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## Using Biophilia in Interior Design and its impact factor on performance's and Wellbeing of the occupiers.

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### Abstract:

The affiliation of the human to nature is innate and known as Biophilia. It has a direct & strong relation to the human health and wellbeing which have been affected by the quality of interior environments that people live or work in. Nowadays a gap exists in the connection between the human and the nature as a result of modernity. This modern lifestyle impacts negatively on the human's health, performance and general wellbeing. Using biophilia in interior design, can be considered as an approach to bridge this gap to connect the human with the nature and positively impacting on health and wellbeing. This study proposed a new method to anticipate, before & after designing, the level of presence biophilic elements needed in any interior design and the positive health effects on its occupiers. This method assumes an integer value from 0 to 2 as impact factor to assess the levels of presence biophilic elements in the design of any interior space. The difference levels of presence biophilic elements used in any interior environment can be increased or decreased according to the health & wellbeing requirements. This method is trying to illustrate the importance of connecting the human being with nature in any interior environment to provide positive environment which affects performing the attitude and health of its occupiers. This method can be used to improve or renovate any interior environment to achieve a healthy and aesthetic environment that affects psychologically, physically and mentally the user of this interior space, as well as saving energy and money. The research applied this method on Children' Oncology Hospital in Cairo 57357 as a case study through analyzing the level of presence of biophilia in its interior design in a health care area.

### Keywords:

Anticipate, Biophilia, Biophilic design, Interior environment, Assesses, Impact factor.

### المستخلص

ييعتبر انتماء الإنسان إلى الطبيعة شئ فطري ويعرف باسم البيوفيليا و له علاقة مباشرة وقوية بصحة الإنسان ورفاهيته التي تتأثر بجودة البيئات الداخلية التي نعيش و نعمل فيها حيث اننا نقضى معظم أوقتنا في هذه البيئات. يهدف التصميم البيوفيلى الى تحسين صحه ورفاهيه الإنسان وأعادة ربطه مع بيئته الطبيعية بالاضافه الى تحقيق الجانب الجمالى للمكان. ظهرت فى الوقت الحاضر فجوة فى العلاقة بين الإنسان والطبيعة , الناتجة عن الحلول التصميميه الحديثه حيث يؤثر أسلوب الحياة الحديثه سلبيًا على صحة الإنسان وأدائه وسلامته العامة. لسد هذه الفجوة يمكن اعتبار استخدام البيوفيليا فى التصميم الداخلى بمثابة اتجاه لربط الإنسان بالطبيعة ولتأثيرها بشكل ايجابى على صحته وأدائه ورفاهيته. أقترح هذه الدراسة طريقة لتوقع مستوى وجود عناصر البيوفيليا اللازمة فى أى تصميم داخلى قبل او بعد عمليه التصميم والتي تؤثر ايجابيا على صحة شاغليها. تفترض هذه الطريقة قيمة عددية من 0 إلى 2 كمعامل تأثير لتقييم مستويات وجود عناصر البيوفيليا فى تصميم أى بيئة داخلية وبذلك يمكن زيادة أو تقليل هذه المستويات المستخدمة فى أى بيئة داخلية وفقاً لمتطلبات الصحة

والرفاهية بها. تحاول هذه الطريقة توضيح أهمية ربط الإنسان بالطبيعة في أى بيئة داخلية لتوفير بيئة إيجابية تؤثر على سلوك وأداء و صحه شاغليها ، مما يعنى أنه يمكننا استخدام عناصر البيوفيليا لتحسين أو تجديد أى بيئة داخلية لتحقيق بيئة صحية جميلة تؤثر نفسيا وبدنيا وعقليا على مستخدم هذا الفراغ الداخلى بالاضافة الى توفير الطاقة والمال لمستخدم الفراغ . قام البحث بتطبيق هذه الطريقة فى مستشفى سرطان الأطفال بالقاهرة 57357 كدراسة حالة كمنطقة رعايه صحيه وذلك من خلال تحليل مستوى وجود عناصر البيوفيليا فى البيئة الداخلية لبعض المناطق بها.

### الكلمات المفتاحية:

توقع ، بيوفيليا ، البيئة الداخلية ، التقييمات ، عامل التأثير.

### Introduction:

The human being was always connected to nature in different ways since the early beginning, the modernized life has disconnected gradually the people from nature and the technological advances including the indoor lives significantly diminished this connection. The decreased natural surroundings of the human being increase impact negatively on him including his physical, mental health and wellbeing as well as his daily performance (Kellert and Calabrese, 2015). Reintroducing the natural surroundings in the modern urban society would be of great benefit to reconnect the human beings with nature (Kellert, Heerwagen, and Mador, 2008). Different studies revealed that direct exposure to the different biophilia elements reinforce the immune system, reduce the stress level, therefore heal the human body. (Frumkin et al., 2017; Ryan and Browning, 2018) Studies also found a direct correlation between human level of cortisol and the direct experience of nature (Ward-Thompson et al., 2012). Physical activity in the greenery areas creates a positive mood and raises the self-esteem (Barton and Pretty, 2010) therefore, people living in green areas have an overall healthy life and better mental health (Beyer et al., 2014). Using an interior environment fulfilling the different biophilia elements that increases the connection between the nature and human being will improve the mental, physical wellbeing and performance of their occupants in addition to the designed purpose.

### Research Problem:

The modern indoor lifestyle increases the isolation and disconnection with nature missing its beneficial effects. This modern lifestyle impacts negatively on the human's physical mental health, performance and general wellbeing.

### Aim of the research.

Using biophilia in interior design, can be considered as an approach to bridge this gap and restore the connection between the human being and his natural environment and regain its positive effects.

### Material and method:

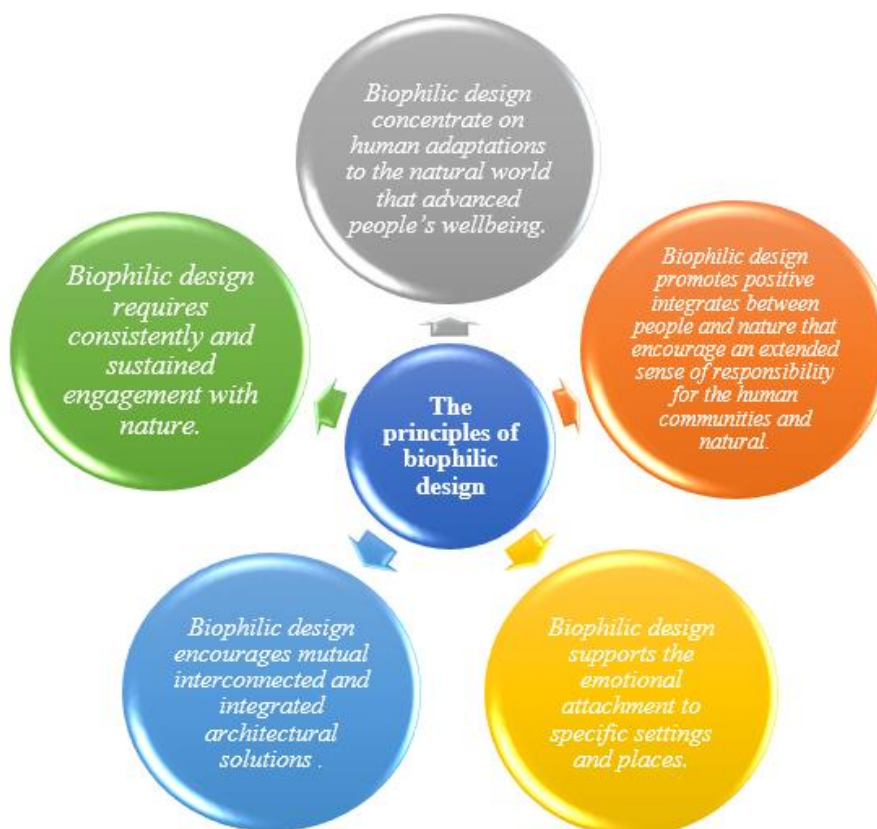
The method is anticipating the levels of presence biophilic elements used in any interior design by assumes an integer value from 0 to 2 as impact factor to assess this level in the design which affect the human health and wellbeing.

## I. Biophilia and Biophilic Design

Human beings should have a strong connection to the elements of nature in this world. If it is not available around us, we can bring it into our lives by mimicking its elements as patterns, colors, shapes and fractals in designs this what we call biophilia in design. Biophilia is an innate human need to affiliate with nature—thereby benefiting from natural situation that positively impact physical, spiritual, social and psychological wellbeing. The word biophilia was coined by the social psychologist Erich Fromm and popularized in the 1980's as Edward O. Wilson. It has Greek roots which means 'love of life'. Bio means "life or living things", philia means "love". (Kellert and Calabrese, 2015). Biophilic design is the practical application of the biophilia hypothesis through design and cover human physiological & psychological-health and well-being through green design ideas. (Kellert, Heerwagen and Mador, 2008)

### I.1. The principles of biophilic design:

To apply the Biophilic design effectively, some principles are needed, which are prerequisites for the success of their applications such as: (Figure 1) (Kellert, S. and Calabrese, E. 2015)



**Figure 1: The principles of biophilic design.**  
Source: (Kellert, S. and Calabrese, E. 2015)

### I.2. Experiences and Attributes of Biophilic Design:

Table 1 describes the three experiences and the 24 attributes of the biophilic design (Kellert and Calabrese, 2015). They are direct, indirect experiences of nature, space and place. The direct experience of nature has actual contact with the environmental features. The indirect experience of nature is the contact with representational of nature. The experience of place and space is a spatial feature.

**Table1: Experiences and attributes of biophilic design. (Kellert and Calabrese, 2015).**

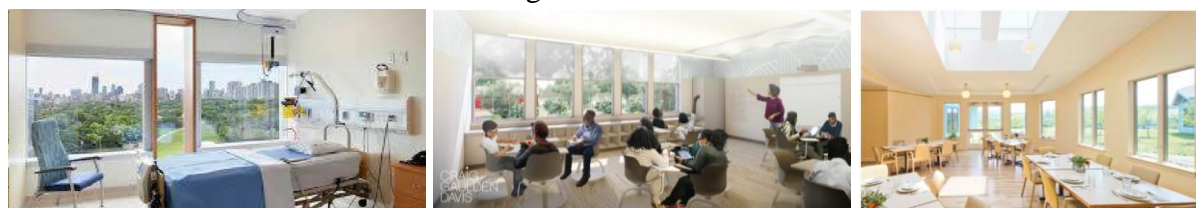
| <i>Direct experience of nature</i> | <i>Indirect experience of nature</i> | <i>Experience of space and place</i>        |
|------------------------------------|--------------------------------------|---|
| Light                              | Images of nature                     | Prospect and refuge                         |
| Air                                | Natural materials                    | Organized complexity                        |
| Water                              | Natural colors                       | Integration of parts to wholes              |
| Plants                             | Simulating natural light and air     | Transitional spaces                         |
| Animals                            | Naturalistic shapes and forms        | Mobility and wayfinding                     |
| Weather                            | Evoking nature                       | Cultural and ecological attachment to place |
| Natural landscapes and ecosystems  | Information richness                 |   |
| Fire                               | Age, change and the patina of time.  |   |
|                                    | Natural geometric                    |   |
|                                    | Biomimicry                           |   |

## II. Implementation of the experiences and attributes of biophilia design in interior environment:

### *a-Direct experience of Nature*

#### **Natural light:**

The human body is entirely affected by the sun and responds positively to the well-lighted areas than the darker ones (Huelat, 2008, Greven, 2017). the sunlight provides comfort and satisfaction and direct therapeutic actions. Natural light can be brought deep into interior spaces transmits the view of the outdoor setting by using different materials and openings like glass walls, windows, glass ceilings, reflecting colors and materials and other design strategies (Figure 2,3). The incorporation of natural light in the interior design has different effects on the human body including easier and comfortable vision of the different tasks (Kim and Kim, 2007), positively controlling the circadian rhythm, (Figueiro et al., 2011) as well as the behavior and mood. An important therapeutic role of the sunlight is activation of vitamin D, inducing the “serotonin” the antidepressant hormone and reducing the “melatonin” hormone, the sleep inducer (Meenakumar, 2017). The integration of natural light and shadows in the interior spaces can create diffuse and variable interesting forms.



**Figure 2: Daylighting in patient room, classroom and dinning room.**





Figure 3: Daylighting in Oncology infusion room, waiting area and workspace.  
Source: (DeGroff and McCall, 2016; Determan et al., 2019)

### Water:

The water has multiple positive effects on the human's health. It reduces stress, increases his sense of tranquility, lowers the blood pressure and decreases the heart rate. Mentally, it improves concentration, memory and restoration, performance, enhances perception and psychological responsiveness (Alvarsson et al., 2010) of the occupiers of the different spaces, work, home. Positive emotional responses are created (Barton and Pretty, 2010; White et al., 2010) including the joy of seeing, hearing and feeling the water in the different spaces. Incorporating the benefit of clean water in interior design as a biophilic element was suggested by several studies (Ryan et al., 2014) like water base in lobby, water walls, fountains, aquarium, paintings of the ocean life (Figure 4). The use of images containing water was found to be preferred than those without (White et al., 2010).



Figure 4: Different ways for using water in the interior environment with a positive effect on human's health.

Source: [www.sbid.org](http://www.sbid.org)

### Natural ventilation:

The natural ventilation renders the human life more comfortable and productive. Its existence in the interior design can be enhanced by variations in airflow, temperature, humidity, and barometric pressure. This can be achieved through opening windows or new technological means. In the interior environment, natural ventilation reduces indoor pollutants, provides thermal comfort, thus, reduces energy consumption by using the air conditions (Kellert and calabrese, 2015).

### Plants:

Plants are one of the most successful strategies for bringing the direct experience of nature into the interior environment. The presence of indoor plants can improve indoor climate, clear air by absorbing atmospheric gases as carbon dioxide and release oxygen (Huelat, 2008, Greven, 2017). Including the plants in the interior spaces provides a comfortable environment, which enhances their occupiers' mental and physical performances, productivity, reduces stress and increases pain tolerance (Bringslimark, Hartig and Patil 2009). Studies showed that occupants

of green office spaces were more productive than those in lean office spaces as well as the valuable effects on patients in health care areas (Figure 5). The small green lightly scented plants were the most optimal for health and wellbeing. (Beukeboom, Langeveld and Tanja-Dijkstra, 2012)

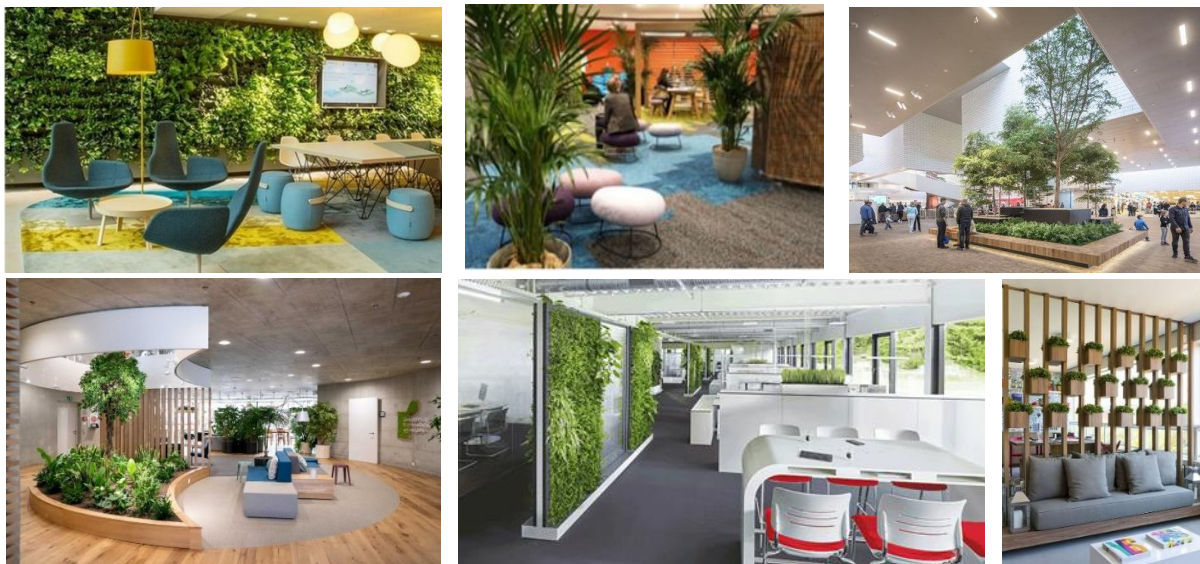


Figure 5: Using plants in different interior environment.

Source: <https://www.oliverheath.com/biophilic-design-connecting-nature-improve-health-well/> (accessed on 13 July 2019) , [www.cognitivestudios.org](http://www.cognitivestudios.org)

### Natural Landscapes and Ecosystems:

Natural landscapes and ecosystems connect the humans with nature by bringing all the natural elements in one space like plants, animals, water, soils, rocks and geological forms. The view of natural landscape and ecosystems attributes have beneficial effects like providing a comfortable environment that reduces stress for human beings (Figure6). In health care areas, patients in rooms with green tree views recover faster and require less medications than those with brick wall views. An interesting study showed that exposure to nature for less than 5 minutes induces positive physiological changes such as lowering blood pressure and that certain scenes can help in distraction from stress (Duzenli, Tarakci and Akyal, 2017). Also, natural multi-colored gardens can be considered as healing environments as they induce positive psychological changes including lowering the blood pressure (Huelat, 2008, Greven, 2017). Biodiversity is important in an ecosystem for balancing atmospheric gases, maintaining clear air and water quality, providing variety of food, crop production and production of medicinal drugs which originate from plants. (Duzenli, Tarakci and Akyal, 2017)



Figure 6: The view of natural landscapes from a window give positive effects on the wellbeing of interior occupants.

### ***b-Indirect Experience of Nature***

#### **Image of nature:**

The image of nature plays an important role in interior design, when direct exposure to the nature is not possible, as a sterile medical environment, or the exterior natural views are not possible due to seasonal changes, adjacent buildings. The images of nature can be alternative to the view of real nature, depending on their content and view (Figure 7,8), providing a connection with the natural world (Kjellgren and Buhrkall , 2010). These images can be photographs, paintings, sculpture, murals, video, computer simulations and other representational means. (Bringslimark, Hartig and Patil,2011).



Figure 7: Using aquariums paints on wall can lower patient anxiety levels in healthcare settings.  
Royal Children's Hospital - Billard Leece Partnership/Bates Smart  
Bournemouth Hospital Jigsaw Building - Stride Treglown



Figure 8: Using images of nature on wall design of healthcare facilities, can reduce patient stress.  
Royal Bournemouth Hospital Jigsaw Building - Stride Treglown

<https://www.nacarchitecture.com/naclab/naturescure.aspx>

#### **Natural color:**

The effective biophilic implementation of colors prefers neutral earthy colors of natural elements as soil, rock, and plants, also emphasizes the attractive surrounding environmental colors of flowers, sunsets and sunup, rainbows and certain plants (Figure 9) and animals. The psychological effect of the colors is very deep, every color has an individual identity. For example, the blue color brings tranquility into an environment, while orange brings a warm and welcoming feeling. The green is calming and reassuring. Many bright or intense colors affect our mood positively, whereas gray and dark brown are associated with depression and remind us of illness and death (Carruthers et al., 2010).





Figure 9: The human being prefers the natural color of his environmental.

### Natural materials:

Natural materials in our design reflect the local material, ecology or geology to create a distinct sense of place, like using wood, stone, clay, bamboo, dried grasses and cork. (Ryan, Browning and Clancy, 2014) These materials engenders positive cognitive and physiological responses in the interior environment such as wood, increases the feeling of comfort and lowers blood pressure. These materials can be used in flooring, wall treatment, windows treatment, doors, furniture, fabrics (Figure 10). Natural materials can be stimulating, reflecting the dynamic properties of organic matter as response to the stresses (Kellert and Calabrese 2015) and decrease blood pressure, improve a creative performance and comfort.



Figure 10: The natural material engenders positive cognitive and physiological responses in the interior environment such as wood, stone, clay, bamboo, palm leaf.

Source: <http://growinginclusivemarkets.org/media/cas es/Egypt 2008>.

### Natural Geometries:

The natural geometries refer to mathematical properties commonly found in nature. These natural geometries include hierarchically organized scales and self-repeating “fractals” like Snowflakes and veins of the leaf, the “Golden Ration” 1:1.618 as seashell, DNA and “Fibonacci Sequence” as the center of a sunflower. Humans prefer designs which have or applied this natural geometry. (Kellert and Calabrese 2015)



Figure 11: Natural geometric shapes and its applications in interior design and furniture.

Source: <http://thesavoia.com>, [www.homedit.com](http://www.homedit.com), <http://www.contemporist.com>, [www.edgemagazine.net](http://www.edgemagazine.net)

### Biomimicry:

Biomimicry inspiring forms, shapes and functions found in nature (animals, plants and organisms). Using the biomimicry approach in interior design and furniture creates new innovative designs, and solved human problems with solutions including sustainability, better performance, less use of energy, waste elimination, material reduction, minimum weight, cost and pollution. This design is called looking at biology, devising a specific characteristic, behaviors or function (or systems and processes works) in a living organism or the ecosystem and interpreting it into human designs. (Nkandu and Alibaba 2018)

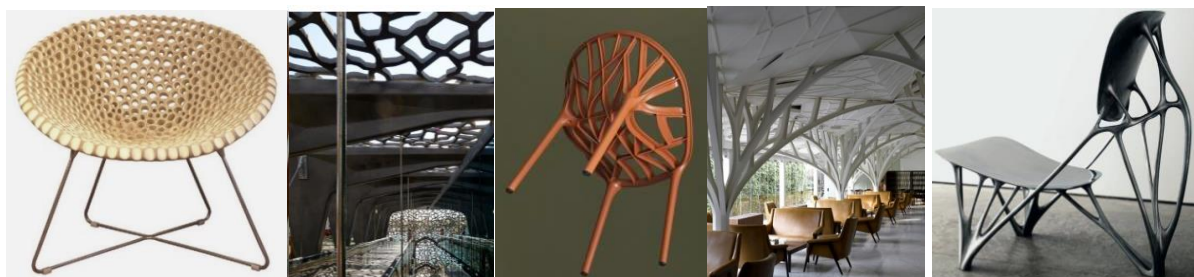


Figure 12: Biomimicry suggest sustainable solutions in interior design and furniture.

Source: [www.technologystudent.com](http://www.technologystudent.com)

### c- Experience of space and place

#### Prospect and refuge:

**Prospect:** is an open space that gives a sense of safety and control, particularly in unfamiliar environments like open views, longer than 6m, partition heights, transparent materials, open floorplans. (Figure 13) Using the prospect in interior design can reduce stress (Grahn and Stigsdotter, 2010), boredom, irritation, fatigue and improved comfort and perceived safety.



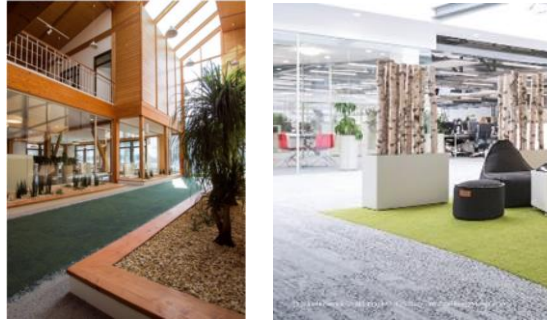


Figure 13: Prospect in interior design.

**Refuge:** refuge space is a place for withdrawal, protection, rest or healing from environmental conditions or the main flow of activity or work and feels separate or unique from the surroundings. Spatial characteristics can be thoughtful, embracing & protective but not necessarily disconnected like Bay window seats, partial refuge, several sides covered, reading nooks and (Figure 14) Canopy beds. Using the concept of the refuge in interior design can improve concentration, attention and perception of safety (Grahn and Stigsdotter, 2010, DeGroff and McCall ,2016)

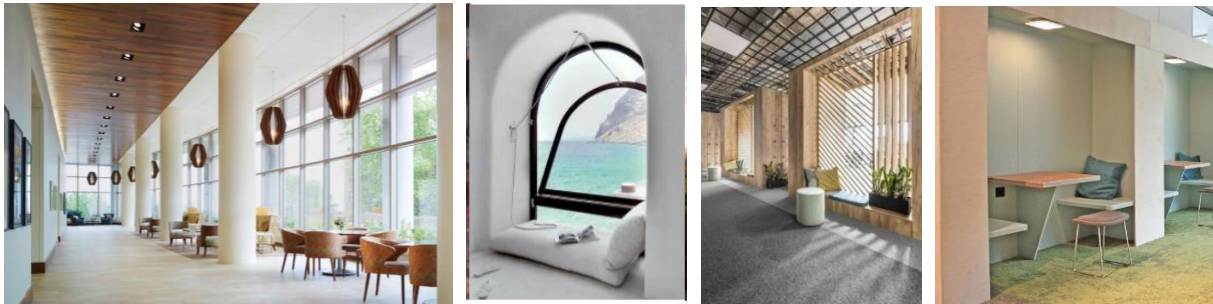


Figure 14: Refuge in interior design.  
Source: (DeGroff and McCall ,2016)

### Organized complexity:

People find the complexity in structures like fractal in both nature and human bodies but in an organized way. Therefore, the people react positively with fractal designs because their body systems are designed in same fractal way like the circulatory and respiratory systems. The fractal design connects subdivisions, similar in patterns to the original one but smaller in size, in one unit in the same organized and symmetrical patterns (Salingaros, 2012). The fractal similarities in both the human body systems and the designed fractal structures create a positive natural link. The design that lack this kind of organized complexity decreases the interest of the space and the complex spaces tend to be variable and diverse, while organized ones possess attributes of connection and coherence (Kellert and Calabrese 2015). Using the organized complexity in interior environment can achieve a positive perceptual and physiological responses as well as increasing the interest to the space (Salingaros, 2012; Taylor, 2006).



Figure 15: different designs achieved organized complexity by using fractal structures.

Source: <http://forums.autodesk.com> , [www.stylepark.com](http://www.stylepark.com)

### Integration of parts to wholes:

People covet settings where disparate parts comprise an integrated whole. This feeling of an emergent whole can often be achieved through the sequential and successional linking of spaces, as well as by clear and discernible boundaries. This satisfying integration of space can be enhanced by a central focal point that occurs either functionally or thematically.

### III. Biophilic interior design:

The Biophilic interior design incorporates the nature in interior environment depending on inherent connections between the humans and their natural environment, through application of the biophilic features in the interior design (Browning, Ryan and Clancy, 2014). Using the biophilia elements in designing residential, work and commercial spaces is important to improve the functional, physical, psychological health and the overall well-being (Kellert, Heerwagen and Mador, 2008). Using the biophilia in interior design results in several physical benefits including enhanced physical fitness, lowering blood pressure, increasing comfortability, less illness symptoms, and improved health. Similarly, several mental benefits appear, like increased satisfaction, motivation, less stress, anxiety and improved problem solving and creativity. Positive behavior enhanced attention and concentration, improved social interaction, and less aggression. (Browning, Ryan and Clancy, 2014, Yin et al., 2018). There is a freedom in designing with biophilia while respecting all previous basic guidelines. The main purpose of adding these features is to have a vital and healthy interior environment to show the strong attachment between the humans and their natural environment.

### IV. Anticipating the level of presence biophilia elements in the different interior environments:

Many studies proved that biophilia can improve the human health and wellbeing (Ward Thomason c. et al ,2012). This study showed how to anticipate the level of presence of biophilia elements in interior design that can improve the human health. We consider for any biophilic element an integer value from 0 to 2 as impact factor to indicate the level of its presence where: 0=not present, 1= present and 2=strong present. The symbol S is the sum of all levels of presence of all biophilia elements in any interior space and permits us to anticipate the healthy effect and wellbeing on its occupiers. The difference levels of presence biophilia elements used in any interior environment can be increased or decreased according to the health and wellbeing requirements. This method illustrates the importance of connecting the human being with nature in any interior environment to provide positive environment which affects performing the attitude and health of its occupiers. This method can be used to improve or renovate any interior



environment to achieve its health and aesthetic and consequently, affects the psychological, physical and mental of its occupiers. This will also save energy and money. This research applied this method on the Children’s Oncology Hospital in Cairo 57357 as a case study through analyzing the level of presence of biophilia in its interior design in a health care area.

## V. Case Study: ‘Children’ Oncology Hospital 57357’

### 1. General description of the project

The 57357 Hospital was built in Al-Sayeddah Zainab district, Cairo in 1998 and was opened 2007. It is recognized as an international well-known children’s cancer specialized hospital and is one of the biggest children s cancer hospital in the world. It has 180 beds and treatment rooms.

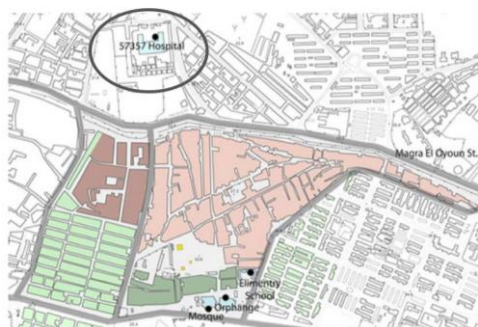


Figure16: The children oncology hospital 57357  
Source: cairobserver.com,2013

## 2. Analysis of biophilic design elements and attributes in the 57357 hospital:

### a. Direct experience of Nature:

#### 1- Nature light:

The spread of the natural daylight in the hospital is through the skylight in the hospital’s reception, patient’s lobby and side windows in the patient’s rooms and the chemotherapy wards (Figure 17). In the buildings, some areas are more lighted than others due to the different angles of sky visibility or the opposing buildings. Using the natural daylight allows spreading the positive energy and reducing the harm and negative energy resulting from the electric light. This provides the patients and the staff with sufficient amount of daylight and affects positively their wellbeing as well as speed the recovery of the patients.





Figure17: different zones (reception, patient's lobby, the chemotherapy ward and patient's rooms) in hospital to illustrate the importance of using the natural light.

## 2- Natural ventilation:

The potentials of natural ventilation in the hospital is negligible due to the urban context of the hospital, however, this was overcoming by implementing the infection control around the hospital in a mixed mode system using filtered natural air.

## 3- Landscape:

The landscape is viewed from the windows of the hospital's rooms, receptions and chemotherapy wards; however it is limited amount of green nature.(Figure 18)



Figure18: Exterior view from patient room, chemotherapy wards and reception.

## 4- Water:

No presentation of natural water inside the hospital.

## 5- plants:

No presentation of natural plants inside the hospital.

## *b. Indirect experience of Nature:*

### 1. Natural materials.

- Using glass and metal in the ceiling allow the daylight to enter the hospital. (Figure 20)
- Using colored glass in the interior wall to minimize using solid materials. (Figure 20)
- The doors are formed of three materials glass, wood, metal. (Figure 19,21)
- Natural material in top of the counter and the waiting chairs. (Figure 19,20)
- Using glass in the chemotherapy ward in the wall windows from the ceiling to the floor to let the daylight enter the space and spread a positive energy in it. (Figure 22)



Figure19: Nurse station



Figure20: Receptions area



Figure21: The doors.



Figure22: Using Glass in the Chemotherapy ward in the wall windows.

## 2. Images of nature:

- The patient's lobby have different images of nature on the walls all around the space (Figure 23).



Figure 23: different image of nature all around the space.

Source: [www.archnet.org](http://www.archnet.org)

## 3. Nature Colors:

- The hospital used the rainbow color in the floor with different geometric shapes in the patient's lobby, reception and nursery station (Figure 24).
- They used different colors on the interior glass of the reception area (Figure 20).
- The grey color was used in the entrance and the exit doors of the reception area (Figure 24).
- The wall and the ceiling are white in color.
- The off-white color was combined with other different colors in the floor.
- The chemotherapy wards have a different colored couch placed around the circumference of the room. The columns in the ward has different color and the floor has different colored decorating geometrical shapes on an off-white based color (Figure 24).



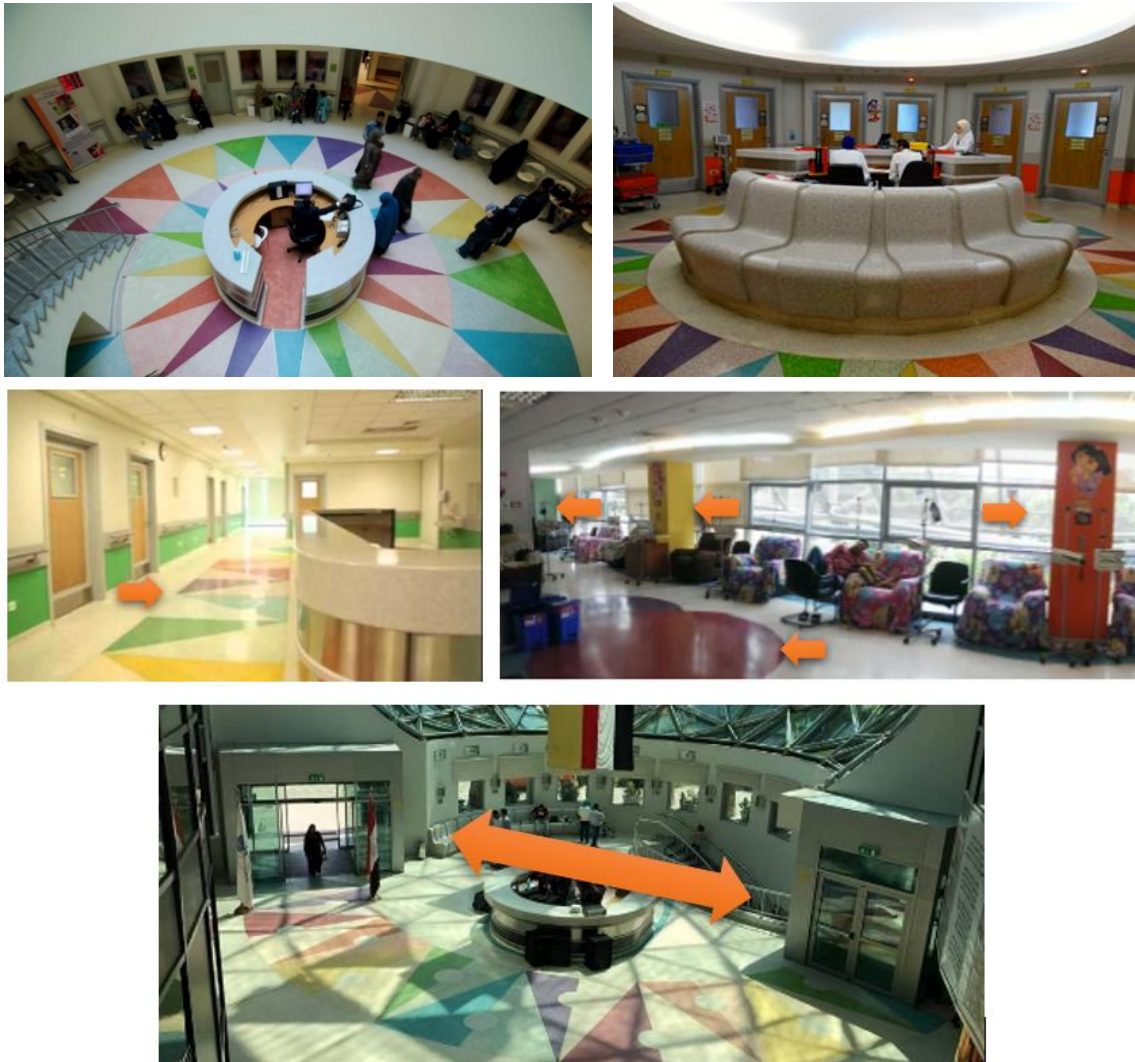


Figure 24: The hospital used the rainbow color in the interior design.

Source: [www.travelreportage.com](http://www.travelreportage.com)

#### 4. Natural geometry:

The ceiling design of the reception has a glass spherical shape decorated with fractal geometric shapes to bring natural healthy light into the core of the reception (Figure25).

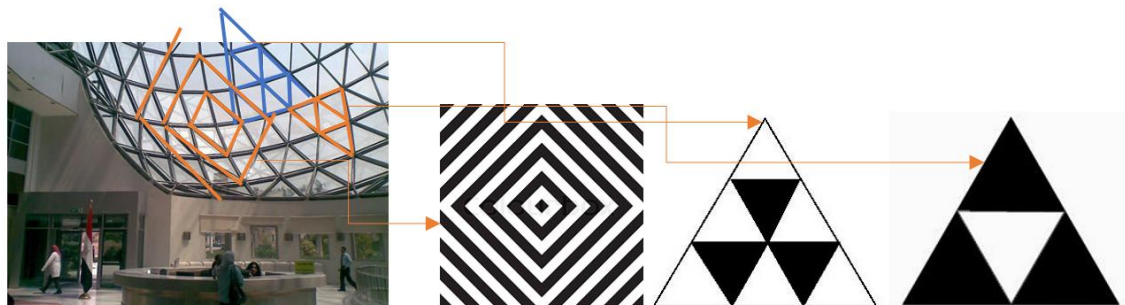


Figure25: Using different fractal shapes as siepernsky triangles and others.

Source: [www.shorouknews.com](http://www.shorouknews.com)



**c. Experience of space and place:**

**1. Prospect and refuge:**

Both concepts were used in the reception and waiting areas (Figure 26) and the prospect concept was applied in the lobby of patients (Figure 23).

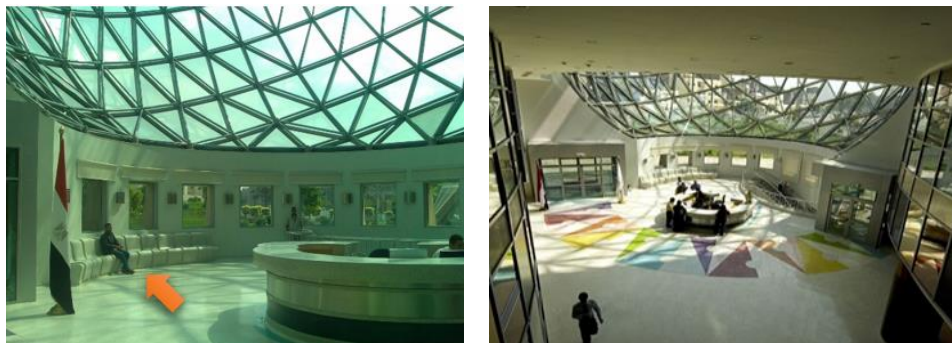


Figure 26: Applied the concept of prospect and refuge in hospital reception.

Source: [www.homewithoutcancer.57357.org](http://www.homewithoutcancer.57357.org)

**2. Integration of parts to wholes:**

The spherical ceiling of the reception area consists of small triangles integrated to give the whole shape (Figure 27).



Figure27: The spherical ceiling of the reception exterior and interior.

**Table 2: Assessment of the level of presence of biophilia design in 57357 Oncology hospital.**

| Attributes of biophilia design | Elements of biophilia           | Reception | Patient lobby | Chemotherapy ward | Patient room |    |
|--------------------------------|---------------------------------|-----------|---------------|-------------------|--------------|----|
|                                |                                 |           |               |                   | R1           | R2 |
| a. Direct experience of nature | Presence of natural Light       | 2         | 2             | 2                 | 2            | 2  |
|                                | Presence of natural ventilation | 1         | 1             | 2                 | 2            | 2  |
|                                | Presence of water               | 0         | 0             | 0                 | 0            | 0  |
|                                | Presence of plants              | 0         | 0             | 0                 | 0            | 0  |
|                                | Natural landscapes and          | 2         | 0             | 1                 | 2            | 1  |

|                                  |                                |       |       |       |       |       |
|----------------------------------|--------------------------------|-------|-------|-------|-------|-------|
|                                  | biodiversity (view)            |       |       |       |       |       |
| b. Indirect experience of nature | Images of nature               | 0     | 2     | 1     | 1     | 1     |
|                                  | Natural materials              | 2     | 2     | 1     | 1     | 1     |
|                                  | Natural colors                 | 2     | 2     | 2     | 2     | 2     |
|                                  | Natural geometries             | 2     | 2     | 0     | 0     | 0     |
|                                  | Biomimicry                     | 0     | 0     | 0     | 0     | 0     |
| c. Experience of space and place | Prospect and refuge            | 2     | 2     | 1     | 1     | 1     |
|                                  | Organized complexity           | 2     | 2     | 0     | 0     | 0     |
|                                  | Integration of parts to wholes | 2     | 2     | 2     | 2     | 2     |
| Sum                              | S                              | 17/26 | 17/26 | 12/26 | 13/26 | 12/26 |

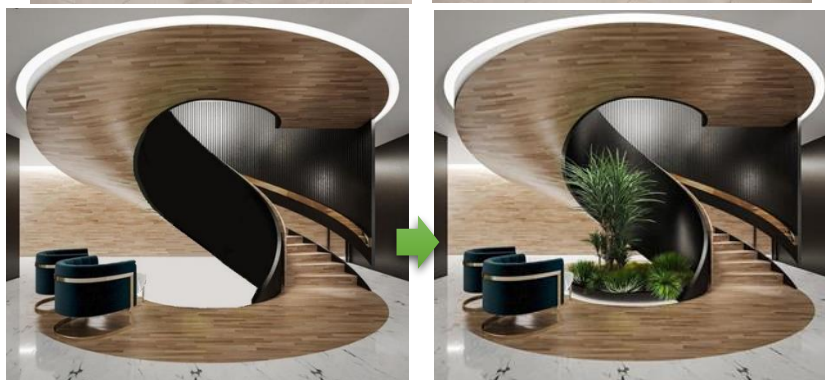
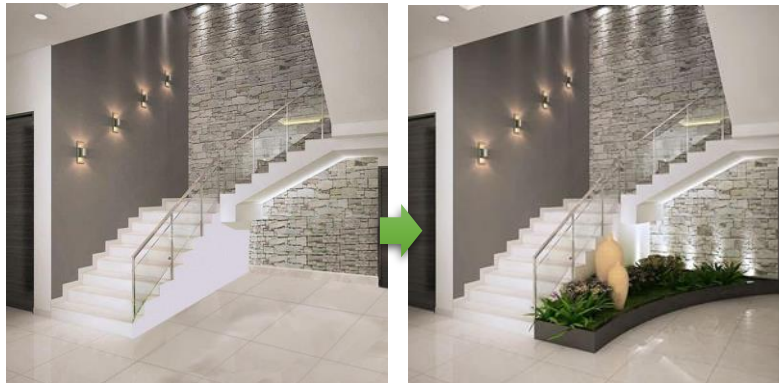
**Impact factor:** 0= not present 1= present 2= strong present.

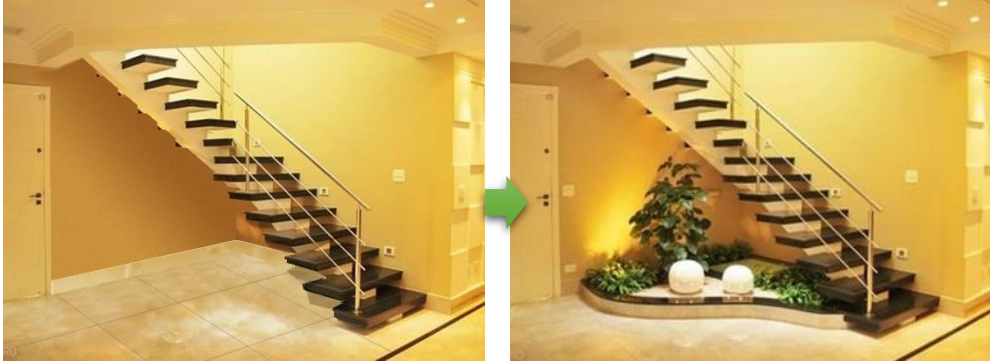
This table analyzed the level of presence of biophilic elements in interior design of the children's Oncology hospital 57357 and found that it is present in obvious ways, but adding some biophilia elements to the hospital would increase **its beneficial effects which can be:**

1. Water: as water walls, fountains, aquarium, paintings of ocean life which has positive impact on the space to improve human health, wellbeing and performance like relieving stress, promoting satisfaction.
2. Plants: the indoor plant life, even in terms of few plants can improve the interior environment quality and bring the natural outdoor greenery life closer. The different shapes like potted plants, hanging plants and living walls according to the function of the place can be used. The plants decrease stress and depression of hospital users, improve patient containment and staff work productivity. (Totaforti, 2018)
3. In-patients' rooms the different images of nature can be considered.

## VI. Application of using elements of biophilia in homes

Figures 28 shows different ideas solving the problem of the unused spaces under indoor stairs which faces the interior designer in villas. Biophilic elements like plants, water and natural materials can be used to render these empty spaces useful, healthy, aesthetic and unique places. Consequently, the occupiers of these places will connect with nature through its different elements. This will restore attention, reduce the frequency of aggressive behavior, as well as reduce the physiological stressful effects on the autonomic nervous system, also, promote social health through social interaction thus, creating a positive environment.





Figures 28: Different ideas solving the problem of the unused spaces under indoor stairs.

## VII. Results:

- The usage of the biophilic attributes in the different interior environments, like health care facilities, workplaces, classrooms, community spaces, homes create a new environmental ambiance that positively affects the physical, mental and behavioral levels of its occupiers.
- Anticipating the level of presence of biophilic elements before designing by using impact factor results in healthier, effective & sustainable interior environment.
- The interior designers need to integrate the nature in their design solutions for a better, sustainable and healthy interior environment.
- The wide varieties of the biophilic attributes can give the interior designer freedom and creativity in designs as well as the chance to improve the health, wellness and performance of the occupiers.
- The sunlight, the greenery and other natural elements of biophilia in the interior environment of hospitals reduce the stressful ambience for patients, staff and health care workers and decrease the patient recovery time, lower absenteeism among staff , as well as increase productivity, job satisfaction, and psychological well-being.
- The study illustrated that people exposed to natural sun light in their interior environments are less exposed to stress, pain and need for medications than the unexposed ones.
- Using biophilia in interior design will save energy and money in different ways

## VIII . Conclusions:

- In interior design the biophilia is an innovative approach that can enhance the importance of human beings contact with nature in any interior environment to increase the positive performance attitude and healthy effects.
- The oncology children's hospital 57357 in Egypt is a good example of a biophilic interior environment, increasing the children's adaption with their surrounding from diagnostic machines and tools, different types of treatment and changing the hard nature of their disease into a healthy cheerful environment.
- The biophilic interior design allows the immediate merge of the interior environment with its surroundings, a one thing, that urged the interior designers to adopt an approach as a prerequisite for solving problems in resilience and sustainability.



**IX. Recommendations:**

- Implementation of the biophilia elements in the interior environment will decrease the gap between the nature and the human being, thus improving their mental, physical wellbeing and performance.
- The constant improvement of the quality of healthcare facilities demands the integration of the biophilia in the interior design to improve the services of its occupiers.
- The interior designers need to integrate the nature in their design solutions for a better , sustainable and healthy interior environment
- Turning interior walls into vertical gardens or green walls will change the conventional interior design into a biophilic one, while including the nature and its advantages inside.

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