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Sustainable Interiors: Green Design Methods and its Influence on Ecopsychology

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Sustainable Interiors: Green Design Methods and its Influence on Ecopsychology

Tillie O'Reilly

Abstract

The profession of interior design proposes to enhance interior spaces through the use of furnishings, lighting, and color palettes while adhering to safety standards and building codes. Although designers follow strict codes to beautify a space, they may disregard the natural environment when choosing materials that are aesthetically pleasing. It is difficult for designers to design sustainably when they must balance many demands in design such as functionality, aesthetics, safety, and clients' tastes. This paper addresses how sustainable design methods can be incorporated into the field of interior design to benefit the environment, while simultaneously improving the beauty of the space. Chapter one offers a problematic view of modern interior design, where most interior designers do not follow sustainable principles or consider the impacts of their actions on the environment. Interior designers use unsustainable practices which harm the planet as well as the inhabitants of the designed space. Chapter two looks into the history of residential homes and interior design, as interior design has not become a profession until the late nineteenth century. Beginning in the early twentieth century in Weimar Germany, designers at The Bauhaus School began to take the initiative to develop sustainable principles that incorporate ecology and art into one discipline. Chapter three further discusses current sustainable design methods such as using renewable resources and materials, energy efficient heating and cooling systems, the use of plants to reduce carbon dioxide levels, and the use of large windows to harvest natural sunlight. Chapter four explores the profound effects of interior green spaces on human psychology. Chapter five presents design principles which build on the current policies outlined in *Hannover's Principles*. New policy recommendations are presented as well, such as valuing ecosystem services, using biomimicry in design, integrating biophilia into design, and only using recycled materials in the design process.

Keywords: urban/environmental psychology, environmental history, environmental design, sustainability, interior design, renewable resources

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Introduction: Interiors Gone Green- Designing Sustainably in an Unsustainable World

Sustainable interior designers are needed more than ever in modern times of environmental degradation and natural resource depletion. A holistic approach to design is indispensable as exteriors and interiors must collaborate to become one sustainable unit. Designers are key forces for change in the world as they design environments that help planet earth, occupants' psychological health, and physical wellbeing. Designers must face the fact that their design practices can potentially hinder or promote life on earth depending on the natural resources they use, the quality of materials, and energy systems that they utilize. Designers possess the responsibility of shaping lives of human beings who inhabit their spaces, as interiors affect human emotion, cognition, and actions. Interior design is not only about aesthetic and functional appeal, but also ethical concerns of human inhabitation on planet earth and environmental consequences. Designers must be sustainable, which according to the World Commission on Environment and Development, means "meeting the needs of the present without compromising the ability of future generations to meet their own needs." Human beings are hazardous members on earth as we have aided in global destruction through warming our planet and using earth's resources unsustainably.

Chapter one will explore issues that designers face in creating sustainable spaces. Environmental issues that designers contribute to will be addressed such as air pollution, water pollution, deforestation, and depletion of earth's resources. Ways to enhance the design process and fix potential environmental hazards are contained in this chapter.

Chapter two will present a history of the profession of interior design, as well as an overview on the concept of the home, in the ancient world of The Stone Age, Medieval times, Renaissance Italy, England and Colonial America, and modern residence. Ecological design developed in The Bauhaus School in Germany will also be discussed. Concepts of naturalism, realism, and religious influence will be discussed.

Chapter three will discuss crucial materials and methods of sustainable interior design. Topics such as energy efficiency, water conservation, indoor air quality, pollution control, ventilation, use of plants, synthetic and natural materials, wood products, plastics, textiles, leather, paints, glass, and panels will be reviewed extensively. Further discussion will include sustainable fabrics and window treatments, appliances and plumbing fixtures, and environmentally friendly cleaning products. Finally, renovating old spaces and restoring ancient furniture will be discussed.

Chapter four explores the connection between interior spaces and human psychology. Factors that go into designing healthy and peaceful environments are presented such as textures, balance, simplicity, flow, and lighting. The natural world affects humans in profound ways that we are not aware of. Dimensions of interior spaces such as lighting, interior views, and indoor plants can greatly influence one's emotions and behavior. Methods to incorporate nature into interior spaces will be discussed.

Chapter five will present policy changes to improve the profession of interior design. Designers will learn to design sustainably through material usage, lighting, painting, and energy systems. Current policies will be evaluated such as *Hannover's Principles* and *LEED Principles*. Resources for designers, current legislation, organizations, and certifications will be presented. Policy recommendations such as using biomimicry in design, valuing ecosystem services, integrating biophilia into design, and using only renewable or recycled materials in furniture, flooring, paints, and fabrics.

Chapter 1. Designer Difficulties: Efficacy of Green Buildings and Design

Interior designers plan spaces that are often sources of environmental degradation, however environmentally conscious designers can not only prevent environmental destruction, but enhance our environment in many ways. Human's impact the environment in astounding ways, as harm to climate, ecosystems, and water systems are directly related to humans. Human

population is increasing at a steady rate and will need to degrade more land to support their needs. Without direct intervention and education, designers will continue to harm the planet through air pollution, water pollution, land degradation, and depletion of natural resources.

Air pollution is a major problem on earth, as greenhouse gases cause global warming, chlorofluorocarbons induce ozone depletion, and burning of fossil fuels contribute to acid rain.¹ Greenhouse gases trap heat from the sun and warm our planet, however when greenhouse gases increase, more heat will be trapped, which will cause an increase in earth's temperature. Greenhouse gases are formed from many industrial activities such as clearing land, burning fossil fuels, and creating cement from limestone. The ozone in earth's atmosphere functions to trap harmful solar ultraviolet radiation from reaching humans. Chlorofluorocarbon production, which depletes the ozone, can come from air condition and refrigeration units, foamed plastics, and upholstery padding.² Acid precipitation occurs from sulfuric and nitric acids and can cause destruction to buildings with marble, stonework, and metal.³ Interior designers can help reduce the effects of air pollution without sacrificing aesthetics in their design. Designers must use energy efficient lighting, adequate insulation to avoid increases in heat usage, natural lighting, energy efficient appliances, natural ventilation, materials that use less energy to manufacture and transport, recycled products, and materials that do not require chlorofluorocarbons in their production or operation.⁴

Pollution of our water systems can change weather patterns, cause acidification, flooding, and desertification, reduce biodiversity, and limit available water to humans.⁵ Within interior design, the textile industry greatly contributes to waste disposal in water. As textiles are

¹ Grazyna Pilatowicz, *Eco-interiors: a guide to environmental conscious interior design*. (New York: Wiley, 1995), 12.

² Ibid., 14.

³ Ibid., 15.

⁴ Ibid., 16.

⁵ Ibid., 18.

produced, a surplus of water is needed to produce, process, and dye fibers in fabric finishing. In residential homes, an excess of water is used for the transportation of wastes. Chlorine that is added to water to prevent bacterial contaminations is a form of pollution and contributes to the deterioration of piping and plumbing structures.⁶ Designers must reduce the amount of textiles they use or implement recycled textiles into their design.

Several contributing factors lead to land and soil degradation such as the production of solid waste and soil erosion. Soil erosion is the destruction of topsoil which can hinder a land's productivity and cause desert-like conditions.⁷ This process can occur naturally, from agricultural practices, or deforestation. Interior designers can help reduce the effects of soil erosion in many ways. Many exotic trees used in furniture production come from rainforests in poor countries and will lead to erosion of their lands.⁸ Designers should be aware of where their materials are coming from. Next, materials such as cotton require heavy uses of pesticides and fertilizers to grow which will directly cause soil pollution and erosion. Humans influence solid waste production by the amount of trash that they discard, the toxicity of waste, and how much they recycle. Landfills are continuously filled with paper, plastics, metal, yard waste, glass, and food.⁹ Landfills create dangerous products such as leachate and methane that contaminate surrounding water and increase global warming. The field of interior design contributes greatly to waste production, as construction industries conduct demolitions to construct or renovate new interiors. Solid waste from interiors includes lumber, sheetrock, plywood, brick, tile, cardboard, asphalt, fiberglass, metal, and plastics. According to Grazyna Pilatowicz, a new home construction generates 2.5 tons of waste, while a renovation of walls, flooring, plumbing, wiring, painting, and roofing saves about 120 cubic yards of a landfill.¹⁰ Interior designers can reduce

⁶ Ibid.

⁷ Ibid., 20.

⁸ Ibid.

⁹ Ibid.

¹⁰ Ibid., 23.

solid waste production through less demolition, recycling materials, using recyclable products, and reducing discarded packaging. For example, home furnishings such as sinks, tubs, doors, and windows can always be polished and reused instead of demolishing and replacing them.

Depletion of natural resources such as the use of fossil fuels or deforestation is a major concern in design fields. Nonrenewable resources such as fossil fuels are in limited supplies and are being used at unsustainable rates. Sun energy is a renewable energy that can be harvested to produce natural light and heating by designers. Electricity is a very complex issue as many people in the world still do not have access to it, while others overuse electricity powered by nonrenewable resources. According to the Millennium Ecosystem Assessment, people use electricity for lighting, water, entertainment, refrigeration, agriculture, and communication. The average amount of electricity per person in a year is 1000 kWh.¹¹ In order to distribute electricity to everyone on the planet, 10,000 gigawatts will be required which is three times our current electricity usage. In order to increase electricity consumption, research needs to be done to incorporate clean energy resources into a global scale. Coal and oil, both nonrenewable resources, cause the most destruction to earth through mining and oil spills. Mining destroys certain species' habitats and coal releases harmful pollutants into the air when burned as energy. Oil can spill and contaminate water and produce pollutants when burned for fuel. Designers must use energy efficient appliances that do not require oil or coal, but use renewable energy resources such as solar energy and hydropower.

Deforestation is another major concern as the reduction of forests impact water quality, air quality, soil productivity, and ecosystems. Forests are rapidly disappearing as many industries desire paper, lumber, firewood, and cleared land for agriculture.¹² Acid rain and other

¹¹ Assessment, Millennium Ecosystem. *Ecosystems and human well-being: opportunities and challenges for business and industry; a report of the Millennium Ecosystem Assessment*. (World Resources Institute, 2005), 14.

¹² Grazyna Pilatowicz, *Eco-interiors: a guide to environmental conscious interior design*. (New York: Wiley, 1995), 26.

forms of pollution also greatly contribute to deforestation as many trees cannot endure polluted conditions. According to the United Nations Food and Agriculture Organization, the world's rainforests near the equator in South America, Africa, and Southeast Asia are being destroyed at a rate of 50 million acres annually.¹³ If this rate of devastation continues, all rainforests will be gone by the year 2050. Farmers greatly contribute to deforestation through shifting cultivation, where all vegetation is burned to create land and fertile soil for crops. Through this process, large amounts of carbon dioxide and nitrous oxides are released into the atmosphere, which aggravates global climate change. Many loggers target poverty-stricken areas as desirable woods are often found there.¹⁴ These loggers destroy habitats through use of heavy machinery that obtains trees and damage surrounding areas. As we cut down more and more forests for personal usage, we damage the earth's ability to regulate oxygen content. Trees naturally take in carbon dioxide from the air and produce oxygen, acting as natural air filters. Trees have many other functions in the environment such as reflecting sunlight, absorbing groundwater, and evaporating water. As trees serve as indispensable habitats for many species, deforestation is also responsible for decreases in biodiversity. Pollution from industrialization can cause acid precipitation which can cause devastating effects to trees as acid prevents nutrients from reaching the leaves of trees, filters nutrients out of the roots, and causes increased concentrations of aluminum in the soil.¹⁵ Designers must become responsible and learn the origins of their products. When purchasing wood products, designers can reject tropical wood products and opt for a more sustainable wood that originated from cleaner practices. It is vital that designers know what resources were used in production, the amount of energy used in manufacture, transportation, and installation, and materials used in packaging.¹⁶

¹³ Ibid.

¹⁴ Ibid., 27.

¹⁵ Ibid., 30.

¹⁶ Ibid., 31.

As interior designers focus their efforts on interior spaces, it is important that they understand how their plans affect inhabitants in regard to indoor air quality. Several factors can affect the indoor environment such as the design and orientation of a space, sources of air pollution such as materials, and use of ventilation systems.¹⁷ As indoor environments are enclosed spaces, any source of pollution is often magnified due to the lack of open air in the outdoors. In an attempt to conserve energy, contractors built homes in the past with heavy insulation and window sealants. Negative consequences arose from this act of conservation as polluted air became trapped and imposed negative health consequences upon inhabitants.¹⁸ Buildings where occupants develop health complications such as respiratory and fatigue issues from air pollutants are known as *Sick Building Syndrome*.¹⁹ Major pollutants found in *sick buildings* include fungi, dust particles, low humidity, bacteria, formaldehyde, vehicle exhaust gas, tobacco smoke, volatile organic compounds, ozone, and fibrous particles. Pollution that originates from the building itself may come from the exterior, materials, finishes, construction methods, or HVAC systems. Pollution may also come from the occupant which mainly includes dead skin cells and carbon dioxide from breathing. Human activities that produce pollution include cleaning, cooking, personal hygiene, smoking, and oil burning.²⁰ A major type of pollution in interiors includes microbial contamination that originates from organic matter in people, plants, and food. These fungi and bacteria thrive and multiply in moist and humid environments, contaminated central air systems, nonresistant moisture materials, and poor ventilation. Examples of bacteria include Salmonella and Legionnaire's disease, while types of fungi include mold and mildew with strong odors.²¹ Volatile organic compounds are another

¹⁷ Ibid., 32.

¹⁸ Ibid., 33.

¹⁹ Ibid.

²⁰ Ibid., 34.

²¹ Ibid.

type of indoor pollutant that originate from solvents in paints, waxes, and other finishes.²² VOCs can come from various interior elements including plywood, fibers, plastics, coatings, cleaning chemicals, and varnishes. These compounds become dangerous when they are converted into gases at room temperature, as their toxicity affects the central nervous system and causes physical and psychological distress. VOCs are especially dangerous as indoor materials naturally absorb these compounds in high quantities and release them in more dangerous forms.

Formaldehyde is a common VOC that is used as a disinfectant, preservative, hardener, and synthesizing agent. It is commonly found in plywood, particleboard, fiberboard, insulation, and textiles. As formaldehyde evaporates into the air, particles are absorbed and cause irritation to the eyes and lungs. Other common VOCs include xylene and toluene which are found in adhesives and solvents, styrene in plastics and paints, benzene in cigarette smoke, and ethyl benzene in solvents. In order to reduce VOCs in interior environments, designers can limit their sources, include proper ventilation, and ban products that contain dangerous levels.

Environmental Tobacco Smoke, or ETS, should be avoided in all interior spaces as it produces a multitude of chemicals and carcinogens that extremely dangerous to humans. There are more than 4,700 chemicals in tobacco products including nitrogen oxide, carbon monoxide, nicotine, carcinogenic tars, and sulfur dioxide.²³ Another type of pollution includes Electromagnetic Fields, or EMF, where radiation is produced from electricity running through wires or appliances.²⁴ To reduce the levels of radiation, energy efficient lighting and appliances can be used while use of electric screens can be eliminated. Other major pollutants that designers and architects must be aware of are radon, asbestos, lead, and ozone. Proper ventilation is vital

Ecosystem Services. The relationship between humans and their environment has changed dramatically throughout human existence on earth. Until recently, humans have begun

²² Ibid., 35.

²³ Ibid., 37.

²⁴ Ibid., 38.

to notice the damaging effects of their actions on planet earth. Burning fossil fuels, eating meat in excess, cutting down forests, and depleting natural resources have had negative consequences to planet earth. Humans began moving to urban areas under the process of urbanization. Land use has changed in cities where pavement replaced agricultural lands and grass. Large amounts of traffic congestion and pollution occur in cities as they are very densely populated. Although some aspects of urbanization are negative, those living in cities take up less land in smaller and dense housing, drive fewer cars, and use public transportation, which therefore reduces the amount of energy they produce. Humans are distancing themselves from green space which may have negative consequences to their overall health and well-being. Certain ecosystem services provide humans with aesthetically pleasing landscapes and clean air that affect our physical and mental health. There are many ways to incorporate nature into interior spaces that will be addressed later such as biomimetics, large windows that promote better views and natural sunlight, indoor plants, and natural incense.

The Millennium Ecosystem Assessment has reviewed the concept of ecosystem services and its relationship with human wellbeing.²⁵ Provisioning Services are the resources that earth provides directly to humans such as food, drugs, and wood products. Regulating services are the basic functions of an ecosystem that support human life such as the purification of water, reduction of diseases, stabilization of climate, regulation of greenhouse gases, and prevention of floods. Supporting services are ecological processes that serve as the foundation for humans and other ecosystems such as soil formation for agriculture, oxygen production, and the release of nutrients for plant growth by decomposers. Finally, cultural services include recreational, educational, aesthetic, and spiritual benefits that humans through ecosystems. All of these services together benefit humans by increasing safety, security, shelter, nutrients, health, and

²⁵ Assessment, Millennium Ecosystem. *Ecosystem and human well-being: opportunities and challenges for business and industry; a report of the Millennium Ecosystem Assessment*. (World Resources Institute, 2005), 6.

social relations. Under recreational services, green space has been proven to improve mental health of individuals who spend time outside. Green environments reduce stress and increase overall happiness. Ecosystem services directly relate to interior design in many ways. If one follows sustainable principles in their practice of interior design, one can mitigate the degradation of natural capital. In green interiors, inhabitants can obtain the psychological services that are provided, as natural sunlight and foliage allow one to be calm.

Ecosystem services are goods and services that planet earth provides at no cost to humans. In order to emphasize the importance of ecosystem services on human life, scientists have begun to quantify them in monetary terms.²⁶ Without services like clean water and breathable air, our economy would be forced to spend large amounts of money to provide these services and stabilize the health of the population. Within the essay, *Emerging Landscapes Toward Ecosystem Services as a Basis for Design*, a policy known as SITES, or Sustainable Sites Initiative is described as a rating system that allows designers to incorporate ecosystem services into the design process.²⁷ SITES addresses many ecosystem services that relate to interior spaces such as water supply and regulation, local climate regulation, waste decomposition and treatment, human health and well-being benefits, hazard mitigation, and cultural benefits.²⁸ In SITES' *Human Health and Well-Being* section, some credits available include reducing light pollution, providing outdoor spaces for social interaction, providing views of vegetation and quiet outdoor spaces for mental restoration, provide opportunities for outdoor physical activity, protecting and maintaining unique cultural and historical places, and promoting sustainability awareness and education.²⁹ Under the *Operations and Maintenance* section, credits include providing storage and collection of recyclables, recycling organic matter generated

²⁶ Steven Windhager, Frederick Steiner, Mark T. Simmons, and David Heymann. "Toward ecosystem services as a basis for design." (*Landscape Journal* 29, no. 2, 2010), 107.

²⁷ *Ibid.*, 115.

²⁸ *Ibid.*

²⁹ *Ibid.*, 116.

during site operations and maintenance, and minimizing exposure to environmental tobacco smoke. The section, *Materials Selection*, contains credits for eliminating the use of wood from threatened tree species, designing for deconstruction and disassembly, reducing salvaged materials and plants, using recycled materials, using certified wood and regional materials, using adhesives, sealants, paints and coatings with reduced VOC emissions, and supporting sustainable practices in the manufacturing of materials. Finally, under the section of *Monitoring and Innovation*, a credit is available for monitoring performance of sustainable design practices.³⁰

Chapter 2. From Caves to Mansions: History of Home and Design

Beginning in the twentieth century, interior design has been recognized as both a profession and a pursuit of the arts that is distinct from the field of architecture. Misconceptions were often present when distinguishing architects from designers, and designers from decorators.³¹ The concept of interior design originated as humans desired a home with both comfort and beauty. “Cavemen” began to engrave elements of nature that they observed in the outside world in their interior environments.³² Early designs tended to reflect the natural world, which is a design process known as biomimicry. Designers would observe elements in nature and attempt to execute its aesthetic and function into an interior space. Early designers appeared to have used fewer resources and materials, making their designs more sustainable. As civilizations became more complex, there was an increased necessity for beautiful homes to not only live in, but socialize, pray, and eat in. Emphasis was placed on increased usage of fine materials which led to overconsumption of natural resources. Designers became interested in all elements of interiors including textiles, furniture, accessories, wall coverings, flooring, carpeting, ceilings, window furnishings, and color choices.³³ Interior design has changed tremendously

³⁰ Ibid.

³¹ C. McCorquodale. *The History of Interior Decoration*. (Oxford: Phaidon, 1983), 2.

³² Alice Fanny and Bettina Jackson. *The Study of Interior Decoration*. (Garden City, NY: Doubleday, Doran and Company, Inc., 1934), 1.

³³ Ibid., 4.

from ancient medieval times to modern designs of the twenty-first century, as earlier designs tended to utilize nature and simplicity into their designs, while modern designs include many nonrenewable resources and less of the natural world.

In the Stone Age, “cavemen” sought after basic needs of food, shelter, and clothing. These ecosystem services, known as provisioning services, are provided to humans through earth’s natural resources. Stones and logs often served as furniture within caves for men to place objects on, sit on, or sleep on.³⁴ Utilizing stones and woods into design involves bringing nature into one’s home, which can provide calming and restorative effects in humans. An ecosystem service, known as cultural services, can provide spiritual qualities to humans, as nature affects humans in profound ways.

Ancient Egyptian Design. In Ancient Egypt, furniture was constructed out of various materials such as wood, stone, or metal.³⁵ Mainly wood was used as there was a great variety of woods, wood was adaptable to carvings and design, and it was lightweight. All sources of wood are examples of provisioning services as wood comes from earth’s natural resources. Egyptians used wood in an unsustainable manner as many types of wood such as cedar, acacia, and sycamore were harvested in large amounts and could not be replenished easily.³⁶ Egyptian culture emphasized the idea of an after-life after death, therefore many belongings of an Egyptian were buried in his or her resting place. In this practice, Egyptians did not implement recycling or reusing of any material or furniture as all of one’s belongings were buried with them for a later life. Thrones that were discovered were grand and elaborate with tall legs that were in the form of ox or lion’s legs. Stools and couches also utilized nature’s animals by carving duck’s heads or other various animals into the legs. Incorporating nature into design is another example of biomimetics, as qualities in nature are observed and executed into design.

³⁴ Ibid., 175.

³⁵ Ibid., 178.

³⁶ Ibid.

Design in Renaissance Italy. The Italian Renaissance produced large amounts of art due to the rebirth of classical civilization after the Middle Ages. Wealthy Italian lineages funded art pieces, while many scholars came to Italy to share their knowledge of classical art and literature.³⁷ The distinction between Renaissance art and earlier art pieces were that the craftsman of design pieces were also artists themselves.³⁸ Throughout history, wood continued to be used in unsustainable manners as large amounts of forest and ecosystems were destroyed for design purposes. Furthermore, excess materials were used to enhance wood pieces with inlay, sgraffito, carvings, gesso, and polychrome.³⁹ Wood that was going to be painted was less superior, which included chestnut, elm, poplar, and pine. Less furniture was used in the Renaissance period as the floors were made of mosaics or marble, the walls had fresco paintings or tapestries, and the ceilings were painted or gilded.⁴⁰ These extravagant decorations required large amounts of materials and chemicals that may have been wasteful or harmful to the environment. Fabrics that were used included silks, velvet, or leather, with cords, tassels, galloons, and fringes. Silk remains a sustainable material in that it is naturally produced by silkworms, biodegradable, renewable, and nontoxic. Italians were famous for the elaborate chest, which was about five feet long, with a hinged top, and stored clothing, money, jewelry, linen, and silver.⁴¹ The chest was also used as a table, a bench, or a step to get on a high bed. Using one piece of furniture for multiple uses represents reuse, a sustainable method that reduces waste and materials used. These chests were elaborately designed with gold, gesso relief, panel paintings, and reliefs of marriage scenes and family life. Other furniture pieces in Renaissance

³⁷ Ibid., 187.

³⁸ Ibid.

³⁹ Ibid.

⁴⁰ Ibid. 188.

⁴¹ Ibid., 192.

Italy included pedestals, mirrors, caskets, picture frames, praying desks, reading stands, and torches.⁴²

Medieval Europe. Gothic architecture is often seen in churches and cathedrals, with pointed arches, buttresses, cornices, finials, trefoil, quatrefoil, roses, wheels, and small animal and human figures.⁴³ Designs in medieval homes heavily mimicked those in the church, as a bishop's throne, refectory tables, and benches were adapted to fit into residential homes.⁴⁴ Although less furniture was present in these homes, the furniture that was used was large and cumbersome. Large amounts of oak wood were obtained and processed in order to furnish homes and churches.⁴⁵ Although these furnishings beautified interior spaces, the nonrenewable resource of wood was acquired at unsustainable rates. Gothic furniture contained hardware such as hinges, locks, escutcheons, and keys, which required wrought iron in its construction.⁴⁶ Iron acquisition requires large amounts of energy through recovery, transportation, and heating. Through uses of nonrenewable resources such as wood and iron, medieval furniture and designs did not show concern for environmental care or conservation.

England and Colonial America. Colonial design in America refers to the English, Dutch, and French influence on furniture and architecture in the New England colonies.⁴⁷ When the colonies were first settled, few resources were available for ornate designs and were therefore plain and simple.⁴⁸ As fewer resources were devoted towards decoration and construction, reduction of materials allowed for sustainable design. Reduction in resources is the first principle to be followed in the phrase, *reduce reuse recycle*. Before placing concern on recycling or reusing materials, it is best to reduce the amount of materials that are used first.

⁴² Ibid., 195.

⁴³ Ibid., 196.

⁴⁴ Ibid., 197

⁴⁵ Ibid.

⁴⁶ Ibid.

⁴⁷ Ibid., 275.

⁴⁸ Ibid.

Later on in American history, the nineteenth century was a time of period reproductions and furniture innovations.⁴⁹ Manufacturing occurred at high rates as homeowners desired pieces from the past as well as ones that would conform to their current needs.⁵⁰ Furniture became based on needs for social gatherings, office work, communication, and technology equipment. Furniture designers began producing chairs of various shapes, materials, and colors to suit homeowners' desires for modern and elaborate pieces. As needs changed throughout the twentieth century, designers were urged to produce up-to-date furniture that conformed to societal demand. The need for designers to produce new furniture designs and disregard prior models promotes our *throwaway* culture in that goods are not reused or recycled.

Modern Design and Nature Deprivation. Modernity in America consists of linear designs, right angles, simplicity, lack of ornamentation, flat roofs, and artificial materials.⁵¹ Synthetic stone and plastic with steel rods are common materials used in modern construction. These homes are durable as they are architecturally strong and can withstand variations in weather.⁵² As all space is utilized in modern homes, reduction of materials is present and therefore represents sustainable design. Modern homes also represent modularity in that they are easily replicable and can adapt to many new construction buildings.⁵³ Although these spaces are strong and simple, some argue that they are not aesthetically pleasing due to linear angles and plain designs. Additionally, these spaces lack nature in design as buildings are devoid of greenery and natural materials. People become disconnected with nature, causing a myriad of health issues as well as a lack of concern for environmental conservation.

Bauhaus and Ecological Design. The Bauhaus School, founded by Walter Gropius in 1919 and located in Weimar, Germany, served to educate architects and designers on the

⁴⁹ Ibid., 283

⁵⁰ Ibid., 285.

⁵¹ Ibid., 453.

⁵² Ibid.

⁵³ Ibid.

importance of nature and ecology in the design process.⁵⁴ He believed it was vital that art and science come together to produce buildings that functioned in harmony with nature.⁵⁵

Furthermore, the school believed in the notion of biomimicry, where functions in ecology and the natural world should be presented in the designs of buildings.⁵⁶ Architects within the school visualized a world where designers would turn to nature to solve social and environmental problems of the built environment.⁵⁷ Bauhaus designers were just as concerned about the human condition as they were with environmental conservation.⁵⁸ Designs were to include human needs in the environmental setting, as human well-being is directly related to environmental health. Through having both a humanist and environmental approach, The Bauhaus attempted to feature conflicting views of biocentrism and anthropocentrism in design.⁵⁹

Raoul H. France', a biologist at The Bauhaus School, was a leading figure in the thought of bionics, where nature is studied to generate techniques, processes, and principles that can be applied to design in human society.⁶⁰ France' named this method as bio-techniques, where one can copy nature and apply it to human efficiency and technology¹⁵. France' directed the Biological Institute of the German Micrological Society in Munich and promoted fields of psychobiology and soil ecology.⁶¹ Psychobiology refers to an underlying psyche in living matter that is the driving force of evolution.⁶² France' believed that humans could obtain this power through copying the natural processes in nature found on earth.⁶³

⁵⁴ Peder Anker. *From Bauhaus to Ecohouse: A History of Ecological Design*. (Louisiana, NY: Louisiana State University Press, 2010), 3.

⁵⁵ *Ibid.*, 2.

⁵⁶ *Ibid.*

⁵⁷ *Ibid.*, 3.

⁵⁸ *Ibid.*, 4.

⁵⁹ *Ibid.*, 5.

⁶⁰ *Ibid.*, 15.

⁶¹ *Ibid.*

⁶² *Ibid.*

⁶³ *Ibid.*

An objective set forth by the Bauhaus School included creating a space for refuge from industrial society.⁶⁴ These microcosms were to be designed as self-sustaining in a future world that is no longer suitable for life. As more and more pollution and environmental degradation occurred, Bauhaus thinkers believed that planet earth would soon become a lifeless planet like Mars. Named *bio-shelters* or *eco-arks*, these sanctuaries would be designed in a way that allowed harmony between humans and all other living things in nature.⁶⁵ While designing these microcosms, designers thought much about space ecology and the lifestyles of astronauts. Astronauts live in closed ecosystems and have to survive for months at a time, therefore their lifestyle fascinated teachers at The Bauhaus. Peder Anker, author of *From Bauhaus to Ecohouse*, argues that an ecological perspective on space exploration heavily impacted how we view closed ecosystems on earth and contributed to a *neo-biological civilization* in architecture and design.⁶⁶

After The Bauhaus School was closed by the Nazi Regime in 1933 for resembling modernity and lacking German style, the school reopened in the Hampstead section of London to educate others on sustainable design.⁶⁷ The Isokon Building, designed by Wells Coates, was structured in efforts to embrace the new field of ecological design¹⁰. Coates consulted with a group of environmentalists, urban planners, and designers which later became known as MARS, or Modern Architectural Research Group. Key figures in MARS included the founder of The Bauhaus School Walter Gropius, ecological designer Laszlo Moholy-Nagy, and Gropius' collaborator Maxwell Fry.⁶⁸

⁶⁴ Ibid., 6.

⁶⁵ Ibid.

⁶⁶ Ibid., 7.

⁶⁷ Ibid., 3.

⁶⁸ Ibid., 10.

An environmental feature of The Bauhaus School was that all of its furniture was composed of plywood instead of the designer's normal choice of tubular steel.⁶⁹ This was due to the need for incorporating organic material into furniture so that it could be in harmony with the organic human body. The furniture produced by Jack Pritchard became known as the Isokon Laminated Furniture Series and consisted of wood-only tables and chairs.⁷⁰ An environmental feature that The Bauhaus School developed was the positioning of a building to face away from the street and into the garden. The brothers Aladar and Victor Olgyay believed that streets were full of disruption and filth while backyards provide natural settings of fresh air and trees. The brothers would go on to study bioclimatic design, which included solar control, shading devices, and flat roofs for rooftop gardens.⁷¹ The Bauhaus school also believed in promoting social change and promoting the health of the public. Modern designers began incorporating more light, fresh air, and open floorplans in order to help amend public health and environmental ills.⁷²

Chapter 3. Succulents, Bamboo, and Lavender: Environmental Design Using

Natural Materials

Biomimicry. Biomimicry is a concept that involves utilizing nature's natural processes as a guide in solving problems in present in humanity.⁷³ Biomimetic design allows for a designer to innovate new spaces derived from concepts in nature and incorporate sustainability into his or her design. Just as nature evolves when faced with a dilemma, interior spaces can evolve to meet the demands for more sustainable spaces. Some designers imitate nature in form only and believe their designs are influenced by nature. Biomimicry involves more than just imitating the physical form of an object, as it must also incorporate biological processes and ecosystems. In her essay,

⁶⁹ Ibid., 11.

⁷⁰ Ibid.

⁷¹ Ibid.

⁷² Ibid., 12.

⁷³ Rasha Mahmoud Ali El-Zeiny "Biomimicry as a problem solving methodology in interior architecture." (Procedia-Social and Behavioral Sciences 50, 2012), 502.

Biomimicry as a Problem Solving Methodology in Interior Architecture, Rasha Mahmoud Ali El Zeiny emphasizes the need for designers or biologists to research biological processes in the environment, communities, or organisms prior to beginning the design process.⁷⁴

Steps are listed to begin the biomimetic design process such as identifying the problem in design, researching biological analogies, understanding biomechanics, functional morphology, and anatomy, detaching biological model from the design, and implementing biology into the design solution.⁷⁵ Many designers first engage with an organism's features such as its shape, color, structure, organization of parts, materials and processes, growth and lifecycle, behaviors and function, motions and mobility, anatomy and patterns, recovery and survival methods, and homeostasis processes. Next, a designer looks at the organism in relation to its community which includes its interaction with other creatures, collaboration, communication, and group management. Finally, the designer will compare the organism to its environment through its adjustment to change, response to climate camouflage techniques, shelter building, waste management, and limited resource management. An example of biomimicry in design is designer David Oakey looked at nature's ground and realized that materials were scattered, dissimilar, and chaotic.⁷⁶ Oakey designed a carpet that had chaotic patterns that allowed for easy installation and replacement, and therefore a reduction in waste and resources.

Materials. Contemporary interior designers have taken the initiative to utilize sustainable products which do not cause harm to the global and interior environments. These products do not pollute indoor air, nor do they harm planet earth in their production or usage. Materials that cause damage to our world can also pose serious problems to human health and well-being.

⁷⁴ Ibid., 505.

⁷⁵ Ibid., 507.

⁷⁶ Ibid., 508.

Indoor Air Quality. Indoor air quality is an issue that interior designers face, as designers choose certain materials, use chemicals, or conduct activities that can adversely affect indoor pollution and poor ventilation. Within an interior space, all aspects of air quality must be monitored, including pollution control, ventilation, plant usage, and maintenance.⁷⁷ When choosing materials, designers should be aware of emissions produced by the product in installation or daily usage, toxicity of material, parts exposed to humans and indoor air, and the required maintenance of a material in the home. Designers should research interior finishes that do not collect dust, as dust can harm human health if inhaled in large amounts. These finishes that do not retain dust include ceramics, metals, hardwoods, stone, and hard plastics.⁷⁸ Dust accumulation can also be avoided by eliminating empty shelving space. Materials that may produce toxins into the air include cotton, acetate, rayon, and wool due to the dyes that they are treated with.⁷⁹ If certain damaging materials cannot be avoided in the design process, materials can be sealed to compress any emissions produced. Electronic equipment used in the home such as televisions, computers, microwaves, and telephones can release radiation that is harmful to humans. Interior designers must position furniture in a way that reduces human impact with electronic equipment. Ample distances, less enclosures, and angled furniture can reduce exposure to radiation.⁸⁰ Ventilation is vital for the movement of clean air into a building and polluted air out. Designers must be careful not to block air circulation with large pieces of furniture or cabinets. Open floor plans and less wall partitions can help air flow through an interior space. Exhaust vents must be utilized in spaces where exhaust contaminants are present such as in kitchens, bathrooms, and office areas. Exhaust systems can remove pollutants from interior spaces and therefore eliminate contaminants in outside air. Proper ventilation can reduce

⁷⁷ Grazyna Pilatowicz. *Eco-interiors: a guide to environmentally conscious interior design.* (New York: Wiley, 1995), 78.

⁷⁸ *Ibid.*, 81.

⁷⁹ *Ibid.*

⁸⁰ *Ibid.*, 82.

humidity and moisture levels responsible for bacteria, fungi, and viruses in humans. Humidifiers can also be used to prevent excessive dryness that allow for dust accumulation which affects those with asthma or allergy problems. In order to maintain proper air ventilation, systems must be inspected, cleaned, filtered, and replaced periodically. During renovations or new constructions, it is important to take precautions for construction workers and occupants within a building. Windows must be kept open, extra fans can be used, and the construction area must be sealed off from the rest of the building. After a new construction or renovation is completed, a sealed building can be heated to high degrees for about a week to eliminate sources of volatile organic compounds.⁸¹

Plants. Plants have numerous benefits in interior spaces such as controlling indoor climate, regulating sunlight, reducing air and noise pollution, and providing psychological benefits to humans. Plants are able to absorb toxins from air during photosynthesis, where carbon, sunlight, and water are absorbed while oxygen and glucose are released. Depending on the plant, specific pollutants can be reduced from the air if the plant is placed in an interior environment. Plants that specialize in the removal of formaldehyde include Chrysanthemums, Azaleas, Philodendron, Golden Pothos, and Bamboo Palm.⁸² Formaldehyde is present in fuel burning appliances, home insulators, and space heaters. Plants that can remove benzene include Gerbera daisy, Marginata, Peace Lily, and English Ivy. Benzene in the home can come from paints, gasoline, and cleaning products. In order for plants to optimize pollution control, activated carbon can be added to potting soil and fans can be placed to promote air movement and contaminant entrapment. Activated carbon helps purify the soil of toxic contaminants and microbial organisms digest these contaminants.⁸³ Succulents are a popular favorite plant to keep indoors as they require little maintenance and can survive with little water. Cut flowers should

⁸¹ Ibid., 87.

⁸² Ibid., 89.

⁸³ Ibid., 90.

be avoided in the home, as they are produced in South America, Southeast Asia, and Africa, and are grown with herbicides, pesticides, and fungicides. These cut flowers travel long distances to North America and use large amounts of gasoline during transportation.⁸⁴

Sustainable Versus Unsustainable Products. A product that consists of renewable materials is one that is processed through recycling to become a new product and does not end in disposal. A non-renewable material is one that cannot be recycled at the end of its life and is left as waste in landfills. Materials that are obtained at sustainable rates are ones that can be replenished within a timely manner. Unsustainable usage occurs when materials that are obtained cannot be replenished and may cause a shortage or decline in a certain resource. When gauging whether the materials we use in interiors are healthy for the environment, we must examine the extraction of raw materials, the production process, transportation of material, packaging, usage, and disposal or recycling of the product.⁸⁵ Within these specifications, a designer must also consider if the materials cause pollution or waste in its production, how long the product must travel, what materials may be used for maintenance, the life cycle of the material, and the energy used at each step of the products life. To reduce large amounts of energy consumption, a designer can shop locally for products and can renovate as opposed to construct new interiors.

Designers often have difficulty when choosing between natural and synthetic materials. Benefits of using natural materials are shorter production processes and less toxicity. Synthetic materials are often believed to be harmful to humans and the environment, but they are not necessarily worse for the environment than natural materials. Natural materials may not be a favorable choice if the material is going extinct, requires toxic products for maintenance, or is grown using harmful pesticides.

⁸⁴ Lori Dennis. *Green interior design* (New York: Allworth Press, 2010), 55.

⁸⁵ Grazyna Pilatowicz. *Eco-interiors: a guide to environmentally conscious interior design.* (New York: Wiley, 1995), 95.

Wood Products. Hardwoods in the design industry grow slowly and therefore cannot be sustained for a long period. They are used as a flooring material, cabinetry, and various furniture pieces. These woods include alder, apple, ash, aspen, beech, birch, cherry, elm, gum, hickory, lime, maple, oak, pear, poplar, sycamore, walnut, and whitewood.⁸⁶ Softwoods can be grown at faster rates than hardwoods and are considered renewable materials. Softwoods are mainly used in construction as opposed to interiors. They include cedar, fir, hemlock, larch, pine, redwood, and spruce.⁸⁷ Designers should avoid woods that are going extinct, including Tropical woods, African Teak, Ebony, Fiji Birch, Mahogany Oak, Purpleheart, Rosewood, Spanish Cedar, Zebrawood, Douglas Fir, Redwood, and Western Red Cedar.⁸⁸ A sustainable alternative to wood flooring is bamboo, which is a fast-growing grass that is grown around the equator. Bamboo is a perennial, meaning it will grow back every year without human intervention. It reduces carbon dioxide in the air, reduces erosion, and protects soil from wind damage. Bamboo flooring is just as durable as hardwood and is also less expensive.⁸⁹

Plastics. The use of the nonrenewable material of plastic in design is devastating for our planet as procurement, transportation, and degradation of plastic causes severe environmental damage.⁹⁰ In order to obtain plastic, drilling for petroleum occurs offshore and must be transported long distances to factories for production. When plastic degrades into viscoelastic fluids, toxic chemicals are released into the air such as nitrogen oxide, cyanide, and acid gas.⁹¹ Plastic is used in many areas of the home such as wallcoverings, plumbing, carpets, padding, insulation, furniture, electrical wire, and plumbing. Plastic is considered an unsustainable material as it is a limited resource and does not degrade. Many plastics have been

⁸⁶ Ibid., 99.

⁸⁷ Ibid.

⁸⁸ Ibid.

⁸⁹ Michael F. Ashby. *Materials and Sustainable Development*. (Butterworth-Heinemann, 2015), 200.

⁹⁰ Grazyna Pilatowicz. *Eco-interiors: a guide to environmentally conscious interior design*. (New York: Wiley, 1995), 105.

⁹¹ Ibid.

constructed with Chlorofluorocarbons or CFFs, which depletes our ozone and warm our planet. Although most Chlorofluorocarbons have been phased out of usage, a new chemical, hydrofluorocarbons or HCFCs, have been used and still cause damage to the earth's climate as a greenhouse gas. If a designer cannot avoid the use of plastics, homeowners must be held responsible for recycling these plastics for other uses. Products with recycled plastic can also be purchased as solid waste and environmental impact is reduced.

Textiles. All textiles are not environmentally friendly as production, manufacturing, cleaning, dyeing, and transporting these materials harm the environment.⁹² Although textiles made with natural fibers are biodegradable, they require large amounts of energy and natural resources to produce. Cotton, a renewable resource that comes from plants, is an example of a natural textile but requires pesticides and fertilizers that can pollute our water systems. Textiles made with synthetic petroleum fiber deplete earth's nonrenewable resources and require energy for transportation. The finishing process for textiles is very damaging to the environment as textiles need to be dyed and treated for wrinkle and stain resistance, mildew, and sizing. Dyes that are used on cotton include formaldehyde and latex polymers that are dangerous to humans and can cause skin reactions. Examples of natural textiles grown from renewable fibers include wool, silk, and linen. These textiles can be produced without toxic levels of chemical pesticides and toxic dyes, making them a smarter choice for designers and consumers.⁹³

Floor Coverings. Carpets and rugs made of synthetic fibers are made of nylon or polypropylene, and contain a backing made of hemp or latex rubber.⁹⁴ In contrast, natural fiber rugs made of linen or wool do not contain a backing but are fused together through a heating process. Some carpets release toxic chemicals into the air, such as the volatile agent 4-PC, which can cause illness to inhabitants of a space. Environmentally friendly carpets are ones that

⁹² Ibid., 107.

⁹³ Ibid., 108

⁹⁴ Ibid., 110.

have low emissions, fusion bonding backs, and fastening systems that do not use adhesives or latex. Proper ventilation is necessary as carpets collect dust as well as emit toxic gases. The Carpet and Rug Institute has developed an initiative to test all carpets for their potential for environmental harm and will identify a safe carpet with a CRI IAQ label.⁹⁵

Synthetic carpet backing can cause much damage to a home through emissions of VOCs and formaldehyde. There are many alternatives such as carpet padding that come from recycled fibers or wool that are tacked down instead of glued. Another alternative to synthetic carpet backing is cork, which is a renewable resource that is naturally grown and does not release emissions.

A great alternative to carpet flooring is harder materials such as stone, brick, marble, and ceramics. Although more expensive, these materials do not emit toxic gases or cause environmental harm. Vinyl and linoleum floors are another option as they are less expensive and do not require maintenance. Natural linoleum is composed of linseed oil, cork, wood flour, clay pigments, tree resin, and a jute backing.⁹⁶

Paints and Adhesives. Most paints contain a pigment, synthetic resin, and solvent.⁹⁷ Pigments, which are made of minerals and organic substances, are suspended in a mixture of resin and solvent. Solvent-based paint includes oil or lacquer and can become dangerous when solvents evaporate as the paint dries. These emissions include hydrocarbons and VOCs and are affected by sunlight and particles in the air. Another type of paint includes water emulsions, latex or acrylic latex, that do not contain solvents. These water-based paints are drastically less hazardous but contain chemicals to prevent fungus growth or decay. Water emulsions contain biocide which kills all growth that causes destruction to the paint layer.⁹⁸

⁹⁵ Ibid., 111.

⁹⁶ Ibid., 113.

⁹⁷ Ibid.

⁹⁸ Ibid., 114.

Many varnishes and finishes contain solvent based urethane which emits formaldehyde gas into the air and damages the health of home inhabitants. Instead of using polymer oil solvents, designers can choose a water-based urethane or wax finishes. Certain flooring and wood stains are also water based and can be color with natural minerals. Dangerous adhesives with solvents such as xylene, acetone, or toluene should be avoided. The safest caulking to use includes those made of silicone and it is low in toxicity and does not produce emissions.⁹⁹

Leather, Wallpaper, Paneling, Metal, and Glass. The use of leather becomes dangerous when tanning and dyeing are involved as these dyes contain alkalis and chromium compounds. Additional toxic chemicals are used in the maintenance and cleaning process. Wallpapers made from renewable resources such as plant fiber, silk, and cotton are a smarter choice than those made of vinyl and metal foil. Wallpaper made of plastic materials cannot be disposed of and may emit chemicals into the air. Acoustic paneling causes many problems as the fiberglass backing emits large amounts of formaldehyde and retains dust. Alternatives may include materials of wood fibers or cork in these panels. The use of metals is generally safe in interiors, although their production requires large amounts of energy. Metals can be recycled easily and used for other design purposes. Lastly, glass is very environmentally safe as it does not require much energy in production, is naturally occurring, and contains no toxic chemicals.¹⁰⁰

Dematerialization. In order to reduce one's ecological footprint, the amount of materials in the design process can be reduced.¹⁰¹ A designer can design spaces with a minimalist design using only materials that are necessary or utilizing smaller areas as functional spaces. Prefabrication, or building furniture and fabricating materials offsite in a controlled factory setting, is a good solution to reduce excess materials. Prefabrication allows for proper waste

⁹⁹ Ibid.

¹⁰⁰ Ibid., 116.

¹⁰¹ Ibid., David Bergman. *Sustainable Design: A Critical Guide*. (New York: Princeton Architectural Press, 2012), 102.

disposal and recycling through assembly lines and transportation. In order to avoid excess packaging waste, modular construction of furnishings can be produced which produces parts rather than a whole piece of furniture.¹⁰²

Reclaimed Materials. Reclaimed materials are used materials that have not been put through reprocessing for reuse.¹⁰³ Using reclaimed materials is an eco-friendly option as these materials do not need to be grown or produced. In addition, reusing materials prevents them from being improperly disposed of or ending up in a landfill. Designers can avoid our *throwaway culture* by reclaiming materials and integrating them into their designs. This is a great alternative to society's notion of new production and disposal of old materials. There are many benefits to utilizing used materials as costs are reduced, aesthetics increase, and the environment benefits. An example of reclaimed materials is distressed wood or wood that has been weathered or aged. Many designers desire this aesthetic and use chemicals to achieve this appearance. Instead of purchasing new wood, a designer can purchase used wood that has been naturally aged. Additional examples include reinstalling old fixtures with updated energy and water efficiency or using old kitchen cabinets for storage units.¹⁰⁴

Recycled Materials. Recycled materials entail reprocessing that include energy usage and transportation, which can deter designers from being environmentally responsible.¹⁰⁵ However, recycled materials are substantially better for the environment than using materials that are newly produced. The most common type of recycled materials is called postconsumer materials which have been used by households and processed for recycling. The other type of is known as postindustrial materials which are scraps that come from factories and industrial waste. When a material is processed for recycling, it is usually degraded and loses its original

¹⁰² Ibid.

¹⁰³ Ibid., 105.

¹⁰⁴ Ibid.

¹⁰⁵ Ibid., 106.

quality which is known as downcycling. Paper, for example, loses its quality as fibers become shorter and paper grade decreases. Homasote, or wallboard, exemplifies recycled paper as it is generally constructed from old newspapers. In contrast, aluminum does not lose quality as it is recycled. For example, aluminum tiles in kitchens can come from post-consumer aluminum used in aircraft parts. When a material is recycled into a new product and gains value, upcycling occurs. An example of this includes crushed glass bottles that can be implemented into kitchen countertops.¹⁰⁶

Materials and Energy. The term, embodied energy, describes the energy required to produce a material which includes obtaining raw materials, production, and transportation.¹⁰⁷ The lower a material's embodied energy is, the more favorable it is towards the environment. For example, wood has a low embodied energy since it is already processed in nature and only requires transportation and refinement. In contrast, aluminum is highly energy intensive due to mining, fabricating, refining, and transporting the material. As embodied energy takes into account materials' transportation, fuel consumption, air pollution, and greenhouse gas emissions must also be accounted for. In order to avoid high embodied energy levels from transportation, designers can shop locally for all of their required materials.

Renewable Materials. When purchasing various materials in the design process, it is important that designers consider whether the material is renewable or can be consumed at the same rate that it can be replaced by nature. These materials are also known as biobased materials and can include trees, cotton, and bioplastics.¹⁰⁸ A biobased material that causes no ecological harm must be organically grown, sustainably harvested, and use species that are indigenous to the area. Bamboo is very renewable in that it is grown very quickly to replace what has already been harvested. Issues arise when monocrop plantations of bamboo are

¹⁰⁶ Ibid., 107.

¹⁰⁷ Ibid 108.

¹⁰⁸ Ibid., 109

implemented by clearing natural forests, which damage ecosystems by killing wildlife and using pesticides. Clear-cutting forests impede forests from regenerating normally and may cause erosion and mudslides. Sustainable forestry must replace the act of clear-cutting in order to harvest biobased materials in a sustainable manner.

Many plastics pose threats to our planet as they do not degrade easily, contain dangerous chemicals, and accumulate in the ocean. Alternatives to petroleum-based plastics include bioplastics which are plastics made from various plant cellulose including corn or sugarcane. In order for these bioplastics to biodegrade, they cannot end up in landfills as they need to be exposed to the elements.¹⁰⁹

Durable Materials. When designers choose materials for their projects, it is important that these materials not only be organic and renewable, but also able to be sustained for long periods of time. Along with sustainable materials, the materials also have to be able to adapt and be recycled easily.¹¹⁰ For example, an office chair has been designed to disassemble very quickly with few tools in order to be recycled.¹¹¹ The goal of constructing for deconstruction involves prevention of materials ending up in landfills, oceans, or ecosystems. Interior designers must rethink how certain materials are placed in spaces such as glued carpeting, adhesive laminate, and metal facets on wallboards. These processes are not necessarily geared towards deconstruction and recycling and as a result, materials might end up in landfills. An option that companies could employ would be selling services instead of the product such as air condition cooling or washer machine cleaning. A consumer would pay for the service and return the machine to the company for recycling after its life cycle ended. Companies would take into consideration proper maintenance, repair, upgrades, and disassembly.¹¹²

¹⁰⁹ Ibid., 110.

¹¹⁰ Ibid., 112.

¹¹¹ Ibid.

¹¹² Ibid., 113.

Chapter 4. Getting Enough Vitamin G?: Effects of Plants on Human

Health

Ecopsychology. The field of ecopsychology serves to improve the quality of all forms of life, including planet earth and human beings. Human beings cannot flourish when the earth is suffering devastation from human causes such as global warming and increased land usage. Ecopsychology promotes the notion that humans live on a planet that is not solely for human usage. Earth is presented in a broader sense, where flourishing is more biocentric and less anthropocentric, or human-centered. Andy Fisher, author of *Radical Ecopsychology: Psychology in the Service of Life*, speaks of the disconnect between humans and the physical environment, where humans experience a void of nature in their lives, and the natural sciences exist without human involvement.¹¹³ In ecopsychology, fields of ecology and psychology become integrated into one cohesive discipline, while synthesizing together humans and the natural world. *Psyche* refers to the soul, *logos* is the study, and *Eco* derives from *oikos*, or home.¹¹⁴ Together, ecopsychology studies humans in relation to their home on planet earth. Ecopsychology is associated with many disciplines including sustainable environments, ecological restoration, contemplative psychology, ecological design, and environmental education.¹¹⁵

Biophilia and Well-Being. According to Stephen R. Kellert, author of *Kinship to Mastery: Biophilia in Human Evolution and Development*, humans have a natural attraction to the natural world and the diversity within it. This concept, known as biophilia, implies that nature has large impacts on human's physical and psychological well-being. In our evolutionary process, humans evolved as a species among the natural world with all other

¹¹³ Andy Fisher. *Radical Ecopsychology: Psychology in the Service of Life*. (SUNY Press, 2013), xiv.

¹¹⁴ *Ibid.*, 4.

¹¹⁵ *Ibid.*

creatures on earth, and therefore have developed a relationship with planet earth.¹¹⁶ Kellert argues that humans learn to love through our capacity to love nature, which increase emotional well-being and improved mental health.¹¹⁷ Kellert also believes that we can connect with nature in many ways through kinship, curiosity, dominance, and exploitation.¹¹⁸ By valuing the diversity on earth, we give value to nonhuman entities, which therefore allows humans to treat earth with better care and not exploit its resources. Nature has the ability to affect humans' thoughts, behaviors, and feelings in positive ways, so it is vital that humans respect and care for the environment.¹¹⁹ As noted in earlier chapters, earth provides many ecosystem services for humans at no charge, which allow humans to appreciate and hold earth in high esteem. Nature aids in human development, as it provides basic needs such as food, clothes, and medicine, and also aids in human capacity for emotional bonding, intelligence, imagination, attraction, security, satisfaction, and existence.¹²⁰

Aesthetics of Nature. Kellert asserts that nature has aesthetic appeals which allow for appreciation in the human experience. Humans from all backgrounds tend to favor environments with vegetation and water features, as opposed to urban environments with only infrastructure.¹²¹ Kellert believes that this attraction to nature produces adaptive benefits such as harmony and striving for ideals, order perception and organization, sustenance and security, mystery and discovery, and physical healing and mental restoration.¹²² Nature's aesthetic qualities have been proven to have healing effects on humans in times of stress, illness, grief, and disorder.¹²³

¹¹⁶ Stephen R. Kellert. *Kinship to mastery: Biophilia in human evolution and development.* (Island Press, 2003), 1.

¹¹⁷ *Ibid.*, 2.

¹¹⁸ *Ibid.*

¹¹⁹ *Ibid.*, 4.

¹²⁰ *Ibid.*, 6.

¹²¹ *Ibid.*, 7.

¹²² *Ibid.*, 35.

¹²³ *Ibid.*, 45.

Beautiful landscapes such as forests, beaches, mountains, gardens, and lakes serve as places where humans can reap healing effects.

Ecotherapy and Human Psychology. Nature, urban gardens, interior plants, and green space, in general, have very positive effects on humans in many ways. In the essay, *Vitamin G: Effects of Green Space on Health, Well-being, and Social Safety*, researchers indicate a positive correlation between green space in one's living environment and general health, wellbeing, and safety.¹²⁴ Researchers present the term of *Vitamin G*, or the green space that surrounds oneself. The Netherlands Institute for Health Services Research argues that Vitamin G helps in restoration from stress, fatigue reduction, and neighborhood safety.

Ecopsychology serves to bring nature back into the human psyche.¹²⁵ A mind that is all interior based cannot be broadened to include the exterior natural world. Andy Fisher argues that therapeutic ecopsychological practices involve therapies where humans focus on centering life into their awareness while aiming to improve ecological conditions on earth. A recollective type of practice according to Fisher, involves humans developing a relationship with the natural world, where one then seeks spiritual guidance and renewal in the process.¹²⁶

Interiors and Human Emotion. In Vinny Lee's book, *Zen Interiors*, he offers many ways that humans can create tranquil homes by incorporating that natural world into the design process. Lees suggests using earth tones for colors, including water features, incorporating plants into a space, and using decorative pieces that resemble flowers.¹²⁷ Lee also suggests adding logs, pine cones, and stones to a fireplace when it is not in use to add more natural features to a space. Elements of zen homes include simplicity, serenity, balance, and

¹²⁴ Peter P. Groenewegen, Agnes E. Van den Berg, Sjerp De Vries, and Robert A. Verheij. "Vitamin G: effects of green space on health, well-being, and social safety." (BMC public health 6, no. 1, 2006), 149.

¹²⁵ Andy Fisher. *Radical ecopsychology: psychology in the service of life.* (SUNY Press, 2013), 6.

¹²⁶ *Ibid.*, 8.

¹²⁷ Vinny Lee. *Zen interiors.* (Stewart, Tabori & Chang, 1999), 7.

harmony.¹²⁸ To achieve simplicity and serenity, Lee advises to keep interior spaces clean and organized, eliminate clutter, and allow natural light in through opening all windows.¹²⁹ If a home is situated in a space where there is less natural light or longer winters, Lee suggests painting walls yellow to resemble natural sunlight. Other earth tone paints that are recommended include browns, sky blue, lemon yellow, and almond green.

For flooring, Lee recommends stone or wood, which are both earthly elements.¹³⁰ To achieve harmony and balance, furniture must be limited and used in symmetry, and light must be regulated using blinds or curtains.¹³¹ Harmony can also be achieved by using scented herbs such as lemon balm, lavender, and rosemary. Centerpieces can be used in different seasons, where apples or leaves could be in an autumn centerpiece, and pine cones or white flowers could be used in a winter centerpiece. Lee discusses the importance of textures in interior spaces for pleasure and relaxation.¹³² Textures from materials engage the senses of humans which aid in the relaxation response. Natural materials that create textures in furniture are wood pulp and cellulose. Next, Lee presents the concept of incorporating nature into interior spaces by using large sliding doors and windows.¹³³ These large glass pieces allow light and the natural world to be let in and enjoyed by the homeowner. Finally, Lee discusses the importance of energy flow through open spaces. It is vital to declutter a disordered home, so energy and air can flow so that more oxygen is available for humans to breathe in.¹³⁴

Nature and Cognition. Green space is often associated with mental restoration and reduction in cognitive fatigue.¹³⁵ When we are in nature, we do not expend effort in

¹²⁸ Ibid., 8.

¹²⁹ Ibid., 15.

¹³⁰ Ibid., 16.

¹³¹ Ibid., 25.

¹³² Ibid., 29.

¹³³ Ibid., 37.

¹³⁴ Ibid., 53.

¹³⁵ Alan C. Logan, Eva M. Selhub. *Your brain on nature: The science of nature's influence on your health, happiness, and vitality.* (Toronto, Canada: Harper Collins Publishers Ltd.), 63.

concentration or focus, as observing the natural environment is an act of involuntary attention.¹³⁶ When we are in the workplace or other interior spaces, we expend much energy in concentration and attention which therefore causes mental fatigue.¹³⁷ The Attention Restoration Theory, developed by psychologist Dr. Steven Kaplan, proposes four components of an environment that is conducive to cognitive restoration.¹³⁸ The first environmental component is the act of *being away*, where one does not necessarily physically travel but instead mentally visualize a calming scene in nature. The next component is *fascination* with nature, where we take in natural scenes that hold our attention such as sunsets, mountains, or ladybugs. The third component is the *extent*, or depth of an environmental scene. An abundance of plants will hold our attention more so than one single plant in an interior space. The final component is compatibility, where natural spaces have to fulfill one's expectations or enjoyment such as a forest or body of water.¹³⁹ Being in nature is also shown to improve one's mood as cognition is restored. When we are mentally refreshed, we are better able to handle high stress, anxiety, and depression.¹⁴⁰ One's physical performance is also tied to the natural environment as mental fatigue is closely tied to physical fatigue. Those who work high-stress jobs become mentally exhausted and do not have the physical energy to exercise. As nature can reduce chemicals involved with stress and inflammation, short and long-term memory increases with less cognitive pressure.¹⁴¹

Research has been done linking improvement in Attention Deficit Disorder in schools or workplaces with window views of nature. A study performed by Dr. Rodney H. Matsuoka of Michigan University showed students in classrooms with views of green vegetation had higher test scores and higher graduation rates than those who had views of a human-built

¹³⁶ Ibid., 62.

¹³⁷ Ibid., 63.

¹³⁸ Ibid., 64.

¹³⁹ Ibid., 65.

¹⁴⁰ Ibid., 75.

¹⁴¹ Ibid., 76.

environment.¹⁴² Another study done by the University of Illinois concluded that children diagnosed with ADHD who walked through a park performed better on puzzles than those who walked in a downtown area.¹⁴³

When our brains are mentally fatigued, all of our perceptions in our lives become negative.¹⁴⁴ Relationships with friends, coworkers, and families suffer as we become negative from cognitive fatigue. This negativity often presents itself in feelings of anger and impulsivity. For example, road rage is less apparent on roads with vegetation than on roads with views of the built environment. When a driver becomes less fatigued through natural restoration, he or she becomes more tolerant of others and can focus better on driving. Feelings of impulsivity are present in cognitive fatigue as we do not consider long-term effects of our actions. Impulsive actions are associated with violence, addiction, or even suicide.¹⁴⁵

Indoor Plants. As nature can improve a myriad of health problems in humans, interior plants also have the ability to affect people in very positive ways. Researchers in office settings have proved a connection between productivity and indoor vegetation.¹⁴⁶ Indoor plants proved to reduce eye strain and mental fatigue, while at the same time improved productivity, reaction time, attention level, and comfort level. In academic settings, research has shown to improve test scores with the presence of potted plants in the classroom. In Sydney, Australia, 350 students were monitored for test score improvement after plants were installed in classrooms. Improvements in mathematics, science, and spelling increased by 10 to 14 percent.¹⁴⁷

Aromatic Nature. Beyond nature's aesthetic services to humans, scientists have studied nature's potential to interact with our senses through aromatic chemicals, natural light, colors,

¹⁴² Ibid., 70.

¹⁴³ Ibid., 76.

¹⁴⁴ Ibid., 71.

¹⁴⁵ Ibid., 73.

¹⁴⁶ Ibid., 76.

¹⁴⁷ Ibid., 77.

sounds, and negative ions.¹⁴⁸ Those who reside in urban environments have much difficulty managing emotional distress as they do not have access to nature and its benefits. Vapors that are derived from plants can enter our brain through our nasal cavity. Similar to certain medications, plant vapors enter through the intranasal pathway into the brain and then circulate into the bloodstream. Aromatic chemicals that enter the body are known as phytoncides and can either be arousing or sedative. Phytoncides that are produced from trees have many positive effects on human health as they reduce the stress hormone, cortisol, reduce anxiety, and increase pain thresholds. Other plants have similar effects such as increasing antioxidant defense system, improved immune function, and increased production of anti-cancer proteins.¹⁴⁹

Aromatherapy involves the use of a plant's aromatic chemicals to alter human cognition and improve various mental health disorders.¹⁵⁰ Aromatherapy has been scientifically proven to reduce symptoms of anxiety and depression through aiding in the brain's production of gamma-aminobutyric acid (GABA), a chemical that calms our nervous system, as well as the serotonin, a mood-regulating chemical.¹⁵¹ Plant chemicals such as lavender, rose oil, and jasmine have sedating effects that relax us and lower anxiety. In contrast, plant chemicals such as peppermint, cinnamon, rosemary, and lemon oil have stimulating effects that increase alertness, physical performance, and memory retention. Designers must be conscious of whether they are designing a relaxing bedroom or office space that requires attention and focus.¹⁵²

Cleansing Plants. Indoor and outdoor air pollution negatively impact humans' lives as they have unpleasant odors and are linked to various health issues. Pollutants in urban and residential settings can contribute to emotional decline through depression, anxiety, fatigue,

¹⁴⁸ Ibid., 81

¹⁴⁹ Ibid., 83.

¹⁵⁰ Ibid., 84.

¹⁵¹ Ibid., 85.

¹⁵² Ibid.

autism, pain, irritability, aggression, and frustration.¹⁵³ Physical problems that air pollution contributes to include inflammation, obesity, diabetes, and cardiovascular disease. As mentioned in earlier chapters, sources of indoor air pollution include cleaning supplies, furniture, electronics, carpeting, paint, plastics, air fresheners, faux wood, and vinyl flooring. The most common volatile chemical in interior spaces include benzene and formaldehyde. Electronics such as televisions and computers produce dangerous synthetic chemicals such as toluene, 2-ethylhexanol, styrene, and formaldehyde.¹⁵⁴

Plants become vital resources as they not only produce oxygen for human consumption but also act as air cleaners through metabolizing pollution. A plant has the ability to take in environmental pollution and transport these harmful chemicals to the soil where bacteria can then break them down. As much as 700,000 metric tons of pollution is absorbed by plants in the United States every year.¹⁵⁵ Designers must be aware of these properties and incorporate vegetation into design as much as possible. All interior spaces, such as offices, classrooms, and residential areas can benefit from plants as they clean our air and calm our minds.

Windows and Light Therapy. Light provides many benefits to humans such as vision, our 24-hour sleep cycle, and mood support.¹⁵⁶ Natural light hits our retina and allows for enhanced cognitive performance during the daytime. At night, withdrawal of light allows for our brain to produce melatonin which allows us to fall asleep. Artificial light in television, cell phones, computers, and lightbulbs tamper with our natural sleep cycle, reduce brain plasticity, and interfere with brain cell structure. When our sleep cycle is running abnormally, numerous health issues can occur such as insomnia, immune deficits, cancer, obesity, Attention Deficit Disorder, depression, irritable bowel syndrome, and fibromyalgia.¹⁵⁷

¹⁵³ Ibid., 86.

¹⁵⁴ Ibid., 87.

¹⁵⁵ Ibid., 88.

¹⁵⁶ Ibid., 89.

¹⁵⁷ Ibid., 91.

Light greatly enhances our lives as it gives us the ability to see and provides numerous therapeutic benefits. Including as many windows as possible in interior spaces can help maximize the therapeutic effects of light on humans. Seasonal Affective Disorder, or SAD, is a mood disorder characterized by low serotonin levels in winter months due to lack of sunlight.¹⁵⁸ The portion of the electromagnetic spectrum that reaches earth as solar radiation is known as visible light. Since blue wavelengths are most influential in mood disorders, many lights have been invented to replace this natural light in the winter months. Although artificial lights can provide some relief to depression sufferers, it is best to obtain natural sunlight through windows or spending time outside. Designs that include large windows, skylights, and natural views must be integrated into modern interiors to receive maximum benefit. Large windows and natural views promote wellness in academic, office, and hospital settings as people are able to access sunshine and nature. In fact, studies have been done in hospitals where sunlight has been proven to expedite the recovery process for patients with various illnesses. In one study, patients who suffered heart attacks were either placed in a room with windows and natural sunlight, or a room that lacked natural sunlight. Mortality rates of patients decreased by 7 percent in rooms that provided healing effects of natural light.¹⁵⁹

Nature and Auditory Sounds. Urban environmental sounds can have negative impacts on our health as they increase stress hormones, decrease our immune defense system, stress our cardiovascular system, and contribute to insomnia.¹⁶⁰ *Acoustic smog*, are sounds in urban areas that place stress on us such as car horns, construction equipment, leaf blowers, airplanes, and motorboats.¹⁶¹ In contrast to these negative auditory sounds, sounds found in nature such as birds chirping, flowing water, or wind whistling can lower our stress hormones and help us relax.

¹⁵⁸ Ibid., 92.

¹⁵⁹ Ibid., 97.

¹⁶⁰ Ibid., 102.

¹⁶¹ Ibid.

In order to reduce acoustic smog in urban environments, trees can be planted which can help insulate buildings against these harmful noises. Additionally, outdoor space such as gardens or patios can help us take in the sounds of nature that are most healing.

Negative Ions. Negative ions are charged molecules in the natural environment that greatly benefit humans as they promote antioxidant defense, lower blood lactate levels, enhance blood flow, improve aerobic metabolism, reduce mental illness, and promote healing.¹⁶² By immersing ourselves in nature such as forests or moving water, we can receive the healing effects of negative ions. Additionally, negative ions are most abundant post rainfalls and on clear days with no humidity. Positive ions can hurt us as they are found in electronic devices such as computers, scanners, printers, and televisions. By reducing the amount of technology in homes and increasing air flow through proper ventilation, designers can maximize amounts of negative ions available to inhabitants.¹⁶³

Ecopsychiatry. Ecotherapy involves interaction with nature that heals the brain while also protecting our environment through awareness and conservation.¹⁶⁴ The Latin term, *medicatrix naturae*, refers to Hippocrates' view of nature and its healing power on humans.¹⁶⁵ Being around nature has medicinal effects that allow for rejuvenation and a deeper concern for earth and its components. As humans are experiencing nature deprivation at alarming rates, it is vital that nature be incorporated into interior environments through design. We must avoid plants made of plastic and replace them with plants that can survive in interior spaces. We must also replace screens and technology with views of nature from large windows and garden spaces.

The field of ecopsychology developed in the mid-20th century as a preventative measure to mental illness and environmental degradation simultaneously.¹⁶⁶ As we spend more time in

¹⁶² Ibid., 98.

¹⁶³ Ibid., 99.

¹⁶⁴ Ibid., 206.

¹⁶⁵ Ibid., 205.

¹⁶⁶ Ibid., 210.

the natural world we can better appreciate and care for earth's limited resources. Ecopsychology serves to mutually benefit earth and humans as we experience mental rejuvenation while caring for our planet. J. Berkely Gibson, an American Psychologist, published *The Psychiatric Value of Wilderness* in 1952, which explains nature's medicinal values and the critical need to conserve our limited resources. Next, in 1959, psychiatrist Karl Menninger supported the National Wilderness Act by addressing the need for green space in urban areas for mental health. In 1974 an ecopsychiatry workshop was held at the American Psychiatric Association's meeting where environmental issues such as population growth, pollution, and limited resources were said to affect mental health, quality of life, and human relationships.¹⁶⁷

Utilizing ecological benefits in interior spaces began in the retail industry in an attempt to encourage shoppers to relax and consume more.¹⁶⁸ Retailers used aspects of nature such as lighting, colors, sounds, and aromas in shops to alter customers' mental states. In response to environmental change, customers remained longer in stores and consumed more goods. Retailers used nature in a negative way as resource consumption was encouraged for monetary gain. Ecological designers must include nature in their designs to benefit the environment as well as mental health. Overconsumption of goods and mental distress must be avoided completely in sustainable design.

An ecological movement in the 1970s promoted the use of plastic plants and virtual nature on plasma screens.¹⁶⁹ It was believed that this artificial nature could induce happiness in people who did not have any access to the natural world. This imitation of nature did not provide any ecological benefits to people and did not allow for engagement with nature. Without mindful interaction with nature, people could not appreciate nor care to protect earth. Another issue with simulated nature is the amount of energy used to operate them. Devices such as

¹⁶⁷ *Ibid.*, 211.

¹⁶⁸ *Ibid.*, 212.

¹⁶⁹ *Ibid.*, 219.

television screens, blue light generators, acoustic machines, and aromatherapy devices all use large amounts of electricity which contribute to increase resource usage.¹⁷⁰

Many psychologists have begun prescribing Vitamin G to patients in efforts to cure illnesses of anxiety and depression. Psychologists urge patients to spend time in greenspaces such as gardens, forests, arboretums, and urban parks.¹⁷¹ Many counseling sessions have also been held outside where patients can begin the healing process through meditation and mindfulness in nature. If healing and peace of mind can be achieved in nature, then designers can bring nature into the home to create a personal green oasis.

Chapter 5. Shift to Solar: Sustainable Design Policies for a Greener Future

Progression in the field of interior design includes using sustainable practices that do not harm the planet or inhibit life in any way. Designers are forces for change as they can choose sustainable and renewable materials, green energy systems, and recyclable wastes.

Existing Legislation, Certifications, and Organizations. Vital mandates have been made in the United States regarding environmentally conscious design, as it imposes regulations on designers to promote sustainable interiors. The National Environmental Policy Act requires that agencies become aware and report all environmental harm of their actions.¹⁷² The National Appliance Energy Conservation Act observes appliances and heating and cooling systems to allow for minimum energy usage.¹⁷³ The Indoor Air Quality Act provides assessments and recommendations for ventilation standards and toxicity in indoor air.¹⁷⁴ Many companies have begun to *eco-label* certain products to express recyclability and sustainability of a product.¹⁷⁵ For example, the *Green Seal* organization serves to examine products

¹⁷⁰ Ibid., 220.

¹⁷¹ Ibid., 216.

¹⁷² Grazyna Pilatowicz. *Eco-interiors: a guide to environmentally conscious interior design.* (New York: Wiley, 1995), 143.

¹⁷³ Ibid., 147.

¹⁷⁴ Ibid., 148.

¹⁷⁵ Ibid., 149.

throughout production for their environmental impact.¹⁷⁶ The Institute for Sustainable Forestry serves to label wood products that were harvested in sustainable manners.¹⁷⁷ The Natural Resources Defense Council aims to protect earth's natural resources from usage and promotes sustainable infrastructure.¹⁷⁸

The Hannover Principles, published in 1991, presents guidelines for designers to become aware of ecological impacts of their designs as well as incorporating sustainable designs into their practice.¹⁷⁹ The first principle presented is for humans and nature to become integrated and coexist on one planet. Similarly, ecopsychology serves to integrate the human psyche and our ecological planet to promote peaceful coexistence. Next, we must recognize the interdependence between designers and the natural world, as nature provides vital resources in the design process. The next principle involves recognizing the relationship between human spirituality and the materials used in design. Materials serve to unite humans in their homes, communities, and other places of gathering. The fourth principle involves accepting responsibility for our designs, as they affect both human well-being and earth's ecosystems. The fifth principle suggests creating sustainable objects in design so that they do not become burdens on future generations. The next principle recommends eliminating waste in the design process so that natural systems can flow efficiently. The seventh principle requests that designers rely on natural energy systems rather than nonrenewable energy sources. The eighth principle suggests that designers mimic nature in their designs but do not exploit nature for its resources. The final principle advises designers to create a community of sustainability by sharing knowledge and practices with other designers.¹⁸⁰

¹⁷⁶ Ibid.

¹⁷⁷ Ibid., 150.

¹⁷⁸ Ibid., 154.

¹⁷⁹ William McDonough, and Michael Braungart. "The Hannover Principles." (William McDonough Architects 640 1992).

¹⁸⁰ Ibid.

Valuing Ecosystem Services. In order to create sustainable designs, I propose that designers must value and utilize natural services that ecosystems provide to humans. Ecosystem services greatly enhance the lives of humans at no monetary cost. Some resources from earth that designers can use include aesthetically pleasing views and landscapes that provide psychological benefits, natural sunlight that creates light and warms a space, indoor plants that create breathable oxygen, and natural incents such as lavender and rose petals that create sensory and relaxation.

Biomimicry in Design. Not only does nature provide a multitude of services for designers to use in the design process, but also acts as a template for designers to mirror. Biomimicry, or the imitation of nature's complex systems to solve human problems, should be used in designing interior environments. Biomimetic design involves more than just imitating the physicality of nature, as systems and processes must be mimicked as well. When a problem is presented in design, one can analyze biological analogies in nature in order to find a solution.

Biophilic Integration. The relationship between human and nature has suffered in modern times as humans have become distant from their natural environments. Humans, along with other species, have evolved among the natural world and therefore have a deep connection to it. Biophilia, or the natural attraction to nature and diversity of other living things, can be incorporated into the design process in many ways. Developing a love for nature allows designers to treat natural resources with respect and not exploit our planet. Incorporating nature into design also allows humans to obtain the benefits of green plants such as increased oxygen consumption and mental restoration.

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