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The Divine Architecture towards a Living Form

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ABSTRACT

The divine architecture towards a living form is an extension to biomimicry, it is the conscious architecture design that are a reflections of the biological common principles in organism (only in living thing). Importance of the research is the creation of biological indicators from the most vital organism (Human, animal and plant) what this living things have in common, that what this research try to deduced the basis of the living organism to have its survival. And provides designers an integrated tools for form exploring and design. Research problem summarized in Since God Almighty is the greatest Architect of the Universe, which create to us the endless greatest examples of forms achieved survival which is include (sustainability, environment, durability, and so on) in the highest sense and solved all the architecture form problems that might we encounter in man-made architecture, it is necessary that there be a reference and a hand book to us to our architectural form design. Research aims to Access to a biological indicators of the organismic level (architecture) effectively addresses the form design to set a form biological environmental principles and guide line and orient the building form to be green (closer to the plant), or gold (closer to humans).

1. INTRODUCTION.

This research illustrate the anatomical philosophy of living architectural form (the form of living creation) by the analysis of two types of organism animals-Human and Plants to discover its success secrets as alive architectural building form achieved survival accordingly increase their chances of flourishing in their environment.

2. HUMAN AND ANIMAL FORM AND MORPHOLOGY (FEATURES).

In most biological respects, humans and animals are alike. For instance, they are made up of cells like those of other animals, have much the basic same composition, have organ systems and physical characteristics and features like many others, carry the same kind of genetic information system.

2.1. Design elements and interactivity.

Every creative process has its own tools and ingredients. All organic structures teach us the same lesson of the element and the principals of design.

> **Conclusion: Tools of living form.**
> The creative living form has its own tools and ingredients.

Rhythm, The bones of all vertebrate animals, from fish to man, illustrate the constant repetition in different degrees of the same character and direction of line (Rhythm). The vertebral column itself is an instance, and the recurring spring of the ribs from it, further expressed in the ramification of the jointed bones of the limbs and extremities.

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The principle may be followed out in the structure of the muscles in their radiating fibers, which the delicate contours and flowing lines of the surface of the body only combine in a greater degree of subtlety.

> **Conclusion: Module in living form.**
> Biological systems features use modularity and hierarchical design.

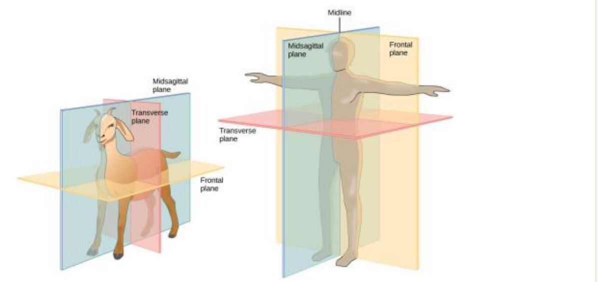


Figure (1): Balance (Different Axis in human and animal body). [1]

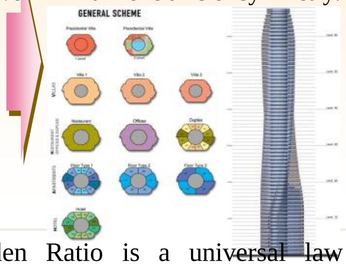
Animals and humans have **one axis of symmetry**: Left/right. They lose two axis of symmetry, but have gained two directions of freedom in up/down and Front/back. All animals and humans grow up/down and front/back in an asymmetrical fashion. **Balance,** the human body can be divided into various sectors, with the dividing lines represented by planes. The following fig. (1) Illustrate the major planes.

Sagittal, Plane that runs down through the body, dividing it into left and right portions. Subsections of the sagittal plane include the Mid-sagittal plane, which divides the body equally into left and right portions, and the Parasagittal plane, which is parallel to midline but does not divide into equal left and right portions. **Coronal** (frontal): Plane that runs perpendicular to the sagittal plane and divides the body into anterior and posterior (front and back) portions. [3]

Proportion, The golden Ratio in human and animal body is a standard for balance and beauty in regards to proportions. Adolf Zeising, found the golden ratio expressed in the skeletons of animals and the branching of their veins and nerves, to the proportions of chemical compounds and the geometry of crystals. [2]

The living movable building design principles:

Living movable building is approximately homogeneous determined by the distribution of mass over volume. And should have minimum one axis of symmetry.



The Golden Ratio is a universal law in which is contained the ground-principle of all formative striving for beauty and completeness in the realms of nature, and which permeates, as a paramount spiritual ideal, all structures, forms and proportions, whether cosmic or individual, organic, acoustic or optical; which finds its fullest realization, however, in the human form. We can draw many lines of the rectangles into the fig. (3). Then, there are three distinct sets of Golden Rectangles:

- Each one set for the head area, the torso, and the legs.[4]
- The length between the tips of the finger and the elbow = X. The length between the tip of the finger and the length of the arm = y.
- Y divided by x = 1.618. [5]

The symmetry of the face has been scientifically proven to be inherently attractive to the human eye. It has been defined not with proportions, but rather with similarity between the left and right sides of the face, this symmetry (formal balance). [6] The face below in fig. (3) Shows the different between (1) which is the original face, (2) after putting the some lines which represent the golden ratio and (3) after applying the golden ratio.

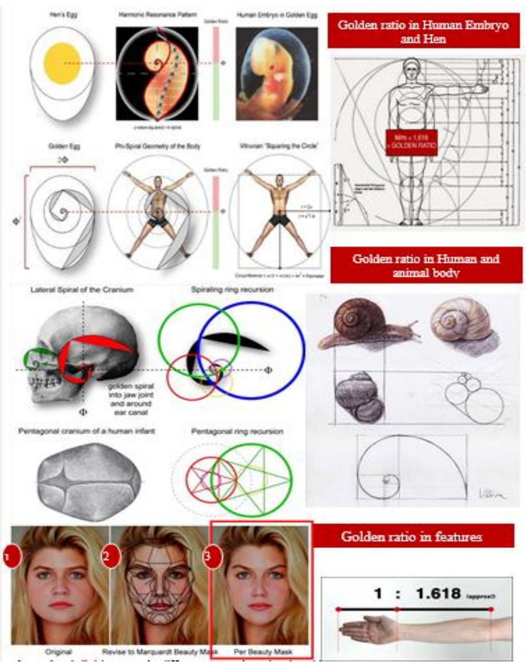


Figure (3):Golden ratio in different parts in animal and human body.[4], [7]

Conclusion: Golden Ratio in the living form design.

The Golden Ratio is a universal law in which is contained the ground-principle of all formative striving for beauty

2.2. Human Identity.

The concept of the identity is a nature concepts and generally refers to a unique and intrinsic qualities that characterize an entity, whether this Physical or moral being. In a nutshell, human Identity, the way he look at himself and his relationship to the world. [8]

1.2.1. The ego identity, (the self or personal identity) is restricted to the present, past and future selves. Represent individuals, what they would like to become, and what they are afraid of becoming. They correspond to hopes, fears, standards, goals, and threats. Possible selves may function as incentives for future behavior and they also provide an evaluative and interpretive context for the current view of self.

1.2.2. The physical identity, the living organism's span an impressive range of body mass, shapes, scales, size, skin color, body proportions, body hair, facial features, muscle strength, handedness, and so on. Their complex languages, technologies, and arts distinguish them from any other species. Human variation stems from a number of sources which can be crudely classed as either genetic or environmental.

1.2.3. The social identity, is the collection of social roles that a person might play, known as either the social identity, which the relationships between self and other agents are organized in relatively stable structures over time. With the emphasis on the socio-cultural milieu in which self relates to other agents and institutions. This identity included gender identity, racial identity, religious identity, ethnic identity and occupational identity. [9]

Conclusion: Living form identity.

Each organism has a language, expression, technologies distinguish him from any other species. There are 3 types of identity should be exist in the living building.

- The ego identity (the self or personal identity).
- The physical identity (physical attributes).
- The social identity.

2.3. Human and Animal Form and Structure.

In biology and anatomy, the skeleton is defined as that part of the body which forms the supporting framework of the body and give a proper shape to the. The muscular/skeletal system of an animal refers to the systems that give the animal its shape, support, stability, and movement to the body.

Conclusion: Living form and structure.

Structure forms the living shape and Form.

2.4. Human and Animal Form and function.

The form, or shape of a body part is usually a good indicator of its function. In the real world that we all study, the living organism. Form and function are never separate. No form exist without function, and no function exist without a formal cause and context. [10]

"Form fits function" means that an organism is designed, structured or shaped in a way that will help it perform a certain function or many functions easily with this structure. For example, the fins of a fish help it to propel itself through the water. [8]

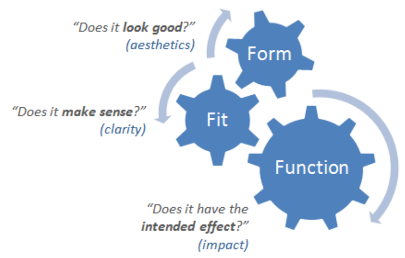


Figure (4): The relation between living **Form** and function.

> **Conclusion: Living form and function.**
> The form is a good indicator of its function. Form fits function.

As example the form of limbs as shown the below figure (5), the bone structure in these limbs of the mammals are different, the function of the limb itself is very different. The homologous limbs can be used for flying, swimming, walking, or everything humans do with their arms. These different functions make all of the diversity. [11]

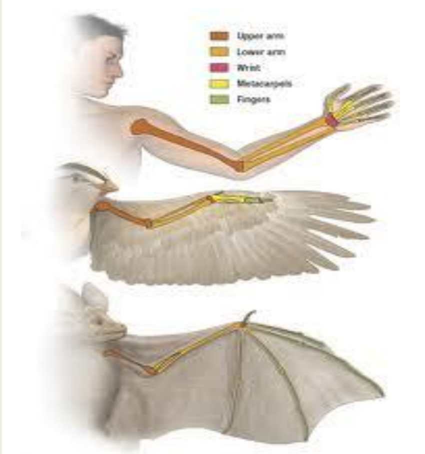


Figure (5): Form and function in animals.[12]

2.5. Human and Animal Form, Features and environment. (Morphological traits):

Organisms are vary in size and shape, skin colour, skin texture, body proportions, body hair, facial features and so on, all of this determined by various environmental factors.

> **Conclusion: Morphological traits.**
> Features is clearly determined by various environmental factors.

2.5.1. Body size:

Heritability estimates for most body size measurements imply that about 80% of the variability in body size is due to genetic factors, and about 20% is due to environmental factors. There are some characteristics to the body size. **The rules:**

- Big people are stronger. Large bodies are beneficial in colder climates according: The larger the animal the better it is at retaining heat. That is why during the glacial times many lineages of animals developed giant forms. People living near the poles tend to be larger on the average than those living near the equator, but there are a lot of exceptions.
- The most important of all selective pressures on body size is that small people require less food and can better survive when food is limited. Famines kill people in size order from largest first to smallest last.
- Smaller people are generally quicker and more agile. This is due to the principle of inertia from physics. A larger body takes more force to get moving and more force to change direction than a smaller body does.
- Europeans have the largest average body size. The largest Europeans are from the far north, and the farther south, the smaller the people.
- Africans include both the world's tallest (if not exactly the largest) people and the world's smallest people. The Pygmies of West Central Africa and the **Khoisan** of Southern Africa are among smallest.
- Asians and Native Americans usually fall in the middle ranges.
- Larger animals usually have a smaller surface area relative to their body mass and, therefore, are comparatively inefficient at radiating their body heat off into the surrounding environment. The relationship between surface area and volume of objects was described in the 1630's by Galileo. It can be demonstrated with the cube shaped boxes shown below in fig. (6). Note that the volume increases twice as fast as the surface area. This is the reason that relatively less surface area results in relatively less heat being lost from animals.[13]
- Comparison of cube surface areas and volumes illustrating Bergmann's rule, drawing in fig. (6). A 2 by 2 cube has a surface area of 24 and a volume of 8, while a 4 by 4 cube has a surface area of 96 and a volume of 64; in other words, the larger cube has a 4 times larger surface area and an 8 times larger volume.
- Polar bears are a good example of this phenomenon. They have large, compact bodies with relatively small surface areas from which they can lose their internally produced heat. This is an important asset in cold climates.

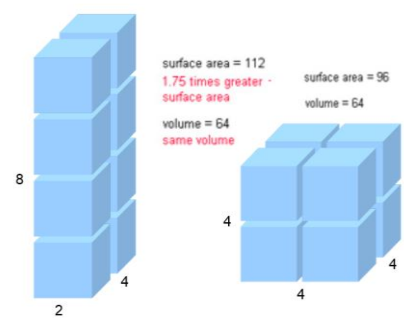


Figure (6): Comparison of different shaped box surface areas and volumes [13]

Bergmann's rule: a strong negative correlation between body mass and mean annual temperature of the region. In other words, when the air temperature is consistently high, people usually have low body mass. Similarly, when the temperature is low, they have high mass. However, there are exceptions. Our clothing and technologies that allow us to keep buildings warm in the winter and cool in the summer tend to offset the effects of natural selection now in shaping our bodies. [13]

Conclusion: The body size

It is a strong negative correlation between living bodies mass and mean annual temperature of the region. Because more surface area results in relatively an increase in the amount of metabolizing tissue, therefore internal heat gain is greater. And there is an overall decrease in the surface area to mass ratio, meaning that heat loss is reduced.

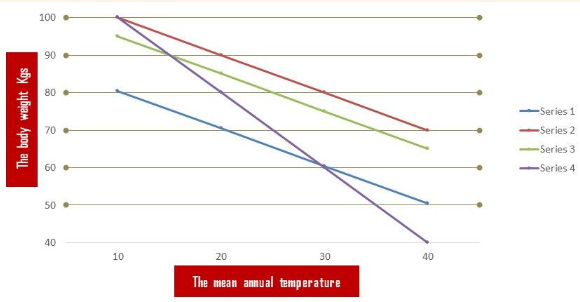


Figure (7): The correlation between living bodies mass and mean annual temperature.

- A linear shaped mammal will lose heat to the environment faster than a more compact one of similar size. The previous boxes illustrate this fact in fig (6).
- Note that the long, narrow box has the same volume but greater surface area. It is comparable to a tall, slender animal. [13]

Conclusion: Exposed portions.

The relative size of exposed portions of the body decreases with decrease of mean temperature.

2.5.2. Body build:

Most of the variation in body build in humans can be reduced to linear build vs. lateral build. Let's contrast an extreme linear build with an extreme lateral build. **The rules:**

- The extreme linear stereotype would be found in the previously mentioned tall peoples of East Central Africa. These people are very tall and slender. The chests, shoulders, and hips are very narrow, the narrowest in the world for their height. The limbs are extremely long, especially the legs.

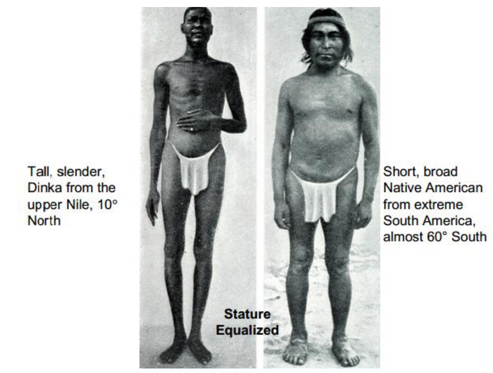


Figure (8): Comparison of different body building in different climate. [13]

- The extreme lateral stereotype would be found in some Asian and Native Americans. Eskimos, Japanese, Samoans, Apache, and many South American Indians exhibit lateral build. Laterally built people tend to have long and broad trunks, with wider chests, shoulders and hips. The widest hips of all can be found in Europeans. The limb bones tend to be short and the legs make less of a contribution to overall height. [14]
- One primary selective force acting on body build is Allen's rule: Animals living in colder climates should have shorter appendages and be more spherical than those living in warmer climates. This says that laterally built people should be found in colder climates and linearly built people in warm climates. The traditional comparison is between the Inuit and the Masai. The Inuit of the far north tend to be stocky with short arms and legs. The Masai of east Africa tend to be very tall and slender, with long arms and legs. These contrasting body builds have definite advantages for certain tasks. The fig (8) illustrate this role, the linear builds seem to have a definite advantage in overall health. Linear builds have the advantage in running speed they make great sprinters.

Conclusion: The living body build.

The living body build has a Positive correlation between bodies building and mean annual temperature of the region. That's mean laterally living body built should be found in colder climates and linearly living body built in warm climates

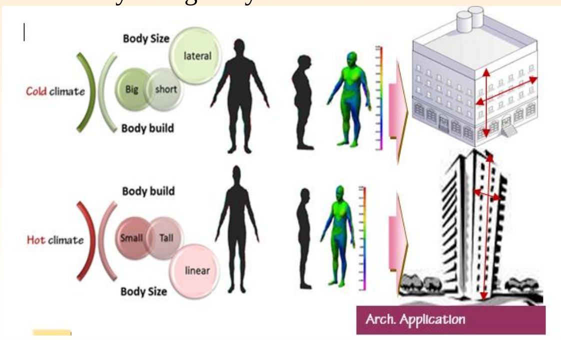


Figure (9): The correlation between bodies building and mean annual temperature.

- Lateral builds have an advantage in endurance running, and any task that requires endurance.

Conclusion: The body Build and motion.

Physically. A larger body takes more force to get moving and more force to change direction than a smaller body does so.

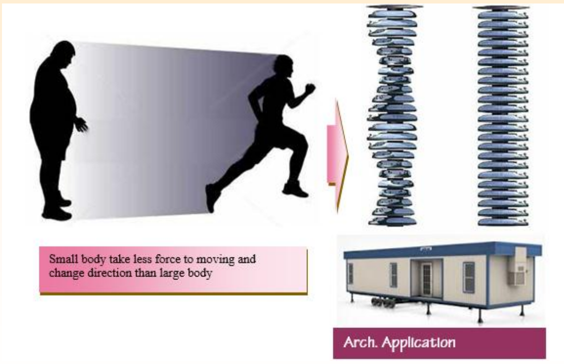


Figure (10): The correlation between bodies building and motion.

2.5.3. Head shape: Populations native to cold climates have larger and relatively broader skulls to conserve heat by comparison to populations in warm climates. [15]

Conclusion: Roofs (Head) shape.

Living building in the cold climates have larger and relatively broader roofs vault but in warm climates the head more curvature.

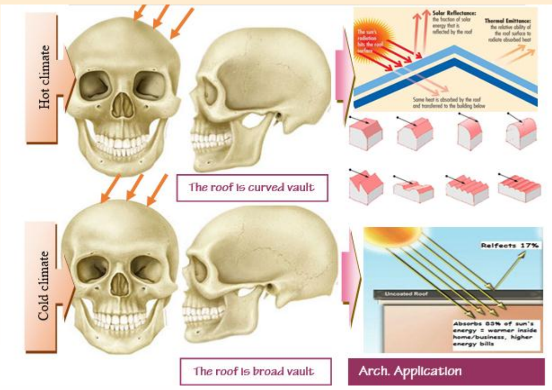


Figure (11): The correlation between roofs shape and climate

2.5.4. Hair: Several things about hair are variable.**The rules:**

- Colour. In general, dark hair goes with dark skin and light hair goes with light skin.
- Hair curvature. The degree of curvature of the hair is broken down into 3 categories: straight, wavy, and curly. Sub-Saharan Africans range from curly to very curly. One explanation for curly hair has been proposed based on the fact that the very hot and dry environment, the body needs to cool itself by sweating, but when sweating water and run the risk of becoming dehydrated. It has been observed that the very curly peppercorn hair does a good job of trapping the sweat on their heads and holding it in place as it evaporates and cools the body.

Conclusion: Roofs (Hair) curvature.

The flat roof in the cold environment to collect sun rays and the Refracted and Corrugated roof cover in hot and dry environment.

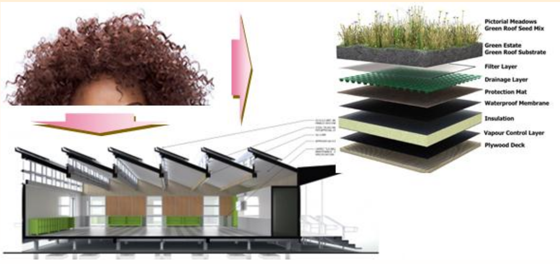


Figure (12): The correlation between roofs curvature and climate.

2.5.5. Nose shape: The rules:

- Nasal sill: cold climate tend to have a pronounced angulation dividing the nasal floor from the anterior surface of the maxilla. Hot climate tend to lack a sharp angulation, Moderate climate tend to be intermediate.
- Nasal bridge: Hot climate tend to have an arching, ``Quonset hut" shape, cold climate tend to have high nasal bones with a peaked angle, Moderate climate tend to have low nasal bones with a slight angulation.
- Nasal aperture: Hot climate have wide nasal apertures.
- The longer the nasal passage, the more efficient the nose is for warming and moistening incoming air and also the less heat and moisture are lost on exhalation.
- In cold or dry conditions: A narrow, high nose gives a longer nasal passages preferable for warming and moistening air before it reaches the lings, and for reducing loss of heat and moisture in expired air.
- In hot, humid conditions a low, broad nose serves to dissipate heat.

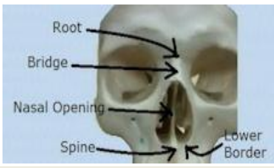


Figure (13): Nose shape **(ventilation slot).**

- The pattern of variation in nasal index corresponds to that expected if nasal form is indeed an adaptation to regional climate. Microscopic hairs which line the nasal passage, help to keep out the dust, and this hair work more efficiently when incoming air is moist.

Conclusion: Ventilation aperture.

Hot climate tend to have a low broad Ventilation apertures, cold climate narrow, high opening, in dry condition a deep passages preferable for warming and moistening air, and for reducing loss of heat and moisture in expired air.

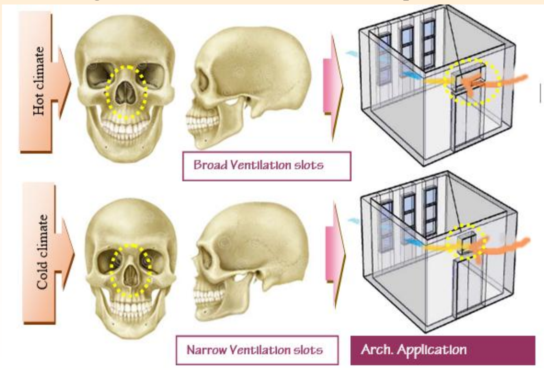


Figure (14): The ventilation slots and climate.

2.5.6. Eye shape:

- Hot climate- rectangular shape.
- Moderate climate more circular.
- Cold climate tend to have the almond-shaped eye, formed by the epicanthic fold, there are several adaptive arguments for the epicanthic fold. [16]

Conclusion: Lighting and sight slots shape.

In the Hot climate the Lighting and sight slots has a Rectangular shape, slightly sloped, large, and farther apart, cold climate slightly sloped, small, there are several adaptive arguments for the epicanthic fold. (Cold protection- glare reduction- Protection from particulates).

Figure (15): Lighting and sight slots shape in different climate.

2.5.7. Eyelid folding:

In snowy conditions, the inner corner of the eyelid has a characteristic fold, this fold makes the inner corner of the lid curve downward and offer some protection against snow blindness, caused by sunlight reflecting off snow. The cold climate have more fat on eyelids which warms the eyes, conserving body heat. Conversely, in the hot climates the eyes have limited fat. This makes their eyeballs look sunken into their skull. [14]

Conclusion: Sun Louvers (Eyelid folding).

In the hot climates the living building has Sun Louvers adapted to heat and the slots sunken into the building.
In the cold climate the in the sun louvers has a warmer materials which warms the slots, conserving building heat.

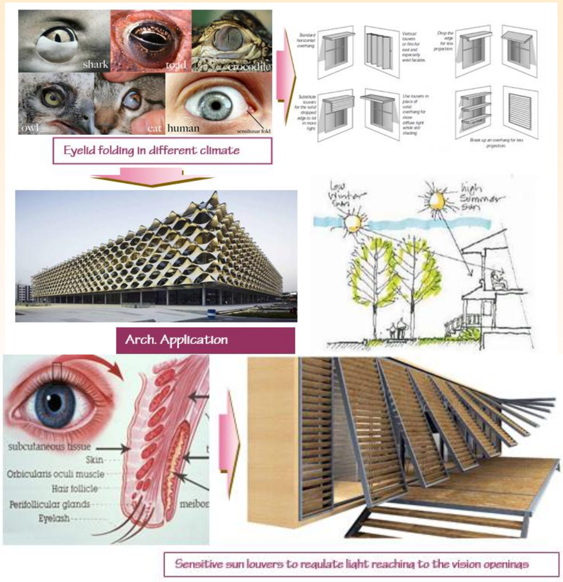


Figure (16): Living Sun louvers in different climate.

2.5.8. Skin: In the world of human and animals there are many environmental solutions.

In hot climate: (Dark skin. [13] - Sweating- Radiating heat- Hiding out- Panting- Shedding- Massing and stuck next to each other in groups). [17]

In cold climate: absorbing solar radiations during the day- feathery coat - a thick layer of fat- dense fur coat- huddle together to keep warm- a Camouflage).

Conclusion: Living building envelope (Skin):

In hot climate: the envelope should have one or more of protective biological shield against sun radiation.
In cold climate: living building must adapt themselves by reducing the heat loss from their bodies.

Figure (17): Living building envelope adaptation for survival.

- Animals in cold climates have small ears tails and short legs as the extreme portions of the body like ears, tails and feet, paws, hooves lose heat first.
- Animals living in the warmer climates have long legs, tail and very large ears, e.g. the fenneco fox, a desert animal, have very large ears. The ears have flood vessels near the surface .The air flowing across the ear cools the blood which in turn cools the body.

Conclusion: The body appendages.

Living building has a negative correlation between sub-species (appendages) and relative temperature that is mean the building in colder climates should have shorter appendages and be more spherical than those living in warmer climates. (Bergmann's rule).

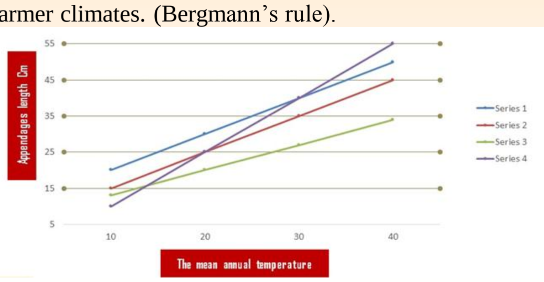


Figure (18): Living building envelope.

1.5.9. Other features:
The table (1) illustrate some of animals' traits as following:

Table (1): Eexamples of animal features adaptation for survival. [18], [19]

Treats of organism to survival		
Big Ears	**Big ears act like radiators**, during hot days, the fox's thick fur coat also acts as insulation during cold desert nights.	
Movable cape	**The cape ground** squirrel takes shade everywhere it goes. Native to the driest areas of southern Africa, this borrowing rodent can actually use its bushy tail as a sort of parasol function.	
Under the Sand	**The blind skin** stays under the sand. This freaky legless lizard has developed an ingenious method of dealing with high desert surface temperatures simply staying out of them. Like the sandworms from Beetlejuice, prefer to stay hidden underground.	

3. PLANTS FORM AND MORPHOLOGY (FEATURES).

The most important thing in the body that controls the external shape is:
First: The canopy of plants (the arrangement and shape of the area of the flat vegetative field for all plants) and are affected by the following: The size of the leaves - the order of the leaves on the stem - angle of contact with the leaves distances between plants form the leaves.
Second: Texture usually refers to the leaf type or size, but should also include branching habit. Texture divides plants into three categories: fine-textured, medium-textured and coarse-textured leaves. Plant materials are

grouped into general categories relative to their size and habitat (Figure. These categories include: [20]

- Over story: tall plants (typically trees) that form overhead canopies.
- Understory: shorter plants (shrubs and small trees).
- Ground cover: plants that grow close to the ground (typically less than 12" tall).
- Vines: plants that attach themselves to other objects for support.

Plants may also be grouped into categories based on their texture- fine, medium, or coarse as illustrated in fig. (19).For design purposes descriptive plant form categories have been developed because certain forms lend themselves to specific functions and portray particular characters or moods.

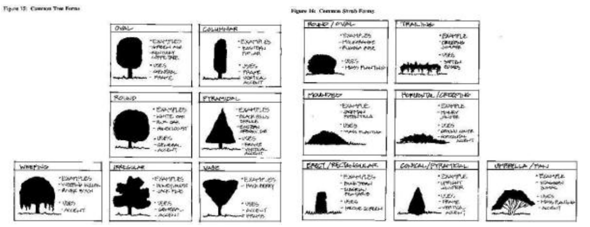


Figure (19): Common Trees and shrubs **Forms**. [20]

3.1. Design element and interactivity.

How was the use of Form principals in design of tree body?

Plants are rooted organisms endowed with heterogeneous self-similar geometry where the mass is concentrated in the stem and branches rather than in the leaves. [21] By addressing the fundamental physics underlying the relation between form and physiology.

The composition of plants uses the principals of design and design element. The use of the elements of design as the lines of structure in flowers and leaves, these combinations of lines are **harmonious** and beautiful, they are organic lines. In principle they are radiating and recurring lines, in each form they repeat each other in varying degrees of direction and declension of curve making a **(Rhythm)**. No two lines are alike, yet there is no contradiction and no unnecessary line, and variety is combined with unity. Each affords a perfect instance of harmonious composition of line, and gives us definite principles upon which to work.

The organic life and structure in trees expressed inter-dependent and corresponding curves, from the rigid sinuous column of the main stem, presently divided into the main forks of the branches, which again subdivide and subdivide into smaller forks, so that the tree may sustain, system of co-operative, subdivided, and graduated. Which this delicate vaulting of branch-work sustains, but perhaps not a greater beauty in the combination or substitution of form and mass for line composition. [6]

Pattern, one of the principles of design of plants, a pattern is the repetition in shapes, lines, or colours.

The pattern of seeds in the sunflower is controlled by the **golden ratio**. Patterns A and B on the left are what the seed spirals would look like if Nature had used a different irrational number. Pattern C shows the golden ratio at work. The Golden Spiral is expressed in Fibonacci sequences appear in biological settings, in two consecutive Fibonacci numbers, such as branching in trees, arrangement of leaves on a stem, the fruitlets, the flowering. [22]

Figure (20): Common Tree Forms (Design principals and golden ratio). [23], [24], [25]

Conclusion: The Golden ratio.
The green building use a universal law (golden ratio) in the living body.

Colour, there are many colours (monochromatic- Multi colour). Plants also has an uncanny talent for constructing colour schemes. These objects in nature (as a Sunflower Spirals) as shown in fig. (20).

The texture or the leaf, and the recurring pattern of fibres in the plant's texture creates repetition. Focusing on just the leaf and allowing the outline of the plant to create both line and organic shape.

Balance, one of the "Principles of plants design as arranges the elements in a plants. There are three types of balance: **symmetrical, asymmetrical and radial**, shows in the fig (21) and overall Distinguished in plants world. [21] The plant figure in this diagram is symmetrically balanced; the same on the left and right sides of a central axis. The tree is asymmetrically balanced, its branches are not distributed equally on each side but their total weight is balanced left and right. The flower is an example of radial balance, all its rays are equal in length from the centre.

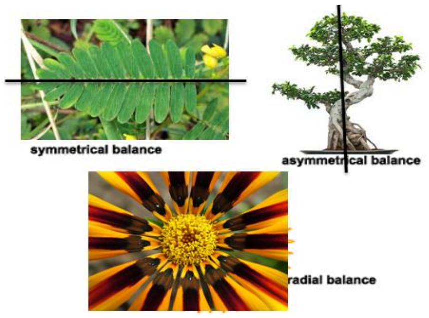
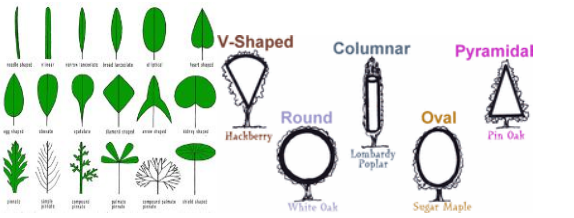


Figure (21): **Types of Balance** in plants. [26], [27]

Conclusion: The design elements and principals.
The whole living design must use the design elements and principals.

3.2. Plants Identity.

The physical identity, bark swathing a tree trunk provides a diagnostic clue to ascertaining the tree's identity. Growing yearly by layers, branches and twigs. Its texture and colour vary widely between species, and often change notably throughout a given tree's lifespan and development. However, the trunk bark is fairly rugged. It may be plated, as in the ponderosa pine, or peeling, as in the Pacific madrone or the paper birch. Or it may be heavily furrowed, as in cottonwoods or, even more extremely, in the shagbark hickory. The white oaks tend to have corky or scaled bark. Many sources can know us about a tree identity.



trees silhouette

Figure (22): Identity by trees silhouette and lef shape. [25], [28]

3.2.1. The Physical identity which divide to:

- Trees silhouette: [29] the arrangement and position of the branches and leaves on a tree give the tree its silhouette, V-shaped, columnar, pyramidal, round and oval as illustrate in fig. (22).
- Trees Parts: Tree botanical parts like leaves, flowers, bark, twigs, shape, and fruit. [30]
- Physical characteristics: Colours, textures, smells, and even taste.

A tree's leaves can also vary in shape according to its position on the tree

3.2.2. The social identity, the collection of social roles that a tree might play. Tree species are not distributed at random but are associated with unique habitats.

Conclusion: The green living identity.
The physical and social identity are the language which is common in animal and plants.

3.3. Form and Structure.

The form of trees follows the structure, where the apparent structure of the tree which affects in form is divided to the trunk structure, branches structure and leaf structure, as illustrated in fig. (23).

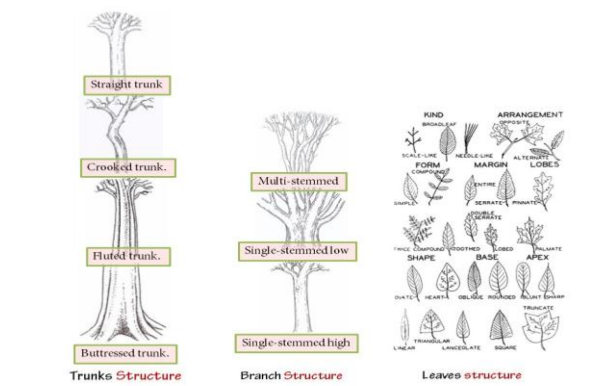


Figure (23): Trunk, branch and leaves structure of tree. [31], [32]

Conclusion: The green living structure.
Form follow Structure.

3.3.1. Trunk structure:

- Straight trunk.
- Crooked trunk.
- Fluted trunk.
- Buttressed trunk.

3.3.2. Branch Structure patterns: [32]

Trees come in a variety of forms based on their branching patterns. There are three main forms:

- Excurrent (Multi-stemmed indigenous tree): The main trunk goes the entire height of the tree, with branches forming patterns; e.g. Evergreens.
- Decurrant (Single-stemmed low-branching): The main trunk continues up about halfway, then splits into more than one main branch; e.g. Fruit trees.
- Columnar (Single-stemmed high-branching): The main trunk continues the full height of the tree, with the branches forming only at the top; e.g. Palm.

3.3.3. Leaves structure:

Leaves have structures, called veins. A tree leaf has several types of veins, the basic central one called the midrib or mid vein. Other veins connect to the midrib and have their own unique patterns. Leaf Arrangements and Structures - Simple, Palmate, Compound, Alternate, Opposite, Whorled. [33]

Conclusion: The green living structure.
The green living building has a hierarchy in the structure elements.

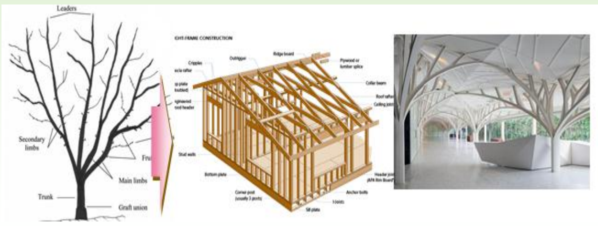


Figure (24): The green living building hierarchal structure.

3.4. Plants Form and function.

A basic principle of modern architecture is "form follows function." This is a good rule to remember when selecting a tree. Selecting the right form (shape) to complement the desired function. Trees grow in a variety of sizes and shapes, as shown in fig (25). They can vary in height from several inches to several hundred feet. There are hundreds of combinations of form and size. As example a small-spreading tree in a location with overhead utility lines, a narrow, columnar form to

Figure (25): Form fits and follow the construction. [34]

provide a screen between two buildings. And large, vase-shaped trees to create an arbor over a driveway or city street. [35]

Conclusion: Form and function.
Form fits function (no function exist without a formal cause and context).

3.5. Form, Features and environment:

There are many different kinds of trees in the world. It must have the ideal characteristics to growing in certain climates and depending on the natural adaptation circumstances with the prevailing environment element, the spread depending on the function and its endurance in this climate, For example:

Conclusion: Form and features.
The green living building Features is clearly determined by various environmental factors and has a protective climatic solutions in each climate.

In hot climate:

- The forest is very dense and some trees are very tall, about 33 meters in height and have a very wide crown to get maximum sunlight. However, other trees successfully make their home in the "understory" far below the towering height of the canopy (the top layer of the forest formed by the branches and leaves). The most common type of leaf found in this area is a broad leaf. These leaves are sometimes thinner than those leaves in a temperate zone because there is enough moisture in the air that the leaves do not need to retain as much water.
- Some plants, store water in their stems or leaves.
- Some plants have no leaves or small seasonal leaves.
- Long root systems spread out wide or go deep into the ground to absorb water.
- Leaves with hair help shade the plant, reducing water loss. Other plants have leaves that turn throughout the day to expose a minimum surface area to the heat. [36]
- Waxy coating help reduce water loss.
- Some plants climb on others to reach the sunlight.
- Some plants grow on other plants to reach the sunlight.
- Roots collect rainwater into a central reservoir which they absorb the water through hairs on their leaves.
- Roots absorb minerals and water from the atmosphere.
- The epidermis in plants that grow in very hot or very cold conditions, the epidermis may be several layers thick to protect against water loss from transpiration. A waxy layer known as the cuticle covers the leaves of all plant species. The cuticle reduces the rate of water loss from the leaf surface. Other leaves may have small hairs on the leaf surface as cactus in the fig (26). They can also reduce the rate of transpiration by blocking air flow across the leaf surface. [37]

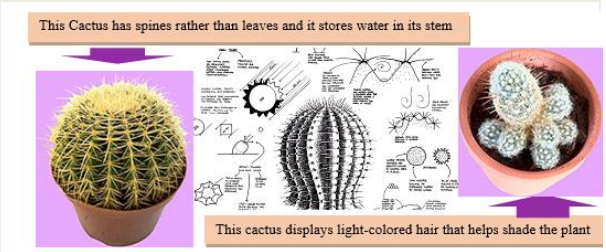
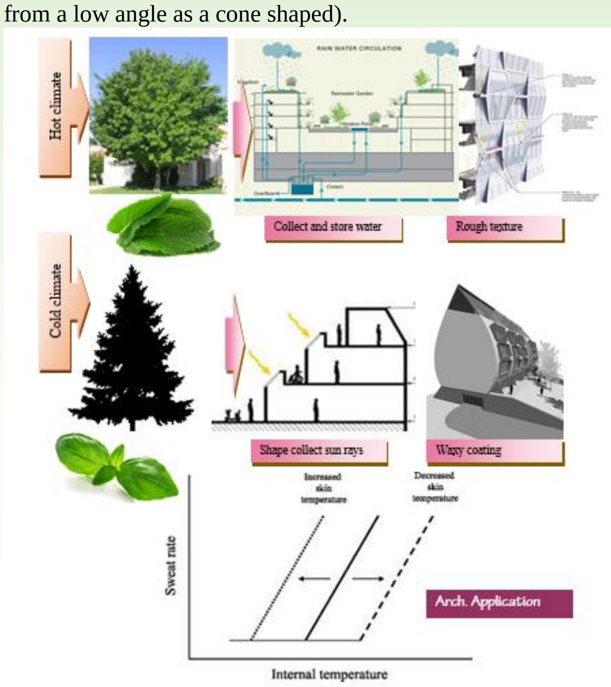


Figure (26): Plant features in different climate. [36],

In cold climate:

- Plants are small and low-growing due to lack of nutrients, because being close to the ground helps keep the plants from freezing.
- Plants are dark in colour, this helps them absorb solar heat.
- Some plants are covered with hair to keep them warm.
- Some plants grow in clumps to protect one another from the wind and cold.
- Some plants have dish-like flowers that follow the sun, helping the plant stay warm.
- Trees must be shaped in a way that captures the sun's rays to absorb light coming in from a low angle.
- Trees tend to have a deep, steeply sloping crown as a Christmas tree.
- They are cone shaped, big at the bottom and skinny on top. This way, sunlight can shine on the tree from lower angles.
- Long, thin needles capture sunlight and through photosynthesis turn it into energy. These needles retain moisture better than broad leaves. [36]

Conclusion: Physical form element adaptation (xerophytes).
The green living building has a protective climatic solutions, in the hot climate building can (collect and store water rain- use a Rough texture- use a waxy coating- absorb water from the atmosphere- use a several layers thickness).
In the cold climate building can (use a Waxy coating - covered with insulation layers- follow the sun- shaped in a way that captures the sun's rays to absorb light coming in from a low angle as a cone shaped).



- Even weeds vary depending on the climate as follows:
- Warm grass (Savannah): The most important flora: the long grass vary in length and intensity depending on the amount of rain.
- Moderate grass (steppes): short grass soft.
- Weeds cold (tundra): grasses and fast-growing algae.
- Desert plants most important flora: bear drought conditions through - long logs (palm).

Conclusion: Correlation between the height and temperature.

The green living building height, in the hot climate some building are very tall and have a very wide crown. Other building "understory" In the shadow zone and collect filtered sun flecks. In the cold climate the green living building is low height.

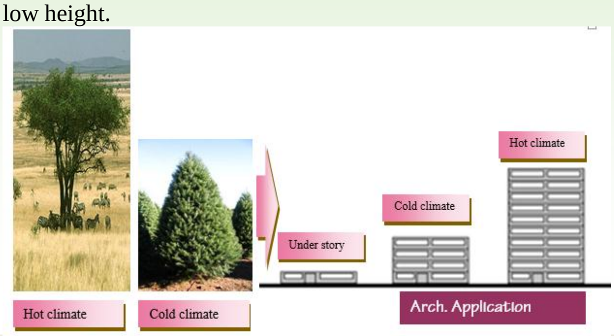


Table (2): Some examples of plants Form adaptation for survival. [39], [40], [41]

Bougainvillea	They are thorny, growing from 1-12 meters tall, scrambling over other plants with their hooked thorns. The thorns are tipped with a black waxy substance. The leaves are 4-13cm long and 2-6cm broad.	
Organ Pipe Cactus	The Organ Pipe Cactus grows in hot sunny slopes. Because of the high temperature and lack of water the plant has water storing trunks what are about 6 inches in diameter.	
Jambu (Watery Rose Apple)	This plant grows in places where rain can fall right on it. This plant has little places in its trunk, where it can collect water. The crown is open and non-symmetrical for helping to collect water because it needs a lot of it to survive.	
Umbrella Thorn Acacia	This tree can survive in 50°C temperatures during the day, and freezing temperatures at nights. The savanna that the Acacias live in is hot and dry in the respective summer of the Southern Hemisphere although at night the temperature can go below -18°C. During the winter months the savanna gets a lot of rain. The Umbrella Thorn grows up to 20 meters high and has a spreading, flat-tapped crown. And Acacia's umbrella-shaped tops enables the leaves to catch as much sunlight as possible.	

4. RESULTS AND DISCUSSIONS

- Research draw architectural biological basics Common between organisms that is represent the survival indicators towards a living architectural form, this indicator is expressed it by gray colour.
- This indicators orient the building form to be green (closer to the plant), or gold (closer to human and animal).
- This indicators is a guide to design a survival building form which is formed of the biological architectural design.
- The 3G architecture Bio-indicator is rules and principles of survival architectural form based on biological indicators. This indicator depend on brainstorming session. Having generated a lot of criteria. Then narrow this list down by combining sister criteria and deleting weaker.

Architecture Living Form bio-indicators		
Architecture Living Form Gray Indicators (mandatory requirement)	1	Using the design elements and principals.
	2	**Design Conditions.**
		Living things have a definite form and have a limited size.
		Design must be innovative.
		Design is aesthetic.
		Design makes building understandable.
		Design is long lasting.
		Design is thorough, down to the last detail
	3	Biological systems features use modularity and hierarchical design.
	4	Using the golden Ratio
	5	Has a physical identity (physical languages)
	6	Has a social identity (Social languages)
	7	Form follow Structure.
	8	Features is clearly determined by various environmental factors and has a protective climatic solutions in each climate.
	9	The living design applied role of "simplicity" or less is more.
	10	The size and shape of the form help the body regulate internal temperature.
Architecture Living Form Golden Indicators	11	Has an ego identity, (the building expression).
	12	It is a negative correlation between building mass and mean annual temperature
	13	The building has a Positive correlation between bodies building and mean annual temperature.
	14	Has a positive correlation between sub-species (appendages) and relative temperature.
	15	Has a positive correlation between the roofs curvature and temperature.
	16	Dark roofs color goes with dark skin and light roofs goes with light skin.
	17	Has a Refracted and Corrugated roof cover in hot and dry environment.
	18	Has a low broad Ventilation apertures, in dry condition a deep passages.
	19	Hot climate Rectangular, slightly sloped, large, and farther apart.
	20	In the hot climates the living building has Sun Louvers adapted to heat and the slots sunken into the building.
	21	The envelope should have one or more of protective biological shield against sun radiation.
Architecture Living Form	22	Skeleton of building is heterogeneous self-similar geometry where the mass is concentrated in the structural elements.
	23	A lighten colour in the hot climate.
	24	building height is very tall and have a very wide crown
	25	has a protective climatic solutions, it can (collect and store water rain- use a Rough texture- use a waxy coating- absorb water from the atmosphere- use a several layers thickness).

5. CONCLUSION

- The Divine architecture represented in Organisms form have the ability to survive in their environments, this organisms teach us a lot of lessons in architectural form design. The 3G architecture bio-indicator is an architecture living indicator led us to survival.
- The 3G architecture bio-indicator not only the principals and indicators to guide the architects in their form designs or to solve specific problem, but also it can be a tool of diagnose and evaluate an idea or constructed project.
- All of project achieved the mandatory indicators (Gray indicators) to survival, and this is itself sufficient to judge that idea or the building has a successful design.
- Whenever the percentage increased in green or gold or the two colours this is means that the building is the nearest to perfection in solving all problems.

6. REFERENCES

[1] https://www.boundless.com/biology/the-animal-body-basic-form-and-function/animal-form-and-function/animal-body-planes-and-cavities/
[2] http://www.theaftermatter.com/2012/04/what-is-golden-ratio.html]
[3] http://www.kungfuonline.com/define.php?s=anatomical-planes-of-the-body
[4] http://www.scienceagogo.com/news/20100008015510data_trunc_sys.shtml
[5] http://celia94109.wordpress.com/category/uncategorized/
[6] John Blackwood, Geometry in Nature: Exploring the Morphology of the Natural World through Projective Geometry, Poland, Floris Books, 2012.
[7] http://www.interferencetheory.com/Articles/GoldenRatio/files/5d22 2bf41ab67d8a339b4aa3f165c797-4.html
[8] Milton Hildebrand and George Goslow, Analysis of Vertebrate Structure, John Wiley & Sons, 5th Edition, 2001.
[9] http://husky1.smu.ca/~etastsoglou1/Publications/Tastsoglou_CanadianDiversity.pdf
[10] Uri Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits, CRC Press,2006
[11] http://www.tutorvista.com/content/science/science-ii/heredity-evolution/evolution-classification.php
[12] http://theoreticallyimpossibl.blogspot.com/2013/02/homologous-and-analogous-structures.html
[13] http://anthro.palomar.edu/adapt/adapt_2.htm
[14] http://lucy.ukc.ac.uk/LOCAL-ONLY/FHC/FHCL1495-6.html
[15] http://anthropology.ua.edu/bindon/ant275/presentations/Distribution_II.pdf
[16] http://johnhawks.net/explainer/laboratory/race-cranium/
[17] http://www.nwf.org/News-and-Magazines/NationalWildlife/Animals/Archives/2010/animals_beat_the_heat.aspx
[18] http://mentalfloss.com/article/57204/20-amazing-animal-adaptations-living-desert
[19] http://www.rosslhatton.com/Sidewinding.html
[20] http://www4.uwm.edu/cuts/noise/noiseb.htm
[21]http://www.pnas.org/content/early/2014/02/13/1401336111
[22] http://www.davidfriddle.com/gm/Math.5/
[23] http://www.featurepics.com/online/Plants-Pattern-1177887.aspx
[24] http://pureoxygengenerators.blogspot.com/2012/07/many-faces-of-kamias.html
[25] http://6enders.weebly.com/branching-patterns--tree-shapes.html
[26] http://yourbonsaitree.com/balanced-bonsai-symmetry-asymmetry/
[27] http://imgarcade.com/1/radial-painting/
[28]http://www.aquascapingworld.com/magazine/April2008/Magazine/Plant-Anatomy-Part-2-The-Leaf.html
[29]http://treesandshrubs.about.com/od/treeshrubbasics/ss/Types-Of-Leaf-Arrangements.htm
[30] http://forestry.about.com/cs/treeid/a/tree_id_web.htm
[31] http://maple.dnr.cornell.edu/kids/leafglos.htm
[32]http://www.wildcard.co.za/blog.htm?action=view post&id=1015
[33] http://forestry.about.com/od/treephysiology/tp/leaf_structure_shape.htm
[34]https://www.dot.ny.gov/divisions/engineering/design/landscape/trees/rs_selections
[35]http://hoosiergardener.comwww.treesaregood.com/treecare/resources/TreeSelection.pdf
[36] http://www.mbgnet.net/bioplants/desert.html
[37]http://cnx.org/contents/185cbf87-c72e-48f5-b51ef14f21b5eabd@9.17:160
[38]https://bouncingideas.wordpress.com/tag/biomimicrydesign-process/
[39] http://www.desertusa.com/du_plantsurv2.html
[40]http://www.oni.escuelas.edu.ar/olimpi99/interolimpicos/elrioatuel/rioatuel/flora.htm
[41]http://www.veeriku.tartu.ee/~ppensa/plant_adaptation.html