BiomassLab

Domestic Microalgae Laboratories

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Project by
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Content

01
Introduction

In the near future, homes will contain small laboratories. *BiomassLab* is an idea that emerged as a final project in the Basque BioDesign Center School in Bilbao, Spain by the student Paula Franco. She has started her entrepreneurial career with the BiomassLab project with the intention of bringing the properties of microalgae to the domestic space.

BiomassLab hopes to advance its goal of becoming a company creating self-sufficient home laboratories and sustainable biomass production. The project offers home microalgae lab kits for consumers to grow and harvest their own fresh and healthy microalgae in the comfort of their own home. This kit includes everything needed for cultivation, including the lab, equipment and supplies necessary to grow microalgae.

By integrating biomass production into everyday life, we can contribute to a healthier future for ourselves and the planet. The change starts inside our homes.

Grow It Yourself

02

The Rooth.

Becoming more self-sufficient and producing our own needs at home can have several important benefits for the future.

By reducing our dependence on industrially manufactured products, we can help reducing their negative impact on the environment and our health. Additionally, producing our own food can help us reducing waste and reutilizing materials, ultimately lowering our carbon footprint.
Lastly, experimenting with sustainable solutions can help us finding new ways to live more eco-friendly lifestyles, while also encouraging creativity and innovation in the field.

Looking towards the future and making these changes, we can become more conscious of our relationship with the environment and help create a more sustainable world.

03

CONECCTING PAST AND FUTURE

How Digitization can keep Tradition alive

The idea of producing our own needs at home, combined with new technologies, can be an important and necessary solution for the future. New technologies, such as 3D printing and automation, can allow us to produce a variety of personalized and specific products for our needs, reducing the need to manufacture large quantities of products in distant factories.

In addition, information and communication technologies can help us share knowledge and solutions more effectively, allowing us to experiment with new ideas and techniques for living more sustainably. We can also use technology to monitor resource consumption and carbon footprint, enabling us to make adjustments and improve our production practices in real time.

In summary, the combination of home production and new technologies can be a valuable solution to create a more sustainable future, reducing our dependence on industrialized products and fostering innovation and creativity in the field of sustainability.

Smart Home Laboratories

Digitization, programming and technological tools can be a great idea to improve crop production, fermentation and recycling in a controlled environment, improving the quality of the final biomass.

For example, in algae cultivation, automated sensors and irrigation systems controlled by a computer program can be used, allowing more accurate and efficient monitoring and adjustment of irrigation and nutrient levels.

In fermentation, automated temperature and pH controllers can be used to control fermentation conditions, improving the quality and consistency of the final product.

With programming, detailed analyses of production processes can be performed and adjustments can be made to improve efficiency and final product quality.

Watering Automation:

Programming can allow an irrigation system in the home laboratory to be automatically activated according to crop requirements, such as soil moisture, temperature and the amount of sunlight received. This can ensure that crops receive the necessary water at the right time, which can improve yield and end-product quality.

Fermentation Control:

By using sensors and monitoring systems, fermentation can be controlled in real time and parameters such as agitation and temperature can be automatically adjusted to ensure optimal fermentation.

Data analysis:

By using machine learning algorithms, data can be analyzed to find patterns and optimize the production process, which can improve biomass quality and efficiency.

Product customization:

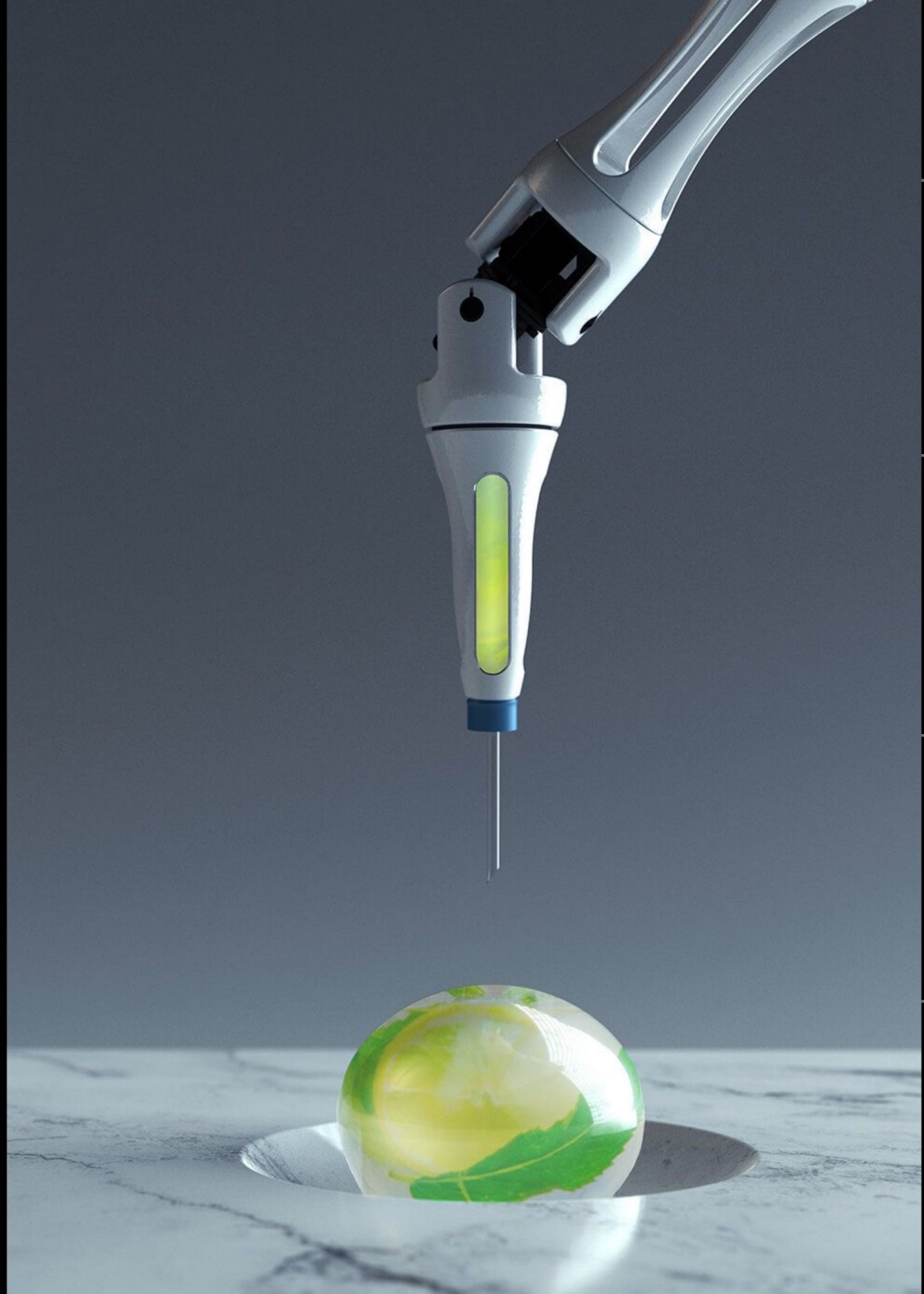
Programming can enable customization of the final product based on user preferences. For example, by using 3D design software and programming, customized products with specific shapes, sizes and features can be created, encouraging in-house creativity.

Re-Educate with Creativity

On the other hand, the tool of organic 3D printing or extrusion in a home laboratory is the production of new sustainable and customized products at home, through the use of organic materials that would otherwise be discarded.

By using organic waste as 3D printing or extrusion materials, the amount of organic waste in the home can be reduced, as well as decreasing the reliance on non-renewable materials for the production of everyday objects. In addition, the ability to create customized products at home allows for greater freedom and creativity in the production of useful objects.

In the same way, it can be education and the promotion of a culture of sustainability and recycling in the home. By incorporating organic 3D printing or extrusion technology with organic waste, a circular economy mindset can be fostered, where organic materials are reused and given a second life.



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Design and Construction

Merging art and science. One of the main objectives of BiomasLab is to build a personal space, an intimate workplace where one can work, play and experiment, getting to know science in a fun and personal way.

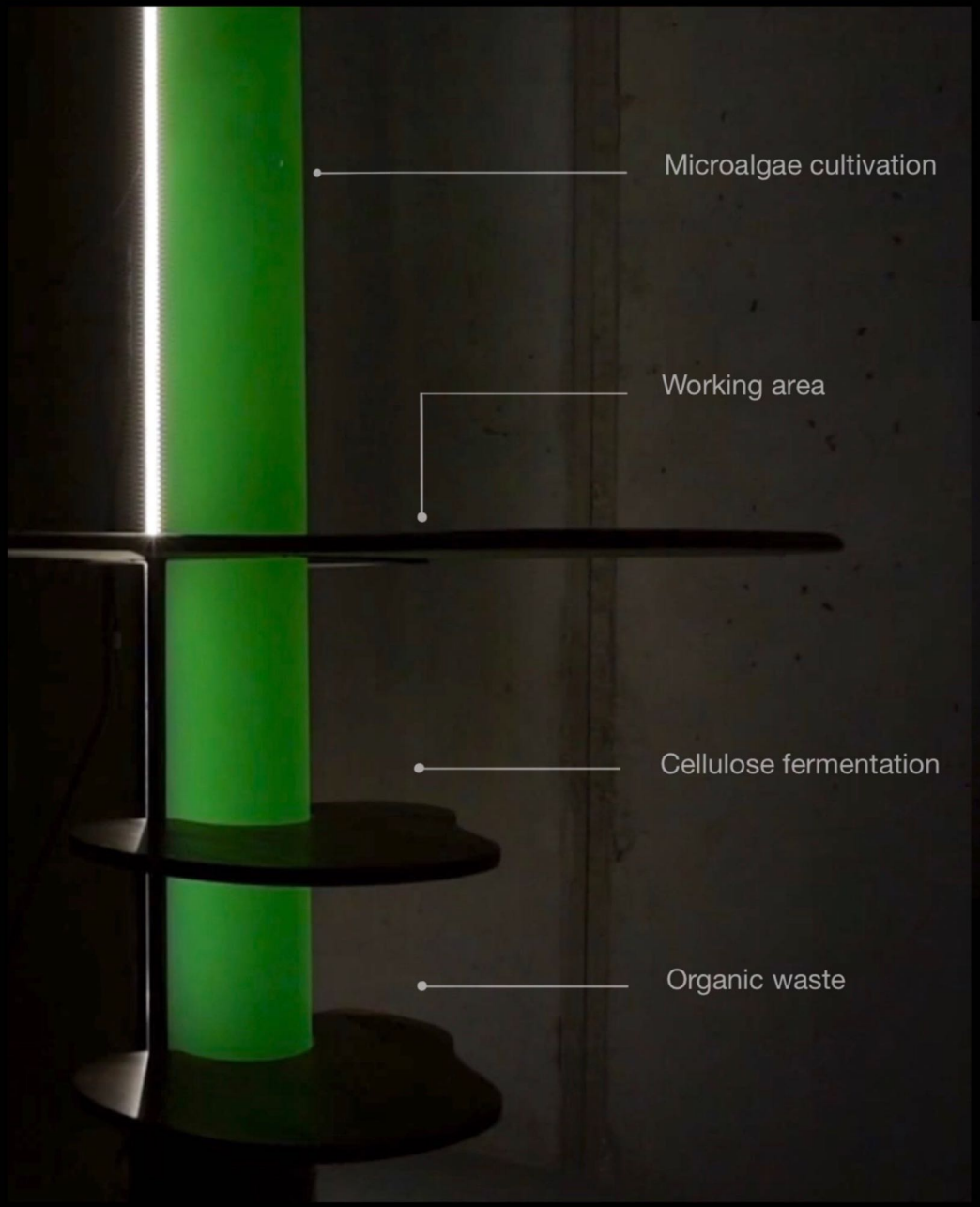
The requirements to be included in a laboratory may vary depending on the type of the activities to be carried out in it, so it is important to know the user's interests in order to build a customized laboratory. However, should meet the following requirements:

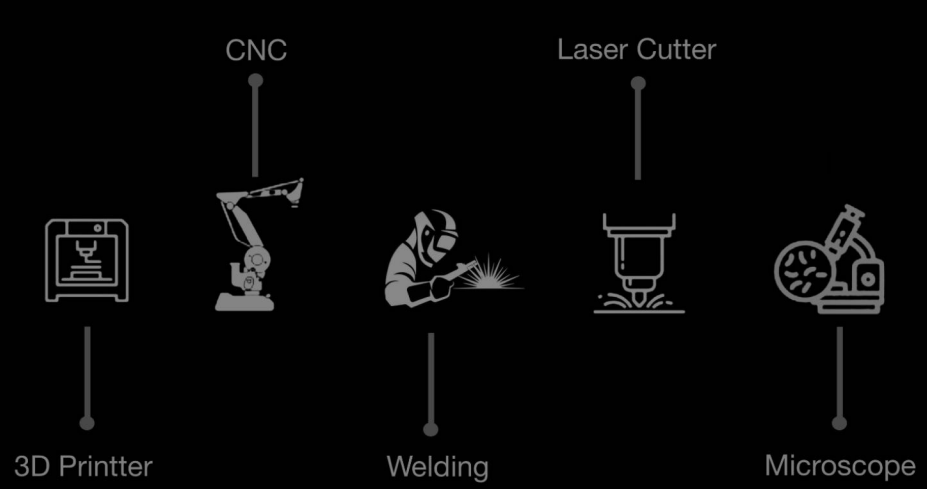
Space: It must have sufficient space for equipment, materials and users.

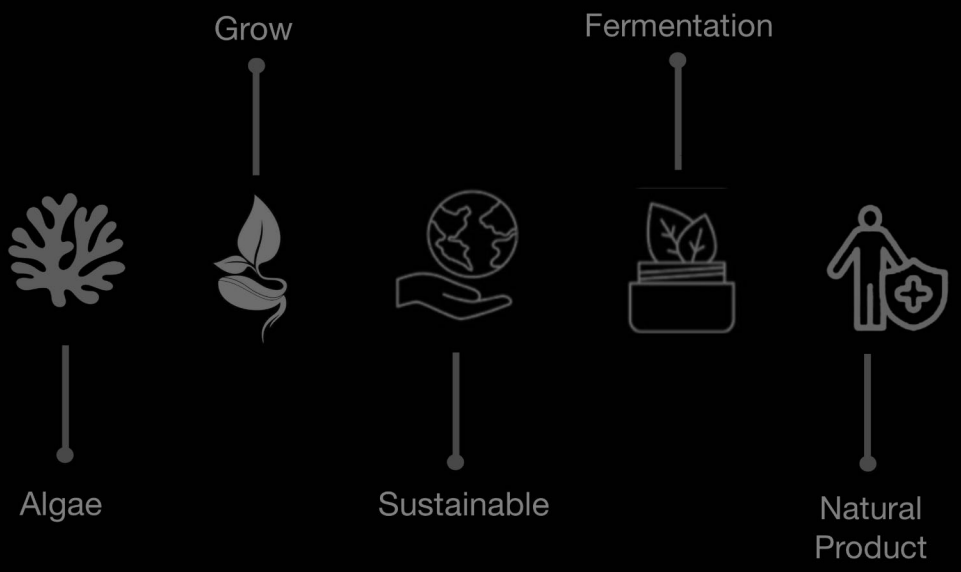
Lighting: Adequate lighting to allow activities to be carried out safely and efficiently. It is preferred to take advantage of natural light to make it more sustainable.

Ventilation: The laboratory should have an adequate ventilation system to control temperature and humidity.

Equipment: Appropriate equipment and tools to carry out the planned activities. The structure of BiomassLab is based on three different processes such as cultivation, fermentation and recycling, therefore the laboratory is divided into different areas.







Digital Tools

This project has been developed with digital tools and technology, giving value to innovation. In this era where advances in technology allow you to experiment, design and merge disciplines in much more creative way finding great results.

Traditional Proces

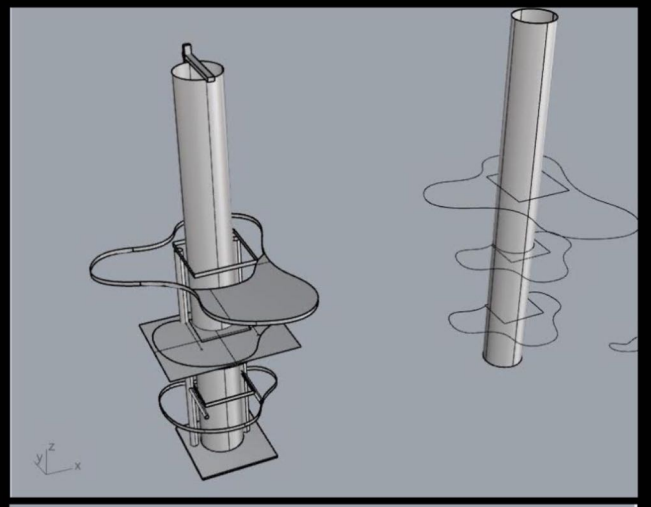
The combination of new technologies with traditional manufacturing process is the key to success. BiomassLab's philosophy is to find a balance where ecological, organic and natural process are built with the help of a team of intelligent tools.

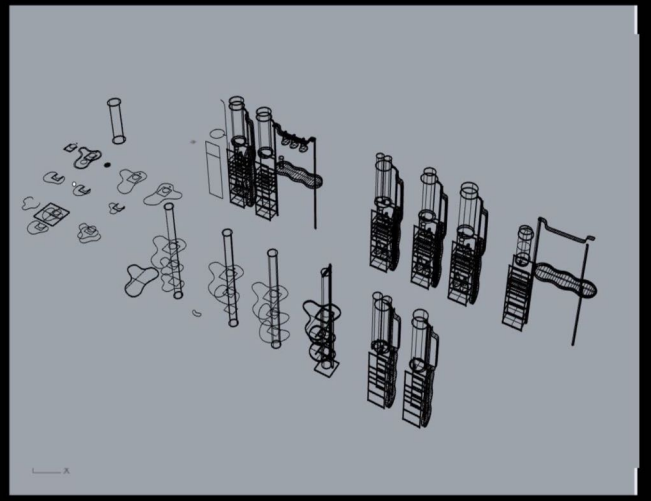
Digital Fabrication

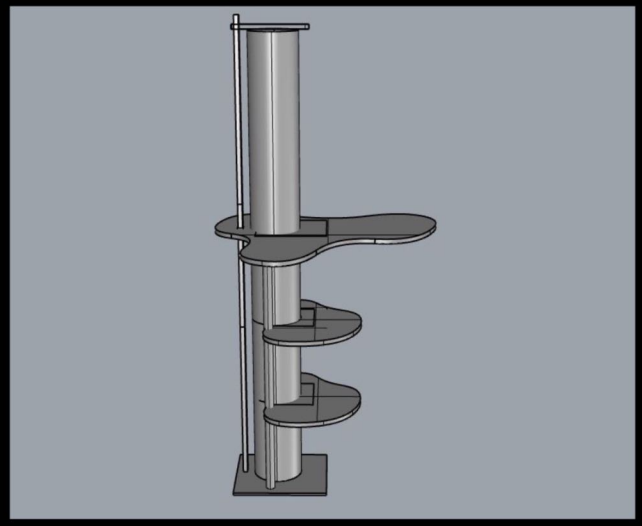
For the 3D design, I used Rhinoceros software, which is a very versatile 3D modeling tool widely used in the design and architecture industry. Rhinoceros allows you to create accurate and detailed 3D models quickly and efficiently, thanks to its intuitive interface and its great ability to process complex data.

Once I have the finalized design in Rhinoceros, I use digital tools such as the laser cutter and CNC to cut the tables and shelves I have designed. These digital tools use cutting-edge technologies to produce precise, clean cuts in materials such as wood, acrylic or metal.

The laser cutter is a tool that uses a laser beam to cut and engrave materials. The precision of the cut is achieved thanks to the high power of the laser and the ability to control the direction and intensity of the light beam. This makes it possible to produce very precise and detailed cuts, which is ideal for cutting complex-shaped parts.

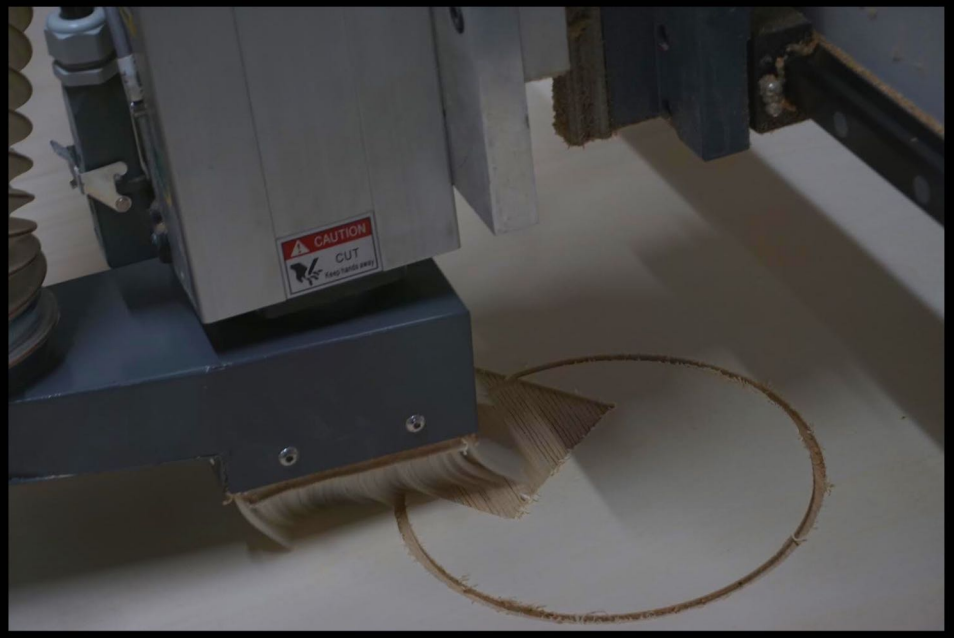


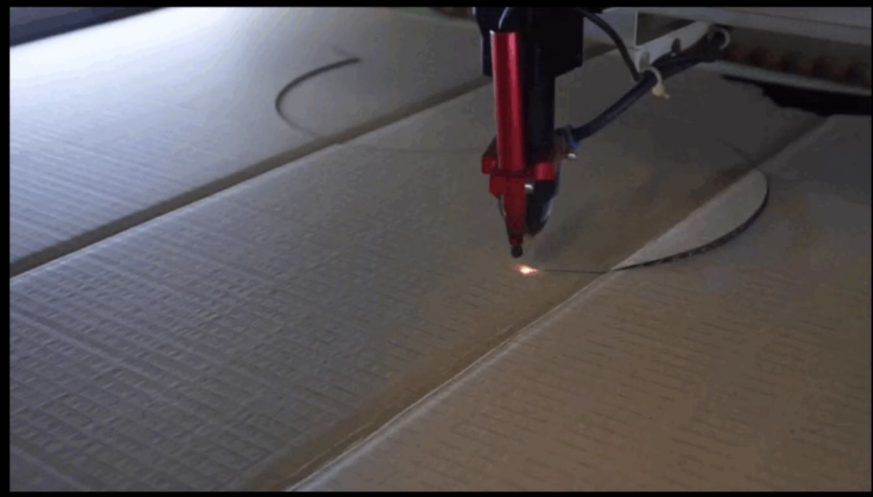




On the other hand, CNC (Computer Numerical Control) is a machine that uses rotating cutting tools to cut and shape materials. The cutting tools are controlled by a computer program that allows for precise and repeatable cuts in a wide variety of materials.

In summary, in the construction and design of BiomasLab I used new technologies that have allowed me to create detailed 3D models, as well as produce precise cuts in materials with digital tools such as the laser cutter and CNC.





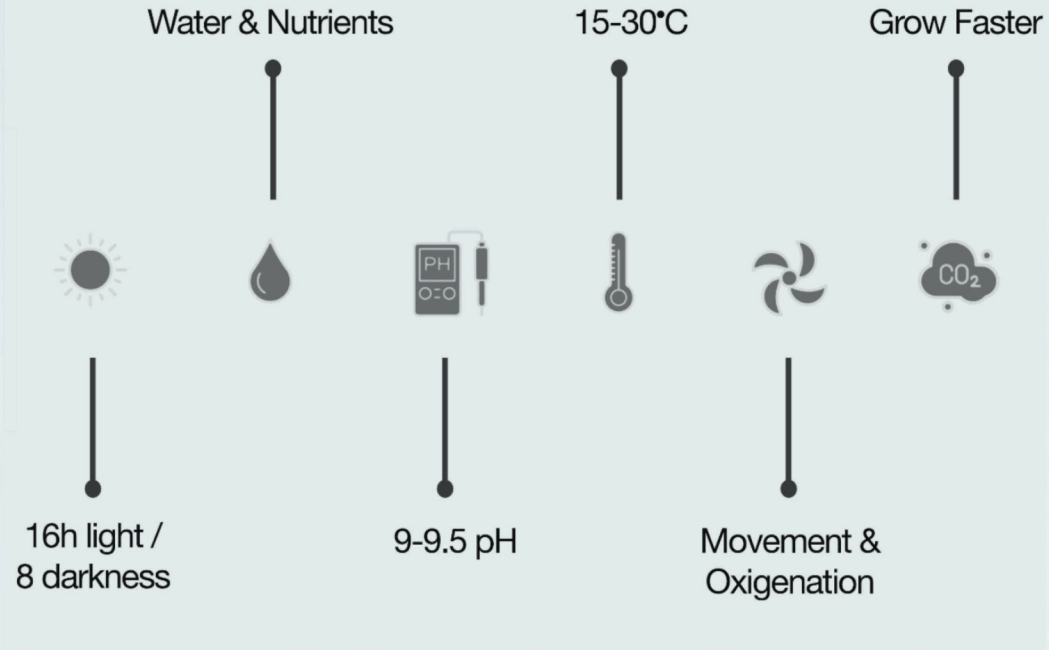
Cutting Parameter	Laser Cutter (2 cm cardboard)	CNC Machine (20 cm wood)
Laser Power	50-100 W	N/A
Cutting Speed	100-500 mm/s	N/A
Cutting Tool	N/A	20 mm straight cutting end mill
Tool Rotation Speed	N/A	10000-15000 RPM
Feed Rate	N/A	500-1000 mm/min

05

Spirulina Growth

Several factors, such as light, temperature, nutrient concentration and pH, can be controlled and adjusted to optimize Spirulina production. In addition, bioreactors offer the possibility to produce microalgae all year round, regardless of weather conditions.

In summary, bioreactors are ideal for controlled, small-scale production of microalgae, while open-air macroculture is more suitable for large-scale, low-cost production, although it is subject to greater environmental risks and challenges.



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Biomass

Microalgae are a promising source of biomass due to their high growth rate and oil content. This biomass can be used to produce biofuels, bioplastics, animal feed, chemicals and other products.

Looking to the future, microalgae biomass production is expected to play an important role in the transition to a more sustainable and greener economy. As technology and production processes are optimized and become more efficient, it is possible that this biomass will become a more widely used source of energy and renewable materials. In addition, research is also exploring how microalgae can be used in biotechnology, medicine and other areas, which could further expand its applications and benefits.

Algae Biomass

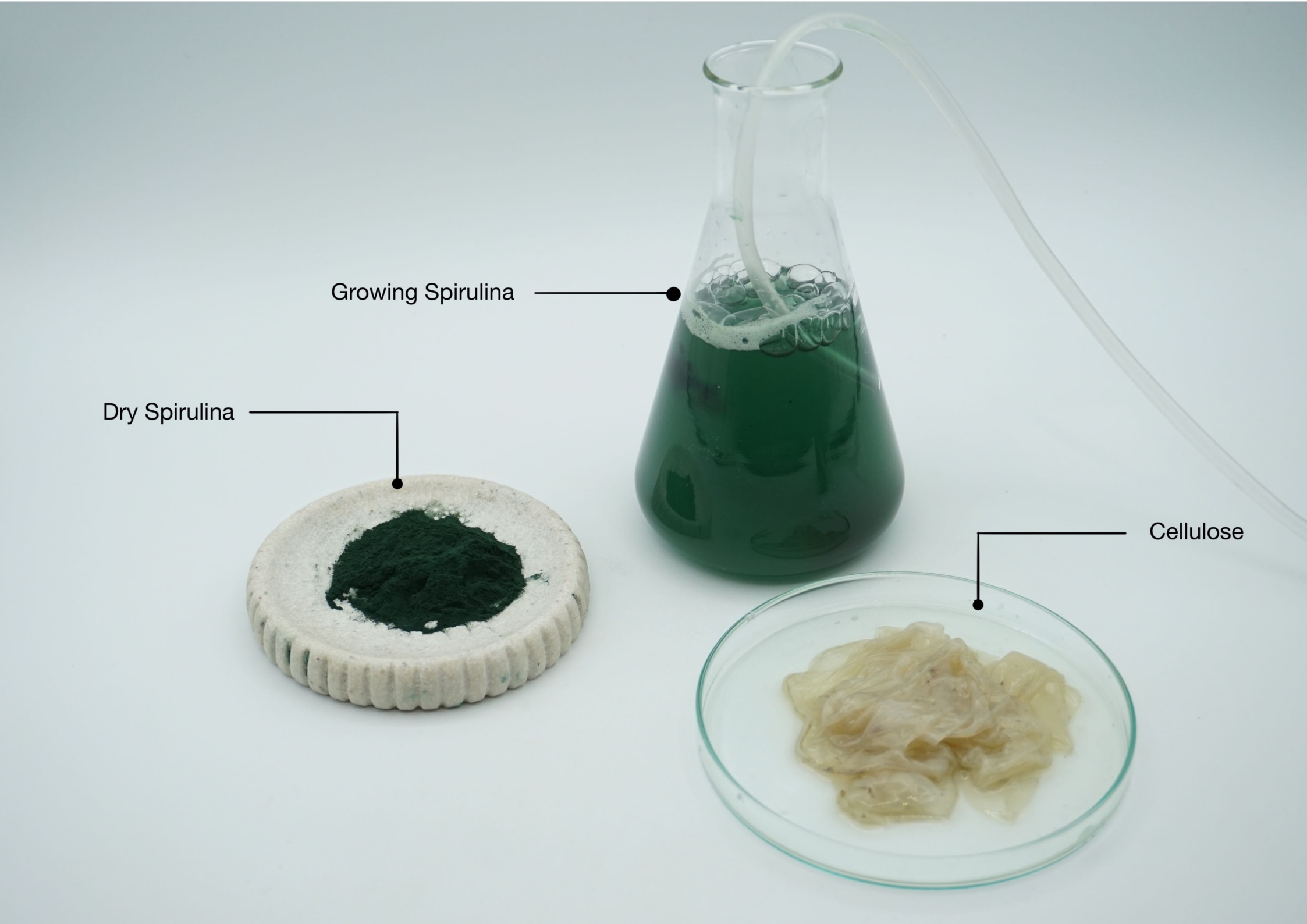
High protein content	Microalgae biomass can contain up to 70% protein, which makes it suitable for animal and human food production.
High lipid content	Some microalgae species can produce biomass with a high lipid content, which makes it interesting for the production of biofuels and other chemical products.
Essential fatty acids	Essential fatty acids that are important for human health.
Vitamins and antioxidants	Contains vitamins and antioxidants, such as vitamin C and vitamin E, which can have beneficial health effects
Natural pigments	Wide variety of natural pigments, such as chlorophyll and carotenoids, which may have antioxidant and anti-inflammatory properties
Low environmental impact	The production of microalgae biomass is less harmful to the environment than food crop production and fossil fuel production.

Cellulose

Purity and high degree of crystallinity	Bacterial cellulose is a pure material, with a high degree of crystallinity that makes it resistant and durable.
Highly hydrophilic	High capacity to absorb water, which makes it useful for medical applications such as dressings and bandages.
Biodegradable and compostable	Making it a sustainable alternative to non-biodegradable synthetic materials.
Strength and flexibility	High mechanical strength and good flexibility, making it suitable for the production of materials such as vegetable leather and strong packaging.
Versatility of applications	Wide variety of natural pigments, such as chlorophyll and carotenoids, which may have antioxidant and anti-inflammatory properties.
Low environmental impact	Produced from renewable sources and its production process has a low environmental impact.

Organic Waste Bioplastic

Sustainable	Renewable and sustainable source of energy, since it comes from waste that would otherwise be disposed of in landfills.
Reducing greenhouse gas emission	Can help reduce greenhouse gas emissions compared to the use of fossil fuels.
Low cost and accessibility	Cheaper and more accessible than other renewable energy sources, such as solar and wind energy.
Diversity of uses	Can be used to produce electrical and thermal energy, biofuels, chemicals and other materials.
Creation of local jobs	Can create local jobs in the communities where the waste is generated.
Low environmental impact	Can help reduce the environmental impact of waste disposal and fossil fuel production.


Growing Spirulina
Dry Spirulina
Cellulose

07

Grow It Yourself

Imagine the possibility of building with sustainable materials, consuming fresh food or even improving your health and personal care with products made from microalgae in your own home.

Cultivating microalgae in our home gives you infinite sustainable possibilities but above all, it is an opportunity to improve your health and eating habits.

Alimentation

- **High in Protein:** Spirulina is one of the few plant-based sources of complete protein, which means it contains all of the essential amino acids that your body needs.

- **Rich in Vitamins and Minerals**: Great source of vitamins A, C, E, and B vitamins, as well as minerals such as iron, calcium, and magnesium.

- **Antioxidant Properties:** Range of antioxidants, including phycocyanin and beta-carotene. Helps to protect your cells from damage caused by free radicals.

- **Potential Anti-inflammatory Benefits**: Beneficial for a range of health conditions, including allergies, arthritis, and autoimmune disorders.

Cosmetics

Some of the microalgae that are commonly used in cosmetics include **spirulina, chlorella, and Dunaliella salina.** These microalgae are often incorporated into skincare products such as face masks, serums, creams and hair care.

Spirulina, for example, is known for its high concentration of vitamins and minerals, and is often used in skincare products to nourish and revitalize the skin. Chlorella is known for its ability to detoxify and purify the skin, while Dunaliella salina is known for its anti-oxidant properties.

Cellulose

Bacterial Cellulose is another material that is produced by bacterial fermentation and is used inthe manufacture of biomedical products such as wound patches, implants and tissue regeneration products due to its biocompatible and biodegradable properties.

Hyaluronic acid is a polysaccharides that is produced by this process and is used in manufctures of gels and skin care products due to its moisturizing and anti-inflammatory properties.

Biomaterials

Reduce or replace plastic and other toxic materials.

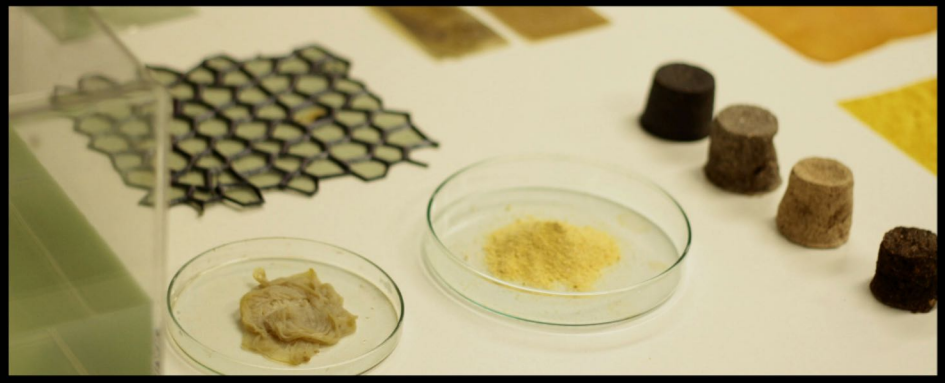
Biomaterials are the new sustainable and creative production that generates unions between different disciplines, building projects with the objective of causing less impact on the environment.
In recent years, massive industrial production and waste have forced us to rethink solutions and build sustainability. To do this, it is necessary to focus on ideas such as substitution, utilization and savings.
By uniting artisanal techniques and technology, we explore alternative resources to develop products with our own hands.

Taking advantage of the fact that our laboratory is domestic, another of the objectives of BiomassLab is to combine the production of microalgae with the waste we have in our homes to get a third biomass. In this way, the project becomes circular as we take advantage of the organic waste from our house to create really functional biomaterials.

Bioplastics are degradable plastics generated from organic matter, usually containing a biopolymer base such as oils, gelatin or agar-agar to obtain strength and flexibility.

Recent advances in bioscience have found potential in organic waste to address sustainable challenges. The possibilities are endless, as the process is a trial and error of ingredients and quantities.

Hard Materials	Flexible Material	Cellulose Paper	Cellulose Resin
50ml of cellulose	30g Gelatin	200ml Cellulose	50g Skoby
60g of Gelatin	20ml Glicerine	30g Spirulina	30g Gelatin
10ml of spirulina	2ml Spirulina	5ml Glicerine	3.5ml Glicerine
40g of walnut shells	350ml Water		200ml Water
8ml of gicerine			
200ml Water			



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“My research focuses on Biomaterials, reflecting on the creative disciplines of the future, a path towards new languages where art, design, technology and science merge. Social change and climate emergency are my main motivation. I work on research and development of biomaterials with microalgae, cellulose and organic waste.”

More information about BiomassLab project, check the process:
https://class.textile-academy.org/2023/paula-hernani/development/01-Investigation%20%26%20Concept/

Video: https://youtu.be/6PSCpwvlUzY

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Bm Lab
Biomass

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Basque BioDesign Center

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