MICHAEL BRANDS INC.
in collaboration with
NIGERIA SOCIETY OF BIOCHEMISTRY STUDENTS

Presents
2017 NATIONAL ESSAY COMPETITION

THEME:
BIOCHEMISTRY:
THE CHEMISTRY OF LIFE

IMPORTANT DATES:
REGISTRATION COMMENCES FROM 26TH JULY - 6TH AUGUST 2017
SUBMISSION OF ESSAYS COMMENCES FROM 14TH AUGUST - 28TH AUGUST 2017

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Competition is an essential element in our ever-evolving society. It brings important benefits such as encouraging enterprise, innovation, efficiency, and a widening of choice. The 1st National Science Essay competition for Biochemistry students seeks to:

a. create a platform for biochemistry students across the country to showcase their scientific prowess as students.
b. engage their intellect with what has been taught in their various tertiary institutions
c. promote interest in and to encourage the study of biochemistry in Nigeria
d. create a veritable forum for intellectual development and provoke discussion and healthy debates amongst participating students
e. unite biochemistry students from diverse cultures and create harmony amongst them.

SUB THEMES:
1. Utilizing Biochemistry in helpless economic situations
2. Biochemistry: a major role player in Health sciences and industrial revolution
4. Role of a Biochemist in sustainable national development
5. Biochemistry: Unraveling the mystery of science
6. Enzymatic and metabolic reactions are the basis of our biochemical being.

PRIZES:
- Top 50 Essays will be published in the maiden edition of "Le'Biocheimiste", biochemistry students' scientific journal.

WINNER: Cash Prize of N100,000 FIRST RUNNER UP: Cash Prize of N60,000 + Lehninger Principle of Biochemistry Textbook SECOND RUNNER UP: Cash Prize of N30,000 + Lehninger Principle of Biochemistry Textbook.

For enquiries, partnership/collaboration
Please visit or contact:
nsbsnational17@gmail.com
Charley: 08147928531
Kenneth: 08085913291

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Biochemistry, sometimes called biological chemistry, is the study of chemical processes within and related to living organisms. Biochemistry can simply be described as the chemistry of life. By controlling information flow through biochemical signalling and the flow of chemical energy through metabolism, biochemical processes give rise to the complexity of life. According to Cornelius Bernardus Van Niel (1897-1985), a U. S. Microbiologist, science is a perpetual search for an intelligent and integrated comprehension of the world we live in. Over the years, Biochemistry has become so successful at explaining certain systematic and complexity in several areas of science. Here, the main focus is how biochemistry helps to unravel certain difficult manifestations of science that ordinarily cannot just be understood. Below are diverse areas of science where biochemistry explains certain systematic dynamics in understanding the entirety of an organism.

In Medicine, biochemistry has been efficient in explaining certain illnesses, injury, and surgical operation thereby providing diagnostic platform for medicine. With the understanding of biochemistry, sickle cell anaemia was discovered as a hereditary disease in humans. The life threatening situations in patients of sickle cell anaemia is as a result of the altered properties of haemoglobin S from a single amino acid substitution of a valine for glutamic acid. The hydrophobic nature of valine leads to a life threatening situation encountered by sickle cell anaemic patients. Thus, demonstrating the importance for the study of amino acids. Many still marvel about how surgeons operate on a patient while breathing. Before any surgical operation takes place, the patient is placed under anaesthesia. Biochemistry tend to unravel the beauty of how certain biochemical metabolism occurs when anaesthetic drugs (like Ketamine and Diazepam) are infused in the patient causing unconsciousness or unresponsiveness of nervous system for a short term. Malaria is not about the presence of the parasite, Plasmodium spp, but the
biochemical expression of the parasite. Excess, insufficient and lack of biochemical metabolites can lead to several medical conditions. Hence, the need for homeostasis via feedback inhibitions and anaplerotic reactions. Doctors prescribe drugs based on the biochemical examination of the blood constituent, urine, faeces, and other blood fluids of the patient. Currently, much of medical practice is based on "standards of care" that are determined by averaging responses across large cohorts. However, recent studies in medicine reveal how the knowledge and application of biochemistry can enhance treatment of individuals by a medical procedure called Individualized Medicine otherwise known as Personalized medicine or Genomic medicine. This is a practice that involves the use of information from a patient's genome and proteome to optimize his or her medical care. In other words, it is the using of information encoded in an individual’s DNA to match a treatment options with patient in a very precise way. Personalized medicine is the ultimate goal in the medicinal stairway because it is the most specific and accurate technique to a patient’s care.

Figure 1: Steps involved in individualized medicine

Psychology is a science of behaviour and mind, embracing all aspects of conscious and unconscious experience as well as thought. Biochemistry is so much essential in psychology that a typical psychologist cannot do without. The application of biochemistry in psychology is the Neuropsychology. For instance, biochemistry helps to unleash the mechanism of the human
nervous system via neurotransmitters (like acetylcholine, serotonin, GABA – Gamma Aminobutyric Acid, and dopamine), Na⁺/K⁺ ions that flow in and out of the spinal cord, hormonal regulation, and also principles of inheritance via the nucleic acid in the genes.

**Agriculture**: The existence of plantation or crops will only be a thing of imagination without the biochemical metabolites. The survival of the livestock primarily depends on the crops. Therefore, plants need to utilize certain organic and inorganic substances in the soil, water and atmosphere with the aid of certain biochemical substances that make up their systems. For instance, there will be no harvest of crops or fruits without photosynthesis or chemosynthesis. In Agriculture, biochemistry explains how herbicides kill or control weeds. Herbicides are toxic chemical substances used to destroy unwanted vegetations. These herbicides inhibit a certain biochemical process, most probably an enzyme that is very essential to the survival of the plant. For instance, glyphosate \([\text{N-(phosphonomethyl)glycine}]\) is implicated in the biochemical alteration of various processes in plants and microorganisms, however, its inhibition of aromatic amino acid biosynthesis is the only well established primary mode of action of this herbicide. The enzyme 5-enolpyruvylshikimate-3-phosphate synthase is inhibited by physiological concentrations of glyphosate in the shikimate pathway and is the most sensitive site of action of glyphosate in reducing aromatic amino acid levels. Aromatic amino acid depletion reduces or stops protein synthesis, causing cessation of growth and eventually cellular disruption and death.

![Figure 2: Shikimate pathway](image)

Also, Farmers want to create high profit from their farm and one of the major ways of gaining such is through high yield of crops. Fertilizer is chemical substances which supplies chemical elements needed for the growth of the crops. They are organic, inorganic, chemical nitrogenous, phosphate and potassium fertilizers.
Plants are green because of the presence of chlorophyll. However, the actual reason is because the chlorophyll absorbs mostly in the blue and to a lesser extent red portions of the electromagnetic spectrum, hence its intense green colour.

![Chemical structure of Chlorophyll A and Chlorophyll B](image)

Figure 3: Chemical structures of Chlorophyll A and Chlorophyll B

**Astronomy and Cosmology:** Crews in space are usually affected by the kind of diet consumed causing loss of vision, bone loss, muscle loss and renal stone formation. Vitamin D levels decline during flight, most likely related to the lack of ultraviolet light exposure. This is very important for bone and calcium metabolism, as well as other body systems. Folate, another vitamin, also declines during flight. This may be related to the content of the food, its stability related to both storage time and radiation exposure, or changes in the body's need for folate. Astronauts undergo certain biochemical profile test before, during, and after spaceflights. Samples of their blood and urine are obtained before, during and after spaceflight to check for specific proteins, chemical substances and biochemical changes which serve as biomarkers. At their tests, comparison is done
between samples from space and samples from humans on earth to better understand diet metabolism.

**Biotechnology:** This is the harnessing of living organism at cellular or biomolecular level to develop or manufacture product that help improve lives towards a better living. Biochemistry is one of the solid pillars of biotechnology because it is the engineering of life, the configuration of creation. GMO (Genetically Modified Organism) is one of the governing factors of biotechnology. Crops, animals, and microbes are bioengineered to function as required of them to stand as alternative to some non-renewable resources like most fossil fuels. A group of researchers from the department of Chemical engineering in the University of Texas has been able to genetically modify yeast, *Yarrowia lipolytica*, to become a new source of renewable energy (biodiesel) by producing oil and fats. A starting yeast strain of *Yarrowia lipolytica*, which has around 15 percent lipid content, has been engineered to contain 90 percent lipid content. This causes the yeast to function as a factory for oil, directly removing and over expressing specific genes that influence lipid production.

![A microscopic view of *Yarrowia lipolytica*. (A) Non engineered Yeast cell having 15% lipid content, and (B) Engineered yeast cell having 90% lipid content.](image-url)

Figure 4: A microscopic view of *Yarrowia lipolytica*. (A) Non engineered Yeast cell having 15% lipid content, and (B) Engineered yeast cell having 90% lipid content.

Also, several crops have been bioengineered, mostly in the United States, to function as they are required to. Some have been configured to have high yield, to produce bigger-sized fruits, to producing substances like ethylene for the production of plastics, to produce more seeds, to have a
different colour and so on. All these are based on the alteration of the amino acid in gene strains thereby creating a new pathway.

In conclusion, there are several undisclosed facts about the importance of biochemistry in explaining and understanding the existence of life and its environment. Hence, biochemistry has proven to be the centre of science as it unites every other aspect of sciences. It spans from diseases to the food we eat, drugs, cleaning our environment, saving time and improving the existence of the human race.