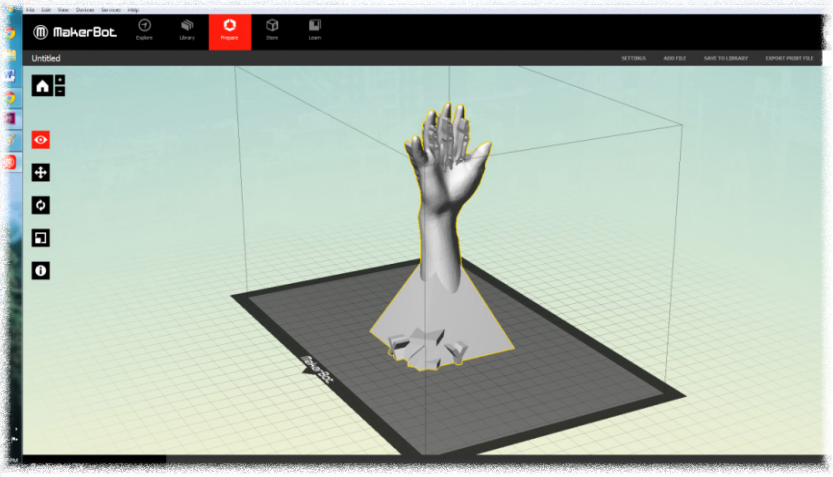


SHAYE RIANO'S POTENCIAL MEANING THROUGH MAKING

3D-REX -by-Namisu

What is the potential of 3D printing in healthcare, and how will it revolutionize the medical field? This is one of the many questions that first inspired me and seized my attention when I began delving into the Making Meaning Matter program. I am still amazed by how cutting edge and truly interesting our texts are for this quarter, I knew this is what I wanted to do and that I was in the right place when I first started reading Makers, by Cory Doctorow, and couldn't put it down. I'm convinced that this is the next big thing to revolutionize our existence and I am overjoyed to be learning about it, as well as fascinated and motivated to be a part of it.

Not to sound too sappy, but the most influential person in my life has always been my Mom, Kim. She is driven, intelligent, loving, and tenacious. She had me at a a relatively young age by today standards, growing up in Olympia she used to take me to class at Evergreen with her. Of course I don't remember this, but she has described pulling me around campus as a bundle of blankets in a little, red, radio flyer wagon. After getting her degree from Evergreen Kim went to midwifery school and became a home-birth midwife, which was rough as a child because she would always be on call and have to leave at odd hours, often in the dead of night, to deliver new life. In my middle school years, Kim went back to school at PLU to get her masters as a Nurse Practitioner for many reasons, but mainly because she wanted a broader scope of practice. She worked so hard all those years and I'm incredibly proud of her, and I grew up knowing that like her, I loved helping people. I've contemplated going into a healthcare profession, but life took over and I decided I didn't really have any clue about what I wanted to do or how to get there. Also medical school is a lot of time, and money, plus I'm squeamish... but who knows what the future has in store for me, right now I'm happy to be moving forward with my education, I'm loving Evergreen, and I'm really interested in 3D printing some bones! I plan on starting small like some teeth, or just a shape that resembles a bone, but I would love to work my way up to a pelvis, femur, or skull.

My mind is still trying to grasp the potentials of 3D printing, but I think that medical advances through technology are game changing, and I am hopeful, and somewhat fearful of how we will use this tool to increase or longevity or quality of healthcare. I could see it being possible for people to make 3D printers that can create new bones, and potentially even organic matter like skin or organs for transplants, but what are the ethics surrounding this? Could we 3D print Stem-cells? Could we create and print machines that are capable of doing automated medical procedures and surgeries. This is important to me because I grew up learning about the medical field and because I'm curious of how this will impact it, and because I think healthcare is a basic need, yet it is heated topic in modern society because of the economical and ethical state of the healthcare and pharmaceutical industry.

As I began my research looking for other people who had significant ideas surrounding 3D printing in the medical field I stumbled quite easily on some incredible tales of heart-warming ingenuity. One such article, titled *"3D printed heart saves baby's life as medical technology leaps ahead"* tells the the story of

a 2-week-old baby who required a complicated heart surgery because the babies heart had holes and the chambers were in an unusual formation like a maze. These issues were due to CHD (Congenital Heart Defects), which is a common defect of the structure of the heart present at birth. Using MRI scan data Morgan Stanley Children Hospital in New York City 3D printed a copy of the child's heart to act as a sort of road-map. This 3D printed heart allowed for the opportunity to study the riddled, structurally unusual organ, and develop a detailed strategy for the complicated and dangerous surgery. Before this technique, they would have of had to stop the heart and take a look inside to decide what to do, which means more dangerous surgery, and less opportunity for strategic planning. I found several other amazing ideas that had put done with 3D printing technology the medical field, including a 3D printed titanium spinal invertebrate replacement that was porous so natural bone can grow through it over time. I am looking forward to spending a quarter exploring this idea and its manifestations because it has the potential to improve the human condition and because its cool as hell.

In my first iteration of my Blue Rabbit 3D printing Idea I posed the question, what is the potential of 3D printing in the healthcare industry, and how will it revolutionize the medical field? This was one of the many questions that first inspired me and seized my attention when I began delving into the Making Meaning Matter 3D printing program. After all the material we have been covering in class in convergence with my own research I am convinced that humanity is on the brink of a continuous revolution, a material, technological, and hopefully conscious and sustainable revolution. The potential of 3D printing and being able to have what is in your mind on the table in front of you is so exciting I get goose bumps thinking about it! The medical industry is massive, and for good reason after all, in this life what is more important than your health right? Everyone wants to be healthy and happy, no one wants to be sick, no one wants to get old and watch their bodies decay and die. Over the last thousand, even the last 100 years, we have made massive strides in longevity and quality of life through "medicine" and "healthcare".

http://www.independent.co.uk/life-style/gadgets-and-tech/news/3d-printed-heart-

The amount of preventative measures, cures, and operations that are discovered or invented every year is astonishing.

http://communitytable.com/345790/parade/how-3-d-printing-is-transforming-everything-from-medicine-to-manufacturing/

I expect 3D printing to eventually impact almost every industry in the coming downloadable material revolution, especially those reliant on technology, kind of like I don't know… the internet? For this reason, and because I grew up with a strong mother figure deeply embedded in the healthcare industry through education and work, I am intoxicated with curiosity, fear,

and anticipation about what the future has in store involving 3D printing and scanning and its ability to help people as a whole, AKA humanity. In the documentary we watched in class, the Netflix original *"Print the Legend"* one of the Makerbot ex-employee/founders says something like, people aren't printing out new kidneys and installing them in in their kitchen...today. But with technology exploding at its current rate I honestly believe that 3D printing bioengineered organs or machines that are capable of doing automatic surgeries is conceivable within my lifetime. One journal I found online titled *"How 3-D Printing is Transforming Everything from Medicine to Manufacturing"* says that 3D printers are...

-A New Tool In the Classroom, and the Factory

A former K–8 teacher in ¬Seattle, Bri Pettis (Former Evergeen Grad) wants to put a 3D printer in every K–12 school in the U.S. "When I was growing up," he says, "there was an Apple IIe in the classroom, and if you were a nerd, you were taking it apart. That was probably the most important part of the education—it had nothing to do with what was on the test that day."

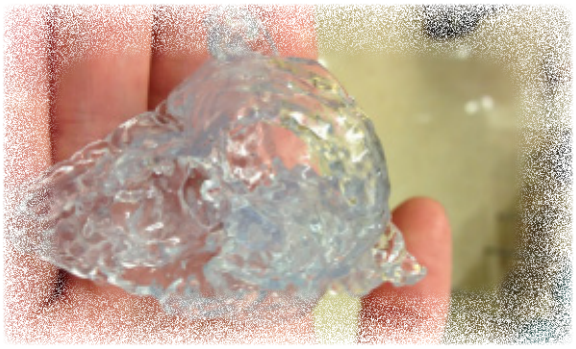
-A Medical Revolution

"By far the most exciting ways in which 3-D printing is being used are in the medical field. Across the U.S., research teams have been making rapid progress in 3-D-printing a bewildering array of human body parts: ear cartilage and muscle tissue; skin, skulls, and bones; organs large and small."

The article also goes into detail about how customization is huge, telling the story of a young girl who has a 3D designed and printed robotic hand that was created for a fraction of what it would cost to buy a standard prosthesis which run upwards of $60,000. And most of the parts can be made on a machine that costs about $1,500 as opposed to its counterpart industrial stereolithography 3D layering or

http://www.businessinsider.com/the-next-industrial-revolution-is-here-3d-printing-2014-8

"printing" machines that have been around since the 1980s for $150,000. So you tell me, how long till everyone has one in their home? Almost everyone I know has a computer in their pocket, and during my parents lifetime computers were the size of refrigerators and the internet was still developing as we know it. With these ideas and concepts I eagerly began seeking out recent resources both scholarly and journalistic in nature regarding what



http://www.independent.co.uk/life-style/gadgets-and-tech/news/3d-printed-heart-saves-babys-life

professionals are doing today with these forms of technology regarding logistics, ethics, and practice. In my first iteration I talked about journals I found online, one regarding an article, titled *"3D printed heart saves baby's life as medical technology leaps ahead"* which told the story of a 2-week-old baby who required a complicated heart surgery because the babies

heart had holes and the chambers were in an unusual formation like a maze. These issues were due to CHD (Congenital Heart Defects), which is a common defect of the structure of the heart present at birth. Using MRI scan data Morgan Stanley Children Hospital in New York City 3D printed a copy of the child's heart to act as a sort of practice pad or road-map. This 3D "blue-print" printed heart allowed for the opportunity to study the riddled, structurally unusual organ, and develop a detailed strategy for the complicated and dangerous surgery. I found another article regarding 3D printing technology in the medical field which described a 3D printed titanium spinal invertebrate replacement that was porous so natural bone could grow through it over time.

http://community-table.com/345790/parade/how-3-d-printing-is-transforming-everything-from-medicine-to-manufacturing/

Continuing forward with my research on JSTOR and EBSCO (digital library of academic journals, books, and primary sources) I found an article published through Proceedings of the National Academy of Sciences of the United States of America titled *"X-Ray Microscopy in 3D"* which talks about conventional tomography, simply put getting an image in slices, just like Makerware does with our STL files when it slices the 3D model layer by layer into the build path the extruder will take. The standard X-ray picture is a shadowgraph. It shows that somewhere in the object a certain amount of energy was removed from the X-ray beam, but it doesn't tell at what depth in the object the removal took place. Medical doctors have been able to use the ordinary X-ray pictures because more often than not their previous knowledge of anatomy allows them to tell which structures inside the body were imaged by the shadows; they already know the depth in the body at which, for example, the spine or the ribs usually lie. But for an object about which there is no previous knowledge such reconstructive reasoning doesn't apply In general, the lack of depth information severely limits the information. Medical people were happy to see the development of X-ray tomography, which gives three-dimensional information about the structures inside a body, this article goes into depth regarding

"A group of scientists has taken tomography into the microscopic range, developing what they consider a threedimensional form of X-ray microscopy. The technique is called X-ray microtomography."

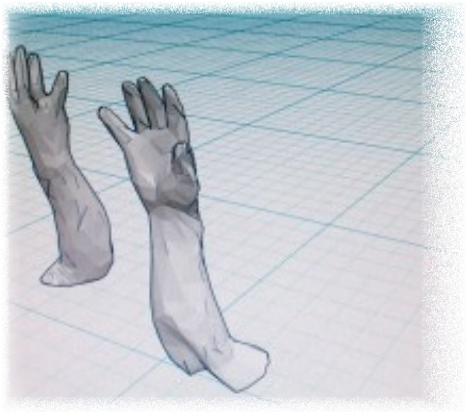
http://www.businessinsider.com/3d-printing-can-create-replacement-bones-2014-8

Another related article I found published by The MIT Press titled *"Artwork Using 3D Computed Tomography: Extending Radiology into the Realm of Visual Art"* speaks directly about CT scanning, the common CT scan stands for computed tomography

"Since its advent in 1972, computed tomography (CT) has played a key role in diagnostic radiology. Computed tomography allows visualization of the human body in cross-section, in slices."

But human anatomy is three-dimensional and complex. Anatomy varies among different individuals, and acquiring knowledge of these differences is of great importance in medical treatment, as iterated in the article about the 3D "road map" printed heart. Doctors would build up a 3D mental picture of the anatom-

ical structure after assimilating a set of 2D CT images in their head, this process sounds abstract and not easy or exact. However, Computer software is now available to rebuild 3D images from these cross-sectional images



Screenshot in Tinkercad
A rough 3D model of my hand

Until recently the quality of these images has been poor because of technological limitations and slow scanning speeds, early CT scanners can only provide limited numbers of relatively thick slives, resulting in low resolution 3D images and taking a heavy toll on computing power. This article goes into detail about a new Developments in CT and Computer Technology. "

A technological breakthrough occurred recently with the introduction of a new generation of CT scanners called multi detector CT. This new generation of CT scanners employs state-of-the-art technology and uses multiple rows of detectors to provide fast, powerful and efficient scanning. A large volume of data covering a wide range of the body can be acquired in less than 20 seconds. The time needed is well within a single held breath, thus avoiding motion artifacts."

My own Blue Rabbit has evolved into me customizing a model of my own anatomy, using relatively cheap technology and free versions of software I am taking a 3D model scan of my hand with an x-box Kinect plugged into a lab top running Skanect, importing it into blender to smooth it out and save it as an STL file. Then I am going to tinker with it and try to 3D model what I think my bone structure looks like, and 3D print a physical model. While John was helping me scan my hand it was hard to stand in one place as he had to circle me and capture every angle in order to make a 3D model, so I experienced "firsthand" the issues with capturing moving artifacts.

The last primary source I would like to incorporate into this scholarly discussion is one I found particularly interesting and relevent headed *"Microscale Technologies for Tissue Engineering and Biology"*, also published by the National Academy of Sciences of the United States. This article brings into conversation the fact that each year in the U.S. alone, millions of people suffer from a variety of diseases that could be aided from organ transplantation therapies. Now think about the widespread need for transplantable tissues and the fact that many patients die while waiting for donor organs. It is from this need that the field of tissue engineering has emerged, as well as the organ harvesting of prisoners in china to sell on the black market. Tissue engineering is an interdisciplinary field that involves the use of the biological sciences and engineering (Bioengineering) to develop tissues that restore, maintain, or enhance tissue function. The article goes on to explain this method of fabricating has issues because,

"Despite significant advances in tissue engineering, which have resulted in successful engineering of organs such as skin and cartilage, there are a number of challenges that remain in making off- the-shelf tissue-engineered organs."

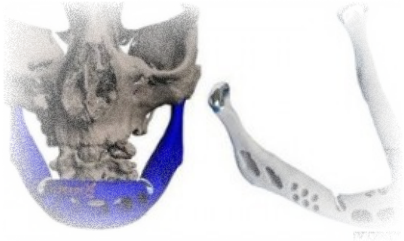
Some of those barriers include the lack of a renewable source of functional cells that are immunologically compatible with the patient or, to be exact in their words...

"the lack of biomaterials with desired mechanical, chemical, and bio- logical properties; and the inability to generate large, vascularized tissues that can easily integrate into the host's circulatory system with the architectural complexity of native tissues."

The article goes on to explain in the past few years microfabrication has been increasingly used in biomedical applications partly because of the emergence of techniques such as soft lithography to fabricate miscroscale devices such as microfabricated scaffolding that many tissue engineering applications use to provide cells with a suitable growth environment, optimal oxygen levels, effective nutrients transport, as well as mechanical integrity. Scaffolds aim to provide the environment to bring cells in close proximity so that they can assemble to form tissues, similar to how a 3D model is printed bead by bead layer by layer. So what happens when we figure out how to 3D print stem cells on the microscale? Is 3D printing organs for transplantation ethical? Who will have access to this potentially life changing technology?

"what is the potential of 3D printing in the healthcare industry, and how will it revolutionize the medical field?"

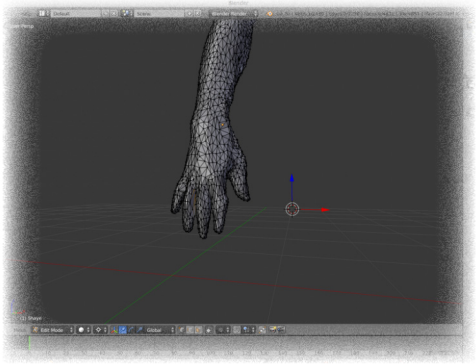
This question has motivated and inspired my focus of study during the past seven weeks as I learn about mechanical computer science aspects of photography, imaging, 3D modeling, and most excitingly, 3D scanning and printing. Below is an pictures I took with a DSLR Canon Rebel digital camera of a 3D printed model bone that I designed in Tinkercad, a 3D modeling software. Foss is the name of my classmate Em's emotional support dog who comes to class with her. I included my 3D printed coin, as well as some US currency coins for scale.



Transplant jaw made by 3D printer. (n.d.). Retrieved November 18, 2014, from http://www.bbc.co.uk/news/technology-16907104

Shot in Raw
ISO 100, F-stop f/4
Shutter speed 1/60

These next images are screenshots in Tinkercad, Blender, and Makerware of a 3D model of my own hand that I scanned, and 3D printed. I scanned my hand with the help of my classmate John using an X-box Kinect connected to a labtpop running the free version of the prosumer software Skanect. The 3D model of my hand has been cleaned up in 3D modeling programs, and sent as an STL file through Makerware to the 3D Makerbot printer, and I now have a physical copy of my hand, in my hand.

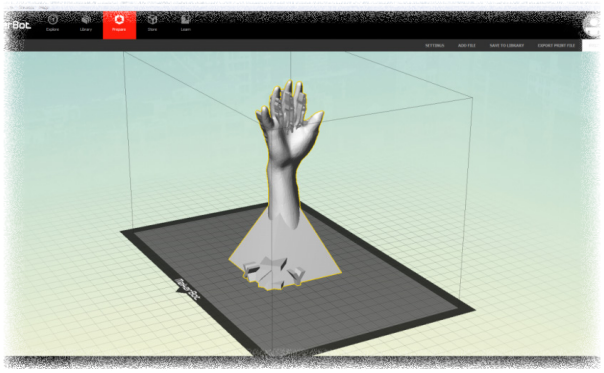


Screenshot of 3D model in Blender
All the virtual faces of my hand

I found several examples online of 3D bone-like material that were printed for the purpose of enhancing the medical industry, in these cases through transplantation or surgery assistance.

Only an individual knows their own true path, many are trapped and haven't found it. I get individual satisfaction that is earned, well deserved, and equal, balanced, or fair trade out of helping people understand and be conscious of the realities around them, in whichever way works the best. Because of who I am, I asked a question at the beginning of my academic career at Evergreen. Below I have included my question and a 3D model product that I made, and that made me, through my learning process.

The model hand is my own, I am my own, yet all is connected. Whatever you put into something is what you get out, the meaning behind art (Art- To artificer -One who invents or crafts), is the time, energy, or matter, that you put into it, and art is everything we make. My 3D model hand has the dimensions X=66mm Y=68mm, and Z=143mm. When it prints, it will use 46.5g of filament, and take about 3 hours for the maker-bot to create.

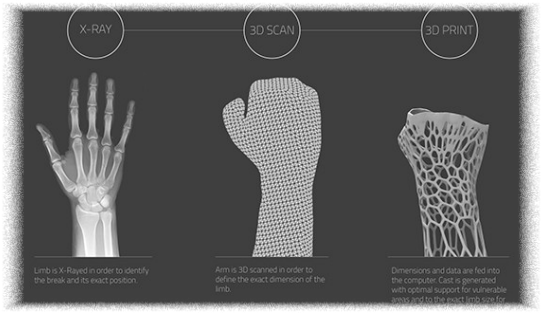


Screenshot of 3D model slicing in Makerware before printing

"What is the potential of 3D printing in the health-care industry, and how will it revolutionize the medical field?"

As I have been exploring this question and its relation to my experimentation and learning regarding 3D imaging, modeling, and printing over the past ten weeks I have come to the simple yet truthful conclusion that the potential of 3D printing, and human ingenuity portrayed through tools and technology... is infinite. I think 3D modeling, printing, scanning, and downloading is going to revolutionize every industry and field on the planet, just like the internet did.

As an individual that always wants to be the best, and make the least amount of mistakes, I understand that if you get stronger, there will be someone who can hit harder. If you build more protective armor, people will develop more destructive weapons. It is the human condition to suffer, but this is the greatest joy of all, because without suffering there cannot be pleasure. All the word "Work" in our language "means" to me, is materialistically wanting something enough to exert the 3rd dimensional energy and time required to get it in this reality. I believe in Magic, I also believe terms are relative, for me…Technology is the magic of the future.



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Cultural Studies of Technology
Who can, and who cant
Invent, share, and utalize new technology?

"Can I go out and have a look?" she said. "I mean, is it safe?" -Suzanne
"Of course! Our robots wont harm you: they just nuzzle you and then change direction." -Fiona
Doctorow, C. (2009). Makers (p. 101). New York: Tor.

The possibility of moving ideas from one medium to another has never been easier with technological tools. I think about this while watching Michael transform an idea into a visual/virtual computer image, and then into another program, and then into another different software sending it to the 3D printer for a physical object. At first it was merely an idea in his mind, now it is something material that you can hold. But is the physical object more "real" than the idea? What are the limitations of human creativity (if any) to create things out of thoughts, should there be limitations?

"She pored over the stack of menus in the kitchen. Does food in twenty minutes really deliver in twenty minutes?"
"Usually fifteen, they do most of the prep in the vans and use a lot of predictive math in their routing. There's usually a van within about ten minutes of here, no matter what the traffic. They deliver to traffic jams too, on scooters."

Doctorow, C. (2009). Makers (p. 169). New York: Tor.

New technology and methods give us more effective and efficient ways of dealing with "problems" or "needs." But recently I have been contemplating the question, are we making more problems then we are solving? How is it consciously acceptable to pay someone to bring you a hot processed chemical meal in fifteen minutes when nearly a billion people around the world are suffering from malnutrition. We have the technology and process to create fast food empires and industrial supermarket chains, but cant figure out how to grow and package food in a way that is sustainable? Some people have so much food they can throw it away, but we cant figure out how to distribute food so that people around the globe aren't starving?

"What if someone prints an AK-47 with it?"
"No ones going to print a working AK-47 with this, Its too brittle. AK-47 manufacturing is already sadly in great profusion across our inner cities anyways."
Doctorow, C. (2009). Makers (p. 312). New York: Tor.

Human ingenuity, intelligence and stupidity alike, cannot be stopped. The exponential growth, evolution, and reinvention of our society and biology represented in the physical 3rd

3D downloadable, printable Lower Receiver from Defense Distrubuted, used for making Ghost Guns with no serial number.

dimension, or reality through that which we make, AKA tools and technology and systems or structures.
It is the human condition to move in time and space, just as all things change. What we make makes us, just as "nature" shaped us, we shape nature, therefor shaping ourselves.

Each individual human is so incredibly complex and different in regards to body, soul, and mind that standardization in society doesn't work for any period of time. As a collective conscious, humans are evolving faster and faster. As they make exponentially make more and more, the meaning is making them in return. In today's capitalist society, this means efficiency and effectiveness at doing what humans do… create, make, and engineer at an all-time high. But change is inevitable; the next big turning point is at hand. As multi-dimensional being, humans are in the process of mastering the 3rd dimension, material reality. 3D printers are the future of this time. But why? What does it all mean? My consciousness can't help but grasp at the "biggest picture." In this material reality human bodies are powerful and effective/efficient machine, but they are helplessly addicted to material. Do humans grow tired of filling the suffering hole with things? After all, it only gets so good, there has to be equal, fair trade. I imagine sometimes humans mind's feels trapped in this dimension, screaming to have their full potential unleashed, will they find out how? Is perfect quantifiable? Or, is change the only consistent. In this material world we are all individual parts of one infinitely reflecting, and incomprehensibly diverse, greater consciousness moving through space and time. I think the answer is to stop enslaving and taking advantage of other entities, so that everyone can see this truth and understand that there is nothing more powerful than willingly sharing and accepting. Even though there are infinite faces in this 3RD dimensional reality, where the triangle reigns supreme, being able to adapt and compromise to work together takes energy. But if we could all see each other's points of view, we could all look in one direction and have the most powerful gaze of all. Humans are visual creatures; the eyes are a doorway to the mind.

In this life, if we could openly accept and share with one another, every individual would have everything. I believe this major shift or evolutionary leap in consciousness could happen in this generation. If and or when, human minds develop mechanical machines that are as capable as human beings, what will happen? I believe humans can evolve technology enough to where no-one will need any-thing. Through 3D printing/Bio-engineering and robotics/programming/machinery, material needs will be obsolete. Potentially humans will move on to master the 4th dimension of time, or other undiscovered dimensions. It is on your doorstep, the 3D printer is the womb of the machine, machines making machines. We can talk to machines, and machines can talk to us and each other through markup language (Text based code) as well as visual, and eventually potentially every other sensory adaptation of the human body. People were developed by nature, we use our own nature and designs found in the nature around us, the nature we create, to make new nature. Therefore perpetuating this infinite cycle or circle of change, but to make something there must be an equal unmaking for the karma of the universe to stay in balance; everything is balancing on a spectrum, or several, depending on which dimension you are talking about. Change is hard work, and work takes time and energy, something that is limited in this cycle of life, or manifestation of reality. I am learning to embrace this, and make as many mistakes as quickly as possible, because that's how you learn the fastest, which is the opposite of what a capitalist society teaches.