RETHINKING THE INDUSTRIAL LANDSCAPE - REVEALING THE CURATIVE POTENTIAL OF GENETICALLY MODIFIED PLANTS

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RETHINKING THE INDUSTRIAL LANDSCAPE - REVEALING THE CURATIVE POTENTIAL OF GENETICALLY MODIFIED PLANTS

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
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Master of Landscape Architecture

by
Susannah Horton
May 2012

Accepted by:
Matthew Powers, Committee Chair
David Pearson
Ellen Vincent
ABSTRACT

At the turn of the 21st century, much like the turn of the 20th century there has been a major shift in North America with its industries and their impact on the landscape. With a trend of massive deindustrialization of large-scale production facilities throughout the (Gibbs 2003, 222-236) United States, it has directly impacted the landscape. There are currently changes underway in the American industrial landscape emphasizing a new technology whereby pharmaceuticals are manufactured in recombinant plants. These plant-derived pharmaceuticals are poised to become the next major part of the pharmaceutical industry. By recognizing the potential and studying the possible shapes and connections we can begin to visualize, develop and improve the outcomes of a new economy focused on plant derived compounds. It is the intent of this research to investigate the Clemson University community’s perception of these genetically modified plants when put into a curative context. Although genetically modified organisms have been put in a negative light over the past 15 years, when put into a curative context they will have a higher rate of support. Through thoughtful design, the curative potential of these genetically modified plants may be revealed to the public and surrounding community fostering good will between industry and the community as well as offering recreational and educational opportunities to the public along with on site employees. It is also the intent of this research to demonstrate that through building upon an interchange of material and energy flows (Gibbs 2003, 222-236) beginning with pharmaceutical production in plants, a local or regional industrial ecosystem hinging on health can be implemented. The design of such an ecosystem, regardless of size, has the potential to reshape the American industrial landscape. This information may then help guide design decisions in creating an industrial landscape for the future.
DEDICATION

To my family without whom this would not have been possible. Jamie, your support has been immeasurable. Caroline, your arrival was the greatest inspiration of all. My parents have always encouraged growth and exploration, for this and their support, I am most grateful.
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CHAPTER ONE
INTRODUCTION

Changes in the American landscape have been dominated by deindustrialization in the past decades (Bélanger 2009, 79-95; Isaksen 1997, 65-76; Rodwin and Sazanami 1989). Deindustrialization is defined as the long-term decline in employment in the manufacturing sector (Rodwin and Sazanami 1989; Rowthorn and Ramaswamy 1997). There has been a shift from the large planned, centralized industries of mass production to a more decentralized system (Isaksen 1997, 65-76). The landscape has the ability to affect humans in many ways from how land is viewed aesthetically to how it affects health and emotional states (Velarde, Fry, and Tveit 2007, 199-212) and how the land is used functionally (Phillips 1998). There are many aspects to consider from deindustrialization including reclamation and reuse of brownfield sites, environmental concerns for abandoned sites (Bluestone and Harrison 1982), massive layoffs (Perrucci et al. 1988), changing economic structures (McKenzie and Welch 1984; Rodwin and Sazanami 1989) and community abandonment (Bluestone and Harrison 1982), however this research is focused on the role new technology can play in rethinking the industrial landscape.

Though the United States has seen a decline in mass-produced goods (Feenstra 1998, 31-50; Staudohar and Brown 1987), today, the United States is the world leader in biotechnology (Pharmaceutical Research and Manufacturers of America (PhRMA) 2010). American biotech companies account for 80% of research and development worldwide (Pharmaceutical Research and Manufacturers of America (PhRMA) 2010). In
1992, a group of American scientists produced a vaccine for Hepatitis B in a genetically modified tobacco plant demonstrating that plants have the ability to produce relevant pharmaceutical compounds (Mason, Lam, and Arntzen 1992, 11745). Genetically modified plants (GMPs) are plants that contain an additional trait determined by introduced genes, which typically produce additional proteins (Ahmed 2002, 215-223). Currently there are 213 drug shortages in the United States alone (fda.gov). With a new method of production available, plant derived pharmaceuticals have the potential to alleviate an array of problems faced by the country as a whole. By focusing on the public perception of genetically modified plants and understanding the various forms and functions of past industrial and healing landscapes we may then begin to design and envision a new industrial landscape, one that not only produces healing compounds but promotes general well being, reveals and illuminates the benefits of new technologies, creates educational opportunities for the public to learn about new technologies such as plant manufactured pharmaceuticals and generates feelings of connection and good will between industry and the public.

Since the United States is a leader in biotechnology research and advancements (Pharmaceutical Research and Manufacturers of America (PhRMA) 2010), and though there is now a large skilled but unemployed workforce due to loss of manufacturing to overseas companies as well automated production practices (Berman, Bound, and Griliches 1994), the United States should be well positioned to move into a new era of American industry. The United States dominates the market for commercial application of biotechnology research and findings (Shan and Song 1997, 267-284) although
Americans are less able to actualize the important follow thorough in turning these innovations into products and manufacturing processes required to turn new technology into a constant stream of commercial products (Florida and Kenney 1990).

“The crux of the situation is that the U.S. technology system is heavily biased in the direction of major new technological discoveries, or breakthroughs.”

Florida and Kenney in *The Breakthrough Illusion* 1990

Florida stresses the importance of synergistic interactions between well-funded R&D and integrated manufacturing. Without the integrated manufacturing, we do not have the ability to capitalize on our innovations. What does this mean for the United States? There is a new technology, a breakthrough, in plant-derived pharmaceuticals. There has been a loss of manufacturing jobs due to massive deindustrialization (Feenstra 1998, 31-50) and we have a large number of drug shortages in the United States, but we are the world leader in biotechnology (Pharmaceutical Research and Manufacturers of America (PhRMA) 2010). By using GMPs and plant-derived pharmaceuticals as the catalyst, a new form of industry can evolve.

Through understanding the role of plant derived pharmaceuticals in a new industrial landscape, it provides the opportunity to answer many of the challenges that are faced today and to change the approach to health care, specifically during diagnosis and treatment. By taking a collaborative approach and encouraging links between different
sectors of the industry, in this case diagnostic and pharmaceuticals, this study propose that the collaboration can spill into other areas and promote better communication between sectors where each can benefit from this increased collaboration and communication.

This research proposal seeks to determine how emerging technology has shaped our industrial landscape over the past century and to understand what a new landscape with plants as the main production engine would look like. Specifically, this study focuses on the perception of genetically modified plants and the design implications that result from these perceptions. It is proposed that if the potential of a new technology in plant derived pharmaceuticals is recognized, public perceptions of using this new technology are understood and the implementation of such an industry is well planned and deliberate, the power of integrated manufacturing, of turning a new technology into a commercial application may then be harnessed. By understanding, planning and designing for this new technology in advance, then the concepts of industrial ecology and consumer experience tourism can be applied to maximize the benefits by linking industries to each other and their and communities.

The site in this research study is an agricultural campus in Charleston, SC focused on research, small-scale production, process development, education and public outreach, this study will help poise pharmaceutical and diagnostic companies for large scale applications of this new technology. America will have the ability to take this breakthrough, and channel it’s potential into a new industrial landscape.
CHAPTER TWO
LITERATURE REVIEW

Industrial Landscapes and Industrial Ecology

The American industrial landscape has seen a shift in the past 30 years due to massive deindustrialization (Bluestone and Harrison 1982; McKenzie and Welch 1984; Patch 1995). This shift provides an opportunity to examine the previous model of industry, the planned industrial district and single use zoning from the turn of the 20th century and propose needed changes. Learning from and then understanding the long-term effects of industrialization at urban and regional scales can help shape the landscape in an economically and environmentally sensitive manner. This emerging field of industrial ecology is an approach to industry that introduces a change to both product and environmental focuses from a linear to a materials cycle approach (Graedel, Allenby, and Linhart 1993, 18-26). It places equal importance on economic development and environmental quality (http://cie.research.yale.edu/).

Figure 1: Industrial ecology in practice at Kalundborg, Denmark (http://newcity.ca/Media/Kalundborg.gif)
Industrial ecology takes the industrial district and attempts to understand the potential for environmental improvements where both the processes and the industries are viewed as systems that interact (Gibbs 2003, 222-236). Gibbs also states that this provides a way to connect systems through process outputs or industries into a web that is designed to minimize waste. By locating a cancer research and small-scale production facility in the West Ashley district of Charleston, South Carolina, exploration into the industrial ecological relationships that might form through the planning and design of a research campus may begin.

In order to move towards a system where industrial relationships are more symbiotic, the history of the American industrial landscape must be explored. Industrial districts and parks shaped the industrial landscape of the 20th century. Industrial parks have been single zone places of economic activity since as early as 1905 (Lewis 2004, 29-49). Recently there has been a push to make them sustainable eco-parks, but the design of the parks as compared to traditional industrial parks has not seen major changes (Peddle 1993, 107-124). Peddle also noted that the Urban Land Institute updated the title of the handbook on industrial development from simply the Industrial Development Handbook to the Business and Industrial Park Development Handbook with little changes to the subject matter. These eco-industrial parks are co-dependent through shared processes or waste cycling, but it ends there. One may use the by-products of the other but there have yet to be cases documented where products from initial conception (research and development) to production (manufacturing) to consumer, in
this particular study where the patient would be the consumer with a medical professional providing the diagnostic and therapeutic expertise.

Another factor influencing the industrial sector is the scale at which things are now produced. As we move toward sustainable production and consumption, there have been improvements in the processes and products (Isaksen 1997, 65-76). The mass production economy of the United States has adopted the lean production ideas of Japan (Robins and Kumar 1999, 75-94; Feenstra 1998, 31-50; Staudohar and Brown 1987). These shifts in production can then begin to shape the physical layout of production spaces where large swaths of buildings and land for single use mass production can be shifted to smaller scale multi-dimensional sites where research, development, small scale production, consumption and public education and outreach can all coexist. A multilayered system has the ability to become more uniquely tailored toward industry demands. The proposed site in Charleston at the Clemson University Coastal Research and Education Center has the ability to encompass the whole. The scope of this project will touch on the broad implications of an industrial ecosystem while focusing on the design and implementation of a research campus with a public outreach and educational component, a small but essential part to the health landscape.
Plant Manufactured Pharmaceuticals

Plants have been used for centuries to cure and prevent disease, and recent advances in biotechnology have been made to allow plant cells to produce complex proteins (Ma et al. 2005, 580-585; Jamal et al. 2009, 7-12). These therapeutic proteins are more commonly known by their pharmaceutical brand names like Herceptin, the breast cancer treatment, Enebrel and Remicade for rheumatoid arthritis and Rituxan and MabThera for non-Hodgkin’s lymphoma to list a few (Elbehri 2005; Jamal et al. 2009, 7-12). Plant manufactured pharmaceuticals are therapeutic compounds, including those listed above, that are produced in genetically modified plants (Andrawiss 2006, 42-52).

These compounds have traditionally been produced through inoculating animals or in the laboratory through mammalian cell culture techniques (Andrawiss 2006, 42-52). Fischer et al. claim that we are facing a growing demand for protein therapeutics and diagnostics with a shortage of facilities to produce such compounds. It is estimated that up to 50% of therapeutic antibodies can be delayed in manufacturing due to lack of capacity (Elbehri 2005). A shift to plants as the bioreactors would enable flexibility in manufacturing, have a focus on target therapy with minimized side effects, save money and increase capacity (Elbehri 2005).
Genetically Modified Organisms and Public Perceptions

Genetically modified plants are created by altering the genetic material in a plant to improve or to change its characteristics (Mitrovic and Tosic 2006). Perceptions of such plants are important when proposing that manufacturing be moved from the laboratory to the field. There have been a number of studies that show two things. One, that genetically modified organisms (GMOs) have been seen in an increasingly negative light but the other, that these GMOs are seen as advantageous if there are sufficient benefits (Hossain et al. 2003, 353-365; Specter 2000, 58-71; Moon and Balasubramanian 2004, 186-208). Hossain et al. report that less than 60% of Americans support the use of genetic technology in food crops when there are no tangible benefits while that number increases to over 80% when there are benefits like rice fortified with vitamin A called Golden Rice (Hossain et al. 2003, 353-365), a huge public health victory when put in the following context. A third of the world’s population relies on rice for a dietary staple but more than 100 million children worldwide suffer from Vitamin A deficiency. This deficiency leads to loss of eyesight of millions and at least two million deaths due to other related infections annually. With the introduction of Golden Rice, this product has the potential to alleviate more suffering than what any other single drug has accomplished over history (Specter 2000, 58-71).

Another study delved further into public perception of agrobiotechnology focusing on GM foods and found that lack of trust of governmental agencies coupled with perceived involuntary exposure to risk were the driving forces behind viewing GMOs in a negative light (Moon and Balasubramanian 2004, 186-208). This negativity
may stem from an increased perception of risk due to lack of trust in federal regulators along with negative reporting from the media (Nevitt et al. 2006; Hossain et al. 2003, 353-365).

An important point to these findings is that consumers tend to overestimate risk when it is involuntary, and that a “right-to-know” provision and allowing consumers to make an informed decision can alleviate these negative perceptions (Moon and Balasubramanian 2004, 186-208). To date, few studies have been performed focusing on GMOs used for pharmaceutical purposes. Nevitt et. al conducted a telephone survey to gauge consumer response to plant derived pharmaceuticals produced in tobacco. The findings showed support for plant derived pharmaceuticals when the plant alternative was less expensive than the conventional pharmaceutical (Nevitt et al. 2006). Perceptions of risk and other ethical concerns were offset by the perceived medicinal advantages (Frewer et al. 2004, 1181-1193) and United States consumers supported agricultural biotechnology applications for producing pharmaceuticals over using transgenic animals (Hoban 1998; Falk et al. 2002, 1384-1390; Initiative 2004).
Production Advantages and Concerns

There have been clear advantages to using plants as pharmaceutical production systems documented, but there are also risks and regulatory hurdles that must be considered (Kirk et al. 2005, 449-462). Advantages included in using plants as bioreactors for pharmaceutical production are a drastic reduction in production costs which have been calculated to save four to five times as compared to cell culture production, large production capacity, faster scale up process, a variety of available plant hosts, the ability to create specific, even patient specific antibodies quickly and effectively, and high production levels from individual plants (Gomord et al. 2004, 83-100). According to the phase I clinical study for the treatment of non-Hodgkin’s lymphoma using plants as the bioreactor, the process allowed for the rapid production and recovery of therapeutic antibodies derived from each patient’s tumor. This allowed the patients to be immunized with a highly specific, individually tailored therapeutic antigen (McCormick et al. 2008, 10131).

A plant derived pharmaceutical production system would also allow for predominantly agricultural societies, particularly in developing countries, to improve health by being able to produce therapies that control infectious diseases including but not limited to HIV/AIDS, hepatitis B and cholera (Ma et al. 2005, 580-585). Although the benefits are numerous, there are risks associated this new technology as there is with any new technology. The risks include contamination of food crops, limited shelf life of some crop types, and the current negative opinion of genetically modified crops, most notably
in Europe (Fischer et al. 2004, 152-158; Ma et al. 2005, 580-585; Mihaliak et al. 2005, 158). Concern over any economic advantages to farmers or pharmaceutical consumers has also been raised by a group called the Union of Concerned Scientists (Marris 2007, 9-9), however this group does not concentrate on the economic impact of the system as a whole.

According to figures released by a Canadian insulin manufacturer one acre of their transgenic safflower would give a yield of over 1 kilogram, enough to supply 2500 patients with insulin for the year (Lewcock 2007). With the world demand at 5000 kg and expected to rise dramatically in the next decade, new production methods are needed. Currently three suppliers control the majority of the world’s production of pharmaceutical grade insulin and use traditional laboratory techniques producing insulin through cell culture (Lewcock 2007).

Critics want plant manufactured pharmaceutical crops restricted to greenhouses and non-food crops. Proponents say drug-producing plants can be safely grown outdoors (Munro and Service 2007, B6). Greenpeace activists have expressed concern over contamination of the food supply while scientists and supports argue that chemical manipulation in the laboratory including intense purification cycles are required to activate the proteins (Munro and Service 2007, B6). Simply put, the plants are the raw material that still must be processed to harness the curative compounds.
Therapeutic, Healing and Restorative Landscapes

Building upon the idea that an industrial landscape may potentially double as an agricultural landscape, this study also introduces the idea that it could also be a therapeutic or healing environment. As Wilbert Gesler succinctly put it in his book *Healing Places*, place matters to health (Gesler 2003). He further argues that there is a tendency to focus on current thinking while ignoring the influences of the past. Healing environments have been a part of human history for thousands of years. The Temple of Asclepius at Epidauros elegantly combined the natural, built and social environments into a place of healing. The ecology of the buildings was one that invited learning, commerce, healing and relaxing in one small area (Burford 1969; Gesler 1993, 171-171).

Healing environments have enjoyed a recent resurgence in study. Led by Roger Ulrich’s study on views through windows influencing recovery from surgery, it has been found that when subjects are exposed to views of nature recovery times are faster, stress is reduced and attention levels are heightened (Ulrich 1981, 523-556; Ulrich 1984, 420; Ulrich 1986, 29-44; Ulrich et al. 1991, 201-230).

Natural environments are more desirable and enhance stress recovery (Ulrich 1984, 420; Ulrich 1981, 523-556; Ulrich et al. 1991, 201-230; Ulam 2006, 46, 48-53; Ulrich 1986, 29-44). Nature scenes included those dominated by vegetation including cultivated fields and nature scenes with water have positive influences on emotional state (Ulrich 1981, 523-556). Nature scenes including fields with high openness lead to high levels of tranquility and low levels of feeling danger (Herzog and Chernick 2000, 29-39).

Leather et al. expanded on Ulrich’s 1984 work and found that it is not the level of
illumination from windows that is most important for workers but the proportion of natural elements they can see from the window (Leather et al. 1998, 739-762).

Other researchers have found that intense focus and long periods of directed attention leads to fatigues but that restorative environments allow for a resting period from this focus (Kaplan 1987, 3-32; Kaplan, Kaplan, and Brown 1989, 509-530; Kaplan and Kaplan 1989; Kaplan 1993, 193-201; Russ 1991, 1-23). Such restorative environments have four distinct features: being away, an ‘otherworldly’ quality (Kaplan 1995, 169-182), soft (or quiet) fascination, and compatibility (Herzog, Maguire, and Nebel 2003, 159-170).

By including design elements found in therapeutic, restorative and healing environments, the proposed research campus will incorporate multiple layers of healing, revealing and illuminating from the actual pharmaceuticals produced to the nature of the space. It is the intent of this research and design to create a healing landscape that not only produces healing compounds, but gives respite to those who work and visit the campus, providing a sanctuary for mind, body and spirit during the work day and beyond.
Consumer Experience Tourism

Each of the following topics is important for the growth of a new industry in plant-manufactured pharmaceuticals. By focusing on the perception of a new technology and recognizing that there may be skepticism of new technologies, particularly in dealing with genetically modified plants. By engaging the public and providing an opportunity to understand the motivation, the process and the opportunities that lie behind the plant manufactured pharmaceutical industry it is proposed that the venture will be more successful. Through consumer experience tourism, which for this study will be defined as an attempt to establish a bond or understanding between consumer and company, the potential of new technologies can be introduced to the public as they learn about the brand, the production process and any history associated with the industry or even the site on which the plant is located (Mitchell and Mitchell 2001b, 1-16). Lukas notes “company museums create the specter of the Wizard of Oz, but factory tours provide a glimpse of the man behind the curtain” (Lukas 1998, 170-171).

Many companies have recognized the value in consumers bonding with brands through plant tours or while visiting company museums or visitor centers (Mitchell and Mitchell 2001b, 1-16). Having activities and spaces dedicated to public outreach and education allow the company to fully share their message, and conveys a sense of openness and transparency (Mitchell and Mitchell 2001a, 61-77).

Harris (Harris 1989, 38-42) and Prentice (Prentice 1993) note that factories and mines historically employed a large percentage of the American workforce. In the shift from a skilled manufacturing economy to a serviced based economy, a nostalgic view of
industrial work has been created (Mitchell and Mitchell 2001a, 61-77). Rudd and Davis point out that the Industrial Revolution defined much of American history (Rudd and Davis 1998, 85-89) and companies that provide a glimpse into their manufacturing and production processes speak to America’s industrial history while look forward to the innovative future (Mitchell and Mitchell 2001a, 61-77). In short, a visitor center works to promote education and foster good will between the public and a private business. Campus tours clarify misconceptions and offer a level of transparency that in turn fosters good relationships between private sector businesses and their surrounding communities.
CHAPTER THREE

METHODOLOGY

The research questions were answered using a combination of qualitative and quantitative research design strategies. The first strategy was in the form of case studies. Studying specific examples from the bodies of knowledge reviewed in the literature helps in understanding the different subjects and any connections they have with one another. Because research is creating a set of patterns, there was a need to take parallel examples to dissect and understand how they can help guide design decisions in rethinking industry.

The second strategy was in the form of a survey containing questions to be answered along the Likert scale. According to Punch, the purpose of a survey is to quantitatively describe a sample in terms of proportions and percentages of people who respond in this way or that to different questions (Punch and Punch 2005). The survey was used to study the acceptance of genetically modified plants used to manufacture pharmaceuticals amongst the Clemson University faculty, staff and students. The results of the survey were used to inform design decisions of the proposed research campus.

By forming a holistic understanding of technology, the industrial landscape and the interactions that all of the industries have with each other and the environment as well as understanding the influence of both modern and ancient therapeutic landscapes, we can then begin to envision an industrial landscape that is sustainable and healing on multiple levels.
Survey Plan of Work and Data Collection Methods

The population identified for the survey was the Clemson University population, which includes faculty, staff and students. This survey aimed to find the current rate of acceptance of genetically modified plants, which were put into a curative context, amongst Clemson University faculty, staff and students. The data collected included individual perceptions of genetically modified plants in two different contexts using a Likert rating scale. Participant’s age range, gender, Clemson affiliation (faculty, staff or student), and major or department was asked. The Clemson University Institutional Review Board application for the survey outlines these steps (Appendix A).

Participants were approached by an email invitation that contained a link to SurveyMonkey, a Web based survey program (Appendix B). At SurveyMonkey the participant read the consent form and checked a box indicating they were willing to participate in the survey (Appendix C). Then two survey questions were asked followed by four demographic questions. Data was downloaded as Excel files and charts. One survey session took approximately 3 minutes. Participants were anonymous and only identified by age, gender, Clemson affiliation (faculty, staff or student) and major or department.

An email was sent inviting 1000 faculty, 1000 staff and 5000 students to participate in the survey, providing them a link to SurveyMonkey. The email invitation was to be resent after one week if less than 100 responses were received.
Case Studies

Kalundborg

The town of Kalundborg in Denmark is about 100 km from the capital of Copenhagen, but this small industrial town is famous in its own right. Kalundborg is home to the most advanced implementation of the concept of industrial ecology that can be found worldwide. The field of industrial ecology has developed to focus on creating linkages between separate industrial activities based on studying the byproducts of one and the energy or materials (also called feedstocks) required of another (Ehrenfeld and Gertler 1997, 67-79).

This small town has become the best example of industrial symbiosis, a principle in the field of industrial ecology where four large industries and the town share materials, energy and recycle waste materials (Cohen-Rosenthal 2000, 245-264). Although the arrangement of the four industries is not accidental, the focus of the industrial complex was not to design an eco-industrial park or to design a system around the principles of industrial ecology, it was a combination of creative business practices and environmental awareness (Ehrenfeld and Gertler 1995). The links in the industrial system of Kalundborg have formed over the past 40 years, and these 11 loop closing links have reduced material and energy throughput without hindering production or compromising quality (Jacobsen and Anderberg 2005, 313-335). The system of Kalundborg is complex, but the links are an important aspect. By focusing on how each is linked to the other and what the cost...
would be if they were not linked, it demonstrates that through creative solutions, these are still the most sound business decisions.

The initial links in Kalundborg revolve around the sale of waste products, or in Novo’s case, the removal of waste products at no cost, with little or no processing while the more recent links focus on the application of new pollution control strategies. These links alter the by products to make them environmentally benign and resalable, something that the United States Environmental Protection Agency (EPA) has made illegal. The Danish EPA has a different approach, looking at waste streams on a case-by-case basis in order to find use for industrial by products. This flexibility has allowed Kalundborg to house industries that gain financially while promoting environmental stewardship. As Gertler says, the decision makers in the four companies are profit seekers as managers but as individuals they are environmentalists (Ehrenfeld and Gertler 1995).

Research Triangle Park

Research Triangle Park was created in 1959 and is considered one of the most successful research parks in the world (Link 1995). It occupies 6700 acres in the middle of a triangle formed by UNC Chapel Hill, NC State and Duke. There are over 50 R&D oriented companies, DuPont, IBM, BASF, GlaxoSmithKline, Novo Nordisk to name a few of the larger ones, and a host of smaller, more specialized companies. They are spread through the park in low density, low rise buildings in, as the name suggests, a park like, wooded setting (Luger and Goldstein 1991).
In the mid 50s, North Carolina Governor Luther Hodges formed a committee to investigate how the strengths of the state’s research universities could help North Carolina’s economy (Link 1995; Link and Scott 2003, 167-175). The committee found that the 3 universities, Duke, UNC and NC State could attract a concentration of industrial research labs to the region to take advantage of faculty expertise in their particular fields. It was an industrialist, Karl Robbins, who was recruited as an investor that came up with the idea of a park (Luger and Goldstein 1991). He proposed to build a park on 4000 undeveloped acres between the universities. For almost 10 years, the park idea was stagnant, but when IBM bought a large site, several more large multinational companies followed suit (Luger and Goldstein 1991).

Currently because of strict building and site restrictions along with zoning, smaller start up companies are not longer able to afford space in the park and as a result growth has slowed. In addition to the lack of start up companies, there has not been growth from the manufacturing sector (Link 1995; Link and Scott 2003, 167-175). One of the original goals of the park was to achieve overall statewide economic development (Luger and Goldstein 1991). There was an expectation that the manufacturing production of these large R&D companies would locate in the Triangle and provide a large number of working class employment opportunities in the park. According to Luger and Goldstein in their book Technology in the Garden, this will not materialize until the state improves the overall skill and educational levels of non-university trained employees (Luger and Goldstein 1991).
The Greenbrier Resort

The Greenbrier Resort was another place that deserved attention. The Greenbrier is a 6500-acre historic health oriented mineral springs resort (Lund 1996, 11-16). In the summer of 2011, owner Jim Justice announced plans to further develop the resort’s healthcare sector by expanding their existing executive clinic into a world class health institute, saying this "forward-thinking medical initiative…will dramatically impact how healthcare is delivered around the world" (Cosgrove).

The area in which the Greenbrier is located was originally Shawnee Indian land, and the small marsh surrounding the spring was an ideal hunting spot (Conte 1989). According to Shawnee legend, two young lovers snuck into a valley to escape the notice of their elders when their chief caught them instead. He shot two arrows, killing the boy and narrowly missing the girl. A sulphur spring appeared where the second arrow pierced the ground, and it is said that when the last drop of water is drunk from the spring, her lover will be brought back to life (Conte 1989). The earliest written account of the curative powers of the waters come from testimonials from a Mrs. Anderson, who in 1778 was carried 15 miles to the springs in an attempt to cure her rheumatism (Conte 1989). Her recovery over the next few weeks was so complete that word of the curative powers of the spring spread to others, and many others came to take the “cure” (Conte 1989). After Mrs. Anderson’s visit, a small group of primitive cabins were built around the spring, beginning the spring’s development into a top rated health resort (Lund 1996, 11-16).
The evolution of the Greenbrier is interesting: from a Native American swamp to a grand resort with functions as a hospital during two wars and a “house” for foreign diplomats in between (Conte 1989), all the while having springs that have a reputation for having curative properties. The resort has shown that it is multifunctional and adaptive, though it has a history of financial troubles (Lund 1996, 11-16). In 1947, the Greenbrier Clinic was created in recognition that many business executives aged prematurely and that preventative healthcare in a pleasant environment was a sound investment (Lund 1996, 11-16). Moving this idea forward, the current owner, Justice would like to capitalize on the Greenbrier’s adaptive and multifunctional history and establish a medical destination focusing on sports performance, wellness, research, product development, education, cosmetic surgery, and preventive care (Cosgrove 2011).

Epidaurus

The last and oldest case study is the example of a Greek sanctuary outside of the seaside town of Epidaurus. The Sanctuary of Asclepios is steeped in history and mythology, and its prominence, as a place of healing, is well known. The temple complex at Epidaurus was built as a sanctuary of the god Asclepios. This sanctuary was one of the most important and revered Askelpieia (Papadakis, Meletzis, and Papadakis 1972), as the places that Asclepios was said to have healed were known (Gesler 2003). It flourished as a place of worship and healing from the fifth century B.C. blending spiritual and therapeutic methods (Burford 1969). The sanctuary outside of Epidaurus embodied the Greek ideal, which called for placement on clear, elevated spots in rural areas. The
journey from the town to the sanctuary was an important part of the healing process (Gesler 1993, 171-171). The 15 km journey is rugged and beautiful, and as anthropologist James Frazer said of his trek in 1890, it has a “pleasing solitariness about it,” (Gesler 1993, 171-171). This shelter along with the ecology of the buildings formed a powerful healing landscape, a place where the natural, spiritual and built environment combined contributed to the healing sense of place (Gesler 2005, 295-297).

Through reading the histories of four very different places a few things were apparent and important for consideration. In Kalundborg, the principles of industrial ecology are apparent as well as the success of the arrangement, however, newly formed eco-industrial parks have tried to mimic the symbiosis found in Kalundborg with varying success (Ehrenfeld and Gertler 1995). In North Carolina at Research Triangle Park, the park floundered for almost 10 years until IBM announced it would have a large operation there. In other words, the success of Research Triangle Park hinged on a large name, well-known corporation locating there (Link 1995). The Greenbrier Resort was built around its healing springs. It has changed owners several times and its successes have been up and down. The current owner has plans to make the Greenbrier into the next destination medical clinic, but questions arise as to whether this is feasible or appropriate for rural West Virginia (Cosgrove 2011). Finally, the Greek sanctuary of Epidauros was prominent healing space for centuries, and the important aspect of this case study is how to relate that sense of healing to a modern landscape (Gesler 1993, 171-171).
CHAPTER FOUR

GENERAL CONDITIONS

The research on the case studies did not accrue any associated costs. The duration of the case studies was approximately two months.

The administration of the survey had an associated cost of $25.00/month for the use of SurveyMonkey Gold. The duration of the survey and the analysis of the results was approximately two months with one month dedicated to administering the survey and one month for the analysis.

A possible limitation of the survey is that it was given to a university population where acceptance of new technologies may be higher. Another possible limitation is that the case studies are parallel case studies to the proposal. Since this research is focusing on a new technology, there are no precedents upon which to compare, contrast or improve.
CHAPTER FIVE

RESULTS

Case Studies

Each of the case studies informed the resulting design guidelines in various ways.

The attached matrix outlines the significance of the case studies.

<table>
<thead>
<tr>
<th>SITE</th>
<th>THERAPEUTIC PROPERTIES</th>
<th>ECOLOGICAL COMPONENTS</th>
<th>PRODUCTIVE ASPECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPIDAUROS</td>
<td>From its beginning, the site became a therapeutic landscape with a strong connection to the natural environment. The landscape features include a therapeutic garden and a healing forest.</td>
<td>The site provides a natural setting with a focus on spiritual and therapeutic components, such as a therapeutic garden and a healing forest. It also includes a therapeutic path for meditation and relaxation.</td>
<td>The site serves as a therapeutic retreat and a place for spiritual reflection. It includes a healing forest and a therapeutic garden.</td>
</tr>
<tr>
<td>KALUNDBORG</td>
<td>The site features a therapeutic garden with a strong connection to the natural environment. The garden includes a therapeutic path for meditation and relaxation.</td>
<td>The site provides a natural setting with a focus on spiritual and therapeutic components, such as a therapeutic garden and a healing forest. It also includes a therapeutic path for meditation and relaxation.</td>
<td>The site serves as a therapeutic retreat and a place for spiritual reflection. It includes a healing forest and a therapeutic garden.</td>
</tr>
<tr>
<td>THE GREENBRIER RESORT</td>
<td>The site features a therapeutic garden with a strong connection to the natural environment. The garden includes a therapeutic path for meditation and relaxation.</td>
<td>The site provides a natural setting with a focus on spiritual and therapeutic components, such as a therapeutic garden and a healing forest. It also includes a therapeutic path for meditation and relaxation.</td>
<td>The site serves as a therapeutic retreat and a place for spiritual reflection. It includes a healing forest and a therapeutic garden.</td>
</tr>
<tr>
<td>THE SALK INSTITUTE</td>
<td>The site features a therapeutic garden with a strong connection to the natural environment. The garden includes a therapeutic path for meditation and relaxation.</td>
<td>The site provides a natural setting with a focus on spiritual and therapeutic components, such as a therapeutic garden and a healing forest. It also includes a therapeutic path for meditation and relaxation.</td>
<td>The site serves as a therapeutic retreat and a place for spiritual reflection. It includes a healing forest and a therapeutic garden.</td>
</tr>
<tr>
<td>RESEARCH TRIANGLE PARK</td>
<td>The site features a therapeutic garden with a strong connection to the natural environment. The garden includes a therapeutic path for meditation and relaxation.</td>
<td>The site provides a natural setting with a focus on spiritual and therapeutic components, such as a therapeutic garden and a healing forest. It also includes a therapeutic path for meditation and relaxation.</td>
<td>The site serves as a therapeutic retreat and a place for spiritual reflection. It includes a healing forest and a therapeutic garden.</td>
</tr>
</tbody>
</table>

Figure 2: Case Study Matrix
Survey

870 respondents completed the survey. A total of 7000 were invited to take the survey. The random sample was comprised of 1000 faculty, 1000 staff and 5000.

The survey demonstrated that when genetically modified plants are put into a curative context (i.e. they cure cancer) approval increases dramatically. The first question sought to determine how the participant felt about genetically modified plants at that time. The largest portion of respondents, 354 or 40.7% neither supported nor opposed genetically modified plants. When asked how the participant felt about genetically modified plants that are used for curative purposes, i.e. to cure specific types of cancer, at that time, support increased from 26.9% (234 respondents) to 49.8% (433 respondents) and strong support increased from 7% (61 respondents) to 33% (287 respondents).
Table 1: How do you feel about genetically modified plants (GMPs)?

How do you feel about genetically modified plants that are used for curative purposes i.e. to cure specific types of cancer right now?

Table 2: How do you feel about genetically modified plants used for curative purposes (GMPc)?
The data was then filtered to examine the results by the demographic categories.

Table 3: Gender GMP

Table 4: Gender GMPc
Table 4: Age GMP

Table 5: Age GMPc
Table 6: University Status GMP

How do you feel about genetically modified plants right now?

Table 7: University Status GMPc

How do you feel about genetically modified plants that are used for curative purposes, i.e. to cure specific types of cancer, right now?
Table 8: University Affiliation GMP

Table 9: University Affiliation GMPC
Design Guidelines

The case studies and the survey responses resulted in the creation of the following design guidelines. Each guideline reflects the data gathered. These guidelines listed below were then applied to the conceptual development along with the final design:

Provide inviting entrances from the main road and through multiple access points along the greenway.

Provide visual access from the main road and through framing the center from key points.

Provide office and laboratory space.

Provide visiting scientist housing.

Create a variety of outdoor spaces including small plazas between campus buildings, interpretive walking trails, demonstration crops and gardens with both GMPs and traditional medicinal plants and private open space for visiting scientist housing.

Create opportunities for education and illumination by providing educational + interpretive signage and a visitors center.

Provide security for the crops through the use of attractive yet functional fencing around the crops.
Site Inventory and Analysis

Current landscape architecture projects were studied to gain insight and inspiration for the design of the Clemson Coastal Research and Education Center (Coastal REC), the site chosen for the design application.

Figure 3: Coastal REC Site Map and Images
CLEMSON COASTAL REC. west ashley

Figure 4: Coastal REC Site Images

Figure 5: Coastal REC Contextual Surroundings Map
Figure 6: Coastal REC Site Analysis Study
Precedent Studies

Contemporary landscape architecture projects were studied to gain insight and inspiration for the design of the Clemson Coastal Research and Education Center (Coastal REC), the site chosen for the design application.

Figure 7: Park Merced Precedent Study

Figure 8: Viet Village Precedent Study
Figure 9: Salk Institute Precedent Study

“A work of art to serve the work of science.”

James Doherty describing the Louis Kahn-designed Salk Institute for Biological Sciences.

The Salk Institute for Biological Sciences occupies a 27-acre coastal site in La Jolla, California. The heart of the institute is an open-ended central courtyard that divides two parallel wings that house laboratories and private studios. Founded by Jonas Salk in 1960, the institute was created to gather together a new community of scientists and scholars engaged in research to prevent and cure human disease. Salk envisioned a kind of secular monastery for people of different disciplines and backgrounds. In working with Kahn, the project quickly grew from a single laboratory building to a small campus.

Figure 10: Kresge Foundation Precedent Study

A LEED-certified building completed in 2006 is nestled by ponds that capture stormwater and attract wildlife at the foundation property. Several outbuildings from a 19th-century farmstead have been preserved along with the 1852 split-rail fence stone Greek Revival house that welcomes visitors and is joined to the modern building. LEED: Leadership in Energy and Environmental Design, is a rating system established by the U.S. Green Building Council.

“Foremost, we wanted to create a workplace that promotes health and productivity for Foundation staff, scholars, and the many nonprofit organizations that visit our space each year,” says John D. Marshall, III, CEO and president of The Kresge Foundation. “Preserving the historic structures was also very important to us. In building green, we found a way to do both and more. We’re preserving the past, supporting current needs of the Foundation and its grantees, and doing so in a way that is sustainable and respectful of future generations.”

Figure 9: Salk Institute Precedent Study

Figure 10: Kresge Foundation Precedent Study
Conceptual Development

The design guidelines, the site inventory and analysis and the precedent studies helped derive a concept for the design application focusing on illuminating and revealing the potential of a new technology using genetically modified plants that have curative properties. Concept sketches helped define the scope of the design.

Figure 11: Initial Conceptual Sketch

Figure 12: Further Conceptual Development
Design Application

Conceptual development led to the final design illustrated through perspective images and plan drawings.

Figure 13: Perspective rendering with views of the research crops and visitor’s center

Figure 14: Campus master plan detailing the response to the design guidelines
Figure 15: Perspective rendering of the Sacred Grove near the visitor’s center

Figure 16: Enlargement of campus master plan including more detailed response to the design guidelines
CHAPTER SIX

CONCLUSION

In a broad sense, this study attempted to discover whether the crux of the problem of which Richard Florida spoke can be addressed and that is whether a new technology in plant derived pharmaceuticals could be turned into a profitable, commercial product. Specifically, this study aimed to address the issue on perceptions and acceptance of genetically modified plants when put into a curative context.

It is proposed that this is a viable industry and that the success depends upon three key points: revealing the potential for the new technology, providing transparency in process and explaining the benefits while weighing any perceived risk. In this application, a research and production campus focusing not only on the curative benefits of genetically modified plants for pharmaceutical but the inherent healing capacity of a landscape for workers, visitors and the environment as well as the creation of new industrial activity attempts to address many of the problems faced today.
Appendix A

Exempt Review Application
Clemson University Institutional Review Board
(Version 10.28.2011)
Clemson University IRB Website

<table>
<thead>
<tr>
<th>Office use only</th>
<th>Protocol Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Approved</td>
<td>Exemption Category ________</td>
</tr>
<tr>
<td></td>
<td>Signature of IRB Chair / Designee</td>
</tr>
</tbody>
</table>

1. **Developmental Approval:** If you already have developmental approval for this research study, please give the IRB protocol number assigned to the study. More information available here.

2. **Research Title:**

   Acceptance of genetically modified plants used to manufacture pharmaceuticals at Clemson University: A contextual perception survey

   If different, title used on consent document(s)

   If class project, include course number and title: LA_891

3. **Principal Investigator (PI):** The PI must be a member of the Clemson faculty or staff. You cannot be the PI if this is your thesis or dissertation. The PI must have completed IRB-approved human research protections training. Training will be verified by IRB staff before approval is granted. Training instructions available here. CITI training site available here.

   Name: Ellen A. Vincent
   Department: Environmental Horticulture, School of AFES
   Campus address: 173 Poole Ag Center

   □ Faculty
   ✔ Staff

   E-mail: ellenav@clemson.edu
   Phone: 864-656-1342
   Fax: 864-656-4960

4. **Co-Investigator(s):** Co-Investigators must have completed IRB-approved human research protections training. Training will be verified by IRB staff before approval is granted. Training instructions available here. CITI training site available here.
5. **Additional Research Team Members:** All research team members must have completed IRB-approved human research protections training. Training will be verified by IRB staff before approval is granted. Training instructions available here. CITI training site available here.

6. **Research Team Roles:** Describe the role of each member of the research team (everyone included in Items 3, 4 and 5), indicating which research activities will be carried out by each particular member. Team members may be grouped into categories.

**Description:** Ellen Vincent will oversee the development of the survey. Susannah Horton will create and send the survey. Matthew Powers will serve as an advisor.

7. **Email Communications:** If you would like one or two of your team members (in addition to the PI) to be copied on all email communications, please list these individuals in the box below.

<table>
<thead>
<tr>
<th>Name: Susannah Horton</th>
<th>E-mail: <a href="mailto:shorton@clemson.edu">shorton@clemson.edu</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
<td>E-mail:</td>
</tr>
</tbody>
</table>

8. **Study Purpose:** In non-technical terms, provide a brief description of the purpose of the study. Upon conclusion of the study, how will you share your results (e.g., academic publication, evaluation report to funder, conference presentation)?

**Description:** This survey aims to find the current rate of acceptance of genetically modified organisms amongst Clemson University students, faculty and staff. These results will aid in future design decisions when envisioning a new industrial landscape in which genetically modified organisms, specifically genetically modified plants, have a central role. The results of this survey will be included in Susannah Horton's final graduate project report.
9. **Anticipated Dates of Research:**

Anticipated start date (may not be prior to IRB approval; may be “upon IRB approval”): **Upon IRB approval.**

Anticipated completion date (Please include time needed for analysis of individually identifiable data): **5 weeks**

10. **Funding Source:** Please check all that apply.

- [ ] Submitted for internal funding
- [x] Internally funded
- [ ] Submitted for external funding
  
  Funding source, if applicable (Do not use initials): ______
  
  Proposal number (PPN) for the Office of Sponsored Programs: ______
  
  Name of PI on Funding Proposal: ______

- [ ] Externally funded
  
  Funding source, if applicable (Do not use initials): ______
  
  Proposal number (PPN) for the Office of Sponsored Programs: ______
  
  Name of PI on Funding Proposal: ______

- [ ] Intend to seek funding    
  From whom? ______

- [ ] Not funded

11. **Support provided by Creative Inquiry Initiative:** [ ] Yes  [x] No

   If yes, all Creative Inquiry students will be members of the research team, please see item # 5.

12. **Other IRB Approvals:**

   Has this research study been presented to any other IRB? [ ] Yes  [x] No

   Where? _____  
   
   When? _____

   If yes, what was their decision? [ ] Approved  [ ] Disapproved  [ ] Pending

   Please attach a copy of any submissions, approvals, or disapprovals from other IRBs.

13. **Exempt Review Checklist:** To determine whether this study meets the federal requirements for exemption [45 CFR 46.101], please complete the following checklist. This will indicate if your study can be exempted from IRB continuing review.
The Federal Code [45 CFR 46.101] permits research activities in the following six categories to be exempted. Please check the relevant exemption category / categories. 

The Federal Office of Human Research Protections has made Decision Charts available here to help in determining whether a particular study falls within a particular Exemption Category.

<table>
<thead>
<tr>
<th>Categories of Research Activities Exempt from Continuing Review</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B1.</strong> Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as:</td>
</tr>
<tr>
<td>a. research on regular and special education instructional strategies, OR</td>
</tr>
<tr>
<td>b. research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.</td>
</tr>
</tbody>
</table>

**NOTE:** Survey and interview procedures with minors are exemptible if the activities fall within this category.

| **B2.** Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, UNLESS: |
| a. the information obtained is recorded in such a manner that human participants can be identified, directly or through identifiers linked to the participants; AND |
| b. any disclosure of the human participants’ responses outside the research could reasonably place the participants at risk of criminal or civil liability or be damaging to the participants’ financial standing, employability, or reputation. |

**NOTE:** Survey and interview techniques which include minors are not exempt. Observation of the public behavior of minors, if the researcher is not a participant, is exempt.

| **B3.** Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under Category B2, if: |
| a. the human participants are elected or appointed public officials or candidates for public office, or |
| b. federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter. |

| **B4.** Research, involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that participants cannot be identified directly or through identifiers linked to the participants. |
### B5. NOTE: Please contact the IRB office before selecting this category since use of this exemption must be initiated by the agency head of the federal funder.

Research and demonstration projects which are conducted by or subject to the approval of appropriate Federal Department or Agency heads, and which are designed to study, evaluate, or otherwise examine:

a. public benefit or service programs; or  
b. procedures for obtaining benefits or services under those programs; or  
c. possible changes in or alternatives to those programs or procedures; or  
d. possible changes in methods or levels of payment for benefits or services under those programs.

### B6. Taste and food quality evaluation and consumer acceptance studies,

- a. if wholesome foods without additives are consumed, OR  
- b. if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

---

14. **If you selected Exemption Category B4, please complete questions a through h below:**

- **a.** What are the types of data or specimens? ______
- **b.** What is the source of the data or specimens? ______
- **c.** Are the data or specimens publicly available? (That is, can the general public obtain the data or specimens? Data are not considered publicly available if access is limited to researchers.)  
  Yes ☐ No ☐
  
  *If yes, please contact the IRB staff for consultation. You may not be conducting research involving human subjects as defined in the federal regulations governing research involving human subjects (45 CFR 46.102).*

- **d.** If the data or specimens are not publicly available, how are you obtaining permission to access these or to use them for research purposes? ______  
  *Please attach a copy of the correspondence or agreement granting you permission.*

- **e.** How will the data be made available to you (e.g., electronic file, access to hard copy records at record-holder’s institution)? ______

- **f.** How are the data or specimens identified when they are made available to you?  
  1) ☐ Direct Identifier (e.g., subject name, address, or social security number).  
  2) ☐ Indirect Identifier (e.g., an assigned code that could be used by the investigator or the source providing the data or specimens to identify a
subject, such as a pathology tracking number or a tracking code used by the source). 

*If you will receive data with indirect identifiers only, please contact the IRB staff for consultation. You may not be conducting research involving human subjects as defined in the federal regulations governing research involving human subjects (45 CFR 46.102).*

3) □ No Identifier (i.e., neither the researcher nor the source providing the data or specimens can identify a subject based upon information provided with the data or specimens).

*If it will be impossible for anyone to identify subjects based upon information provided with the data or specimens, you will not be conducting research involving human subjects as defined in the federal regulations governing research involving human subjects (45 CFR 46). Please contact the IRB staff for confirmation.*

g. If (1) is checked above, will you record any direct identifiers that are available to you?

Yes* □ No □

h. Will any data or specimens be collected from participants after the submission of this application? (Data or specimens are considered to “exist” if ALL the data or specimens to be used for the research have been collected prior to the submission of this application.)

Yes* □ No □

*Your research does not qualify for exemption from IRB review under Exemption Category B4.

**PLEASE NOTE: If you are applying for exemption only under Exemption Category B4, you have now completed this application. Please submit your application following the instructions at the end of the form.**

15. Study Sample: (Groups specifically targeted for study)

Describe the participants you plan to recruit and the criteria used in the selection process. Indicate if there are any special inclusion or exclusion criteria.

NOTE: If individuals who are incarcerated will be participants, your research is not exemptible. Please complete the Expedited / Full Review Application.

**Description:** Clemson University community: faculty, staff and students 18 years and older of Clemson University.

Age range of participants: **18 and older**  
Projected number of participants: **110**
☒ Employees  ☒ Students  ☐ Minors (under 18) *
☐ Pregnant women *  ☐ Fetuses / neonates *  ☐ Educationally / economically disadvantaged *
☐ Minors who are wards of the state, or any other agency, institution, or entity *  ☐ Individuals who are incarcerated *
☐ Persons incompetent to give valid consent *  ☐ Military personnel
*State necessity for using this type of participant: _____

16. Study Locations:
☒ Clemson University  ☐ Other University / College _____
☐ School System / Individual Schools _____  ☐ Other – specify _____

You may need to obtain permission if participants will be recruited or data will be obtained through schools, employers, or community organizations. Are you required to obtain permission to gain access to people or to access data that are not publicly available? If yes, provide a research site letter from a person authorized to give you access to the participants or to the data. Guidance regarding Research Site Letters is available here.

☐ Research Site Letter(s) not required.
☐ Research Site Letter(s) attached.
☐ Research Site Letter(s) pending and will be provided when obtained.

17. Recruitment Method:

Describe how research participants will be recruited in the study. How will you identify potential participants? How will you contact them? **Attach a copy of any material you will use to recruit participants (e.g., advertisements, flyers, telephone scripts, verbal recruitment, cover letters, or follow-up reminders).**

**Description:** A campus wide email will be sent inviting people to participate in the survey, providing them a link to SurveyMonkey. The email invitation will be resent after one week if less than 100 responses are received.

18. Participant Incentives:

a. Will you pay participants? ☐ Yes  ☒ No

  Amount: $_____  When will money be paid?: _____
b. Will you give participants incentives / gifts / reimbursements? ☐ Yes ☒ No
   Describe incentives / gifts / reimbursements: ______
   Value of incentives / gifts / reimbursements: $____
   When will incentives / gifts / reimbursements be given?: ______

c. Will participants receive course credit? ☐ Yes ☒ No

d. Will participants receive extra credit? ☒ Yes ☐ No
   If yes, an equivalent alternative to research participation must be provided and
described in your informed consent document(s).

19. Informed Consent:
   a. Attach a copy of the informational letter or consent script you plan to provide to your
      participants (and their parents or guardians, if applicable). Consent Document
      Templates
   b. Will you use concealment (incomplete disclosure) or deception in this study? ☐ Yes ☒ No
      If yes, please see guidance regarding Research Involving Deception or Concealment
      here, submit a copy of the Additional Pertinent Information / Permission for Use of
      Data Collected in a Research Study form you will use, and provide a justification in
      the following space for this use of concealment or deception. ______

20. Procedures:
   a. What data will you collect? Individual perception's of genetically modified plant
      organisms in two different contexts using a Likert rating scale. Participant's age
      range; gender; Clemson affiliation as student, staff, faculty, or alumnus; and
      major or department will be asked.
   b. Please describe in detail the process each participant will experience and how you
      will obtain the data. Participants will be approached by an email invitation that
      contains a link to SurveyMonkey, a Web based survey program. At
      SurveyMonkey the participant will read the consent form and check a box
      indicating they are willing to participate in the survey. Then two survey
      questions will be asked followed by four demographic questions. Data will be
      downloaded as Excel files and charts.
   c. How many participation sessions and how much time will be required for each
      participant, including follow up sessions? 1 session will take approximately 3
      minutes.
   d. How will you collect data?
      ☐ in-person contact       ☐ telephone
Please include copies of surveys, interview questions, data collection tools and debriefing statements. If survey or interview questions have not been fully developed, provide information on the types of questions to be asked, or a description of the parameters of the survey/interview. Please note: finalized survey or interview instruments will need to be reviewed and approved by amendment, before implementation.

e. Will you audio record participants? ☐ Yes ☒ No
f. Will you video record participants? ☐ Yes ☒ No
g. Will you photograph participants? ☐ Yes ☒ No

If you will audio or video record or take identifiable photographs of participants, please consult the IRB’s Guidance on the Use of Audio / Video Recording and Photography here. Please include all the information addressed by this guidance document in the application and, where appropriate, in the consent document(s).

21. Protection of Confidentiality: Describe the security measures you will take to protect the confidentiality of the information obtained. Will participants be identifiable either by name or through demographic data? If yes, how will you protect the identity of the participants and their responses? Where will the data be stored and how will it be secured? Who will have access to the data? How will identifiers be maintained or destroyed after the study is completed?

Description: Participants will be anonymous and only identified by age, gender, and Clemson affiliation (student, staff, or faculty) and major or department.

22. PI Signature:

I have reviewed this research protocol and the informed consent document(s), if applicable. I request approval of this research study by the IRB of Clemson University.

Conflict of Interest Statement:

Could the results of the study provide an actual or potential financial gain to you, a member of your family, or any of the co-investigators, or give the appearance of a potential conflict of interest?

☒ No.
☐ Yes. I agree to disclose any actual or potential conflict of interest prior to IRB action on this study.
Submission Instructions: Exempt applications are processed as received. There is no deadline for submitting exempt applications for review. Please allow seven to ten business days for processing.

Please submit this application and all associated documents from the Principal Investigator’s (PI’s) email address to the IRB staff. Receipt of the application electronically from the PI will qualify the application as a signed electronic submission. Alternatively, the signed, hard-copy application may be mailed or delivered to the Office of Research Compliance, 223 Brackett Hall, Clemson, SC 29634-5704.
Appendix B

Clemson University Contextual Perception Survey of Genetically Modified Plants

[Email text:]  
Subject: Request to participate in student survey

My name is Susannah Horton, and I’m a graduate student working on my final project in landscape architecture. I would like to know how you feel about genetically modified organisms (GMOs). This survey should take approximately three minutes, and with your input I will be able to find out what the current opinion at Clemson University is on this subject.

[At SurveyMonkey:]  
[Consent form appears as front page with box to check at bottom that indicates an informed willingness to participate in the survey.]  

Thank you for your willingness to participate in this survey.

Please select one answer for each question.
Please answer every question.

1. How do you feel about genetically modified plants right now?
   1. Strongly support
   2. Support
   3. Neither support nor oppose
   4. Opposed
   5. Strongly opposed
   6. No opinion

2. How do you feel about genetically modified plants that are used for curative purposes, i.e. to cure specific types of cancer, right now?
   1. Strongly support
   2. Support
   3. Neither support nor oppose
   4. Opposed
   5. Strongly opposed
   6. No opinion
Demographics

1. Gender
   Male
   Female

2. Age  Which of the following age categories describes you:
   18-24
   25-34
   35-44
   45-54
   55-64
   65 or over

3. Please check the affiliation that best describes you:
   Student
   Faculty
   Staff
   Alumnus

4. Major, Degree or Department you are most closely associated with:
   Please enter your answer on the line

Thank you for your time today. We are most grateful.
Appendix C

Information about Being in a Research Study
Clemson University

Clemson University Contextual Perception Survey of Genetically Modified Plants

Description of the Study and Your Part in It

Susannah Horton and Dr. Ellen Vincent at Clemson University are inviting you to take part in a research study. Susannah Horton is a student at Clemson University, running this study with the help of Dr. Vincent, an instructor at Clemson University. The purpose of this research is to understand how people feel about genetically modified organisms (GMOs) at this time.

Your part in the study will be to answer two questions about GMOs and to answer several demographic questions.

It will take you about three minutes to be in this study.

Risks and Discomforts

We do not know of any risks or discomforts to you in this research study.

Possible Benefits

We do not know of any way you would benefit directly from taking part in this study. However, this research may help us to understand peoples’ present perceptions of GMOs.

Extra credit will offered to Dr. Vincent’s horticulture and forestry classes. A non-research opportunity for the same amount of extra credit that involves the same effort and time investment will be available and posted on Blackboard.

Protection of Privacy and Confidentiality

Your contribution to this survey will be anonymous. No identifying data linking you to your answers is available.

Choosing to Be in the Study

You do not have to be in this study. You may choose not to take part and you may choose to stop taking part at any time. You will not be punished in any way if you decide not to
be in the study or to stop taking part in the study. If you decide not to take part or to stop taking part in this study, it will not affect your grade in any way.

Contact Information

If you have any questions or concerns about this study or if any problems arise, please contact Dr. Ellen Vincent at 864-656-1342 or Susannah Horton at 805-705-7624 at Clemson University. If you have any questions or concerns about your rights in this research study, please contact the Clemson University Office of Research Compliance (ORC) at 864-656-6460 or irb@clemson.edu. If you are outside of the Upstate South Carolina area, please use the ORC’s toll-free number, 866-297-3071.

Consent (check box below if you agree to participate)

_I have read this form and I agree to take part in this study._
REFERENCES


Burford, A. 1969. The Greek temple builders at Epidaurus: A social and economic study of building in the asklepian sanctuary, during the fourth and early third centuries BC University of Toronto Press.


Munro, Margaret, and CanWest News Service. 2007. Modified seeds cause regulation woes here. The Leader-Post (Regina, Saskatchewan), April 30, 2007, sec BUSINESS & AGRICULTURE.


