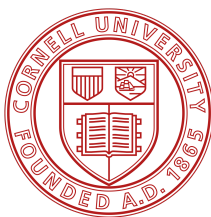


Green Cities

Towards a more
sustainable
and equitable
future



Cornell University

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

Cornell University Summer College, June 22 – July 10, 2020

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Disclaimer

All ideas and opinions in this book are students' own, and may not reflect opinions of the course instructor, teaching assistants, or Cornell University. Students are responsible for correct citations, acknowledgment of others' work, and proper use of copyrighted materials.

Suggested reference

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Student quotes

A green city is a balanced social-ecological system, where citizens, government, and nature are integrated and support one another, and it harnesses its existing natural and community resources to implement programs that make the city sustainable and livable for everyone.

– Sophie Newmark

Sustainable development in urban areas should focus not only on protecting ecological systems, but also on preserving a city's culture and fostering social capital among residents.

– Maya Thakor

Green city means that its citizens and government work together to integrate the city into ecological processes. In addition to the green infrastructure, it also includes environmental stewardship, and connecting all citizens to nature.

– Yuhang Du

I used to have a mentality of not taking environmental actions because my efforts seemed so small compared to global climate change. But I recognized that small strides are still strides towards more biophilic and eco-friendly cities.

– Lynnea Bao

I find that taking action as an individual, community, city, and country is really important to change the environment and foster social justice.

– Bolu Xu

My vision of green cities has changed to accommodate the social aspects of a green city, rather than just the infrastructural and environmental elements. The process of making a city green requires civic action, and not just top-down policies.

– Emma Carter

I learned that green cities not only benefit the environment, but also have tremendous social effects. I realized that green cities can unite a community, encourage reciprocity, and increase well-being of individuals.

– Michael Fischgrund

My vision of green cities is a place where nature and humanity meet in the middle. There are parks and rivers everywhere, and people feel a strong sense of attachment to their home. Every place is improved ecologically and socially, and the city produces very little carbon emissions.

– Reid Vaughan

Green cities should have a community mentality towards preserving the environment, and collectively making choices that benefit urban and global ecosystems, and all urban residents.

– Alexander Grim

What stuck with me the most from this course is the extent to which community collaboration is essential to achieving all aspects of a sustainable and green city.

– Inga Gous

People from all walks of life can contribute to improving their cities, both from environmental and social justice perspectives.

– Akanksha Basil

Even the most sprawling, concrete-filled urban metropolis is inherently an ecosystem of human connections. By grappling with how to build green cities, I've come to better understand how connected humans are to the nonhuman world, as well as how closely tied sustainability is to social justice. You can't fight for green cities without also fighting for equitable and inclusive cities.

– Esther An

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Introduction

The world's population has recently transformed from mostly rural to mostly urban. Billions of people call cities their home. In cities, urban residents hope to take care of their families, enjoy time in green spaces, meet friends, access quality education, find gratifying jobs, get equal social opportunities, experience diverse cultures, obtain good healthcare, and take action to improve the urban environment.

However, rapid urbanization creates unprecedented social and environmental problems that influence human well-being and threaten global sustainability. Yet cities can address social-ecological problems by advancing civic participation, environmental policies, environmental governance, green infrastructure, education, and ecosystem management. Various frameworks describe our efforts to create a more just and sustainable urban future – including green urbanism, biophilic cities, smart cities, and resilient cities – which we collectively refer to as “green cities” frameworks. These frameworks and related research help us understand, analyze, and create sustainable, livable, just, resilient, and biophilic cities that contribute to the well-being of all people in and outside cities.

This book presents projects of students who participated in the Green Cities course, and who explored how to advance green cities while addressing environmental and social injustice. This course, organized by the Cornell University Summer College, was taught at Cornell University in summer 2020 as an online course. More than 20 students worked in small groups to identify and describe the values that should guide the development and aims of green cities. Described in Part I of this volume, these urban values include: equality, environment, nature, community, health, and infrastructure. Furthermore, students worked individually to investigate solutions for specific urban social-ecological issues of their interest. These research essays are found in Part II.

The course teaching team (instructor and TAs) hope students will use their new understanding of green cities to inform their current and future environmental actions in their own cities to improve the lives of all urban residents and enhance urban ecosystems.

Part I

Values that guide green cities

Equality

Inga Gous, Nanxi Fang, Sophie Newmark, Yanni Pang

When thinking of a sustainable city, solar panels, public transportation, and parks might first come to mind. However, without equality, the privileged members of the community are the ones to most enjoy the benefits of this sustainable infrastructure. Justice, empowerment, and education must be indispensable considerations in the planning of a truly sustainable city.

Achieving environmental justice is essential to make a city sustainable and equitable. Environmental injustice means people of lower socioeconomic status or oppressed people do not experience the benefits of a green urban environment. The concentration of waste sites in predominately minority or low-income neighborhoods is an example of this discrimination (Mohai et al., 2009). The enforcement of environmental policies such as the Environmental Justice Act could be a plausible remedy. This act would prevent constructing the majority of landfills near African-American communities, guaranteeing the health of people regardless of color or socioeconomic status. It would also lead to health benefits, since polluting facilities cause asthma and pose other health hazards for nearby residents.

Enabling true participatory governance through a polycentric government in cities is an effective way to empower people to make a difference in their communities. The Stockholm Resilience Center (2019) describes a polycentric government as “supportive collective action with open decision making which decreases vulnerability to tension.” Encouraging citizens to voice their opinions, and more importantly, listening to them, helps people trust their government, their community, and their ability to make change. The empowerment of citizens starts with the opportunity to take part in community projects, such as a local farmer’s market or community gardening plots. It is most important for citizens to feel connected to their environments, whether they be social or ecological. Citizens who feel connected to their surroundings tend to get more involved in their communities.

Education is another important value to better build a sustainable city, listed by the United Nations as Sustainable Development Goal 4 (United Nations, 2019). By applying equality to education, more people will be educated, and more benefits will be shared by human society writ large. Many schools have environmental clubs now, providing students with a place to discuss current environmental issues. Media is also a good way to inform people of our living environment. If all people, regardless of gender, class, age, or ethnicity, were equally educated about the environment, they would act more consciously to protect our Earth and make a more sustainable and livable planet.

Imagine a city in which every citizen has equal access to resources, every resident's voice can be heard, and every individual is educated about the environment they live in. This is a community that can go forward in planning a sustainable future for everyone.

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Environment

Michael Fischgrund, Bolu Xu, Haoran Yang

As the process of urbanization continues globally, the percentage of the world's population living in urban areas is likely to increase from 55% to 68% from 2018 to 2050 (World Population, 2018). Cities also produce around 60% of the world's greenhouse gases (Cities and Pollution, n.d.). As cities keep on growing, emissions will rise even more unless something is done. Thus, in order to preserve the environment, scientists have come up with concepts such as planetary boundaries, ecological footprints, and carbon zero – which can guide environmental protection in cities.

Planetary boundaries are composed of nine areas that we cannot exceed or else our world will go through detrimental changes. Four of the nine boundaries have already been exceeded, including climate change and loss of biosphere integrity. One area that has not yet been crossed is ocean acidification. These boundaries set the metrics for a safe operating space, which can greatly impact the decision-making of leaders as times goes on (Steffen et al., 2015). Cities should help our society stay within these boundaries to protect the global environmental system.

Cities and other settlements have a responsibility not to consume more than our planet can produce. An ecological footprint is the total amount of land and water ecosystems needed to produce the resources each person needs to sustain their lifestyle (Ravi & Subha, 2013). For example, the area of forest needed to produce the paper one uses and the cropland needed to produce the food one eats are both components of a person's ecological footprint (Ravi & Subha, 2013). It is crucial for individuals to reduce their ecological footprint because as the world's population increases, the world will eventually run out of resources to provide. Simply shutting off the lights when one leaves the room, taking shorter showers, and eating a plant-based diet can dramatically reduce one's ecological footprint.

Having specific goals, like reaching carbon zero, can reduce a city's ecological footprint. Reaching carbon zero is when there are no carbon emissions produced, either by eliminating carbon emissions altogether, or removing the same amount of carbon as the amount produced (Rott, 2019). Cities produce 78% of the world's energy, so if they switch to renewable energy, carbon emissions would be significantly decreased. Since plants absorb carbon dioxide, green roofs, green walls, and city gardens could also lower emissions by reabsorbing greenhouse gasses. Additionally, getting to carbon zero requires the efforts of individuals. Driving less, walking and biking more, and hang-drying clothes are all ways individuals can help. Cities are full of people and require tons of energy; they have a substantial influence on the world's greenhouse gas emissions. It takes the individuals, communities, and leaders of cities to truly make a positive impact on the environment.

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A CITY'S GUIDE TO PRESERVE AND PROTECT THE

ENVIRONMENT



PLANETARY BOUNDARIES

- Guides cities in the right direction by telling them the environment's limits
- Tells us what cannot be exceeded, to help us preserve the environment



ECOLOGICAL FOOTPRINT

- A way to measure people's impact on the environment
- Tells people how much land/water needs to be used to sustain their way of life, so they can reduce the consumption of resources in their cities



CARBON ZERO

- A specific goal cities can reach to help preserve the environment
- Guides cities to integrate more green and renewable infrastructure

Nature

Cheng Zhang, Yuhang Du, Alex Grim, Qiaosen Huang

When we think about nature, we imagine ourselves shrouded in trees and running water, but living in urban areas, it is hard for us to relate “nature” with “city”. However, the fact is that people need nature to be tightly related to their daily life for their mental and physical well-being, and so do other organisms. Therefore, it is extremely necessary for people to realize the value of nature and take actions to protect the environment.

City residents can experience nature deficit disorder, which is caused by a severe lack of time in nature and has many negative health effects which can include childhood obesity, declined adult immune function, reduced lifespan and increased disease (Frances and Kuo, 2013). Nature can treat many human psychological and spiritual illnesses, and helps humans release stress. Not only can nature treat nature deficit disorder (Frances and Kuo, 2013), but it can protect animals in cities. People need diverse nature in the city because different plants attract different kinds of animals, insects, and birds and add more vitality to the city. Green roofs also provide aesthetics, cool down the area and benefit people psychologically in urban areas. Even when green roofs only act as visual relief, the benefits may include relaxation and restoration, which can improve human health.

A related question is how do we get people to value nature? The solutions include a “technological fix”, which solves a problem with technology, a “cognitive fix”, which uses information to change people’s attitudes, and a “structural fix”, which alters the social environment so people adapt and change their behaviors in response (Heberlein, 2012). Technological and cognitive fixes have been deemed to be ineffectual given examples such as how New Deal Dams failed to solve flooding in Topeka, Kansas and the U.S. Geological Survey’s floodplain maps were ignored and people “discounted the map’s validity” (Heberlein, 2012). A structural fix saw success in this case after a simple policy indirectly changed people’s behaviors. In order to change the public’s attitude and behavior regarding nature, cities must implement similar changes

Understanding the value and benefit of urban nature, preserving nature is equally as important if not more important to cities. It is certain that nature is harder to maintain in urban areas than in the countryside, but it’s also achievable in relative degrees. As Alvey (2006) argues, there is a large amount of evidence showing that biodiversity in urban and suburban areas can also be at a high level. One effective way adopted by numerous cities is called an urban forest. Urban forests contain any greenery in every little corner of a city, including trees along the sidewalk, city parks, or gardens in the corner of streets (Alvey, 2006). Imagine a city as a sophisticated model, the urban forests as the glue to fill in empty space, connecting each part of the city.

No matter where you live, cities or villages, nature is vital for humans. Everything people need in life is taken from nature. People who work in cities have many stresses, so nature in the city is extremely valuable for helping heal them physically and mentally.

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What?



Urban nature,
parks, biodiversity



Green roofs, green
infrastructure

How?



Green
technologies



Regulations



Environmental
education

Why?



Mental health,
connection to nature

Community

Lynnea Bao, Akanksha Basil, Esther An

Numerous environmental dilemmas, including climate change, stem from human development. The roots of the overarching climate crisis lie in a global socioeconomic design that enforces a systemic web of environmental injustice and racism. This has led not only to mass environmental degradation but the oppression of minorities and low-income people. In order to properly address current environmental injustices, urban planning must prioritize community and participation by focusing on the values of social capital, diversity and inclusion, and empowerment.

The social pillar of sustainable development is often seen as the weakest, as people tend to focus only on their self-benefit, ignoring the needs of the “other.” Strengthened social capital allows for better democracy and more progress as people learn about other perspectives and experiences, enabling them to advocate for spatial equity and equal accessibility (Selman, 2001). The value of a sustainable city lies in its ability to serve everyone. Growing interpersonal relationships makes it more likely for people to learn how green space can benefit others and why individual participation is essential for representation in urban design.

An emphasis on community is critical also because it can drive city planners to properly address and incorporate the inherent human diversity of urban centers. Urban design should, at its core, be a democratic process—the heart of a city lies not in its inanimate buildings but the people who live in them. Simply put, effective planning requires meeting the unique needs of all socio-cultural groups in a place (Burayidi, 2015). Environmental injustice in the U.S. must be viewed in context of the historical exclusion or “conquering” of minority communities: city planners have an ethical responsibility to reach out to marginalized groups to hear and appropriately address their needs, potentially by regularly hosting community workshops or events. Creating these inclusive spaces can enable diverse voices and perspectives to contribute to the planning conversation.

The formation of community depends largely on individuals’ beliefs in their own agency. Communities can come together to spearhead sustainable development only when social and emotional factors are being addressed (Ghai, 1994). These factors, ranging from mental state to poverty, have a significant impact on a person’s ability to take initiative. Therefore, urban planners must prioritize empowering previously marginalized communities. Local reformers must facilitate connections with those in their community to understand the people they will be encouraging to lead. Communities that feel understood can successfully involve themselves in leadership processes and problem solving, which in turn can bolster self-esteem and empower future generations of leaders. These leaders will follow in our footsteps to better the world around them, keeping in mind that the building of equitable and sustainable cities requires strong social capital, the inclusion of residents in the planning process, and the empowerment of community members.

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Sustainable Community Development

Strong social capital

Interpersonal connections equal empathy and connectivity.



Inclusive outreach and planning



Participation of all community members in planning leads to the creation of diverse landscapes that meet everyone's needs.

Community empowerment

Attention, leaders!

What are steps to empowering your community?

1. Connect with those around you.



2. Facilitate their involvement in reform, help them solve problems, and empower them!



3. With your support, the next generation of empowered reformers will rise!

Social and emotional needs come first!

Social justice issues are connected to environmental issues! Both must be addressed together!



Health

Emma Carter, Susannah Smith, Maya Thakor, Elizabeth Tolrud

Unhealthy behavior can produce a positive feedback loop. For instance, unhealthy eating can lead to weight gain and the development of weight-related diseases. However, cities can work to halt these vicious cycles. For green cities to maximize health, urban communities should prioritize walkability, locally-grown food, and green spaces.

Urban planners should prioritize walkability to enhance residents' health. Key aspects of walkability include short and aesthetically pleasing blocks, safety, and clean air. By making it easier for citizens to walk, cities can promote exercise, which contributes to better physical and mental health. Furthermore, walkability encourages residents to engage with their environment, which may translate to a heightened sense of environmental consciousness (Lo, 2009).

Locally produced food is another way to improve a city's health. Americans consume less than $\frac{2}{3}$ of the recommended amount of fruits and vegetables, which makes them more susceptible to disease (Wilkins et al., 2014). To combat this, community supported agriculture (CSA) gives shareholders locally-grown produce to support a healthy diet. Historically, CSA participation targeted middle-income consumers, but 83% of CSA farmers now explore methods to reduce prices, making fresh produce more accessible to low-income households (Wilkins et al., 2014). Moreover, local food travels short distances, emitting fewer greenhouse gases and improving environmental health.

In addition, urban green spaces improve the health of a city's citizens, making them happier and healthier. Green spaces, such as parks, prevent obesity by promoting exercise and vegetation removes pollutants from the air. Exercise releases endorphins, reducing symptoms of depression. Also, public parks reduce stress by serving as a space for relaxation and recreation. Nature lessens attention fatigue and triggers positive emotions related to safety and survival (Russell et al., 2013). The mental and physical benefits of urban green spaces contribute to healthy cities.

By emphasizing walkability, locally grown food, and green spaces, cities can increase overall health. If cities take responsibility to improve the health of all residents, a healthy community will encourage a brighter future.

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HEALTH IN GREEN CITIES



WALKABILITY

Walkable cities are built on the premise of convenience. They encourage people to be active and thus have many physical and mental health benefits.

LIMITING FOOD WASTE

By utilizing sustainable food waste management systems, cities can build healthier economies, protect the environment, and encourage healthier lifestyles and mindful consumption.



LOCALLY GROWN FOOD

Local community gardens encourage healthy eating through shipments of organic, fresh fruits and vegetables. Food travels shorter distances from the farm to your house, so there are less carbon emissions and risk of contamination.

OUTDOOR SPACES

Outdoor spaces in cities, such as parks, community gardens, playgrounds, and others enrich people's physical and mental health. They offer a space to relax, exercise, and get in touch with nature.



Infrastructure

Juan Higuera, Joseph Park, Reid Vaughen, Sasha Youn

As cities become more urbanized, the global carbon footprint is increasing with the consumption of fossil fuels. As a result, climate change is rapidly growing, causing harm to Earth's ecosystems. Green infrastructures are becoming a necessity in urban areas to create eco-friendly facilities while continually satisfying citizens' needs. To increase green infrastructure and decrease our ecological footprint, city governments must increase the installment of public transportation, renewable energy infrastructures, and self-sustaining buildings.

Cities require public transport infrastructures to increase mobility and efficiency. Public transportation, such as buses or trains, are the only ways for "low- and middle-income non-drivers" to travel for "medical services, education, and employment" (Litman, 2015). The community can also benefit from urban transportation by decreasing traffic congestion and unnecessary payments such as parking fees. Furthermore, travel by public transport was estimated to conserve half the energy consumption and carbon emissions compared to travel by personal automobiles (Litman, 2015). With the benefits public transit provides, urban areas should put greater emphasis on public transportation infrastructure.

Additionally, increasing the use of renewable energy sources leads to a more sustainable city. Seventy-five percent of worldwide energy use occurs in cities, with 80% of the energy coming from fossil fuels, such as the burning of coal, oil, and natural gas (Kammen, 2016). To counteract the consumption of fossil fuels, urban planners can implement more renewable energy in the form of solar, wind, and hydropower. These sources do not produce as many emissions as fossil fuels. Renewable energy can also "increase regional energy independence and can be redundant with other sources, thus increasing resilience" (Kammen, 2016). Cities can reduce their emissions with more renewable energy sources. They eventually create an overall sustainable environment.

Finally, self-sustaining buildings can support ecosystems by composing a Biophilic City through supporting rooftop gardens, green walls, and courtyards. A Biophilic City "recognizes the essential need for daily human contact with nature as well as the many environmental and economic values" (Beatley, 2011). For example, green rooftops encourage gardening, green walls allow plants to grow on the sides of buildings, and courtyards can house small parks. The promotion of more greenery can help mitigate climate change. Leadership in Energy and Environmental Design (LEED) is an example of a sustainable building organization that ranks new buildings on their efficiency, sustainability, and cost. Some LEED-certified buildings include the Bank of America Tower in New York, the KK100 in Shenzhen, and Apple Park in Cupertino, CA. Sustainable buildings contribute to their environment by being ecologically friendly and reducing the city's carbon footprint.

Climate change is becoming more urgent, and cities must combat the issues with realistic approaches. Thus, city governments need to construct more public transportation, renewable energy infrastructure, and self-sustaining buildings to meet public needs while reducing urban ecological footprints. With correct implementation, cities can become more sustainable and pave the way to a greener future.

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Renewable energy:

- Solar, wind, and hydropower
- Takes advantage of local climate
- Cuts fossil fuel usage

Self-sustaining building:

- Rooftop gardens, green walls, and courtyards
- Promotes greenery
- Conserves energy

Infrastructure

Accessible public transport:

- Buses and trains
- Increases mobility
- Cuts carbon emission

Part II

Urban social-ecological problems and solutions

Cognition and environmental engagement

Akanksha Basil, Horace Greeley High School, Chappaqua, NY, USA

Over the past few decades, it has become clear that humanity's social, political, and economic structures are wreaking havoc on the natural world, destroying ecosystems, threatening life, and driving the climate crisis. Society's grounding in the unrelenting, unrealistic pursuit of limitless growth, coupled with abstract ideals of progress and power, have led many to realize that the very fabric of society must be woven with a different cloth to even begin climate crisis mitigation or reversal. These qualities have not only driven environmental destruction but made the fight against inequity, inequality, and socio-economic injustice onerous and complicated. Since cities remain the hubs of human society, diversity, and the myriad difficulties facing different demographics, all of whom will face the extra burden of climate change, reform must start in cities and work itself through every layer of life. In an effort to combat a lack of societal engagement in urban environmental causes, reformers must use social and psychological fixes, promote early-age environmental cognition, and advocate for social justice reform and community building.

Understanding the mechanisms behind behavioral patterns is essential in changing an individual's underlying social and psychological paradigms. Values, instincts, interactions, and pleasure are all driving factors behind the motivation to keep, rethink, or change a behavior. Researchers have identified a number of theories that explain human social behaviors and show promise as tools for change. Social norm theory, for instance, recognizes the extent to which perceived 'acceptable' social norms affect a person's choices and interactions with others. Social norms drive behavior through expected reward or gain and the internalizing of cues from actors in an individual's environment (Stern 2018). Individuals are likely to be influenced by 'reference groups', or people believed to be important enough to base behaviors on, making this theory useful in persuasion and the targeting of groups with the ability to influence a larger population (Stern 2018). On an individual level, norm activation theory explains that if a person has knowledge of potential consequences coming from inaction, in combination with feelings of obligation and responsibility, personal norms are activated, in turn influencing behavior and intention (Schwartz 1977, Stern 2018). Therefore, reforms must have some basis in invoking responsibility, empowerment, and one's morality. Additionally, much of human motivation is based in personal gain or pleasure, contingent on an established sense of truth, reality, and control (Cornwell et al. 2014). Especially regarding stressed or underserved communities, society must allow groups and individuals to take back what they need to feel in control, secure, real, and empowered if any change is to be made. Reform starts in the mind -- so this, in combination with frameworks that target personal and social norms, reference groups, build community, and allow social and spiritual gain will prime the human mind to rethink its relationship to the environment.

Humans must actively cultivate their connection to nature, as it seems our collective society characterizes itself as separate and removed from the place we arose and evolved. Emotional connections are among the most powerful forces for sea change, because human nature is wired to genuinely care about and protect these connections. Early childhood experiences in nature have indicated time and again to result in pro-environmental attitudes, perspectives, and behaviors into maturity (Fisher 2013), especially when children engage with nature of their own volition and in a way of their choice (Collado and Evans 2019). Young people, whose brains are especially malleable, feel an intrinsic connection with the world around them when allowed to exist in it freely, and so develop a

lasting emotional and spiritual connection to nature. Environmental education reformers must look to incorporate immersive opportunities for children to engage and connect with nature, in a fashion that is unforced and unscripted. Studies have already indicated differences between pre-K school children with early exposure to nature and children with little exposure. In particular, a 2013 study by Fisher et al. on children in naturalistic Forest Kindergartens (FKs) vs. children without nature immersion opportunities in early education concluded that FK children demonstrated a developed nature-based vocabulary (suggesting nature's cognitive impacts), greater creativity, and significantly more ideation than their non-FK peers. Nature had a measurable impact on students' creativity, literacy, and thought processes (Fisher 2013), a revelation that shows much promise for these children as passionate future environmental problem-solvers.

History has shown that the fight for equality, equitability, and freedom is an everlasting struggle, and the 21st century has dredged up its share of social justice issues that undermine efforts for both social and environmental reform. Poverty, racism, and injustice plague every city and lower the quality of millions of lives. Consequently, environmental reform must first focus on social reform and the building of civic ecology-- systemically providing a better quality of life for those in neglected places (Krasny 2015). Following this, communication and connection-building between reformers in underserved communities and communities themselves is essential. Fostering engagement means a careful consideration of one's own intentionality, connectivity, and relatability to those in question (Price 2020). People need to feel valued, heard, understood, and ultimately challenged to build better lives and communities. When emotional connections are formed, a reformer has the ability to empower leaders to connect with themselves, their communities, and eventually nature -- and this newfound power leads people to make change for causes they have grown to care about.

Society has largely focused on ideals and goals far removed from environmentalism and the importance of nature, leading to much of its destruction-- but hope still lies in the psychological processes and social changes that occur in this life. Humanity still has the opportunity to be better stewards of the environment, and must use social norm patterns, encourage nature in early development, build community, and bring justice to the underserved as part of the process.

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Food and nutrition inequality

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There is a large food inequality problem in the U.S. and around the world. Processed foods and fast food chains have taken over in low-income communities and contribute to disproportionately growing health risks such as “heart disease, high blood pressure and diabetes” (Fox, 2019). America’s food production system is not sustainable with mono-culture practices, and harms the environment with chemical solutions such as pesticides. In order to mitigate food inequality in big cities as well as make cities and the U.S. more environmentally sustainable, I would establish farming warehouses in outer boroughs that utilize vertical, aeroponic farming methods developed by companies like AeroFarms to produce high quality low-cost produce.

Food and nutrition inequality stems from a lack of low cost, high quality produce in the U.S. With such a high population and a massive demand for food at a low price, the standard for food is extremely low and it is tolerated because it is cheap. Organic food is a novelty in America and is quite expensive compared to mass grown produce. As a result, low-income households are forced to purchase low nutrition, low quality produce from the supermarket. Tasteless produce can also influence people to consume unhealthy alternatives since “taste perception influences dietary habits,” as seen with the prevalence of fast food chains in less affluent neighborhoods. America has seen a “decrease in fruit and vegetable consumption, particularly among low income families” (Popkin et al., 2005) as fast food and processed snack consumption increases. The main problem is the underlying health risks that occur among these populations. Research has shown low-income adults with poor diets have “higher rates of heart disease, diabetes, stroke, and other chronic disorders than wealthier Americans” (Woolf et al., 2015). By implementing urban farms that utilize aeroponics and vertical farming, cities can reduce the cost of produce and make high-quality, tasty produce available to impoverished communities and reduce health problems. With a co-op business model, it can provide jobs for the unemployed and young people, and teach them new marketable skills. Plus, these young workers can spread knowledge into their communities, further expanding a positive attitude towards urban agriculture.

Implementing vertical farming and aeroponics in cities will improve the city's environmental sustainability and the rural environment by reducing monoculture practices and long distance delivery. Monoculture is when hundreds of acres of land are used to produce one (mono) single crop year after year. The only downside is the particular nutrients needed to grow a strong crop rapidly diminish with over-farming, so farmers must utilize fertilizers and pesticides to make sure they don't lose money. But this practice is not sustainable as the soil can't recover and the pesticides used “negatively alter neighboring ecosystems” (Watts, 2018) by polluting the groundwater. Not to mention that pesticides remain on the plants and in some cases can be ingested by livestock and humans. Produce in the U.S. is grown predominantly in the Midwest and California, where the only way to get food to cities is to transport it with thousands of trucks, burning fossil fuels and contributing to traffic congestion in cities. If cities were to become more sustainable and grow a lot of their food with limited space, it could help mitigate the problems caused by the current system. Too many valuable resources are needed to maintain a dying system, so why not change it before it is too late?

The proposed solution is already proven to be more effective than traditional farming and the methods are being optimized by companies who recognize the importance of this situation. Cities

should acknowledge the gravity of the situation and recognize there are solutions to food inequality and environmental problems in cities. A Newark based company, Aerofarms, has developed a system that is far more efficient than traditional farming methods in America. Their analytics team has unveiled that their warehouses see “390 times greater productivity per square foot annually vs. traditional field farming while using 95% less water and zero pesticides” (Rosenberg, 2020). With alternative methods already in play, the next step would be to optimize the technology, and reform its business model for city communities, especially low-income ones with the least access to organic, highly nutritious food.

Some might argue that the sole dependency on electricity is a downside to using urban farming methods such as aeroponics and vertical farming. The reliance on electricity makes food production very risky in places prone to natural disasters such as hurricanes or earthquakes, because all the crops would die if the electricity was cut all of a sudden. Not to mention the extreme cost to implement these facilities in places where real estate prices are high, and the cost of produce would have to be increased to make up for the loss. Would low-income communities have optimal access to the low amount of produce in the beginning stages of implementation instead of the rest of the taxpayers?

Although the economics behind my proposed solution have yet to be figured out, the idea is what stands out. The best solutions are ones that solve problems on multiple dimensions and environmental issues. Food and nutrition inequality is a multi-faceted problem plaguing the world today. My solution encourages environmental sustainability in cities, decreases health risks in low-income communities, and brings back good quality food seen as a luxury by many in America.

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Sustainable agriculture for schools

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The first five years of life are a time of rapid physical growth and change, and are the years when eating behaviors that can serve as a foundation for future eating patterns develop (Savage et al., 2008). During the early years of childhood, children form their eating habits based on what, when and how much food their school or guardians provide to them. However, many schools across the United States don't serve fresh vegetables or fruits to kids from grades K to 12, and those young people are missing essential nutrients and vitamins from their diet. Unhealthy diets in underserved urban communities can be improved by involving schoolchildren and other community members in sustainable agriculture educational programs by teaching people the value of eating leafy greens through hydroponics, introducing garden-to-cafeteria programs in schools, and teaching parents how to grow their own food.

A growing number of hydroponic farms and hydroponic systems in schools can educate local people about the health benefits of eating leafy greens. Hydroponics, or growing plants in a nutrient solution root medium, is a growing area of commercial food production and also is used for home food production by hobbyists (National Agricultural Library, n.d.). Leafy greens contain high amounts of vitamin K and minerals which provide many health benefits like preventing inflammatory disease and protecting bones from osteoporosis. Many schools across the country have decided to take on school gardens or hydroponics programs as a way to educate students about food choice and healthy lifestyle. This sense of control and active participation by students could potentially foster the development of food literacy and the acceptance of fresh foods as part of normal food choices. In addition, each of these programs allows students to see the importance of healthy food as it impacts different important sectors in their lives (Nowak et al., 2012). For younger kids in schools where they work in teams and grow their favorite vegetables, they can make amazing observations on the growth of vegetables. This can ultimately lead to drawing their interest on tasting the vegetables they grow and accepting fresh fruits and vegetables as a daily choice of foods for their diets.

In schools with elements of urban agriculture (such as greenhouses, schoolyard gardens, hydroponic systems), their produce can be used in the garden-to-cafeteria programs. Introducing hydroponics systems into younger grades, where children make observations on the plant's growths, while for older teenagers, hydroponics can inspire them to design new ways of growing methods, exercise leadership skills, maybe even entrepreneurship. When students harvest the foods they grow in the school greenhouse or gardens, it gives them a sense of accomplishment and responsibility for being part of the school community. Those harvested foods will be served directly in the school cafeteria for the students' lunch, used in menu items such as salad or sandwiches. The knowledge gained from this research can be used to increase the effectiveness of school garden programs to promote vegetable consumption among children. School lunch presents a useful opportunity to increase children's vegetable consumption (Cotugna, 2012). Using school garden produce for a school's cafeteria lunch is an effective approach to increase children's vegetable consumption during school time as well as to cultivate healthy eating habits.

Communities and schools can also establish education programs for parents to teach them to grow their own food in their urban backyards and in home-based hydroponic systems. For many young children, they need a large portion of fruits and vegetables daily, but many parents are not aware of the lack of nutrients their children are receiving. In previous qualitative work, parents expressed an interest

and desire to learn about nutrition and in addition wanted to know the ‘how’ for changing unhealthy nutrition behaviours (McKee et al, 2010). Many parents’ main goal was to feed their kids and worry about whether they get hungry during the day, but parents may fail to make sure the food is healthy and not junk food. The most common barriers to eating healthy foods were cost, difficulty in getting children to eat healthier foods and easy access to fast food (Slusser, 2011). By teaching parents easy ways to grow fresh vegetables in their own homes, they won’t need to worry as much about buying costly vegetables from the store. On the contrary, their kids can develop a healthy diet and help their future body growth. Using a home-based hydroponics system can be more beneficial than just growing food from soil, as hydroponics use less water, can grow vegetables faster than traditional planting, and make it easier to manage plant growth. With hydroponics, you have control of providing your plants with optimal levels of nutrients by using specific formulations optimal to the plants you wish to grow (Resh, 2015).

Children from grades K to 12 across the U.S. have not developed healthy diets mainly due to their parents' lack of knowledge about healthy eating and schools failing to provide healthy foods. Starting hydroponics systems or gardens in schools or underserved communities as educational programs can promote the benefits of eating leafy vegetables, offering garden-to-cafeteria options, and educating parents on how to grow healthy foods in their own gardens.

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Urban disease control and health promotion

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There have been too many cases of infectious diseases that have devastated humanity in history. Since the Industrial revolutions, cities have developed around the world. Living in cities has become very desirable because cities have a better economic opportunity, more entertainment places and life is very convenient. Cities have a dense population, so it is terrible when infectious diseases spread in a city. Coronaviruses are found in cities and have spread to 9.7 million people to date. Urban health management and disease prevention information are extremely important during this period. From my research on how current cities fight against coronavirus, I found that popularizing disease prevention knowledge, restricting citizens' behavior, cleaning urban public facilities, and having sufficient supplies for disease prevention have a significant effect on reducing the spread of infectious diseases.

Firstly, disseminating knowledge about disease prevention in cities plays a key role in controlling infectious diseases. People who are most susceptible to infectious diseases are often those with poor immunity such as the elderly and children. Old people like to gather in some urban parks or community greenways to exercise. During the spread of the coronavirus, this group of people were the first victims. "It was suggested that the population most at risk may be people with poor immune function such as older people and those with renal and hepatic dysfunction" (Adhikari, 2020). Social media, newspapers, and park poster boards should popularize disease prevention and hygiene knowledge. At this stage of the coronavirus outbreak, almost everywhere in the cities have called for people to wash their hands frequently, wear masks, and other measures to protect against the virus. Research shows the correct prevention of viruses depends on people's compliance (Cowling, 2020). If the government can promote disease prevention in cities and social media, it will improve people's compliance by letting them have more insight into health knowledge and disease hazards. As a result, most people will obey and make protective measures such as washing hands and wearing masks a daily habit. This move undoubtedly played a role in reducing cases in cities.

Secondly, the urban government taking action to restrict citizens' behavior will help reduce the spread of disease. During the outbreak of China's coronavirus, Wuhan's government limited citizen's behavior by creating laws of blocking the city and restricting transportation. These methods are very effective in helping China reduce the spread of the virus. People will not stay in a city with a severe epidemic. The coronavirus caused panic in Wuhan, and people started to escape to different cities, which spread the virus. In this crucial situation, the government had to use policy to restrict citizen's behavior. After the closure of the city, people could not leave Wuhan. The Chinese government sent a large number of medical personnel and medical resources to Wuhan to ease the epidemic. "The travel quarantine of Wuhan delayed the overall epidemic progression by only 3 to 5 days in mainland China but had a more marked effect on the international scale, where case importations were reduced by nearly 80% until mid-February" (Chinazzi, 2020). Many city governments should learn from the example of Wuhan. This shows that in epidemic outbreaks, city governments have to take action to control citizens, because it is not enough to rely on the consciousness of the citizens.

Thirdly, the cleaning of public facilities should not be neglected; dirty public equipment will cause a great hidden danger of infection. It is easy to get sick if there are viruses in public facilities and they are not cleaned in time after being touched by human hands, because many people forget to wash their hands and touch their faces inadvertently. Paying attention to hand hygiene has always been an

important measure to prevent infectious diseases (Aiello, 2008). Cities need to regularly clean public facilities such as chairs in parks, and even more often during the virus transmission period. “Many studies have reported an association between improvements in hand hygiene and reductions in rates of infectious illnesses in the community.” (Aiello, 2008) Cities must take these measures to make the lives of people in the city safer.

Finally, during this epidemic, we saw the shortage of medical supplies in cities, and the shortage of food, medicine, and daily necessities after Wuhan was blocked. When a city lacks supplies, people will fall into panic and it will be out of control. If there is a shortage of masks, people will not be able to prevent disease. This problem was solved in Wuhan by receiving help from other cities in China and even other cities in other countries that distributed supplies to Wuhan. Now that China’s epidemic has been brought under control, China began distributing supplies to other parts of the world (Ranney, 2020). In the face of the virus, every part of the world should help each other.

Urban disease control and health promotion have finally seen their importance in this coronavirus period. Coronaviruses continue to spread in cities around the world. We need to further strengthen the methods of disease control to eliminate this epidemic. When a city can solve the problems brought by these viruses, it also symbolizes the progress of the city.

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The ecological weight of light

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The tiny head of a young sea turtle pops out of the ground; it struggles across the sand, dodging the beaks of gulls and the claws of crabs. In addition to a plethora of physical challenges, a hidden obstacle looms: light. Relying on visual cues to reach the cool ocean, the hatchling becomes disoriented by light pollution, turning inland and spending its short life slowly dying of dehydration. Although this is a relatively small death in a large ecosystem, light pollution results in many wildlife fatalities. Streetlights and sport installations cause 78% of shearwater deaths, and 100 million birds die in collisions across North America every year, with most occurring from light disorientation (Raine et al., 2007). Artificial light emanating from cities is a major source of light pollution. From birds and turtles to frogs and worms, light pollution disrupts the behavioral patterns of numerous species and therefore harms natural ecosystems. Light permeates diverse aspects of urban life, leading to widespread impacts. Cities must mitigate the harmful effects of light pollution on wildlife by decreasing levels of illumination and utilizing new light wavelengths while educating the general public.

By using light-reducing technologies, cities can decrease wildlife deaths caused by disorientation and maintain balanced ecosystems. Although light disorientation affects many animals, birds are especially vulnerable. Over-illumination disorients nocturnally migrating low-flying birds, like night herons (Raine et al., 2007), causing lethal collisions with lighted structures, fatal encounters with flock members, and exhaustion (Longcore and Rich, 2004). Furthermore, nocturnal seabirds have wider eyes with more rhodopsin and rods in their retinas than diurnal species (Raine et al., 2007), resulting in increased sensitivity to artificial light. Shearwaters, a nocturnal seabird species, use star patterns to orient themselves for hunting. However, the presence of sky glow, reflected atmospheric light that blocks view of the night sky (Longcore and Rich, 2004), causes these birds to mistake artificial light as stars. Rather than flying out to sea, shearwaters fly inland, away from food sources. They may experience “fallout” and become grounded, dying from predation, starvation, or injuries from falling (Raine et al., 2007). If a vital part of an ecosystem becomes endangered, ecosystems can become unbalanced; fewer shearwaters cause more squid, and more squid leads to fewer fish. However, the life-threatening effects of over-illumination can be combated through full cutoff lights that use a mirrored bowl to redirect light below the horizontal plane, reducing upward light that contributes to astronomical light pollution and sky glow (Raine et al., 2007). Moreover, full cutoff lights can utilize motion sensors to ensure that light is used only when necessary. Some cities are already implementing lamps that change lighting intensity based on the heat signatures of people nearby (Beatley, 2011). Cities can use full cutoff lighting with motion sensors to decrease over-illumination, thereby balancing ecosystems.

Additionally, specific spectral characteristics can decrease light pollution’s disruptive effect on wildlife behavior. Attraction and repulsion, especially of insects, depend directly on the type of light source (Longcore and Rich, 2004). Most species are minimally attracted to red and blue lights but are extremely attracted to white lights (Raine et al., 2007). Therefore, cities need to pay attention not only to limiting luminance but also to the spectrum of emitted light. Specific light spectra and high watt light bulbs increase glare, which increases ecological light pollution and alters vital light cycles for ecological balance (Falchi et al., 2011). Cities can use red, non-flashing lights for areas like construction sites at night and find new spectra that are best for local species. Since surface reflection and atmospheric scatter causes upward light emissions even from full cutoff lighting (Falchi et al., 2011), mindful

spectrum choices can reduce light pollution. By avoiding white lights and utilizing red and blue lights, cities can minimize the attraction and repulsion of wildlife species.

Furthermore, public education about light pollution can encourage city residents to decrease excessive light use. Corporations drastically increase light pollution by lighting shopping malls, an illuminance 200,000 times brighter than the natural environment during a new moon, and lighting tall buildings (Falchi et al., 2011). Often disregarded, smaller sources like house lights, fishing boats, and vehicles substantially increase light pollution as well. Many people do not recognize the severity of light pollution. To spread awareness, cities can offer financial incentives to building owners who educate tenants and staff about light pollution. Owners can post information in elevators, have lobby notices, create information packets, and inform staff about critical light seasons (Raine et al., 2007). Additionally, public education can encourage small actions like closing curtains at night, turning off light switches in empty rooms, buying low emission light bulbs, and programming light timers to lower illuminance. Culturally, light symbolizes wisdom, innovation, sophistication, and safety (Hölker et al., 2010), but light currently provides a threat to the environment. With proper education of citizens, cities can restore the positive connotation of light.

Although individuals may believe that light pollution only affects distant ecosystems, light pollution also disrupts natural circadian rhythms, leading to human health problems. Studies show that two hours of exposure to 460 nm light in late evening decreases pineal melatonin production, disrupting circadian cycles and causing “performance, alertness, sleep and metabolic disorders” (Falchi et al., 2011). Furthermore, low melatonin levels can lead to health problems, like diabetes and obesity, and increase the likelihood of some cancers, since melatonin is an oncostatic. However, individuals can decrease their exposure to light before bed, limit screen time, and have dark blinds to reduce the effects of light pollution. In the U.S. and Europe, 99% of people live under light-polluted skies, so light pollution is a direct threat cities must address (Falchi et al., 2011).

Light pollution mitigation must serve as a foundation of urban planning to decrease the disastrous effects on wildlife populations and human health. Through full cutoff lighting, mindfulness while choosing light spectra, and public education initiatives, cities can efficiently reduce light pollution and protect balanced ecosystems. Although addressing light pollution may initially appear daunting, cities innovate exciting new developments every day, and environmental advocates are raising awareness. Advancing forward, individuals must continue to strive to lighten ecological footprints and reduce the ecological weight of light pollution.

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True change requires true education

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Environmental education is often relegated to the edges of school curricula, perhaps because it is seen as a political issue. However, environmental education is becoming increasingly necessary as climate change becomes an ever-more pressing issue since it allows students to connect with nature and take responsibility for the environment around them. With the terrible realities of human damage to our planet ever-present, it is vital that future generations are equipped with the skills not only to repair the damage, but prevent further harm. Authorities must give priority to environmental education for students of all backgrounds by making it a central subject of all education to promote stewardship of the environment.

When done right, environmental education (EE) fosters a connection with nature and encourages and teaches students to repair and maintain the environment. The proposed purpose of EE in the United States is to bring awareness to environmental issues, and give students the problem-solving skills to take action locally and globally to protect the environment. Often an aspect of this education is hands-on experience outside of the classroom, which builds a love of nature in students, and may inspire them to help work to maintain it. Leaving the classroom for nature is a particularly important element of EE in urbanized areas, where students are often detached from nature. Additionally, EE is increasingly important for urban students as cities make efforts to become greener and more sustainable. EE has the potential to create a generation of caring and educated students who are civically engaged and work towards creating a more sustainable and equitable future. While environmental awareness may be perceived as a political subject, care for the environment ought to be held as a universal belief, and it is vital to instill in young people the understanding that we are connected to our environments and rely on them, even in urban areas.

In many large cities, most students are enrolled in public schools, and thus it is important that environmental education become a central part of the curriculum for these students, and that students in urbanized areas are exposed to nature. We have learned it is not enough to simply inform students about environmental crises and expect this cognitive fix to change their attitudes and behaviours (Heberlein 2012), as EE in its current form has existed since the 1970s in the United States and created no powerful change. EE must give students a personal stake in their environment, encourage them to take responsibility, and give them the tools to do so. Relationships between school systems and the city's green infrastructure programs are the best way to ensure urban students have the same access to and love of nature as their suburban or rural peers. Urban students should regularly be able to visit local parks and wild spaces, and interact with environmental and animal rights activists. It is also important to note that without social justice, sustainability is largely impossible, as economic growth and inequality will prevent environmental sustainability and justice from being realized. EE must be improved and promoted for *all* students, regardless of race, religion, or milieu, and the connection between social justice and environmental sustainability, especially in cities, must be explored and understood.

Finally, environmental education must keep up with environmental degradation, and a serious commitment must be made by school systems to prioritize the environment. Given how pressing climate change has become, along with the rapid degradation of natural habitats especially prominent in urban areas, simply informing students that there is a problem is not enough to create change. Students must be encouraged and assisted to make changes in their own community, and to take

those ideas further. They must learn how to create structural change, by turning their beliefs and love of the environment into new policies that will help us progress to a greener future, and not hold us back. While having outdoor experiences and being taught about the wonders of nature may help, students ultimately need the skills to bring their love and respect for nature to a governmental level. Current EE standards are much the same as they were in the 1970s, which is clearly an ineffective curriculum for current students and contemporary environmental problems. EE must be reformed so future generations are equipped to repair and maintain the Earth they inherit.

Environmental education has immense potential to help save our planet, but it must be improved to better mesh with today's natural and social environments. Governments and educational systems, particularly in cities, must ensure environmental education is universally available at a high quality to all students, or it will not be able to reach this potential. Students must be taught to love and honor the natural world, and they also must be taught how to protect it. By changing the attitudes and behaviors of today's youth, we can ensure the Earth of the future is healthier.

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Rewilding urban lawns

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Though globalization has enabled the sharing of new green ideas and technologies, it has also fostered the onset of urban biocultural homogenization—the loss of native biological and cultural diversity that characterizes growing urbanization (Celis-Diez et al., 2017). Most commonly demonstrated by the widespread adoption of the lawn, an extensive monoculture, biocultural homogenization is incredibly detrimental to regions' local ecology. The spread of green infrastructure consisting of popular but nonnative plants, most notably the nonnative grasses that compose lawns in cities across the U.S., ultimately distances urbanites from the ecology of where they live and has, historically, exacerbated an unsustainable use of water and other resources due to the high maintenance requirements of nonnative species (Celis-Diez et al., 2017). The creation of more green space, though important, is not enough on its own to bridge this gap between humans and nonhuman urban life—an integration that is necessary for successful biophilic, smart-growth cities (Beatley, 2011). Due to the environmental and social consequences of biocultural homogenization, city governments must work to replace lawns with sustainable native ecosystems by prioritizing equitable development, conducting environmental education programs, and using financial incentives.

Equitable development planning can facilitate the transformation of lawns into natural habitats for native species by implementing designs unique to the specific social, economic, and ecological conditions of a community (von Hoffman, 2019). Previously posed as a solution for environmental gentrification, equitable development is broadly defined as a form of city planning that emphasizes the involvement of all communities, especially marginalized groups, in urban design (von Hoffman, 2019). The current biocultural homogenization of urban landscapes across the U.S. as seen by the propagation of the lawn reflects a lack of inclusivity in city-building that must be addressed by this approach, along with the connected values of diversity and inclusion (Burayidi, 2015). An inherent goal of equitable development is the preservation of biocultural heritage, which refers to the knowledge and practices of local and indigenous communities (Gavin, 2015). By hosting public workshops or seeking feedback from residents during planning, city governments can actively prioritize biocultural heritage and recognize diverse sets of environmental knowledge—ultimately fostering a diversity of thought that can build resilience (Gavin, 2015). Incorporating the perspectives of all local ethnocultural groups in urban planning can lead to the development of more heterogeneous urban landscapes and, in addition, empower communities to exercise agency in their cities to make the changes they need.

Since most urban residents are unaware of the plant and animal species native to their region, education programs can foster the social-ecological memories necessary to recreate places and communities, as described by civic ecology principle #4 (Krasny, 2015), and reinvigorate the desire of residents to cultivate native ecosystems instead of lawns (Celis-Diez et al., 2017). Globally, city and turf development has caused significant native biodiversity loss (Celis-Diez et al., 2017). The resulting lack of individuals' personal interactions with local biodiversity has subsequently enabled biocultural homogenization. This ultimately drives a positive feedback loop, where reduced public awareness of native species and reductions in the actual biodiversity of a region reinforce one another (Celis-Diez et al., 2017). There exists a larger trend of dissipating social-ecological memories, which diminishes the possibility of native ecosystem revitalization (Celis-Diez et al., 2017; Krasny, 2015). Therefore, local governments must fund and support environmental education programs that focus on informing residents of the natural history of cities and the issues associated with nonnative species (McKinney,

2002). Environmental education can act as a cognitive fix (Heberlein, 2012) that helps adjust public attitudes about cultivating native ecosystems rather than resource-intensive lawns.

Financial turf-replacement programs led by city governments can also push residents towards more sustainable alternatives and, through civic peer pressure, lead to widespread adoption (Pincetl et al., 2017). An analysis of the impact of turf-replacement programs by the Metropolitan Water District of Southern California in the city of Los Angeles revealed that 70% of lawns in sampled front yards were completely removed over the span of two years while 11% were partially removed (Pincetl et al., 2017). Moreover, the report noted spatial clustering of lawn removal in the areas studied, which suggests that neighbors can inspire one another to transition to more sustainable ecosystem alternatives by making the change themselves (Pincetl et al., 2017). Since financial incentives have demonstrated success in motivating not only individuals but larger communities to take action against biocultural homogenization, they show great potential for urban landscape transformation.

Some may still argue that retrofitting cities with more sustainable ecosystems will be costly, but this change is necessary because lawns are simply too energy intensive. With the support of financial incentives and savings over time from the transition to more efficient land-use, moving away from lawns will eventually be more economically viable for urban residents throughout the country.

A three-pronged approach involving an urban planning focus on equitable development, the implementation of environmental education programs, and the creation of more local government-led financial incentives is critical for motivating residents to replace their lawns, which have a significant ecological footprint and social impact, with more sustainable natural habitats. The development of equitable biophilic cities relies on urban residents' ability to make this change.

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Preventing day zero

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Climate change is already resulting in changing weather patterns, forcing communities to adjust. Changing water supply to cities is of particular concern, ranging from vast flooding in places like the United Kingdom to extreme droughts, often caused by the lack of rain during wet seasons. Droughts can affect every part of a city, from its agriculture and income to its citizens' everyday lives. Thomas Heberlein, former professor at the University of Wisconsin, proposes a division of environmental solutions into three fixes: technological, cognitive and structural. While technological fixes often focus on expensive innovations, cognitive fixes aim to alter human behavior and structural fixes aim to develop new policies. In South Africa, Cape Town's "Day Zero" was expected in 2018. The citizens and government worked together to save the city from running out of water, but their cognitive strategy cannot be a long term solution. Urban water crises can be effectively mitigated only through a combination of active citizen support, innovative technological solutions, and policy reform.

A cognitive fix is most effective in the short term because of the psychological effect widely publicized, easy-to-understand goals and statistics have to encourage citizen support. In Cape Town, cognitive fixes were the fastest way to slow the impact of the drought because of the urgent timeline it provided the citizens with to alter their lifestyles and "get through it together." The term "Day Zero" was officially adopted in November of 2017 in city discussions, and water maps were launched online to publicly expose people who were using too much water and pressure them to stop (Ziervogel, 2019). Before citizens would trust the government's statistics and recommendations, however, they had to trust it was the most reliable source of information. The Water Resilience Advisory Committee was founded to help with this, "making Cape Town a high trust city through community engagement and proactive partnering to build social cohesion and empowerment across the city" (WRAC, 2018). Once these connections were established, government-provided information became the most accessible and important resource across water reduction campaigns, including on social media.

Besides the global technological challenge of slowing climate change, local technological advances can be made to prevent future crises. It seems governments are only in recent years investing in new technology to prevent future droughts, instead of crossing the bridge when they come to it. Frankly, Cape Town didn't have the time or the resources to look toward technological solutions in 2018. Day Zero was coming up too quickly. However, we can see another example in Australia's response to long-lasting drought, where Australian policymakers turned to water recycling and desalination as solutions. A \$90 million dollar recycling facility was installed in Victoria, providing 5% of the city's water (Heberger, 2011). Many citizens still don't trust recycled water to be potable, so this water is distributed via "purple pipe" for non-potable use (Heberger, 2011). Many desalination plants are under construction in Australia's big cities. However, this is a very costly option, and to finance construction, suppliers have raised water prices, which has forced citizens to spend more (Heberger, 2011). In Australia, desalination contributes significantly to the emission of greenhouse gases, because most of the cost goes towards purchasing electricity, which in Australia is mostly produced from coal. These challenges do bear concrete solutions, like finding new sources of electricity and educating citizens about recycled water, that will make them very effective and valuable in the long term to prevent future drought emergencies and to be modeled by other countries.

Structural fixes enable cities to be more cost effective than implementing new technologies by permanently integrating efficient use of water into the city's design and policy. During the height of the

need for drought crisis management in South Africa, the government realized there was a lack of communication of water use policies already in place, like switching to alternative water sources such as boreholes or rainwater. The most effective restriction put in place by the Cape Town was the use of water restrictions and large fines for water misuse. The city also reduced water pressure in municipal pipes, reducing human water consumption and water loss due to pipe leaks (Parks, 2019). Water management devices and smart water meters helped regulate water use by enforcing daily limits and providing resources to educate school children and adults about how much more water they may be using than they realize. Overall, water demand initiatives decreased water use by 59% in a period of four months (Parks, 2019). Wilhite (2014) claims governments must adjust their policies with each incoming drought, depending on the needs of the situation, assessing the vulnerability of the community at the time. However, the U.S. has shifted from reacting to drought crises to mitigation planning in many states. The 10-step planning process adopted in U.S. drought preparedness plans focuses on an organizational framework of citizens having a clear understanding of the process and the importance of keeping plans current, updating a “checklist” as part of the process (Wilhite, 2014).

South Africa’s government has a poor track record implementing infrastructure changes required to deal with population growth due to financial constraints, corruption, political rivalries and government capacity. This is not only an issue in South Africa. Drought preparedness, though recognized as crucial, is difficult to conduct because “most nations lack the institutional capacity and human and financial resources necessary to develop comprehensive drought plans and policies” (Wilhite, 2003). Cape Town’s government held issue with the city’s Department of Water and Sanitation, which had dealt with water issues in the past, so drought management was handed off to the Water Resilience Task Team (WRTT) in 2017 when the situation became dire (Ziervogel, 2019). Part of this challenge around the world will eventually involve the UN’s 6th Sustainable Development Goal (SDG) of implementing drought prevention on a global scale.

While global drought risk and water stress levels are increasing dramatically with global warming, these issues have concrete solutions to help stop them before they arise. Resources and models are available for cities ready to take action. It is a global community issue to work together to stop global warming and regional drought crises, and as water becomes scarcer, decreasing water use will become the norm.

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Electric vehicles: Increasing preference

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Internal combustion engine vehicles are widely popular in metropolitan areas. For example, cars contribute around 12.5% of carbon emissions in London, U.K., while cars and trucks contribute 48% of emissions in Los Angeles, U.S. (Sovacool and Brown, 2010). Reducing vehicle emissions is necessary to decrease the overall urban ecological carbon footprint. Otherwise, their continued contribution to global warming will ultimately make Earth uninhabitable. Thankfully, electric vehicles' introduction reduces dependence on fossil fuel cars, which leads to a decrease in carbon emissions from personal transportation (Langbroek et al., 2016). Nonetheless, Langbroek et al. (2016) recognize cost as one of the primary reasons people are reluctant to adopt electric vehicles. Many consumers who reject or cannot afford these vehicles survive with gasoline vehicles despite the necessity of climate change mitigation. It is necessary to change the attitude (degree of favorable evaluation), subjective norms (social pressure to perform), and perceived behavioral control (perceived ease of behavior) of these consumers to change their practices (Ajzen, 1991). Thus, given the low enthusiasm and concerns for costs, city governments must promote public charging facilities, the marketing of electric vehicles, and car sharing to make electric vehicles more attractive and accessible in urban areas.

Constructing public charging facilities can improve urban consumers' attitudes toward electric vehicles. One of the main concerns with electric vehicles is the high cost of charging. For example, Columbus, OH (U.S.), has the yearly average cost of charging at home for \$452 (USD) per year (Tulpule et al, 2013). Similarly, the maintenance cost is expensive for charging, especially in urban areas with high population densities. To address this problem, Tulpule et al. (2013) suggest installing public charging facilities near workplaces. For instance, in Columbus, OH (U.S.), they could charge \$333 (USD) per year, which can provide benefits to vehicle owners while garage owners can continuously operate these facilities. Furthermore, the increase of public charging facilities is necessary to reduce electric vehicles' maintenance costs compared to individually owned charging stations. As a result, consumers will reconsider the possible maintenance costs of electric vehicles, making electric vehicles a more viable option.

Further, the government needs to encourage urban residents to purchase electric vehicles. Barth et al. (2016) recommend spreading positive and collective messages such as public support for buying electric vehicles to mitigate carbon emissions. The underlying reasoning is that normative messages can increase positive electric vehicle adoption norms (Barth et al., 2016). Whereas individuals may feel discouraged from acting independently, these messages allow them to understand that the broader public shares a similar mindset, thus strengthening their intentions to act. It is a vital issue since the government can spread favorable opinions on electric vehicles and dismiss possible false concerns. Furthermore, individuals would buy and display their electric vehicles with more confidence. Ultimately, a ripple effect can be created with more privately owned electric vehicles on the roads, leading to more purchases.

Additionally, electric car sharing programs allow more consumers to interact with and access these vehicles despite price concerns. The method of car-sharing extends the number of users while lowering individual operating costs (Kley et al., 2011). Electric automobiles can serve as a lower price as semi-public transportation while providing the necessary functionality of traveling. Moreover, this allows individuals to travel with privacy, unlike public buses and trains. By increasing the accessibility of electric vehicles, individuals can drive electric vehicles with more ease.

Critics of electric vehicles argue that electric vehicles are not valid for mitigating climate change due to the over-emphasis on the individual consumer rather than improving public transit options. However, improved public transportation may not be preferable over automobiles if the public perceives cars to have significant advantages. For instance, respondents positively evaluated cars to be convenient, comfortable, free, and cozy, whereas public transport was evaluated to be either negative or neutral for these criteria (Steg, 2003). Therefore, even if public transportation options are upgraded and can reduce carbon emissions even further, there stands a more significant obstacle for the public to use public transit instead of fossil-fueled automobiles. Furthermore, destinations cannot change easily with public transportation, and privacy is another problem where people may not feel safe since they need to interact with other people.

In essence, the difficulty exists in changing people's opinions and behaviors to utilize electric vehicles. If people continue to use fossil-fueled vehicles, then climate change mitigation will not be achievable. No longer will there be stories of natural ecosystems filled with miraculous creatures nor various scenery only nature can provide. Thus, it is essential for city governments to promote public charging facilities, the marketing of electric vehicles, and car sharing in urban areas. While it is a small step for climate change mitigation, it is one closer step towards cleaner skies and greener pastures.

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Dressing up means tearing down

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It's strange to think of how such little things such as the clothes we wear can have an impact on the world around us. As humanity has evolved, almost all aspects of our lives have changed with the introduction of new technology, oftentimes seemingly for the better. Fast production and greater ease of access to products are luxuries of the 21st century that we often take for granted. But in certain ways the fashion industry has caused great harm as a result of their lack of attention towards planetary boundaries, or limits on production that ensure safe operation without negatively impacting the environment (Steffen 2016). The fashion industry is frequently placed as the pinnacle of cultural importance in cities, with high-end designers and brands littering every street corner. As such, cities can focus on reducing the environmental effects of the fashion industry by reducing the amount of clothing stores, increasing use of eco-friendly production materials, and making buying secondhand more easily accessible.

The overabundance of retailers and designers in cities creates a surplus of clothing that often goes unused; this can be solved by reducing the number of stores that are allowed to be in a certain area. Although a large quantity of stores in a certain industry is not typically seen as a bad thing due to the competitive nature of capitalism, it is in fact the large quantity of stores in conjunction with the idea of “fast fashion” that is causing such detrimental effects. Fast fashion is when retailers take a “speed to market” approach to capitalize on apparel that is not in the stores of the competitors, commonly seen in the forms of release dates of apparel sprinkled throughout the year (Bhardwaj and Fairhurst 2010). As each individual store creates their own lines of clothing and consistently pumps out apparel throughout the year, there is bound to be an overabundance as not all the clothing is going to sell. Overstocking is so prevalent that “of the total fiber input used for clothing, 87 % is incinerated or disposed of in a landfill” (The World Bank, 2019). To help combat this, a viable option would be to limit the amount of the same store chain throughout a city, thus reducing the amount supplied and created. Another possibility is to limit the amount of seasonal apparel, with new releases becoming more sparing in order to bring down production rates.

Another way fashion is a leading cause of environmental deterioration is through its harmful choice of materials, which are taken at a rapid and unsustainable pace. Out of all materials used to create clothing, two of the most harmful are those which are plant based and synthetic materials. Cotton is the most widely used plant based material, but is also the most harmful, as it is considered to be the crop with the single highest rate of pesticide use, resulting in chemical runoff seeping into the surrounding areas (“Is Cotton Conquering” 2017). Synthetic materials are solely created using chemicals that when combined, create affordable materials, but leave lasting marks on the environment due to their non-biodegradable properties. There are already solutions attempting to solve and reduce the use of these products, including switching to materials such as hemp and bamboo, though the problem oftentimes arises with production cost leading to difficulty making these materials a worthwhile investment to manufacturers. To help bring down costs, manufacturers could begin growing material in-house or within the same country, drastically reducing prices in comparison to importing goods.

Finally, the easiest and most impactful way we can feasibly reduce the effects of overproduction of clothing is simply by increasing the number of secondhand marketplaces and incentivizing citizens to practice upcycling. As outlined in an article by Leon et al. (2015) at the Student Environmental Resource Center of UC-Berkley, there are three main benefits to the practice of “thrifting” for clothing,

those being the reduction of clothing in landfills, reduction of resources spent, and the reduction of pollution (Leon et al., 2015). By creating a more accessible way for people to thrift within cities, the waste produced by the fashion industry transitions from becoming more clothing in landfills to potentially being used by a new individual who may not have been able to afford it at its original price. Cities can introduce marketplaces or bring in large chains such as Goodwill, with a focus on reselling older items to other people at lower costs.

Moving forward, we must not only ensure that cities properly manage fashion-focused businesses and their practices to ensure the safety of the environment, but to help create a community in which the reuse of clothing is not seen as a trend but as a norm. By limiting clothing production as well as making the materials themselves sustainable, citizens will adapt to the limited supply and begin seeking clothing that is second hand. These factors will ensure we not only protect our environment, but preserve the identity of our clothing that we hold with such importance.

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Green gentrification

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As designers and residents progress toward sustainability together, it's important to recognize that greening practices often benefit the wealthy and perpetuate marginalization. Mantay and Maroko (2018) found that most unused land in cities is available in lower-income neighborhoods, which creates potential promise for spatial equity. The desirability of living close to green spaces, however, attracts higher-income residents, driving up housing prices and the cost of living in surrounding areas, displacing low-income residents due to unaffordability. This phenomenon is known as green gentrification (Banzhaf and McCormick, 2006). Green gentrification disproportionately affects communities of color due to preexisting redlining and ghettoization of urban areas, which makes greening cities crucial in achieving urban social justice. In order to prevent green gentrification, local legislators need to support inclusionary zoning, production of affordable housing units, and asset-based community development education.

Inclusionary zoning could be a solution to ensure equitable access to green spaces by redistributing concentrations of poverty into mixed income communities. The purpose of inclusionary zoning (IZ) is to integrate communities and ensure that low income housing units are available in traditionally middle or higher income areas, reversing the effect of restrictive land use regulations (Kontokosta, 2013). Since higher and middle income neighborhoods tend to congregate around green spaces, subsidizing or implementing IZ means cities and developers will be able to ensure more equitable access to green spaces. Green spaces and biophilic areas have proven to mitigate the trauma many low income households experience by improving mental health (Engemann et al., 2019), reducing asthma (Feng and Astell-burt, 2017), and lowering cost of living in mixed income communities through local food production and ready access to efficient transit systems (Mouzon, 2006). The increased affordability and opportunity that mixed income communities and IZ provide help to combat the lack of green spaces in lower income neighborhoods.

IZ can only partly integrate communities if the market demand for housing from high-income families doesn't fall; creation of infrastructure is needed to support IZ needs. Cities need to consider producing more units in places that might not be the most profitable. Currently, mixed-income developments are incredibly difficult to implement and sustain due to "commercial lending, steep investor/lender return requirements" and "rent levels that limit affordability" (Talen, 2012). With lack of continual legislative support to convert or create more low income housing, IZ measures will have relatively no effect (Porter, 2004). There are two ways cities can effectively increase the profitability and accessibility of mixed income development: build smaller units in subsidized housing or increase commutability. Production of smaller units, namely apartments, allow cities to subsidize a smaller lot and provide the benefits of IZ to more residents. Additionally, living in a mixed income community increases likelihood they will have access to more transportation options (Zhao and Gustafson, 2013). Consistent production and protection of low-income units is necessary to ensure the success of IZ.

In terms of social change, asset-based community development (ABCD) could help amplify marginalized voices and move toward a more equitable city in terms of land use. The idea of ABCD revolves around recognizing all of the assets city residents already possess, thus increasing social capital and strengthening community bonds among the residents and with the local government (Mathie and Cunningham, 2003). This connection would allow low income residents to voice exactly what amenities they need to alleviate problems they face on a daily basis. The leveraging of relationships

extends to all sectors of development, and therefore helps amplify marginalized voices and cater to community needs.

Apprehension surrounding the effectiveness of IZ comes from ideas of forced relocation as well as a disruption of social networks (Chaskin and Joseph, 2015). It's important for ABCD and IZ to be supported by the government and used in tandem to maximize effectiveness. However, it's understandable that people fear there will still be social discrimination in mixed income communities on the basis of class and race, and it won't provide a truly inclusive social environment. The multifaceted nature of sustainable development means these three proposed solutions will not fix all issues, specifically social issues. Yes, ABCD can help, but it would be more effective if coupled with anti-racist curriculum in schools and inclusive community events. Ultimately, social, governmental, and infrastructural changes need to be implemented to achieve true sustainable development.

To promote inclusion and prevent green gentrification, city and state governments as well as residents should consider participating in efforts like inclusionary zoning, continual support and production of low-income housing, and ABCD in order to move toward a city that provides accessible green spaces and comfortable residence to everyone.

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Cool air, warm planet

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I walk through New York City with my sister on a muggy August afternoon, weaving in and out of stores in the summer haze. After an hour has passed, temperatures have climbed to above 90 degrees Fahrenheit, and we retreat to Starbucks for temporary rest, where we find ourselves instantly refreshed by the air conditioning (AC). We are not alone. Others are basking in the cool air. Yet, the irony is not lost on me that the same AC that is cooling the room is warming the planet. The refrigerants in the machine, which absorb heat from the air, contributing to the cool temperatures of the Starbucks, release some of the most harmful greenhouse gases (Donev et al., 2018). The main refrigerants in AC — hydrofluorocarbons (HFCs) — are 1,000 times more potent than carbon dioxide (Ospina, 2018). While most air conditioning takes place in the U.S, China, and Japan, air conditioning coverage is expected to rise by 50% by 2050 (Ospina, 2018). Cities around the world are aware of the polluting effects of air conditioning systems yet continue to use them. To address the air pollution problem, city governments must implement smart temperature regulating technologies and green and cool roofs.

Smart technologies can minimize energy use by adapting to changes in weather and human behavior. Smart glass adapts to climate and time of day to regulate the temperature of city buildings, thus reducing energy consumption. The most well-known form of smart glass is electrochromic, which changes color and reflectivity when electricity is applied, affecting how much light and heat a building takes in (Hawken, 2018). In the summer, smart glass may adjust to block heat while allowing heat in during winter months to naturally regulate a building. Smart glass was implemented by the California company View, where an electrochromic line reduces energy use by 20% (Hawken, 2018). Despite smart glass's effectiveness, the source of energy remains a problem; energy sources can be expensive and polluting if they are nonrenewable. Yet, a simple solution is to attach photovoltaic films, which generate energy from solar radiation to the smart glass (Wong & Chan, 2013). By using a renewable energy source — the sun — photovoltaic film proves to be a green and affordable solution to energy generation in electrochromic glass. Smart thermostats are another way to reduce energy consumption. While normal thermostats are often too difficult to operate, resulting in unnecessary heating and cooling, smart thermostats are much simpler to use. Smart thermostats learn about an individual through gathering and analyzing data via sensors, including sleep patterns and the time an individual normally leaves the house (Hawken, 2018). Using this information, smart thermostats adapt to an individual's routine, reducing energy consumption. Smart thermostats maximize the efficiency of heating and cooling systems, lessening the polluting effects of these systems (Lu et al., 2010).

Green roofs cool buildings through plant processes, thus reducing the need to use air conditioning systems. Green roofs are covered with foliage and can have a deep substrate layer (intensive) or a shallow one (extensive) (Zinzi & Angoli, 2012). The soil and vegetation in green roofs provide insulation and the process of evapotranspiration in plants keeps buildings cool (Zinzi & Angoli, 2011). Research shows that on the floor beneath a green roof, energy use for cooling can decrease by 50% (Hawken, 2018). Through transitioning to green roofs, city governments can decrease dependence on air conditioning systems. In addition to their cooling and insulating properties, green roofs provide various ecosystem services, such as serving as a habitat for wildlife and cleaning the air. Moreover, green urban spaces can add aesthetic value to a city and serve as a place for residents to connect with nature. However, one drawback of green roofs is the cost: the upfront costs of installing a green roof can be much more expensive than that of a conventional roof. However, city governments

can subsidize green roofs, making them more accessible to the average person, a fundamental aspect of environmental justice (Ageyman, 2003).

By reflecting incoming solar radiation, cool roofs provide another way to cool buildings. Cool roofs can be made from light-colored metals, shingles, tiles, and coatings (Hawken, 2018). The light color of cool roofs reflects radiation, preventing incoming heat from entering the building. While cool roofs may not completely eliminate air conditioning systems in cities, they can reduce dependence on costly and inefficient cooling systems. Furthermore, cool roofs have some advantages over green roofs; they are cheaper and generally easier to install (Hawken, 2018). For example, one could simply paint a roof white to obtain some of the benefits of a cool roof. Cool roofs are a simple yet extremely effective alternative to conventional cooling systems.

The heating and cooling of cities have inflicted great costs on the environment. However, solutions are simple and depend on city planners' abilities to implement technology that uses what is readily available — such as plants and sunlight — and be adaptive to change. Nonetheless, these technologies will not work unless they include everyone in the mix. By including people in the design process and allowing them to enjoy environmental benefits, we can create a better life for all people.

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Walkable cities: The key to social capital

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In cities, cars create a variety of problems, including air pollution, traffic, accidents, and limited opportunity for interactions with other urban residents. A low amount of social interactions can have a negative effect on a city's social capital. The concept of social capital is defined as the networking, trust, and cooperation of a society (Paldam, 2008). Social capital is necessary for community-based environmental stewardship and working together to solve urban environmental problems. Walkable cities increase social capital by enabling more opportunities for social interaction and connection. Increased social interactions and trust, civic engagement, and more green spaces are all elements of walkable cities that can increase social capital. While urban residents are increasingly disconnected from each other, city planners and community leaders can establish more walkable spaces to facilitate face-to-face interactions and thus foster social capital.

A key factor in building social capital in cities is for the residents to develop trust and relationships with one another. If a city creates more walkable places, there are more opportunities for social interactions to occur. Brief conversations, waving hello to a neighbor, or even accidentally bumping into someone can create a sense of trust and connection between people and their environment (Leyden, 2003). Creating more walkable areas can also encourage people who cannot afford a car or transportation to walk around and socially interact with others. This can give them the opportunity to feel a sense of trust and belonging that could be lacking in unwalkable environments.

Residents working together to solve communal problems is beneficial to any community, and this idea of civic engagement can greatly increase the social capital of a city. Walkable environments have a positive impact on increasing the rates of civic engagement in cities (Lo, 2009). Civic engagement increases social interaction since it enables residents to work together to solve environmental, social, political or economic issues within their community. The process of working together increases social capital, and the results of these community projects can have social benefits as well. Civic engagement often involves active citizens improving the conditions and shaping the future of the city (Alder & Goggin, 2005). Thus, civic engagement and participation in urban areas can significantly increase social capital in various manners.

Integrating nature and green spaces is a large component of designing walkable cities since it encourages people to go outside and walk around. Being surrounded by nature can lead to a higher sense of community for individuals (Mayer & Frantz, 2004). Also, interacting with nature can improve one's happiness and help reduce stress (Samuelson et al., 2020). Social capital is greatly boosted when there is improved well-being and a higher sense of community. These green spaces in cities foster well-being in general, and lead to more social interactions since people are encouraged to walk outside when there is nature surrounding them.

One may argue that creating a walkable city will have a negligible effect on a city's social capital, since those who can afford cars will still prefer them because of their convenience. However, car owners can be convinced to walk instead because of the many personal benefits walking provides. Walking is free of course, and it provides many health benefits including reducing the risk of obesity and other threatening conditions. Appropriate cognitive fixes can be very beneficial for this situation since this type of fix influences human behavior by educating the public (Herbelin, 2012). Informing the public about the economic and health benefits walking provides can influence car owners to walk, which will increase a city's social capital.

Integrating walkable areas in cities can be done in a variety of ways, and can be achieved in new and old cities. Redesigning an existing city and developing walkable areas in new cities can be very costly. However, this can be compensated since an increase in social capital boosts local economies in a variety of sectors (Kay, 2005). Creating more green infrastructure and spaces (like sidewalk gardens), reducing litter, and improving street safety are all ways cities can make their environment more walkable. Since there are many manners to create a walkable city, and because it can be done in any stage of development, it is an achievable and realistic goal. This will benefit cities in the long run since an increase in social capital leads to more connection, civic participation, reciprocity, and engagement in environmental actions. Conversely, cities with low social capital are likely to experience worse health issues, less economic development, increased crime, weakened sustainability, and an overall less functional city (Leyden, 2003). Clearly, having high social capital has its numerous advantages, and integrating walkable areas in cities is a crucial step to getting there.

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Incomplete urban expansion: Urban villages

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Urban villages are former rural regions with villages and farm fields that have been partially replaced by urban areas. When this happens, the former villagers are moved into arranged apartments and the region is left without any continuing management or clear policy. The former villagers stick to private farming and animal feeding, which bothers other residents and prevents new residents from moving in. These urban villages, without enough development and management, are just a waste of land and source of disruption. This essay focuses on resolving the problem of urban villages in China by proposing a policy I call Work-and-Home Transformation Policy (WHTP), which offers organized jobs and encourages planting suitable home plants. The WHTP addresses the urban village problem and creates more sustainable urban residential areas by preventing private farming, lowering the poverty rate, and improving mental health.

The WHTP can build a better urban village community by transforming the villagers' work and living conditions. According to Ferkany (2014, p. 134), "...environment attitudes are linked to behavior in ways that are difficult to predict and control and that 'cognitive fixes' ...are generally doomed to fail." For example, there is an urban village near my housing estate; even if villagers move into an urban apartment, they maintain their old practices: illegally building, planting vegetables, feeding animals, and using smelly animal excreta for fertilizing, which causes noise and bad smells. By offering them new jobs and giving them a chance to live in a more residential-friendly manner, as suggested by the structural fix idea proposed by Heberlein (2012), villagers will gradually change their behaviors, and then the whole community environment will gradually get better.

In addition, by offering jobs to villagers, farmers will work on an organized farm or participate in a project to improve the urban environment and sustainability. This will prevent them from privately farming in the community. These villagers do private farming because it used to be what they relied on to support their family. However, by offering them new jobs to work on an organized farm or project, they can be self-sufficient with a paid salary. Thus, there will be no need to farm on the community land anymore. As the old farming land becomes vacant, urban design for resident recreation such as playgrounds and exercise facilities (Gehl 2010) could be created to enrich community life. Offering jobs could not only improve the community environment, but also be good for the local economy.

Furthermore, besides enhancing community life, WHTP could also lower the unemployment and poverty rate. The relocated villagers are very poor because of the lack of opportunity to access jobs. Farming is the only way for them to make a living, and the vegetables they plant can be just enough for their survival. However, private farming resources are limited and vulnerable to climate change; for instance, once a severe climate change fueled weather event ruins their crops, whole families would starve. After joining an organized farm, farmers can plant more variable and manageable crops and vegetables efficiently by using technology such as hothouses, drip irrigation, and vertical gardens. In addition, cooperating with local firms and schools is also a good choice. For example, there is a middle school beside the urban village; the previous private farm land can be transformed into an organized vegetable garden like schools in the Bronx. Local non-profit organizations or commercial firms can ask to manage the farm land and then hire the farmers to create vegetable gardens for students. The vegetables can be used for school dining halls as healthier and cheaper food, which can save money for educational facilities, and at the same time raise students' awareness of building sustainable cities.

Getting a standardized job and stable salary, the villagers could live a better life and reinforce the stability of the local economy.

Other than local economic improvements, residents' mental health could also benefit from WHTP. Residents' mental health could be improved by the botanical plants planted on the roofs and balconies. According to Helbich (2018), "...environmental exposures [such as] noise, air pollution... housing conditions might trigger mental disorders or be protective factors, facilitating stress reduction, mental recovery, etc." Thus, the noise and smell can trouble nearby residents and lead to mental distress. By freely giving flower seeds in the community, villagers who are passionate about planting can plant flowers on their balconies and roofs. This would not only improve the air quality and local climate, but also, when the flowers bloom, color and decorate the whole community. According to the World Happiness Report, "Kaplan (2001) ... confirmed the positive well-being effects of visible, nearby nature." When seeing the enjoyable scenery of nature--the beautiful flowers--the residents can relax their mind and build a mental association with the community.

Opponents may argue organized farms and projects may need specific techniques such as operating heavy machinery, which need extra training, but that could be covered by villagers' experience and skills. I do not deny that the machines and new technologies require extra training for villagers. However, accumulated experience of decades of farming brings valuable knowledge that cannot be learned from school. Hiring the villagers is a mutually beneficial strategy; young staff can learn real experience from the villagers, and villagers can learn modern techniques from the young staff. Also, farmers may operate the machines easier for being familiar with farming. In this case, the extra time spent on training is well-worth it.

For urban afforestation, economic development, and citizen happiness, WHTP could make urban village communities and even larger urban areas more sustainable, livable, and harmonic. We still have a lot of work to do using WHTP to deal with existing urban villages, so "optimize rather than maximize" (Beatley 2011). I believe the situation can be changed as all the residents and policy makers work together.

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Urban water quality struggle

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In heavily urbanized cities, pollution is always lingering within notice: air pollution, water pollution, and noise pollution, etc. Air pollution and noise pollution have been mitigated by the increased amount of greenery everywhere. However, water pollution hasn't seen much progress in many cities. In this essay, Shanghai is used as an example to illustrate the water quality struggle that can be found in many other cities as well. Nine percent of Shanghai is covered by rivers, about 569.6 square kilometers (Yu, Deng, et al, 2013). To protect water, the city government created numerous policies and infrastructures to purify water in many rivers, but the problems keep coming back. The rivers remain heavily polluted, and the river in front of my neighborhood is still labelled as type V water, which can only be used for irrigation; it is not even cleared for industrial use. The problem of polluted urban rivers should be addressed by separating water pipes for sewage and stormwater, strict prevention of illegal dumping, and increasing biodiversity in these rivers.

Many rivers' black and odorous problems can be solved by separating stormwater pipes and sewage pipes. Many districts in Shanghai are still using combined sewers to deal with both stormwater and sewage, which can eventually lead to sewage in these urban rivers. Sewage includes industrial wastewater containing dangerous chemicals. Sewage and sludge in Shanghai contain perfluorinated acids, which may cause severe health problems like cancer from long-term exposure (Yan, Zhang, et al., 2012). These kinds of chemicals destroy living organisms in rivers. In 2019, a member of a neighborhood committee asked our family if they could destroy part of our garden to install a new pipe solely for stormwater, which was great news to me. However, these measures should have been taken years ago, which reflects the problem is still severe in suburban and urban parts of Shanghai, where many factories are located and pollutants come from. Separating pipes for stormwater and sewage would be a great technological fix to reduce the lethal chemicals that end up in rivers.

Furthermore, stricter supervision can prevent companies from illegal dumping in rivers. Shanghai has been collecting service fees for treating wastewater from companies since 2003, which created additional expense for these businesses, so some of them were being sneaky and dumping wastewater in the river directly or through secret pipes. Since the majority of factories had moved out of urban Shanghai, they operate in suburban areas with relatively lower local population density and less supervision. It allows companies to do whatever they want to the rivers. However, there can be solutions to this. In most companies there is a party committee from the government, and "the local party committees still succeed at keeping their fingers in the decision-making process even after two decades of economic transition" (Oppen, Wong, et al, 2002). The party committee's job in companies is making sure the companies operate in alignment with the government's policies and ideas. This can be a breakthrough for further supervision. Most party committees in companies don't have in-depth sustainability education backgrounds, so they do not realize whether the companies are harming the environment or not. However, after educating them with environment preservation ideas, they would focus more on illegal dumping in their companies and create more supervision inside the company. The government thus can create an eye in each company focusing on its water treatment.

Finally, implementing the idea of ecological resilience, which is the environmental concept that ecosystems with good biodiversity can recover their normal patterns after experiencing relative degrees of disturbance, making rivers' ecosystems more diverse would help rivers endure more challenges from urban environments, which prevent recuperate rivers from going back to the black and odorous phase.

With more biodiversity “supporting and protecting ecological, economic and social diversity, countries or regions make themselves less vulnerable to adverse effects of future change” (Berkes, 2007). Too often scientists finish restoring a river and leave, claiming their rewards and the end of their project. The water quality goes back to normal and it smells good, but this only lasts for a few years, if not months in some cases. It is because the biodiversity isn't right. When the rivers were fixed, planting willow trees in rows alongside the riverbank doesn't help in the long term. Too much litter from fallen leaves causes the leaves to rot in the river without enough living organisms to consume them. The river soon turns a dark greenish color with lots of algae and hardly any fish in it. If the ecological balance of the was carefully considered when fixing a river's water quality, the effort from the scientists would have stayed effective longer.

Some people might point out that separating pipes for separate uses could be really expensive since it's in such an established city, and it can be hard for the government to pay. However, this isn't as much of a problem for China. The physical labor price in China is overwhelmingly lower than in Western countries, which makes the labor process very cheap for the people or government to pay. In addition, the materials of these pipes don't need to have high quality since it's just for either water treatment plants or rivers. Some would also say that educating party committees would be costly and time consuming. In fact, educating party committees about the environment could just be another class in the party committee training schools, which create great effects. Another possible opposing idea would be that sustaining biodiversity is a tricky task and unpredictable in urban areas. However, while creating such an environment might be hard, it would prevent scientists' efforts at restoration from becoming a waste of time.

As Shanghai's rivers' water quality still faces major struggles, separating water pipes, applying close supervision through party committees, and building biodiversity, in ideal situations, would effectively help to solve, or at least mitigate, the problem. However, some of these solutions only apply to certain cities and countries. For example, party committees in companies don't exist in the U.S. A company from Boston, MA, cannot use the second solution, but it can take inspiration from the idea of strict and close supervision. To implement these solutions in different cities, the planners would need to modify it to fit each unique context.

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Paving the road to sustainable transportation

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Congested and outdated transportation systems exist in most high density areas throughout the world. Cities install rail lines, bus routes, and freeways to transport their citizens from one place to another. Yet after their installation, the city pats itself on the back and leaves the system untouched for decades. For example, in San Francisco, the main railways BART and CalTrain have been operating trains from 1989 and 1985, respectively. These carbon-belching beasts hurt the environment, and replacing them with sustainable designs would be a large step in the right direction. It is time to revive these public transport systems, and the most effective method is implementing a structural fix. The public needs to rise and demand a complete transformation to our public and private transit systems. To mitigate carbon emissions created by transport, cities should upgrade their public transportation systems by installing more renewable energy sources, levying substantial prices for carbon emitting vehicles, and encouraging companies to adopt private buses to shuttle their employees.

City governments can introduce renewable energy sources for public transportation to charge their vehicles. A fleet of electric buses and trains powered by renewables would decrease the carbon footprint of the city. Renewable energy sources include solar panels, wind turbines, and hydroelectric turbines. However, energy creation is not the problem, energy storage is. The energy storage technology is still in its early stages, with lithium ion batteries leading the industry. It would be difficult for a bus to drive its full route without recharging (Vilppo & Markkula, 2015). Transportation accounts for approximately 28% (~12% commercial) of U.S. greenhouse gas emissions, thus encouraging the public to use public transportation would lower the percentage from anywhere to 5-10% (U.S. EPA, 2020). If electric transportation took over, perhaps citizens would be more apt to use public mobility, if it maintains a clean and friendly environment.

By levying taxes on inefficient and carbon emitting vehicles, cities can encourage people to switch to electric vehicles powered by renewable energy. A carbon tax is a small price added on to gas powered vehicles that incentivizes people to buy more fuel-efficient vehicles or electric vehicles. When a carbon tax was implemented in Sweden, data shows that carbon emissions in the transport sector decreased by 6% annually on average, starting in 1990 (Andersson, 2017). Also, if citizens must pay more for their gas vehicles, they might abandon gas vehicles, and they could purchase an electric vehicle, or seek other means of travel like by foot, bike, bus, or train. The goal of a carbon tax is to reduce the amount of carbon emitting vehicles on the road – effectively lowering the carbon footprint created by mobility.

Another way to reduce cars on the roads and the city's ecological footprint is to embolden companies to embrace private buses to transport their employees from their houses to work. Already, several companies have adopted this tactic, namely Facebook, Instagram, Google, and Apple. The buses they use are called Charter Buses, which are more advanced, efficient, and comfortable than regular buses. This trend started when companies started moving out of the cities due to rent prices, but still needed their employees to come to their new location. This, combined with millennials entering the workforce and not owning a car or not wanting to drive, produced a practical solution (Marketplace, 2019). In many tech heavy areas, like New York, Silicon Valley, and Boston, buses line the roads filled with passengers. Buses surpass cars in fuel economy after carrying just 7 passengers, and the average charter bus can hold up to 60 people (maximum). "Buses also use less energy per passenger mile than a typical automobile" (Division of Air and Waste Management, n.d.). Buses reduce traffic and carbon

emissions, so public and private bus systems are beneficial for cities.

While everyone loves to talk about the beauty of these proposals, there are some that criticize this wishful thinking. Many authors label these prospects as “hopeful,” “far off,” and “unattainable” (MacKechnie, 2018). They say these goals are so long into the future that it is useless to outline them now. But in reality, the goals are as far in the future as we make them to be. If humanity decided that in five years we wanted global sustainable transportation, we could do it. We are only thinking about when it is good timing for us. Unfortunately, we are running out of time to pick and choose when, and it is time to act now. If we begin earlier, we finish earlier. If our cities had sustainable public and private transportation completely implemented, governments could focus on other projects to advance our society into a greener future.

Instituting renewable energy sources, imposing substantial taxes for carbon fueled vehicles, and spurring companies to take up private busing systems could diminish a city's carbon footprint created by transportation. Clogged roads and air pollution would see a turn for the better as less cars are on the road because people are taking public and private transit systems. The more electric vehicles powered by renewable sources such as solar, wind, and hydro would heavily reduce carbon emissions. But this is only one of the problems cities face. By working together, city governments and communities can alter their environments to become a more sustainable city. It will not be easy, and it will not be fast, but the outcome would produce a better economic, social, ecological, and physical justice for everyone.

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Battling environmental racism

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Across the globe, underprivileged and communities of color are being affected by injustices based on race and systemic and environmental oppression. Environmental racism refers to the environmental injustice experienced by communities of color, most of which are low-income. Examples of how environmental racism manifests include lack of protection against natural disasters, greater health risks, and proximity to landfills and other pollutants. The effects of environmental racism can be mitigated by enforcing more disposal laws on factory waste, renovating poverty-stricken neighborhoods to be more prepared for natural disasters, and building more green spaces.

Health disparities caused by environmental racism can be lessened through the enforcement of laws focused on the disposal of factory waste. One of the greatest contributing causes of environmental racism is when factories adjacent to the residential areas release thousands of chemicals daily through burning, dumping, and other waste. This negligent disposal of toxic chemicals directly correlates to whose wellbeing is valued -- for instance, it is rare for such factories to be located near white and/or wealthy communities. Instead, the health of communities of color are put at risk, which is precisely how environmental racism functions. In the predominantly African American neighborhood of St. James Parish in Louisiana, also known as "Cancer Alley," the risk of developing cancer is 700 times higher than the national average. A large factor causing this rate to be so high is due to the city being right next to the Mississippi River, where multiple factories dump their waste (Ettachfini, 2020). If more laws were put in place to force factories to dispose of their waste in safer ways, this rate would decline, and the health of the residents living in these areas, as well as the environment, would improve. Therefore, stricter regulations and more consistent enforcement would lower the risks to these communities and move toward achieving environmental justice.

Helping minority communities be more prepared for natural disasters is another way to help alleviate environmental racism. In many of the communities that face environmental racism, the buildings and areas are not well prepared for natural and man-made disasters, such as oil spills, earthquakes, flooding, and fires. These areas also usually lack resources and financial aid to rebound from the natural disasters. One example can be found when juxtaposing aid sent in response to hurricanes, to affluent white Americans in Texas and Florida, compared to Puerto Ricans. The former were helped within days of Hurricane Maria making landfall. Contrasting to this, Puerto Rico was left for weeks without safe drinking water, electricity, or food, and were told to "help themselves" (Walz, 2017). The cost to families and economies shouldn't be based on race or socio-economic status; more effort should be put into making sure aid is allocated equitably. Everyone should be protected from natural disasters, or have access to resources to be prepared when they hit, instead of only those who are wealthy or white. To diminish this inequality, all communities should have access to emergency resources, such as back-up generators, water filters, and canned food, and be prepared when disaster strikes.

Environmental racism generally occurs in lower-income areas, and the people who are affected by it usually only live there because they can't afford to live anywhere else. Too often, these neighborhoods lack recreational areas for kids to play and families to enjoy nature, or even simply trees and other plants around the neighborhoods to green the areas. Within Milwaukee, most of nature is found around white neighborhoods, and the African American or Hispanic populations receive much less canopy coverage (Heynan, 2006). This drastically lowers their health, and makes them more

susceptible to acquiring autoimmune diseases, cancer, and other illnesses. Adding more green spaces and parks in impoverished communities would allow residents to engage in nature more regularly. The plants in the area can help filter out some of the pollutants being released by the factories and manufacturing plants nearby, as well as absorb some water during flooding. These can help with the physical health of the residents by creating cleaner air and assisting with flood control, both problems exacerbated by environmental racism (Northridge, 2014). By adding more green space and parks in low-income areas, the effects of environmental racism can be diminished.

The effects of environmental racism aren't going to disappear anytime soon. However, if more laws are put into place to dispose of factory waste properly, areas are more prepared for natural disasters, and more greenspace and parks are added to these areas, the effects can be mitigated. By making these changes, people's health and wellness will improve, and environmental justice can begin to be achieved.

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Sustainable development: For all?

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Sustainable development like the High Line park in New York City has visible benefits. The park provides more green space in the area, and a dense, walkable neighborhood has been created around it (Immergluck & Balan, 2017). These amenities are compelling, but they have not been shared equally. Studies have shown that the High Line disproportionately serves Whites, and critics have found that sustainable development reinforces gentrification, a phenomenon where higher-income families move into an area and displace lower-income ones over time (Immergluck & Balan, 2017). To avoid gentrification around sustainable development projects, cities must implement measures to maintain housing affordability, preserve businesses and employment that support lower-income residents, and involve the whole community in urban planning.

City governments must counter the trend in which sustainable development makes an area more appealing, increasing housing costs and causing gentrification. This development can include adaptive reuse projects that turn abandoned infrastructure into trails and parks (Immergluck & Balan, 2017), or brownfield developments that build neighborhoods on formerly industrial areas (Dale & Newman, 2009). The amenities of these projects, like green space and walkability, make surrounding residential areas more desirable (Immergluck & Balan, 2017; Dale & Newman, 2009). This in turn increases housing costs. Immergluck and Balan (2017) found the median sale price of homes within 0.5 miles of the Atlanta Beltline, an adaptive reuse project, increased significantly more than the price of homes in the rest of the city between 2011 and 2015. Property taxes and rents also increased. This pushes lower-income people out of the area and keeps them from moving in (Immergluck & Balan, 2017). To lessen these effects, city governments can take action to keep housing affordable. Atlanta mandated some funding be put toward affordable housing around the Beltline, but disputes and market forces meant that fewer than 1,000 affordable housing units were built (Immergluck & Balan, 2017). Similarly, in Dockside Green, a Canadian brownfield development, the amount of affordable housing available is much less than the amount suggested during planning (Dale & Newman, 2009). Cities therefore need to take action beyond designating a certain amount of funding for affordable housing or a certain number of affordable housing units in new development. Immergluck and Balan (2017) propose that cities implement measures limiting property tax and rent increases to protect existing housing and require a “significant” (p. 15) percentage of new housing to be set aside as affordable. This combined approach could increase the amount of available affordable housing, but it won’t eliminate all the forces behind gentrification.

To prevent gentrification, cities also need to preserve retail and employment opportunities that serve lower-income residents. Dale and Newman (2009) point out that gentrifiers, typically “young professional couples with high incomes” (p. 672), spur the arrival of businesses that are often not accessible to lower-income residents. Affordable housing might be present in the area, but if other needs of lower-income residents are not met, they could be pushed out anyway. This effect can be countered by providing resident-owned businesses with technical assistance, skill development, and access to capital (Maurrasse & Bliss, 2006). With these resources, the original businesses in the area would be placed on a more equal footing with new ones. Furthermore, if lower-income residents have access to employment at new businesses that includes opportunities for training and advancement, they benefit more from the area’s development (Maurrasse & Bliss, 2006). If development empowers

lower-income communities in these ways, the presence of wealthier residents and new businesses can be an asset to lower-income residents instead of pushing them out.

When the whole community is involved in urban planning, development is more likely to be equitable and not cause gentrification. Citizen involvement in policy making “can place community interests and government decisions in greater accord” (Maurrasse & Bliss, 2006, p. 138). Since government policies influence development, this would guide development into serving the existing community. It could also put extra pressure on the city to implement other policies that counter gentrification, like affordable housing. Resident participation can be made continuous and effective by involving community-based organizations (Maurrasse & Bliss, 2006). These organizations give residents a way to magnify their voices and help consolidate their ideas. This consolidation would make it easier for city governments to react to resident opinions, which in turn would make the partnership between the city and community more effective. This would ensure developers serve all residents of an area, whatever their income level.

Affordable housing, business protection, and development projects desired by the community are less likely to be implemented if urban planners are closely connected with private interests rather than the public. Hanssen (2010) found that in Norway, where private entities have a prominent role in urban development, urban planners had much closer contact with those private developers than the local community. This could be a barrier to hearing citizen input, which would make the community less likely to benefit from development. However, Hanssen (2010) also found that city politicians have extensive contact with both planners and developers, placing them in an ideal position to mediate between the two groups. Since city politicians make policies that guide development, they can ensure community interests are heard and measures against gentrification enacted even if planners have their closest contact with developers.

Scholars such as Agyeman (2003) have argued that sustainable development exists at the intersection of environmental protection, economic growth, and equity. Many modern sustainable development initiatives cover the first two traits, but as gentrification follows the creation of parks and construction of brownfield developments, the third trait, equity, is not realized. This is not truly sustainable: sustainable development is meant to honor the interdependence among all people and the environment, but this is not possible when inequity means certain groups are excluded.

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Sustainability and affordability in urban housing

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When many people think of sustainable urbanism, they picture buildings like the Bahrain World Trade Center or the Robinson Tower, that is, towering, expensive skyscrapers with revolutionary architecture. While these buildings are successful at being low energy, low waste, and environmentally friendly, they are made for a specific group of consumers: middle to high income people. This group of people are able to afford to live in eco-friendly houses with amenities like solar panels, LED lights, wind turbines, and more. However, in order for cities to become more “green”, sustainable living must be created for people of all socioeconomic backgrounds. Sustainable housing should be made accessible at minimal costs to low income communities through integration of green spaces, natural lighting, and cross-ventilation.

Use of green spaces, specifically green roofs, allows residents to connect with nature from their homes. Apartment buildings could have a community garden for all tenants to participate in located on the roof as not to take up more space. A community garden would allow for multiple people to maintain the vegetation, which could include fresh produce, at low costs. While the initial installation costs of green roofs can be high, multifamily green roofs have social benefits, reduce greenhouse gas emissions, and provide a form of natural air conditioning (Blackhurst et al., 2012). Construction of buildings with green roofs does not have to occur from scratch, as modifications can be made to existing roofs to make them viable for a garden. Cities are beginning to pass laws that mandate green space on top of buildings, so by placing these in low income communities, the quota of green roofs are met and a larger group of people benefit from the new laws.

Buildings that are dependent on natural lighting save money on interior lighting and boost productivity. To maximize the amount of natural light, a long and narrow building shape is recommended (Lockwood, 2006). This way, the amount of interior rooms is greatly decreased, and each household has access to the outdoors. Large windows and open floor plans allow more light in and provide a view of outside, which raises morale. Interior lighting would still be required on cloudy days and at night, however electricity costs would be much lower during the day if “daylighting” was observed by each household. Lastly, energy-efficient housing has a positive impact on income due to savings on energy cost (Mulliner et al., 2011). One of the largest household expenses is electricity, so architects and designers can reduce costs by purposefully incorporating natural lighting into homes.

Cross-ventilation is another way to integrate sustainability into low income housing. Mechanical ventilation systems like air conditioners pollute the air and contribute to global warming (Stavrakakis, 2008). In natural air conditioning, each room has an exit and entrance, giving air a passageway to flow thus preventing it from becoming stale. Buildings that use a natural ventilation system cost 40% less than their mechanical counterparts (Stavrakakis, 2008). Another benefit of replacing air conditioning with natural ventilation is the lack of maintenance. If a mechanical system is not properly installed and cared for, it can cause health issues that fresh air would not cause. Cross-ventilation and natural lighting work together, as they both benefit from open floor plans and window access.

A flaw with some of these features is that enforcement is difficult. While “daylighting”, or only using natural light during the day, is extremely cost-effective and has significant psychological benefits, it cannot be guaranteed that everyone will participate. Environmental education is important in this situation, because people are given the knowledge as to how they can help the environment without spending too much money and how their actions have consequences. Green roofs require some work

to maintain, and without monetary compensation, some people may not see the benefits. However, if fruits and vegetables were able to be grown, they would be less expensive than the grocery store variety, which would save money. As population becomes more dense and climate change continues, the demand for energy will boom, yet cities will not be able to supply it. Reducing energy consumption by taking advantage of natural lighting, using non-mechanical air conditioning, and growing produce on a small community scale are ways that people can change their actions to slow down this process.

If individuals were to take steps to live sustainably, their communities would strengthen, grow more adaptive, and become more resilient. A resilient community is defined as “one that takes intentional action to enhance the personal and collective capacity of its citizens and institutions to respond to and influence the course of social and economic change” (Berkes et al., 2013). A city should encourage its citizens and designers to incorporate both affordability and sustainability into urban housing, thus becoming stronger both on an individual and community level. Many sustainable measures have a stigma of being overly expensive, but each individual can take steps to be more environmentally conscious. Whether that means owning a wind farm or simply using less electricity, every contribution is important and unique. Economic status should not impede on a person’s ability to live a more sustainable life.

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Reintroducing nature into urban places

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Entering the border of Jinan City in China, people feel suffocated – rows of residential buildings cluster together along the road like lines of graves left on deserted land. According to official statistics of Jinan, one in thirteen residents has depression, and more are dangling on the edge of depression (2019 Statistics on depression, 2020). People are born to be connected to nature, so introducing nature into the city is indispensable for urban dwellers' physical and mental health. While relatively few urban residents have access to nearby large green spaces, cities can establish more small-scale green spaces such as pocket gardens that are also effective in mitigating depression.

Building small green spaces in communities could foster different cultural practices (Ramaswami, 2013), alleviating people's depression. People in any given neighborhood may come from different places around the world, embodying a variety of cultures. Imagine a pocket garden located between two residential buildings, Chinese people are square dancing to their traditional music, Indians are practicing yoga on their mats, and Americans are growing organic vegetables in the garden. Whose mood would not get better when they are part of this beautiful scene? Furthermore, people in the green spaces could learn from others. Through communicating, people who are depressed could find comfort in new friends and thus ease their condition (Christopher, 2015). According to a research done by Alan Teo, people who met up with family and friends at least three times a week had the lowest level of depressive symptoms two years later--6.5 percent--than those who had less frequent contact (Teo, 2018). Thus, by helping people get together and become involved in cultural practices, small green spaces can relieve depression.

Small green spaces also encourage education programs which can prevent participants, especially elders, from getting depressed. This is due to the fact that green spaces have the capacity to promote intergenerational connections as they interact in the education program (Krasny, 2012). While young people are learning from the old in the education programs, older people are benefiting from the teaching as well--people who suffer from work pressure could have a valuable opportunity to take a break, and the retirees would be able to have more exercise as they step into nature. For instance, in the Garden Mosaic science education program, young people in cities across the U.S. shadowed the older community gardeners, communicating with the elders and learning about the relationship between planting practices and cultural traditions. Therefore, small green places are crucial for preventing depression in older people.

Providing opportunities for people to grow fruits and vegetables is another way that small green spaces can help mitigate depression. This is because many fruits and vegetables contain vitamin A, vitamin B-12, and antioxidants that can protect the body against oxidative stress. A high fruit and vegetable input (FVI) aids in reducing the risk and symptoms of depression. A determinant factor in maximizing the antidepressant effectiveness of the nutrients in fruits and vegetables is their freshness. In one study of 10,602 men living in France and Ireland, higher intakes of fresh raw fruits and vegetables contribute to a less depressed mood (Appleton, 2007). In sum, if people could grow fruits and vegetables in green spaces, they could have more access to a higher FVI. thus reducing their stress-related symptoms of depression.

Tucking small green spaces into the urban fabric connects people with nature and reduces the stress of living in a dense city. Unlike large urban parks, pocket parks can be squeezed into many corners of the metropolis, showing people the beauty of nature. Harvard University professor, E.O.

Wilson in the *Biophilia Hypothesis* (1993, p. 31) presents the idea that humans are “hard wired” to need connection with nature and other forms of life. While walking in the pocket parks next to their workplace or sitting in a small green park in their neighborhood, people will see the trees directing the way and hear the birds humming. These offer psychologically restorative experiences to people, helping them to reduce their stress as they are enjoying nature and finding a balance between work and leisure. Therefore, it is likely that the possibility for people to have symptoms of depression will be decreased if they feel closer to nature in small green spaces.

Some people may argue that urban areas are too dense to permit more green spaces. However, a recent study shows that small green areas could fit into the limited space available in urban areas (Lydon, 2015) and work to relieve depressive symptoms even better. Green walls and green roofs can be implemented in every building without taking up any in-use space, and other tiny gardens could be established in narrow open spaces, providing people with more walkable green areas to enjoy with family and friends, relieving their stress and improving their mental health.

In a nutshell, having more small-scale green spaces within urban areas could be a silver bullet in reducing the percentage of city dwellers who are suffering from depression. It is because small green gardens and parks are effective at fostering different cultural practices, encouraging education programs, providing land for growing fresh fruits and vegetables, and connecting people with nature. Incorporating small green spaces into the fabric of a city is not a difficult task to do, but its success depends on every resident in the city. If people are able to get access to green spaces everywhere within the city, the overall health of individuals will be enhanced, and a happy life will be there waiting for everyone.

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Green roofs for urban climate and civic life

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When people are dealing with the modern environmental problems, they would never solve those problems if they separate nature from the city, both of which must cooperate with each other. As cities become more and more developed, the natural environment has many problems, like haze and the heat island effect, due to people's neglect. Densely distributed high-rise buildings and scarce greenery, for example, lead to a severe urban heat island effect, wherein urban regions are significantly warmer than surrounding suburban and rural areas. In recent years, people plant trees without taking care of them in an attempt to increase green areas, but this method is inefficient. On the one hand, a few trees sparsely planted along the road cannot play a substantial role in bringing enough natural benefit to such a large city; on the other hand, many trees die from the harsh growing environment, and replacing the saplings wastes a lot of money. In contrast, building a green roof can easily increase green areas and does not require the use of additional land; green roofs can absorb solar radiation to lower the temperature inside and outside at the same time while buildings provide a living environment for the green roof with their waste water. More importantly, green roofs efficiently and effectively solve the problem. A regional simulation model using 50% green-roof coverage distributed evenly throughout Toronto showed temperature reductions as great as 2°C in some areas (Bass et al., 2002). Therefore, city governments should require all new buildings to establish green roofs to mitigate the urban heat island effect and to improve the quality of life for their citizens.

Creating green roofs on new buildings is a highly land-efficient and cost-effective way of increasing greening to mitigate the urban heat island effect. Shenyang is a crowded city, with tall buildings everywhere, that only has few parks as green areas. Furthermore, although planting trees on the ground level regions is cheaper than on the roof level, ground space for trees is very limited; exploiting extra space for afforestation costs so much money that the government would not make such an unworthy decision. Therefore, a green roof is a perfect choice to solve these problems: on one hand, most buildings' roofs are vacant, which provide a lot of space for growing plants; on the other hand, it saves a large amount of money since the government would not need to spend money developing expensive new lands for increasing greenery.

In addition, conventional stormwater management techniques include storage reservoirs and ponds, constructed wetlands, and sand filters; however, these surface-area intensive technologies may be difficult to implement in dense urban centers (Mentens et al., 2005). Green roofs are ideal for urban stormwater management because they make use of existing roof space and prevent runoff before it leaves the lot. Green roofs store water during rainfall events, delaying runoff until after peak rainfall and returning precipitation to the atmosphere through evapotranspiration (Mentens et al., 2005).

Besides just planting trees or grasses, people can even grow crops on the green roof. It can not only reduce the carbon footprint—the carbon emission produced by people—by preventing them from driving several miles to buy commercial foods, but also reduce both the interior and outside temperatures and make use of rain water and the used water in the building for irrigation. In other words, it mitigates the urban heat island effect, provides people with some food, and makes better use of wastewater and rainwater.

Finally, these green roofs play a role as green areas like parks where people can relax. Since there are only few parks and gardens in the city, not all the people can easily go to the park or gardens for a walk whenever they want. Besides the concentrated distribution of plants in a relatively small

place like the roof allows the plants to breathe in carbon dioxide and some other toxic gases and then absorb intense sunlight to make the air cool and clean, leading to a great natural lounge for citizens. To sum up, these green roofs can provide people who do not live close to gardens or parks an “artificial natural oxygen bar” to relax in nature.

While green roofs provide benefits for urban climate and air quality, they can be costly. However, implementing new technologies makes them more cost-effective and affordable for developers. A little-investigated avenue is the combination of green roofs with other green building technologies, including solar thermal and photovoltaic applications. One of the key goals of industrial ecology is to move toward integrated ecological-industrial systems that eliminate waste products and maximize energy capture over the entire life cycle of the materials (Korhonen 2005). Green roofs can assist in meeting this goal by providing a sink for gray water among other integrated benefits.

Green roofs benefit the city in two main ways: on one hand, it reduces the urban heat island effect and cleans the air; on the other hand it improves the quality of life by providing a garden as well as an “artificial natural oxygen bar” for citizens.

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