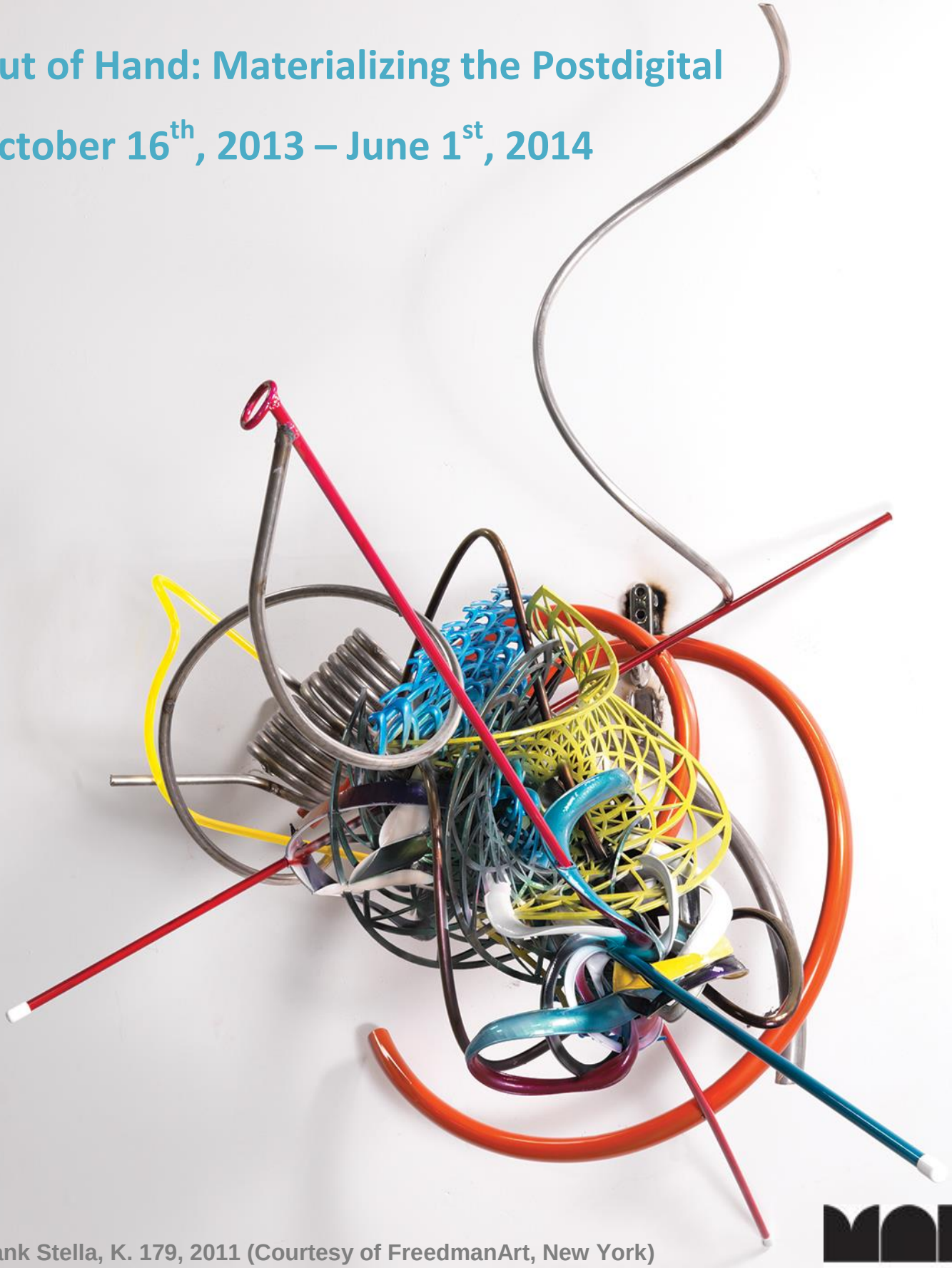
TEACHER RESOURCE PACKET

Out of Hand: Materializing the Postdigital

October 16th, 2013 – June 1st, 2014



Frank Stella, K. 179, 2011 (Courtesy of FreedmanArt, New York)

museum of arts and design

museum of arts and design

WELCOME

Dear Educator,

We are delighted that you have scheduled a visit to *Out of Hand: Materializing the Postdigital*. When you and your students visit the *Museum of Arts and Design*, you will be given an informative tour of the exhibition with a museum educator, followed by an inspiring art-making project in the museum's MADlab. To make your museum experience more enriching and meaningful, we strongly encourage you to use this packet as a resource, and work with your students in the classroom before and after your museum visit.

This packet includes topics for discussion and hands-on activities intended to help students investigate the similarities and differences between analog and technology processes in digital fabrication. The packet includes contextual information and art workshops about innovations emerging from the intersection of science, engineering, arts and design transforming our economy, culture and learning contexts.

Please feel free to adapt and build on these materials and to use this packet in any way that you wish.

We look forward to welcoming you and your students to the Museum of Arts and Design.

Sincerely,

Nakeisha Gumbs
Manager of School and Teacher Programs
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Lessons written by Nakeisha Gumbs, Manager of School and Teacher Programs, in collaboration with Kamau Patton (artist educator) and the Museum of Arts and Design Education Department. Special thanks Andrea Bansil and Hae Lin Park, School and Teacher Programs interns; as well as Carli Beseau, Education Program Assistant and Leila Zobgy for their input and assistance gathering and formatting information. Special thanks to Shapeways on the digital fabrication content, and MAD's Docent Corp on the digital fabrication glossary.

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THE MUSEUM OF ARTS AND DESIGN has been functioning as an international resource center for craft, arts and design since 1956. Through its collections, exhibitions, programs and publications, the Museum serves as a forum for critical debate concerning the nature of craftsmanship and the engagement with the process that links materials, techniques, forms, patterns and concepts in all creative work.

HOW DOES A MUSEUM WORK?

ADMINISTRATION: The team led by the Director of the Museum determines the programs, plans and philosophy of the Museum. It also raises funds to realize the Museum's goals and works directly with the Board of Governors, which guides the Museum's functions.

CURATORIAL: This is the team, led by the Chief Curator, that works together to decide which exhibits will be shown, how they will look, what artwork is to be included, and how they are to be interpreted.

REGISTRATION: Led by the Registrar, this team arranges the safe handling of art to be placed in an exhibition and maintains the permanent collections acquired by a museum.

EDUCATION: This team provides the interactive interpretation of the objects on view through the educational programs designed for children, adults and families who visit the Museum.

FACILITY MAINTENANCE: This is the team that allows the day-to-day operations of a museum to continue: from the lights being turned on, to the safety of all who enter the building.

SECURITY GUARDS: This is the team most often seen in a museum, because its main task is to protect the artwork from harm so that in the future people will be able to see the same objects as seen in a museum today.

Museums are places where we can learn about the past, present, and future of the world around us. The diversity of knowledge is endless when the habit of museum exploration is formed at an early age. We look forward to welcoming your group into our galleries.

HELPFUL HINTS FOR YOUR MUSEUM VISIT:

"I try, when I go to museums, to do two things. One, to appreciate what I'm looking at, just to see it, but then to isolate a few pieces that I really look at in detail. I study and I draw not with any purpose in mind. I mean, I don't go looking for specific things. I just try to be open-minded and keep my eyes open. It's interesting that every time I go back to the same place, I see something different." Arline M. Fisch (1931-) Brooklyn, New York

While visiting the exhibition try to use all your senses. Notice the way the pieces are displayed. *Are there any specific groupings of pieces you can distinguish? If you enjoy looking at one piece more than others can you explain why?*

Here are some questions and suggestions to think about as you move around the exhibition:

I. What can be objectively observed?

a. *What is the physical description? Measurement, weight, materials used, articulation of materials…*
b. *What iconography, if any, is used? Designs, words, diagrams…*
c. *What are the object's formal design characteristics? Lines, shapes, forms, color, texture…*

II. What would it be like to interact with this piece of art? How would you handle, lift, display it?

a. *How would the piece of art feel, move, and sound?*
b. *What does the piece do? Does the piece have a function? How would the figures move if they were alive?*
c. *What is our emotional response to this beaded figure? Fear, joy, indifference, curiosity, revulsion, excitement…*

III. *What is in the mind of the artist? What are the viewers thinking and feeling?* Use creative imagining and free association.

a. Review all of the above information and consider what was going on in the world when the work was produced to develop possible interpretations of the piece. (Theories and hypotheses)
b. *Do the figures tell a story? Does the piece have underlying political or social meaning? (Understanding and visual thinking)*
c. Develop a program to investigate the questions posed by the material evidence. (Program of research)

IV. Brainstorm about an event or situation that is happening in your life at the moment which you could animate into one scene which could be made into your very own figurative sculpture. (Design themes)

OUT OF HAND:
Materializing the Postdigital

October 15, 2013 – July 6, 2014

INTRODUCTION:

Out of Hand: Materializing the Postdigital, examines trends in contemporary digital design and fabrication. The exhibition features 21st century artworks created through the use of technology as a tool; featured artists employ advance methods of computer-assisted production, also referred to as digital fabrication. The exhibition focuses on works created between 2005 and 2013. 2005 was a moment when advances in 3D modeling, 3D scanning and 3D printing made it possible to design and fabricate objects that previously could only exist as digitally rendered concepts. The term postdigital does not refer to the end of the epoch; rather it refers to period after the beginning of the age of digital design.

As the first museum show to consider the impact of these new, revolutionary methods of computer-assisted manufacturing on fine art, design and architecture, the exhibition will introduce the public to the imaginative expression that these emerging processes enable. Today's digital fabrication methods such as 3D printing, CNC (computer-numerically-controlled) machining and digital knitting unite divergent artistic approaches, offering new opportunities for individual artists, architects and designers to integrate these skills as a vital part of their personal creative processes, representing the fruits of a new movement, where disciplines merge and the bounds of imagination and technology are pushed.

This exhibition takes a closer look at the global impact that new technologies have had on art, science, architecture, fashion and other aspects of everyday life. This exhibition is not about replacing handmade with machine processes; rather it is about the discovery by artists and designers of constructing and assembling complex forms and expressions that redefine our notions of creative production and the creative process.

The exhibition themes include:

- Modeling Nature
- New Geometries
- Pattern as Structure
- Rebooting Revivals
- Remixing the Figure
- Processuality

THEMES FOR DISCUSSION:

- Is the artist or designer's hand ever really gone from the process?
- Various digital fabrication processes allow forms to be created that were previously impossible. How are artists and designers avoiding die-lock and the inability to remove tools?
- How are these artists and designers using scientific inquiry of natural phenomena in the creative process?
- Several of the artists and designers in the exhibition approach environmental concerns and sustainability. How will the availability of digital fabrication change the landscape of specific regions?
- Many of the tools used are software applications and resource material taken from open-source libraries. What are the benefits of the evolving design processes?

RECURRING QUESTIONS:

- What are the different processes of digital fabrication?
- How are artist combining traditional artisanal techniques with new digital media?
- How are artists and designers using algorithms in the design process?
- How do artists and designers represent data in a digital structure?
- What are the patterns and relationships present in the environment that connect to mathematics, science, and technology and everyday experiences?

DIGITAL FABRICATION OVERVIEW:

"One of the inherent characteristics of the digital medium is its generative quality, the possibility to produce evolving forms and structures by activating a computerized process. Artists are able to establish rules by writing or activating software that, with some degree of autonomy, produce an artwork. Possibilities for interaction between elements are outlined in programming, and structures evolve through actions and movements of the elements within the given parameters. Processuality thereby becomes one of the defining aspects of digital creation and not only allows for the creation of new geometries and structural patterns, but also connects generative software processes to natural systems … Many artists create abstractions of systems that occur in the natural world, or actively model nature through computerized generative processes."[1]

Due to technological advances over the last two decades, tools for producing digital art have become more refined, common and accessible. The term, digital sculpture, is most often used to describe various digital fabrication processes, including computer-aided design (CAD), computer-assisted manufacturing (CAM), CNC milling and/or Rapid Prototyping processes.[2]

The 1990s was the decade when "digital sculpture" officially began to exist. *The Computers and Sculpture Foundation (CSF)* was founded in the early 1990s and *Intersculpt*, a biennial computer sculpture exhibition premiered in 1993. Some sculptors used technology both in the preliminary design and the execution of the physical object, while others created works that exclusively occur in the virtual realm, represented in the form of computer-aided design (CAD) model or animation. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and create data used for manufacturing.

[1] Paul Christiane, "Objecthoods From the Desktop," Out of Hand: Materializing the Postdigital catalogue
[2] Paul Christiane," Objecthoods From the Desktop," Out of Hand: Materializing the Postdigital catalogue

3D PRINTING

The 3D printing process involves objects built layer by layer, from bottom to top. The printed material is deposited thinly, almost invisible on the printer bed. This process can capture very small-scale detailing, and is a viable solution to forms that would be impossible to mold due to die-lock and the inability to remove the tooling from the object.[3]

CNC MILLING

A subtractive manufacturing method, wherein a three-dimensional form is constructed by removing material, very similar to traditional techniques of chiseling down a block of stone or marble. Instead of manually carving and chiseling, a machine cuts the block of plastic, stone, rubber, glass, etc. down to the desired form as determined by the computer model.

METHODS OF THE DESIGN PROCESS: MODEL, SCULPT, SCAN

There are three main methods for creating the models to 3D print using Computer Aided Design (CAD) software and 3D scanning:

I. **Solid modeling** software creates 3D models using base solid forms called primitives that use density and thickness, extrusions and Booleans, which is a type of programming language,[4] to create a virtual 3D model. Solid modeling software is primarily used by architects, engineers, jewelry and product designers. This technology takes physics and materials into account during the design process to create an incredibly accurate virtual model of the form to be manufactured, making it a perfect tool to design for 3D printing.

II. **Surface modeling** is a second method used primarily by 3D animators, artists and character designers. Surface modeling allows designers to sculpt elaborate curvatures and complex shapes that translate well into flowing organic forms and cartoon animation. These “surface models” usually must be optimized for 3D printing.

III. **3D scanning**, the third method for designing, is using structured light scanning or photogrammetry to then create point cloud data of the surface of the physical object. This point cloud data can then be converted into a surface model to be 3D printed.[5]

Many designers use a combination of all of these tools to create their designs to 3D print.

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[3] Greg Lynn, Everybody’s an Architect These Days, Out of Hand: Materializing the Postdigital catalogue
[4] http://www.thefreedictionary.com/Booleans
[5] Shapeways

PREPRATION + PROCESS: TRIANGULATE- SLICE

To prepare for the 3D printing stage, the CAD design file needs to be converted into a file that a 3D printer can read. The surface geometry is calculated into a set of points connected into triangles. This triangulated approximation of the model is then sliced into layers describing the cross section of the object to the specification of the 3D printer, material and build height.

PRINT: LAYER BY LAYER

The sliced files are then loaded into the 3D printer. Each slice layer is translated into physical material. In the case of *Selective Laser Sintering (SLS*), a layer of nylon powder is laid down in a bed and heated to just below melting point. A laser then melts the powder into solid according to the slice file for that layer. The print bed is then lowered a few microns and the process is repeated, building the object layer by layer, from the bottom up.

The time it takes to 3D print an object is directly related to the height of the object. The overall shape and complexity has very little effect on the print time or cost of manufacturing. Because the object is built up within support material, multiple items can be printed simultaneously and fully articulated objects can also be 3D printed in this manner, ready to use with no assembly. Post-processing treatments may include polishing, dying, painting and plating to achieve different surface finishes.[6]

[6] Shapeways

INTRODUCTORY ACTIVITY:
Understanding Process

Process is a conceptual thread that connects the works presented in *Out of Hand.* Many of the artists in this exhibition render their ideas with computer-aided software. The artist or designer communicates to the printers, giving the computer specific instructions. Computers communicate in a mathematical language called algorithms. Algorithms are the sequence of logical steps that a computer program must execute to carry out a certain task.

The following activity is designed to encourage students to think about "process" as a series of actions that bring about a result. Considering our own processes and how we communicate instructions can provide a basis for understanding the various processes and approaches presented in the exhibition.

1) From Here to There: *Giving Good Directions*

Ask students to create a list of instructions that clearly explains how someone would get from their home to their school.

Start (Home)

Step 1, 2, 3, 4…

End (School)

** This exercise can be modified for early literacy by asking students to give their instructions verbally and then to draw a sequential set of pictures corresponding to the landmarks that someone would encounter along the route they describe.*

Reflections:

After students have created their lists, have them compare in small groups.

- Did they miss anything steps?
- Were steps in different orders for different students?
  What steps were primary (most important, and what steps where secondary (non-essential)?
- Have students share their observations, and reinforce: Is it important to consider process?

ART & DESIGN LESSONS

These lessons connected to the exhibition ***Out of Hand: Materializing the Postdigital*** highlight innovations emerging from the intersection of the sciences, engineering, arts, and design transforming our economy, culture and learning contexts.

MODELING NATURE

In today's computational world, biological and ecological phenomena often serve as models for creative expression. Generative art and design approaches provide ways to mimic biomorphic structures ranging from microscopic unicellular organisms to the macroscopic environment, and to simulate physical occurrences such as bone development, plant growth and water flow. These procedures involve the use of automated planning systems − from computer-based algorithms to such schemata as mathematics, data mapping, symmetry and tiling − that direct the machines to produce the work. In addition, some generative models introduce subtle "genetic" changes to the fabrication process, allowing for the possibility of endless mass-customization.

Maya Lin
Imaginary Iceberg, 2009
Plaster, 27 ½ x 76 ½ x 50 inches (69.9 x 194.3 x 127 cm)

"I love the environment. I love the world around us."
– Maya Lin

LOOK

- Describe the color of the form? Is it warm or cold?
- Describe the shape.
- Describe the lines.
- Describe the edges of the surface.
- How is the work balanced? Does it have symmetry?
- Does it resemble something you would observe in nature?

THINK ABOUT

Maya Lin addresses notions of landscape and geologic phenomena in her art.[7] Bringing traditionally outdoor landscapes indoors, she creates works that are studies of natural terrain and topography. Using scientific analysis represented through models and maps, Lin began studying actual icebergs and the topology of the ocean floor.

- When a glacier is observed, what is the overall shape? How much of a glacier is visible above the waterline?
- Where is the horizon line on the artwork?
- How does Maya Lin use the horizon line in this work?
- What does she choose to make visible, above and below the horizon line?

Lin's process includes mapping and digitally modeling the structure, before printing. Using twentieth century technologies to observe the natural world, Maya Lin referenced sonar views of the ocean floor and aerial and satellite views to reveal invisible parts of the natural world. She then proceeded to create imagined glaciers, referencing the data collected.

- How might Maya Lin plan to sculpt this tiered form?
- Describe the process of making the work symmetrical, wide and narrow, and three-dimensional.
- What does revealing above and below the horizon line reveal about the glacier?

DISCUSS

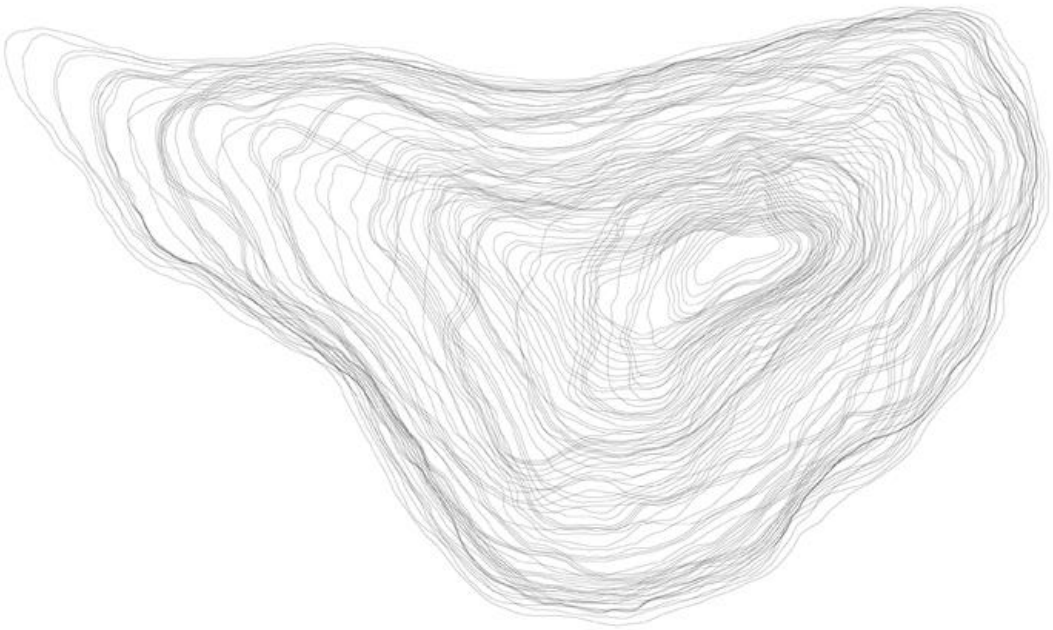
> "As a young woman growing up in Athens, Ohio, Lin staged protests against environmental crimes and cruelties. She continues to be an activist today, using her art to encourage closer examination of the natural world."[8]

As part of her *Bodies of Water series,* Lin's artwork explores how people perceive and experience the landscape.

- What does Lin's artwork *Imaginary Bodies* reveal about the natural world?

[7] http://www.corcoran.org/sites/default/files/MayaLinTeachersPacket.pdf
[8] http://blog.art21.org/2013/07/12/maya-lin-examines-disappearing-bodies-of-water/#.UnAeH3Csh8E

DO: Create a 3D Map



Materials:

Clay, Cardboard, Ruler, stick (chopstick or pencil), Paper, Toothpicks, String or wire

Take a look at this image.
What does it look like?
Describe the direction the lines move in.

This topographic map is a digitally rendered sketch that Maya Lin uses to model her 3D form.

1. Take a lump of clay and shape it into the island of your choice.
2. Determine the horizon line and define your parameters. What does 1 inch represent on a real world scale?
3. Using a long pencil, poke 2 holes through the tallest point of your island, 1 inch apart from each other. This will help in realigning the clay later on. Remove the pencil.
4. Divide the island into 4 even horizontal segments and make these with indentations along the clay.
5. Taking the string or wire, stretch it until it is taut and grip it tightly. Use it to cut across the island while holding the string horizontal to the floor.
6. Remove the clay slice and place on the paper. Carefully trace around the layer and the two interior circles. Make sure this slice is intact.
7. At the next mark, cut the second slice and lay it over the paper. Make sure to align the holes in the slice with the two dots and then trace.
8. Repeat for the third and fourth slices of clay.
9. Restack the slices to reassemble your island.
10. Admire your new topographical map!

NEW GEOMETRIES

Advanced mathematical theories play a fundamental role in the creation of three-dimensional forms that extend beyond the limits of traditional Euclidean geometry. Whether drawn from complex repeating arrangements found in nature or abstract concepts that determine spatial order, these algorithms map out mathematical space into diagrams with distinctive angles, facets, and whorls. This data is then translated into physical objects by machines using 3D printing for smaller works or CNC machining for larger structures. Scientific terminology such as fractal, space truss, hexagonal tiling, crystallography, and Voronoi diagram − once solely the language of mathematicians and engineers − are used in the titles and descriptions of these works, revealing the interrelationship between science, art, architecture and design.

Andreia Chaves
Invisible NakedVersion from *InvisibleShoe Collection, 2011*
3D-printed nylon exterior structure, handmade leather internal
Heel: 5 inches (13cm)

LOOK

- Take a look at this object. What do you notice?
- What shapes do you notice? Are the shapes uniform?
- How do the shapes interact with the overall form?
- What are the individual components that make up the overall object?
- How do the different components of this shoe interact with each other?
- Describe the color of each component.

THINK ABOUT

- Describe the exterior form and the interior form.
- Is this object functional?
- Can the exterior and interior function alone? How?
- How do you think this object was made?

The Invisible Shoe Series is a series of 3D-printed shoes created by Brazilian fashion designer Andreia Chaves, in collaboration with Amsterdam rapid prototyping studio Freedom Creation. Chaves combines leather-making techniques with advanced 3D printing technology. The collection includes a pair of shoes covered in a mirrored shell.

- Which elements were made with traditional shoe making techniques, and which were created using 3D printing?

- What is a benefit of using traditional leather-making techniques?

DISCUSS

Chaves expresses that The “Invisible Shoe” was born from a study of optics applied to shoe design.

- What is an optical effect? How does an optical effect change the way we see an object?
- Looking at the photo, how does each component interact with light?
- How does Chaves explore the concept of invisibility through the “chameleon effect”?

The shoe has a reflective finish on the surface, creating a disguise with each step taken. The series is described as a study of optical effect applied to shoe design, the ‘Invisible

Shoe' series explores the ideas of invisibility through the 'chameleon effect' or blending into a background. The shoe's reflective finished surface creates and obscures its form with each step taken. This new design goes beyond the function of the shoe, where "protecting " the foot also means "deleting" or" immersing" or hiding it in its environment.

DO: Design for the Sole

Materials: cardboard triangles and rectangles, tape or string, foam sheets, patterned paper and art straws

- What is the anatomy of a shoe?

  The anatomy of a sole: http://www.shoeguide.org/Shoe_Anatomy
  The anatomy of a heel: http://www.queeninheels.com/about/the-anatomy-of-a-high-heel/

- Investigate the role of line and form in objects

Challenge your students by giving them two-dimensional materials to create three-dimensional form. Students are to devise a scaffolding structure enfolding or surrounding an original form. Students should consider whether the structure has the characteristics of a machine, an animal, an architectural structure, a usable household object, a personal object or piece of jewelry.

Example:
Have the students use one of their own shoes as the original form. How would they enhance it? Change it? Manipulate it? Have the students consider not only what they can do, but why. How can they alter their shoe to reflect their own sense of style, identity or personal interests?

PATTERN AS STRUCTURE

Patterns, whether repeating or chaotic, commonly recur in nature, but not all are visible to the naked eye. Computer applications, in association with other devices, allow for the transcription of data such as sound, light, motion and electrical activity, which may then be translated into three-dimensional objects. Sound waves, brain waves and light reflections take the form of vases, furniture and sculpture, allowing us to see and touch what we could not before.

Decorative motifs and shapes cut into sheets of metal or wood yield light and airy large-scale constructions. Advancements in digital knitting and winding allow for controlled fiber placement, generating structurally inherent designs ranging from footwear to architecture.

Mass Studies
Korea Pavilion, Shanghai World Expo, 2010
Aluminum panels; computer numerical control

LOOK

- Looking at the photo, describe this exterior design.
- Is the surface made up of two-dimensional or three-dimensional features or both? How can you tell?
- Describe the use of line. What direction are the lines?
- What shapes do you notice? How are they arranged?
- What does it resemble? Describe the symbols.

THINK ABOUT

Mass Studies, a Seoul-based Architectural Engineering firm, featured the work *Pavillion* at World Expo 2010 in Shangai, China. With the theme "Better City, Better Life," it was the largest World Expo to date, held in Shanghai, China, 192 countries participating and 73 million visitors attending.

This installation was located in the Korean Pavillion situated in Zone A, directly neighboring the Japan and the Saudi Arabia Pavilion, and in close proximity to the China Pavilion. Designated one of the largest lots within the Expo compound, the site estimated 6,000 m2 or 64,583 sq.[9] ft.

The key reference of "signs" used in the design was Han-geul, the Korean alphabet. Clad with two types of pixels, the surface of the pavilion is made up of Han-geul Pixels and Art Pixels. The Han-geul Pixels are on 6mm thick white aluminum panels. They were **CNC cut**, a subtractive 3D printing technique, removing material to achieve a texture-heavy relief of letters and different font sizes. The combination forms the vertical and outermost exterior surfaces, defining the overall footprint and volume of the pavilion.

- What is the designer's process for reproducing so many identical fonts or letters?

"Various digital processes were used to achieve a mass reproduction of the artist's work initially drawn by hand with crayons. These original works were then scanned and digitized, allowing for him to digitally arrange, compose and edit the Art Pixels on the facade of the Korea Pavilion. The artist's final composition was then digitally printed on the aluminum composite panels to install. About 40,000 of these panels repeat a poem titled *What I Know* throughout the Art Pixel surfaces, expressing the artist's message on hope and unity." (Mass Studies, artist statement)

- How does light interact with the surface?

Mass Studies installed sequential lighting behind the Han-geul Pixels to highlight the individual letters on the exterior facade at night, further animating the pavilion as a sign (similar to a text message) on a larger scale.

DISCUSS

[9] http://www.metric-conversions.org/area/square-meters-to-square-feet-table.htm – used this to convert

Considering its geographical advantage, having the influence of both land culture (China) and sea culture (Japan) surrounding the peninsula, as Mass Studies describes:

"Korea has been permeable to imported cultures and global influences, whose progressive mix defines contemporary Korean society. Using 'convergence' as the main theme, the Korea Pavilion was conceived as an amalgamation of 'sign' (symbol) and 'space': Signs become spaces, and spaces become signs." (Mass Studies, artist statement)

- How is contrast created? What element of the surface makes these signs appear as spaces?
- What is convergence used to describe? How does the amalgamation of many signs allow us to think about 'convergence'?
- Are there other features that convey the notion of coming together? What role does color play?
- How does the pavilion act as a map?

A map can be thought of a type of sign that depicts space. In the *Korean Pavilion*, the ground level piloti, was itself a sign that depicted an abstract 3D map of a typical Korean city. The map illustrated the convergence of mountains, water and a dense metropolitan area, as exemplified by Seoul, the national capital. The design also included an artificial river modeled after Seoul's Han River.

"The Korea Pavilion," exhibited in *Out of Hand*, was awarded the Silver Medal by the Bureau International des Expositions, as well as a Presidential Citation from Korea.

DO: Interventionism/ Site-specific Installation

Ask students to design an art installation in a specific locale in or around the school. The design should interact or intervene with, on, or around the existing space, change the existing surface of the locale and how viewers interact with the location. The installation should attempt to make viewers aware of a condition they previously had no knowledge of, such as history related to the school or surrounding area. Students should investigate the design process, consider the location, examine activities that occur in the space, identify a need or want, and decide how to impact the location. Students may decide to add two-dimensional or three-dimensional designs. Students may create stencils, remove materials from a plate or board, and/or open a surface for light to come through. Students may also collaborate by creating individual designs that are tiled and arranged into one overall design, or work in smaller size groups at multiple locations.

PROCESSUALITY

For some artists and designers the process of making plays a crucial role in the presentation of the final work. Highlighting a generative approach, the systems they create range from being fully autonomous − in which the formal qualities of the artwork are determined by the computer program − to those that require audience participation or interaction to complete the activity. Installations may include such documentary schema as charts, video, interactive elements, or the machines themselves − 3D printers or multiaxial industrial robots − physically fabricating the objects as a multimedia performance.

EZCT
Computational Chair
(Best Test 1-400), 2004
Elm, 35 3/8 inches (89.9 cm) high

LOOK:

- Take a look at this object. What does it resemble?
- How many parts support the structure? How many legs does this object have?
- Describe the surface? How many sides does it have?
- Describe the back of the object.
- Describe the edges? How did the designers achieve the cascading edge? Is this a functional object?
- How do you think this object was made?

THINK ABOUT

EZCT is an Architecture & Design Research group that focuses on solving design problems. In 2004, EZCT led a project where a series of chairs were created using human collaboration, along with algorithms and computer software.

Through open-source libraries (online resources that make a design or blueprint available to the general public for use and/or modification) this chair was created in a collective effort. This process allows individuals to model and experiment on different variations of this chair; sometimes called peer production, where designers improve on various aspects of the original design through open-source libraries.

DISCUSS

- Why would this chair be described as an evolving object?
- What are some benefits to the chair having multiple designers and influences?

DO: Our Chair

Materials: Graph paper, Colored pencils, Packing peanuts, and Toothpicks or Lego blocks

First working independently, ask each student to design a chair with modular parts on paper. Using graph paper to plan the design, encourage students to use simple shapes to show standardized units or dimensions, similar to the cascading surface on the edges of the chair. Consider how the chair will be assembled. Set design rubrics pertaining to balance, functionality, and creativity.

Afterwards, working in groups of 4 to 5 students, ask each group to vote on the best chair design. Use the design object as parameters for judging: balance, functionality and creativity. Groups may consider combining parts or elements from different chair

designs, to create alternative hybrids. Each group should decide on one collaborate chair design and execute a prototype of the chair using packing peanuts and toothpicks.

After finalizing the design, ask students to construct a model of the design for the rest of the class to observe. Using foam sheets or packing peanuts and toothpicks, or legos, ask students to create modular pieces to configure their design. Arrange a series of encounters with each group design, allowing new students to modify models of the chairs. Document each variation of the chair through photography and share the evolution of the collaboration as a final presentation. Your final presentation may be made into a stop-motion film using Photoshop.

REBOOTING REVIVALS

In the past decade, various artists and designers have taken a postmodern approach, using the tools of digital design and manufacture to create works that reference or reproduce historical artworks and past decorative styles. Some take advantage of advancements in 3D laser scanning − in which real objects are scanned optically and converted into digital, three-dimensional models − allowing for the accurate re-creation or dramatic reconfiguration of the original on the computer. Forms and decoration associated with Neoclassicism, Gothic Revival, Rococo Revival, Machine Aesthetic, Organic Modernism, and other styles are digitally reworked with a contemporary twist into sculptural objects that seem at once familiar and new.

Barry X Ball
Envy, 2008–2010
Golden Honeycomb Calcite, stainless steel
22 x 17 1/5 x 9 1/2 inches (55.9 x 43.8 x 24.1 cm)

LOOK:

- Is this work new or old? When do you think it was made?
- Does it look fragile or durable? What makes you think so?
- Describe the surface of the sculpture. Is it opaque or translucent?
- Describe the color.
- Describe the expression of the figure.

Barry X Ball employs multiple digital fabrication techniques in production. The techniques include 3D scanning, virtual modeling, computer-controlled milling and hand polishing.[10] He reconfigures these traditional sculptures using both traditional and technological processes. His work is a direct reference to two 18th century sculptural works—Antonio *Corradini's La Purità (dama velata) (Purity, Veiled Woman)* and Giusto Le Court's *La Invidia (Envy).* In the Baroque period (1600-1790), artists used realism to depict figures in portraits, paintings, busts and other sculptures.

THINK ABOUT

- Although this artwork closely resembles older masterpieces usually made with Italian marble, what do you notice about the material? What material do you think the artist uses?
- Was it made from one piece of stone, or individual components? How can you tell?
- What processes do artist usually use for sculpting busts?
- Why do artist recreate a work someone else already made?

Using unconventional stones and methods to depict traditional figurative stone sculpture, Ball sources the raw materials he decides to work with the assistance of mining companies. This stone, Golden Honeycomb Calcite is mined exclusively in the state of Utah. It compares to stones like onyx and marble for its ability to accept a high polish. The translucent quality offers a luminous glow.[11]

[10] http://www.e-flux.com/announcements/barry-x-ball/
[11] http://www.honeycombcalcite.com/id1.html

DISCUSS

Contemporary artists often take inspiration from works of art that were made long ago. Think about a work of art that you have seen that was made before you were born. If you had an opportunity to add on, to improve, or to alter that work of art, what would you do? Why?

DO: Remake history

Materials: Clay

Unlike many of the digital fabrication processes in this exhibition, Barry X Ball uses a reductive sculpting process similar to traditional craving. Use clay to model and create a bust of a historical figure. Start by identifying a pre-existing bust or portrait of a historical figure. The figure may be from any period in time.

Once the bust is modeled, have students consider manipulating it. Perhaps two students will want to fuse their busts together, or add contemporary features such as hair or accessories. Once your students have them, consider the formal (how the changes look aesthetically) and conceptual qualities (how the changes alter the feel and thematic qualities).

Examine the life and work of a specific historical figure.
What is/ was the person's occupation? How would a person in that line of work dress? If the figure lived in contemporary times, what job/career is the equivalent to the former occupation? How would the figure dress now? Decorate the figure, using pattern paper and other materials to add clothes and other characteristics of a person in our time.

REMIXING THE FIGURE

Digital advancements have inspired a re-examination of the body and figural representation in art and design. Appropriated forms pay homage to past masterworks while the ability to capture the true likeness of a live sitter brings the venerable tradition of portrait sculpture into the 21st century, both made possible by 3D scanning. Visceral works, created by splicing together digital figures into grotesque creatures, allude to hybridity and metamorphosis in a fast-changing world. In the fashion industry, designers build fabric and clothing mathematically on the computer, permitting a more sculptural approach through improvised alterations to the virtual model, for production by 3D printing or whole-garment knitting.

Richard Hamilton
Hutton Award, 2008
Created for the *Medals of Dishonor* exhibition, 2009, British Museum
Commissioned by the British Art Medal Trust
Cast bronze 2 3/4 inches (7 cm) diameter

LOOK

- Compare both sides of this medal
- What are the similarities? What are the differences?
- Describe the color and texture of the surface.
- How did Hamilton achieve the subtle detailing?
- How might Hamilton shape the surface of the metal?

THINK ABOUT

The Hutton Award, is a double sided medal inspired by the Hutton Inquiry, an investigation into the death of scientist David Kelly in 2003. The two figures on the surface are politicians; on one side, the surface features a portrait of former Prime Minister Tony Blair, and the reverse, Alastair Campbell, Director of Communications during Blair's administration.

- Why are these figures paired together? What narrative is the artist telling?
- Describe the portrayal of these figures. What expressions are visible?
- How did the artist manipulate the faces?

Richard Hamilton uses various technological techniques in the construction of *The Hutton Award*. Working with press photographs that remodeled the images into grayscale, the tones of the photographs were then Photoshopped in order to add detail to the nose and mouth. Hamilton used the embossing function within Geomagic software. 3D printing technology was used to fabricate a wax copy. After the piece was finalized, a cast silver version was created.

DISCUSS

Commissioned by the British Art Medal Trust as part of the exhibition *Medals of Dishonor*, held at the British Museum in 2009, this artwork reflects the artist's interest in mass media and political commentary.

Experts conclude that Kelly's death was a suicide; although many speculated that he was murdered by the British government. As a UK government weapons advisor, Kelly was later publicly identified as a BBC information source, and identified Tony Blair's role in exaggerating the presence and capabilities of weapons of mass destruction in Iraq, in pursuit of war.

Hamilton exaggerates the facial features of these figures. Prime Minister Blair is shown wearing a haunting smile.

- What kinds of accomplishments are medals usually associated with?
- What statement is Hamilton making on these two politicians?

DO: Leave a lasting Impression

Materials:
Paper; watercolor; metal sheets; embossing tools

Ask students to create a medal that demonstrates a balance between two opposites. Using paper to prepare two drawings, ask students to use watercolor to color detailing in grayscale. Using the detailing of light and shadow as an indicator of height and depth, ask students to use their watercolor sketches as a guide to emboss their design on two metal sheets. Afterward, ask students to cut identical shapes around their designs and join the two sides.

Glossary

3D Printing:

Additive manufacturing or 3D printing is a process of making a three-dimensional solid object of virtually any shape from a digital model. 3D printing is achieved using an *additive process*, where successive layers of material are laid down in different shapes. 3D printing is considered distinct from traditional machining techniques, which mostly rely on the removal of material by methods such as cutting or drilling (*subtractive* processes).

A materials printer usually performs 3D printing processes using digital technology. Since the start of the 21st century, there has been a large growth in the sale of these machines, and their price has dropped substantially.

The technology is used for both prototyping and distributed manufacturing in jewelry; footwear; industrial design; architecture, engineering and construction (AEC); automotive, aerospace, dental and medical industries; education; geographic information systems; civil engineering and many other fields.

3D Modeling:

In 3D computer graphics, **3D modeling** is the process of developing a mathematical representation of any three-dimensional **surface** of an object (either inanimate or living) via specialized software. The product is called a **3D model**. It can be displayed as a two-dimensional image through a process called *3D rendering* or used in a computer simulation of physical phenomena. The model can also be physically created using 3D printing devices.

Models may be created automatically or manually. The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts, such as sculpting.

3D Scanner:

A device that analyzes a real-world object or environment to collect data on its shape and possibly its appearance (i.e. color). The collected data can then be used to construct digital, three-dimensional models. Collected 3D data is useful for a wide variety of applications. These devices are used extensively by the entertainment industry in the production of movies and video games. Other common applications of this technology include industrial design, orthotics and prosthetics, reverse engineering and prototyping, quality control/inspection and documentation of cultural artifacts.

ABS Plastic:

An easily machined, tough, low cost rigid thermoplastic plastic with high impact strength, ideal for turning, drilling, milling, sawing, die-cutting, shearing. **ABS** provides a

balanced combination of mechanical toughness, wide temperature range, good dimensional stability, chemical resistance, electrical insulating properties, and ease of fabrication.

Acrylic:
A synthetic polymer used in high-performance latex or water-based paints. As the paint's binder, acrylic resins enable the coating to last longer and retain its color.

Acrylic Resin:
Resins which have established a pre-eminent position among coating formulators, having shown superiority in such respects as color and gloss retention, alkali and oxidation (chalk) resistance, hardness, adhesive and cohesive strength, and overall film durability. Generically, these resins result from the polymerization of derivatives of acrylic acids, including esters of acrylic acid, methacrylic acid, acrylonitrile, and their copolymers. Also known as acrylate resins.

Algorithm:
An algorithm is an effective method, expressed as a finite list of well-defined instructions, for calculating a function. Starting from an initial state and initial input (perhaps empty), the instructions describe a computation that, when executed, proceeds through a finite number of well-defined successive states, eventually producing "output" and terminating at a final ending state. The transition from one state to the next is not necessarily deterministic; some algorithms, known as randomized algorithms, incorporate random input.
An informal definition could be "a set of rules that precisely defines a sequence of operations" which would include all computer programs, including programs that do not perform numeric calculations. For some people, a program is only an algorithm if it stops eventually. For others, a program is only an algorithm if it performs a number of calculation steps.
Algorithms are essential to the way computers process data. Many computer programs contain algorithms that detail the specific instructions a computer should perform (in a specific order) to carry out a specified task, such as calculating employees' paychecks or printing students' report cards.

CAD/CAM:
Computer Aided Design (CAD) involves the use of computer hardware and graphics software to generate design drawings. Modern CAD equipment enables the designer to quickly produce very accurate and realistic images of products to be manufactured. Computer Aided Manufacturing (CAM) is a system of automatically producing finished products by using computer controlled production machines. CAD and CAM work together in that the digital model generated in CAD is input to the CAM software package. The CAM software needs to know the physical shape of the product (CAD model) before it can compose a proper set of fabrication instructions to a production machine.

Carbon fiber (alternatively **graphite fiber**, **carbon graphite** or **CF)**:

A material consisting of fibers about 5–10 um (micrometer) in diameter and composed mostly of carbon atoms. The carbon atoms are bonded together in crystals that are more or less aligned parallel to the long axis of the fiber. The crystal alignment gives the fiber high strength-to-volume ratio (making it strong for its size). Several thousand carbon fibers are bundled together to form a tow, which may be used by itself or woven into a fabric.

The properties of carbon fibers, such as high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and low thermal expansion, make them very popular in aerospace, civil engineering, military and motorsports, along with other competition sports. However, they are relatively expensive when compared to similar fibers, such as glass fibers or plastic fibers.

Carbon fibers are usually combined with other materials to form a composite. When combined with a plastic resin and wound or molded it forms carbon fiber reinforced plastic (often referred to as carbon fiber), which has a very high strength-to-weight ratio, and is extremely rigid although somewhat brittle. However, carbon fibers are also composed with other materials, such as with graphite to form carbon-carbon composites, which have a very high heat tolerance.

Ceramic (Matrix) Composites:

CMCs are a subgroup of composite materials as well as a subgroup of technical ceramics. They consist of ceramic fibers embedded in a ceramic matrix, thus forming a ceramic fiber reinforced ceramic (CFRC) material. The matrix and fibers can consist of any ceramic material, whereby carbon and carbon fibers can also be considered a ceramic material. CMCs were developed to overcome the problems associated with the conventional technical ceramics like alumina, silicon carbide, aluminium nitride, silicon nitride or zirconia – they fracture easily under mechanical or thermo-mechanical loads because of cracks initiated by small defects or scratches. The crack resistance is – like in glass – very low. To increase the crack resistance or fracture toughness, particles (so-called monocrystalline *whiskers* or *platelets*) were embedded into the matrix. However, the improvement was limited, and the products have found application only in some ceramic cutting tools. So far only the integration of long multi-strand fibers has drastically increased the crack resistance, elongation and thermal shock resistance, and resulted in several new applications.

Digital Fabrication:

The art of using computers to describe physical objects and using genetics, robotics and nanotechnology (GNR) to create them; the making of physical objects through the use of computer-controlled tools. In general, there are currently two methods of digital fabrication:

1) Solid Free-Form Fabrication - Common methods of solid free-form fabrication are 3D Printing (3DP), Selective Laser Sintering (SLS), Stereo-lithography (SLA), Fused Deposition Modeling (FDM), and Laminated Object Manufacturing (LOM), among others

and

2) CNC (computer numerically controlled machining tools).

Digital File:

A collection of data or software stored in the computer. Everything permanently saved in a computer system is a digital file, identified by file name. An entire digital file, such as an image, spreadsheet or executable program, is often read into the computer's memory and thus duplicated in memory temporarily for display or editing.

EPS Foam:

Extruded polystyrene foam (also XPS) consists of closed cells, offers improved surface roughness and higher stiffness and reduced thermal conductivity. Extruded polystyrene material is used in crafts and model building, in particular architectural models. Because of the extrusion manufacturing process, XPS does not require facers to maintain its thermal or physical property performance. Thus, it makes a more uniform substitute for corrugated cardboard.

Extrusion:

Refers both to the process in which material is forced through a die or series of dies in order to shape it, as well as to the product of that operation. The process is used in the home and in manufacturing. The shapes most often produced in this way include round objects like tubes, rods and pipes, rectangular objects like solid and hollow bars, and plates.

Fractal:

The word "fractal" often has different connotations for lay people than mathematicians, where the lay person is more likely to be familiar with fractal art than a mathematical concept. The mathematical concept is difficult to formally define even for mathematicians, but key features can be understood with little mathematical background.

The feature of "self-similarity," for instance, is easily understood by analogy to zooming in with a lens or other device that zooms in on digital images to uncover finer, previously invisible, new structure. If this is done on fractals, however, no new detail appears; nothing changes and the same pattern repeats over and over, or for some fractals, nearly the same pattern reappears over and over. Self-similarity itself is not necessarily counter-intuitive (e.g., people have pondered self-similarity informally such as in the infinite regress in parallel mirrors or the homunculus (the little man inside the head of the little man inside the head...). The difference for fractals is that the pattern reproduced must be detailed.

Interfacing (iron-on):

Interfacing is a textile used on the unseen or "wrong" side of fabrics to make an area of a garment more rigid. Most modern interfacings have heat-activated adhesive on one side. They are affixed to a garment piece using heat and moderate pressure from a hand iron, for example. This type of interfacing is known as "fusible" interfacing. Non-fusible interfacings do not have adhesive and must be sewn by hand or machine.

Jacquard Tapestry:

The term tapestry is used to describe weft-faced textiles made on Jacquard looms. Before the 1990s, tapestry upholstery fabrics and reproductions of the famous tapestries of the Middle Ages had been produced using Jacquard techniques. More recently, artists such as Chuck Close and the workshop Magnolia Editions have adapted the computerized Jacquard process to producing fine art.

"Kinect" Controller:

Kinect is a motion sensing input device by Microsoft for the Xbox 360 video game console and Windows PCs. Based around a webcam-style add-on peripheral for the Xbox 360 console, it enables users to control and interact with the Xbox 360 without the need to touch a game controller through a natural user interface using gestures and spoken commands. The project is aimed at broadening the Xbox 360's audience beyond its typical gamer base.

Lamination:

The technique of manufacturing a material in multiple layers, so that the composite material achieves improved strength, stability, appearance or other properties from the use of differing materials. A laminate is usually permanently assembled by heat, pressure, welding or adhesives.

Laser Cutting:

A technology that uses a laser to cut materials and is typically used for industrial manufacturing applications, but is also starting to be used by schools, small businesses, and hobbyists. Laser cutting works by directing the output of a high-power laser, by computer, at the material to be cut. The material then either melts, burns, vaporizes away, or is blown away by a jet of gas, leaving an edge with a high-quality surface finish. Industrial laser cutters are used to cut flat-sheet material as well as structural and piping materials.

LED Light:

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting. Modern

versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness.

An LED is often small in area (less than 1 mm^2), and integrated optical components may be used to shape its radiation pattern. LEDs present many advantages over incandescent light sources, including lower energy consumption, longer lifetime, improved physical robustness, smaller size and faster switching.

Light-emitting diodes are used in applications as diverse as aviation lighting, digital microscopes, automotive lighting, advertising, general lighting and traffic signals. LEDs have allowed new text, video displays and sensors to be developed, while their high switching rates are also useful in advanced communications technology.

Line-X Finish:
A protective coating for any surface from vehicles to sneakers. These commercial products can be used alone or in conjunction with one another for industrial applications.

Low-density polyethylene (LDPE):

A thermoplastic made from the monomer ethylene. It was the first grade of polyethylene, produced in 1933 by Imperial Chemical Industries (ICI) using a high-pressure process via free radical polymerization. Its manufacture employs the same method today. The EPA estimates 5.7% of LDPE is recycled. Despite competition from more modern polymers, LDPE continues to be an important plastic grade.

MDF Panel:

Medium-density fiberboard is an engineered wood product formed by breaking down hardwood or softwood residuals into wood fibers, often in a defibrator, combining it with wax and a resin binder, and forming panels by applying high temperature and pressure. MDF is denser than plywood. It is made up of separated fibers, but can be used as a building material similar in application to plywood. It is stronger and much denser than particle board.

Milling:

Using a multi-toothed milling cutter to remove metal from the workpiece surface to create flat and angular surfaces and grooves.

Photopolymer material:

A photopolymer is a polymer that changes its properties when exposed to light, often in the ultraviolet frequency of the electromagnetic spectrum. These polymers are used as image carriers in flexographic printing, as components of fillings for dentistry, as ADA-compliant architectural signage, and in rapid prototyping for the stereolithography and

3D printing processes. The basic material is soft and light sensitive and, when produced, will undergo a selective exposure, development and curing process.

Polyamide: a polymer containing monomers of amides joined by peptide bonds. They can occur both naturally and artificially, examples being proteins, such as wool and silk, and can be made artificially through step-growth polymerization or solid-phase synthesis, examples being nylons, aramids, and sodium poly(aspartate). Polyamides are commonly used in textiles, automotives, carpet and sportswear due to their extreme durability and strength.

Polycarbonates (PC):

Known by the trademarked names Lexan, Makrolon, Makroclear and others, are a particular group of thermoplastic polymers. They are easily worked, molded and thermoformed. Because of these properties, polycarbonates find many applications. Polycarbonates do not have a unique resin identification code and are identified as Other, 7.

Post-Digital:

The **Digital Revolution** is the change from analog mechanical and electronic technology to digital technology that has taken place since about 1980 and continues to the present day. Implicitly, the term also refers to the sweeping changes brought about by digital computing and communication technology during the latter half of the 20th century. Analogous to the Agricultural Revolution and Industrial Revolution, the Digital Revolution marked the beginning of the Information Age.

In the context of *Out of Hand*, post-digital refers to the art, design and architecture that resulted from the digital revolution. Therefore, the work in the exhibition is part of the digital age.

Rapid Prototype Technology:

A group of techniques used to quickly fabricate a scale model of a physical part or assembly using three-dimensional computer aided design (CAD) data.[1][2] Construction of the part or assembly is usually done using 3D printing technology. The first techniques for rapid prototyping became available in the late 1980s and were used to produce models and prototype parts. Today, they are used for a wide range of applications and are used to manufacture production-quality parts in relatively small numbers, if desired, without the typical unfavorable short-run economics.

Resin:

(1) General term applied to a wide variety of more or less transparent and fusible products, which may be natural or synthetic. They may vary widely in color. Higher

molecular weight synthetic resins are generally referred to as polymers. (2) A solid, semi-solid, or pseudo-solid organic material that has an indefinite and often high molecular weight, exhibits a tendency to flow when subjected to stress, usually has a softening or melting range, and usually fractures conchoidally. In a broader sense, the term is used to designate any polymer that is a basic material for coatings and plastics.

Stereolithography (SLA):

A 3d printing process that makes a solid object from a computer image by using a computer-controlled laser to draw the shape of the object onto the surface of liquid plastic.

Selective Laser Sintering (SLS®):

An additive rapid manufacturing process that builds three-dimensional parts by using a laser to selectively sinter (heat and fuse) a powdered material. The process begins with a 3D CAD file that is mathematically sliced into 2D cross-sections. The **SLS** prototype or part is built a layer at a time until completed.

Thermoplastics:

Materials that soften or melt when heated and harden when cooled. Thermoplastic polymers consist of long polymer molecules that are not linked to each other. i.e., have no cross-links. They are often supplied as granules and heated to permit fabrication by methods such as molding or extrusion. Thermoplastics include polyethylene, polypropylene, polystyrene, polyester, polyvinyl chloride, acrylics, nylons, spandex-type polyurethanes, and cellulosics.

Urushi-e:

Literally meaning "lacquer picture," refers to two types of Japanese artworks: paintings painted with actual lacquer, and particular woodblock printing styles that use regular ink but are said to resemble the darkness and thickness of black lacquer.

Wire Cutting:

A wire EDM (electrical discharge machining) is a machine that cuts metals using a wire as thin as a hair (non-contact cutting). Metals are fuse-cut by electric power (heat generated from electrical discharges like lightning).
Wire EDM features various advantages: Able to easily cut very fine shapes like a thin slit; Able to easily cut quenched metals, in addition to difficult-to-cut hard materials and viscous materials; Even a single wire can cut any shape, including curves and complex shapes. Changing or re-clamping tools is not necessary; Un-manned operation is possible as the machine runs according to the NC (numbered cutting) program, enabling other operations while the machine is running or long periods of unmanned operation during the night.

Webography

Andreia Chaves
http://www.andreiachaves.com/AndreiaChaves/index.php/invisible2

Barry X Ball
Find images and text about the process:
http://www.barryxball.com/process_cat.php?cat=1&process=1
interview with the artist: http://www.youtube.com/watch?v=79giVCovYCg

EZCT
http://ezct.net/home.php

Find images of Computation Chair Design
http://www.flickr.com/photos/transphormetic/232286232/

Find video on the Evolution of Computation Chair Design Project
http://vimeo.com/3226203

Mass Studies
Find artist statement and text about project at:
http://www.massstudies.com/projects/expo_txtEN.html

Find images of Korean Pavilion:
http://www.flickr.com/photos/ettubrute/sets/72157624077657663/

Find digitally rendered models of interior and exterior of Korean Pavilion :
http://www.dezeen.com/2009/04/15/korean-pavilion-at-expo-2010-by-mass-studies/

Maya Lin
Find images in Art, Bodies of Water Series
http://www.mayalin.com/

“Maya Lin Examines Disappearing Bodies of Water”
http://blog.art21.org/2013/07/12/maya-lin-examines-disappearing-bodies-of-water/#.UmrHn3Csh8E

Find Art 21 video interview with Maya Lin:
http://www.youtube.com/watch?v=_r-9VB04eFg

Richard Hamilton
Find images and text about the series
http://www.uwe.ac.uk/sca/research/cfpr/news/archive/2009/summer_09/the_hutton_award.html