

An aerial photograph of a city, likely Bogotá, Colombia, showing a dense urban landscape with numerous buildings and green spaces. In the background, there are mountains under a blue sky with some clouds. The text is overlaid on the top half of the image.

Green Cities: Sustainable, Resilient, and Biophilic

“Green Cities” Course Projects
Cornell University 2019

This book features students' projects from the "Green Cities" course.

Cornell University's Summer College, June 24 – July 12, 2019.

Instructor: Alex Kudryavtsev ("Alex Russ").

Teaching Assistants: Yue Li and Bethany Jorgensen.

Taking this course and learning about green cities has allowed me to realize that this is something I am interested in pursuing in the future. It helped me learn about the importance of both social and ecological aspects in cities. Now I feel responsible to do my part to preserve the environment of our cities and our planet. — Heidi Boerschig

I've always thought that it's hard to convince urban residents to participate in environmental protection, but through this course, I see hope and a great possibility that people can create greener cities together. — Chloe Song

Green urbanism has the potential to slow down the scary effects of climate change. Environmental improvements are not easy, but our grit, drive and compassion will help us make cities more sustainable. — Rishabh Gharekhan

Working with other students in the Green Cities course to compile an ebook addressing urban environmental issues was a wonderful experience. It expanded my worldview by fostering collaboration among a diverse group of young urban environmentalists from around the world who shared their unique perspectives and innovative ideas. The future of green urbanism is bright, as the next generation of urban environmentalists, led by passionate environmental educators, offers so much potential. — Gabrielle Day

For millions of years, species have evolved in order to survive. Whether it was the first multiplying bacterium, the first fish to step on land, or the first human to walk on two limbs, change is inevitable. So why won't humans make the evolutionary change towards green cities for the survival of our entire planet? — Giselle Dalili

People often think, "What can I do? I am just one person." However, through this class, I saw that even one person can greatly improve his or her local environment, and inspire their community to do the same. — David Rogers

This class gave me an interdisciplinary perspective to analyze and solve urban issues. It may be a foreword of my career as an urban planner in the future. — Frank Xu

Cities are not separate from or opposite to nature; they are part of nature. Accepting this idea determines whether humans can overcome today's environmental crises. — Ziyang Zhang

The future of green urbanism is not merely about green spaces, it's also about environmental stewardship and connection to nature. To create a strong bond with nature and involve citizens in environmental action, we need to involve more urban residents in direct and hands-on experiences with urban ecosystems. — Andy Wang

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Introduction

Rapid urbanization causes unprecedented social-ecological issues, yet cities also offer solutions to global environmental challenges. Green infrastructure, effective environmental institutions, social norms, and involvement in environmental stewardship are some of the strategies for improving urban residents' well-being and reducing the urban ecological footprint. We use various terms to describe environmentally-friendly cities, including green urbanism, biophilic cities, and sustainable cities; and we refer to them collectively as "green cities." These green city frameworks aim to understand and create *sustainable, livable, just, resilient, and biophilic* cities.

This book contains student projects from the Green Cities course taught at Cornell University from June 24 – July 12, 2019. Students from several countries analyzed green city frameworks and sustainability concepts, and applied them through short essays and illustrations to address specific urban social-ecological issues. In addition to 35 essays, this book contains nine versions of biophilic cities rankings, developed by students to monitor and compare the performance of green cities. Students' original language and content was preserved; students are responsible for the content of their essays and illustrations, including proper citation and attribution. This work does not represent the views and opinions of the teaching staff or Cornell University.

Most of the course content was taught and organized by the instructor (Alex Kudryavtsev; pen name "Alex Russ") and Teaching Assistants (Yue Li, Bethany Jorgensen). Yet students have also greatly benefited by learning from guest lecturers, workshop leaders, and advisors, including Marianne Krasny, Jon McKenzie, Camille Andrews, Matt Ryan, Mel Jensen, Philip Silva, Bryce DuBois, Rebecca Schneider, Danielle Eiseman, Colleen Kearns, Suzanne Wapner, Jeffrey Surine, Ryan Graves, and Janna Dawn. Huge thanks to everyone who contributed to students' learning in this course.

Natural antidote for water pollution

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Imagine a house beside clusters of foul-smelling, monstrous green slime, and then imagine another house standing by a pristine lake. In which house would one choose to live? The answer is obvious. Not only are algae blooms unsightly, but they also pose a profound threat to local biodiversity by depleting the oxygen level in waters. As rapid urbanization takes place, eutrophication, characterized by the presence of excessive nutrients in waters, will only occur more often (Chislock et al., 2013). On the other hand, clean urban waters are more reliable water sources because they require less energy to purify water. They enrich the surrounding biodiversity; they serve as public spaces, uniting nearby neighborhoods and attracting tourists. In short, a clean body of water near residential areas makes the community both ecologically and socially resilient (Nemec et al., 2014). Deploying a new de-eutrophication method known as bionet not only effectively improves water quality, but also educates the public about sustainability.

Developed by Guan et al. (2015), a bionet system can effectively improve water quality. One bionet includes a five square meter area that is enclosed by vertical biofilters in which filter feeders (oysters, mussels, etc.) are placed. Meanwhile, submerged plants are planted on the riverbed. Biofilters will capture larger pollutants, filter feeders will feed on algae in the water, and submerged plants will prevent any sedimenting pollutants from suspending. Multiple bionets would be installed in close proximity in an efficient water purification system. Bionets can successfully reduce nutrients in waters while bringing no negative effects to the environment compared to traditional solutions. Composed of all natural materials, bionets function gradually yet successfully. A study conducted by Liu et al. (2016) in Taihu Gonghu proves that submerged plants are able to reduce about 60% of pollutants' concentration in water during the summer. These authors only experimented with submerged plants. If all three methods (biofilter, filter feeders, and submerged plants) are effectively used, the detoxification efficacy would only increase.

Moreover, the bionet system, a novel method that embraces the spirit of ecological sustainability, will certainly gain public attention if widely implemented. By providing information, one could change human behavior-- a method known as "cognitive fix" (Heberlein, 2012). In this case, the information represents bionet's sustainable nature, and the human behavior is people's indifferent stance on sustainability. Although admittedly, bionets may be complicated to install, they could serve as an educational site. Constructors could accept volunteers and interns in order to support community engagement. Not only would it make construction more effective, but also would nurture more active youngsters to support sustainable development.

In an urban setting, clean waters are pivotal because they improve citizens' living environment, enhance local biodiversity, and attract tourists. A water purification method known as bionet would be the ideal solution to water quality problems because they purify water effectively and safely while acting as an educational site to promote the spirit of green urban spaces.

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a conceptual illustration of bionet

Yoyo Lu

Energy from above

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With climate change and global warming already on the doorsteps of humankind, the problems can't go unaddressed. In this struggle against global warming caused by air pollution via greenhouse gas emissions through fossil fuels, cities are the main perpetrators of this global crisis but are also the ones that can solve the problem. To reduce greenhouse gas emissions, clean renewable energy need to replace fossil fuels in cities and one of these clean renewable energies is solar energy. Although solar energy is unstable and accompanying energy storage technology is still relatively expensive, in order to decrease air pollution within cities, solar energy should replace fossil fuels as the major energy generator with the assistance government subsidies and feed-in tariffs solar panel installations.

Solar energy is a clean renewable energy that does not emit greenhouse gases and generates electricity through energy from the sun, the largest energy source (Lewis & Nocera, 2006). In fact, the energy that hits earth from sunlight in one hour exceeds the energy that humans consume in one full year (Lewis, 2007). If this massive amount of energy can be used and taken advantage of in order to reduce air, human electricity needs will be satisfied completely just through one clean energy source which reduces air pollution greatly. Unfortunately, this is not possible because technology for the storage of solar energy is still too high for widespread use (Kenisarin & Mahkamov, 2007).

Solar energy is not as stable of an energy source as fossil fuels because its dependency is really subject to influence by weather and time. This instability of solar energy can impact people socially to avoid wasting energy if they knew that they can only use the amount of energy their own solar panels produced. Grids are now also buying extra electricity from individual household producers of solar energy which can really prompt people to save. Yet, at the same time, in order to compete against cheap fossil fuels, crucial to solar energy is the cost-effective storage of this energy (Lewis, 2007). Though there is another way to promote wide implementation of solar panels other than improving technology--government policy.

Government policy like subsidies and feed-in tariffs can cover the extra costs of installing solar energy panels. For example, Indian states used feed-in tariffs where money is paid to solar energy producers for each unit of electricity produced to encourage the production of solar energy (Sharma, Tiwari & Sood, 2012). In Australia, "Solar Credits" are used where government subsidizes the installation of solar energy systems directly which levels the playing field between the cost of fossil fuels and solar energy (Bahadori & Nwaoha, 2013). Government policy can help achieve the goal of clean and cost-effective for solar energy which can then fully replace fossil fuels.

Air pollution caused by greenhouse gas emissions through fossil fuels can be mitigated by replacing fossil fuels with clean and renewable solar energy. Solar energy is in abundance yet what is postponing the widespread use of it is its costly installation and storage system. Fortunately, these problems can be solved through government policy like subsidies and feed-in tariffs.

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Solar Energy

Problem?

Burning fossil fuels emits harmful greenhouse gases into the atmosphere causing air pollution.

Solution?

Solar Energy is a clean and renewable source of energy that does not emit greenhouse gases.

Innovation?

Government subsidies and feed-in tariffs can cover part of the expenses of solar energy.

0% Toxic, 100% Life

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“Did you put on your mask?” is what I hear from my mother on a regular basis. This is due to extremely high levels of fine dust in the air in East Asia. These are micro particles in the air that include toxic substances, which are the effect of manufacturing industries and the cause of health issues. With the particles being 2.5 micrometers, allowing it to stay in people’s lungs and blood, people are at risk for heart attacks, lung cancer, and polluted red blood cells. In addition to health issues, the Earth’s atmosphere and the global air quality is already impacted. Despite the cheap cost of fossil fuels, which are the main sources of fine dust, reducing fine dust is urgent and technological improvements, public awareness and active government involvement is the only way out for people to have their full rights to breathe fresh air.

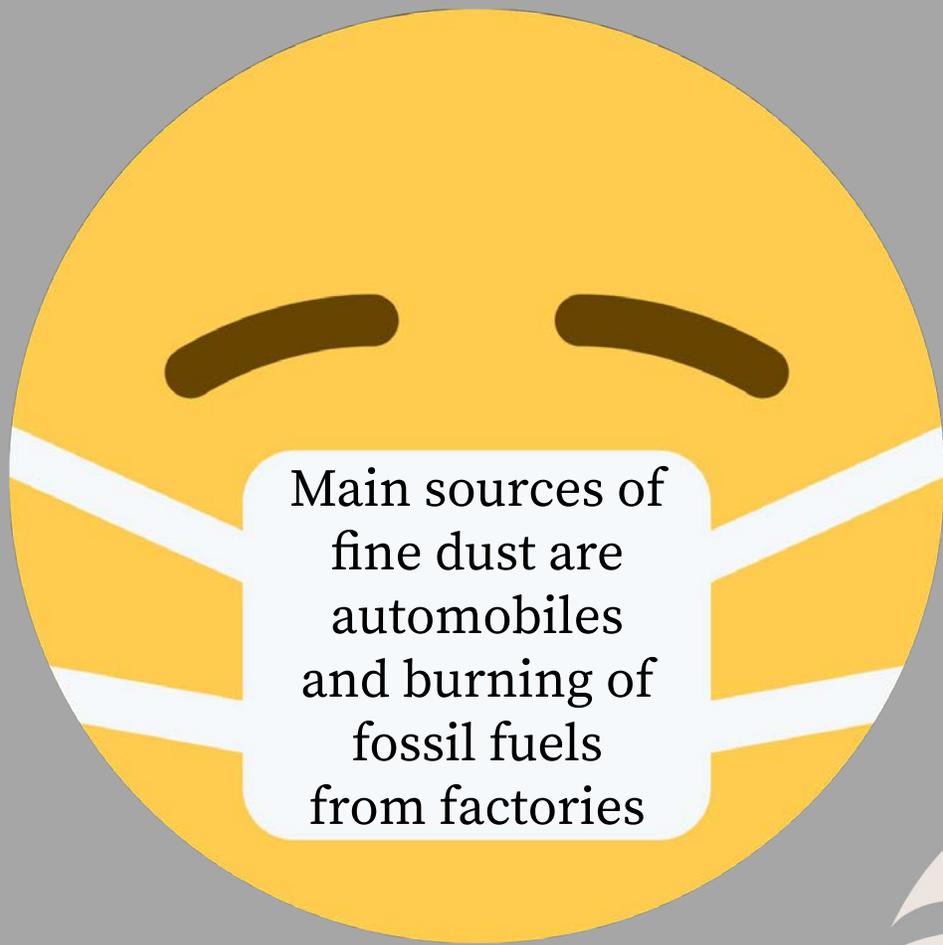
The first solution is dealing with fine dust already emitted in the air and assuring the public’s health through new technologies. For example, according to a collective research from Kyung Hee University, air purifiers are on a rise on both sales: 0.8 million units of sale in 2015 and 2.0 million units in 2018 (Kim, 2019). These purifiers are now capable of absorbing fine dust. Better masks with multiple layers of filtration and apps that inform people of the concentration levels are also amazing progress to resolve this issue.

In addition, the contemporary assumption that China is responsible and thus fine dust is inevitable should change. It is urgent to trace back these dusts to their original birthplaces and inform the public. The mayor of South Korea, Park Won-Soon, recently announced that China contributes only 50% to Korea’s air pollution (Bicker, 2019). The media should inform the public of the actual sources for fine dust and encourage them to actively engage in the policy making of fine dust regulation. For example, the news should portray compelling infographics of the difference in fine dust emissions between a diesel fuel car and a hybrid car. Then, the citizens themselves would act differently to reduce fossil fuel use or drive cars.

Finally, the governments in East Asia should be the leading force to distribute renewable energy, replacing fossil fuels and processing energy more efficiently. There should be increased inspection of manufacturing practices to minimize burning fossil fuels and take actions to replace them with renewable energy. For example, the Korean government announced that the six major cities in Korea will replace their energy with solar power by 2030. The issue of higher costs can be settled by discount deals when buying apartments. One system is already being incorporated: “if the electricity of less than 100 kW new and renewable energy generator is self-consumed at factories... 50% of the electricity charges are discounted” (Lee, 2018). These discounts and financial incentives can further convince the general public to consume less fossil fuels, in turn, reducing fine dust.

A combination of technologies that protect citizens from fine dust, public awareness of the sources of fine dust, and governmental engagement in replacing fossil fuels through regulation and intervention is necessary to combat this issue. Humanity has its hope to initiate this now.

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Average
Concentration:
12.5 ppm

Average
Concentration
in East Asia:
25.1 ppm

10% reduction
in **fine
dust**

**Saves 13,000
lives**



Green roofs: Using what we already have

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When you search the word “city,” the first image results show tall and dark buildings that touch the clouds, busy streets filled with traffic, and little green space. Natureless cities have brought forth many problems: air pollution, heat islands, flooding, and nature deficit disorder. Nature deficit disorder is not a medical term, but rather the idea that as we spend less time around nature, people of all ages are more susceptible to negative mental health effects (Briggs, 2016). As more people move to cities and spend more time indoors and on electronics, nature deficit disorder is growing to be a big concern (Briggs, 2016). Although densely populated areas generally do not have an abundance of spare, farmable land, using green roofs for urban agriculture can help address nature deficit disorder.

One way to address nature deficit disorder is by creating an abundance of green roofs in urban areas. Because not everyone has convenient access to public green spaces in their area, especially those living in less wealthy urban areas, adding green spaces to the roofs of urban apartment buildings can make spending time in nature a reality for everyone (Mesimäki, Hauru, Lehvävirta, 2019). As an added benefit, urban farming can also offer physical health benefits in the form of fresh, local produce (LaCroix, 2010).

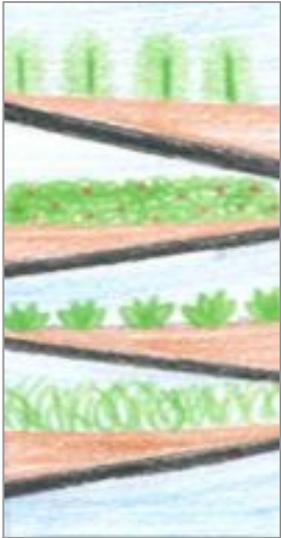
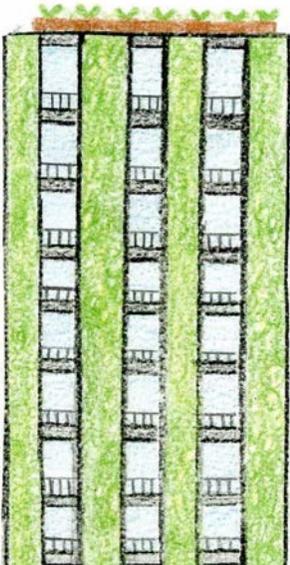
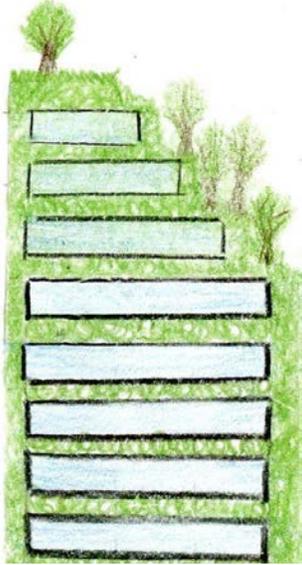
While street-level gardening may be cheaper than green roofs to set up and maintain, big cities don't always have the space for ground-level gardens. Some cities have created long-term zoning plans to address urban farming, like Cleveland, Ohio, which created a plan that involved holding plots of land throughout the city for the purpose of creating community gardens. Unfortunately, in many cities, urban agriculture is used as a short-term zoning label for areas that don't have another immediate use. As soon as government-owned properties gain value, they will generally sell, despite the community gardens that may have lived there for years (Meenar, Morales, Bonarek, 2017).

Spending time on green roofs can offer the same benefits as walking around in a forest, so long as the plant life is diverse and able to be explored. A study conducted in Helsinki, Finland found that green roofs offer communal and recreational spaces. Participants in this study mentioned feelings of happiness and contentment while spending time on green roofs, indicating the positive benefits of green roofs specifically, and not just parks. Also, the study found that if the plant life on green roofs was diverse and explorable, participants recorded even more positive results (Mesimäki, Hauru, Lehvävirta, 2019).

As nature deficit disorder becomes more and more prevalent, we need to make sure that everyone, especially city dwellers, is getting enough time outdoors and surrounded by nature. Green roofs are an excellent way to get more people spending time in and exploring nature without taking up ground-level space.

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MIND + BODY + GREEN



Green roofs: Friends of the city

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Urban heat islands (UHI) are cooking cities around the world. Although the worldwide collaborations are dedicated to limiting global warming to 1.5°C, UHI have ranged 2-5°C warmer than surrounding rural areas (Zinzi and Agnoli, 2011). Since UHI can negatively affect the public health and quality of life, the government should take the responsibility of UHI mitigation (UHIM). One effective approach is to install green roofs, vegetative layers grown on rooftops, despite their high costs.

Studies of urban surface composition indicate that 20-25% are roof surfaces which provide ample space to apply UHIM techniques (Akbari, Shea Rose and Taha, 2003). Green spaces have cooling effect because plants absorb solar radiation, the main source of heat, to support their life-cycle, such as photosynthesis and respiration. Chicago, a leading city of green roof installation with more than 50,000m² installed in 2008, has since experienced significant temperature reduction by 2-3°C compared to the simulated situation without green roofs (Smith and Roebber, 2011).

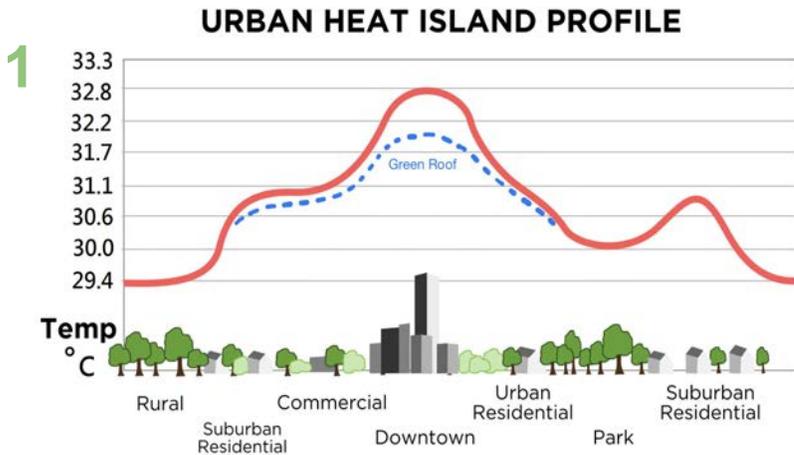
Green roofs can also reduce room temperature, thereby eliminating energy consumption. A case study in Brazil suggests that the green roofs reduce thermal loads by 92-97% compared to conventional ones in warm periods (Parizotto and Lamberts, 2011). Another study in the UK indicates that using a green roof proved to use 10-60% less annual energy compared to a white roof that reflects the most solar radiation among any colors (Silva, Gomes and Silva, 2016).

Admittedly, green roofs installation is very expensive. The generalized cost of conventional roof installation was \$167 per m², and green roof \$306 per m² which is 83% more expensive (Niu et al., 2010; Clark, Adriaens and Talbot, 2008). However, the cost can be recovered in 20 years from stormwater management fee reductions, avoided pollution emission benefits, and stormwater and energy savings (Niu et al., 2010). The number can be further reduced by taking reduction of health care expenditures and many jobs created by the installation. Thus, initial high costs can be recovered. The benefits of the green roofs outweigh the costs because they create a better living environment for citizens that allow the government to gain higher satisfaction rate and more taxes.

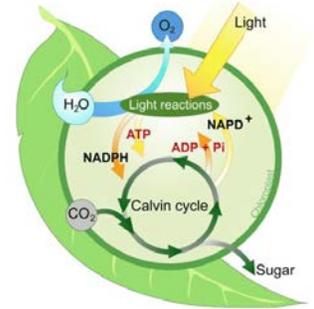
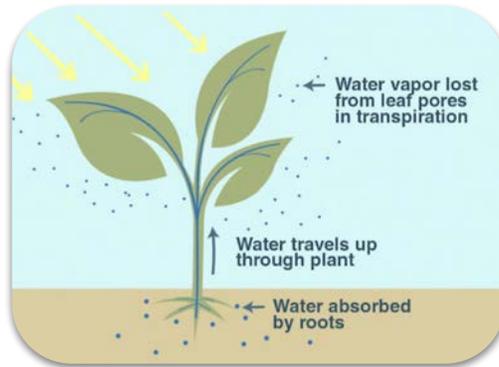
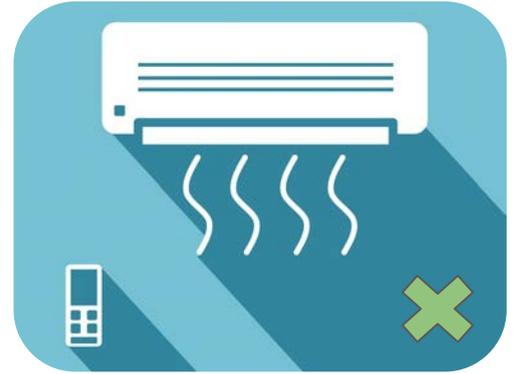
Green roofs are beneficial for the cities, since they help with UHIM and energy efficiency, improving citizens' quality of life. While installing green roofs is expensive, clearly the long term benefits pay off the initial costs. The only issue the government should be concerned about is how to integrate green roofs into a strategy to shift toward biophilic cities and stable green economy.

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Green Roof Benefits



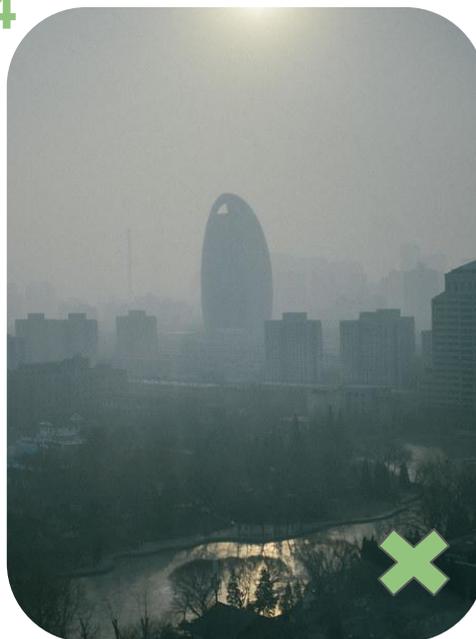
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Raise the roof

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Have you ever wondered how far food has to travel before it reaches your plate? In the United States, food travels an average of 1,500 miles before it reaches the consumer (Pirog, 2001). Due to the absence of farms in city communities, many Americans are alienated from the production and process of food systems, and are equally unaware of the journey before the grocery store shelf. Despite the lack of space in cities, low-income communities can construct rooftop gardens to supply local produce, thus reducing food miles and their carbon footprint.

A Rooftop Garden is a sustainable human-made garden on a roof space that absorbs sunlight and water, which simultaneously supports city drainage systems. Normally, rooftop areas go unused by residential or industrial buildings, proving to be an accessible and beneficial setting for a garden. Grewal and Grewal (2012) concluded that if 62% of commercial rooftops were converted to green roofs, 100% of Cleveland's fresh produce needs could be met. With the installation of rooftop gardens, many Americans would become conscious of their food habits and focus on health along with convenience.

Food miles are increasing the amount of carbon emissions each year, and negatively affecting the carbon footprint of cities. A carbon footprint is the carbon emissions released or consumed by a person or corporation. An example of increasing one's carbon footprint is buying commercial produce, which requires miles of transportation. Wilkinson and Dixon (2016) linked health and wellbeing benefits to those engaged in local production as well as an awareness to food miles. Rooftop gardens provide spaces where urban community members could be educated about food systems and their carbon footprint while reaping the health benefits simultaneously. Furthermore, cities would rely less on imported goods and use more local produce thus reducing food miles in cities

Rooftop Gardens alleviate the food desert crisis of low-income America by providing local and healthy options to struggling families. Food deserts occur in low-income communities without access to healthy food options. Researchers found these gardens supply food in a closer radius to these communities and begin the process of providing a healthy and inexpensive diet for all (Auten, 2017). Local produce from rooftop gardens decreases the consumption of unhealthy goods and provides a sustainable source of healthy food to these communities.

Rooftop gardens are a sustainable method of overall benefit for a community. They reduce food mileage and carbon footprint, as well as have the opportunity to provide local produce for low income families. These gardens help resolve the issue of food deserts in low-income communities and provide local, nutritional options.

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RAISE THE ROOF



Integrated pest management for green walls

Bailing “Chloe” Jin, Hangzhou Foreign Languages School, Hangzhou, China

As cities experience rapid urbanization, they suffer from climate change, population explosion, and resource scarcity. On the local scale, green walls, which can be defined as climbing plants grown either directly against or on support structures integrated to external building walls, may be effective to mitigate some of urban problems such as climate change (Erdem, 2016). Green walls can not only decrease exterior and interior temperatures by shading and evaporating water, but can also ameliorate the climate change by converting carbon dioxide into oxygen. While some urban residents avoid installing green walls, which may attract insects, governments can provide training and assistance on integrated pest management (IPM) to encourage the adoption of green walls in communities.

The implementation of integrated pest management provides a healthy and effective way of combating insects. IPM, a holistic strategy to eradicate plant pests using all available methods, requires minimal applications of chemical pesticides (Stenberg, 2017). With the guidance of IPM, professional groups will come to monitor and identify those pests after firstly setting a threshold to indicate the places required to take the pest control action. Then, only if the first line defense of non-chemical methods fails, low-risk pesticides would be used (United States Environmental Protection Agency). As a result, the insects’ resistance will not be easily established, which helps to ensure the long-term effectiveness of pest control. Also, IPM will not harm humans’ health. In the past, pesticides have been widely used to control the growth of insects; however, exposure to pesticides greatly endanger humans’—especially children’s—health, leading to many severe health issues, including asthma, diabetes, Parkinson’s disease, leukemia, etc (Kim, Kabir, and Jahan 2016). Implementation of IPM will not cause such health hazards. This method will combat pests effectively without bringing in the potential problems of overuse of pesticides. This may promote the adoption of green walls in a wider range of applications.

Some people may view IPM as a troublesome task, due to its tedious learning and implementation process. However, government provision for related training and assistance can reduce people’s burden to a great extent. Rather than having to learn these methods by themselves, residents can obtain professional training from their governments. Each community can organize lectures and invite experts to teach IPM-related knowledge to residents on a regular basis, and distribute pamphlets printed with relative points for attention. In the meantime, the government might send professionals to assist them when needed. What’s more, the government may also advance the green ideas during training, improving public awareness about severe environmental issues. In this case, it would not take much energy for residents to combat the pests in the process of maintaining the plants anymore, which may be helpful in popularizing the green wall.

In general, the provision of IPM training and assistance by government is one of the best options to combat insects fostered by the planting of green walls, whose crucial role in preventing further deterioration of the natural environment has been recognized widely. And once the insect problem is solved, the green walls can be promoted and erected in more communities in the future.

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We have a goal to adopt more

GREEN WALLS

by implementing

INSPECTION

IDENTIFICATION

**Integrated Pest
Management**

EVALUATION

ACTION

MONITORING

TRAINING & ASSISTANCE

To

END YOUR PEST NIGHTMARE !!!

Less means more

Ruoxi “Rosie” Wu, North Raleigh Christian Academy, Hebei, China

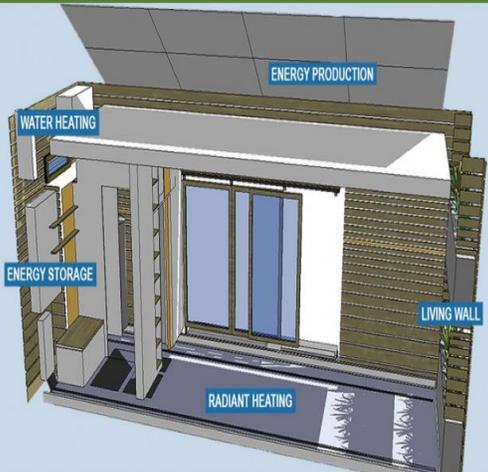
As economy develops, many people decide to spend money building and living in higher quality homes. People have begun to expand the size of their houses excessively, and as a result, an exceeding amount of construction materials are wasted. Every second, urban sprawl and the ecological footprints of humans are taking over more and more space in nature. Thus, there is a solution called a tiny house. Tiny houses are minimized family homes sizing from roughly 10 to 40 square meters, built with wooden or steel boards, and basically all furniture has multiple functions to store things and provide space to work, eat or rest. Moreover, changing policies could encourage this housing choice by lowering income taxes for citizens who decide to live in tiny houses. In addition, establishing more solar farms enables more citizens to live in tiny houses, which can reduce their ecological footprint. Despite the general preference for large houses, tiny house projects supported by policy changes will mitigate the problem of large ecological footprints.

Tiny houses minimize the construction materials used. The majority of family houses cause a considerable amount of construction waste, even apartments that are considered to be more sustainable (Pilkington, Roach, & Perkins, 2011) cause roughly seven tons of wood and concrete construction materials for each floor. However, according to studies conducted by the National Associations of House Builders in 2017, the average cost of construction for each family house was US\$ 237,760 (Ford, 2017), whereas each tiny house (10ft*8ft) costs roughly US\$ 10,000, including the whole construction and power systems (Ford & Gomez-Lanier, 2017). The main concern for this point is that building houses for every family is not practical enough in megacities (populations over 10 million) because the population density and limited area fit better in the solution of living in apartments. Nevertheless, the tiny houses can still be implemented in a great number of cities that are not over-crowded, helping with resource minimization, space efficiency, and money saving.

Tiny houses are suitable for a clean and renewable energy systems. Since tiny houses are physically smaller, it is more practical to install and implement a solar power system. For each tiny house, all the electricity can be provided by solar panels on top of the roof (Solar Today 2016-17 Winter). When there is extra solar energy produced, the battery or energy storage can store the extra energy for future use during extreme weather (Blakers, 2015). Also, solar farms can provide and transport electric power to areas lacking sunlight, so more areas can have access to solar power, and tiny houses can provide benefits on a wider scale.

In order to reduce the ecological footprint of human civilization by minimizing construction waste and energy consumption, the idea of the tiny house community should be broadly implemented in less populated cities. Decreased ecological footprints bring more sustainability and beauty of nature.

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Tiny Houses
Live a greener urban life!

Isn't it amazing when you have a small eco-footprint and small house in a small city?



zeroconsumption
renewable
ENERGY SUSTAINABILITY
Cities energy
GREEN ecofootprint
Minimization SOLAR
Tiny houses

Go Green!

Health and wealth: Urban agriculture

Heidi Boerschig, British International School of Houston Y13, Katy, Texas, USA

One of the most crucial attributes of green cities is the wellbeing of the residents, including their access to quality food. With a growing population, it has become increasingly difficult to provide adequate and accessible nutrition for all citizens, especially to those residing in lower-income areas. Six months ago, I volunteered at the Houston Food Bank and was able to witness first hand areas often referred to as 'food deserts'. These areas often lack grocery stores and farmers markets where families can buy fresh nutritional options (Stein, 2011). Working at this food bank allowed me to see the type of food that was provided for these families: canned vegetables, boxed pasta, and processed proteins. Although providing areas such as these with fresh produce is not considered a priority in large cities, educational and agricultural actions taken by community members can increase the overall well-being of urban residents and communities.

Implementing educational programs about proper nutrition can teach students and help spark an interest in their wellbeing and their communities. Many children who grow up in these low-income areas lack understanding of the health risks that come with having a poor diet, which can lead to overweight or underweight adolescents. The Community Childhood Hunger Identification Project surveyed a sample of children from low-income families and found that nearly one in three children younger than 12-years-old often went hungry or were at risk of hunger (Casey et al., 2001). Educational programs that not only educate the next generation about these risks, but also allow them to engage with and take action in their communities are needed. Children who are interested and educated about proper diets are more likely to participate in community movements and programs that enable them to access fresh produce.

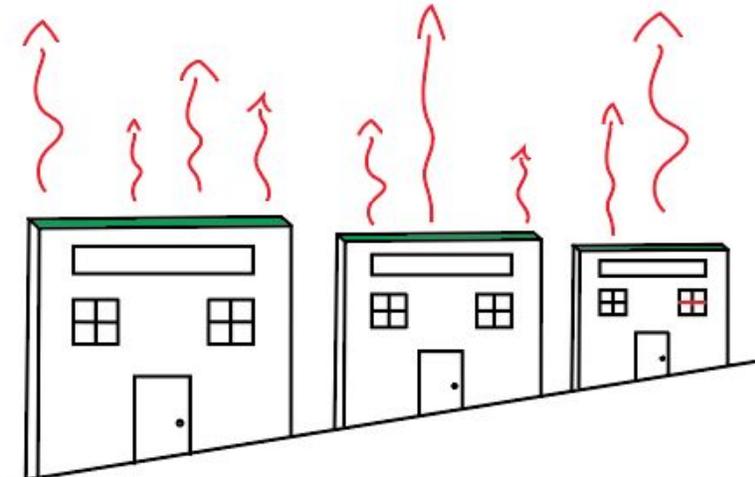
Integrating community gardens directly into these communities will increase participation in and awareness of these issues. Urban agriculture is beneficial for all communities, but a prevalent issue is finding space and areas that are easily accessible and that take little toll on the future development of these areas. If developers can see that these gardens are essential to residents' well-being, these agricultural spaces are more likely to be protected (Aubry et al, 2012). A low-income neighborhood in Houston, known as the Fifth Ward, is an area mostly made up of abandoned buildings and shops. By using spaces already a part of the neighborhood, these urban agriculture spaces become easily integrated into the daily lives of the people who are going to use them most. They serve as multifunctional spaces, providing families with accessible nutrition while simultaneously functioning as a community green space, allowing for interaction with nature and community members.

Urban agriculture is an essential element to all cities in order to help eliminate food deserts in low-income areas. All citizens should have equal nutrition and access to food. It is also important to educate the next generation about their diet as part of healthy self-care and spark an interest in an intriguing way caring for themselves and their communities through gardening. The ideal outcome of incorporating urban agriculture is to create a more sustainable and inclusive city.

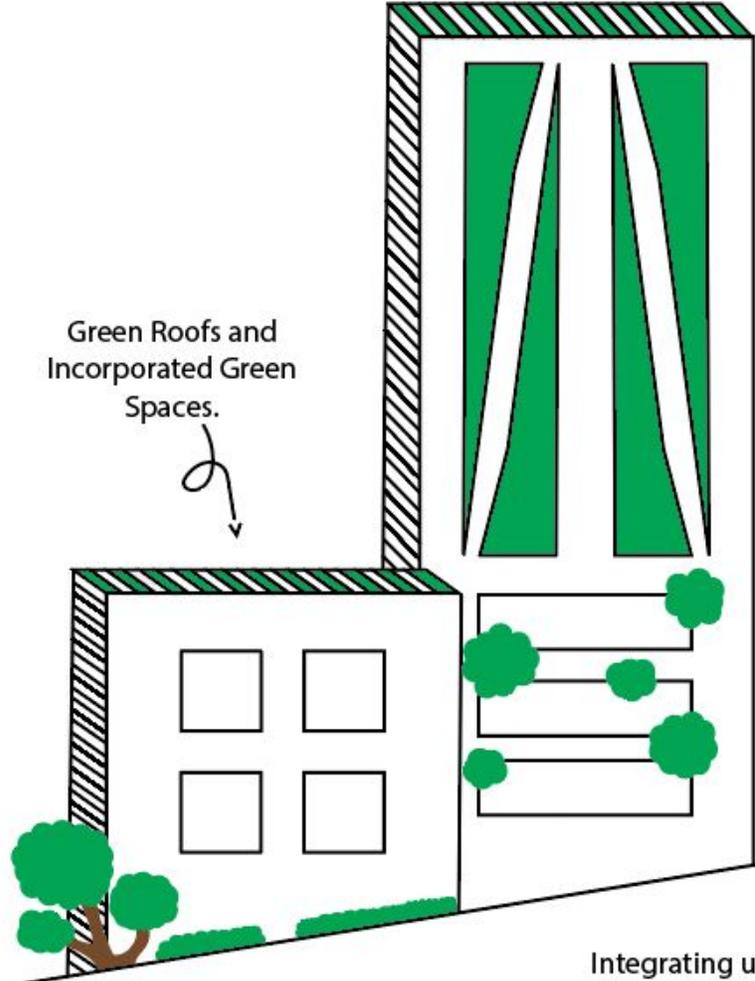
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Urban Agriculture & Green Spaces

Heat is reflected off the green roofs, creating cooler cities.

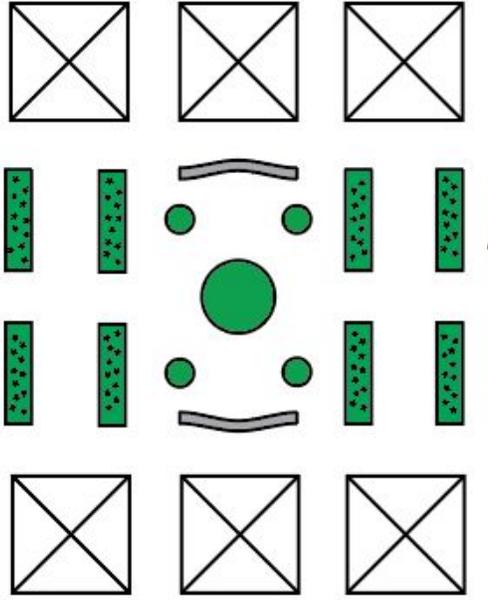


Green Roofs and Incorporated Green Spaces.

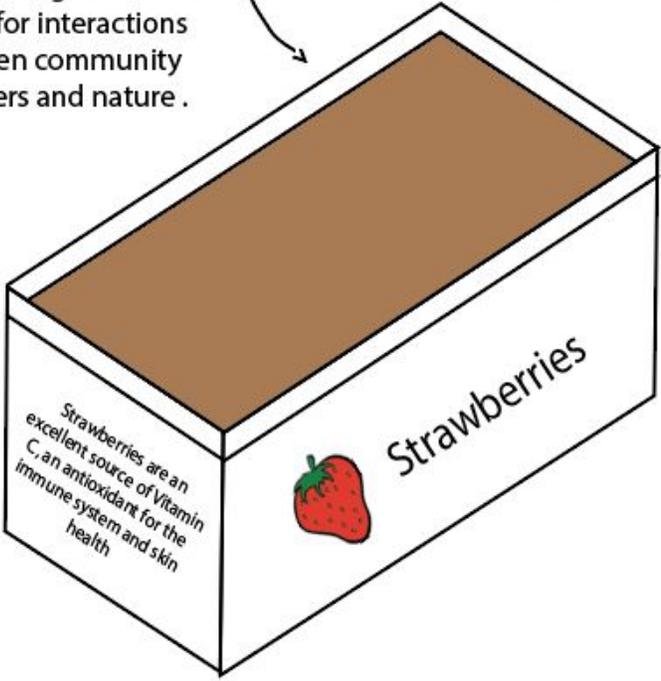


Integrating urban agriculture directly into unused spaces in neighborhoods allows for interactions between community members and nature.

Using the garden as an educational object allows the youth to learn about their diets in an engaging way.



Suburban Houses



Active green walls: A healthier indoors

Janis Chen, Deerfield Academy, Deerfield, Massachusetts, USA

On average, humans spend 87% of their day indoors (Klepeis et al., 2001). Studies by the U.S. Environmental Protection Agency indicate that indoor air pollutant levels may be up to 100 times higher than outdoor pollutant levels, and illnesses, such as the Sick Building Syndrome, are prevalent in the 21st century. Common air purification technologies, for example mechanical filtration and ultraviolet germicidal irradiation, may be effective in purifying air up to 80% (Vonberg et al., 2010), but they produce harmful secondary pollutants as by-products and are energy inefficient. Whereas many urban residents rely on technological air purification, using living green walls indoors can be a more effective way to improve indoor air quality and to increase a building's energy efficiency.

Active green walls improve air quality through the process of the wall's plants' leaves capturing pollutants and having the wall's biofilter and plant and soil microbes break down those pollutants. Green walls consist of pre-vegetated panels or vertical modules, holding soil or substrate, that are fixed vertically to a waterproof backing that has a biofiltration system that uses active airflow in order to increase the exposure of pollutants to the plants' foliage (Medl, Stangl, & Florineth, 2017).

Green walls have the potential to absorb particulate matter and to reduce pollutants such as volatile organic compounds, inorganic gaseous compounds, and carbon dioxide. An experimental active green wall had the capacity to remove 90% of formaldehyde, a carcinogenic indoor pollutant that is released from aging furniture and pressed-wood products (Wang and Zhang, 2011). Moreover, in a study by Irga et al. (2015), active green walls had the removal efficiency of 53% for large particles, 54% for PM10, and 48% for PM2.5, demonstrating the effectiveness of these walls.

Hesitations towards installing green walls can be attributed to a lack of technical knowledge of the walls and of the social benefits that these walls bring to a space. People fear that green walls come with expensive installation and maintenance fees, but any fees can be offset by the 25% of building electricity fees these walls can save annually. In warm climates, temperature reductions of 4–6 °C have been observed in proximity to an indoor wall (Fernández-Cañero, 2011), decreasing the need for air conditioning. Also, having indoor greenery can reduce physiological stress, improve work productivity, and make people feel more connected to nature (Ewert, A. and Chang, Y., 2018).

Instead of installing technological systems to purify indoor air, turning any indoor wall into an active green wall, in addition to purifying air pollutants, can increase a building's energy efficiency and, at a time where urban biodiversity is on a decline, make people in cities feel more in touch with nature.

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Let's collect the stormwater together!

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As global warming gets worse, many regions experience more days with heavy storms (Easterling et al., 2000). Floods cause economic loss in urban areas, making them a problem to be solved urgently. In fact, the floods can become a serviceable resource. According to Professor Rebecca Schneider (Cornell University), these storms are "drinkable pure water, but we just let it go." Sponge City is a model for dealing with excess water, but the conventional model of Sponge City needs to be updated. By adding citizen participation and building on universities' campus, a new model of Sponge City can be built while lessening the cost.

First, allowing people to contribute can subsidize the expense of the project. The expense of building a Sponge City is tremendous. It costs an estimated 0.10-0.15 billion RMB/km² to build a conventional Sponge City (Xia et al., 2017). In this new version of Sponge City, it needs a drainage system connected with tunnels for conveying water to agriculture and industry (Nordmark, 2002); however, instead of planting vegetation directly on top of the drainage, it uses individual pots of plants to cover the drainage. Thereafter, people can purchase a pot of reasonably priced plant to name and take care of. The profit can be allocated to the construction of the project, beginning a virtuous cycle for relieving financial stress.

Further, establishing this project on a university's campus can save money on recruiting staff while providing people professional guidelines. Universities typically have majors related to the environment, which attracts students interested in environmental issues. Maximizing the use of stormwater is a potential solution to water scarcity, a contemporary environmental problem. Hence, some students would want to volunteer or work for a low salary to contribute to this project. Moreover, these students in environmental-related majors are emerging experts who can explain the project to others and offer valuable opinions to improve the model. So, students can make the project be more economical and urge it to be better.

In addition, initiating this renovated model of Sponge City in a university can foster the spreading of knowledge on Sponge City to other citizens. The public usually does not understand phrases such as "total suspended solids (TSS)", "chemical oxygen demand (COD)", and "recreational water quality" (Maršálek & Sztruhár, 1994). In the encouraging and curious atmosphere of universities, once students recognize the advantages of Sponge City, they would discuss this concept with others, such as their families and friends. If the citizens learn that stormwater is a usable resource from people they trust, they would support this idea and it would be spread more widely. Therefore, the program can save money on advertisements.

This renovated model of Sponge City can obtain a successful result with the participation of citizens. The three ways that citizens can participate are by claiming their own plants, volunteering as universities' students, and educating more people about how a Sponge City can be used to combat overflowing stormwater.

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Claim your plant for \$15
Name it!
Feed it!

Structure of the drainage

Call For Everyone
The New Sponge City
Let's collect Stormwater together!



Mummy, where does the rain go?



Can I join?

It is playing with flowers now!



Drainage covered by pots of vegetation
(Pots have pores on the bottom)

Maintenance of urban waterbodies

Jingfan “Harry” Xia, Nanjing Foreign Language School, Nanjing, China

Urban development, in spite of its facilitation for convenient and colorful life in general, takes up more and more limited urban areas including former waterbodies. As water bodies are degraded, cultural loss, degradation of water quality and ecosystems, as well as frequent flooding occurs and it costs much more to renovate a damaged environment than maintaining it at first.

Urban development is accompanied by the damage of local topography, which can require broad investment to restore (Mariarinaldi, 2007). Take Cheonggyecheon, a major urban river since 1394 in Seoul, South Korea for example: it was paved over by a highway in 1968 due to limited usable land. From 2003, Mayor Lee Myung-bak’s municipal planning team took 27 months to dismantle the highway, distribute water to the dried riverbed, and plant native species on its riverbanks. In the three years following its daylighting, it has cost US\$ 11.55 million to maintain a grade III (slightly polluted) water quality and preserve the plants. The net cost is US\$ -1.023 million due to maintenance of this “artificial” environment with weak resilience (Lee and Jung, 2015). Despite benefits for the urban environment, this renovation is far from cost-effective when considering financial, ecological and sociological perspectives.

Current urban sewage disposal conditions also deteriorate water quality, threatening the hospitality of a city. In China, “more than 90% of the river sections” in urban areas suffer from “water quality of grade V (heavily polluted) or worse.” For Taihu Lake, domestic sewage discharge accounts for 42% of COD and 60% of total phosphorus (Shao, Tang, Zhang and Li, 2006). The economic cost of algae blooms in cities around it exceeds one hundred million yuan. Though China has invested “more than US\$10 billion” in pollution control of the lake, little significant improvement can be seen in water quality. The reason is that severely polluted waters are allowed to flow into the lake, where they become well mixed and accumulate in silts, which obstruct the removal process (Yang and Liu, 2009). The current follow-ups attempting to mitigate this issue may be more effective, but much more expensive as well.

Devastating disasters like flooding are also prone to happen in areas with covered and compromised waterbodies. Compared to the 1980s, the number, length, and density of rivers decreased greatly in Nanjing. In temporal scale, the river network complexity “dropped by 23.72% from 18.50 in the 1980s to 14.11 in 2009”. In spatial scale, a “simplified river network structure: tributaries supporting main rivers are gradually disappearing” happens, a phenomenon that steeply increases the probability of flooding in wet seasons (Ji, Xu, Hang and Yang, 2014). The fluctuation of flooding does much more harm than the benefits brought by the degradation of urban waterbodies.

Urban Waterbodies are an essential component of green cities. Once damaged, restoration is expensive and highly uncertain. In general, we ought to protect urban waterbodies even if they have been affected by human beings to avoid further interference to the scenery and ecosystems.

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MAINTENANCE OF URBAN WATERBODIES



Ideas



IV A restored reach with decent water quality ✓

- ~ Plant native species on banks
- ~ Provide supplementary water
- ~ Eliminate combined sewage overflow

~ In general, conservation is way more efficient and meaningful than restoration!

I Loss of culture 😞

Problems

II Growing possibility of flooding 🌊

III Severe water pollution 💩

Sponge Cities: Protecting our environment

Jye Shang, Jericho Senior High School, Jericho, New York, USA

Modern cities' water systems are far from perfect. In urban settlements near bodies of water or those that receive heavy precipitation, wastewater is collected into a treatment facility where it is filtered and sent back into our ecosystem. However, when it rains, that water also enters the facility, which can cause the system to overflow, unable to take the strain of the vast amount, forcing it to send polluted and dirty water back into the environment. Water drainage systems are also not sufficient to deal with flooding. Therefore, in order to end the floodings and harms to the marine ecosystem, which most coastal cities face, we should implement sponge cities, armed with the fact that there are other solutions to the problems.

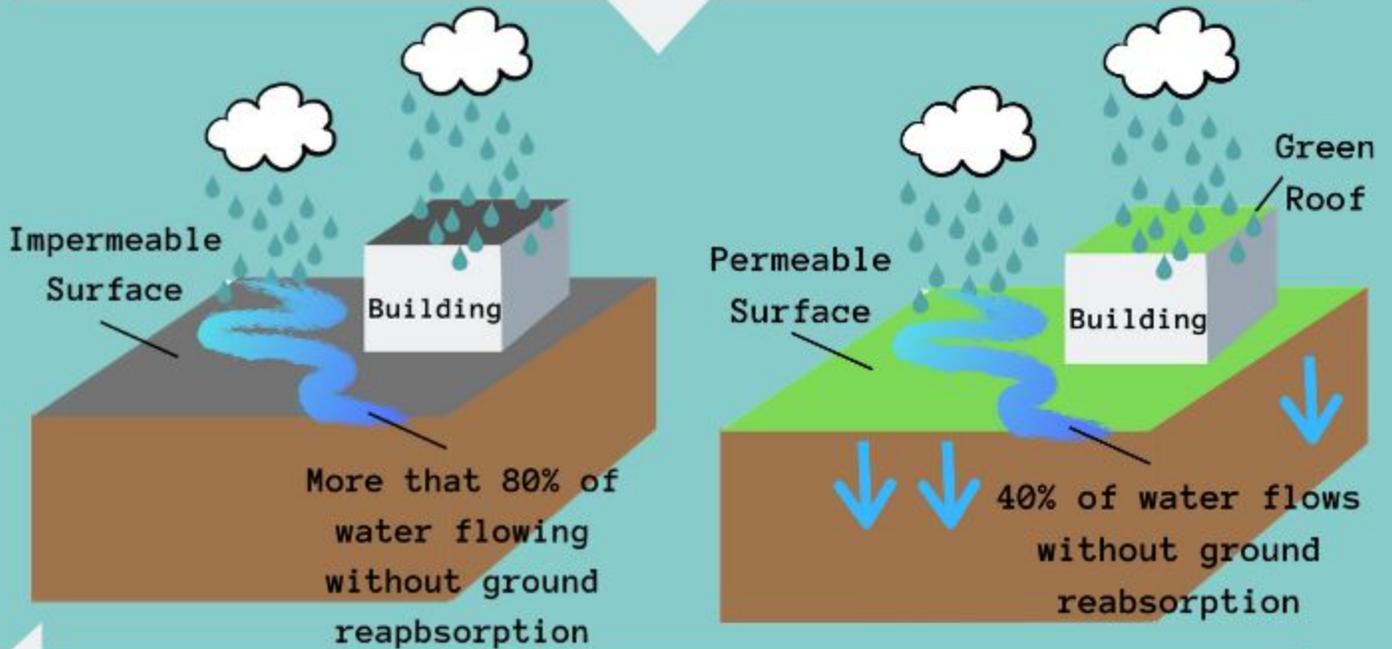
Current cities cannot deal with vast quantities of water. One of the most common issues is the inability for the ground to absorb stormwater, due to the impermeable surfaces. This prevents natural drainage of water, forcing city planners to shift that water to treatment facilities. Sponge cities, however, have semi-permeable surfaces that allow water to pass through, allowing soil to collect it as groundwater (Zevenbergen, 2018). Water will then flow back into the ecosystem or be reused, relieving the strain on water treatment facilities, thus protecting the environment. These cities also help with natural disasters. When a flood occurs, the ground is able to absorb more water, ceasing the flood. As a result of the ground to have the ability to retain water, it can not only deal with floods but also with droughts. Also during times of drought, this aids people, as the cities can now hold large amounts of water until time of need. This program is also efficient as 34.5% of bio-retention facilities and 46.0% of sunken green spaces had the best comprehensive performance in water runoff (Li Chen, 2019).

While it may seem clear that a sponge city should be implemented, some believe that the risks are too high, particularly the cost. In order for China to implement its sponge city program, they must invest 20.7 billion yuan (US\$ 3,014,541,000) (Chenyao Xiang, 2019). This will cause China to be in debt, have credit risk, and inflate the yuan-dollar. Not only this, but there could be unpredictable risks such as an earthquake during construction, and unexpected accidents (Lin Zhan, 2019). However, the cost to build a sponge city does not need to be expensive. Individuals can build green roofs, yard gardens and parks. Moreover, floods cause families to pay large amounts of money. In 2011 a flood hit Bangkok and damaged thousands of homes, killed many as well. The flood affected 469 households, who claimed that the mean cost to replace items and repair their building/home was US\$ 5261 (Nabangchang Orapan, 2015). In a more populated and affluent city, the price would drastically rise. In comparison, building a sponge city is not only cheap but it saves money.

By implementing sponge cities, numerous benefits follow along with it. Even though there may be temporary setbacks due to the cost, the outcome of having this significantly outweighs the harms. The number of floods, droughts, and environmental concerns that could be prevented will cover US\$ 3 billion dollars within a short period of time.

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SPONGE CITIES

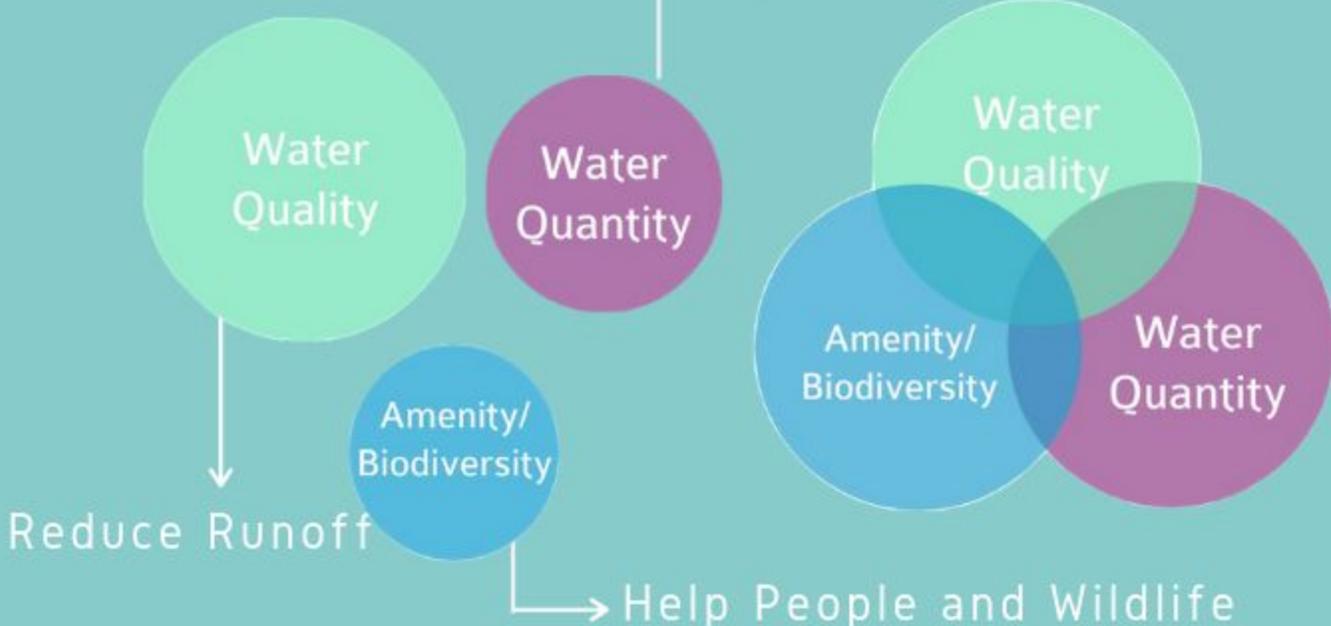


- China predicts 20% of cities to conform to sponge cities by 2020
- By 2030, the prediction reaches 80% (Thu Thuy Nguyen 2019)

TRADITIONAL

SUSTAINABLE

Mitigate Pollution



Naturally a city

Dylan Fu, Garden City High School, Garden City, New York

We live in constantly growing concrete jungles. The seemingly never ending cities are a pleasure to have and be a part of, but we as one of the species on this planet need to realize that we are not the only ones here and need to share this beautiful planet. This is an urgent problem that needs to be focused on immediately. Plant life needs to be more abundant everywhere, especially in the urban communities. There are many benefits of expanding the greenery in our lives, for other species and our health. Urban communities with more green spaces have healthier and happier populations, cost less to renovate and maintain, and improve the environment for all.

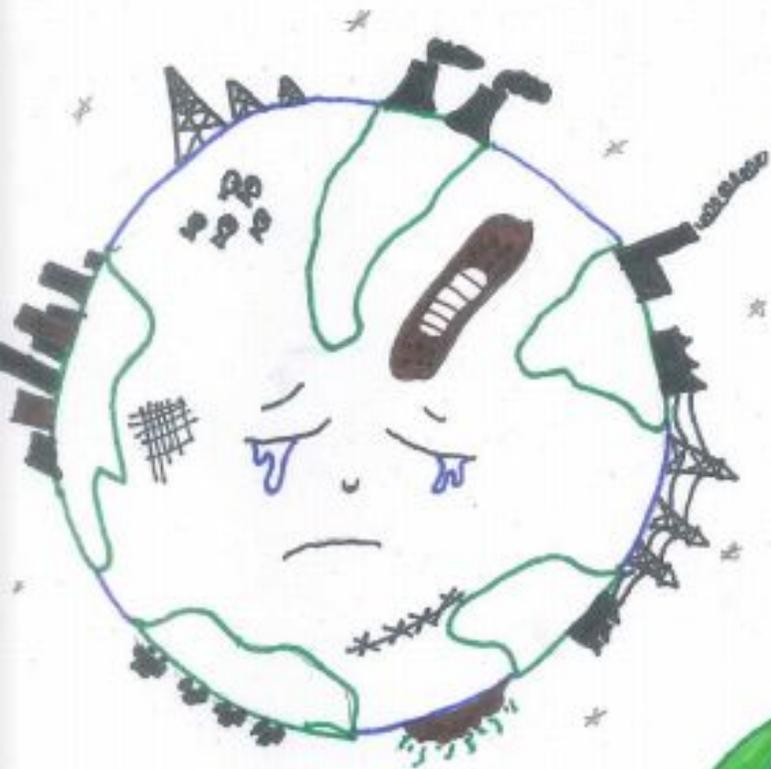
The first and arguably the most important benefit of incorporating more nature in our urban communities is it improves inhabitant's health. More plant life will make cities act more like an ecosystem, which is how nature is supposed to act and where it is most beneficial for all parties. More plant life means there will be more carbon dioxide taken in by the plants and therefore more oxygen released. The workers or residents in the buildings will experience higher air quality, which is currently a serious issue in major cities. Greenery and other environmental components, such as ponds, waterfalls, or certain animals, offer added health benefits as well. Water adds a calming effect which will relax the usually stressed out workers and diminish the harmful anxiety that people deal with everyday, which poses health threats. The animals will not be large scary ones, but calming and beautiful creatures such as fish or frogs or small lizards in a secluded area as to not pose any danger of escaping. Studies show that certain animals such as fish like the beautiful koi can significantly reduce stress (Friedman, 2015). Adding an urban fish pond with fish is an example of improving environmental quality for humans and providing habitat for fish.

Beyond the considerable health benefits, another upside of adding more nature into cities is the idea of a sponge city. Sponge cities are about making a city more efficient while using nature wherever possible (Bloomberg, 2017). In some sponge cities, there are green spaces everywhere and no conventional sewer systems because of how efficiently the water is cycled through the ground. The plants and soil give the city a good look and a simpler way of cooling down a hot city. There are green walls and roofs that, when the water evaporates, cool down giving the buildings an air conditioned affect. These green infrastructures can be less expensive and sometimes more efficient.

One roadblock to creating such an amazing city as this may come in the idea that all this change and building would cost more money than just leaving the urban communities as they are. However this is easily refuted by the fact that airports make more money on non-flight related sales. Therefore if airports were a more beautiful, calming, and overall a more enjoyable to be in, people would go and the airport would make more money. Making it cheaper in the long run to be biophilic.

The cities we know and love could be even better; the lack of biodiversity is holding us back. With more biodiversity cities can be more efficient with happier and healthier people. There should be no controversy at all: cities need to be green.

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Pranav

Using bioswales: Biophilic and equitable

Joshua Cai, Great Neck South School, Great Neck, New York, USA

Water is a fundamental resource for human survival— becoming increasingly costly in cities. More than half of the current world population lives in cities, contributing to the billions of gallons of sewage cities produced daily. The combined sewer system (CSS), introduced in 1855, was intended to manage stormwater and sewage (Tibbetts, 2005). However, the CSS is unable to deal with excessive quantities of rainwater and enable combined sewer overflows (CSOs). CSOs entails the dumping of raw sewage into local waters during storms, which harms both public and environmental interests. 772 American communities with about 40 million inhabitants continue using CSSs, including prominent cities such as New York City and Philadelphia. Furthermore, an estimated 850 billion gallons of untreated water are released into the United States' waters (Tibbetts, 2005). One way to mitigate the impacts of CSOs is bioswales. Bioswales can be used to filter stormwater and channel it towards areas with access to lesser quality water or areas of lesser affluence. Although bioswales require a substantial urban land and do not resolve CSOs— they can considerably contribute to the mitigation of CSO and social inequity.

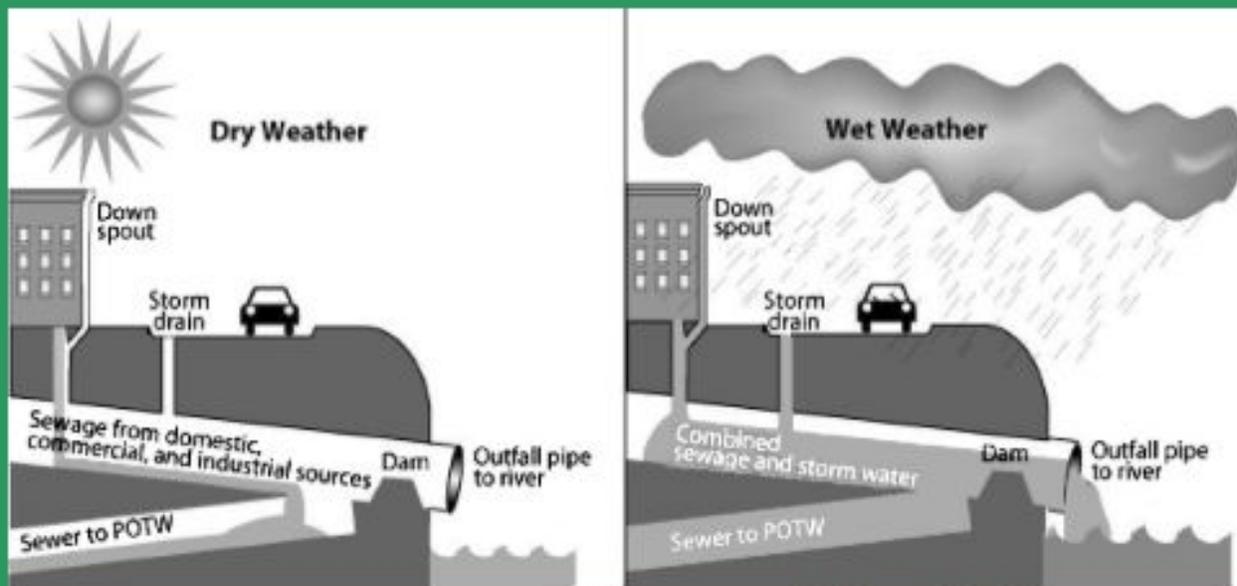
Bioswales reduce pollutants from stormwater and help cities deal with vast quantities of stormwater that cannot permeate concrete and asphalt surfaces. Bioswales are vegetated areas consisting of a drainage course that can collect and filter stormwater. Bioswales reduced suspended solids by 81%, metals by 81%, hydrocarbons by 82%, and pyrethroid pesticides by 74% (Anderson, 2016). Additionally, bioswales reduced runoff by 88.8% (Xiao and McPherson, 2009). The stormwater collected by bioswales can then enter a perforated pipe beneath the bioswales to be provided to areas in need of subsidized water. About 828 million people lived in areas with inadequate water. Additionally, the urban poor can pay up to 50 times more for water than their more affluent counterparts (United Nations, 2010). By providing filtered stormwater to less affluent areas, the bioswales can limit the harmful impacts of CSOs while also addressing preexisting social inequities.

While using bioswales to combat CSOs can be an implementation to mitigate CSO and inequity, there are some inevitable issues including urban space limitations and impact limitations. In order for bioswales to be implemented, a substantial amount of land needs to be set aside. However, in many urban settings, parking lots are abundant. In some cities, millions of square meters of land are used for parking. Parking lots can be reduced in size or built over bioswales to maximize land use. Additionally, bioswales only limit the impacts of CSOs, but do not solve CSOs. Bioswales are effective in stormwater management, flexible, and aesthetically pleasing (Feit, 2018) In order to completely eliminate CSOs, cities must replace their CSSs with separate sanitary and storm sewer systems.

By implementing bioswales, a multitude of environmental and social good can be achieved, including better stormwater management and increased accessibility of water for less affluent communities. Even with the spatial and impact limitations that bioswales have, the collection and filtration of stormwater outweigh its limitations.

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Combined Sewer Overflow (CSO)



Typical Combined Sewer System
(EPA, 2004)

Combined Sewer Systems (CSS) in the USA



Map of the CSSs in the USA (EPA, 2008)



~860

Number of communities in the US with CSSs (EPA, 2017)



~40,000,000

Number of people that live in areas with CSSs in the US (EPA, 2017)

New York City

1

46.23 inches

Annual NYC Precipitation- Rainfall (US Climate Data)

2

1,300,000,000 gallons

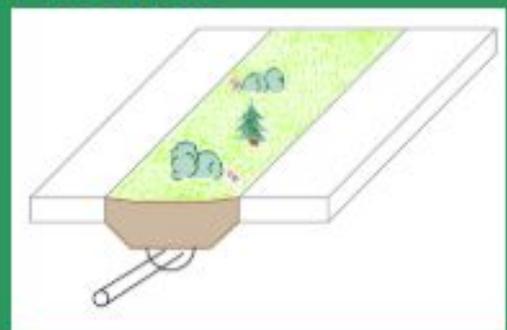
Amount of Wastewater Produced in NYC (NYC Gov)

3

19.0%

Percent of NYC Population in Poverty (NYC Gov, 2017)

Bioswale



1. Water flows into the bioswale
2. Water is slowed and cleaned by plants, rocks, and dirt
3. Water sinks through the ground and enters a perforated pipe that carries the water to less affluent communities

Will garbage sorting make a city more sustainable?

Qinxin Zhang, Laguna Blanca School, Shanghai, China

Cities around the world are attempting to solve health and environmental issues caused by irresponsible trash dumping. The city of Shanghai is enforcing a new set of governmental waste regulation policies. On July 1, 2019, Shanghai became one of the first few cities in China to start its mandatory domestic waste management. Even though garbage sorting can be very costly and hard to manage, to build a resilient and lively city, the city government should enforce policies and make scientific innovations to collect garbage in a cleaner, healthier, and more organized way.

There are only two rules: first of all, all trash will be sorted into four categories: kitchen waste, other waste, recyclables, and harmful waste, and whoever fails to do so will receive a fine of 200 yuan; secondly, residents can only toss their trash at 6:30-9:30am and 5:00-8:00pm everyday at fixed location close to where they live. Problems can be categorized into three groups: time, space, and execution (Shanghai Government, 2019).

With only 6 hours of trash collection per day, people who work at those hours have to leave their trash at home; after a few days, this trash will stink and affect the residential condition. To solve this time issue, people can ask their neighbors or special waste-collecting agents who work for the government for help. However, it's expensive for the government to hire that many people to collect trash and move garbage-sorting facilities. The government must offer subsidies in education, employment, and infrastructure as well.

Also, to make disposal easier, the Shanghai government decided to put at least one set of trash bin in each community (Chen, 2019). Since living space is very limited in an urban area, some residents reported that they had smelled the stench from trash collecting center, which lowers the price of houses in the surrounding area (Yang, 2019). In terms of spacing, the government can purchase removable trash collecting facilities. Specific employees will carry the facilities in and out of a community four times a day to make sure this area remains clean and open to the public. Even though the government has given this project full support, most of the money for infrastructure and processing is pulled out of the property management fee, which is collected from house owners.

Finally, most people still have trouble sorting trash into different categories, especially old people who are not well-educated (Liu & Wang). The solution, of which the Shanghai government has already been doing, is to inform residents about how to sort trash properly using posters, brochures, and various types of social media. The city government should put more effort and money into a project of this scale. This initiative of making cities better places to live in should gain support from both residents and executives. Furthermore, engineers and administration should discuss and come up with a more effective model to minimize cost.

These initiatives will have a better effect in terms of making the city more sustainable and livable if new policies such as using mobile trash collection points and employing people to run the process smoothly can get support from government and residents in the community.

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Kitchen Waste



Recyclables



Other Waste



Harmful Waste



From landfill to your backyard: Reusing plastic

Jiaqi Chen, Hong Kong International School, Hong Kong

Imagine there is a clear blue sky and a breeze blowing on your cheeks. You decide to show your daughter the pure nature of the beach but all that you see are white pieces of plastic sticking out of the sand and floating on the surface of the water. It's not too late to change this around. Although plastic production seems impossible to be stopped, correctly recycling these materials can prevent environmental damage when reused into our daily lives around the city.

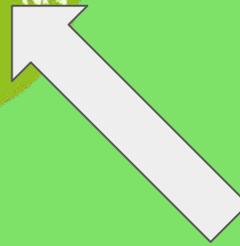
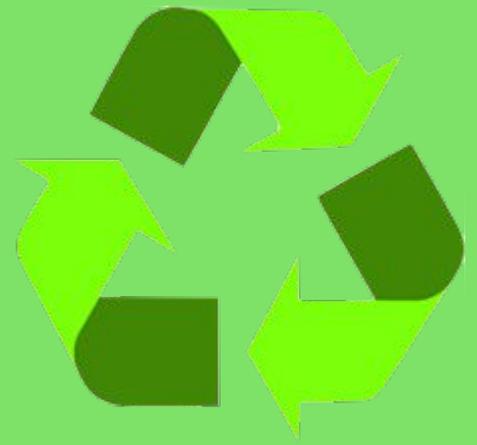
Plastic pollution has been a long lasting problem that haunts every environmentalist as it is known to be not biodegradable. Currently, around 5 percent is recycled and the rest is either dumped into landfills or just thrown away which eventually leak into the environment (Hawken, 2019). Scientists offer that the best solution is to reduce the usage of plastic or even completely eliminate it. Although this sounds like the perfect plan for the disastrous problem, it fails to realize the benefits that plastic serves to humans. In one instance, plastic used in transportation can save huge amounts of both material and fossil fuel energy. A comprehensive study showed that packaging with plastic rather than metal or glass reduced energy consumption by 52% and reduced greenhouse gas emissions by 55% (Andrady & Neal, 2009). Plastic has shown to possess great value in current society, and although it needs to be reduced, it cannot be completely eliminated. Therefore we need an alternative solution.

By reusing plastic and constructing infrastructure around the city, our environment can be maintained at a manageable level. Such infrastructure includes objects such as traffic cones or park benches. They not only promote convenience for the citizens, but also allow for community building. Instead of having plastic sitting in the landfill, unable to decompose, we can use the longevity of plastic to our convenience and create long-lasting infrastructures for both beauty and practicality.

In Greece, a project started by the zero waste lab targets on reusing plastic with a 3D printing technique that creates park benches around the city while encouraging the citizens to come up with designs. This allowed the people of the city to contribute to making their city a better place while raising recycling awareness across the city. Not only can this project reduce the usage of wood and metal, citizens actually prefer it and each bench consumes up to 68 kg of recycled plastic (Sakkas, 2019). Additionally, these benches are designed to last for decades, and if it is damaged, it can easily be recycled again 7-9 times without worrying about the quality ("How many times", 2016). With all these benefits, recycled plastic benches are clearly the better option for cities as it improves various aspects of city life. Recycling, has then become a process that involves joy and participation by all citizens that represent different cultures while saving the environment.

Plastic waste is an urgent issue that begs for the attention of all citizens. Not only are all created plastic still present on Earth, we are still constantly creating more and more. Action such as the reusing process must be followed by cities in order to help achieve a more balanced and clean society. By regrouping as one, our impact on this planet can't undo all the harm that we have already done, but certainly can prevent any more to come.

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That is Earth

Containing cities

Containing our home

One million seabirds and 100,000 marine animals die each year because of plastic. No other known planet can support life as we know it. The Earth's resources and carrying capacity is limited. Don't wait until it's too late to make a change.

Reuse and reduce plastic waste within cities



Government's leadership = YIMBY

Zhewei "David" Chen, Cornerstone Christian Academy Texas, USA

Have you heard of landfills? They are one urban waste disposal method, but they are able to handle all the garbage we make in the urban environment because landfills can only hold so much trash and need to be located far from water sources (Harnik, Taylor & Welle, 2006). The increasing amount of urban garbage causes a lack of land for landfills, since garbage piles up instead of breaking down. Although the landfill is a relatively easy way to dispose of urban waste, it is space limited. There are other waste disposal techniques to solve the problem, however, the main roadblock for building such waste disposal plants in the city is the NIMBY, "not in my back yard," attitude. Locating government offices near such disposal plants may be one way to get around this issue.

One of the more clean and effective solutions is the trash disposal method of incineration. Urban waste incineration plants involve the combustion of organic substances contained in waste materials and transfer the heat generated by the incinerator to electric power. Incineration plants can also cooperate with the landfill by sending the leftover ash and residual material to be buried, which can effectively reduce the amount of waste that needs to be landfilled (Baetz, Pas, Neebe, 1989). In fact, citizens generally agree with building a sustainable waste industry that can help create a better living environment, but they do not agree with building a trash disposal plant close to their houses, even though this kind of disposal industry theoretically will not affect their living conditions if the incineration plants deal with the 1,4-Dioxin problem. In 2014, Hangzhou, China, over 5,000 local citizens initiate a parade against building new trash incineration plants near their living area. The parade even turned into violent demonstrations, with protesters finally forcing the government to delay the incineration plant building plan.

Since simply educating is not enough to convince citizens, one of the most effective ways is to let people know that the waste disposal plant will not cause any problem in their living environment would be to put the government's offices near the disposal industries. In Joanne Hambleton's study of *Why Do People Follow the Leader?* (2014) she mentions, "People will follow the lead of those they know and trust." And the government will be the best choice to serve as a leader people know and trust. When the government puts itself in the perceived "danger zone," people will start to doubt their previous idea about the waste disposal industries as harmful for their living conditions and slowly turn to believe that the "danger zone" is actually safe. Simultaneously, when the government department is set near the waste disposal plants, it will also make the industries become more responsible and reliable. The government officials will not want to work beside a harmful and polluted area, so it will cause the government to invest more funds in non-toxic waste disposal methods.

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They really don't want to recycle?

Ziyan "Sophie" Zhang, Shenzhen Middle School, Shenzhen, China

Recycling is being carried out by more and more schools. However in some schools, facilitating students to change behavior is not working out. Studies have shown that there are three important factors that determine student recycling behavior: the attitude of students toward recycling, their knowledge related to recycling, and the infrastructure schools provide for recycling. The problem is that when trying to improve students' recycling behavior, schools tend to focus on only one or two related factors, which is not sufficient. Focusing on students' attitudes, knowledge, and school's infrastructure would better prompt school recycling action.

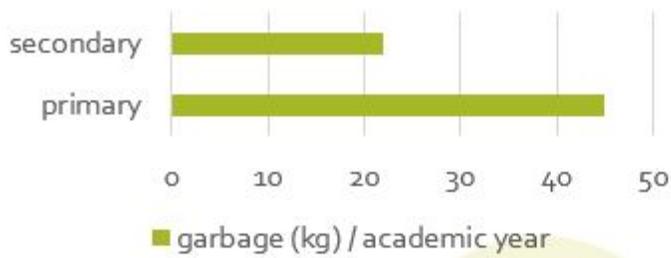
Generally, pro-environmental attitudes are suggested as the major determinant of environmental behavior by most studies (Ding et al., 2017), but only fostering attitude is not enough. Research about recycling-active people and non-active people shows that there are no significant differences in their general pro-ecological attitudes toward environmental problems (Oskamp et al., 1991), meaning that there is something else that must be considered as well. For example, the other factors that affect environmental attitudes are appropriate opportunities, facilities, and related knowledge (Tonglet et al., 2004; Davis et al., 2006; Lange et al., 2014).

Knowledge relating to recycling, such as understanding its importance or whether certain thing is recyclable, is also essential, but simply providing knowledge is not enough. Environmental impact was not found to be the strongest predictor of pro-environmental behavior intentions, suggesting that simply educating the public about the environmental benefits of a behavior is not an effective strategy (Heather et al., 2018). Besides, just imagine that students in schools deeply know the necessity of garbage sorting and have a great knowledge in what is recyclable or not, but there are no or a few recycling bins or other infrastructures. This would certainly make it difficult for students to recycle successfully.

In terms of infrastructure, though there is a positive correlation between infrastructure and pro-environment behavior (Mozo-Reyes et al., 2016), improving it without providing knowledge and fostering pro-environmental attitudes in students will not work effectively. Although studies suggest that recycling infrastructure has the capability to attract users and engage them with statistically-significantly more recycling activity than normal bins do, there is still a large proportion of participants who do not recycle even with the appearance of recycling bins (Mozo-Reyes et al., 2016).

Schools produce mountains of garbage, which makes recycling necessary and urgent. The aim of this article is to strongly recommend schools consider more when trying to make changes to increase recycling. It is no good to blame students for their lack of consciousness of citizenship unless schools provide them first with a chance to foster pro-environmental attitudes, knowledge related to recycling, and recycling infrastructure.

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Primary School



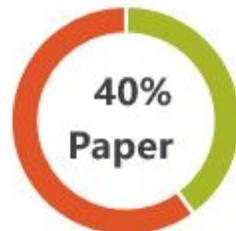
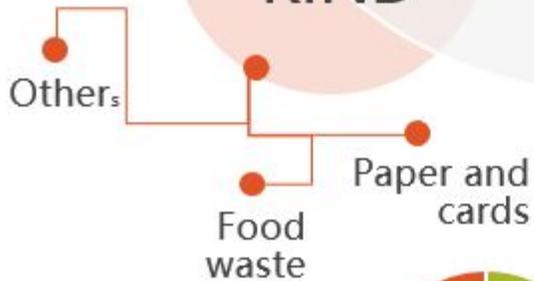
HOW MUCH



Secondary school

School Garbage Facts

WHAT KIND



■ paper & cards ■ others

WHERE



Decomposing plastic with innovative products

Heyan “Eric” Gao, Woodside Priory School, Shanghai, China

As residents of modern cities, we are surrounded by plastic products. However, as more and more plastics are produced and used, the question of “where the plastics go” emerges. From 1960 to 2015, 60% of all the urban plastics produced were either transported to landfills in suburban areas or scattered in the natural environments of cities (Geyer 2017). To cope with the increasing environmental concern, it is crucial to find innovative ways to manage the millions of tons of plastics consumed by cities every year. A solution is to efficiently recycle plastic waste and transform them into sustainable goods. Although facing the challenge of cutting production costs for firms, green products made of plastic waste have limitless potentials with the creative innovation of city corporations, just legislation of the government, and alternation to green lifestyle of city residents.

First, innovative and green ideas of leading corporations in cities are the fundamentals of a sustainable market for recycled plastic products. In June 2018, Adidas started a successful partnership with Parley, an environmental organization, and created eco-friendly shoes, each made with 11 recycled plastic bottles and fishnet fibers. The product sold over a million pairs in the United States by the end of the year (Parley 2019). The success exhibits the technological and innovative ability of corporations in making green products. In 2012, only 9% of the plastics produced in the United States are recycled, in which only a tenth are reused more than once (Gourmelon 2015). Thus, the participation of city corporations in the green urban market and the production of goods with recycled plastics can effectively reduce plastic burial in urban landfills. Nevertheless, the production costs become the main obstacle for companies to produce goods with recycled plastics.

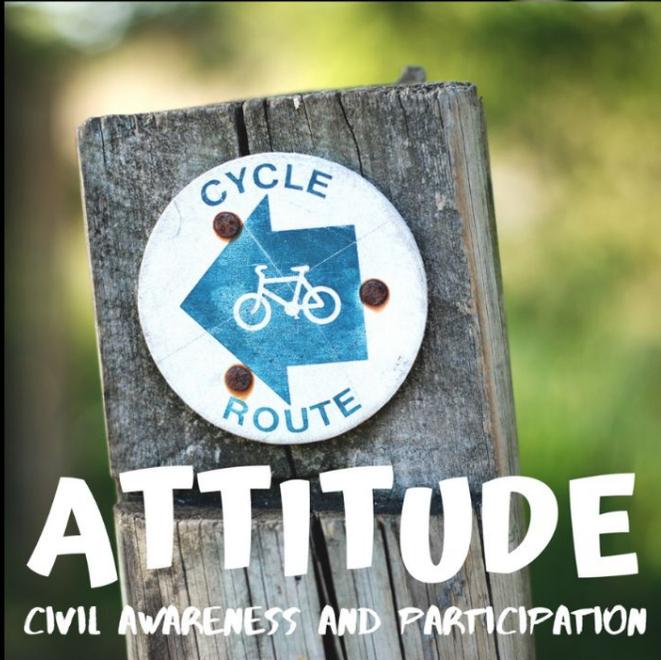
Second, it is the government’s duty to provide necessary subsidies to firms and encourage purchases of recycled plastic products. To help establish the green market for urban companies, the government has to motivate firms to use recycled plastic waste as raw materials. For example, the government can provide subsidies for green corporations. As a result, more and more companies will join the green market and become sustainable corporations. Then, the government can implement just policies on the production and usage of new plastics. According to Njeru (2006), the root of plastic issue for cities is mainly the unsustainable consumption of residents. To resolve the problem, the government should put more taxes on new plastic chairs but not on the ones made of recycled plastics. These policies would effectively promote the purchases of recycled plastic products.

Third, alternation of people’s attitude towards plastic recycling can be achieved by education and civic ecological activities. By giving students sufficient information about the environmental effects of plastic waste on cities, students are more likely to embrace green lifestyle. However, there are no clear links between people’s knowledge and attitude nor their attitude and behavior (Baker 2013). Thus, in addition, by encouraging citizens to participate in ecological activities, individuals get a chance to witness the effect of plastic waste on urban environment. As a result, they are more likely to choose recycled plastic products to reduce the plastic waste entering city environments or landfills.

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URBAN GREEN MARKET

Products made of recycled plastics



The art of changing mindset

Wei “Chloe” Song, Huafu International Department, Guangzhou, China

Despite the mass propaganda of recycling in cities, a major problem has never been solved. The issue lies at that most citizens are lack of awareness to participate, causing inefficient recycling in residential communities. To reverse this, the theory of planned behavior, a chain of mental building process, including attitude, adjusting subjective norm, and perceived behavioral control, can be an effective approach to address the lack of participation (Ajzen, 1985). Due to the integrity of a city, the article will focus on the two social aspects in the theory which will be achieved by two innovations in residential areas, experiential social learning and improved garbage bins.

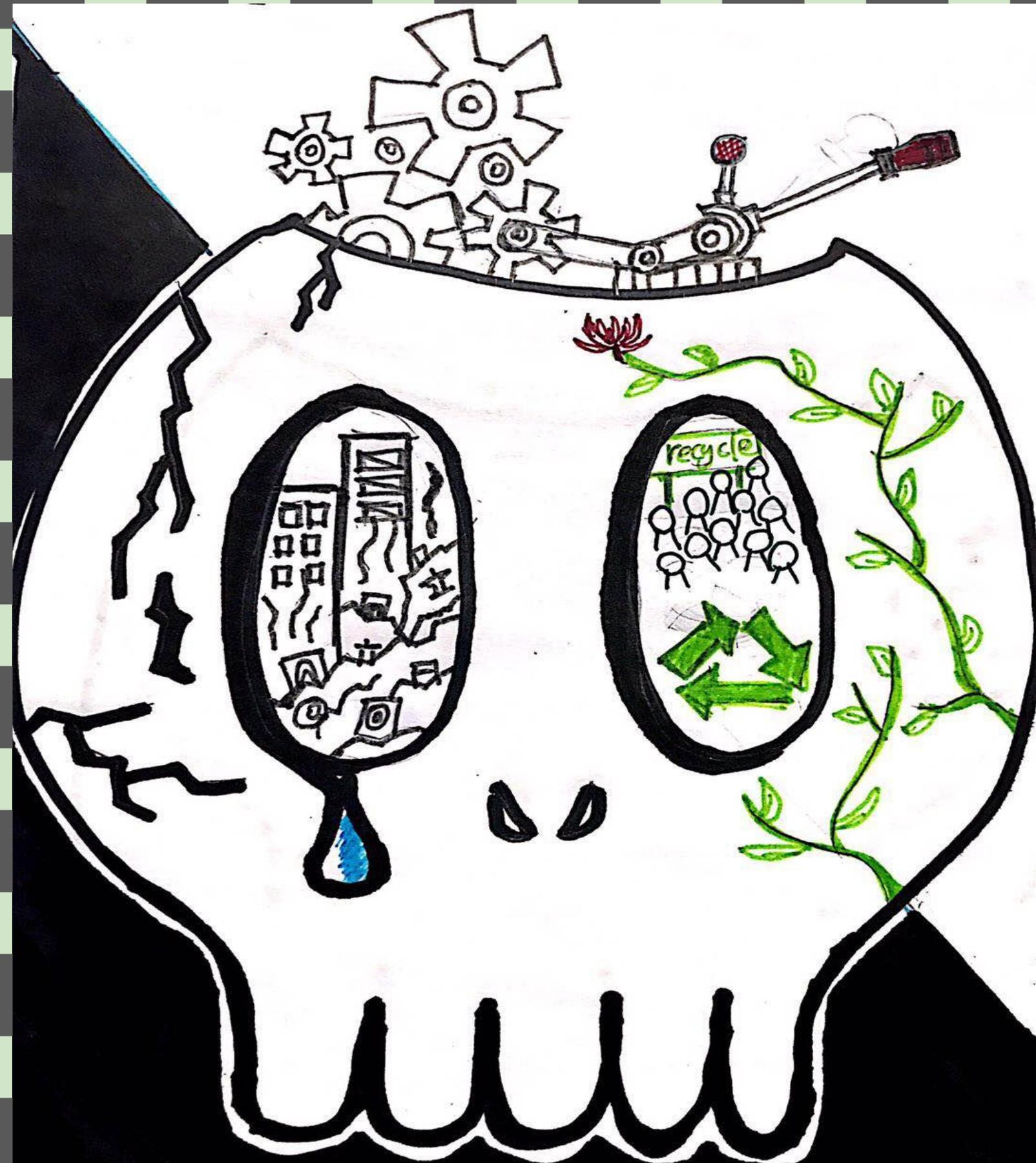
To change people’s mindset, creating subjective norms (social norms) through experiential learning is the first step. Subjective norm means having a phenomenon in society that adds pressure on people to perform certain things. To be specific on the matter, the education institutions need to create an atmosphere for everyone to participate in recycling. In a residential area, not just children, but people of all ages need to be educated in order to get every family to take actions. However, science and science communication are usually not enough to change minds or behavior, and are often abstract and remote for people (Moser & Dilling, 2007). Facing such a big variety of people, easy experiential learning with a clear purpose that includes activities for family might be an ideal strategy. For example, organize recycling competitions every weekend to see which family finish recycling the fastest or field trips for families to walk around the neighborhood or parks to pick up garbage and recycle them correctly. Visualized knowledge like drawings of recyclable objects will be carried throughout all the activities and attached to recycle bins to make them easy to learn and remember. Confirmed by the founder of Experience Based Learning Systems, the experiential method has proved a useful mean to changes in small groups or community system (Kolb, 2015).

The second step is to implement perceived behavioral control on citizens by introducing rewarding recycling machines that make recycling desirable. Reward can increase the probability of the occurrence of behaviors that are rewarded, and a part of the definition of rewarding is objects or events that cause pleasure, like wealth (Richmond, 2009). Based on the concept, a kind of motivating recycling machines that allow people to gain profits from recycling are invented and have walked into over 8000 residential communities in 32 cities in China (Xiaohuanggou, 2019). The idea is simple: people separate the recyclable garbage into a bag; put it into the machine to get the equivalent amount of money. Meanwhile, the machine will scan the garbage and return the non-recyclable waste back out. Under the temptation of simple operation and profits, within one year, the machines have over 3 million users and have saved almost 200 million kilograms of natural resources (Xiaohuanggou, 2019). If the machines can be applied throughout the world, the accomplishment will be huge in a very short time since people will be highly motivated and start taking actions.

Changing people’s mindset helps solve the fundamental issue of people not participating in recycling. Following the theory of planned behavior and having subjective norm and perceived behavioral control help gather a large number of people’s support on recycling garbage. So many citizens together will create a strong force to make our planet clean again.

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The art of changing *a city's mindset*



Walking in automobile-dependent cities

Gabrielle Day, Bishop Dunne High School, Dallas, Texas, USA

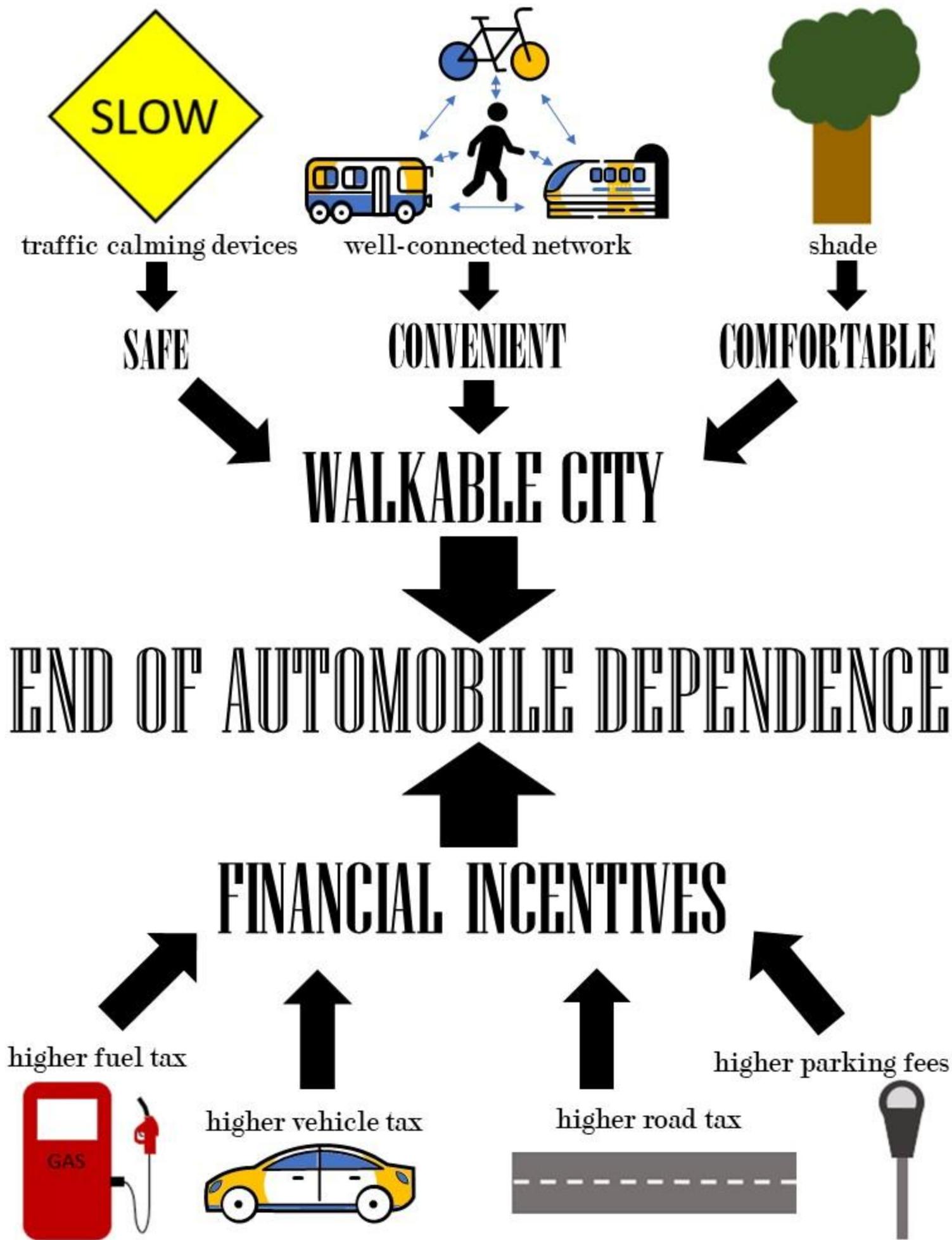
As climate change ravages the planet, car usage, especially in urban areas dependent on automobiles, continues to contribute to the greenhouse gas emissions that cause global climate change. One effective way to slow climate change involves substantially decreasing car usage with a special focus on cities, where a large and growing proportion of the world's population lives, by promoting walking. Walking saves energy while producing no air pollution, encourages social interaction, and provides health benefits (Southworth, 2005). Although belief in the necessity of cars might cause people to resist changing their behavior, improving pedestrian infrastructure to increase walkability can address automobile dependence when coupled with raising fuel, road, and vehicle taxes and parking fees to motivate people to walk.

Promoting walking as a safe, comfortable, and convenient alternative to cars is the first step of ending automobile dependence. Cities can increase walkability by using traffic calming devices to ensure pedestrians' safety, maintaining smooth pavement and planting trees for shade to make pathways comfortable, connecting sidewalks with different modes to provide a seamless network of transportation, and implementing mixed-use development to establish services that meet people's needs within walking distance of their houses (Southworth, 2005). To encourage more people to walk, cities must enact measures to support walking and foster a pedestrian-friendly environment.

The second step of ending automobile dependence is disincentivizing car usage. Even when a sustainable transportation alternative exists, people still might resist behavior change due to the ingrained belief that cars are necessary. Therefore, cities must not only improve walkability, but also motivate people to change their behavior and to use the improved pedestrian environment. Local governments can pressure people to drive less by raising fuel, road, and vehicle taxes to make car usage more expensive (Handy, 2000). According to a sensitivity analysis in a case study of Delhi, imposing fuel taxes is one of the most sensitive options for reducing air pollutant emissions from cars (Han, Bhandari, & Hayashi, 2010). While some people claim that fuel taxes disproportionately affect the poor, recent research indicates that the taxes primarily impact high- and middle-income people, due to poor people's difficulty affording cars (Espey, 2013). Additionally, increasing parking fees can provide more money to pay for sidewalk improvements to make the area more walkable. Pasadena is one city that successfully used parking fees to repair city sidewalks (Shoup, 2010).

Decreasing carbon dioxide emissions is imperative in slowing climate change. Automobiles greatly contribute to greenhouse gas emissions, so ending urban automobile dependence will reduce emissions. If cities improve walking conditions and financially motivate people to opt for walking instead of driving, people will stop relying on automobiles as their primary mode of transportation. It is vital that cities integrate both of these measures, not implement them separately, to encourage citizens to use cleaner, more sustainable forms of transportation.

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Footbridges in the city

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Traffic accidents frequently occur in urban areas, causing a big part of fortuitous casualty in people's life. The number of annual road traffic deaths has reached 1.35 million. The burden is disproportionately borne by pedestrians, cyclists and motorcyclists, in particular those living in developing countries (World Health Organization, 2018). But most of roads still use crosswalks which expose pedestrians and riders to cars, enhancing the potential of accidents and casualties. Despite the high cost and the lack of people's awareness, the city should create footbridges on every busy and wide road, especially where accidents used to happen, to make the city more livable.

Footbridges can separate pedestrians, who are more vulnerable to traffic accidents, from cars to protect them, especially at intersections. Pedestrians encounter cars mostly at the intersection. Take the United States as an example, 40 percent of all these crashes involve intersections (Edward A Smith Law Offices, 2018). And pedestrians are 1.5 times more likely than passenger vehicle occupants to be killed in a car crash on each trip (Beck LF, Dellinger AM, O'Neil ME, 2007). So if we can save all these pedestrians, we will reduce more than half of traffic death in theory. Also if people use normal crosswalks at intersections, both cars and pedestrians have to wait for each other. This not only wastes their time but also lets cars and pedestrians accumulate during waiting time, making the intersection more crowded and thus more dangerous.

Footbridges make traffic safer and more efficient in non-intersection areas, too. Most pedestrian deaths occur in non-intersection locations (National Highway Traffic Safety Administration, 2018)(this doesn't mean "Pedestrians encounter cars mostly at the intersection" isn't true because non-intersection areas including far wider scale of positions than intersections). Maybe because there are some very long roads in the city and sometimes people are too lazy to walk to the intersection, so many of them just cross the road straitly even without crosswalks. This is extremely dangerous. And even if this does not cause an accident, it will create traffic jams especially when there are a lot of people jaywalk because they see others doing so. Setting footbridges on these roads can offer pedestrians a safer, faster and more convenient way to go to their destination, and stop them from interrupting vehicle driving.

Well-designed footbridge can even be a landmark of the city, creating nice and unique public space. Before the reconstruction, the High Line Park in New York was a rail transit line, like a footbridge for trains. Unveiled in 2009, the High Line has become one of the most visited tourist sites in the city (Nate Millington, 2015). People can relax themselves, chat with others, and enjoy the beautiful views while passing through this wonderful place.

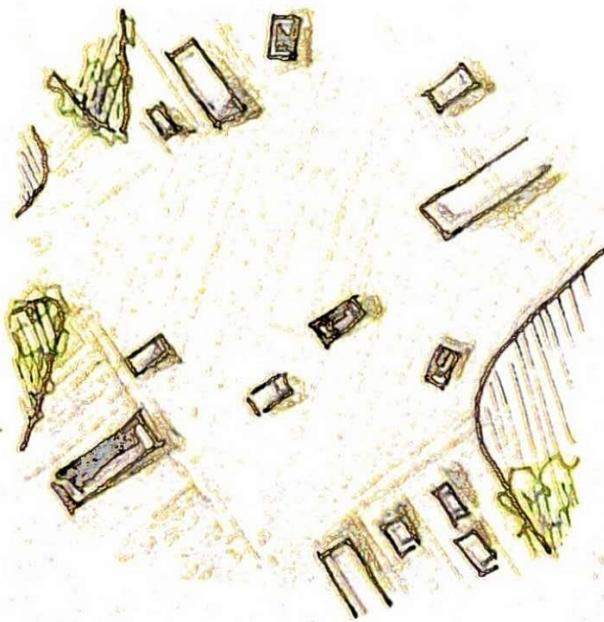
Footbridges in the city can improve people's lives by making transportation safer and more efficient. They can also become features of city's culture and history, making the city lively and charming.

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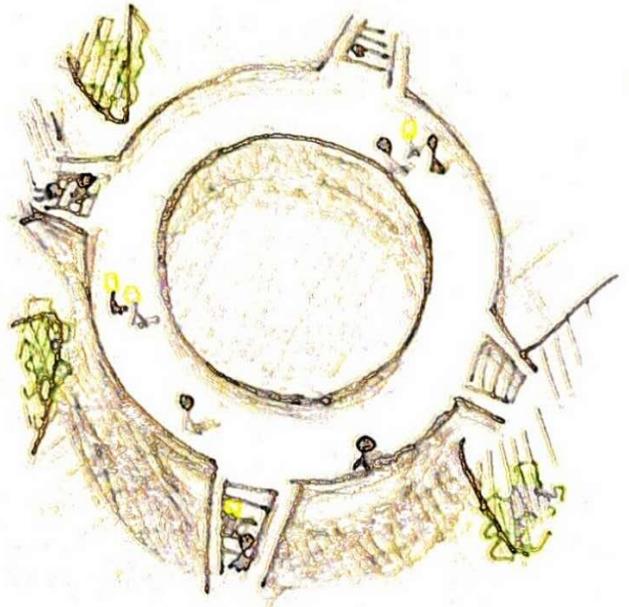


BUILD THE

FOOTBRIDGE !



FOR CARS



FOR PEDESTRIANS

In the age of sharing bikes

Yixin “Sammy” Huang, Changwai Bilingual School, Changzhou, China

Based on its “as-needed” principle, the stationless sharing bikes system is prevalent around the world. Bike sharing addresses the first/last-mile problem, reduces ecological footprint and improves people’s health (Médard de Chardon, 2019). But the current situation is that in the United States, just 1 percent of trips are taken by bike (Hawken, 2017). In order to increase ridership, bike sharing systems could implement the following three elements: governments and manufacturers can remodel bikes, give coupons through a recycling program, and provide discounts.

Business can collaborate with a bike recycling program to give coupons to bike users. Every year, there are millions of bikes being discarded. Mike Than Tun Win, a Singapore-educated philanthropist, builds business on recycling motto. He collected and sent previously used bikes to poor areas like Myanmar so that kids there did not need to walk long, rugged distances any more (Gaia Discovery, 2019). Manufacturers can encourage people to bring their discarded bikes to a specific station and give them some coupons for bike sharing apps as rewards. For example, if you bring two discarded bikes to that station, you get 15 percent off when renting sharing bikes. In this way, discarded bikes can be recycled instead of being disposed.

Since refurbished bikes would be used for the bike sharing program, they would include diverse models, which give riders more options to find the right fit and style. To give enough incentives for users, manufacturers can redistribute bikes by refurbishing sharing bikes. In downtown, people usually require more bikes, but every station only has a fixed amount of bikes; therefore, a bike shortage appears. What’s more, too many bikes at one station will also take up other private bikes’ space (Yan, et al., 2017). To solve this problem, manufacturers can install a tiny monitor on each bike to record the location and duration of users. To balance the supply of bikes, people can ride free from place A to place B when place B needs more bikes, which will attract more people to ride and hence modify the number of bikes.

Some discounts on utilities can drive people to use more sharing bikes. The tiny monitor tracks people’s duration of riding sharing bikes. The more they ride, the more discount they get for their utilities. For example, if someone rides for 10 hours a week, he or she can get 5 percent off for his or her family’s utilities. As a result, people will use more sharing bikes. But the success of discounts requires officials to negotiate with the relating department and try to give subsidies to frequent users. Additionally, more lectures should be made to encourage people to change their attitudes to environment and form a biophilic city.

Sharing bike systems brings countless benefits for the whole ecosystem and people’s social lives, containing lots of social value and ecological value. In order to encourage more frequent use of sharing bikes, the government and manufacturers must work together to give enough incentives for people, such as coupons, discounts, and redistribution.

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LET'S GO GREEN!



**Every year, millions of people discard their bikes...
It's time for us to USE MORE SHARING BIKES NOW!!!**

See below to get countless rewards ↓

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OR

GET

use



999,999 likes



A new incentive to carpool

David Rogers, Lake Braddock High School, Fairfax, Virginia, USA

It is common to hear how dangerous it is to get into a car with a stranger. With various innovations and apps to ensure the safety of the driver, carpooling can become the norm. Large amounts of the total carbon emissions are released from cars. Carpooling would reduce traffic, increase parking spots, and reduce carbon emissions. Even though it is against social norms in the U.S. to ride along in a car with a stranger, a successful carpool plan can provide a proper incentive to carpool and greatly reduce carbon emissions by expanding the Slug (a program connecting drivers and those looking for a ride), and High occupancy vehicle (car pool lanes) programs.

The Slug program is a government program that helps connect drivers with people trying to reach their same location. In a big parking lot, there are a series of bus stops that people stand under. Each stop is labeled with a location. If there is a driver going to that location, then the driver and rider carpool to their mutual location. The Slug program can be much more effective if there is a sign up to get into the program. If there are requirements to get into the program, drivers would be more likely to trust that the person getting into their car is not dangerous, and therefore would be more likely to use the program in the future.

High occupancy vehicle (HOV) lanes allow carpoolers to skip the normal rush hour traffic, which gives people more of an incentive to share a ride. The HOV program is a program that lets those who have more than one person in the car to use a fast lane. When commuting into a major city, there are two types of lanes in addition, there are lanes for those with only one person in the car, and then there are other lanes reserved for cars with multiple people. The lanes that only allow carpoolers to drive in is quite a bit faster, avoiding nearly all rush hour traffic (Shaheen and Coehn, 2018).

Cars produce over half of the carbon monoxide emissions and 27 percent of carbon dioxide emissions in the world (Anand, 2002). Carpooling and carpool lanes will give people more incentives to carpool and therefore drastically reducing carbon emissions. If even half the people who drove to work alone carpooled, carbon emissions produced by automobiles would be cut down to 50 percent. This may not seem much, however, if half of the people who normally drive carpooled, CO₂ emissions for the entire planet could fall as much as 13 percent (Antonella, 2002). That means that if every single driver took one passenger, each year there would be as much as 13 percent of existing carbon emissions that would not go into the environment.

Carpooling lanes and carpooling programs will never be 100 percent effective in carbon emissions and nor will it they ever end all traffic issues. However it is one important step forward toward a sustainable future. The common person may not see the ecological footprint they lay when driving a car, however, if they see that carpooling saves them time on their daily commute, then the average 9-5 wage worker would be far more inclined to carpool, and work for that future that everyone wants. With this program with such initiatives, carpooling may become the accepted way to get to work. One ride in someone else's car may not save the environment right then, but however, but it is a step in the right direction – a step towards a more eco-friendly, sustainable future.

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Top 10 most dangerous things in the world

10. BOX JELLYFISH
9. BLACK MAMBA
8. CAPE BUFFALO
7. SIAFU ANTS
6. DEATHSTALKER SCORPION
5. PUFFER FISH
4. HYENA
3. STONEFISH
2. Komodo Dragon
1. A Driver without a Passenger

The carbon emissions that are put into the environment are far more dangerous than nature's most venomous animals. The CO₂ that is going into the atmosphere is largely coming from the emissions of automobiles.

You can not spell carbon emissions without CAR

Mixed land use vs. urban sprawl

Shenghan “Frank” Xu, Suzhou Foreign Language School, Suzhou, China

Urban sprawl is a widespread phenomenon. Actions must be taken to end urban sprawl as it harms both ecological and social aspects of cities. First, Nechyba and Walsh (2004) asserted that the low-density structure elongates the distance between places and subsequently forces people to waste more time and resources. Further, Calthorpe and Fulton (2001) suggested that urban sprawl and car use forms a vicious cycle. The more space is exploited in the suburbs, more cars are demanded to overcome long distances. A surge of cars requires more open lands and intensifies urban sprawl. Moreover, Calthorpe and Fulton (2001) pointed out that urban sprawl is correlated to social injustice. So how can we end urban sprawl? Although obstacles exist, mixed land use with ecological democracy promise to end urban sprawl, which reduces ecological footprints, enhances accessibility, and supports social justice.

Cervero (1996) proved that mixed land use could reduce auto-commuting. Mixed land use can enhance accessibility by shortening the distance between different places of service. A distance under 300 feet between commercial and residential areas encourages non-motorized commuting (Cervero, 1996). To inhibit urban sprawl and car-directed traffic systems, several community centers could be established along the outskirts of the urban area. Different types of service should be incorporated in the community center.

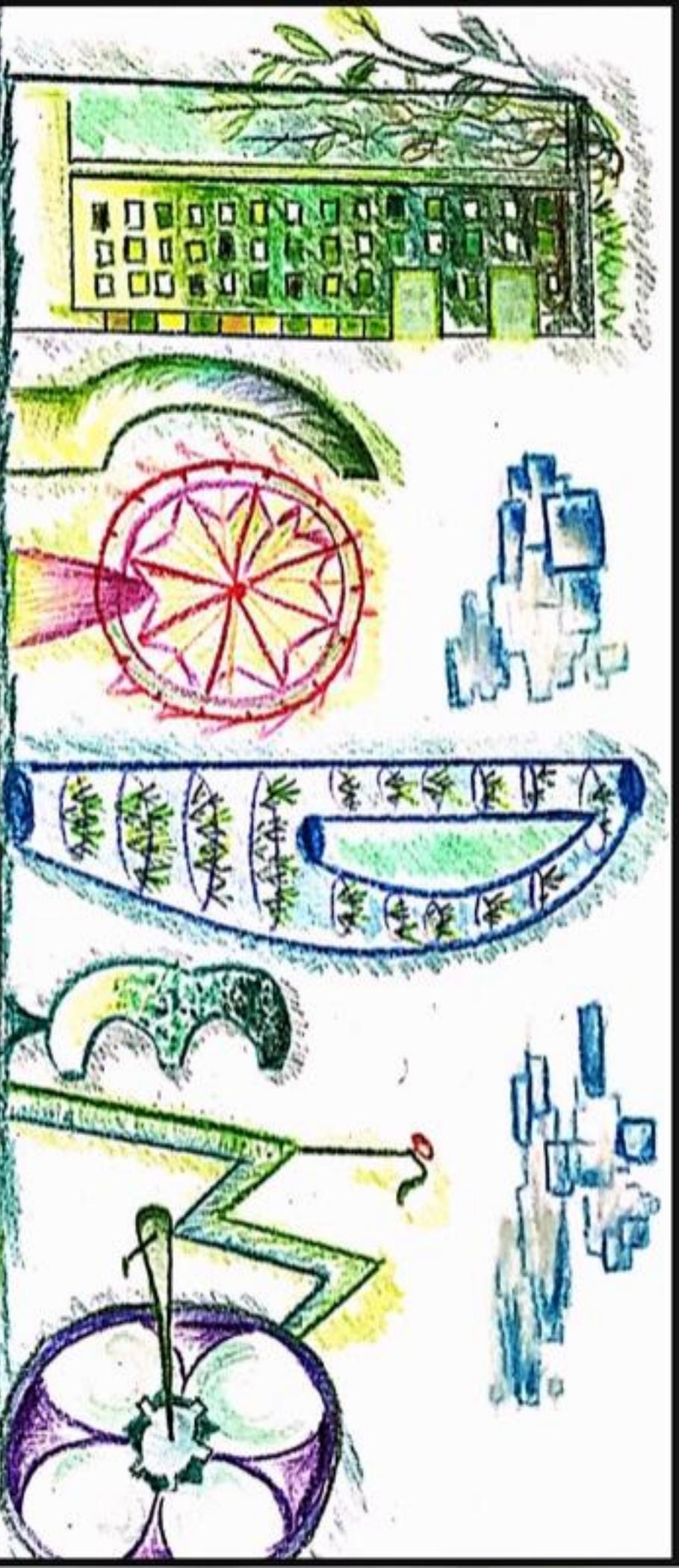
However, accessibility and justice are yet not fulfilled. If all the services are concentrated at the same spot, they are less accessible to people living at the edge of communities and competition for housing close to communities centers may be intensified, which mainly privileges the upper class. Therefore, ecological democracy should be urged. People should be encouraged to participate in planning projects (Lehmann, 2011). Recently, an MIT research group (Fighter & Aderghal, 2017) let citizens directly design their community and combines everyone’s design as a final result by computer modeling. Such a measure could be harnessed to maximize the accessibility in communities and well reflect most dwellers’ desires.

However, a new concern arises. Unal and Uslu (2018) admitted that public space size determines the amount of green space. However, Calthorpe and Fulton (2001) proposed that ecological corridors can be built at boundaries of communities or cities to enhance green space. Besides, people can also participate in conservation projects, reflecting ecological democracy.

In all, aided by ecological corridors, mixed land use with ecological democracy could fulfill the three goals that are ignored in previous urban sprawl: low ecological footprints, accessibility, and social justice.

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ECOLOGICAL DEMOCRACY



Affordable downtown housing

Hanzhang "Helena" Jiang, Nanjing Foreign Language School, Nanjing, China

Downtown areas, cities' commercial, cultural, historical, political and geographic hearts, are developing very quickly due to the advance of technology. However, downtown is troubled by extensive traffic congestion and excessive air pollution. Meanwhile, the city center is also filled by skyscrapers, resulting in limited areas for expansion. This fact leads to the unaffordable housing prices in downtown. In Manhattan, New York, for example, median home value is approximately \$915,300 (Burrows, 2019). All of these problems make downtown unsuitable for living. Although it's hard to control housing prices for established neighborhood in downtown, building new, affordable, and small apartments can create more livable and sustainable downtown communities.

Affordable small downtown housing will attract a more diverse population and create a more livable community. It is true that housing prices kept rising in recent years and are difficult to control. To reduce housing prices, the government needs to introduce policies to limit the maximum size and the price of a downtown apartment. For example, a building's plane area is 1000 square meters, which can hold approximately 3 apartments of 300 square meters or hold 20 apartments of 50 square meters. This new set-up will be suitable for bachelors who are working in the downtown area. More people will be attracted to live in downtown because of the lower housing prices and the short distance to work. Companies located downtown holds more diverse populations, which will be represented in the community. The community will be attractive to both young people and elders. While the young people ensure the vigor and vitality in downtown and promote the development of the city, the elders can bring peacefulness and harmony to the neighborhood. In the meantime, health and living services are considered the most appropriate by the old and the young in an inclusive community (Ma, Siu, & Zou, 2019). As the design and services of these places differ less with age, all people can share them in the community, and people can improve their well-being in a more diverse environment.

Furthermore, people will need to drive less in downtown areas and decrease their ecological footprint, building more sustainable communities. Nowadays, working people live in the suburbs and drive cars to work every day. Alas, the gasoline and diesel fueled vehicles generate approximately one-sixth to one-fifth of the world's greenhouse gas emissions (Poder & He, 2017). By building affordable downtown apartments, people will live closer to their office buildings and will choose to walk or cycle to work. Along with the decrease in automobile uses, the emission of greenhouse gases will also be reduced. Meanwhile, this change will allow cities to largely reduce the motorways and build a walkable city. Increased levels of physical activity boost health and well-being, addressing widespread problems of obesity, heart disease, and diabetes (Hawken, 2017).

In general, building affordable small apartments strengthens the resilience of the city by creating a more sustainable and livable community. It will help attracting more people and reducing automobile uses, which further promote city development.

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FUTURE

*1 walk 5min
to my office!*

*1 only need to
walk downstairs
to my office!*

*1 cycle
5min to
work!*

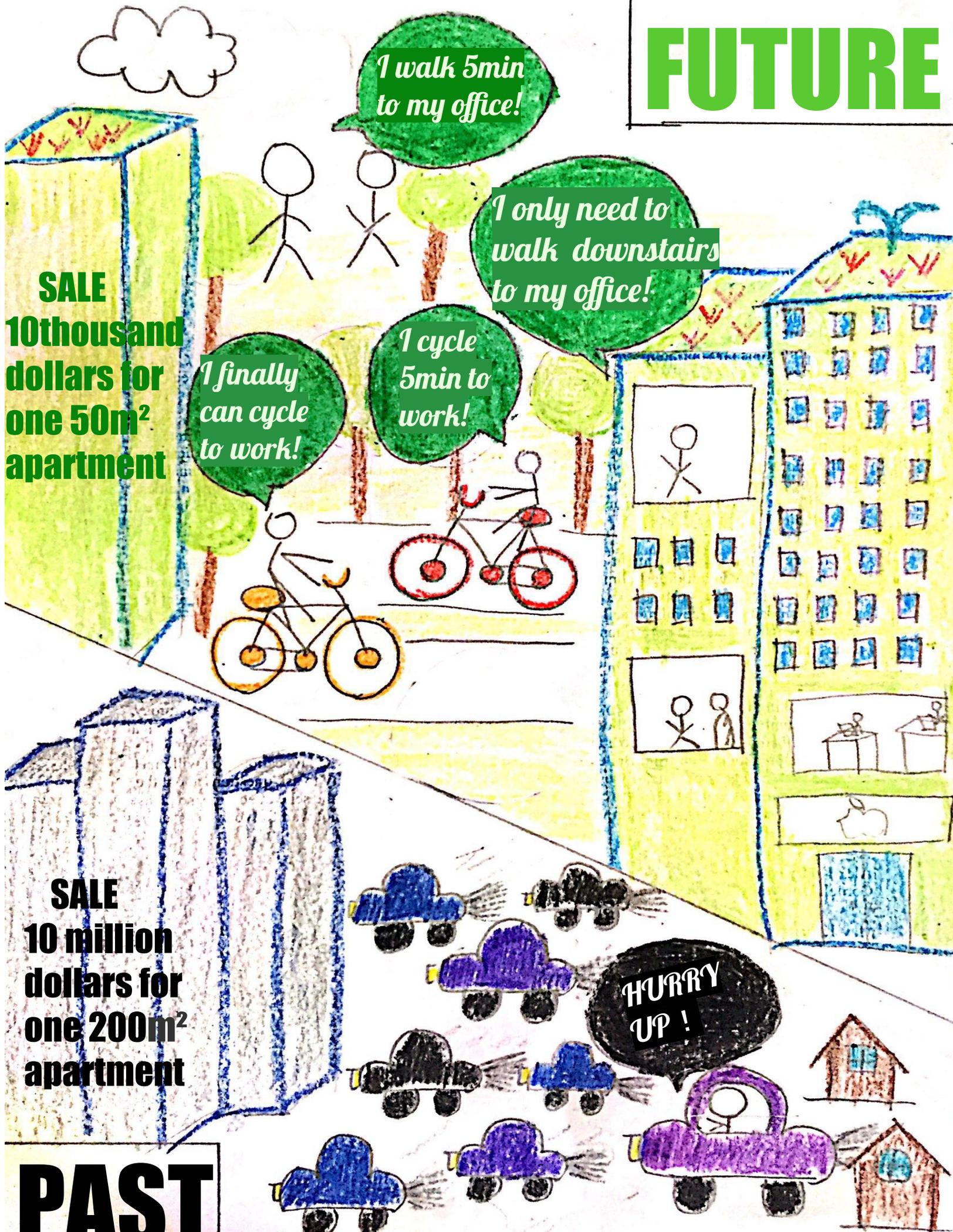
*1 finally
can cycle
to work!*

SALE
10 thousand
dollars for
one 50m²
apartment

SALE
10 million
dollars for
one 200m²
apartment

**HURRY
UP!**

PAST



Policies addressing urban gentrification

Fanshun “Steven” Shi, Anchor Bay High School, Wellington, Michigan, USA

City gentrifications have long been a severe concern for government officials and city planners. The harmful impacts they have for the environment of cities are huge and disastrous. Research confirms that younger workers prefer to live closer to work, and many renters who said they'd pay \$250 more a month to live in a better location said living close to work was their reason (*Phil's stock world: 80% of renters can't afford to live close to work*, 2018). With that said, people who suffer from city gentrifications are forced to move out of their original houses and move to places that require less money to live in, which are usually in the suburbs. Since more people need to drive to work because they now live far from workplaces, there will be a tremendous rise of carbon emissions (Holian and Kahn, 2015). Although spending more money on government-funded houses may exacerbate government deficit, building more public houses can address problems caused by gentrifications using the method of incremental income taxes for middle-class.

Raising taxes is a good solution to address government deficit caused by funding more houses in regard to solve gentrifications. Taxes have been a controversial topic for years. A conflict between government and individuals exists and influences the society obviously. Policy makers struggles with making decisions regarding taxes. Research confirms lawmakers often face difficult choices when setting tax policy, and taxes influence the economy by altering people's behavior, which generally results in a less efficient allocation of resources. People from middle-class are extremely sensitive to issues regarding taxes, and their rate of satisfaction towards the government will decrease if the government increase taxes too much at a time. However, raising taxes indeed has its outstanding point in this case. According to a report from the federal government, almost 42 percent of government revenue comes from individual income taxes, and they had much more effects when deciding government income and GDP share (Congressional Budget Office, 2011). This way, it may be an excellent method to address government deficits. In addition, the government can successfully resolve the problem of gentrification and dissatisfaction of middle-class due to tax increase by working with organizations to provide them loans and discounts when buying houses. There is an example in Detroit that solved the problem of gentrifications and dissatisfaction towards the government by providing loans to attract people to buy houses in a certain area (Congressional Budget Office, 2011).

Moreover, another merit it has in this case is the discouragement it may has on middle-class to increase rents prices by trying to purchase houses. The building block that usually causes gentrifications is that middle-class dedicating to buy houses as the environment of an area suddenly increases, which will in turn increase the rent of housing in that area. However, if middle-class now has to pay more taxes due to their decent income, there will be less people trying to buy or rent houses. As a result, there will be less incentives for house-owners to increase their rents.

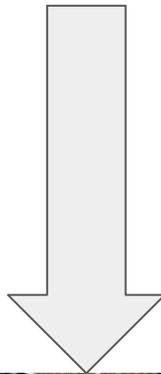
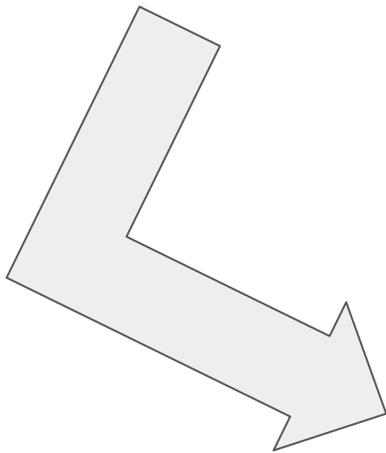
City gentrifications can be solved by putting out policies that provide more public houses and increase income taxes for middle-class while giving them benefits such as loans at the same time.

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Policies Addressing Urban Gentrification



Solve



Tackling environmental racism

Carolina Cordon, Senior at Nightingale Bamford, New York, USA

Imagine a community where people don't have access to clean water or air. Where people don't go for walks outside without breathing in chemicals from industrial factories or chemical facilities. Where kids don't play with their neighbors in parks. Such areas can be found in most cities. In the U.S., we live in a nation plagued by racial prejudices and xenophobia, but it is necessary that we create green public spaces in underprivileged areas without gentrifying or neglecting communities' culture.

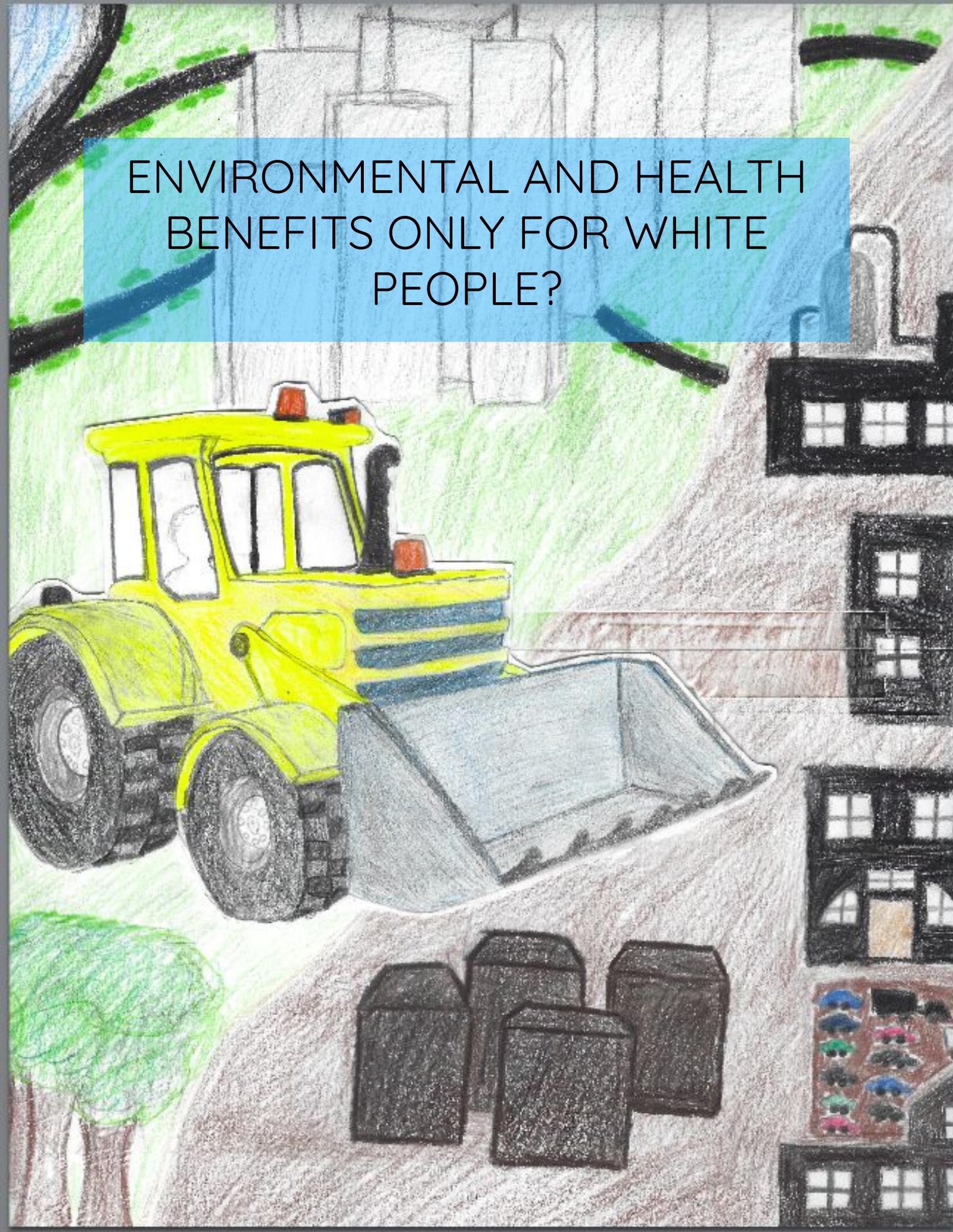
People of color are disproportionately more exposed to environmental health risks due to the location of their communities and the absence of green public spaces. Black and Latino people in the U.S. are twice as likely as a White person to live in an area where air pollution is their greatest health risk (Carter, 2006). They are five times more likely to live near a landfill or sewage plant. People in these neighborhoods with air pollution are more likely to have asthma and diabetes, be overweight, and be exposed to carcinogens (Carter, 2006). People usually associate these problems with poverty, but racial discrimination is the real perpetrator. Middle-class people of color who make about \$55K are more likely to live in polluted neighborhoods than Whites who make only \$10K a year (AJ+, 2016).

In predominantly white communities, residents are more likely to find green areas that promote physical and mental health. Green urbanization is a necessary shift the world needs to make to preserve and protect all natural life. For ecological reasons and health reasons, we need more green spaces in our cities (Beatley, 2011). However, green spaces are mostly associated with white, affluent communities. New parks and neighborhood gardens should be established in underprivileged areas. They unify the community while helping the urban environment. These spaces will be open for everyone to join in activities like planting and getting to know about our natural resources. They will instill a connection to the environment that is lacking in these cities while also building on the connection neighbors have to each other. Also, with the construction of these green spaces, the younger generation will grow up feeling more inspired to keep their neighborhood clean and united.

However, the only way these spaces will have a positive effect on the community is if the developers of these projects work hand-in-hand with the residents. Too often developers enter a community and tell the people what they should want rather than listening and learning about what makes that area and its people unique. Planners should get a sense for the people of an area in order to best represent them with this new space. But it does not end there. Once stereotypical slums have been cleaned up, tourism starts to increase and more white people start visiting these areas. This inevitably leads to gentrification unless we set new legislation that protects the homes and rights of the residents. When communities become greener and new public spaces are built, it becomes more expensive to live in those areas. To ensure residents can continue to afford their homes we need to enforce new regulations that will protect the homes of families. With the help of the government, we can freeze property taxes for these homeowners that are at risk of losing their homes due to green gentrification.

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ENVIRONMENTAL AND HEALTH
BENEFITS ONLY FOR WHITE
PEOPLE?



Schools: The playground for the future

Rishabh Gharekhan, Scarsdale High School, Scarsdale, New York, USA

In my school, over 60% of students considered themselves environmentally conscious. Yet there is an appalling amount of plastic waste in our dumpsters. If people care so much about the planet, why do we still see so much trash? Convenience trumps care in my score-centric society. Taking action for a cause does not merit success - only scores from exams do. These trends are not just unique to my school. Cars continue to burn fossil fuels despite the median of 68% of people who see climate change as a threat (Fagan & Huang, 2019). In order to align student attitude with behavior, cities must implement project-based learning to motivate students and promote partnerships to create a generation of environmental stewards.

Project-based learning would motivate students to pursue their passions to solve problems in an urban setting. Cities face a slew of issues ranging from climate change to violence. Knowing the skills to address these problems is vital to reinvigorating both social and ecological urban spaces (Russ & Krasny, 2017). Traditional education causes intrinsic motivation to “drop between grades 3-9” (Tohidi & Jabbari, 2012). Project-based schools, like The High Tech Schools in Southern California, stimulate intrinsic motivation. These schools help driven students identify and then address an urban issue. Cities must follow the lead of these schools as increased intrinsic motivation results in higher completion rates and ultimately change in a city (Fukuzawa, Boyd, & Cahn, 2017). By using The High Tech Schools as an indication that project-based learning leads to greater intrinsic motivation, cities must encourage this system’s use to grow future change-makers.

Project-based learning encourages partnerships with local governments who facilitate opportunities for students. Urban classrooms do not expose students to real life situations, only textbooks. However, in a project-based system, teachers, who understand the attitudes that cause student action, must collaborate with local, urban governments. In Birmingham, UK, education meetings began to include head-teachers to indirectly give students a voice (Hatcher, 2014). Birmingham’s meetings soon began to address the issues of society while giving students a platform to speak. Partnerships like this can encourage student-driven urban projects. With hopes of citywide implementation, students would create a design plan to address the issue. UNESCO’s “Whole School Approach” emphasizes “school governance and cooperation with partners” to provide opportunities (Sachs, 2016). While UNESCO’s approach may be radical as it overthrows conventional education, it highlights the value of environmentally enlightened students.

Cities must act unconventionally to prepare their youth for the uncertainties of climate change. Traditional education has yielded success for generations but as the problems cities face evolve at unprecedented rates, traditional education will not work. We must design ways for students to think out of the box and creatively. Project-based learning is the spark our education system needs. Environmental education spearheaded by project-based learning must be implemented to unlock each student’s potential to assure a sustainable future for ourselves and our loved ones.

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LEARN FROM YOUR SURROUNDINGS

*project-based
learning*



Immerse in green: Make parks more attractive

Yiyao “Andrew” Wang, Jinling High School American Division, Nanjing, China

In *Last Child in the Woods*, Louv points out that a nature-deficit disorder is influencing nearly every human being, which may result in a wide range of behavioral problems. According to the International Union for Conservation of Nature (2012), there are more than 4,000 national parks and numerous public urban parks around the world -- though with ample access to greenery, people often choose not to immerse themselves in it. In order to encourage a more diverse population to use public parks, physical and cultural improvements must be made.

Humans' connection with nature is becoming weaker and weaker. A study shows that the percentage of nature-related words in fictions and lyrics went through a significant decline in the past 90 years (Kesebir & Kesebir, 2017). However, 70% of people in large cities in the United States have access to parks within a 10-minute walk (McCabe et al., 2018). Madge (1997) proposes a possible reason through the notion of the “geography of fear”, which means that some women and minorities do not feel safe in public parks because of a fear of sexual or racial attacks. Moreover, the monotonous greenery does not convey any historical or cultural values, making it hard for people to form an emotional bond with nature.

To make people feel safer in parks, more street lamps need to be installed and people should have easier access to contact the police. Biologically speaking, humans have a fear of the unknown. As a result, lighting up parks by street lamps gives pedestrians a sense of safety. Other than that, people need to have someone to ask for help, in case they are in danger. The rest of the world can learn from the practice undertaken by Cornell University – the Blue Light System. Made up of about 950 blue street lamps, the Blue Light System provides safety to people on campus by letting them contact the police for help within a simple press.

Moreover, mere greenery does not emotionally resonate with people, so historical and cultural values should be represented with visualizations in parks. African Americans, Latinos, Native Americans, and other minority groups are often underrepresented as park visitors. Urban designers can provide information about the past of the park: what was this piece of land used for, who used to inhabit this place, or how human activities have influenced the area. Knowledge like this creates a sense of place, the interaction between physical and social environments, from which people would have a personal connection with the places (Campelo et al., 2014). On top of that, visualizations of local climate changes can also be developed so that people can gain personal connections with nature (Sheppard, 2015) – it not only strengthens environmental awareness, but also motivates people to appreciate the beauty of nature.

After improving the physical condition and enriching the historical and cultural connotations of public parks, people would be more motivated to visit them. In this way, the coming generations would form a strong bond with nature.

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People need more...

<https://pixabay.com/photos/park-path-bench-trees-grass-lake-335565/>



<https://www.flickr.com/photos/davidberkowitz/3692427372>

*Promote
urban culture*

*Save
precious history*



<https://www.panpacificseattle.com/blog/story-behind-gas-works-park/>

Saving the world one click at a time

Giselle Dalili, MEF International School, Istanbul, Turkey

Earth is experiencing more environmental crises than ever before. Social media (SM) has become an important part in humans' urban lifestyle and can aid our issues by enabling efficient and cheap advertising, instant global communication, and erasing geographical barriers; all supported by psychological theorems. Nonetheless, there are still many drawbacks, one being the current egotistical culture it encourages. Increased presence of environmental action groups with the help of lower advertising costs on SM can construct collaborative virtual communities that prevent environmental issues.

The psychological aspect of SM exemplifies its efficacy. Statistics show that although many people have high awareness of urgent situations (Robelia & Murphy, 2012) action remains low (Laurian, 2004). This is due to the bystander effect (Garcia et al, 2002), which can be counteracted by having media applications advertise groups focused on pragmatic actions and ideas. These online societies will drive people to act thanks to Group Motivation theory (GMT). GMT states that an individual is more likely to do something if a group is doing it. Therefore, most people who view these advertisements will be urged to organize and/or join one, ultimately escalating humanity's ecological efforts.

SM fosters awareness of virtual communities, thus increasing action efficiently and inexpensively. Advertising via SM is more cost-efficient than any other form of broadcasting, and public mandates for decreased advertising costs provided by SM companies will make it even more economical. This way, these organizations' unused advertising expenditure can be reallocated towards future projects, further supporting sustainability. Moreover, SM applications are constantly gaining accounts so SM advertising is more effective than traditional media. Research exhibits that SM can increase audience size for organizations' sustainability officers (Carpenter et al, 2015). SM facilitates a space where individuals can easily and instantly share data to large audiences, hence more manifestations of people's online activism.

Although increased action via SM seems direct enough, it is still flawed. The intentions of some 'environmentalist groups' could be questionable and this system is the perfect petri dish for trolls to dilute the visibility or legitimacy of well-intentioned communities. However, a verification system can filter out malicious parties. Regulations should be implemented that force the capital for this to come from the SM companies themselves rather than governments.

Overall, lowering advertising costs for authorized environmental groups to advertise through posts and stories and therefore promote the creation of online environmental communities is an adroit solution for the lack of action on environmental sustainability problems.

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“Illegal” environmental art education

Jessica Rampersaud, Eastchester High School, Eastchester, New York, USA

In low-income urban communities, there is an obvious disparity in both the quality and access of education and resources. In urban regions of the world, many young people are not introduced to equal academic and social privileges compared to more affluent neighborhoods. A low-income region is defined as minority, urban cities that lack fair and equal resources in comparison to wealthy, predominantly Caucasian environments (Gordon et al., 2011). In the face of educational inequality, environmental art can influence a city's interest and action in its local environment (Jacobson, McDuff, & Monroe, 2006). Environmental art has the power to generate diverse ideas surrounding social-ecological influences and is accessible to everyone through public urban spaces. In spite of stigmatized urban art forms such as graffiti and murals, increased exposure to urban eco-art can address a lack of environmental education in low-income cities by promoting environmental responsibility.

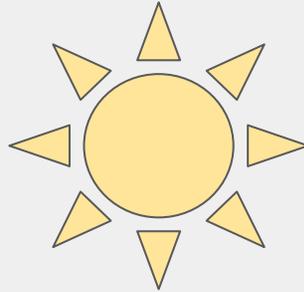
Environmental art has the potential to expose the true nature and underlying ecological issues that impact the residents of particular urban cities. In Ghana, the painting of environmental murals translate the ecological impacts of air, water and land pollution to the city's inhabitants. Participating, as well as enjoying these murals that depict scenes of the degraded environment, served as a lasting message of overall environmental responsibility and self-reflection (Opoku-Asare, Gyekye-Ampofo, & Yeboah, 2013). Once aware of their weakened and polluted environment, the people of Ghana were moved to act and take notice of their environment. Similarly, urban cities can institute their own eco-art to shed light on their local and contaminated environments, especially in neighborhoods experiencing food deserts.

Food deserts occur in low-income neighborhoods where it is difficult for residents to access fresh produce. Evidence has shown that there is a disparity between neighborhoods based on race and socio-economic status, with less access to supermarkets, bakeries, and fruit/vegetable markets (Gordon et al., 2011). Despite this inequality, with additional exposure to non-traditional forms of education including environmental art, people can expand their knowledge and take action.

Eco-art enables environmental education in a personal and empathetic way (Boeckel, 2007). Shifting focus from the specific science, data, and technicalities of climate change or environmental science education, eco-art appeals to people of all ages in a more emotional way. Environmental urban art forms have the potential to translate images of the root causes of ecological distress and can identify the true inequalities between the availability of resources in low-income cities and more affluent communities. The promotion and establishment of eco-art can be a key component in transforming the way humans behave and interact with the environment. Eco-art opens both the educational and creative doors that spur environmental interest and action in cities.

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ENVIRONMENTAL ART



Bridging the gap between human and birds

Bohan “Jason” Zhang, Shenzhen Middle School, Shenzhen, China

Human activities at Shenzhen Bay greatly diminish birds' biodiversity, impacting the ecological functions of the whole region. Hence, urban managers agree that bird species in the Shenzhen Bay area need timely protection, especially changing visitors' destructive behavior through publicity. However, it does have several difficulties when implementing it: Funding and mentor's deficit issues need to be addressed; More importantly, adult visitors are often indifferent about the issue, and children, though curious, lack the necessary environmental knowledge. Even so, the innovative three-stage procedures, which will be discussed later, can close the gap between citizens and precious bird species, cultivating citizens' environmental literacy from the perspective of wildlife.

Public advocacy for the promotion of bird conservation has its sufficient environmental and social causes as well as natural advantages due to birds' special ecological and recreational function. Wetlands, including Shenzhen Mangroves, can contribute massively to biodiversity within a landscape (Flinn, Lechowicz, & Waterway, 2008), following by the fact that wetlands are among the most threatened ecosystems on our planet (Lambert, 2012). The features of birds are equally important: As the most common wild animal near us, birds not only have a cute figure but also play as the major contributors to the wetlands' biodiversity. In this case, this rarest sanctuary on the migratory route of international migratory birds attract tourists and lay a good audience foundation for public advocacy.

On the basis of audience, local NGOs can provide financial and voluntary assistance for public promotion, and are critical as implementing agencies of conservation programs and projects (Gordon, 2006). Though tourists in Shenzhen Bay appreciate birds, they don't have the determination and duty to protect them: they are generally absent or disvalued. Therefore, it is necessary to lead a cognitive fix that changes their attitudes and behaviors (Heberlein, 2012), which demand funds and instruction. Cooperating with local NGO, the Shenzhen Mangrove Conservation Foundation, is a very suitable choice: they have a better understanding of the indigenous ecological situation, and the strength to raise money and volunteers. Its trained mentors, particularly, can make the advocating flow smoother.

Although the advocating process is hindered by the audience of different ages, it can be effectively tackled through “fostering interest, promoting engagement, and guiding acknowledgment” procedures. It is remarkable that most people come to visit Shenzhen Bay in family units. Therefore, Three-stages activities play a crucial role on it: providing introductory touring of birds near the coast to attract people's attention. Then, holding engaging activities for kids like bird drawing competition to let them build deeper connection with birds while grabbing parents' concerns. Finally, proposing the purpose and determination of protecting bird species. At this moment, the resistance of advocacy is minimized, making it possible for the visitor collective to participate in public advocating event.

Although the undertaking of bird preservation in Shenzhen Bay is just getting started, we can already see the feasibility of protecting birds through advocacy. With the help of persistent publicity, the grand bridge between humans and birds can be made, guiding to the true ecological harmony.

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BIRDS NEED MORE CARE

Wetlands are considered to be one of the most threatened ecosystems in the world. Birds within them are particularly at risk due to anthropogenic behavior. Higher social transparency and advocacy could work, as it will be in Shenzhen Bay.

Snipe, shorebird
Photograph by pxhere.com



Loss of cultures from our plates

Vedant Agrawal, Neerja Modi School, Jaipur, India

Today, one of the reasons young people are losing touch with their cultures is the unavailability of fruits and vegetables to cook native dishes. Food is not only a unit of consumption to satiate appetites, but also a means of expressing one's culture and a medium of communication from within one's soul. Rapid urbanization and widespread globalization have caused individual species of fruits and vegetables to be homogenized by methods of genetic modification and artificial selection. These processes have resulted in a loss of numerous species of produce, causing a loss of food dishes which may represent one's culture and identity. Young people need to engage in activities such as rooftop farming to prevent the loss of their identities and links to their cultures. Even though numerous people in cities are following the trend of rooftop farming, this has been to promote urban ecologies and as a safeguard against unsafe agricultural practices, and not with the primary objective to maintain a diverse variety of produce. The youth, who find rooftop farming a fruitless utilization of time and socially unacceptable, must actively engage in an attempt to keep alive their cultural ties. Rooftop farming, with the aim to maintain cultural diversity, needs to be popularized among the youth by using community-involvement projects, collaborative and social learning, and positive youth development.

In order to get the youth involved in an initiative to maintain cultural links, schools would need to shift from information-based to practice-based designs of environmental education, such as developing and maintaining a school garden. Working autonomously over extended periods of time on such practice-based designs, which facilitate collaborative learning, will help in motivating and involving students actively in the learning process (Laal & Ghodsi, 2012). Students can then be motivated to create rooftop gardens in their homes. Using a specific selection of seeds that have not undergone genetic modification and artificial selection is key to maintaining diversity of species of fruits, vegetables, and spices. This will thus allow the youth to connect to their cultures by being able to cook native dishes using specific ingredients.

Organizing social events related to rooftop farming such as seed exchanging meet-ups and workshops may help popularise rooftop farming by collecting larger groups of participants, who may attend with the purpose to network and socialize with peers. Functioning as community gardens in large residential buildings, rooftop gardens can increase social interaction between participating peers contributing to social cohesion (Sia, Kua, & Ho, 2019), creating a sense of togetherness, knowledge about and understanding of each other's cultures, and deeply rooted respect for diversity.

Reconnecting with one's culture by enabling one to cook oneself's native dishes using a diverse variety of fruits, vegetables, and spices and learning and thriving in diverse settings will help define assumptions of positive youth development among active participants (Damon, 2004). Strengthening weakening links with one's culture via rooftop farming will not only help maintain one's unique identity, but it will also help strengthen intercultural ties. Developing this sense of community will aid build a truly resilient city.

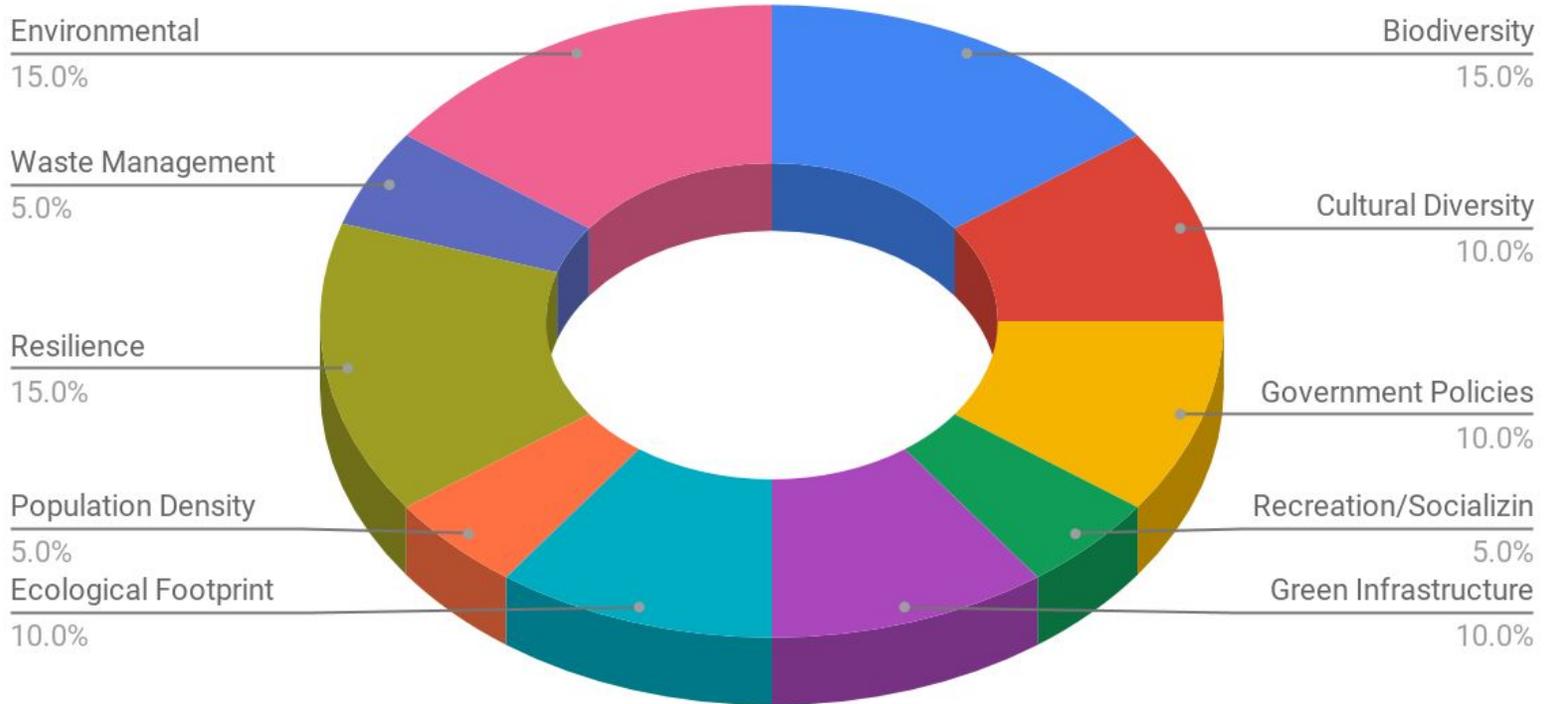
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“Food is not rational. Food is culture, habit, craving and identity.”

- Jonathan Safran Foer



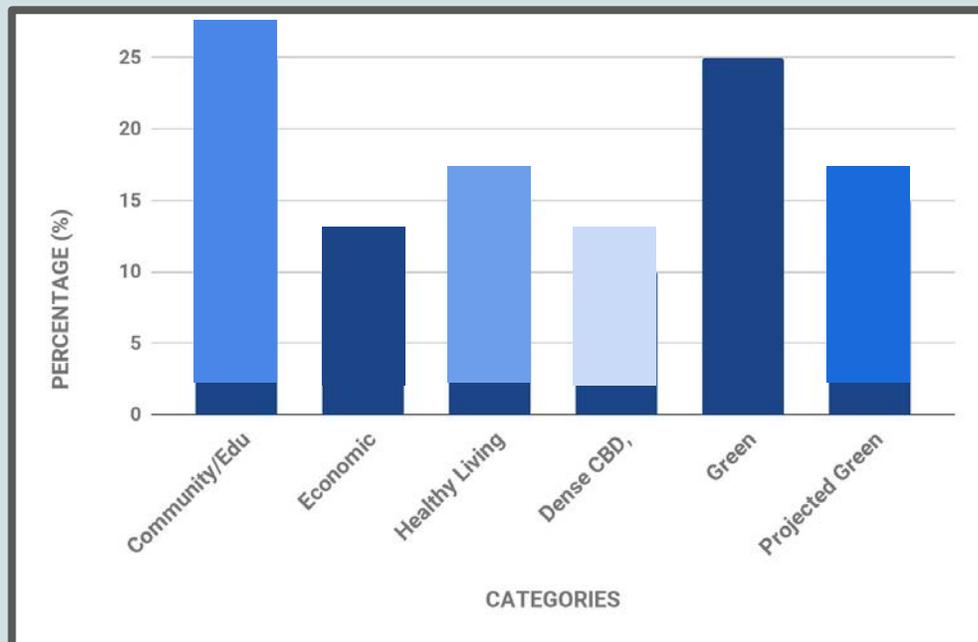
Biophilic Cities Ranking



Developed by: Joshua Cai, Dylan Fu, Fanshun Shi, Yiyao Wang

- Biodiversity (15%)
 - Quantity of species
 - Quantity of biomass
- Cultural Diversity (10%)
 - Quantity of immigration
 - Cultural mixing
- Government policies (10%)
 - Environmental-friendliness or restrictiveness of regulation
 - Justice/equality
- Recreation/Socializing spot (5%)
- Green infrastructure (10%)
 - Percentage of green spaces: quantity and quality
- Ecological footprint (10%)
 - Carbon emission and footprint
- Population density (5%)
 - Quantity of people
- Resilience (15%)
 - Ability to recover from major change
- Waste management (5%)
 - Water and garbage disposal and treatment
- Environmental education/youth education (15%)
 - Courses availability

BIOPHILIC CITIES RANKING FOR URBAN SUSTAINABILITY



- 1. Community & Education (25%)**
 - a. Plant locally sourced fruits and vegetables in community gardens/public spaces
 - b. Early green education and environmental clubs with youth leaders
 - c. Diverse demographic (Integration and equality of all races/gender/socio-economic identities)
- 2. Green infrastructure/ Transportation & Accessible Green Spaces (25%)**
 - a. Public transportation and opportunities to safely bicycle or walk
 - b. Efficient clean energy
 - c. Parks and gardens within a walkable distance with native flora and fauna
 - d. Connects community and creates a sense of unity
 - e. Able to sustain and recover from extreme climate events
 - f. Green spaces that reflect the values of the community
- 3. Healthy Living Conditions (15%)**
 - a. Access to clean water, air and healthcare
- 4. Projected Green Development/ Governance (15%)**
 - a. Ongoing projects and communication between young adults and politicians on green issues
 - b. Potential to be a carbon-neutral city
- 5. Economic Sustainability (10%)**
 - a. High employment rate and salaries; diversity of jobs; affordable living
- 6. Dense central business district, minimal urban sprawl (10%)**
 - a. Reduction of the use of personal autonomous vehicles

BIOPHILIC CITIES CRITERIA

I. Housing condition (10%)

- A. LEED certification
- B. Water conservation
- C. Availability of recycling options

II. Youth education (10%)

- A. Kids spending time outdoors
- B. Awareness of sustainable development

III. Green and public space (40%)

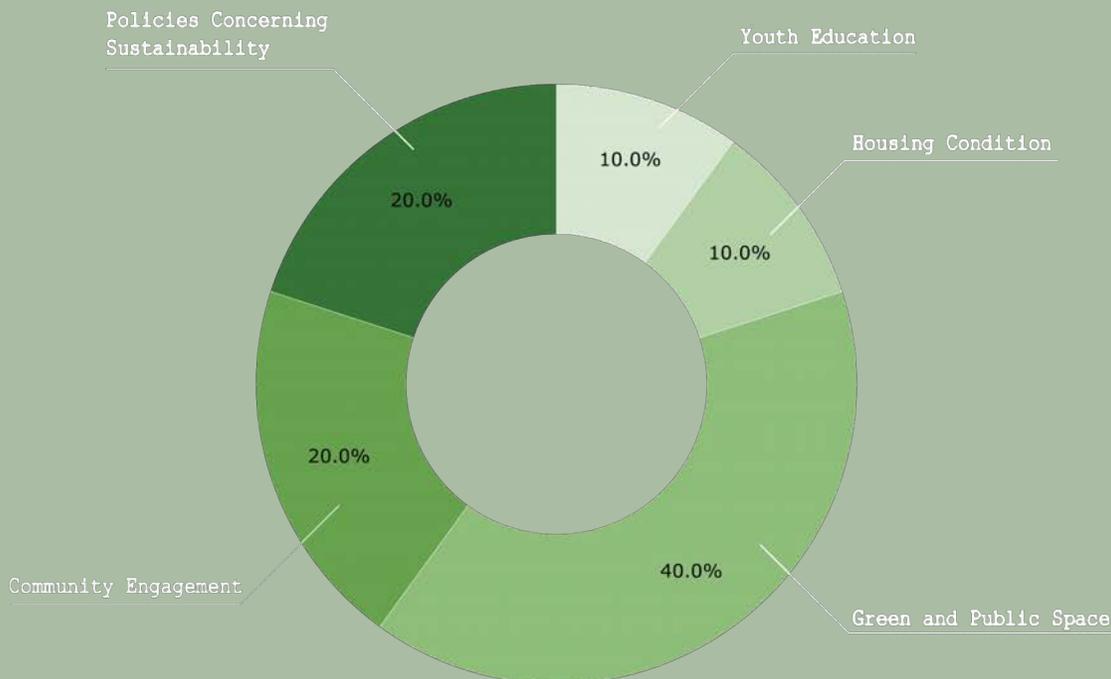
- A. Amount of green space per distance of road
- B. Unpolluted green space-- water quality, air quality, littering, etc.
- C. Amount of “urban wilderness”

IV. Community engagement (20%)

- A. Volunteering actions/community service

V. Policies concerning sustainability (20%)

- A. Supporting community engagement
- B. Subsidies for green enterprises

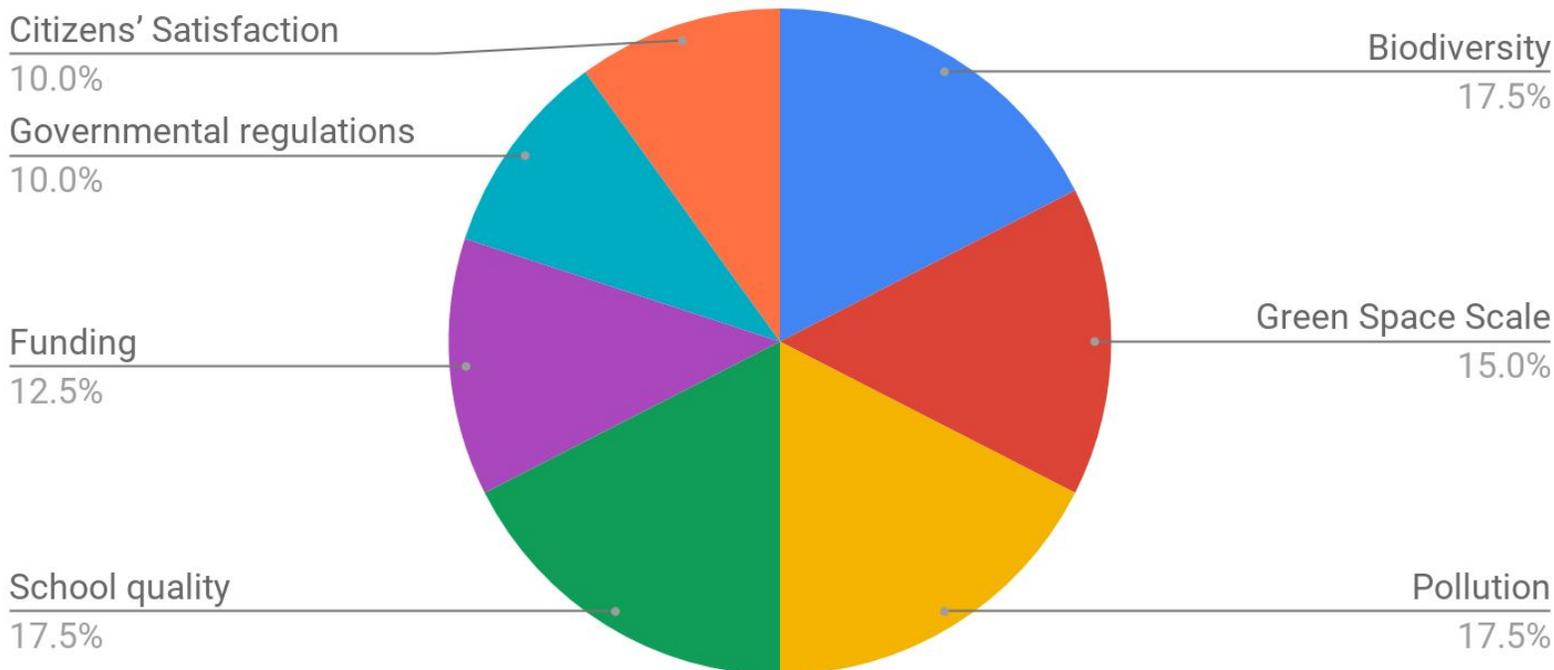


Yoyo Lu
Kevin Tang
Sammy Huang
Melissa Zhang



Sleepy Penguin Team
Green City, CUSC 2019

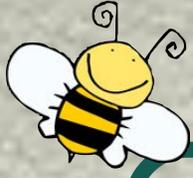
Biophilic City Ranking System



1. Biodiversity [17.5%]
 - a. Number of species
 - b. Population of organisms
2. Green Space Scale [15%]
 - a. Percentage of green space in city
 - b. Diversity of plants used
3. Pollution [17.5%]
 - a. Air quality, water quality, noise level, light production
4. School quality (Environmental Education) [17.5%]
 - a. Qualitative meetings with school directors and parents
 - b. Percentage of school time used for environmental education
 - i. Time spent in the wild
5. Fund in Environmental Maintenance and Restoration [12.5%]
 - a. The funding amounts by government and other organizations
6. Governmental regulations [10%]
 - a. Qualitative effectiveness of policies
 - i. How easy is it to create new policies and put it into action
7. Citizens' Satisfaction [10%]
 - a. Random survey on satisfaction of cities from a scale of 0-100



BEE-ophilic Living



Green space (20%)

*green roofs or green spaces,
and how much are they
visited*

Green Infrastructure (15%)

*Environmental Impacts
Sustainability Value
Level of leed certification for city*

Resource management (25%)

*Grey water,
recycling,
composting*

Community involvement(15%)

*Size and number of
community for public green
space*

Environmental Education (15%)

*Experiential/social
education(gardening,
hiking, etc)*

Urban Agriculture (20%)

*How much food is
produced within city
limits*



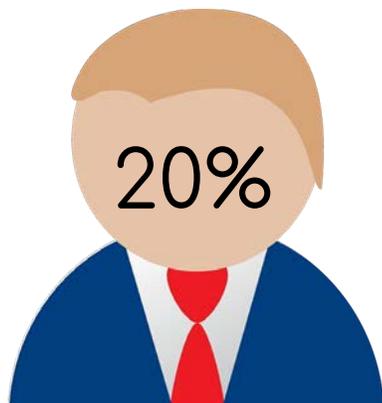
STANDARDS OF A BIOPHILIC CITY

Developed by Eric, Kristina, Zhiyue, Gabby



20%

CIVIC ECOLOGY ACTIVITIES



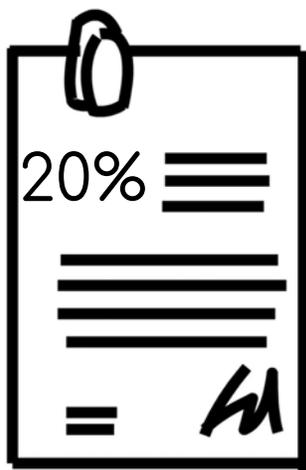
20%

**GOVERNMENT
POLICIES**



20%

EDUCATION



20%

**PUBLIC SUPPORT
OF BIOPHILIA**

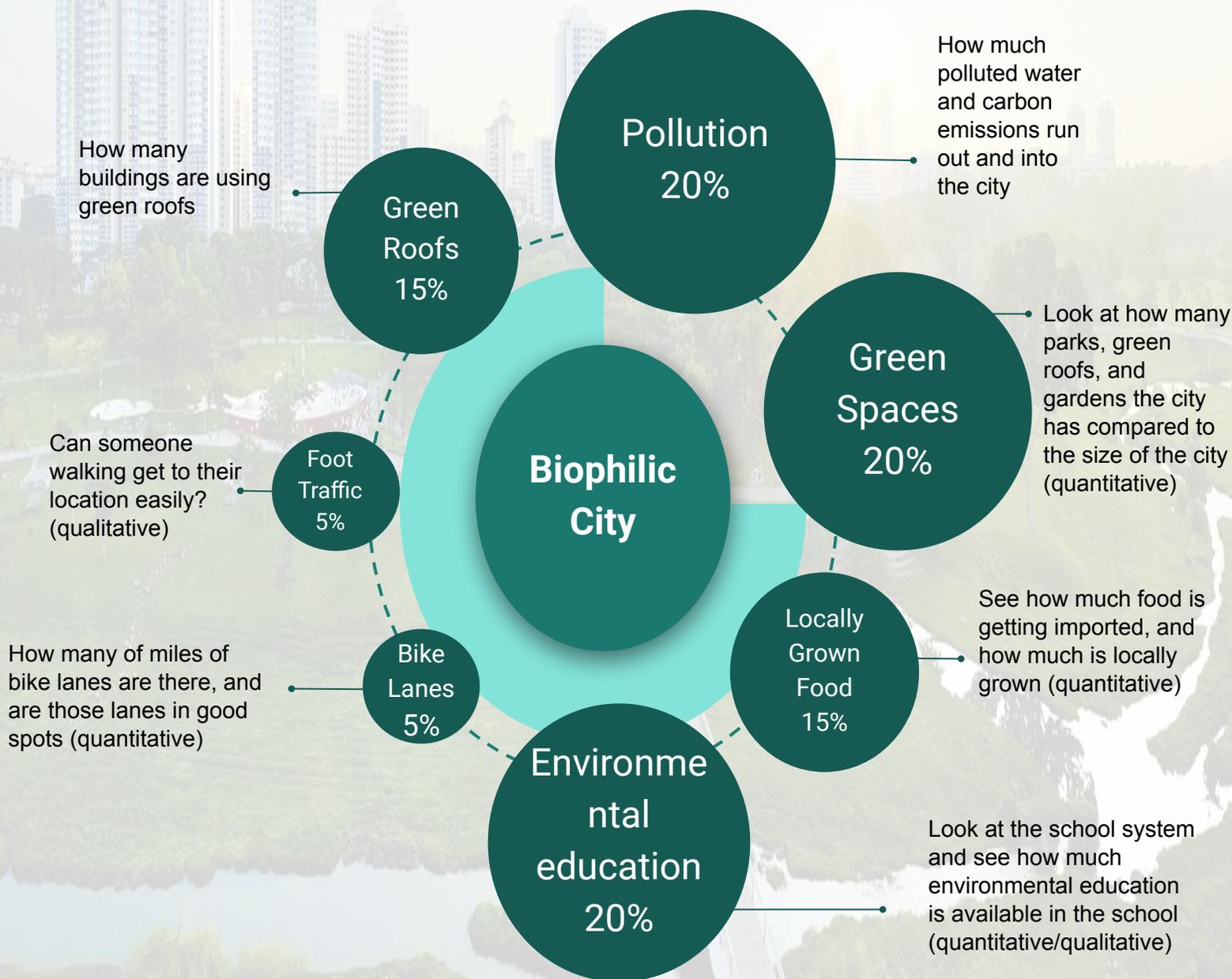


20%

**GREEN
INFRASTRUCTURE**



Biophilic Cities Ranking System



Jye Shang
Yi Hyun Kwon
Frank Xu
David Rogers

BASIC LIVING ENVIRONMENTS 60%

Water, air quality 25%

Area of green coverage 10%

The public transportation system 10%

Affordability and number of apartments 5%

Renewable energy proportion 10%

- ACCESSIBILITY TO GREEN FEATURES 20%

Access comfort level

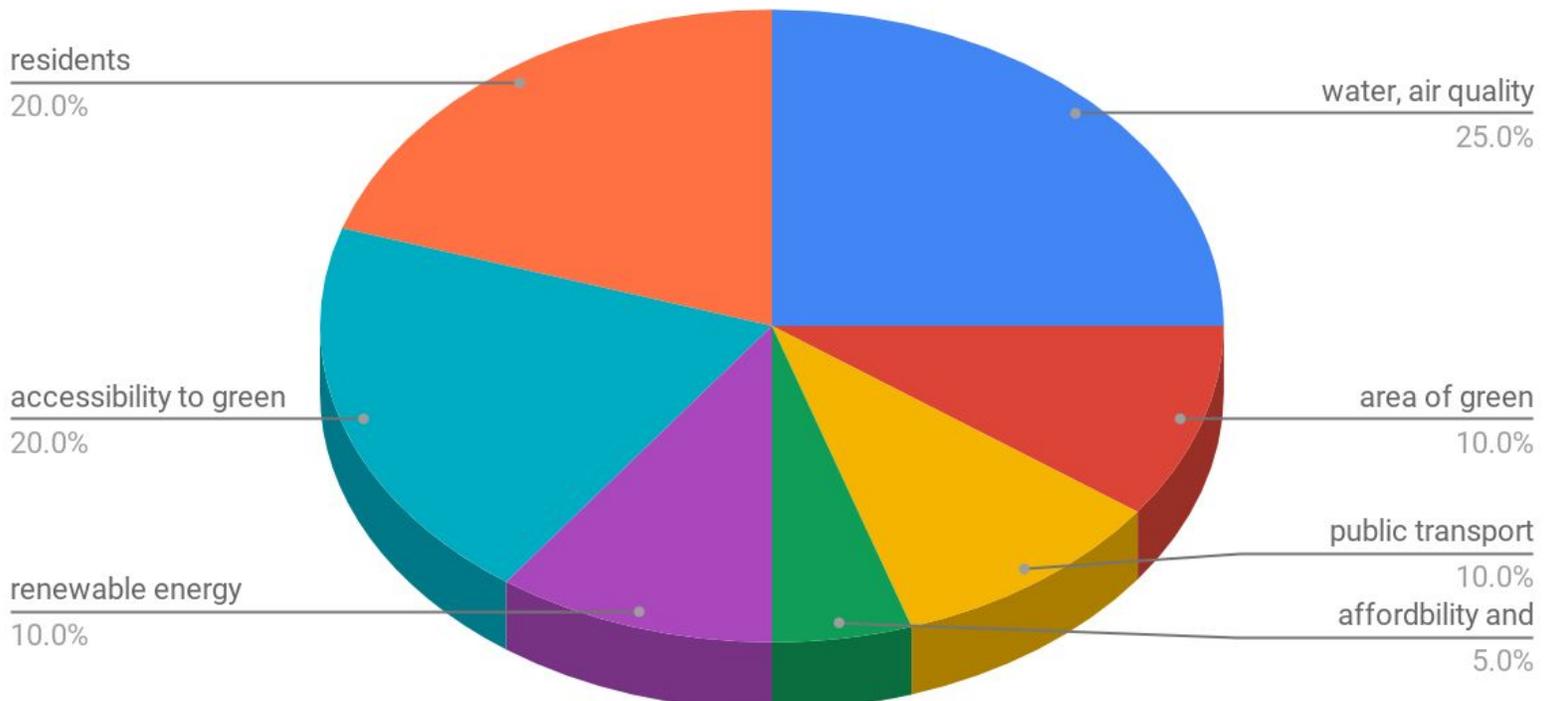
Density of green features in streets, communities, and neighborhood level

- HOW ACTIVELY RESIDENTS ENJOY AND PARTICIPATE IN THE NATURE AROUND THEM 20%

Non-profit organization Volunteering activities Policy support

“Go Green” ranking

Developed by
Rosie Sophie Chloe Jason





*Socio-cultural
environment
(25%)*

*Government
Regulations
(15%)*

*NGOs
(5%)*

*Green Space
Ratio +
Biodiversity
(20%)*

*Air & Water
quality (10%)*

*Disparities in
Education/
Awareness (10%)*

*Public
Transport
(10%)*

*Affordability
(5%)*

Branches For Success

*Developed by
HB, HJ, GD, RG*



Cornell University

Suggested reference:

Russ, A., Jorgensen, B., Li, Y. (Eds.) (2019). *Green Cities: Sustainable, Resilient, and Biophilic. Students' projects from the Green Cities 2019 course*. Ithaca, New York: Cornell University Civic Ecology Lab.