



# **Biomimetic Techniques in Architectural Design**

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- Part 1**    **Definitions**
  - Part 2**    **Biomimicry Applications in various fields**
  - Part 3**    **Evolution of Biomimicry in Architectural Design**
  - Part 4**    **Methods of information transfer from nature to architecture**
  - Part 5**    **Case study**

# WHAT IS **Biomimetics** ?

Biomimetics is the

**IMITATION**  
of the

**Models**      **Systems**      **elements**

of

**NATURE**

for the purpose of solving complex human problems

.

# WHAT IS **Biomimetics** ?

Biomimetic originates from  
two Greek words

**Bios**



**Life**

**Mimetic**



**Imitation**

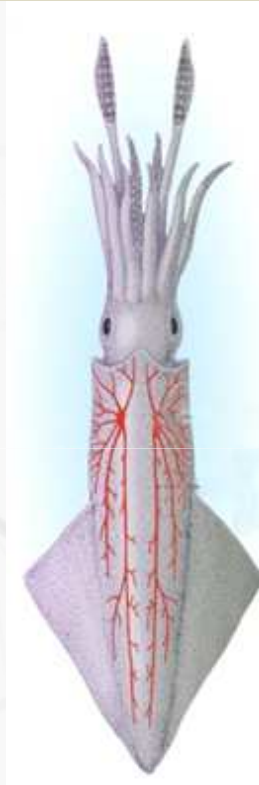
# HOW DID IT BEGIN ?



Otto Schmitt

- Biomimetics was coined by **Otto Herbert Schmitt** during the **1950** .

- American biophysicist and polymath.
- The Starting point when He Studied the nerves in squid.
- Tried to engineer a device that replicated the biological system of nerve propagation.

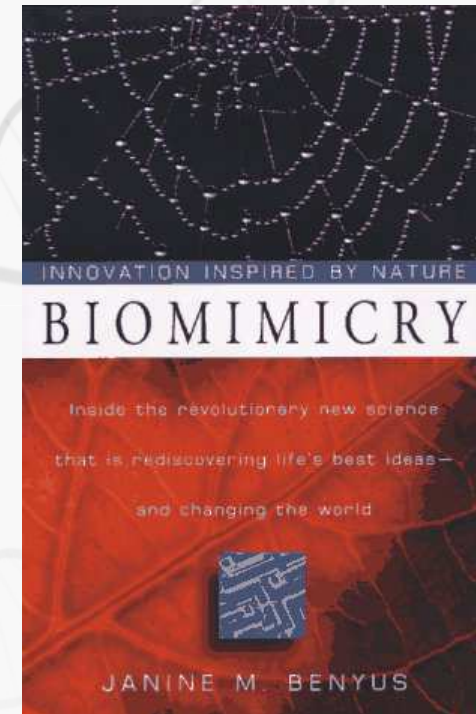


## HOW DID IT BEGIN ?



- The term biomimicry appeared as early as 1982.
- Biomimicry was popularized by **Janine Benyus** during the 1997.

- American writer and scientific observer from Montana.
- Janine Benyus is the most important pioneer of this science.
- Wrote the book **“Biomimicry: Innovation Inspired by Nature”** in 1997
- The book gives an insight on how significant biomimicry is in shaping the future.



**Part 2**

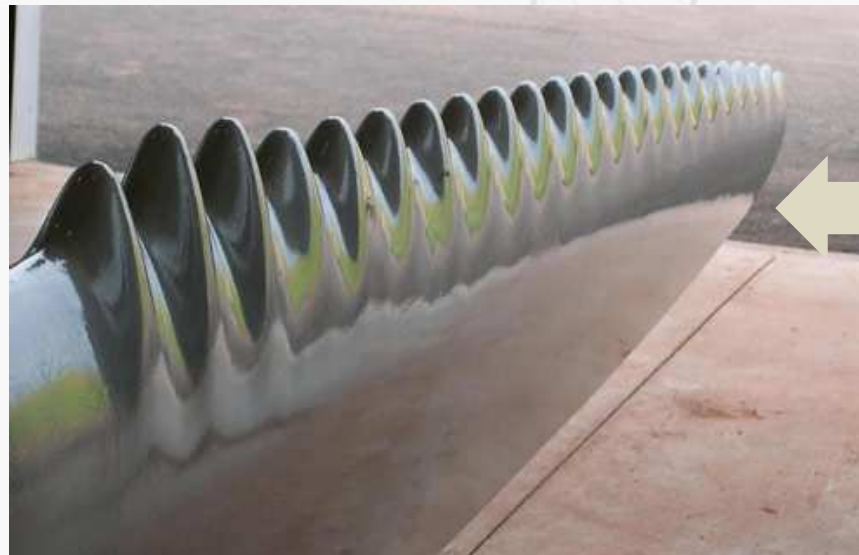
**Biomimetic Applications in various fields**

## Mimicking wind turbine blade from Humpback whale fins

### Electric Power Generation Field

- Increase the amount of energy created per turbine

- Speed movement for humpback whales comes from the bumps on the leading edges of their fins.
- Mimicking the bumps on humpback-whale fins lead to more efficient wind turbines.





## Part 2

## Biomimetic Applications in various fields

### Transportation Field

- This train in Japan is the fastest train in the world.

- problem was



### Noise

large thunder claps

as a result for Air pressure changes

When the train emerged from a tunnel

Biomimetic Techniques in Architectural Design

### Mimicking Front-end of the train in Japan from Kingfisher beak



#### In Nature

- the King fisher bird dives from the air into water surface with very little Friction to catch fish

#### Mimicry Result

- Reduce noise resulting from air friction with train body. And 15% less electricity use even while the train travels 10% faster.

**Part 3 Evolution of Biomimicry in Architectural Design**

**Unintentional Mimicry**

**Intentional Mimicry**

## Unintentional Mimicry

• Similarities in The Form and the arrangement method

between

“Alsquia Trees” and “Paestum Basilica Columns”

Nature



Alsquia Trees

Architecture



Paestum Basilica Columns, Italy

Intentional Mimicry



Santiago calatrava

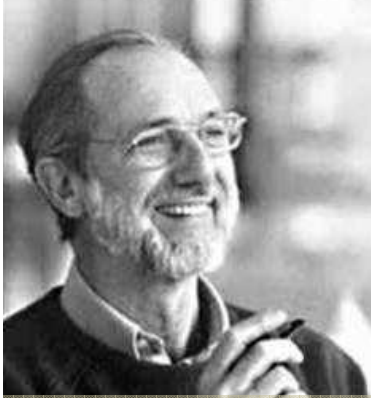
Milwaukee Art Museum, USA

calatrava mimicked the Eagle's **Form**, **Skeleton**, and **Movement of the wings**

the wings are opened that means the show has begun, and when it is closed that means it's over.



Intentional Mimicry



Renzo Piano



He Mimicked structure of spider legs in designing the structure of Padre Pio Church

Padre Pio Pilgrimage Church, Italy

- This imitation gave him the ability to create spaces without columns in the middle.

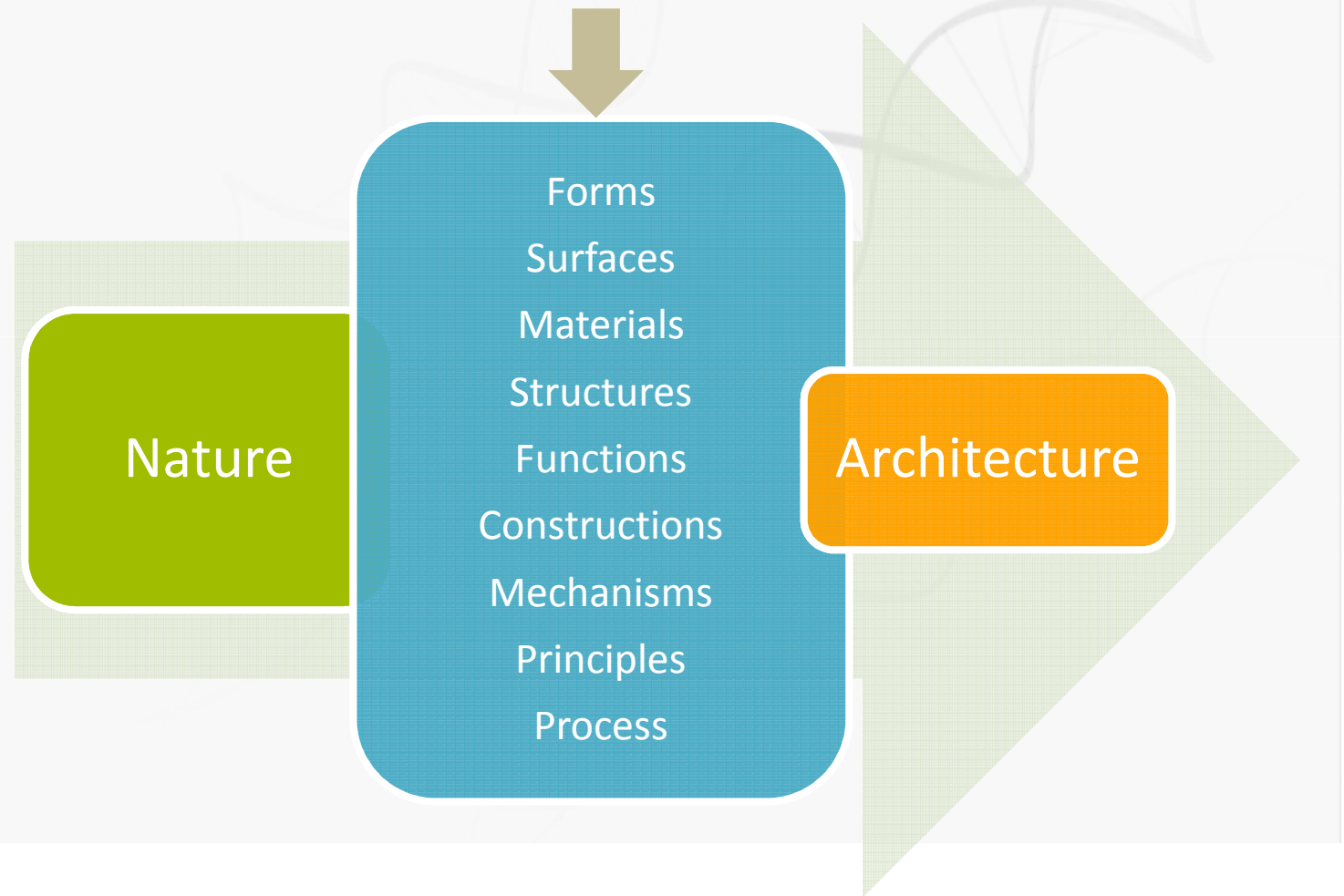


**Part 4**

**Methods of information transfer from nature to architecture**

## Fields of Inspiration From Nature to Architecture

The fields of inspiration from nature to architecture are not limited to shapes but become applied in to



## Techniques of BioMimetic Analysis

To complete the simulation between **Architecture** and **Nature**, there should be Methods for **Analysis** and **Transfer** the information from nature to architecture

Mathematical

Physical

Molecular biology

Environmental

Geometrical





## Techniques of BioMimetic Analysis



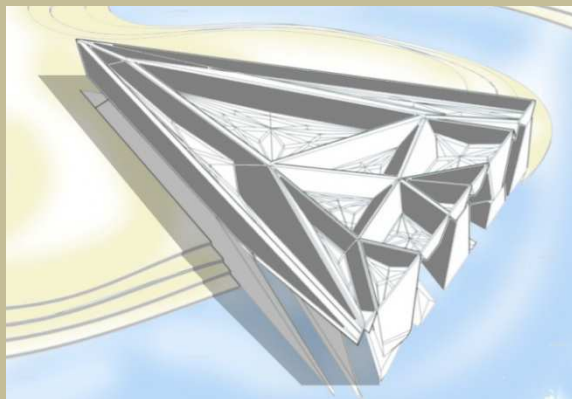
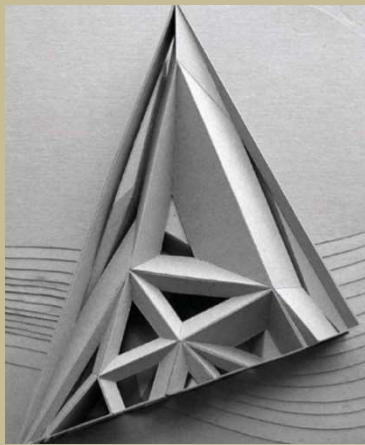
Mathematical

Physical

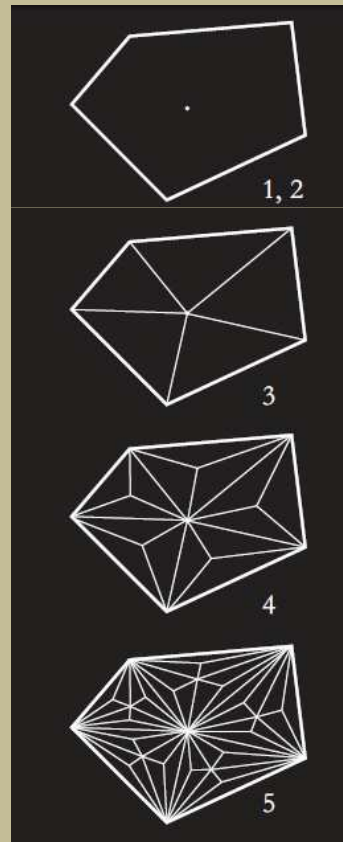
Molecular biology

Environmental

Geometrical

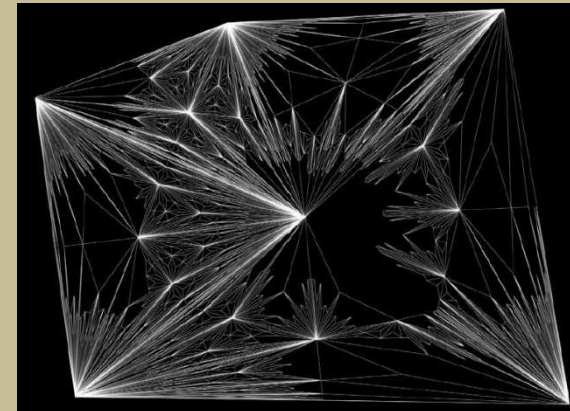


Biomi  
Arc



Crystal Structure of surface

- Analysis of the crystal form using a geometry analysis method to take advantage of it design new geometry Form and surfaces.



## Techniques of BioMimetic Analysis



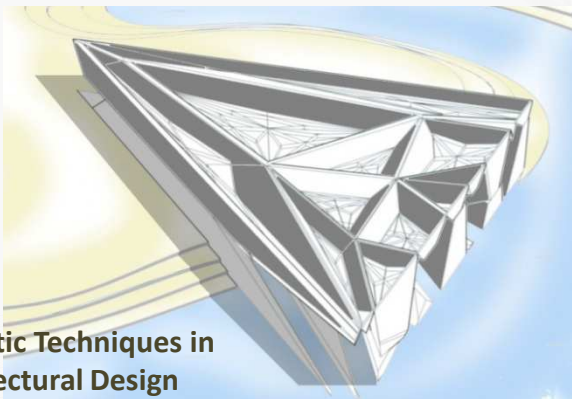
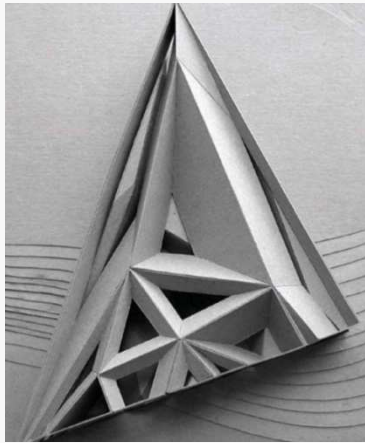
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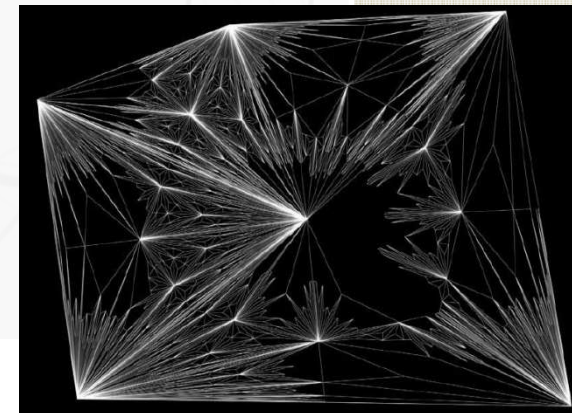
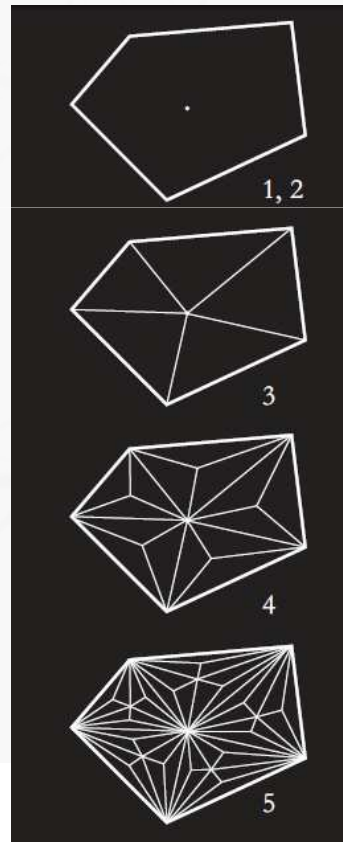
Molecular biology

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Biomimetic Techniques in Architectural Design



# Techniques of BioMimetic Analysis



Mathematical

Physical

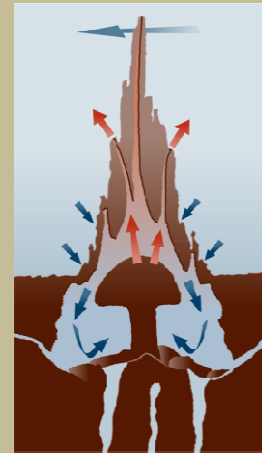
Molecular biology

**Environmental**

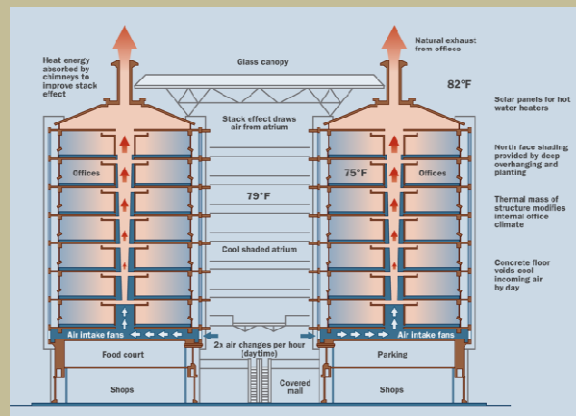
Geometrical

Environmental remediation

- Analysis of ventilation system, cooling and heating system in termite mounds and take advantage of them at Ventilation system in buildings To overcome the high or low temperature inside building.



Termite mounds



# Techniques of BioMimetic Analysis



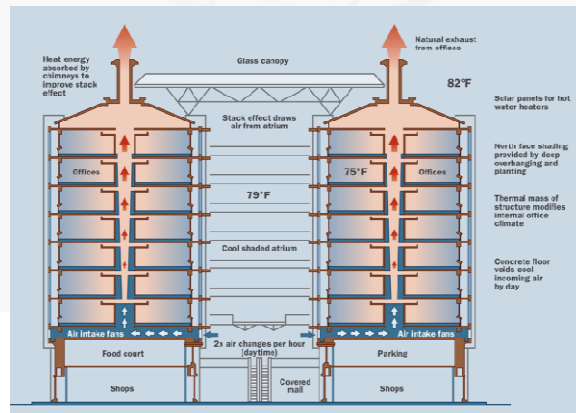
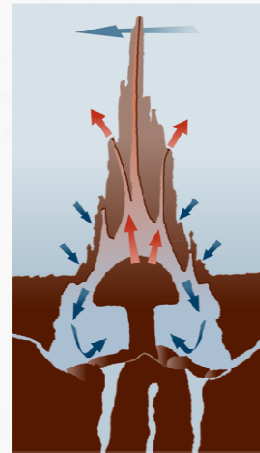
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Biomimetic Techniques in Architectural Design

## Techniques of BioMimetic Analysis



Mathematical

Physical

Molecular biology

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- Analysis of the surface of a lotus flower and take advantage of the self-cleaning feature and simulated it to Manufacturing Materials Paints which are characterized the same property " Self-cleaning" and uses it at painting building.

Lotus

Self cleaning

# Techniques of BioMimetic Analysis



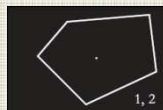
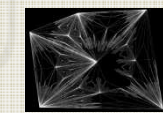
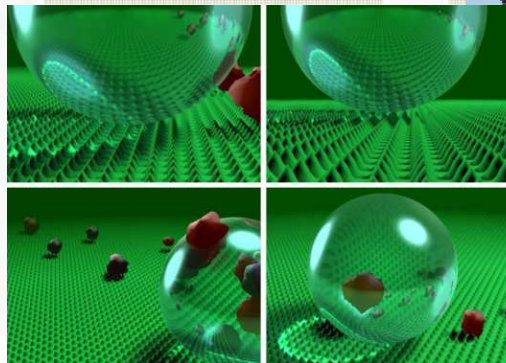
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Physical

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## Techniques of BioMimetic Analysis



Mathematical

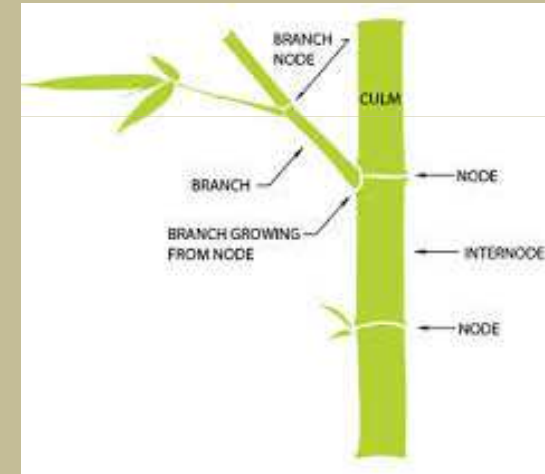
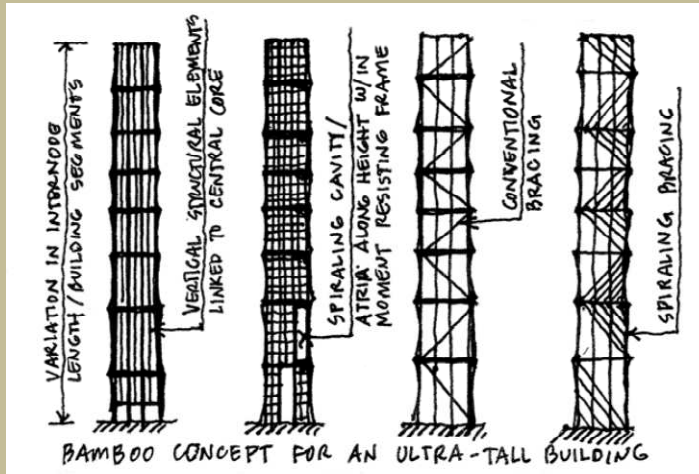
Physical

Molecular biology

Environmental

Geometrical

### Bamboo Structure system



- Using Physical analysis Technique to analyze structure system of bamboo, which overcome the side loads by cross divisions.

# Techniques of BioMimetic Analysis



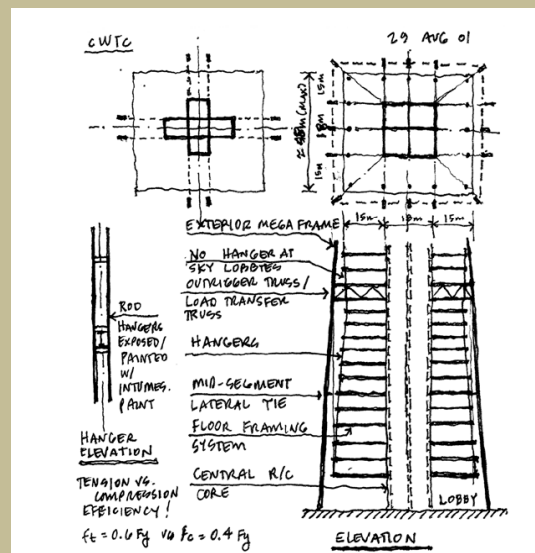
Mathematical

Physical

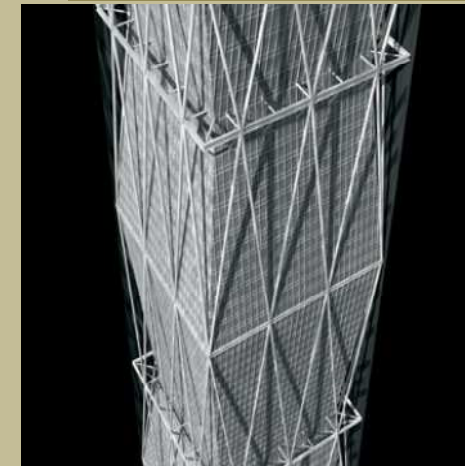
Molecular biology

Environmental

Geometrical



Bamboo Structure system



- Simulating the structure system of bamboo in the structure of tower to become More resistant to side loads.



# Techniques of BioMimetic Analysis



Mathematical

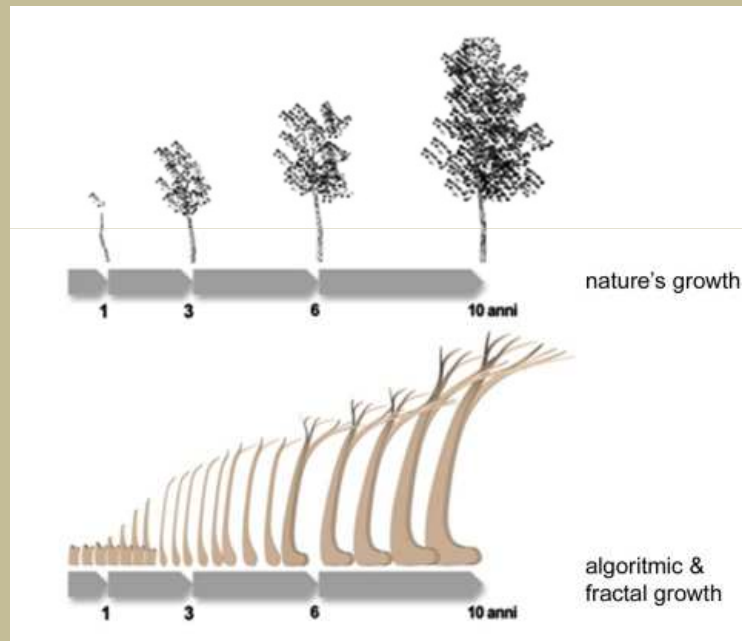
Physical

Molecular biology

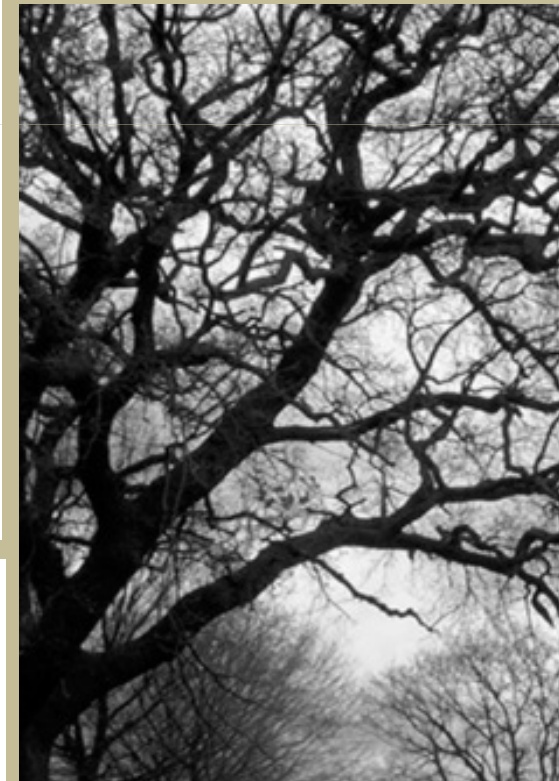
Environmental

Geometrical

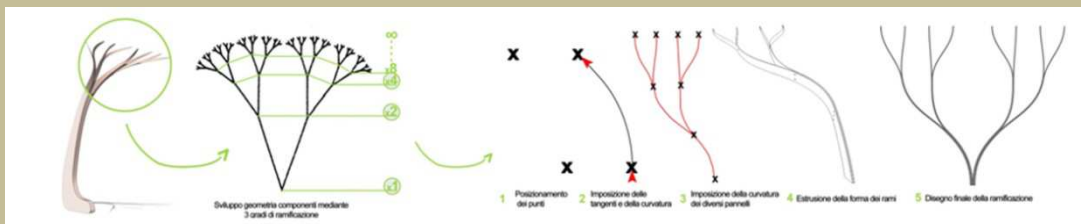
Analysis of the growth process of plants and trees. Then knowing the growth patterns and simulate them to take advantage in the design process.



Growth process



Biomim  
Arc



# Techniques of BioMimetic Analysis



Mathematical

Physical

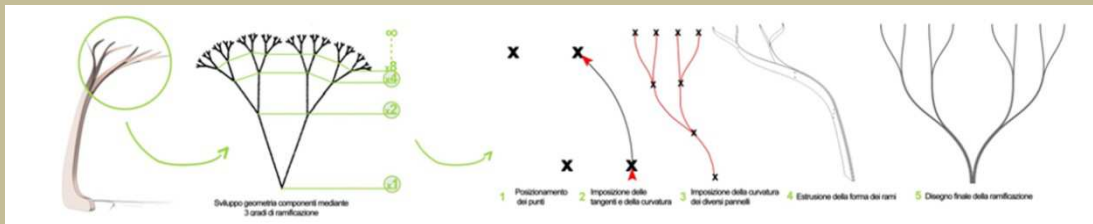
Molecular biology

Environmental

Geometry

Analysis of the growth process of plants and trees. Then knowledge of growth patterns and simulate them to take advantage in the idea of design.

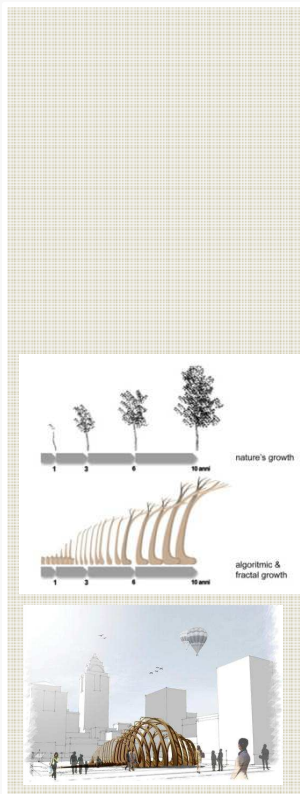
Growth process



# Techniques of BioMimetic Analysis

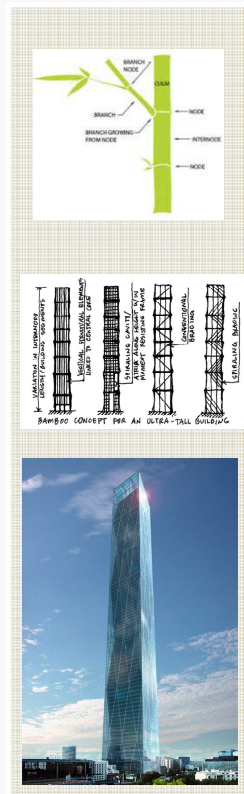


## Mathematical

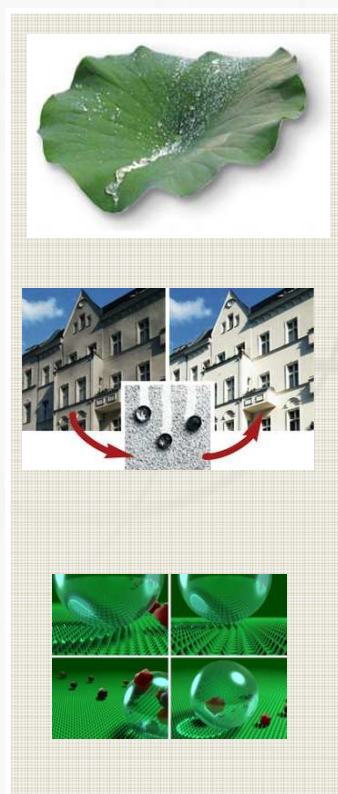


Biomimetic Techniques in Architectural Design

## Physical



## Molecular biology



## Environmental



## Geometrical



## Techniques of BioMimetic Analysis



Mathematical

Physical

Molecular biology

Environmental

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## Techniques

### of BioMimetic Analysis

Mathematical

Physical

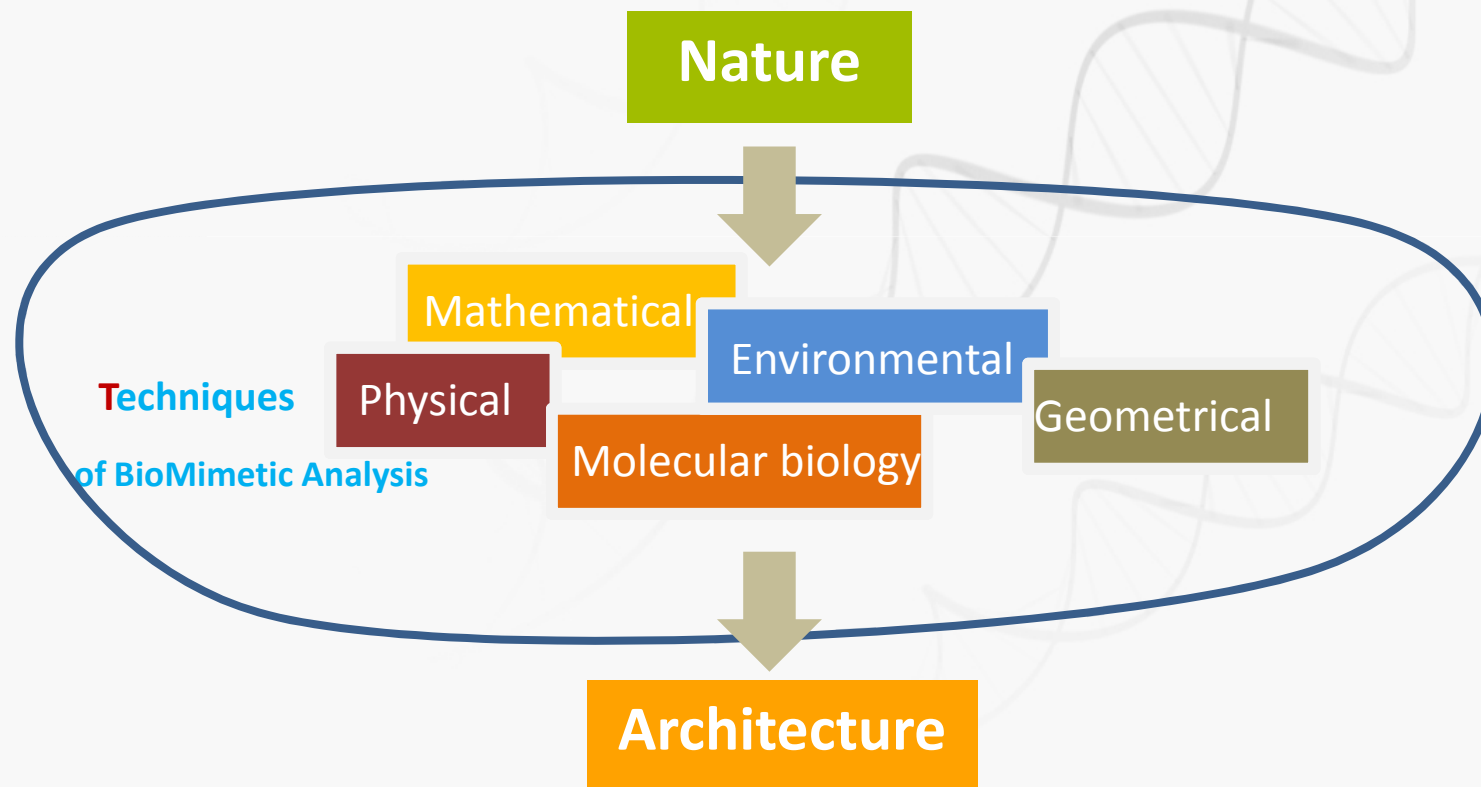
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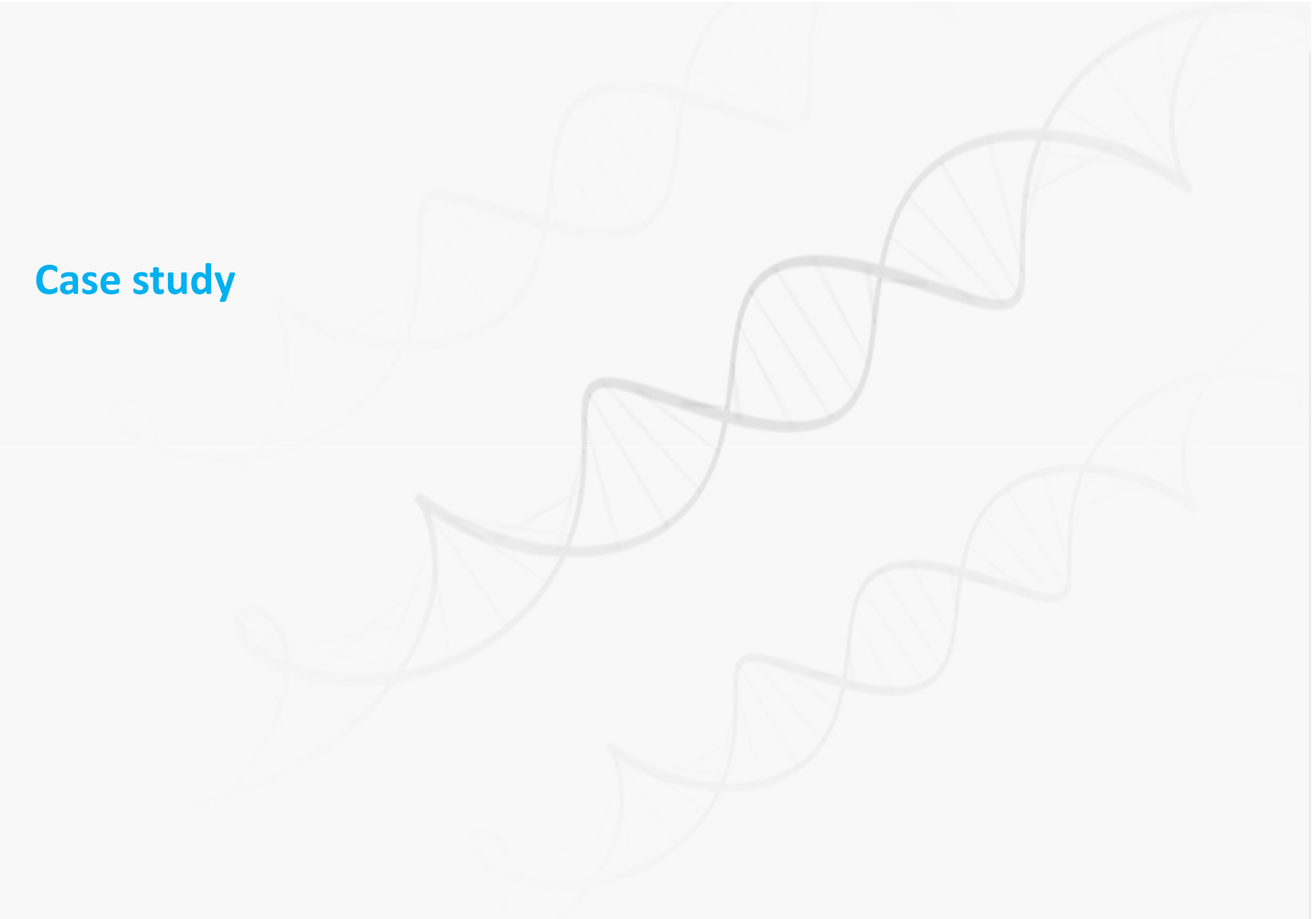
## Techniques of BioMimetic Analysis

All of these techniques are different methods of analysis and other methods are tools to analyze and transfer information from Nature to Architecture, and also to find solutions to problems of architecture.



**Part 5**

**Case study**



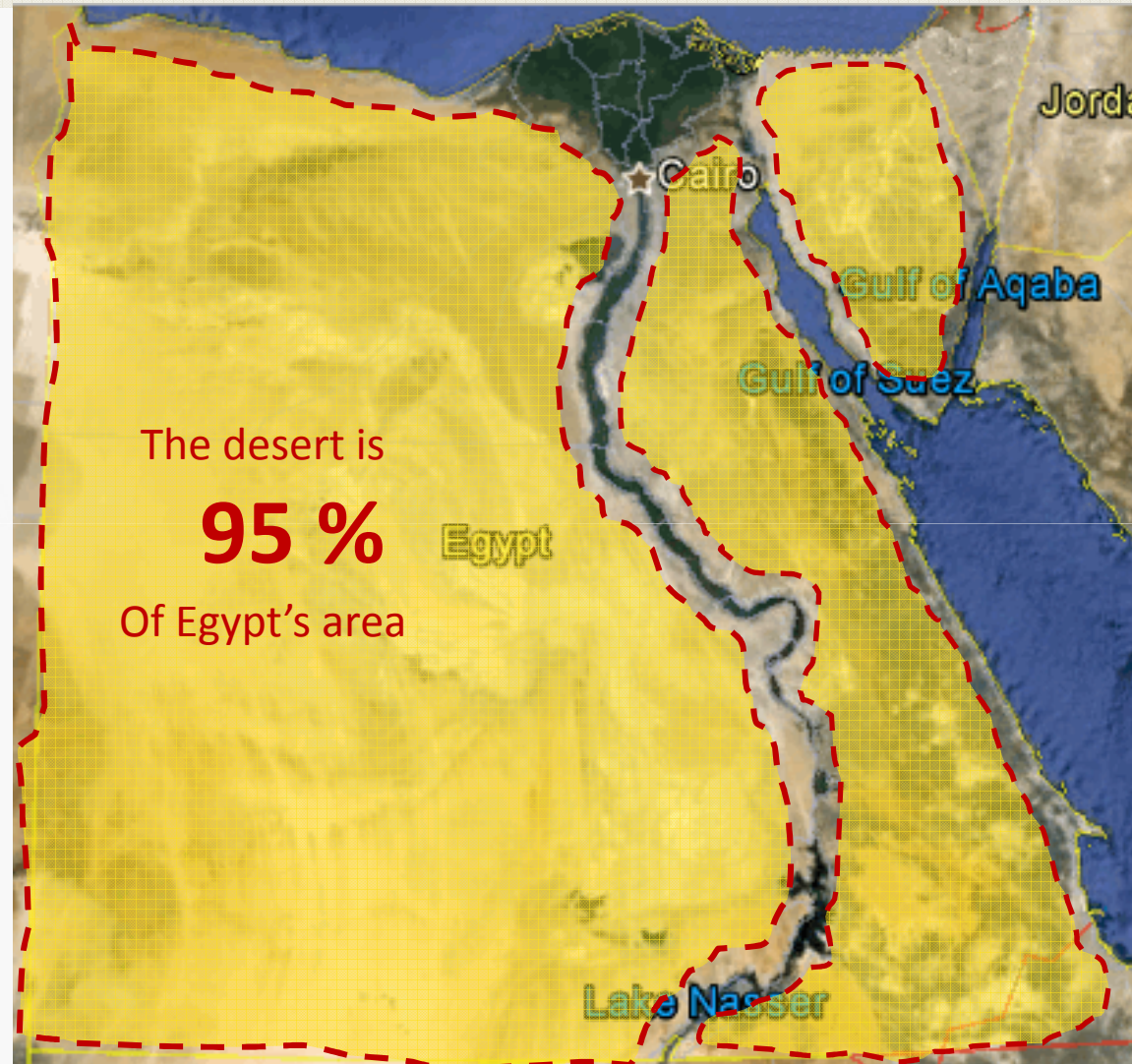
# Egypt

## Desert of Egypt

**Egypt's area**  
1.002.000 km<sup>2</sup>

**Egypt's population**  
86,895,099

**Populated Area**  
7.8 % from The total area



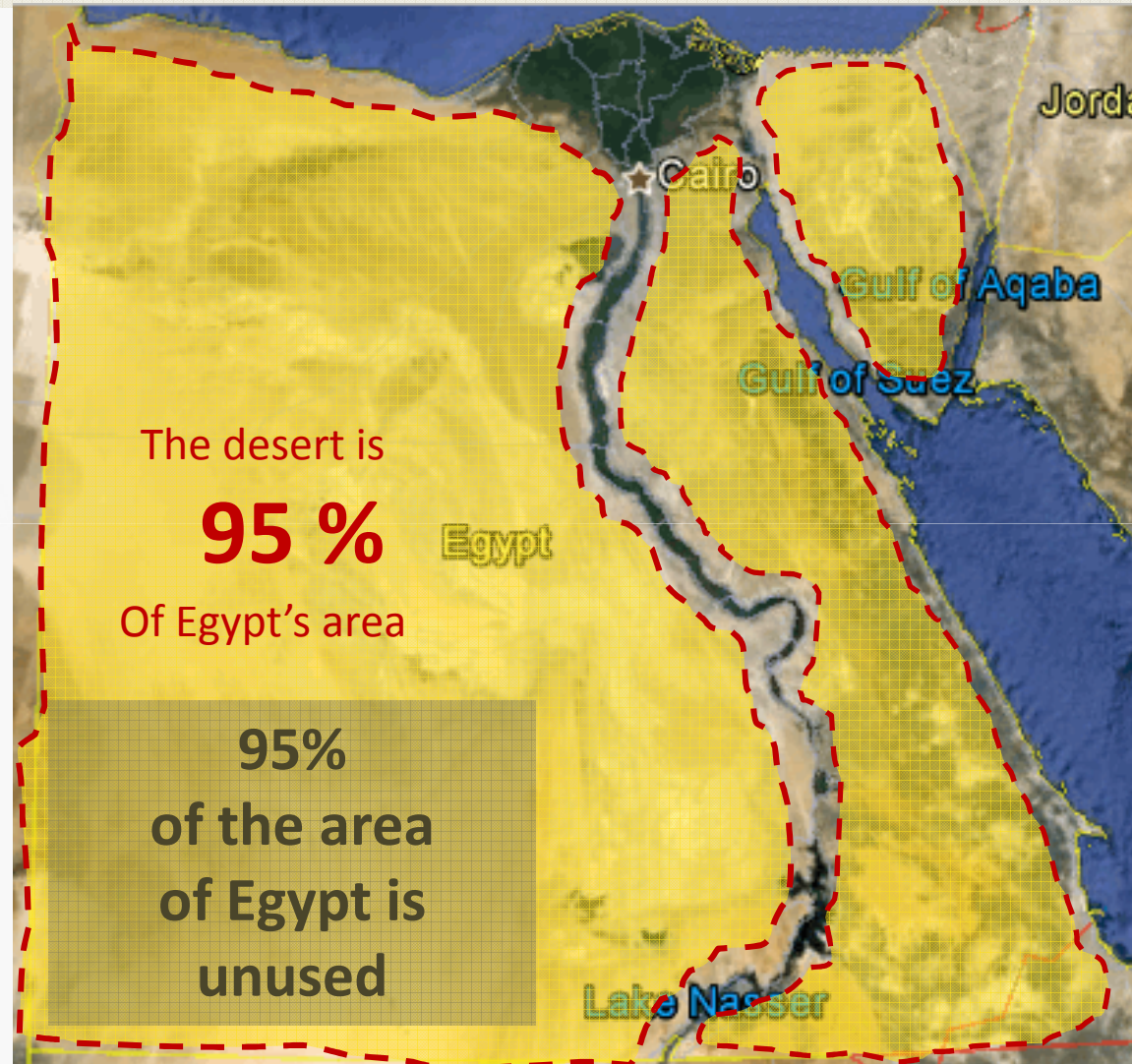


# Egypt

## Desert of Egypt

95%  
of the area  
of Egypt is  
unused

Because of the  
environmental  
problems at  
the desert



## The main problems in the desert environment

### Climate

- 1- The climate in summer, fall and winter is characterized by an increase of heat
- 2- High temperature during the day and very low temperature at night



## The main problems in the desert environment

### Water

- 1- Water and rain are rare and it falls a little in winter and spring.
- 2- Sometimes the water to reach the Earth's surface by wells and springs

- Wells and springs are the main reason in the presence of people in the desert environment to do the agricultural activity



## The main problems in the desert environment

### Soil

- 1- Soil contains sand dunes which is difficult to build on.
- 2- Soil in the desert environment is sandy with a few fertility due to water scarcity

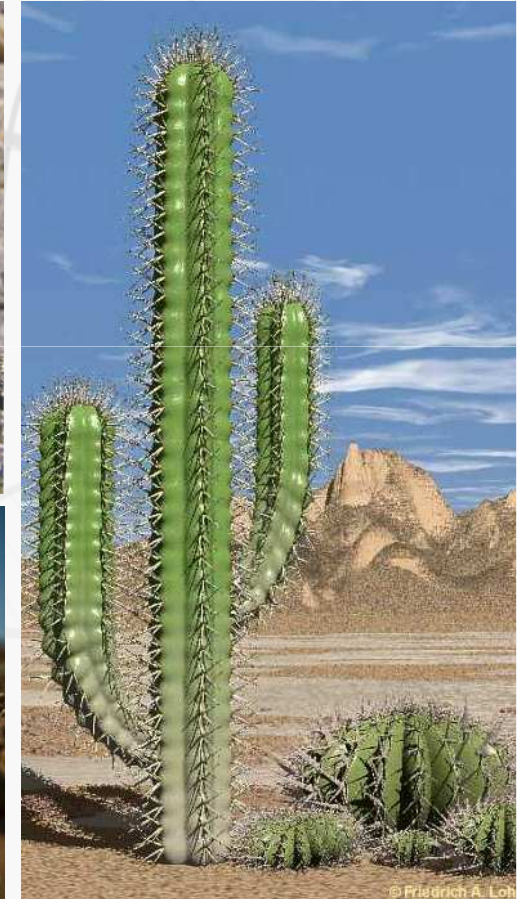


## Part 5

## Case study

### How can we overcome these problems ?

We can overcome these problems by mimicking the living organisms in this desert environment.



Biomimetic Techniques in  
Architectural Design

Part 5

Case study

## Lizard

Climate

Study and analysis of lizard skin

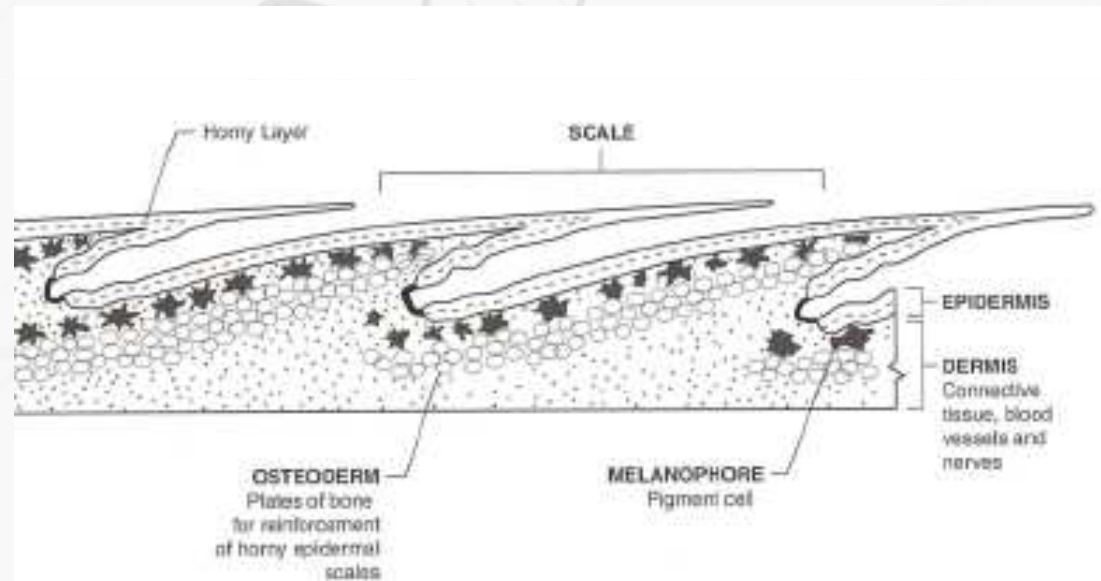


## Lizard

## Climate

## Study and analysis of lizard skin

Studying and analyzing the lizard skin and understanding how to beat the temperature and save the internal temperature of the Lizard's body.

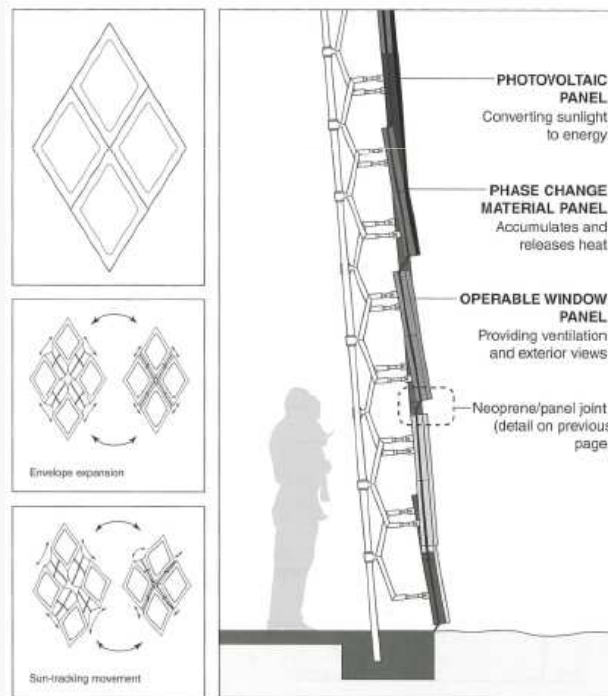
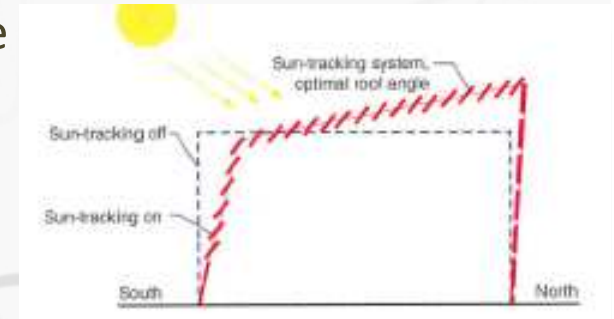


# Lizard

## Climate

This Example is a result of co-operation between an architect and a biologist

Mimicking the lizard's skin in the envelope of the building to beat the temperature in the same way.





## Beetle

water

Study how to obtain these living organisms on the water

beetles in the Desert collect drinking water from fog-laden wind on their backs .

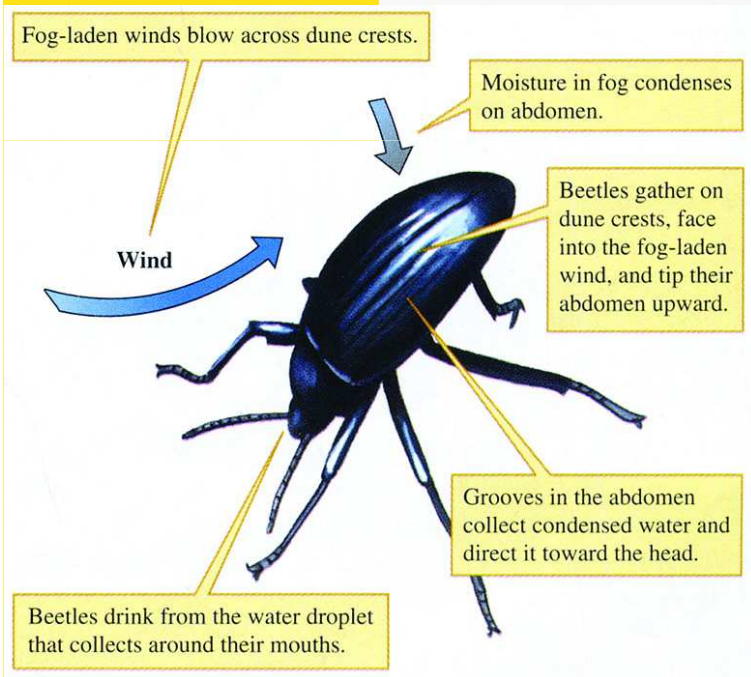


# Beetle

water

Study how to obtain these living organisms on the water

The skin of this beetles works as a condenser which transfer cool air into drinking water .



**Biomimetic Techniques in Architectural Design**

## Beetle

water

### Study how to obtain these organisms on the water

The design of this fog-collecting structure can be reproduced cheaply on a commercial scale and may find application in water-trapping tent and building coverings for example, or in water condensers and engines.



## Recommendations

We need to learn from **Nature** and **living organisms** and know their abilities, which God created them

Solving the problems that are facing us in  
**Nature** and **living Organisms**



**Thank you**