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EcoChic BioDome

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Problem Statement: Traditional farming faces challenges from climate change and resource scarcity. This project investigates how a small-scale biodome can sustainably grow fruits, vegetables, and flowers with low maintenance.

Research Question: To what extent can a small-scale biodome support sustainable growth of fruits, vegetables, and flowers using limited external sources?

Introduction & Background Info

The EcoChic BioDome is a design-thinking team project developed to promote sustainability and foster an eco-friendly environment at FCS Innovation Academy. Initially conceived as a simple structure, the biodome has evolved into a fully functional system that replicates the conditions of a farm, providing an optimal environment for plant growth.

Our primary goal is to create an ecosystem-like environment that supplies both the energy and nutrients necessary for healthy crop cultivation. Beyond its agricultural benefits, the EcoChic BioDome serves as an educational platform, offering students hands-on experience in engineering, design, and sustainable farming. Through this initiative, we aim to inspire future innovators to integrate environmental responsibility into technological advancements.

Challenges

During this project, we faced a multitude of challenges. However, it should be noted that during any far-fetched project such as this one, challenges are how we grow. And we believe we have done that. Some challenges we faced were the initial costs, coming to adequate conclusions, temperature and humidity control, and the need for proper ventilation and irrigation. But through careful planning and a newly claimed grant, we were able to obtain the money to buy gardening tools, soil, and any other materials we may need. To ensure we were all on the same page, we met every Friday and wrote all our ideas on a whiteboard, discussed, and modified the ideas depending upon what we believed. Through this process we realized the importance of teamwork and reliance. Controlling temperature and humidity was especially hard as we cannot predict the weather. But we intend to incorporate Plexi glass and ensured that it had enough shade. Moreover, we also intend to plant certain plants depending upon when they are in season and when they will grow the best. Lastly, we discussed how we will provide the biodome with proper irrigation and ventilation. Though we will not have a full-fledged irrigation system, we might have a solar powered irrigation system.

Research

We've done a lot of research about building outdoor structures and using proper gardening tools and techniques. Our team has spent hours pouring over ideas and designs for how to create the best dome we can.

When we visited the Botanical Gardens and Old Rucker Farm, they explained how they made their environments more sustainable, often relying on local resources and less external input. Those field trips also allowed us to investigate the design of farm structures (e.g., farms, greenhouses, irrigation systems) to learn about how they supported food production. They also told us about how they maintained soil health and used organic materials (manure, and compost) for fertilization. Lastly, we understood more about crop rotation and pest management so we could integrate bio-tech solutions into our biodome.

Building the Dome

The biodome started off as a simple vision. However, slowly, through research, collaboration, and dedication, it has been transformed into a tangible project.

Meeting every Flex Friday, our team developed a structured plan. Currently, we have painted the structure, planted a few crops, and have begun to formulate a plan so that the biodome thrives year-round.

We intend to include plexiglass into the roof to allow adequate sunlight to enter while maintaining structural integrity. Moreover, we will include hanging plants and a diverse array of other plants inside the biodome to create a flourishing, green environment. We also want to include a drip-irrigation system and compost-based fertilization to ensure optimal care. We intend to explore options such as rainwater collection and eco-friendly sources to minimize environmental impacts.

Method

- 1. Ideation:**
 - Brainstormed ideas for the biodome's design and sustainability features.
 - Researched existing biodome models, sustainable farming techniques, and plant requirements.
 - Discussed goals: growing fruits, vegetables, and flowers, creating a space for culture and innovation, potential collaboration with other departments/institutions.
- 2. Field Trips and Research:**
 - Visited local greenhouses and botanical gardens to observe how controlled environments work.
 - Took notes and photos of plant setups, irrigation systems, and ventilation methods.
 - Spoke with experts at the botanical gardens and Old Rucker Farm to understand what plants thrive in biodome-like conditions.
- 3. Planning and Design:**
 - Sketched different design concepts for the structure of the biodome.
 - Selected a final design based on space, materials, and functionality.
 - Created a materials list.
 - Chose plant species based on climate compatibility, feasibility, and sustainability.
- 4. Building the Structure:**
 - We intend to install plexiglass and ventilation openings.
 - Ensure the structure was designed in a way to simulate a controlled environment.
- 5. Interior Setup:**
 - Added soil beds, pots, and hydroponic systems for the plants.
 - We will set up irrigation systems (e.g., drip irrigation or water recycling).
- 6. Painting and Decoration:**
 - We painted the exterior and interior of the biodome for visual appeal.
 - We will add signs explaining sustainability features and plant types.
 - We will clean up and pave the surrounding ground.
- 7. Testing and Monitoring:**
 - Monitored temperature, humidity, and plant health regularly.
 - We will adjust conditions if necessary to maintain a suitable environment.
 - We will collect data on plant growth and the effectiveness of sustainability systems.
- 8. Evaluation and Reflection:**
 - We will assess whether the biodome met the success criteria.
 - We will identify strengths and areas for improvement.
 - We will reflect on what was learned about sustainability and self-sufficient growing systems.

Criteria of Success

We have many criteria for success for this project:

- At least 80% of the planted fruits, vegetables, and flowers show visible healthy growth after approximately 2 months.
- The biodome includes at least 3 sustainable systems (e.g., rainwater collection, composting, and natural pest control).
- The internal temperature, humidity, and light levels are consistently kept within optimal ranges for plant growth.
- The design allows for adequate airflow, water drainage, and sunlight access for all plants.
- The biodome includes clear labels or a guide that explains its sustainability features and plant types.

These criteria for success ensure that our biodome isn't just a cool-looking project—it functions well, demonstrates sustainability, and teaches others about it. Overall, these criteria ensure that our biodome is functional, sustainable, informative, and successful in its purpose.

Results



Initial Prototype of the BioDome completed in 2022.

Prototype two was started in 2023.



Prototype two was completed in 2023.

Prototype two was painted in 2024.



Prototype two was primed in 2024.

Prototype two will be completed in 2025.

Field Trips



Field trip to the Atlanta Botanical Garden with the BioDome team.



Field trip to Old Rucker Farm in Alpharetta.

Next Steps

In the future, we aim to spread our project throughout Alpharetta to raise awareness of our sustainability initiative. Integrating with the community will help widen our scope. This may also include working with other sustainability organizations and environmental groups to gain more resources and improve our abilities, or partnering with small businesses or other institutions. This will help bring new ideas, discover the best practices, and overall enhance our efforts. Another step we can take is visiting other schools to host workshops and lessons to teach younger audiences about the importance of conservation, raising the community to be environmentally smarter.

We'd like to grow more types of plants and host more organisms overall to promote biodiversity. We currently have a small selection of fruits and flowers, and by growing more species, we can increase our versatility. Another thing we wish to consider is creating a space to sustain bees and possibly butterfly populations. Including plants with different flowering seasons will ensure year-round ecological activity and help sustain a balanced habitat. Including elements like insect hotels or decomposer habitats can help support a diverse ecosystem. These efforts will not only enrich the surrounding environment but also transform it into a powerful educational tool that demonstrates the importance of biodiversity.

Acknowledgements

A huge thank you to Ms. Dania Taha for supporting us through this entire project since day 1. Thank you to Mr. Denato and Mr. Seymour for their support, insights on the structure, and engineering advice. Thank you to FCS Innovation Academy for allowing us to do this project. Thank you to the Atlanta Botanical Garden and Old Rucker Farm for helping us understand gardening and sustainability. Thank you to the Innovation Academy Parent Teacher Student Organization for supporting us financially.