Civil Engineering and Architecture 10(6): 2669-2685, 2022
DOI: 10.13189/cea.2022.100632 http://www.hrpub.org

The Effect of Directing Architectural Spaces towards Astronomy on Living Organisms: An Experimental Study on Chlorella Vulgaris Algae

N. M. Mahmoud[1,*], H. H. Azmi[1], O. Fatehe[2], M. S. EL-Sawy[3]

[1]Department of Architecture, Faculty of Engineering, Cairo University, Egypt
[2]History of the Medieval Astronomy BOD Member, Egyptian Society for Astronomy, Egypt
[3]Department of Architecture, Faculty of Engineering, Misr International University, Egypt

Received June 7, 2022; Revised August 16, 2022; Accepted September 19, 2022

Cite This Paper in the Following Citation Styles

(a): *[1] N. M. Mahmoud, H. H. Azmi, O. Fatehe, M. S. EL-Sawy , "The Effect of Directing Architectural Spaces towards Astronomy on Living Organisms: An Experimental Study on Chlorella Vulgaris Algae," Civil Engineering and Architecture, Vol. 10, No. 6, pp. 2669 - 2685, 2022. DOI: 10.13189/cea.2022.100632.*

(b): *N. M. Mahmoud, H. H. Azmi, O. Fatehe, M. S. EL-Sawy (2022). The Effect of Directing Architectural Spaces towards Astronomy on Living Organisms: An Experimental Study on Chlorella Vulgaris Algae. Civil Engineering and Architecture, 10(6), 2669 - 2685. DOI: 10.13189/cea.2022.100632.*

Copyright©2022 by authors, all rights reserved. Authors agree that this article remains permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

Abstract It has been noted that ancient civilizations, like the Ancient Greeks, Babylonians, and the Ancient Egyptians, were interested in directing buildings towards astronomy. This directive represents a mystery that the modern architect could not understand, which rompted the research to deal with this problem experimentally to prove whether or not there was an effect of architectural spaces oriented towards astronomy on living organisms. Accordingly, this experiment was implemented on microorganisms such as algae of the type (Chlorella Vulgaris) by designing spaces and then directing them towards astronomy at times with unique characteristics being chosen and directed to it, and placing algae in them to study the changes that occurred in them as a result of placing them in those spaces. The experiment concluded that there was a clear relevance between directed spaces according to astronomical parameters and the well-being of living organisms. The search objective was to reach an answer to the research question, is there any importance to the effect of directing architectural spaces toward astronomy or not on living organisms? And why? The research results showed the importance of orientation towards astronomy, as it was in all previous civilizations, and the absence of this importance at present. The choice of building construction time and the guidance of the astronomer enhance the required purpose of the building and increase its efficiency and the efficiency of its users. The Scientific addition to research showed that the main value of the research is proving the effect of directing architectural spaces towards astronomy on living organism using an experimental study on microorganisms, it was found that there is an important effect of space that is oriented to astronomy on living organisms to raise its efficiency and the efficiency of its users.

Keywords Architecture; Astronomy, Directing Temples and Pyramids, Directing Buildings, Microorganisms, Algae

1. Introduction

All ancient civilizations perceived the significance of directing their buildings to astronomy during the construction process. This is evident in the first buildings in Prehistoric Periods (Neolithic Era) as shown in figure 1 that appeared in the form of (columns, stone circles, carved tombs):

Figure 1. View of the excavated ruins at Tell Half, Syria; It was the first find of the Neolithic culture, subsequently dubbed the Half culture

1. The circle of the stone calendar and the standing stones in the “Napta” region in Egypt dating back to 6000 BC was in the direction of the true “North-South”. The three stars were linked to the constellation of Orion, and the entrance to the circle corresponds to the position of the sun at the time of the summer solstice, as shown in figure 2 and it is considered the first clock in human history to know the time and seasons [1].
2. New Grang cemetery in Ireland, as shown in figure 3, which dates back to 3200 BC, is considered the oldest building in Europe from the Neolithic era, as the astronomical phenomenon, the entry of sunlight on the morning of the winter solstice (December 21) through a box opening above the entrance door to the main room of the cemetery [2].
3. The Stonehenege Circle in England, as shown in figure 4, which was built in stages between (1800:3100) BC, is considered a temple to the sunand an astronomical calculator [3].
4. In the Babylonian civilization, there emerged a relationship between the influence of many astronomical phenomena and the engineering of buildings dating back to 2000 BC. The Babylonians were the first to draw maps of the locations of celestial bodies, as shown in figure 5, for the purpose of predicting events on Earth and places for seeing the crescent [4].

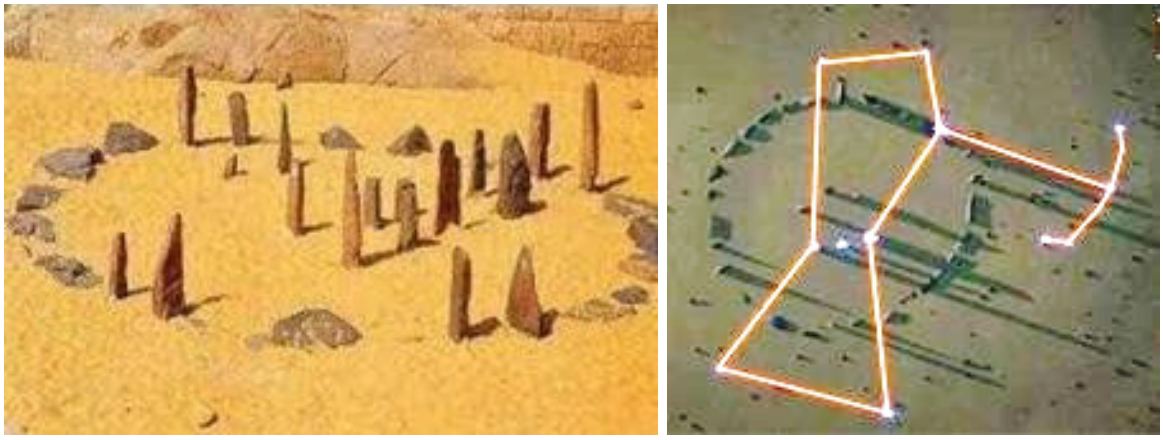


Figure 2. The relationship between the Orion constellation and Remains of the stone calendar circle in the "Napta" region in southern Egypt

Figure 3. An exterior view and entrance to the New grange cemetery in Ireland and the entry of sunlight annually on the winter solstice

Figure 4. The Stone Heng circle in England, which was an astronomicalobservatory in the Neolithic era

Figure 5. Parts of the Babylonian sidereal calendar

Figure 6. The discovery of the oldest astronomical map in Iraq

5. The discovery of the oldest astronomical map of the celestial dome, which is a circular, concave piece of pottery with the sun in the middle, as shown in figure 6, found in Iraq [5].
6. The Greek civilization also directed its buildings towards the ark, which appeared in the Parthenon temple in Athens, Apollo in Delphi and Avaya on the island of Agena, and the locations of the three temples representing an isosceles triangle associated with astronomicalphenomena, as shown in figure 7 [6].
7. Chinese civilization has been concerned with astronomy, calculating time and achieving a chronological calendar. The ancient Chinese astronomical ideas and the method of movement of stars and planets were reflected in the design of their cities and imperial buildings. The capital is usually planned on the basis of a main axis extending from north to south, and theroyal palaces are placed on the same axis. This axis shows their connection with the Polar Star, and this is evident from the design of some cities, such as the city of "Changan", whose site planning was linked to the arrangement of the stars in the "Big Bear" and "Little Bear" groups, and the Polar Star is located between these two groups [7]. This appears clearly in the Forbidden City in Beijing, as in figure 8, which was associated with the original destinations and the center of the old city of Beijing and had a strong relationship with the location of the polar stars [8].
8. The ancient Egyptians were interested in studying the stars since 4000 BC and knew the astronomical constellations, constellations, and many ofthe planets and created the astronomical calendar, as well as the zodiac circle found in the ceiling of the temple of "Dendera" in Qena in southern Egypt [9]. The ancient Egyptian architects were also interested in orientation towards celestial bodies such as the sun and the moon and this appeared in the astronomical orientation of the pyramids of Giza, where they are considered the most accurate building in orientation, because its foursides completely face the four original directions as concluded in a research published in 2003 in the *International Journal of Scientific History* entitled **Orientation of the Primary Egyptian Pyramids.** it presented some of the most important researchers'

theories of the way to direct the Egyptian pyramids using the stars [10]. Most of the ancient Egyptian temples are linked to the daily and annual movement of the sun and the stars., for example, the sun's rays enter the sanctum in the Great Temple of Abu Simbel for the first time on the birthday of King Ramses II (February 21) and the second time on his sitting day on the throne (October 21) every year [11], while the sun rays penetration of the main axis of the great temple of Amun at Karnak in Luxor at sunrise in the middle of winter, then penetrating it again from the west at sunset in the middle of summer, then finally the sunrise on the face of The Sphinx on the spring and autumnal equinoxes in Giza [12]. Consequently, it could be concluded that all civilizations were motivated to direct their buildings towards certain directions and celestial bodies, which is the core of this study.

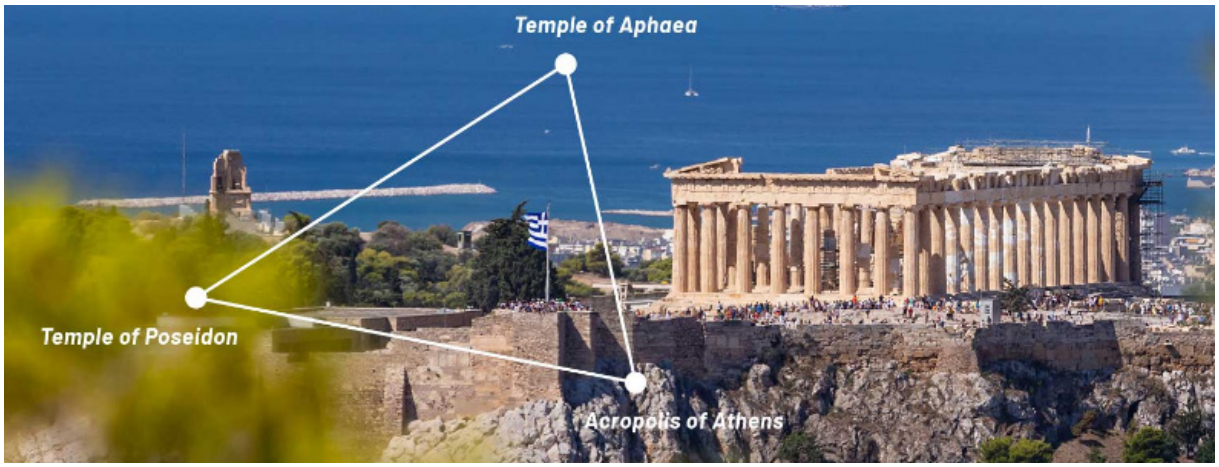


Figure 7. The temple of Aphaia in Aegina is said to form an isosceles triangle with several other temples across Greece

Figure 8. The Forbidden City in China follows the cosmic system of theancient Chinese

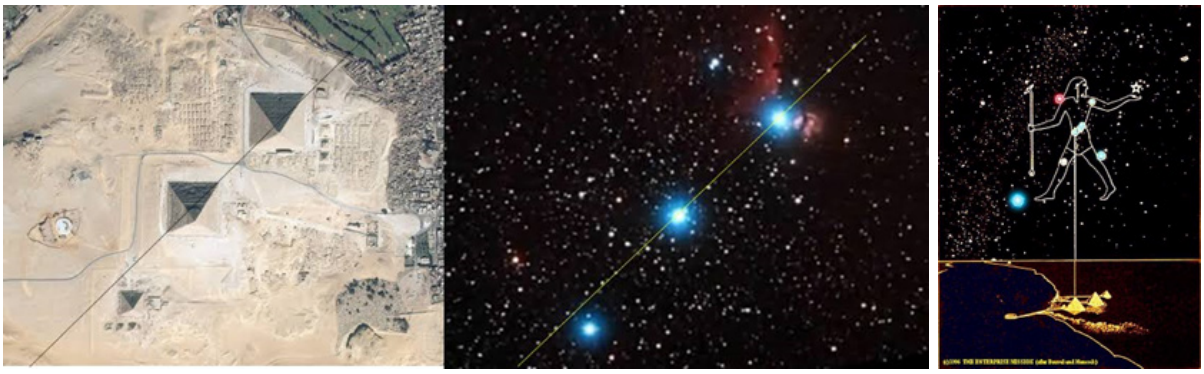


Figure 9. The three pyramids of Giza are identical in arrangement with three stars representing the belt of the constellation of Orion

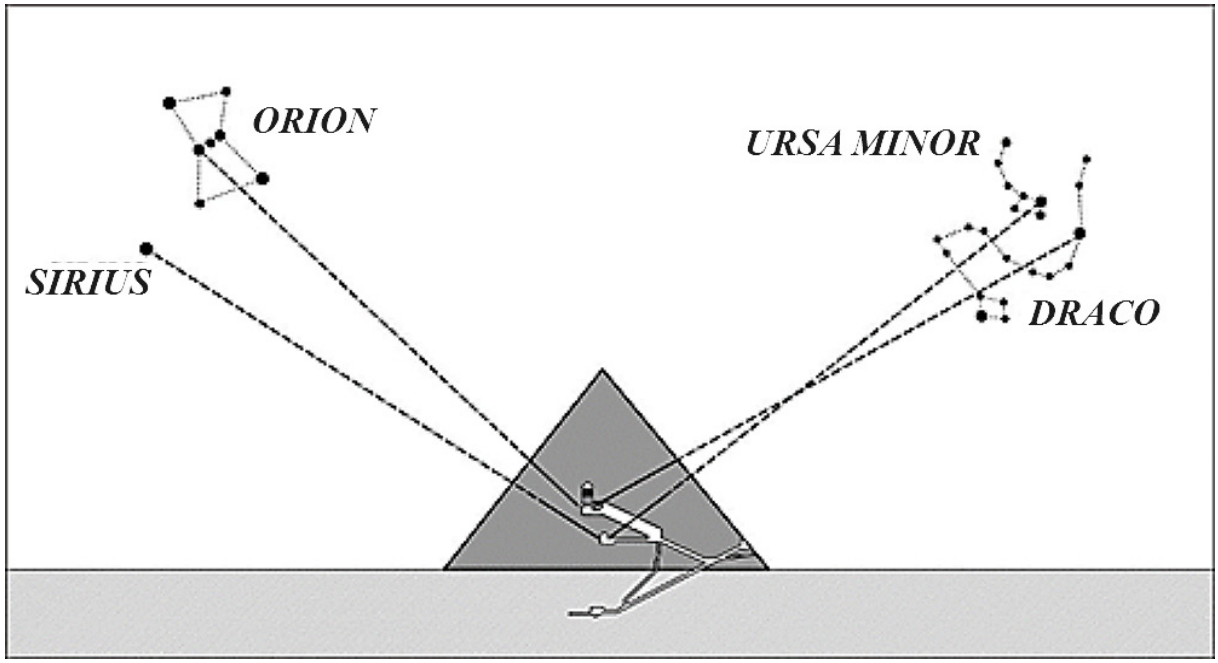


Figure 10. The relation between the stars and the inner channels of the Great Pyramid.

2. Ancient and Modern Studies and Research that Focused on Directing Buildings towardsAstronomy

Some archaeological architects were interested in studying the orientation of buildings and temples and connecting them to some astronomical phenomena. The beginning was in Egypt, where the pioneer of archaeological astronomy, Mahmoud Pasha Al-Falaki, in 1885 AD, studied the pyramids and Najm Al-Shiari in the book “The Age of the Pyramids and the Purpose of Building them” [13].

In the year 1894 AD, Norman Lockyer conducted studies in architectural astronomy in a book entitled “The Dawn of Astronomy”, on Pharaonic temples and their relationship to astronomy [14]. In 1906 he also added a study on Stonehenge in England in his book "Stonehenge and the British Stone Archeology: An Astronomical Study".

In 1967 AD, the architect "Alexander Thom" from the University of Edinburgh published his study on (The Sites of Mihalithic Buildings inthe British Isles and their Link to Astronomy), which included a study of three hundred sites [15]. In 1994, researchers Bauval and Gilbert published a book entitled "The Orion Mystery" in which they explained how the three pyramids of Giza are identical in arrangement with three stars representing the belt of the constellation of Orion, as shown in figure 9. They also studied the orientation of the channels of the Great Pyramid and its association with constellations as shown in figure 10 [16].

In 2000, Buffal added a book titled "Secret Chamber: The Quest for the Hall of Records" in which he explains the secret of the Great Pyramid and the existence of secret chambers and how they can probably be linked to constellations and stars [17].

In 2001, Juan Antonio Belmonte (Professor of Ancient Astronomy in Spain) did a research entitled "On the Orientation of the Old Kingdom Pyramids" [18].

Also, Muslim Shaltout and Jean Anthony, two researchers specialized in Egyptology and astronomy, published research on the orientation of Egyptian temples with the aim of measuring the direction of the axes of most temples and their relationship to astronomy. The first, in 2005, was about Upper Egypt and Nubia [19], and the second, in 2006, was about new experiences in the oases of the Western Desert [20], the third, in 2007, was about the main points in Upper Egypt and Siwa [21], the fourth, in 2008, was about directing the temples of Serapid al-Khadem in Sina [22], and the fifth, in 2010, was about directing the temples of Central Egypt and Sudan [23]. This research concluded that most of the ancient Egyptian buildings were directed. In 2009, they published a book entitled “In Search of Cosmic Order” comprising a number of studies on some of the secrets of the ancient Egyptian civilization, namelythe constellations of ancient Egypt, the Egyptian calendar, landscapes and symbolism, especially how they relate to the orientation of temples and royal tombs [24].

In his latest study in 2014, he did research entitled “Temples in Ancient Egypt and Archeoastronomy” in which the orientation of the axes of 330 temples was measured in 5 regions in Egypt (the Valley, Delta, Oasis and Sinai) with the aim of finding an answer to whether the ancient Egyptian sacred buildings were astronomically related or not. The Egyptian-Spanish mission asserted that there were temples astronomically oriented to the sun and stars, such as the Ipet Sut complex of God Amun in Karnak and the Jubilee Temple of Ramses II in Abu Simbel. However, Western Thebes and the Temple of the Goddess Isis in Dendera in Qena, were directed to the rise of Spi dit. Also, there are some other temples whose axes are directed to both the Nile Valley and the Delta i.e. perpendicular to the course of the Nile, such as the Amun complex in Karnak and the Great Abu Simbel temple in Aswan or directed to the sunrise in the winter, such as the Ancient Thebes [25].

In 2015, Jean Anthony also published a book entitled "Orientation of Egyptian Temples: An Overview", which deals with the importance of astronomy and the idea of orienting Egyptian temples. This book also presented an analysis and measurement of 400 axes of temples in the Nile Valley, Delta, Oasis and Sinai to find out whether the ancient Egyptian sacred buildings were astronomically oriented or not, and the results were that the vast majority were oriented to the ark and the others to the Nile or to the original directions [26] Recent research on astronomy and architecture continued, and a study published in 2019 asserted the relationship between the construction of Chartres Cathedral and astronomy [27]. This highlights the important role that astronomy has played throughout ages and in all fields, as was proved by analytical studies, old and new. But research in this field still lacks the experimental part to clarify the real effect and its significance, which prompted the researchers to address this point by studying and conducting a practical experiment to test that effect. To prove this, various experiments were carried out through research using microorganisms (Algae) as a means to show such an effect.

Previous Experiments on Algae and Their Growth

Experiments were made on simple organisms such as (Algae) to find out their growth rates, as they are single-celled organisms that use light energy and carbon dioxide with high efficiency in photosynthesis for growth, which is fast growing and produces food on its own.

Figure 11. The models show the beginning and end of the experiment, with algae inside

In 2013, a research entitled "Kinetic Model of Chlorella Vulgaris Growth with and without Extremely Low Frequency-electromagnetic Fields (EM- ELF)" was presented to determine whether the growth rate of Algae (Chlorella vulgaris) increases when exposed to electromagnetic fields after a period of 15 days' cultivation. Clusters and agglomerations occurred and led to the promotion of increased growth of algae when exposed to these electromagnetic fields [28]. In 2014, a laboratory experiment entitled “Measuring the Biological Effects of Geometric Shapes on the VitalActivity of Algae” was conducted to study the effect of geometric shapes on the activity of the algae (Chlorella OVATE). Hence, the biological functions of the organism and their impact on

external factors are measured by measuring the growth level of this organism inside the nutrient medium through measuring the turbidity of the medium the organism is planted in. To do that, a set of geometric angles, such as those inside the pyramid and the golden ratio, were chosen and modules based on these angles were built as in figure 11. The research concluded that there was a positive effect on algae in five forms of the eight tested, which is evidence that the algae is exposed to an increase in growth as a result of placing them in design modules with special angles [29].

3. Experiment Design

The research aims to study and analyze the effect of directing architectural spaces towards astronomy. These spaces were represented in the form of stereoscopic models to answer the question of whether the orientation has an effect or not. Therefore, the experimental study was carried out on simple organisms such as (Algae) *Chlorella Vulgaris* Microalgal type, which is fast-growing, taken from the water pollution laboratory of the National Research Center in Dokki.It seemed to perform all the vital processes of breathing, feeding, growth and movement, reproduction of the organism and increase in numbers in the shortest possible time, which is very suitable for the dimensions of the experiment. Hence, the sample of algae was placed inside three boxes, to test its growth and to be compared and monitored, with the confirmation of the experiment factors such as the size of the boxes, orientating them to the north, the type of the test sample, the number of pellets, temperature, humidity, lighting and method of feeding. The change was in only two factors; the orientation of the tubes in the direction of the ark and the astronomical times for each box, then measuring the biological functions of the organism and the extent to which they are affected by external factors by measuring the growth level of this organism within the food medium, and measuring the weight of the Algae by doing a gravimetric analysis of the test sample. The experiment was prepared in the Biochemical Engineering Laboratory, Engineering Division building at the National Research Center in Dokki and completed at the researcher's house by placing algae inside three-dimensional boxes that were astronomically oriented and designed with specific dimensions and angles.

3.1. Experiment Tools: Materials and Methods

3.1.1. First, the Architectural 3D boxes

Three stereoscopic boxes made of foam (foam-core panels) (50 cm long, 30 cm wide and 27 cm high) were designed to represent architectural spaces with unified geometric dimensions and two holes were made in the boxes directed towards the celestial bodies, similar to those at the Great Pyramid in Egypt.

Four cylinders are made of cardboard (25 cm in length and 5 cm in diameter), where two of them are installed in each of the test boxes designated for astronomical guidance.

- Magnetic compass to determine original directions.

3.1.2. Second, the Essentials for Bio-Testing

The tools were prepared, such as a 250 mm flask, a syringe for extracting a sample of moss and cotton, a 10 mm test tube, a 30 mm Chinese Porcelain Crucible for 9 crucibles, a sensitive scale for four decimal places, and a one meter fixed lighting strip of a white LED, and a sample of a test for *Chlorella Vulgaris* Microalgae type, as well as a compound prepared in the laboratory for food for Algae Media of the type PG11.

3.1.3. Third: Microorganism and Culture Conditions (Algal Strain & Culture Medium)

The microalgal strain *Chlorella Vulgaris*, was procured from National Researcher Center, Egypt by Dr.Sayeda M.abdo (the researcher in the Hydrobiology lab), provided us with the microalgae strain "Chlorella Vulgaris". Stock culture was cultivated photoautotrophically in 250 ml flasks containing BG11 media at room temperature (20°-25° C) and pH 7 under continuous cool led white light. Each liter of BG11 media contained 1.5 g Sodium Nitrate, 0.02 g Sodium Carbonate, .04 g di- Potassium Hydrogen Phosphate, 0.75 g Magnesium Sulphate Heptahydrate, 0.36 g Calcium Chloride di-hydrate, 6 mg Citric Acid, 6 mg Ammonium Ferric Citrate, 2.86 mg Boric Acid, 1.81 mg Manganese Chloride, 0.22 mg Zinc Sulphate Heptahydrate, 0.39 mg Sodium Molybdate, 0.08 mg copper sulphate, 0.05 mg Cobalt Nitrate, 0.01 mg EDTA [30,31,32].

4. Steps of the Experiment

The experiment was divided into two stages, where astronomical studies were implemented to choose two different times of influence to study the difference between orientations at certain astronomical times and compare it with the disoriented box (control).

4.1. The First Stage

In the first stage, a three-dimensional model was implemented, and it is called, in this research, the first model with a circular opening on two closed sides in order to install the two cylinders directed to the astronomical plane, as shown in figure 12. It is directed by special angles of inclination to determine the locations of the stars by the horizontal altitude method (Alt-Azm) with two angles known as altitude and azimuths [33] as shown in figure 13. Source: researcher.

The first box was built on November 24, 2019 for the

occurrence of an astronomical composition; the conjunction[1] of Venus with Jupiter, which has a distinctive astronomical composition according to The Astrology Book [34], and this conjunction has a distinctive effect at 4 pm and 9 pm, so at 4 pm the first tube was directed at the azimuth angle = 210° 58° [35] and the elevation angle Altitude = 29° 48°. Then, at 9 pm, a second tube was directed at the sky with the azimuth angle = 258° 32° and the elevation angle = 29° 20°. The angles were determined using the Stellarium Astronomy Software, and each tube was installed separately in the slot designated for it according to its angles at the specified time. The tube is placed inside the first box, as shown in figure 14.

Then, the northern axis of the box was determined via a compass and the lighting element from the white LED strip was installed at a fixed angle in the direction of the true north of the box, then the box was directed towards the true north after the completion of its construction and it installed on it in the ground for the length of the experiment, then 3 flasks (test tube) were put in it to start the Alga growth test. The researcher started to observe the algae samples daily by providing 12 hours of artificial light and 12 hours of darkness and stabilizing the temperature so that the room temperature was 20° -25° degrees Celsius. The 3 flasks (test tube) were placed in it to start the Alga growth test at the same time. At that point, the fixed disoriented box (control) was placed, which is called the third model. This model is a three-dimensional stereotype with the same dimensions as the other models, but without astronomical orientation as shown in figure 15. Finally, three flasks (test tubes) were placed in it to start the Alga growth test, and then the samples of the Algae were observed following the same steps of monitoring the first model for two weeks, the time allotted to the experiment.

4.2. The Second Stage

At this stage, a three-dimensional model was implemented, which is called the second model, where the same steps of the first and third models were followed, with a different construction time, which was on January 13, 2020, due to the occurrence of a distinctive astronomical composition, which is the conjunction of the planet Saturn with the sun[2] according to The Astrology Book [36].

This conjunction is distinguished between 7 pm and 12 am. Therefore, orientation was made at 7pm at the azimuth angle = 257.5° and the altitude angle was -22.66°, but at 12 am, the orientation was at the azimuth angle = 355° and the altitude angle = -81.3°. The angles were determined by (Stellarium Astronomy Software) and each tube was installed separately in the slot designated for it according to its angles at the time specified for it inside the second model as shown in figure 16. Then, three flasks (test tubes) were placed in it to start the Algae growth test following the same steps used in the first model and at the same time. The third model (control) was then placed, but without astronomical orientation, and three flasks (test tubes) were placed in it to start the Algae growth test to observe the Algae samples with the same steps followed in the first model for two weeks, the time allotted to the experiment.

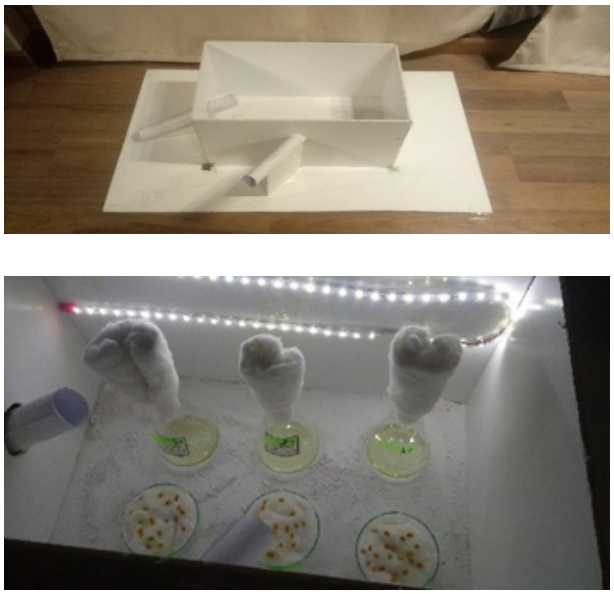


Figure 12. The first box after its design and the start of the experiment, source by researche

1 Conjunction: is, as the name implies,an aspect in which two points-such as two planets, are close enough that their energies join. A conjunction is a major aspect, regarded as harmonious or inharmonious depending on the planets involved. For example,a conjunction involving planets such as Jupiter and Venus would exert an agenerally fortunate influence, while a conjunction involving Saturn or Pluto would be challenging, to say the least. A conjunction is sometimes called the aspect of prominence because it brings the planets involved into prominence in a chart [36].

2 A planet is said to be combusted when it is within 8 30 (many would say less) of the sun. In traditional astrology, this was regarded as having a weakening (debilitating) effect on the planet involved. Contemporary astrologers have not found that this close conjunction with the Sun weakens planets, and, to the contrary, some researchers have asserted that such a position tends to strengthen the influence of the planet involved. The notion of combustion might have been based on the observation that during partile conjunction in which the sun actually came between a particular planet and earth (i.e, during occultations,) the matter and processes ruled by the planet involved in the conjunction were weakened [36].

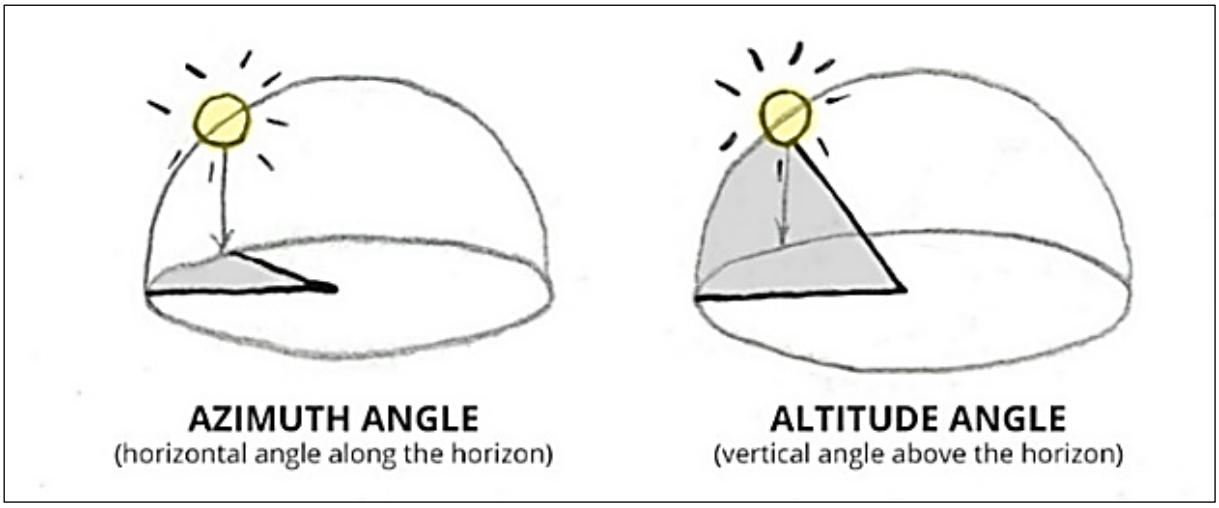
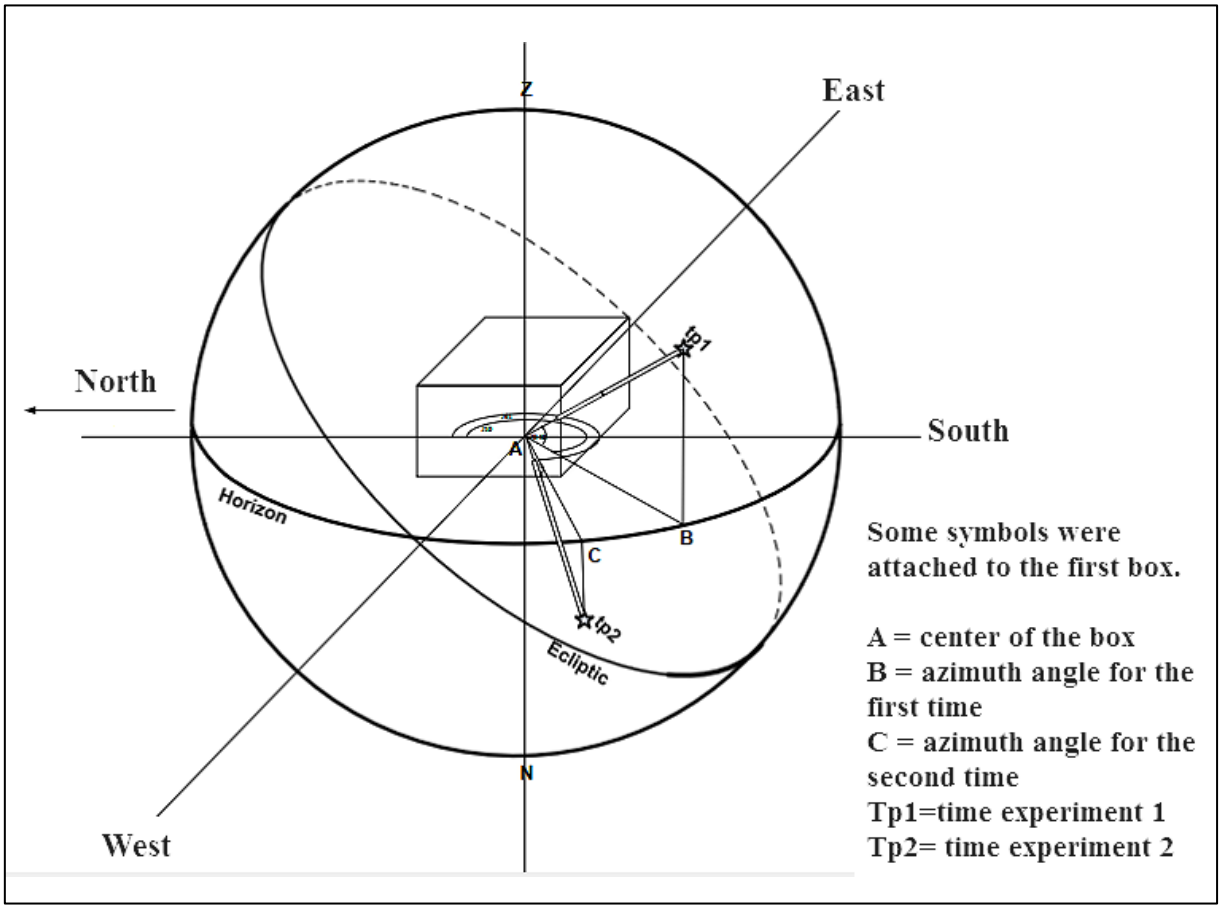


Figure 13. The Determination of the stars by elevation method



Source: the researcher

Figure 14. The relationship of the first box towards the tubes in the direction of astronomy.

4.3. Third: How to Prepare and Measure the Test Sample (Algae)?

1. A sample of Chlorella Vulgaris was taken from the type Microalgal, as well as a sample from PG11 (food medium), which is the feeding liquid for Algae prepared in the same laboratory. Then, 3 ml of the test sample was placed in a 250 ml flask using a syringe, and 17 ml of feeding liquid (Media) at a concentration of 1 g per liter by means of a tester, a flask closed with a cotton stopper in order to filter the air interacting with microalgae and also to regulate the entry of air into the flask. The second step was to prepare 9 flasks to start the experiment so that each box contains 3 flasks with the provision of a fixed lighting element for each stereoscopic model of a white LED strip installed in the direction of the north so that it would light up for 12 hours a day and also fix the room temperature from 20° - 25° degrees. Then, the experiment was followed up for two consecutive weeks where 10 milliliters of feeding liquid (Media) were added to each flask after a week from the beginning of the experiment for healthy algae growth.
2. Then, by the end of the two-week experimental period, the biomass test[3] was done by drying the 30 mm empty crucible and burning it at a temperature of 105° degrees Celsius, then weighing it on a sensitive scale of decimal numbers. After that, 25 ml of the existing mixture in each flask was taken by means of a glass tester and put in a 30 mm burning crucible. Then, 9 burning crucibles were taken to the dryer device and dried at a temperature of 60°C for 4 days. Watts equals 96 hours. After the completion of drying, the weight of each crucible was calculated separately by means of a sensitive balance in order to know the amount of increase in the form of a percentage and to know the rate of algae growth in grams per liter. The difference in weights is calculated by subtracting the weight of the crucible after drying the algae in it from the weight of the crucible while it is empty.

5. Experiment Results

The results of the experiment were inferred by doing a Biomass weighting analysis of the test sample in the three boxes and comparing them in two stages:

The First Stage: is a comparison between the rate of Algae growth in the first and third models at the time of the conjunction of Venus with Jupiter.

To find out whether there is an effect of directing the first model of astronomy at the time of conjugation and the third model that is not oriented to astronomy, the researcher compared the growth rate of algae in the two boxes by finding the growth rate in grams per liter of on micro-algae (algae) in each planet separately, and this is done by calculating the weighted analysis (Biomass) for the test sample separately in both boxes as shown in Table 1:

1. The growth rate of each flask is calculated separately in grams per liter by calculating the difference in weights through subtracting (W*) [the weight of the crucible with algae after drying] minus (-W) [the weight ofthe crucible with algae before drying].
2. The average growth rate is taken in three flasks.
3. To find out the rate of Algae growth in each box, an equation was made by assigning 25 mg/L of the weight of the Algae sample to the weightdifference of the sample to 1000 mg/L.
4. To find out the rate of increase in algae growth, was subtracted from the algae concentration ratio in the feeding liquid, 1 gram per liter, which is the concentration with which the experiment began.

It is clearly noted in the first stage that at the beginning of the first day, the Algae were ready to grow at a rate of 5%, and 14 days after the end of the experiment, there was an increase in the growth rate in the first model oriented to the astronomy by 64% at the time of the astronomical conjunction, but the third model increased by 50%. This confirms the occurrence of a significant effect of algae growth in the first model that differs from the third model (control).

The Second Stage: a comparison between the rate of algae growth in the second and third models at the time of the conjunction of Saturn with the Sun.

3 Biomass test: The biological functions and the organism are measured outside by measuring the level of growth inside the food medium, by measuring the weight of the algae before and after the experiment.

Source: the researcher

Figure 15. The third box after its design and the start of the experiment

Source: the researcher

Figure 16. The third box after its design and the start of the experiment

Table 1. A comparison between the first and the third boxes to find outthe percentage of the increase in algae growth in the two boxes

The first Box in the first stage			**The third Box in the first stage**		
W*-W=0.0412 g/l	W*=25.8746 W=25.8334	**1 firstflask**	W*-W=0.0384 g/l	W*=26.3084 W=26.2700	**1 thirdflask**
W*-W=0.0400 g/l	W*=25.3207 W=25.2807	**2 firstflask**	W*-W=0.0397 g/l	W*=25.8431 W=25.8034	**2 thirdflask**
W*-W=0.0390 g/l	W*=25.4232 W=25.3848	**3 firstflask**	W*-W=0.0392 g/l	W*=24.6282 W=24.5890	**3 thirdflask**
g/l 25~0.0412 g/l 1000~X X= 0.0412*1000/25= 1.64=1.6		The equation of algae growth	g/l 25~ 0.0384 g/l 1000~Y Y=0.0384*1000/25= 1.536=1.5		The ratio of algae growth
The ratio of algae concentration in the feeding liquid is 1 gram per lit. 1.64-1=.64 g/l .64 * 100= 64 %		The increase ratio of algae growth in the first box	The ratio of algae concentration in the feeding liquid is 1 gram per lit. 1.5-1=.5 g/l .5 * 100= 50 %		The increase ratio of algae growth in the third box

Note: The abbreviations for the definitions are shown in Table 3

Source: by the researcher

Figure 17. The first box includes three flasks containing algae test samples and the box is directed to the north. The box contains two tubesdirected to Venus and Jupiter.

Source: by the researcher

Figure 18. The third flask contains three flasks; each containing an algae test sample and the box is directed to the north

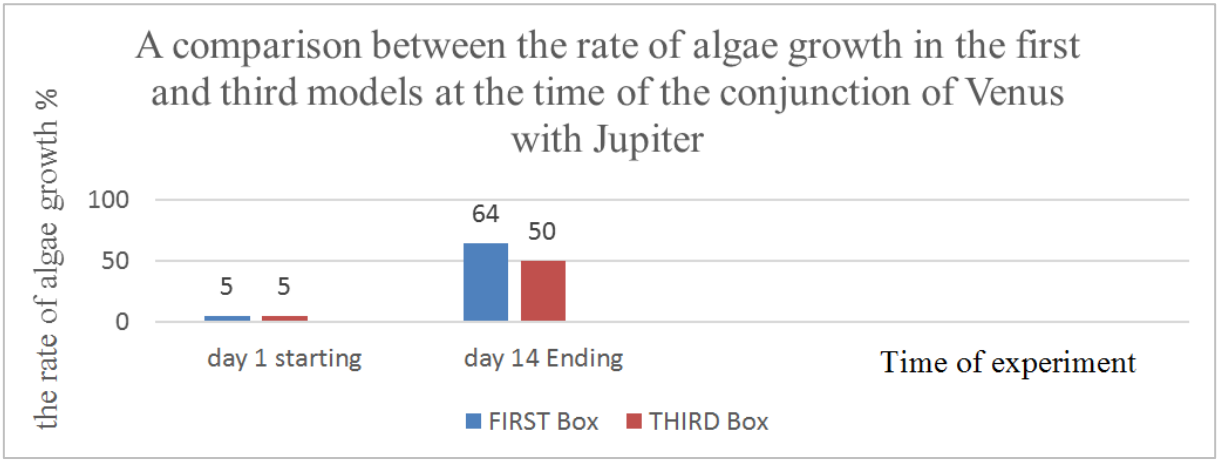


Table 2. A comparison between the second and third boxes to find out the percentage of the increase in algae growth in the two boxes

The second Box in the second stage			**The third Box in the second stage**		
W*-W=0.0685g/l	W*=25.3853 W=25.3168	**1 second flask**	W*-W=0.0561 g/l	W*=26.3711 W=26.3150	**1 thirdflask**
W*-W=0.0693 g/l	W*=26.0311 W=25.9618	**2 second flask**	W*-W=0.0578g/l	W*=25.9071 W=25.8493	**2 third flask**
W*-W=0.0710g/l	W*=25.7505 W=25.6795	**3 second flask**	W*-W=0.0567g/l	W*=24.6898 W=24.6331	**3 third flask**
g/l 25~0.0685 g/l 1000~X* X*= 0.0685*1000/25= 2.74=2.7		Theequation of algae growth	g/l 25~0.0561g/l 1000~ Y* Y* = 0.0561*1000/25= 2.44=2.4		The ratioof algaegrowth
The ratio of algae concentration in the feeding liquid is 1 gram per lit. 2.7-1=.1.7 g/l 1.7* 100= 170 %		The increase ratio of algae growth in the second box	The ratio of algae concentration in the feeding liquid is 1 gram per lit 2.4-1=1.4 g/l 1.4 * 100= 140 %		Theincrease ratio of algae growth inthe third box

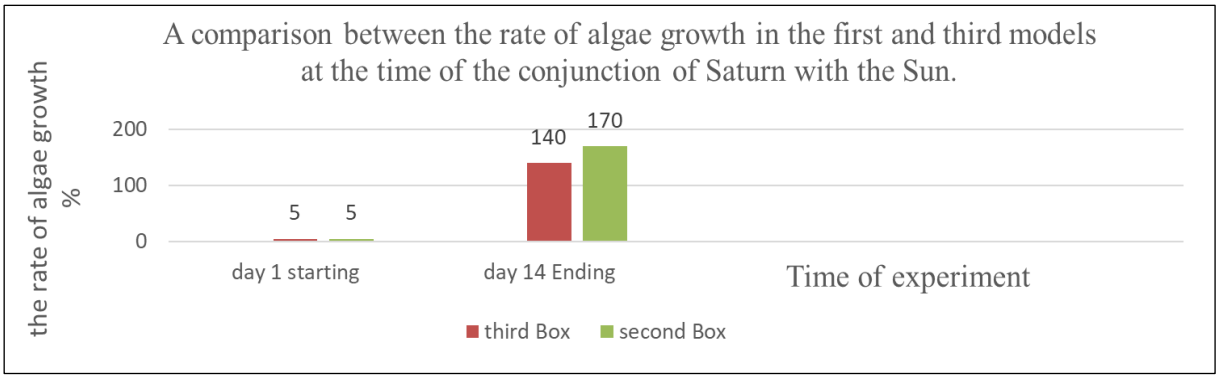
Note: The abbreviations for the definitions are shown in Table 3

Source: by the researcher

Figure 19. The second box with the three flasks containing algae and the two tubes oriented towards Saturn, towards the Sun

Source: by the researcher

Figure 20. The third box in the second experiment, with the three flasks inside containing algae, and the axis of the box is oriented towards the north



To find out whether there was an effect when guiding the second model of astronomy at the time of the conjunction of Saturn with the sun and the third model that is not oriented to astronomy, a comparison was held to find out the growth rate of Algae as indicated in the first experiment to know the growth rate in grams of the test sample as shown in Table 2.

After observing the three flasks in the two models for a period of 14 days, weight analysis was carried out, then averages were taken, and the levelof algae growth between the two models was compared.

It was noticed in the second stage that at the beginning of the first day, the Algae were ready to grow by 5%, and after the end of the experiment time, by 14 days, there was an increase in the growth rate in the second model by 170%, which was, the box oriented to the astronomy for the

conjunction of Saturn with the sun, but the third box was proportional to 140% which was not directed to astronomy.

6. Analysis and Discussion of the Results

1. The results indicated in the first stage of the experiment using the first and the third models, that the first model oriented to the conjunction between Jupiter and Venus, resulted in an increase in the rate of, Algae growth by 64% at the time of the conjunction, while the third model, that was not oriented to the astronomy, increased by 50%, which indicated a positive effect on Algae growth which occurred when orienting the first model of the astronomy at the time of the conjunction of Venus with Jupiter as indicated by the research study entitled “Planetary Influences on Human Behavior Effect’ which presents the influence of the planets on human behavior and performance and how to link the planets to the significance of human behavior, and that there are some planets that affect the increase in behavior in general, such as Jupiter and its influence on politicians and actors, Saturn on scientists, and the Moon on writers and artists [37]. Similarly, the research study entitled Update on the "Mars Effect" refers to the effect of the planet Mars on the performance of athletes, doctors and military leaders [38]. Likewise, the research study about "Growth and Development of Astronomy and Astrophysics in India and the Asia-Pacific Region". Within Proceedings of the 9th International Conference on Oriental Astronomy in 2018, it refers to the effect of astronomy on the design and planning of some monuments, from simple stones such as dolmens to temples, and how to link between guidance and astronomy [39]. This concludes that when architectural spaces are directed towards astronomy, an effect occurs that changes the health and performance of its users. This study also confirms the results achieved in the experiment of providing a positive climate suitable for the vital processes.
2. Correspondingly, after carrying out the second stage of the experiment at a completely different time from the first experiment, which was the time of the conjunction of the planet Saturn with the sun, it was found that there was an increase in the growth of Algae, but with the appearance of clusters and agglomerations of Algae, as shown in figure 21, in the second model by 170% over the third model which was not oriented to the astronomy, that naturally increased by 140%. This confirms the occurrence of an effect when directing to astronomy that led to a dense growth of Algae due to the orientation at the time of Saturn’s conjunction with the sun, as shown figure 22 as indicated by The Astrology Book [36], and In 2013 by the research study entitled "Kinetic model of Chlorella vulgaris growth with and without extremely low frequency-electromagnetic fields (EM- ELF)", whose results indicated that when Algae is exposed to electromagnetic fields and their sense of danger, and the inappropriateness of the vacuum, agglomerations occur and lead to the promotion of increased growth of Algae [28], which confirms the results achieved in the second phase.
3. The growth rate in the second stage is much greater than the first stage because the Algae need a period of adaptation [40] to the place of growth and the temperature of the place [41], which was provided in the second stage of the experiment, as the Algae interacted at a greater growth rate [42] where the beginning of the experiment was at the same beginning of the first stage at a concentration of 1 gram per liter, but the increase was greater.
4. The discussion of the experiment shows a number of obstacles which make it difficult to implement the experiment at the human level by constructing a building to test orientation in terms of astronomy on human health, due to the difficulty of implementing the tools of the experiment. It is possible to repeat the experiment in the future on more genetically evolved organisms such as mice, rabbits and monkeys to be close to the natural results of humans.

Figure 21. Algae growth increased in the form of agglomerations and clumps when orienting the second box to the conjunction of Saturn with the Sun

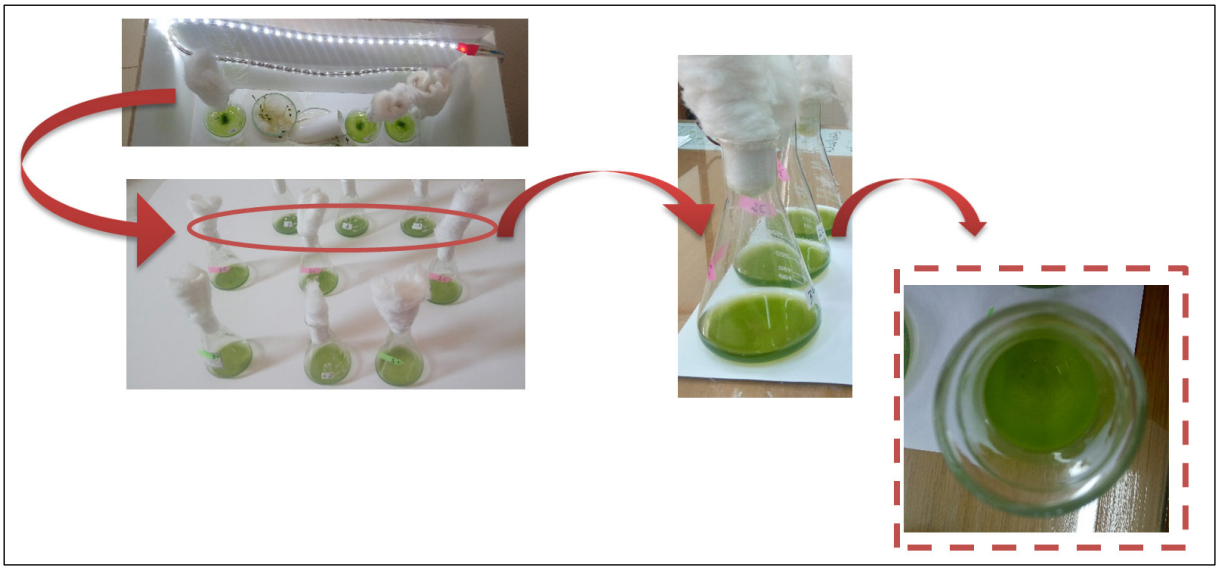


Figure 22. It shows the stages of algae growth in the third box at the beginning, during and at the end of the experiment

5. Also, the analysis and discussion of experience leads to the discussion of the idea of directing buildings and benefiting from the vibrational energies of astronomical structures, following the example of ancient civilizations.
6. The idea of directing the building (the stereoscopic model) towards astronomy and designing it with specific geometric dimensions was chosen due to the importance of orientation in all ancient civilizations towards the astronomical map of constellations and planets, as well as following the example of the ancient Egyptians in all temples, pyramids and buildings, which were very important at the time.
7. Two angles and two times were used for the same model, whether the first or the second model, to add two different types of influence. Prior astronomical measurements indicated that these times may be suitable for growth and increase and also suitable for building and construction. Thus, two different types of impact energy or vibrational frequency of the stellar structure inside the vacuum model have been retained to consider the desired properties of the vacuum and try to link them to construction time and astronomical orientation.
8. The aim of carrying out this experiment is to reach an answer to the research question: is there any importance of orienting buildings towards astronomy or not? And why? The results show that there is an importance of directing significant towards astronomy as it was significant in ancient civilizations and the absence of this importance in our present time, and that the choice of the time of constructing the building and directing the astronomer enhances the required purpose of the building and raises its efficiency.

Table 3. List of abbreviations for the definitions.

Abbreviation	Definition
W*	the weight of the crucible with algae after drying
W	the weight of the crucible with algae before drying
X	the rate of algae growth in The first Box in the first stage
Y	the rate of algae growth in The third Box in the first stage
X*	the rate of algae growth in The Second Box in the second stage
Y*	the rate of algae growth in the third box in the second stage
A	center of the box
B	azimuth angle for the first time
C	azimuth angle for the second time
Tp1	Time experiment 1
Tp2	Time experiment 2

7. Conclusion

The research aimed to study the effect of oriented spaces on astronomical parameters and the wellbeing of living organisms through careful experiments on microorganisms. The research could trace a positive influence of oriented spaces on such organisms. This is to highlight that such orientations of buildings could have a positive influence on users of such buildings and confirm the significant effect of orienting buildings towards astronomical parameters.

Acknowledgements

The authors would like to acknowledge Dr. Sayeda M.

Abdo, the researcher in the Hydrobiology Lab, Egypt, for providing us with the microalgae strain "Chlorella vulgaris", and Dr Ola El-Ardy, the Chemical Engineering and Pilot Plant Dept, National Research Centre, Dokki, Giza, Egypt for Assist and review everything related to the theoretical and practical part of doing an experiment on algae.

Availability of Data and Materials

The datasets generated and analyzed during the current study will be available in this area after approval.

Competing Interests

The authors declare that they have no competing interests.

Funding

The research received no specific grant from any funding agency in the public, commercial, or non-profit sectors.

Authors' Contributions

The corresponding author, N.M., wrote the paper, analysed, and performed both theoretical and analytical data as well as the empirical work in this research as part of the author's PhD thesis at the Architecture Department, Faculty of Engineering, Cairo University. H.H. supervised, guided, helped to interpret, and reviewed this paper as the main supervisor of N.M. PhD thesis. M.S. performed guidance and reviewed both theoretical and empirical work and shared the implementation of the experiment as part of being the second supervisor of my N.M. PhD. thesis. O.F. performed guidance and reviewed both theoretical and empirical work of astronomy and shared the implementation of the experiment. H.H. was a major contributor in revising the paper. The authors read and approved the final paper.

Ethics Approval and Consent to Participate

The authors declare that the manuscript is our original work. The ideas, views, innovations, and results presented in the above manuscript are totally ours unless otherwise referenced in the text. Works of others necessary for the development of ideas presented in this manuscript are clearly referenced within the text and accurately listed at its end. Also, the authors declare that they consent to publication.

REFERENCES

[1] Gaffney M, "The Astronomers of Nabta Playa," Rising magazine, no.56, pp.42-43&68-70, 2006. DOI: https://atlantisrising.com/product/issue-56-astronomers-of-nabta-playa/.

[2] Mythical Ireland,"ANCIENT SITES | NEWGRANGE – SÍD IN BROGA". https://mythicalireland.com/ancient-sites/newgrange-sid-in- broga/(accessed Jan. 1, 2021).

[3] Great Buildings, "Stonehenge," http://www.greatbuildings.com/buildings/Stonehenge.html (accessed June. 7, 2021).

[4] Feigert, Zimmerman (translated by Ayad AQ), "The Astronomical Encyclopedia," in The Egyptian General Book, Authority (Al- Osra Library), 2002, Cairo, p. 289.

[5] Rahmeh A, "Astronomy in Mesopotamia and its impact on modern astronomy in the light of cuneiform texts and archaeological evidence," Journal of Education College, Waist University, vol.2, Iss1.1238., 2020, PP.533-534, doi:10.31185/eduj.

[6] Campion N, "Astrology in Ancient Greek and Roman Culture." the Oxford Research Encyclopedias. https://doi.org/10.1093/acrefore/9780190647926.013.46 (accessed May. 23, 2019).

[7] Carter J, "Chinese astronomy: a guide to ancient stargazing in China" BBC Sky At Night Magazine. https://www.skyatnightmagazine.com/space-science/chinese-astronomy/(accessed May. 27, 2021).

[8] Al-Taie M, "Astronomy for the Ancient Chinese, "China Today Magazine, October 2002 issue (Arabic translation), Marwa A.E-M," The Zodiac in Gaeco-Roman Egypt", Ph.D.,thesis, unpublished, Alexandria, (2006), pp 66-100.

[9] Thurston H, "On The Orientation of Early Egyptian Pyramids, "The International Journal of Scientific History, Vol.13, No.1, 2003. DOI: https://www.abebooks.com/magazines-periodicals/Orientation-Early-Egyptian-Pyramids-Vast-Eclipse/30172756012/bd.

[10] Shaltout M., Antonio J., "On the Orientation of Ancient Egyptian Temples:Upper Egypt and lower Nubia, "Journal for the History Astronomy, vol. 36, no. 3, pp. 273-298, 2005, DOI:10.1177/002182860503600302.

[11] Hancock G., Bauval R., "The Message Of The Sphinx : A Quest for the Hidden Legacy of Mankind," Crown Publishing Group, 1996, pp. 141-151,

[12] El-Falaki M, "The age of Al-Ahram and the purpose of its construction, "the Modern Technical Press, 1971.

[13] Locker N, "The Dawn of Astronomy: A Study of Temple Worship and Mythology of the Ancient Egyptians", Dover Publications,1894, March 17, 2021 [eBook #64849].

[14] Thom A, "Megalithic sites in Britain", OUP Oxford, Britain, August 1, 1967, pp.166-177.

[15] Bauval R., Gilbert A., "The Orion Mystery: Unlocking the Secrets of the Pyramids," Crown Publishing Group, 1994, pp.150-200.

[16] Bauval R, "Secret Chamber: The Quest for the Hall of Records, "Arrow Books, 2000, pp. 50-140.

[17] Belmonte J, "On the orientation of the Old Kingdom pyramids, "Journal for the History of Astronomy, vol. 32, no. 26, pp. S1–S20, 2001, DOI: 10.1177/002182860103202601.

[18] Shaltout M., Belmonte J., "On the orientation of ancient Egyptian temples (1): upper Egypt and lower Nubia," Journal for the History of Astronomy, vol. 36, no. 3, pp. 273–298, 2005, DOI:10.1177/002182860503600302.

[19] Shaltout M., Belmonte J., "On the orientation of ancient Egyptian temples (2): new experiments at the oases of the Western Desert, "Journal for the History of Astronomy, vol. 37, no. 2, pp. 173–192, 2006, DOI: 10.1177/002182860603700203.

[20] Shaltout M., Belmonte J., Fekri, M, "On the orientation of ancient Egyptian temples (3): key points at lower Egypt and Siwa, parts I and II," Journal for the History of Astronomy, vol. 38, no. 2, pp. 141-160, 2007, DOI: 10.1177/002182860703800201.

[21] Belmonte J., Shaltout M., Fekri, M, "On the orientation of ancient Egyptian temples, (4): Epilogue in Serabit el Khadem and overview," Journal for the History of Astronomy, vol. 39, no. 135, pp. 181-211, 2008, DOI: 10.1177/002182860803900203.

[22] Belmonte J., Shaltout M., Fekri, M, "On the orientation of ancient Egyptian temples (5):Testing the theoty in Middle Egypt and sudan," Journal for the History of Astronomy, vol. 41, no. 1, pp. 1-65, 2010, DOI: 10.1177/002182861004100103.

[23] Shaltout M., Antonio J., "In Search of Cosmic Order: Selected Essays on Egyptian Archaeoastronomy," Supreme Council of Antiquities Press, pp. 285-300, 2009.

[24] Shaltout M, "Temples in Ancient Egypt and Archaeoastronomy," researchgate, 2014, DOI: 10.1007/978-94-007-3934-5_10162-1https://www.researchgate.net/publication/278812649_Temples_in_Ancient_Egypt_and_Archaeoastronomy, (accessed Jan. 1, 2022).

[25] Belmonte J., "Orientation of Egyptian Temples: An Overview, "Handbook of Archaeoastronomy and Ethnoastronomy, C.L.N. Ruggles, pp 1501-1518, 2015.

[26] Herrera1 B., Samper A., Seguí J, "Justification about the existence and location of Chartres' cathedral labyrinth based on astronomy and geometry," Cogent Arts & Humanities, Volume 6, 2019.

[27] Beruto D., Lagazzo A., Frumento D., Converti A, "Kinetic model of Chlorella vulgaris growth with and without extremely low frequency- electromagnetic fields (EM-ELF)," Journal of Biotechnology, vol. 169, no. 1, pp. 9–14, 2014. DOI:10.1016/j.jbiotec.2013.10.035.

[28] Islam R, "Measuring the Biological Effects of the Elements of Architectural-Engineering Space", Ph.D. thesis, unpublished, Cairo University, PP 66, 2014.

[29] Yadavalli R., Rao C., Reddy D., Sivasal K., Rao S, "Effect of different culture media on cell concentrations of Chlorella pyrenoidosa under photoautotrophic conditions," IJNES, Vol. 4, no. 3,2010, pp. 47-51.

[30] Yadavalli R., Roa R., Roa C.,"Lipid accumulation studies in Chlorella pyrenoidosa using customized photobioreactor – effect of nitrogen source, light, intensity and mode of operation," IJERA, vol. 2, pp. 2446- 2453, 2012.

[31] Yadavalli R., Roa R., Roa C., "Response surface methodology approach to optimize process parameters for the biomass production of Chlorella pyrenoidosa," IJBTR, vol.3, pp. 37-48, 2013.

[32] Philip's E., Eugene H., Moore p, "Astronomy Encyclopedia-Philip's, "Philip's, London, pp. 92, 2002.

[33] Lewis J., "The Astrology Book," Visible Ink Press, p 169, 2003.

[34] Barbieri C., Bertini I, "Fundamentals of Astronomy", CRC Press, 2021 pp. 12.

[35] Lewis J.,"The Astrology Book, "Visible Ink Press, 2003, pp. 164.

[36] Muller A, "Planetary Influences on Human Behavior "Gauquelin Effect": Too Absurd for a Scientific Explanation?," Journal of Scientific exploration, vol. 4, no. 1, pp. 85-104, 1990.

[37] Ertel S, "Update on the "Mars Effect," Suitbert Ertel, 1992. https://www.researchgate.net/publication/242150722 (Accessed May.5, 2022).

[38] Orchiston W., Sule A., Vahia M, "The Growth and Development of Astronomy and Astrophysics in India and the Asia-Pacific Region," Proceedings of the 9th International Conference on Oriental Astronomy, Mumbai, Tata Institute of Fundamental Research, pp. 241–258, 2019.

[39] Raquel G., Balboa C., Molina M., Rodas V, "Adaptation of microalgae to lindane: A new approach for bioremediation," Aquatic Toxicology, vol. 109, PP. 25-32, 2012, (https://doi.org/10.1016/j.aquatox.2011.11.015) (Accessed April 7, 2022).

[40] Ras M., Steyer J., Bernard, "Temperature effect on microalgae: A crucial factor for outdoor production," Environmental Science and Bio/Technology, vol. 12, PP. 153–164, 2013. DOI:10.1007/s11157-013-9310-6.

[41] El-Kassas H, "Growth and fatty acid profile of the marine microalga Picochlorum Sp. grown under nutrient stress conditions," Egyptian Journal of Aquatic Research, vol. 40, PP. 233–239, 2014.