

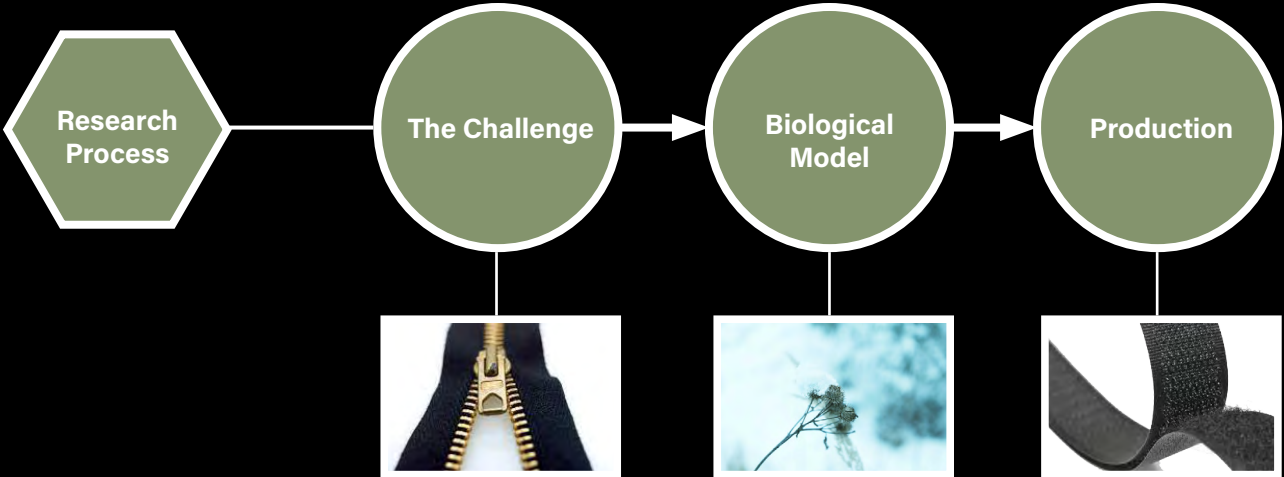
BIOMIMICRY MAZE

EXHIBITION DESIGN
LOCATION: CAPE COD, MA
INSTRUCTOR: YOUNGJIN SONG
TYPE: SINGLE WORK
TIME: 2022 SPRING

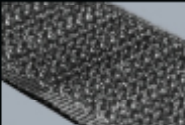


The exhibition site is the Marshview room at the Cape Cod Museum of Natural History. From there, students will expand their design concepts and scope by intervening within the museum's spaces and collections and beyond, inviting the visitors to go outside the museum—to the salt marsh and Wing's Island—and explore and learn from the immediate nature themselves. Serving the museum's mission: to inspire appreciation, understanding, and stewardship of our natural environment and wildlife through discovery and learning, as well

As delivering the key message: Nature is the pathway to science and invention, the exhibition will also conceive answers to these questions—Can this exhibition design itself be an example of biomimicry? Can this exhibition extend its narrative to larger conversations around climate change and function as a call for action? Can this exhibition engage with and support the local community of Cape Cod and bring lasting impacts on environmental awareness and education?



Vending Machines



The Challenge
Many conventional fasteners create permanent changes to the textiles they are attached to. Additionally, common fasteners often only hold items together in a certain direction.

Innovation Details
Velcro® was inspired by burr seeds, which are covered in tiny hooks that easily attach to mammal fur. Similarly, Velcro has one side made up of tiny hooks, while the other side is covered in tiny loops. When the two sides are pressed together, the hooks attach to the loops and the two sides stick together to form a strong bond.

Biological Model
Burr is a seed from the Burdock plant that is covered in tiny hooks. These hooks make it easy to attach to an animal's fur, allowing the seed to travel long distances before germinating. This helps the plant to spread its seeds over a wider area.

Detailed Info



The Challenge
Buildings and bridges are usually made of very rigid materials such as concrete and steel. When an earthquake or other natural disaster hits, the inflexible structure can crack or break. If structural damage occurs, the repairs can be costly, or could lead to catastrophic failure of the overall structure.

Innovation Details
The material has a diagonally-reinforced square lattice-like skeletal structure, inspired by the Vena flower basket. The diagonal reinforcement increases the material's resistance to buckling or breaking under a large force. The structure also has a high strength-to-weight ratio, meaning it can withstand heavy forces with less material than a typical lattice structure.

Biological Model
The Vena flower basket lives anchored to the deep ocean floor. Also known as glass sponges, their cylindrical skeletons are made out of silica, the main component of glass. The silica is arranged in concentric layers known as spicules. The spicules are arranged into a tube-shaped square lattice. Two separate but overlapping lattices make up the main frame, and because these lattices can still move relative to one another, the skeleton can be flexible while it's growing. The squares of the lattice are reinforced by struts that run vertically, horizontally, and diagonally. These struts are made of bundles of spicules and further support the lattices against bending, sliding, and twisting forces.



The Strategy
The secret is in the shape of the kingfisher's beak. A long and narrow cone, the kingfisher's beak pierces the water without creating a compression wave below the surface or a noisy splash above. The fine point of the conical beak presents little surface area or resistance to the water upon entry, and the evenly and gradually enlarging cross-section of the beak keeps fluid flowing smoothly around it as it penetrates further into the water column. This buys the bird crucial milliseconds to reach the fish before the fish knows to flee. The length of the beak is critical here: the longer it is, the more gradually the angle of the wedge expands. A shorter, fatter, or rounder beak would increase the wedge angle, resulting in a splash, a compression wave, and a fleeing fish.

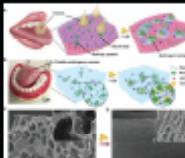
The Potential
Eiji Nakatsu, chief engineer of the company operating Japan's fastest trains, wondered if the kingfisher's beak might serve as a model for how to redesign trains not to create such a thunderous noise when leaving tunnels and breaking through the barrier of tunnel-air and outside-air. Sure enough, as his team tested different shapes for the front of the new train, the train became quieter and more efficient as the geometry of its nose became more like the shape of a kingfisher's beak, requiring 15% less energy while traveling even faster than before.



The Challenge
The joining of materials creates everything that we depend on in our daily lives, including products, machines, buildings, cars, airplanes, computers, medical innovations, and many more. However, many current joining systems are complicated, aesthetically troubling, and permanent. Additionally, the glues used in them can be toxic to humans and not environmentally friendly.

Innovation Details
Striplock® attachments are formed by wedging together two or more parts that have intermeshing, castellated edge hooks. These are then joined with a castellated Joinlock® key, which bends to take the loads imposed by the parts on the joint. This design was inspired by clams and other shellfish that attach to rocks with incredible force. They do this by many special threads to tiny overhangs and overhangs on rocks. The cumulative effect of all these attachments converts the shear forces into tensile and flexural forces, just like in the many small points of contact on the Striplock design.

Biological Model
Blue mussels attach to rocks in wave-battered intertidal seashores. They attach using stringy fibers called byssal threads that emerge from their protective shells, secreted by glands on the soft bodies inside. These fibers, while thin and flexible, also have a high tensile strength and produce a very strong hold when their combined strength is added together.



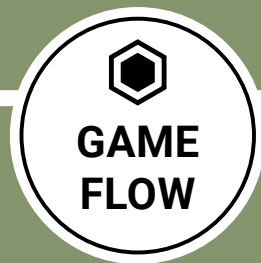
The Challenge
Artificial tongues have been developed to detect the five basic tastes, including sweet, sour, bitter, salty and umami. However, more complex tastes such as astringency (acidity or bitterness) is more difficult to detect. These artificial tongues have been developed based on lipid-polymer membranes or stripped epithelium cells, giving the tongue reduced selectivity and a narrow detection range.

Innovation Details
The specific molecules that cause the perception of astringency can be found mainly in unique fruits, wines and teas. The thin layer of saliva on the tongue is important for tasting because it absorbs the molecules and enables them to bind to receptor cells, which send signals to the brain that it is tasting an astringent food. Researchers mimicked this salivary layer by creating a thin hydrogel layer on top of a 3-D porous polymer network that facilitates the flow of electrolytes. The hydrogel absorbs the astringent-causing molecules, causing them to clump together. This enhances the ion-conductivity of the hydrogel, causing an increased current that sends a signal that astringent molecules are present.

Biological Model
Tongue are soft, flexible muscular organs responsible for the sense of taste. The tongue has mechanical receptors and ion channels that assist in the translation of signals used for taste perception. In addition, saliva plays a key role in tasting because it absorbs the water-soluble tastants, allowing them to bind to receptor cells. The receptor cells pass electrical signals to the brain with information about the taste.



Mammalian Tongues



Starting Point

Card Machine

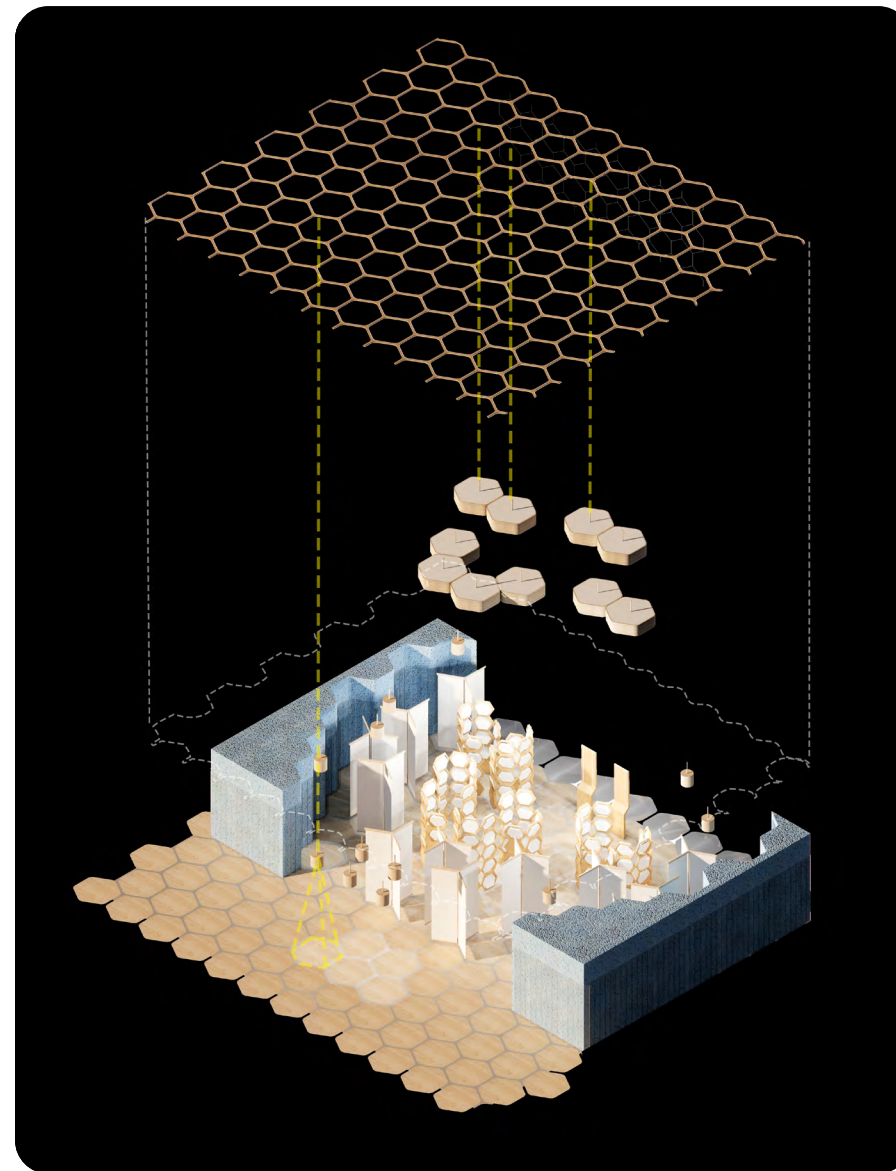
Info Boards

Biological Model Warehouse

Terminal A

Terminal B

BIOMIMICRY MAZE

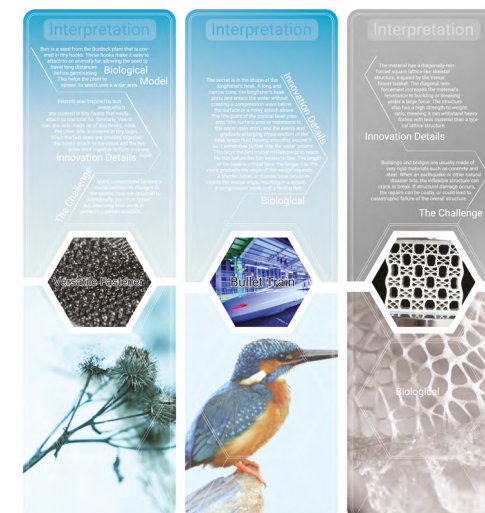


Part 1: Winner Judgment Mechanism

Game rules must be simple and concise. Who will be the winner and why is this player the winner?

In a marathon, the first person to cross the finish line is the champion; In chess, the first player to eliminate the opponent's king is the winner; In Monopoly, when someone goes bankrupt, the player with the most assets wins.

In the new design, the strategy adopted by the designers is a points system. When the game reaches a certain time, the staff will calculate the score of each player. The person with the highest score at the end wins a prize. Plus, games have to be diverse. Therefore, players will not get bored. In other words, after completing a game, the player is interested in returning to the field to play again.





Part 2: the flow of the game

The course of the game is very similar to orienteering. Orienteering is a sport with the help of a compass, a map, and check-points. The sport can be played in wilderness, woods and urban environments. The athlete needs to find each check-in point along the route on the map, and the athlete has to mark the corresponding mark on his card to prevent cheating.

How to combine the game rules of orienteering with bionics? The designer's intention is to let players experience the bionic research process in the process of the game.

The study of biomimicry is very complex. The research steps can be roughly divided into 6 steps. However, in order to simplify the flow of the game, the collection is divided into three steps, the challenge, biological model, and the production.

In detail, the challenge means the problems or questions that we meet with in daily life. The biological model refers to the plants and the animals in the natural environment. Finally, the production is actually the invention from the companies or the institutes.

In the actual game, it is also divided into 3 parts. These 3 parts and the research process are slightly different. This is done to simplify the game. Players need to get the card with the product written on it first. The player then needs to find the corresponding product, explanation, and flora and fauna in turn. After players find explanations, animals and plants, they need to record the corresponding codes. Finally, the player enters the code in the final terminal to calculate the score.