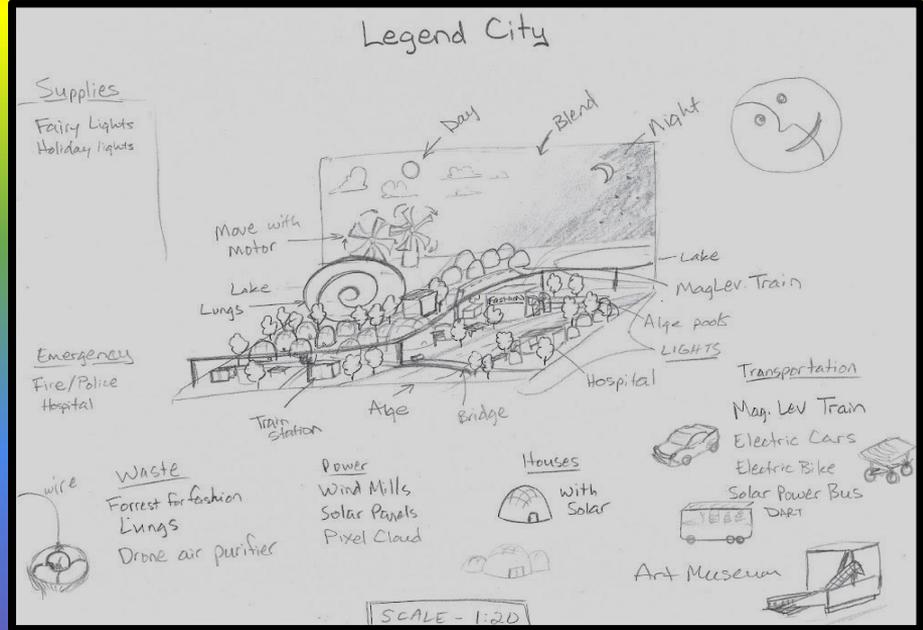# The Circular City

Waste Management - Biomass Energy - Urban Lungs - Circular Economy

The Problem & Engineering Challenge

The Linear Economy is "killing the Earth". The problem is people are using lots of non-renewable resources, after being used, get wasted or thrown away. An astonishing 90% of all plastic is not recycled. The rest ends up in landfills, burned, or broken down into millions of tiny particles into the oceans and we eat the fish in those oceans! There is textile, food, and product waste that is polluting the environment. Engineers and scientists are working on solutions for rethinking waste, and eliminating air pollution, water pollution, and land pollution that comes from unnecessary waste. **This project offers solutions to the waste and pollution from a linear economy like urban lungs.**

Research - Pollution

Linear Economy: A cycle of using natural resources, to make products and then disposing of it after it has no use

Circular Economy: The circular economy is system of reusing, recycling, reducing, redesigning and rethinking resource uses, and therefore produce less pollution and waste while regenerating nature.

Textile and Fashion Waste Pollution: Each year 99% of textiles get wasted and only 1% of clothing gets recycled. Sportswear is made of polyester and cotton, for their moisture absorbent properties and elasticity and low cost. Polyester is a commonly used plastic. These have big environmental challenges. Half a million tons of plastic microfibers – equal to 50 billion plastic bottles – comes from washing textiles.

Unplastic: Bioengineer Lori Goff created UnPlastic, a circular material that comes from food by-products, and beer brewery waste. A totally plastic-free foil that is flexible, lightweight, odorless and transparent, making it good packaging for everything from candy to chocolates to other things. Unplastic is designed to compost in soil and water, with no harm to the environment.

Research - Food

Food Waste: Today, just four crops – wheat, rice, corn, and potatoes – provide almost 60% of the calories consumed on the planet. The problem with this is that since they are relying on only 4 sources, if one gets infected and or stops growing it is a big problem. Sadly more than 30% of food on planet earth gets wasted or thrown away, that's crazy!

Regenerative agriculture: A solution is rather than depending on getting food from nature, food can be designed for nature to thrive.
- Planting a variety of crops can make food supplies more resistant to disease or pests.
- Diverse Ingredients: Businesses can use a bigger range of ingredients in products. For example, sweetness comes from sugar cane, sugar beet, or corn, but it can also come from date palms, carob, and coconut.

Benefits of regenerative farming:
- Help reduce Greenhouse Gasses (GHGs).
- Support biodiversity.
- Food Made of Plants rather than animal proteins.

Research - Urban Lungs

Urban Lungs Do the Earth a Favor: These are buildings that breathe in pollution and clean the air.

Shaped a bit like a seashell, Urban Oasis works on being carbon negative and scrubs CO_2. The building pulls wind through tubes in the building, cleaning air pollution using filtration beds.

The Pixel Cloud is a modular building that you add and pull apart, depending on air quality. The idea of the "pixel cloud" is to maximize surface area and capture as much air pollution as possible. The air is driven down and heated in pressure tanks, breaking down CO_2. Steam escapes and surrounds the building in a fog, "making a cloud."

Formula Algae is a building surrounded by algae tubes. Air drifts up from the street, following walkways to the top, where it is captured and fed into the "gunk". Through photosynthesis, the algae multiplies, producing biomass that can be burned for energy.
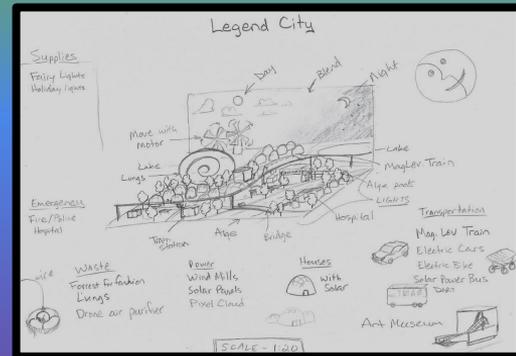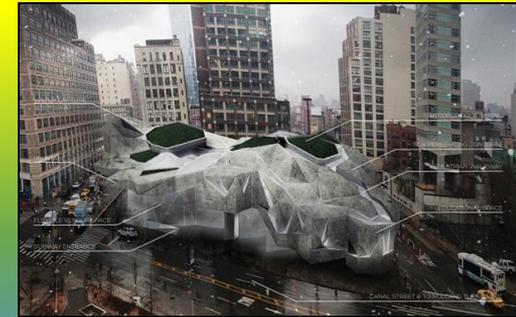
Research-Fashion

Forest For Fashion Challenge and Regenerating natural systems: We can regenerate eco-systems by <u>using man-made cellulosic fibers</u>, made of dissolved pulp, from wood, and using wood resources with FSC certification only; Forest Stewardship Council.

- Sportswear manufacturers can lower their carbon footprint by choosing renewable materials instead of non-renewable plastics, which makes microplastic fibers which eventually end up in our oceans.

- Athletes, sports celebrities and influencers can encourage people to use sportswear that is recyclable and can be reused!

Fashion Sharing Economy: can design out waste and pollution and keep products/materials in use. Rent, share, swap clothing using digital clothing apps. When people finish wearing their clothes or want a new outfit, they can swap clothes with another person! An App matches people with the clothing they want, and people give their likes and dislikes, age, size, fashion choices. People can rent clothes also. This helps the environment because clothing is recycled and reused, instead of making new clothes all the time, and taking new resources from nature.

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Research - Cradle to Cradle

Some key designs and planning decisions to turn a city like Legend City from a linear economy into a Circular Economy Legend.

- Cradle to cradle means that we use products until they have reached their limit and go back to nature or the landfill.

- Digital Technology gathers information on all materials and products.

- "Waste + Information =Resources"

  a) DNA markers are a resource to help track products to know when it's at its limit and cannot be used anymore.
  b) Digital watermarks are a resource to help track products to know when it's at its limit and cannot be used anymore.
  c) QR codes are a machine-readable code, typically used for storing URLs or other information for reading by the camera on a smartphone.

Investigative Procedure: The Engineering Design Process

One: Identify the problem or need; create a waste free city with a circular economy.

Two: Form a research team of three students.

Three: Make a project plan (set goals, create a calendar, have team check-ins, final reflections)

Four: Research and brainstorm ideas and solutions to the problem.

Five:Write a research essay which includes solutions to problem with benefits and tradeoffs.

Investigative Procedure: The Engineering Design Process

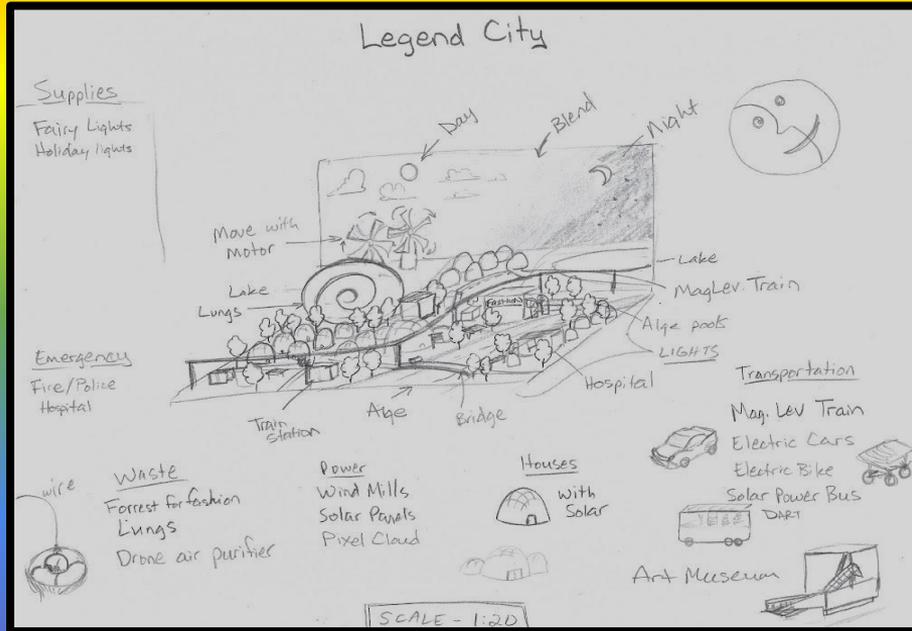**Six**: Use research essay and sketch out city concept drawing- **Prototype 1**.

Seven: Get feedback on city drawing and create **Prototype 2: a 3D scale city model.**

Eight: Present the model and research to engineers, scientists, and architects. Get Feedback.

Nine: Final team reflection in the Project Plan.
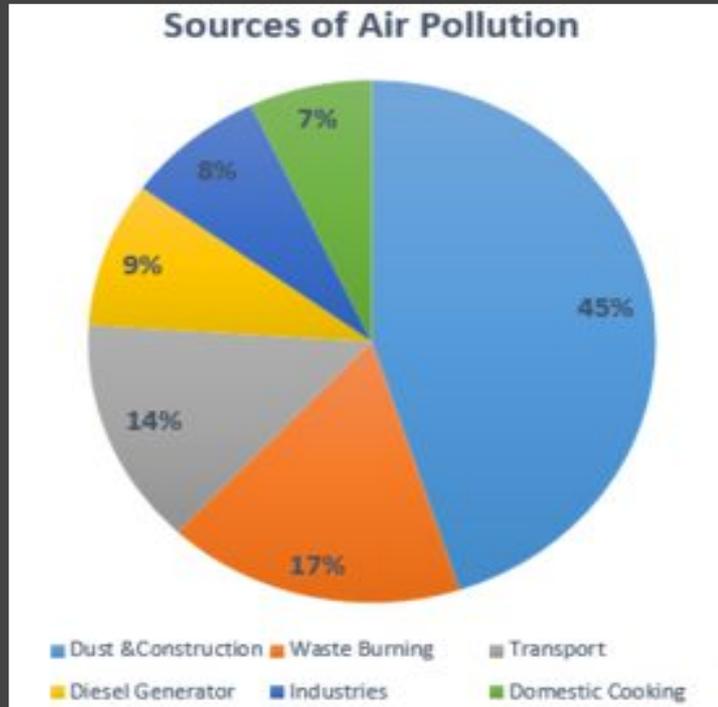
Prototype 1: Drawing

Prototype 2: 3d Model

Data Table

Sources of Air Pollution 2022

Dust & Construction	Waste Burning	Transport	Diesel Generator	Industries	Domestic Cooking
45%	17%	14%	9%	8%	7%

Results and Data Visualization

Sources of Air Pollution

- 45% — Dust & Construction
- 17% — Waste Burning
- 14% — Transport
- 9% — Diesel Generator
- 8% — Industries
- 7% — Domestic Cooking

- The highest factor in air pollution is from dust and construction. As cities grow this will be an even bigger problem.

- Transportation is the third biggest part of air pollution. Green, clean transportation designs can solve this pollution problem.

- Sustainable design cities can help fix many other parts of air pollution shown in this chart - waste burning (17%), diesel generator (9%), and industries (8%).

Discussion and Interpretation of Results

With some key design and planning decisions, and contributions from engineers, scientists, and architects, cities like Legend city can go from being a linear economy into a Circular Economy Legend. The circular economy shows us that we won't need to use all of the resources, instead we can reuse, recycle, reduce, and redesign and therefore produce less pollution and waste.

- Civil engineers design, and supervise infrastructure projects like the Urban Lungs to keep our air clean and produce some biomass energy.

- Waste Management Engineers develop recycling strategies, engineering waste site and remediation plans.

- Energy Engineers develop solutions for improving energy use like Biomass and green energy..

- Bio Engineers combine engineering and sciences to design/create equipment, computer systems, and software.

- Environmental engineers use knowledge about soil science, biology, and chemistry to help solve environmental problems.

Implications and Ideas for Future Research

1) <u>Why is this project important to the real world?</u> It is important because it solves problems in the world, like pollution and waste which is very common these days in a linear economy. This projects shows how the linear economy affects the earth in negative ways. Also, this projects shows what a circular economy can do to solve this problem.Since there is more pollution it is harmful to the environment and that is not a good thing.

2) <u>Why is this issue interesting or critical to you and your community</u>?

   Th waste of the linear economy effects not just ourselves but people we love. It is important for students out age to investigate these problems to that we be more prepared for future and help the earth.

3) <u>Discuss ideas for future research that would build on your current project</u>. Our team would research more ideas on low tech and low cost solutions to pollution and waste. Some of us are interested in research on sustainable power plants and sources. Another interest we have is how clothing can be made from natural resources and materials. We would get even more advice from engineers during our procedures.

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