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Address

C/ Trinidad, 4

CP. 18001

Tlf. 958 29 28 44

Granada - Spain

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Interior Design

INVESTIGATING BIOMIMICRY IN DESIGN

RESULTS FROM A RESEARCH WORKSHOP AT L'ÉCOLE DE DESIGN NANTES ATLANTIQUE

Julien Delannoy ⁽¹⁾; José Antonio González Casares ⁽²⁾

1. Introduction

This article presents the findings of a research workshop conducted at L'École de Design Nantes Atlantique, focused on exploring the possibilities biomimicry offers in design. The workshop aimed to investigate how natural organisms can inspire innovative approaches to product and systems design.

To achieve this, the workshop employed a hands-on research methodology centred on a biomimicry table—a curated collection of organisms selected for their potential to inspire design solutions. Participants were encouraged to study the organisms' structures, functions, and behaviours, translating these insights into conceptual and practical design outcomes. The interdisciplinary nature of the workshop was further enriched by the collaboration of a biologist, who provided scientific guidance and ensured the biological accuracy of the participants' analyses.

This investigation not only explored the application of biomimicry in design processes but also demonstrated the value of integrating biological expertise within creative practices. The workshop outcomes underline the potential of biomimicry as a tool for sustainable innovation, fostering a deeper understanding of nature's role in addressing complex design challenges.

The project was undertaken by three teams of international students, with the primary objective of selecting an area on the Île de Nantes, where the school is located, and designing a space for the island's residents using biomimetic design principles. The project was led by a team of professors: José Antonio González Casares from ESADA and Julien Delannoy from L'École de Design.

We would like to extend our deepest gratitude to L'École de Design Nantes Atlantique and its outstanding Erasmus team, led by Zoe Lacey, for the incredible experience and their immense effort in making the International Week such a remarkable success. Additionally, our sincere thanks go to the Erasmus team at ESADA and their coordinator, Félix Guerrero, for their enthusiasm and dedication in preparing the project. Finally, a special thanks to the team at Biomimicry Granada (<https://biomimicrygranada.com/>), particularly Abraham Ortega and Theresa Millard, for preparing the materials and providing the essential scientific support that ensured the workshop was both productive and inspiring.

Keywords: Sustainable, biomimicry design, Nantes island, research in design.

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⁽¹⁾Corresponding authors: j.delannoy@lecolededesign.com ⁽¹⁾; josegonzalez@esada.es ⁽²⁾,

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PROJECT 1

DESIGNING A PAVILION BY THE LOIRE

PROPOSAL FOR A PROTECTIVE AND REGENERATIVE SPACE. AMPHIBIAN SHELTER

Josephine Baudu; Carolina Capdevila; Francesco De Toni; Emma Rebelo; Chhavi Rijhwaney

Abstract. Our workshop project integrates biomimicry and relaxation, drawing on nature's evolutionary designs for human-centred engineering. It serves both students from Nantes Atlantique School of Design, managing intense creative workloads, and Nantes residents seeking balance between work and personal life.

Inspired by the rounded, protective forms of frog eggs, the structure evokes a sense of security. Colour therapy is employed to boost morale, while the proximity to water enhances relaxation through its soothing sounds. The project provides a protective, restorative space within the city, offering users a moment of pause and connection with nature

1. INTRODUCTION AND OBJECTIVES

The project aims to create a 25m²–100m² space on the island in Nantes, near the School of Design, for students and local residents to foster creativity, reconnect with nature, and support well-being. Located at “La cale 2,” near the Loire River and the Yellow Crane, the site offers a serene atmosphere ideal for relaxation, alongside historical and cultural significance associated with Nantes' industrial past.

While challenges include a 7% slope, slippery conditions, tides, and local vegetation, the site's natural light, tranquillity, and panoramic views make it ideal for an inclusive, sustainable design that respects biodiversity.

- Create a space to regenerate and take care of yourself thanks to colour therapy.
- Inspire students to escape reality and connect with nature.
- Design innovative and sustainable structures inspired by the forms of nature using biomimetic.
- Learn about the different ways you can relax and reconnect with yourself thanks to the environment.
- Discover yourself and your surroundings in a new creative way thanks to the path and the different colours/point of view proposed to you.
- Awaken the mind and senses to attain mindfulness and help people discover themselves.

1.1. STATE OF THE ART

Well-being refers to a good quality of life, both physically and mentally. However, stress remains a significant issue, leading to workplace absenteeism and persistent anxiety among students, with few seeking treatment (Regehr, 2012). Our project aims to provide a natural space to alleviate stress, incorporating colour therapy. Although the therapeutic use of colours emerged around the 1950s (Birren, 2006), this method leverages specific wavelengths from colours to positively influence the body and mind, particularly when combined with meditation.

The design draws inspiration from biomimicry, specifically the egg frog. Frog eggs symbolise protection, aligning with the project's intent to create a safe and nurturing space. These eggs develop near water in moist environments and cluster in gelatinous structures, which mirror protective molecules and melanin patterns (Byju's, 2022). This form emphasises protection and integrates naturally with the site's context.

The Watching Tower in Aarhus, Denmark, designed by Studio Olafur Eliasson (2011), inspired the application of colour to alter perceptions of the environment and self. Immersion in colour fosters curiosity and a shift in perspective. Additionally, we incorporate principles of land art, creating ephemeral structures that interact with nature over time. For instance, a pinecone-like structure made from beach

rocks disintegrates with tides, symbolising impermanence and harmony with nature.

2. METHODOLOGY

The project began with identifying user needs, followed by analysing the location, its advantages, and challenges. Inspired by biomimicry, particularly the concept of protection, we considered various functions for the space, such as exercise, art therapy, and meditation, ultimately deciding on colour therapy. Initial sketches explored multiple forms, leading to the adoption of the frog egg as the primary shape, which symbolises protection and aligns with the theme of biomimicry.

The design incorporates smaller rooms for chromotherapy and larger rooms featuring information on colour therapy and biomimicry, linked to an Instagram platform. A pathway on the water adds movement and sound, encouraging users to reconnect with themselves and their environment. The frog egg shape was chosen for its natural aesthetic and its association with melanin, the molecule responsible for colours in frogs, reinforcing the connection between form and function.

Feedback from class presentations highlighted areas for improvement, including material selection, slope safety, and enhancing the link between colour changes and biomimetic shapes. These suggestions were integrated into the

final design, creating a space that aligns with nature's rhythm and supports user well-being.

3. RESULTS

The final structure incorporates sustainable and biodegradable materials. The floating platform will be constructed from cork, a durable material capable of holding weight while naturally degrading over time. The structure's flooring and furniture will use Sulapac, a type of recycled wood, ensuring both durability and eco-friendliness. Transparent domes will be made of bioplastic, allowing for light play and colour effects.

As envisioned, all materials will gradually disintegrate, symbolising the project's impermanence. This process reflects the metaphor of a hatching egg, signifying the transition to a new life phase as the structure detaches and blends into nature.

4. CONCLUSIONS

Overall, we achieved most of the objectives, but for some, we could have explored further, such as in the principles of construction and the use of materials. We could have developed the concept of escaping reality and connecting with nature more thoroughly. Currently, this idea is approached in a limited way, focusing on creating an ambiance, but users do not have a direct connection to nature.



Image 1: Final image of the project.
Own elaboration



Image 2: Final model.
Own elaboration

PROJECT 2

EXTERIOR DESIGN AND BIOMIMICRY

PROPOSAL OF A SHARING SPACE FOR DESIGN STUDENTS AND INHABITANTS OF NANTES.
THE FINGERPRINT FORUM

Josephine Baudu; Carolina Capdevila; Francesco De Toni; Emma Rebelo; Chhavi Rijhwaney

Abstract. This project applies biomimicry and sharing to create a multifunctional space that fosters interaction and creativity. Biomimicry, inspired by evolutionary solutions from nature, is integrated into human engineering principles. The space is designed primarily for students of Nantes Atlantique Design School but is accessible to the wider public, including Nantes residents. The project serves three core functions: Overcoming Creative Blocks: Providing a collaborative environment where students can engage with outsiders to gain new perspectives on their projects. Cultural Exchange: Facilitating language learning and cultural integration, particularly for foreign students, to promote international understanding. Human Books: Hosting conferences where individuals share personal experiences, encouraging knowledge exchange.

The design draws inspiration from the fingerprint, a natural and human symbol rooted in the Fibonacci sequence, which appears throughout nature. This element highlights the connection between human identity and the natural world, embodying both human creativity and the impact humans leave on their environment.

1. JUSTIFICATION

The project aims to create a tranquil space near the Nantes Design School, intended for both students and residents of Nantes. Located on the island of Nantes, near the popular Machines of the Isle, the site is a sheltered, semi-hidden underground area, offering protection from the wind while allowing sunlight to interact with its features. Its contrasts—height, natural vegetation, and human-made materials like wood and concrete—make it an ideal retreat from the urban environment.

Challenges include potential noise from a nearby playground and limited air circulation due to the site's sheltered nature, necessitating thoughtful design solutions. The target audience includes French and international students from nearby art-focused institutions, as well as residents. The space is designed to encourage cultural and intergenerational exchanges, fostering creativity, collaboration, and the appreciation of language and diversity, while serving as a hub for learning and project development.

Creating a space for exchange between students and residents of Nantes;

- Offering new sharing experiences
- Creating an environment conducive to exchanges that adapts to the functions of the place.

- Creating harmony between location and biomimicry.

1.1. STATE OF THE ART

The Fibonacci sequence, an infinite series where each number is the sum of the two preceding it, appears frequently in nature, such as in the shape of snail shells, the arrangement of leaves, the curvature of animal horns, and the number of flower petals.

Fingerprints, though unique and subtle, are powerful graphic forms. British artist Chris Drury's *Fingermaze* transforms this small-scale element into a walkable large-scale maze, resonating with the micro/macro principle.

In ancient Greece (5th century BC), agoras served as central spaces for citizens to discuss politics, religion, trade, and social issues. Similarly, modern public speaking spaces like Speaker's Corner in Hyde Park, London, allow open expression and debate. Our chosen location, on the bank of the Loire River, reflects the geographical significance of such gathering spaces, traditionally positioned in central or port areas.

2. METHODOLOGY

Our creative process began with an exploration of biomimicry, followed by sketches testing va-

rious shapes and scales while considering the site's spatial constraints. Influences included the Fibonacci sequence, site-specific advantages and challenges, material studies from workshops, and the relationship between humans and nature—a central theme in our project.

We ultimately focused on the fingerprint as a symbol of the connection between humans and nature. Feedback from the "6 Thinking Hats" process led us to refine our design, incorporating more biomimicry elements such as the fibrous texture of palm trunks and the internal structure of cacti.

The final concept is an exchange space shaped like a fingerprint, visible from above but transforming into a more intimate setting at ground level. Rounded seating, curved sunshades, and organic structures define the space. The walls feature honeycomb-inspired alcoves housing plants and flowers, symbolising growth and creativity. Arches in the walls cater to viewers of different heights, encouraging interaction.

Visitors can leave their imprint using Moroccan clay pigment, contributing to the evolving "DNA" of the site. Seating is arranged amphitheatre-style to foster conversation or host lectures, while integrated sunshades provide comfort during hotter periods. This interconnected design unites the space's functions, fostering a meaningful relationship between nature and humanity.

3. RESULTS

Our structure takes the form of a fingerprint through interconnected modules such as walls, benches, and sunshades. These elements

integrate biomimetic principles and materials, drawing inspiration from nature. For instance, the walls and benches feature cactus-like cellular patterns. In the walls, these cells support plant growth, facilitate airflow, and provide an open view of the surroundings. Additionally, the material absorbs water and distributes it to plants, creating a semi-self-sustaining system. The benches incorporate similar patterns to ensure structural strength while minimising material use. Palm fibre is included to further support plant growth.

To ensure the structure's upkeep, a student association, *Le Bureau des Plantes* (The Plant Bureau), would be established. This group would oversee site maintenance and manage the Fingerprint Forum Instagram account, coordinating events and activities. This initiative would help sustain the project for at least one year.

4. CONCLUSIONS

In conclusion, we have designed a sharing space centred on humans and guided by biomimicry principles. While we achieved our objectives to varying degrees, future improvements could focus on better integrating the location's environment. Expanding the project within the city could involve sites with elevated viewpoints to enhance visibility of the fingerprint design. The scalable structure allows for modifications, supporting its evolution while maintaining its focus on connection and biomimicry.



Image 3: Final image of the project.
Own elaboration



Image 4: Final model.
Own elaboration

PROJECT 3

URBAN DESIGN IN THE CITY OF NANTES

REDESIGNING THE BANKS OF THE LOIRE. THE GROWING ISLAND: DISCOVER, TAKE A BREAK, LEARN, EXPERIMENT AND (RE)CONNECT TO NATURE!

Selma Gobin; Mouli Gupta; Lisa Hervy; Shénoa Huault; Jodie Maugin

Abstract. Our project - the growing island of biodiversity, was created around the biomimicry principles. It is a method used in design, which consists in mimicking and understanding all the details, patterns and techniques that nature has to offer. This method allowed us to create an urban oasis for people to escape the city and to (re)connect with nature.

Promoting sustainability in design is the goal of tomorrow and of l'Ecole de design, we invite students and citizens of the world to join us on the island. The users will go through moving sunproof trees, seashells exhibitions, spider nets, and an immersive algae workshop to open up creativity. A change of scenery in the city of Nantes is a great opportunity and the Growisland website accompanying this urban space gives even more details and fun insights to get even more interested in the project.

1. JUSTIFICATION

Our project is located on the Fernand Trouan dock near the Anne de Bretagne bridge, currently an underused metallic structure with few benches. It offers a serene escape, blending nature, buildings, and water, with sounds of water and wind creating a rare urban feature. However, challenges include noise from the metal flooring, its transparent surface causing discomfort for those with vertigo, and limited accessibility due to stairs.

The brief required a space near the school campus for students and citizens, using biomimetic principles to foster well-being, creativity, and connection with nature. Inspired by the dock's island-like appearance, the design incorporates biodiversity through elements reflecting trees, flowers, and seashells, while addressing issues like sun exposure, noise, and flood risk.

The project aims to connect students and residents, creating a venue to share student projects and host sustainability workshops, welcoming all curious participants.

- Raise Awareness of Sustainability: Highlight sustainable projects by L'Ecole de Design, showcasing their approach to tomorrow's design.
- Display sustainable projects and demonstrate their design processes.
- Provide a space for users to connect with nature, unwind, and reflect on the projects.

- Educate visitors on algae's benefits and its role in sustainable design, allowing them to harvest and grow algae at home in a glass cube inspired by natural fractal patterns.
- Serve as a living exhibition of how biomimicry inspires harmonious, nature-integrated design.
- Encourage visitors to explore, observe the structure, appreciate the environment, and engage with the site's sounds and features.

1.1. STATE OF THE ART

To better understand and refine our project, we researched similar initiatives. The Bio-ID lab's algae-infused material, which absorbs water pollution and provides sun protection, served as an inspiration. Our project draws on various natural principles to address challenges, similar to a self-sufficient ecosystem, using biomimicry to find sustainable solutions. The "Ture Tower" by Victor Ortiz, with its evolving platforms, also influenced our design.

Biomimicry involves replicating nature's solutions, developed over 3.5 billion years, to create efficient human-made designs. This includes studying shapes, textures, and functions. Designers can apply this approach to architecture, objects, and sustainable projects.

Our design draws inspiration from several natural elements: the pine cone (which opens and closes depending on moisture), the spider's web (strong and shock-absorbent), seas-

hells (resistant to pressure), mangrove trees (able to absorb water pressure and create shade), and algae (which absorb CO2 and produce oxygen). We also reference flowers (which track the sun) and the water cycle in trees.

Our pavilion, inspired by an island oasis, incorporates natural forms like seashells and uses layering systems for structural reinforcement. The space organically extends to create a relaxing beach area, blending algae and flower-inspired trees. All elements harmonise, creating a sanctuary distinct from the surrounding city.

2. METHODOLOGY

Our design process involved several creative steps, illustrated by sketches in the appendices. The hats activity provided valuable feedback. Some found the connections between elements unclear, while others appreciated the diversity, which created a unique biodiversity. This led to the idea of an "island" to unify our spaces, which suited the open, tidal platform location. A comment about the space between the platform and wall further inspired this concept.

To strengthen the "growing island" idea, we decided to plant climbing vines at the workshop building's base, which would reshape over time. Vines, typical to Nantes, were chosen to connect the project to the local culture. The grooves in the architectural ceramics would support the plant's growth.

To ensure accessibility, including for wheelchair users, we designed a hydraulic elevator inspired by water cycles and tree water movement. This elevator connects three levels: the platform floor, the island on the platform, and the underground algae gardens for the workshop.

To promote the space, we created a website featuring information on the island, student projects, and updates on the growing plant. It also includes workshops on algae, environmental information, and daily sustainability quotes.

Final views of each element can be seen in the drawings.

3. RESULTS

We created an urban oasis using biomimicry, focusing on integrating sustainability into the city in an engaging way for all, regardless of design knowledge. The connection with the school and students was key, as we envisioned using and showcasing the space ourselves. Our research led to diverse structural elements, immersing us in biomimicry techniques and enabling the creation of a biodiversity island. With more time, we would have explored how the tide could influence the structure's evolution, allowing the space to grow in new, creative directions.

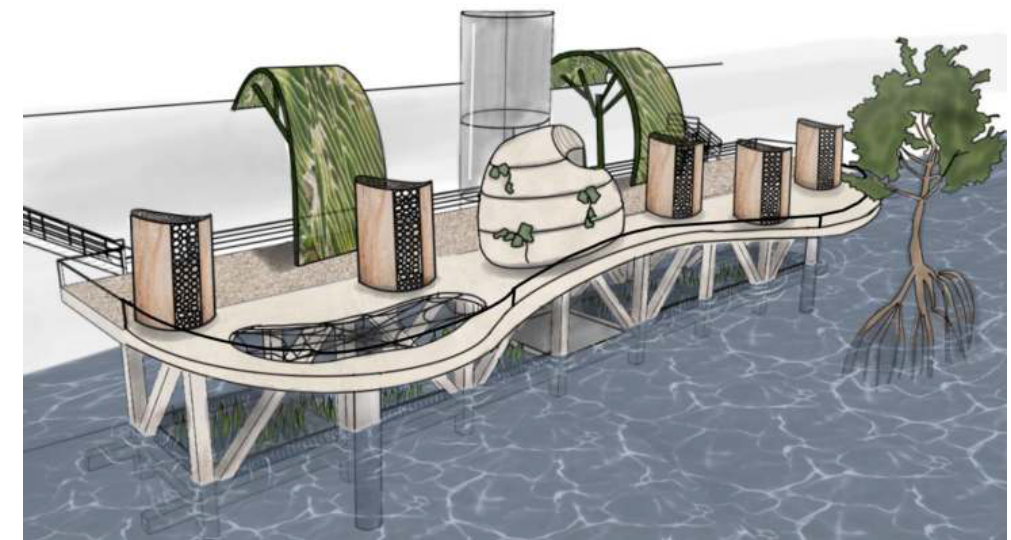


Image 4: Final design.
Own elaboration

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