aerial, trying to fix it but not succeed...Carrying a powerful seed, a gift from Woodie nation years before, with him in his core all the time, which is a secret that nobody knows.

Nee

Textee nation, linen

Became a member of Anti-polly association after they lost the United War. An incredible assassin, helping people all around the world to fight against the Polly army. Rescue people that were captured by the Polly from time to time. Broke into the prison where Simen, Yeo and Ale were, helped them escape.

Under her bamboo weaved hat is her double-buns. Love wearing her felt cloak, acting cold but actually warm-hearted. Doesn't like arguing, instead, just act determinedly when she make up her mind.

ME



TWINNS



HOPPE

"Twins"

Kingdom of Polly, HDPE/LDPE

No.2 & 4 of the Seven Elders, leaders of the kingdom. Smart, devoted into scientific research. Micro-polly is their latest work, using their prisoners to conduct body test.

Argue to each other a lot usually.

“Poison”

Kingdom of Polly, PP

No.5 of the Seven Elders, leaders of the kingdom. One of the oldest in Polly Kingdom. Will get angry everytime people call him “bubble head” .

Sophisticated tactician. Made the strategy to rule the world.

PRISON





"Opium"

Kingdom of Polly, PVC

No.3 of the Seven Elders, leaders of the kingdom.
Insidious, extremely dangerous.

Quiet but attacks fatally.

"Sting"

Kingdom of Polly, PS

No.6 of the Seven Elders, leaders of the kingdom.
A living joke. Surprisingly kind to others.

Harmless or even cute appearance, but could be a
bait, like his sting, colourful but poisonous.

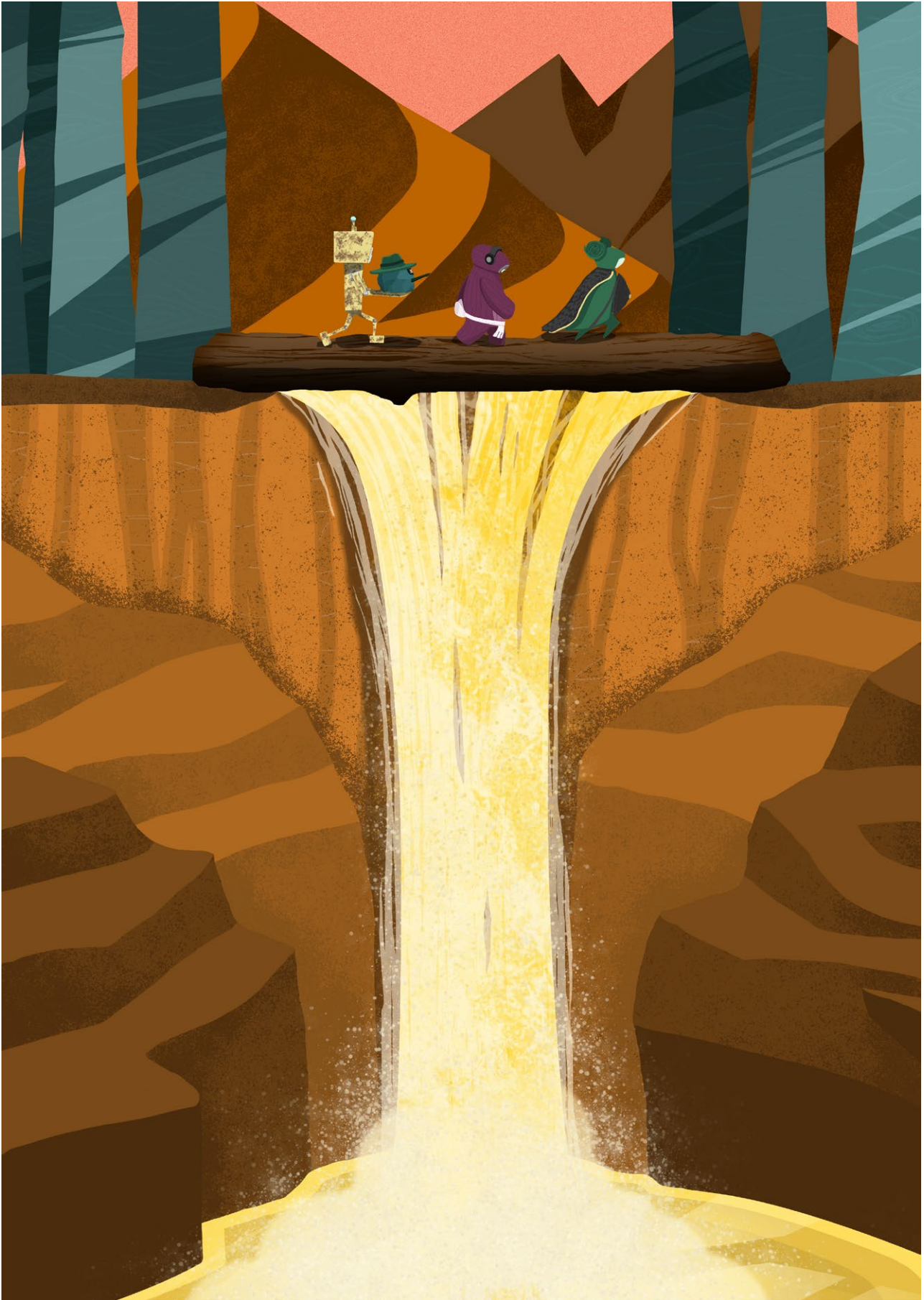
STING



The P Age: conceptual illustration





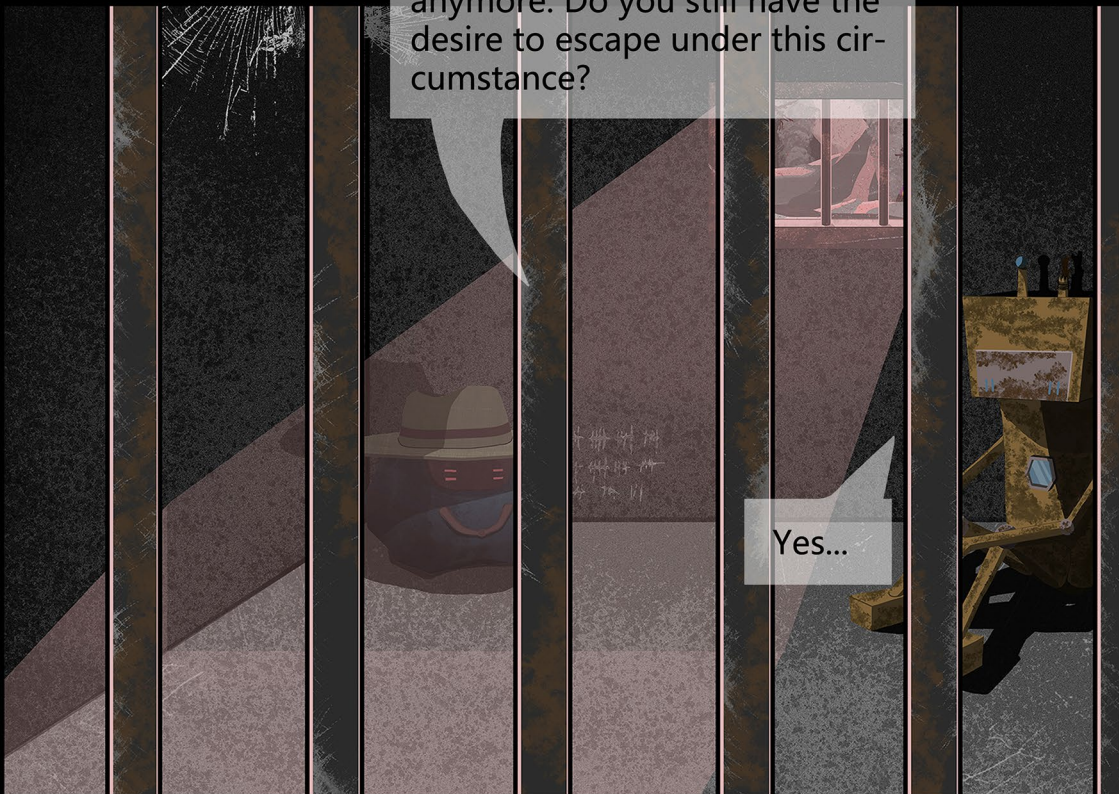




Sometimes, I rather be in here...

No...

What do you mean no? Look at this, totally a mess! The world is not as pretty as it used to be anymore. Do you still have the desire to escape under this circumstance?



Yes...

Hum..I don' t understand you Yeo..well but I guess I didn' t understand you all the time.. since..you know.. you don' t talk too much..

No...

But that's good, people used to said I talk too much. So we are perfect to each other! Right? Buddy!!

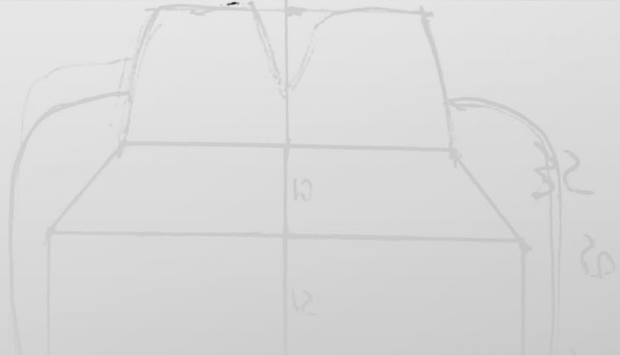
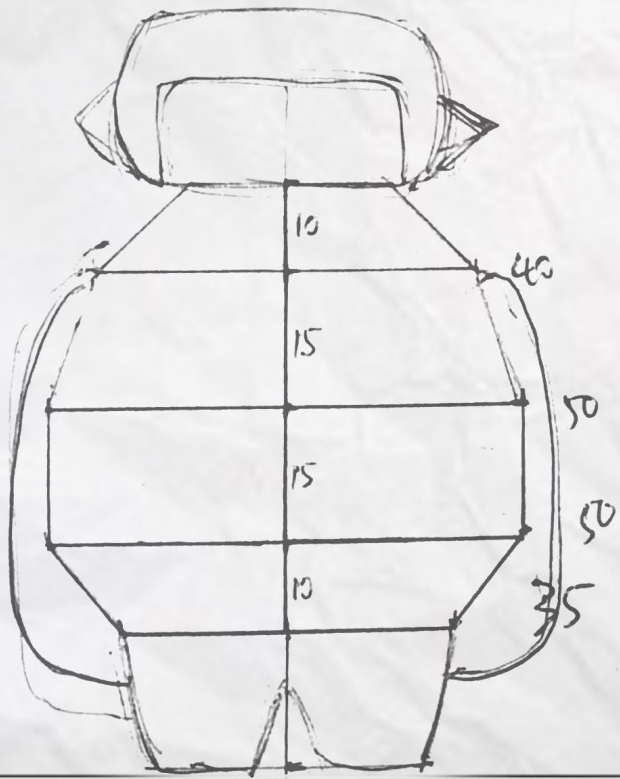
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crunch

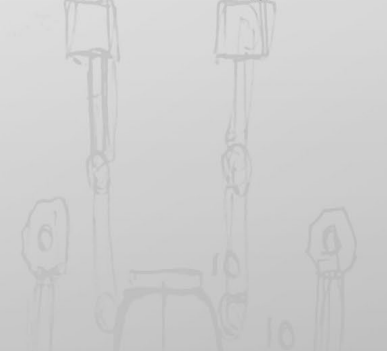
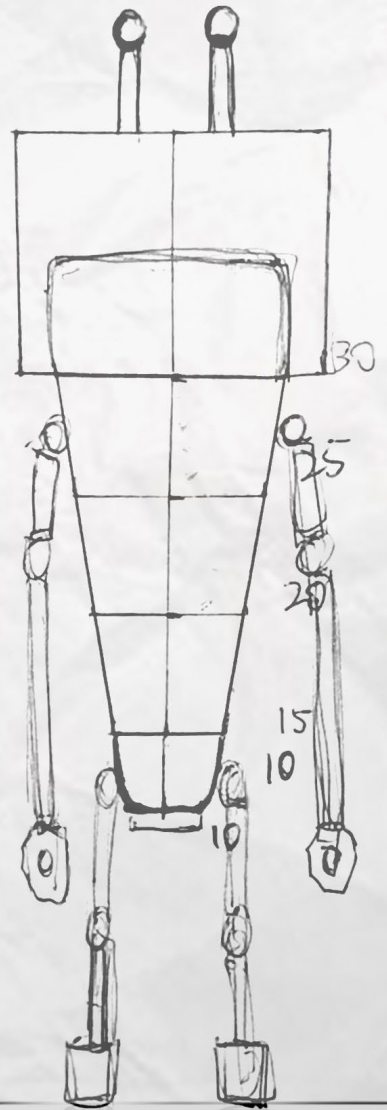
crunch



Alex



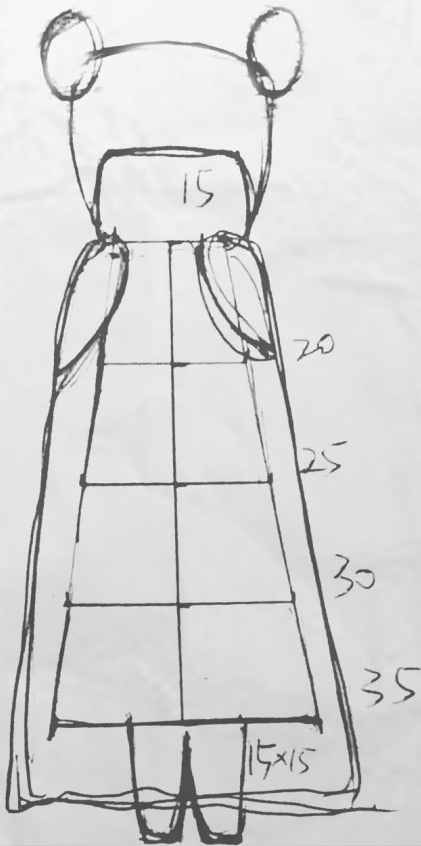
Yeo~



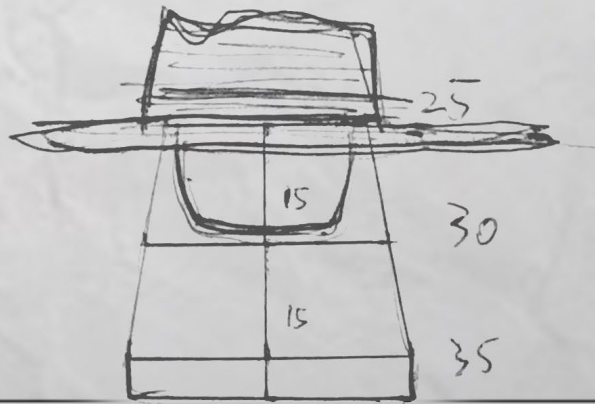


Sketching for modular eco toy

Nee



Simen





Mock-up 1: the weaving expression







Mock-up 1: the weaving expression







Mock-up 2: the stacking figure

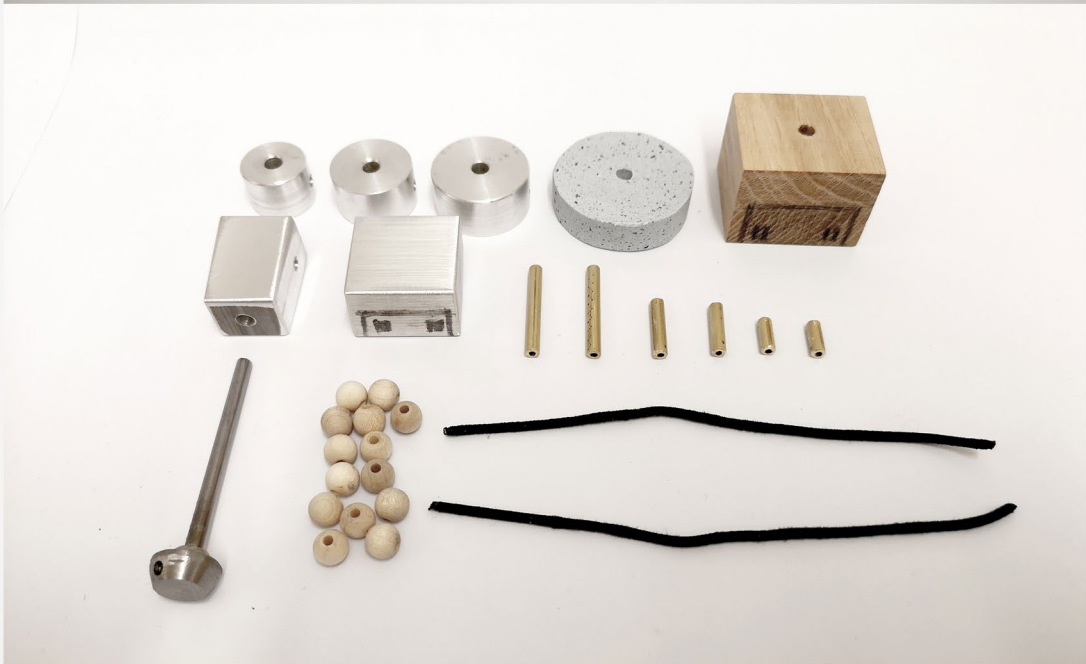
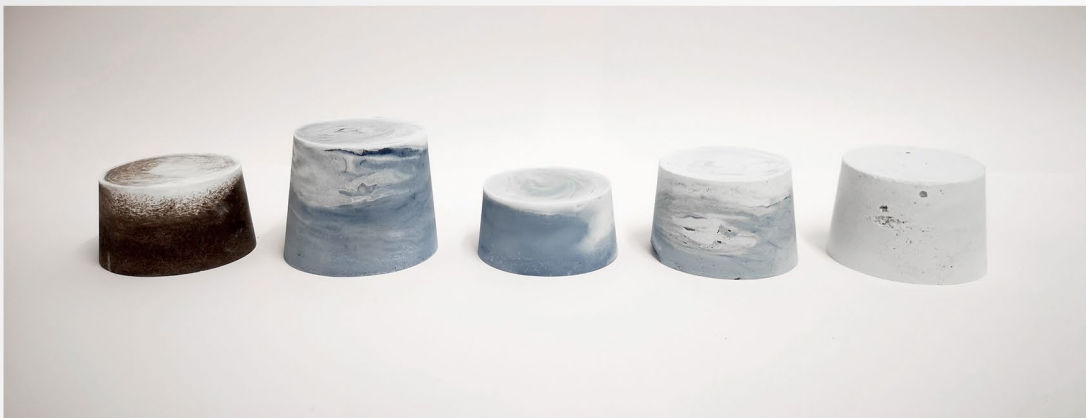
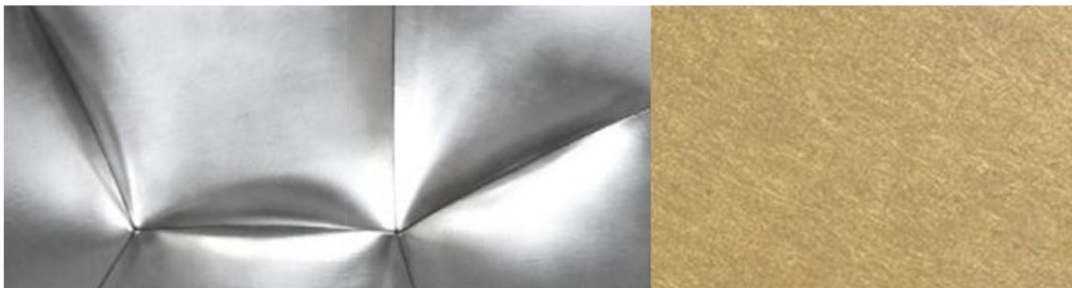




Figure U Out:
Material choices



Based on beech and decorated with walnut.



Stainless steel and brass for metal category.

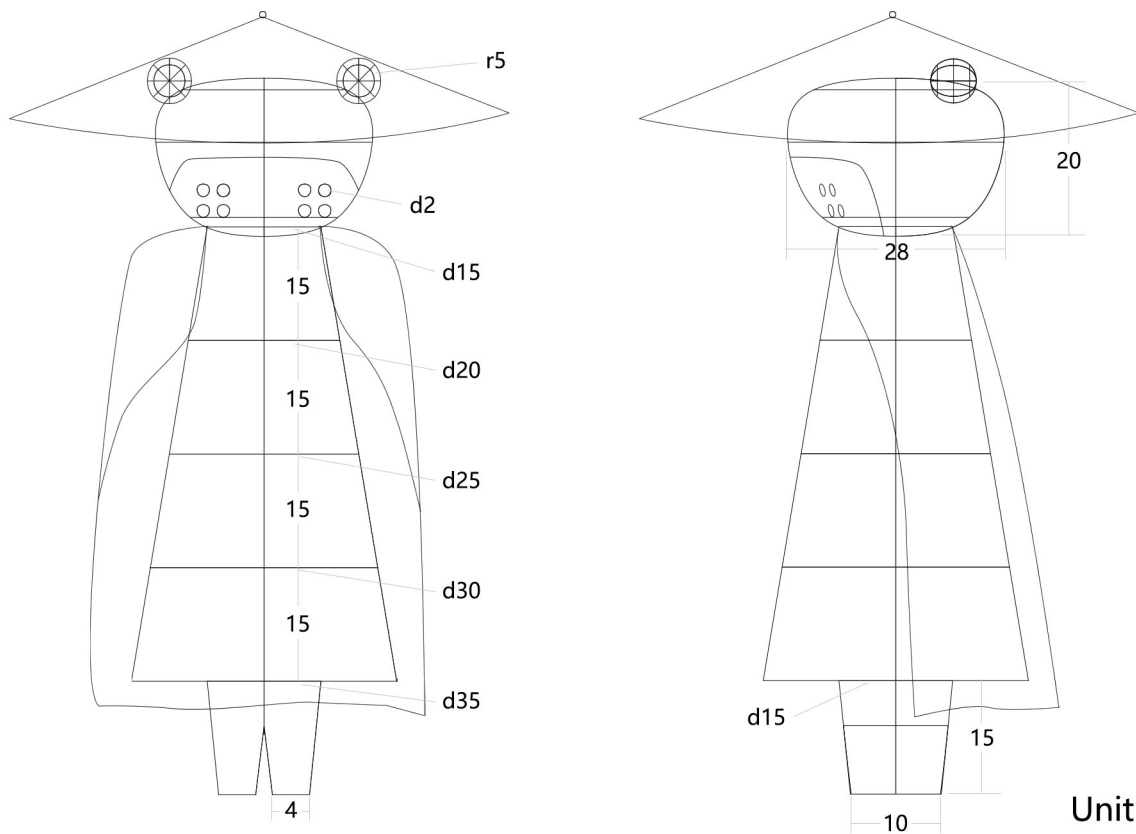
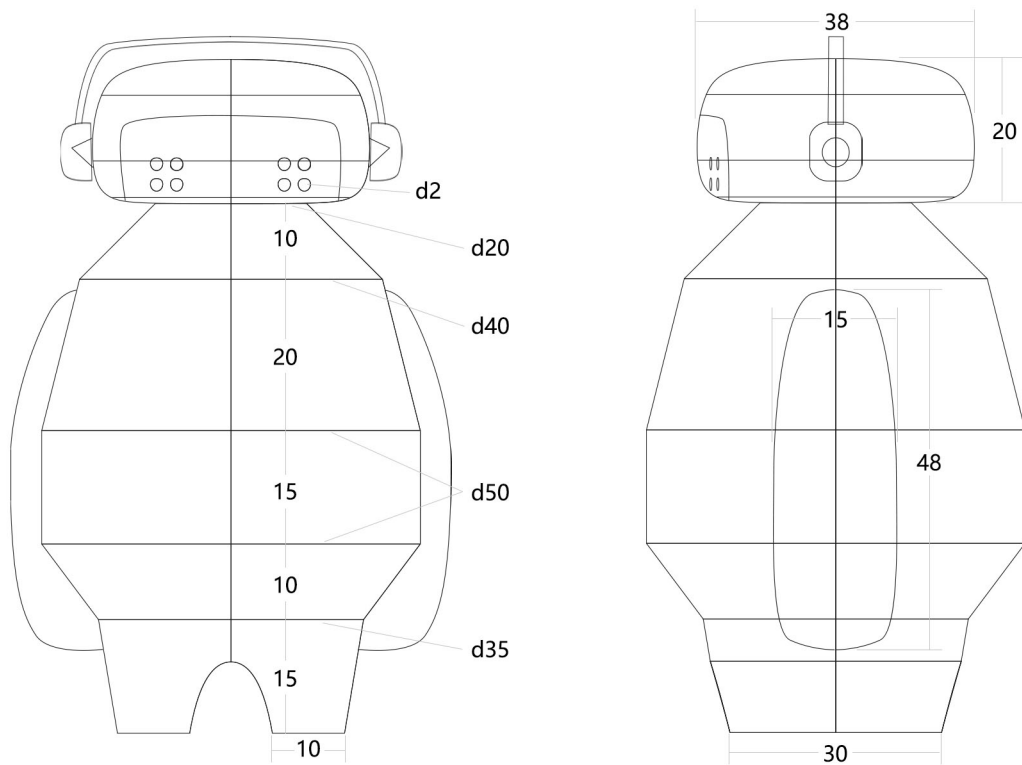


Linen and wool represent textile material.

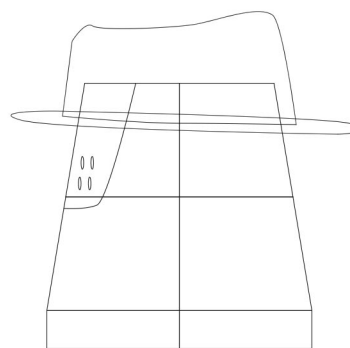
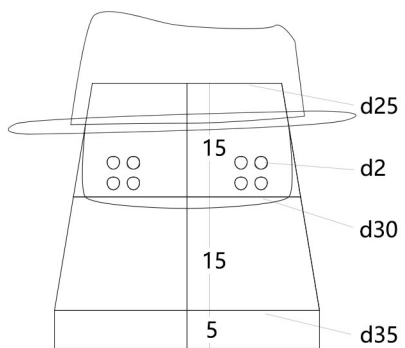
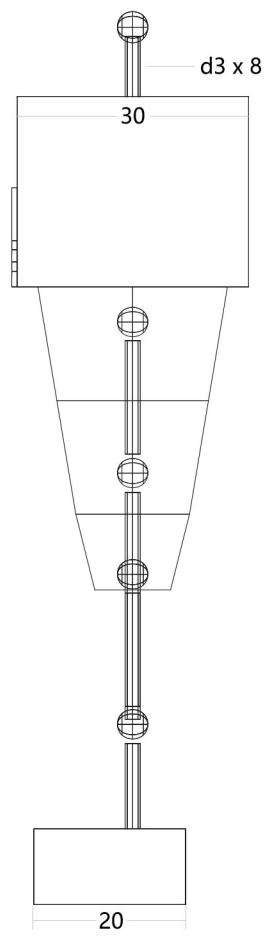
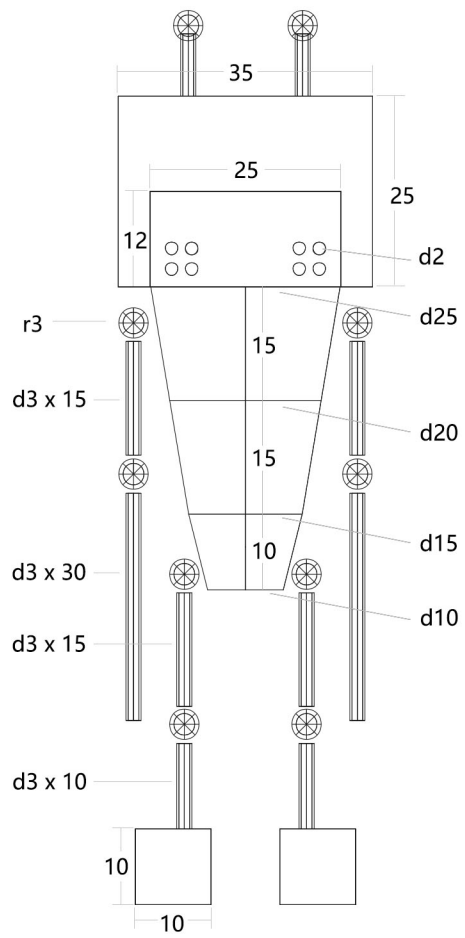


Stone plaster with acrylic paint to mimic the texture of stone.

Figure U Out:
 Technical drawing



Unit : mm



Unit : mm



FIGU



RE U OUT







FIGURE U OUT

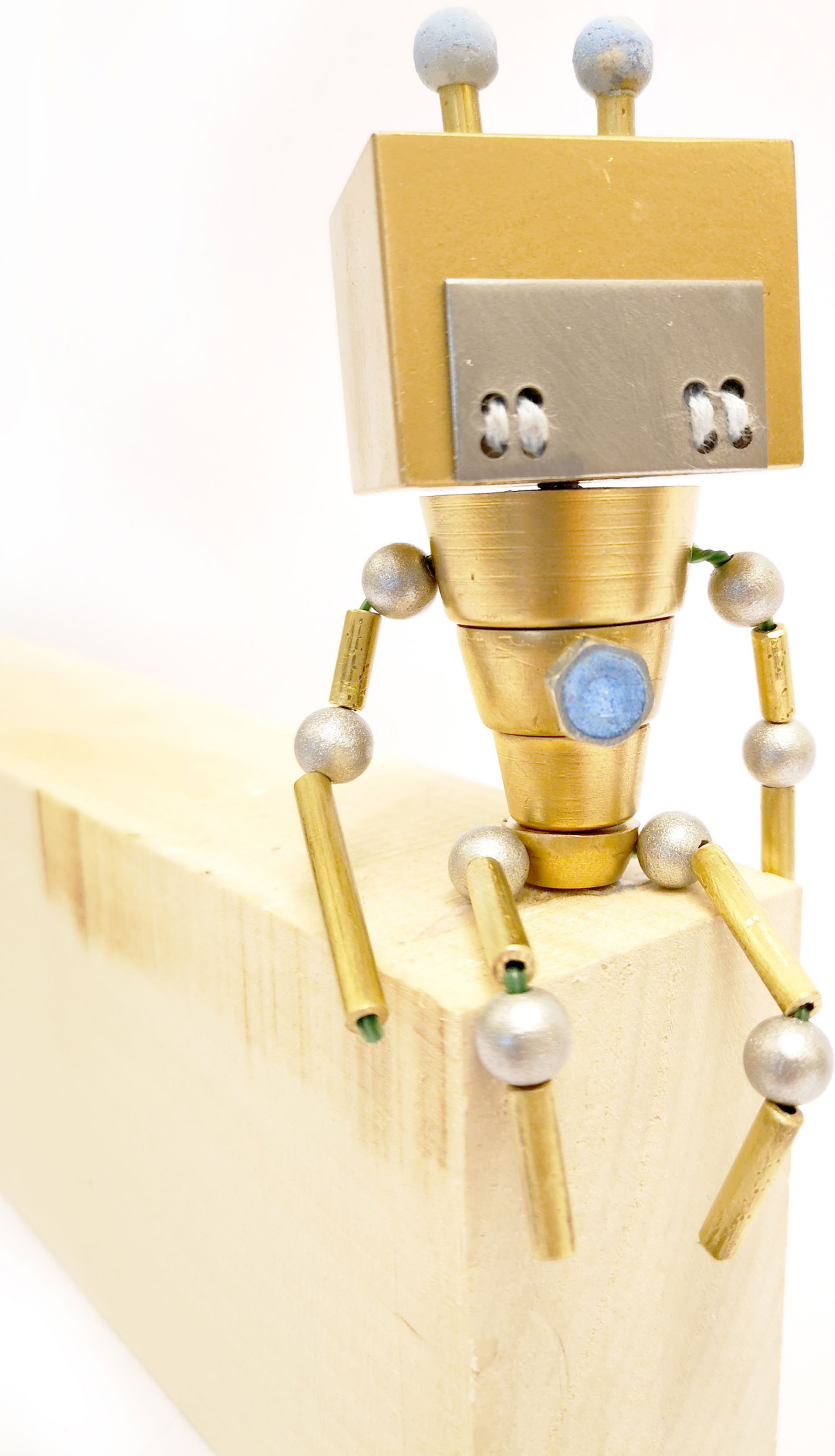
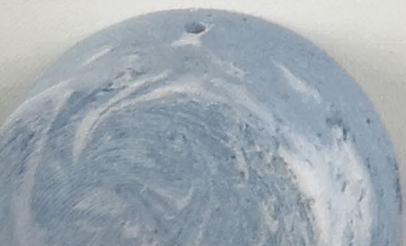
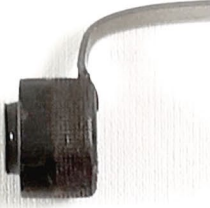




FIGURE U OUT



FIGURE U OUT



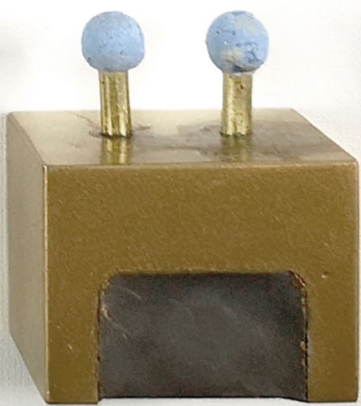
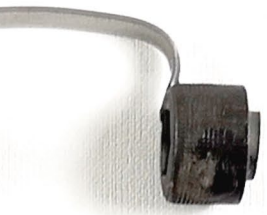


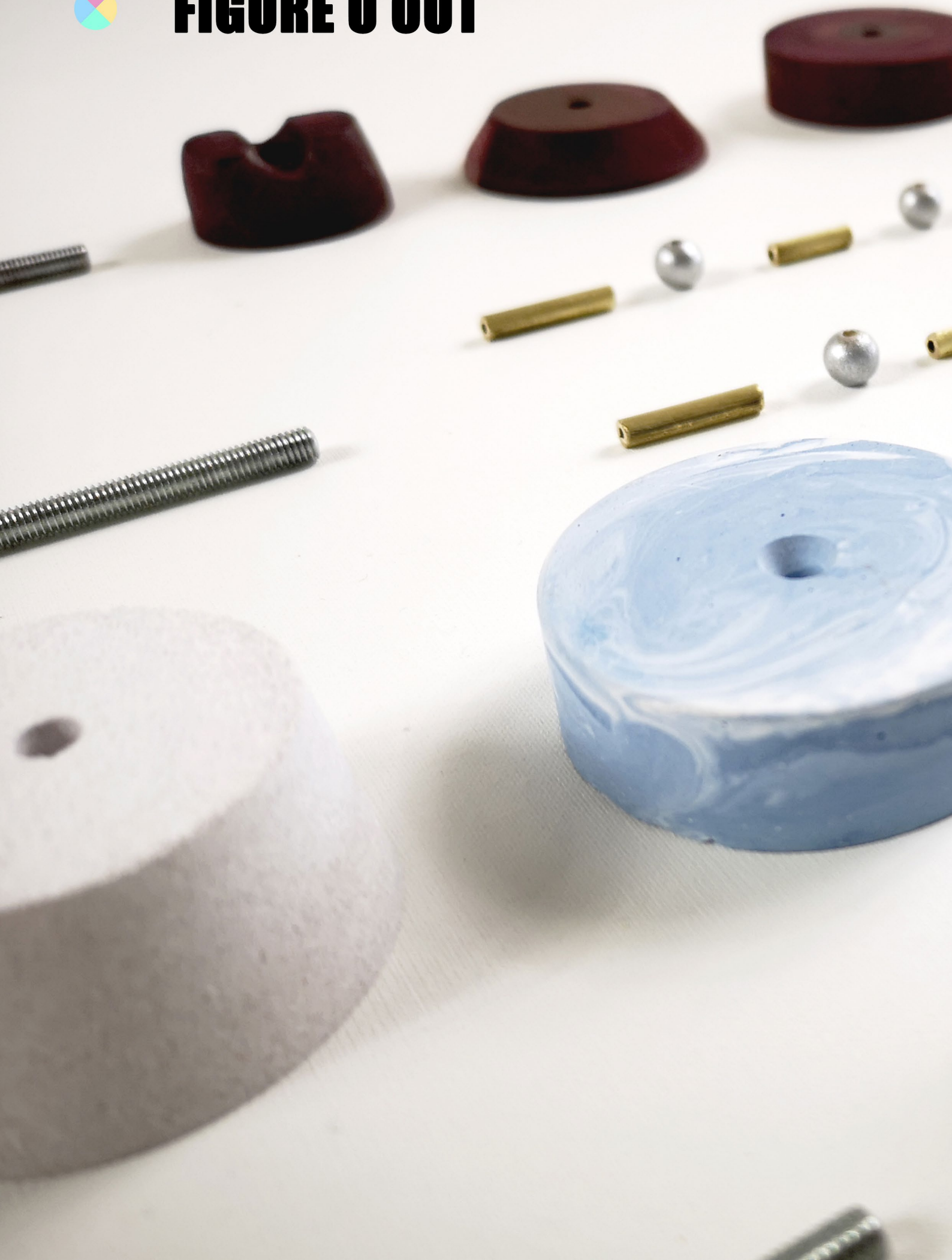


FIGURE U OUT





FIGURE U OUT





This project is unfinished yet. The set up of the comic is just started. The main character development is almost done, with a well-designed story outline, but the background world need further construction and more supporting character need to be developed. And it's supposed to be a serial comic, so I will continue my creation, and hopefully, will publish it online. In additionally, I will reconsider the drawing style and content according to the feedback from children once I show them the sample. Some suggest that it might be too dark for kids from 4 to 6. But I argue that 4-6 year-old is just a starting age group, older children or even teenagers are more than welcome to read it.

As for the toy figure, a couple of updates need to be done, to simplify the construction and assemble process and stabilize the figure. And ideally, to explore more natural materials. There is still a long way to go to make it commercial, such as how to modify each module to make the manufacturing process of different materials easier, and how to ensure the safety of children and so on. Most importantly, since this project is meant to make changes in people's minds and behavior, I need to scale up the potential age group and make them last longer, so that it can really make an influence. Learning from the business plan of LEGO might be helpful.

Generally speaking, I am satisfied with this project and its outcomes. And it actually changes my perspective towards plastic and also my design methodology. I start to realize what is the true drive of designing, not just trying to improve our lives as a human, but to keep the big picture in mind and think about what kind of life is sustainable and healthy that we should have in the future and guide people to form their lifestyle by our design.

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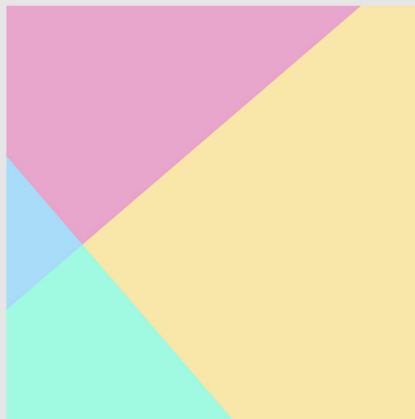
<https://www.youtube.com/watch?v=WrYO02j-Ak8>

<https://www.youtube.com/watch?v=RS7IzU2VJIQ&t=308s>

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