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Editorial Disclaimer:

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Ghana Science Association

Introduction

The Ghana Science Association (GSA), a voluntary, non-profit making and multidisciplinary organisation of scientists, technologists and mathematicians was formed in 1959. The Association traces its origin to the West African Science Association (WASA) which was formed in 1953 at the University College of the Gold Coast. WASA was formed to provide West African scientists the forum to advocate the importance of Science and Technology as a necessity and bedrock for national development. The formation of GSA broadened the scope of activities from reading of scientific papers to involvement in national and international affairs. The Association was placed on government subvention under the Ministry of Education as far back as 1961 by a Presidential Fiat. Hence the Association is supported through a budgetary allocation from the Ghana Government. Other sources of income include membership dues and proceeds from workshops and conferences. The GSA was mandated to promote, popularize and demystify science and create a scientific culture in the country. The Association has made tremendous contributions to National Development, Health and Economic Growth through scientific interventions. The Secretariat is a point where scientific and technological information and research findings are obtained by individuals and corporate bodies.

Membership of the Association is drawn from the Universities, Research Institutes, Industry, Government and Persons interested in the promotion of Science and Technology.

Vision and Mission

Vision

To become a dominant voice in Science and Technology advocacy by promoting and popularizing Science and Technology to meet national developmental needs.

Mission

Advancing Science, Technology, Engineering and Mathematics (STEM) through interaction and cross-fertilization of ideas of all interested people to: -

1. Popularize, promote and disseminate scientific information and technology transfer for national development.
2. Contribute to the development of National Science and Technology policy.
3. Collaborate with industry to set national research agenda.
4. Establish linkages with industry to promote the transfer and application of Science.
5. Seek affiliation and foster cooperative links with other national and international organizations.

Activities

1. Organization and participation in scientific conferences, workshops, seminars, symposia, public lectures, quizzes and science fairs.
2. Promotion of carrier development of scientists in Universities and Research Institutes in Ghana and elsewhere.
3. Publication of the scientific journal, magazines and books (e.g. Journal of the Ghana Science Association and Everyday Science for Schools magazine).
4. Training programmes for mathematics and science teachers to improve the teaching and learning of these subjects in Schools and Colleges of Education.

Contribution to National Development

Issues of national importance have been regularly and consistently highlighted at biennial workshops, conferences etc. Communiqués had been submitted to Government and other stakeholders on very topical themes to help shape national policies.

THE ARTICLES

EXPLORING THE FASCINATING WORLD: ECHINODERMS AND CNIDARIANS - A COMPREHENSIVE LOOK INTO THEIR DESCRIPTION AND BIOLOGY

Dr. Lailah Gifty Akita[1], Alhassan Michael[2] and Sawyerr Nicholas[3]

Institution: *[1]Lecturer-University of Ghana, [2]Student-University of Ghana, [3]Teaching Assist. - University of Ghana*

Email: *lgakita@ug.edu.gh*

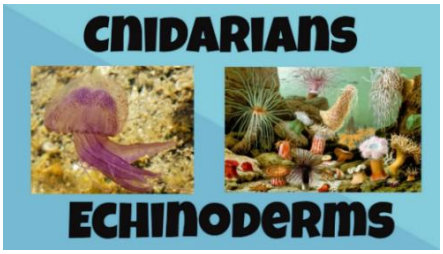
How Deep-Sea Coral Reefs Protect Marine Biodiversity
www.livekindly.com/scientists-discover-hundreds-deep-ocean-coral-reefs/

Abstract

This comprehensive and detailed explanation focuses on the description and biology of echinoderms and cnidarians, two diverse phyla within the animal kingdom. Echinoderms are characterized by their spiny skin and radial symmetry, whereas cnidarians possess specialized stinging cells called cnidocytes. The description of echinoderms includes their body
structure, such as the presence of a water vascular system and tube feet, as well as their various classes, including sea stars, sea urchins, and sea cucumbers. In contrast, cnidarians encompass jellyfish, corals, and sea anemones, each with distinct morphological features. The biology of these phyla involves their unique reproductive strategies, feeding mechanisms, locomotion abilities, and ecological roles within marine ecosystems. Understanding the description and biology of echinoderms and cnidarians will contribute to our knowledge of marine biodiversity and provide insights into their evolutionary adaptations.

The Enigmatic Inhabitants of the Ocean: Exploring Echinoderms and Cnidarians

The vast tapestry of life woven across our planet unveils wonders in every corner, even at depths in the oceans. Among many marine marvels, echinoderms and cnidarians are the two captivating groups. Though seemingly disparate, these invertebrates share a stage within the aquatic realm, each playing a critical role in the ecosystem's delicate balance. This article delves into the fascinating world of these creatures, unveiling their unique characteristics, ecological significance, and the challenges they face in ever-changing oceans.



https://i.ytimg.com/vi/VgQyAAeR39Y/maxresdefault.jpg

Introduction to Invertebrates

Life thrives in numerous forms beyond familiar vertebrates. The invertebrate kingdom encompasses an expansive realm of animals that lack a vertebral column. From the glistening wings of butterflies to the intricate webs of spiders, invertebrates display an astonishing diversity in body plans, adaptations, and ecological niches.

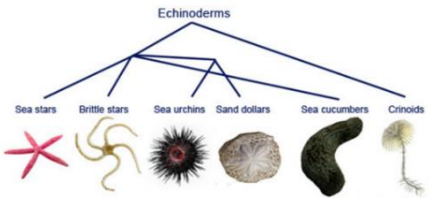
Within this diverse kingdom, echinoderms and cnidarians stand out as captivating examples of the ingenuity of evolution.

Overview of Echinoderms and Cnidarians

Echinoderms, meaning "spiny-skinned," encompass a group of marine invertebrates boasting an unmistakable five-ray radial symmetry. From spiky sea urchins to graceful sea stars, these creatures capture our imagination and curiosity. Unlike echinoderms, cnidarians, often known as jellyfish or anemones, exhibit bilateral symmetry in their polyp forms. However, their medusa stage exhibited mesmerizing radial symmetry, with tentacles trailing around a mesmerizing bell.

Echinoderms: List of Beautiful Echinoderms with Facts .7ESL

Both groups thrive in marine environments, occupy diverse niches, and contribute significantly to the health and balance of the oceans.



Echinoderms (mesa.edu.au)

Characteristics of Echinoderms

Echinoderms can be distinguished using a combination of unique features. Their most recognizable trait is their pentameral radial symmetry, in which their body parts are arranged in multiples of five around a central axis. This symmetry, prominent in their iconic star-shaped bodies, is lost only during their larval stage. Beyond their striking appearance, echinoderms possess a calcareous exoskeleton composed of interlocking plates. These plates, often adorned with spines or tubercles, offer protection and support, allowing echinoderms to navigate the harsh ocean floor. Another defining characteristic is their water vascular system, a network of canals and tube feet powered by hydraulic pressure. These tube feet serve multiple purposes, from locomotion and feeding to respiration and sensory perception.

Types of Echinoderms

The echinoderm phylum encompasses a diverse array of organisms, each showing remarkable adaptations to specific ecological niches. The Asteroidea class, which includes sea stars, is a master of scavenging and predation, with flexible arms and potent digestive enzymes. Echinoidea, represented by sea urchins, utilize their sturdy spines for defence and graze on algae and kelp with specialized scraping mouthparts. Holothuroidea, also known as sea cucumbers, is a gentle seafloor giant sifting through sediments for organic matter with sticky tentacles. Each class within the phylum Echinoderm showed remarkable adaptability and versatility in this captivating group.

Description of the Different Echinoderm Species

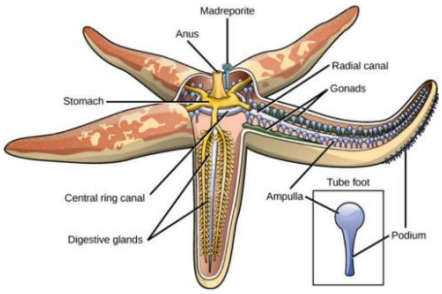
Each class of echinoderms is a treasure trove of a unique species. The vibrant crimson starfish, Pentaceropsis recurvata, with its delicate arms, contrasts with the colossal Sunflower Star, whose sprawling form can reach a diameter of over 3 m. Sea urchins exhibit equally diverse appearances, from the spiky Diadema setosum to the heart-shaped Clypeaster humilis. The bizarre-looking sea cucumber, Holothuria papillata, with its pulsating body and wart-like papillae, further highlights the astonishing variety within this phylum.

Radial Symmetry in Echinoderms

The five-rayed radial symmetry of echinoderms is not merely an aesthetic quirk but a crucial adaptation for their lifestyle. This arrangement not only provides efficient movement across the seafloor but also allows them to sense and respond to stimuli from any direction. This is particularly advantageous for sessile species like sea urchins, where food can come from any direction, and predators can approach from any angle. Additionally, radial symmetry facilitates regeneration, allowing echinoderms to regrow lost limbs with remarkable efficiency.

Exoskeleton Composition in Echinoderms - Calcium Carbonate and Calcite

The formidable armour of echinoderms is composed primarily of calcium carbonate, a mineral secreted by specialized cells. This calcium carbonate takes the form of calcite, a specific crystal arrangement that provides exceptional strength and rigidity. The exoskeleton not only protects against predators but also serves as a platform for anchoring muscles and spines. The porous nature of the exoskeleton also facilitates gas exchange and sensory perception, playing a critical role in the various functions of these magnificent creatures.



Echinoderm - Definition, Characteristics & Examples | Biology Dictionary

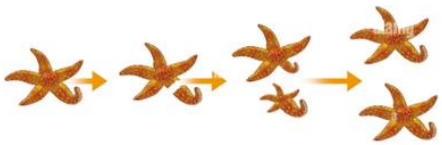
Unique Features of Echinoderms - Tube Feet and Sessile Lifestyle

Beyond their imposing exoskeletons, echinoderms wield another remarkable tool: the tube feet. These tiny, tube-like appendages powered by a hydraulic system are multi-talented marvels. They propel echinoderms across the seabed, assist in capturing prey with sticky secretions, and even facilitate respiration by drawing water into and out of the body. Some echinoderms, like sea stars, employ their tube feet to climb rocks or pry open bivalves, showcasing the versatility of these adaptable appendages.

While some echinoderms, like sea stars, embrace a mobile lifestyle, others choose a more sedate approach. Sessile species like sea urchins and some sea cucumbers anchor themselves to the substrate, relying on their tube feet and spines for defence and their specialized mouthparts for feeding. Sea cucumbers, for example, utilize their sticky tentacles to filter small food particles from the surrounding water, ensuring a steady supply of nourishment while remaining firmly attached to their chosen spot.

Reproduction and Life Cycle of Echinoderms - Fragmentation and Metamorphosis

Echinoderms exhibit diverse reproductive strategies to ensure the continuation of their lineages. Many species reproduce sexually by releasing sperm and eggs into the water column. Fertilization occurs externally, and the resulting larvae undergo a complex metamorphosis, often transitioning from bilateral symmetry to the iconic pentameral form. Additionally, some echinoderms possess the remarkable ability of fragmentation, whereby a severed body part can regenerate into a complete individual. This asexual reproduction method enables certain species to quickly increase their populations and establish themselves in new habitats.



https://c8.alamy.com/compfr/p80b56/la-reproduction-par-la-regeneration-et-la-fragmentation-p80b56.jpg

Introduction to Cnidarians

Sharing the marine realm with echinoderms are the cnidarians, an ancient phylum renowned for their stinging beauty.

https://i.pinimg.com/474x/b2/3f/79/b23f79976cee4152d49aea8e11f2b135.jpg

Jellyfish, with their mesmerizing pulsating bells and trailing tentacles, are perhaps the most familiar representatives of this group. Yet, cnidarians encompass a far greater diversity, including the graceful anemones, the colonial hydroids, and the enigmatic Portuguese Man o' War. Unlike echinoderms, cnidarians exhibit both bilateral symmetry in their polyp form and radial symmetry in their medusa stage, further adding to their captivating complexity.

Description of Cnidarian Species

The visual brilliance of cnidarians rivals the vast tapestry of coral reefs they often call home. The translucent Moon Jellyfish, Aurelia aurita, drifts gracefully through the currents, its pulsating bell shimmering with an ethereal glow.

physalia physalis - Google Search | Caravela portuguesa, Criaturas marinhas, Caravela (pinterest.com)

Anemones, like the vibrant Carpet Anemone, Stichodactyla gigantea, adorn rocky outcrops with their colourful tentacles, providing a haven for clownfish and other symbiotic creatures. With its gas-filled sail and venomous tentacles trailing below, the Portuguese Man of War embodies the duality of beauty and danger often associated with cnidarians.

Nematocysts in Cnidarians - Their Role in Capturing Prey

One of the defining features of cnidarians is their arsenal of nematocysts, microscopic capsules packed with stinging barbs. These harpoons, triggered by touch or chemicals, inject toxins that can paralyze or even kill prey. Tentacles armed with nematocysts serve as

cnidarians' primary hunting tool, ensuring a steady supply of zooplankton and small fish. The potency of these stinging cells varies greatly, with some jellyfish capable of causing painful stings to humans, while others pose little threat.

Polyps and Medusae - The Two Body Forms of Cnidarians

Cnidarians display a remarkable biphasic life cycle, alternating between two distinct body forms: polyps and medusae. Polyps are sessile creatures rooted or attached to the substrate, often resembling anemones or hydroids. They utilize tentacles equipped with nematocysts to capture prey and reproduce asexually through budding, forming clonal colonies. In contrast, medusae represent the free-swimming stage, using pulsating bells and trailing tentacles to propel themselves through the water column. Medusae reproduce sexually by releasing gametes into the water to support the next generation of polyps. This intricate life cycle adds another layer of fascination to the already captivating world of cnidarians.

Tentacles and Their Function in Cnidarians

Beyond their role in capturing prey, cnidarian tentacles serve a multitude of functions. They provide locomotion for free-swimming medusae, with rhythmic contractions propelling them through the water. Tentacles also act as sensory organs, equipped with specialized cells that detect chemicals, light, and water currents. Additionally, the tentacles facilitate gas exchange and waste removal, playing a crucial role in the overall physiology of these remarkable creatures.

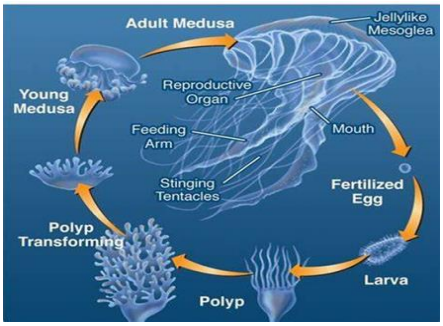
Pulsating Movement or Locomotion and Sessile in Cnidarians

The mesmerizing pulsations of jellyfish and anemones are not simply graceful displays but rather efficient mechanisms for locomotion. Cnidarians possess a network of muscles surrounding their gastrovascular cavity. By rhythmically contracting and relaxing these muscles, they create a jet propulsion effect, pushing water out and propelling themselves forward. In medusae, this pulsating movement provides thrust, allowing them to drift through the currents or actively navigate the waters. Polyps, though primarily sessile, can utilize pulsations to sway their bodies, enhancing their reach for prey or facilitating the flow of water for respiration. This pulsating movement, while seemingly slow and deliberate, allows cnidarians to navigate their world with surprising agility and efficiency.

Anthoni, J. F. (2007). Poor Knights Marine Reserve: Common cliff dwellers. Retrieved from http://www.seafriends.org.nz/issues/res/pk/cliff_dwellers.htm

Reproduction in Cnidarians - Hermaphroditism and Budding

Cnidarians exhibit diverse reproductive strategies that ensure the continuation of their lineage. Many species are hermaphroditic, meaning they possess both male and female reproductive organs. During spawning season, these cnidarians release sperm and eggs into the water column, where fertilization occurs externally. The resulting larvae undergo complex metamorphosis, transitioning from planktonic forms to either polyps or medusae, depending on the species. Additionally, asexual reproduction through budding is prevalent in cnidarians. Polyps can bud new individuals, creating clonal colonies that expand rapidly and colonize new habitats. This versatility in reproduction allows cnidarians to adapt to changing environmental conditions and ensures the persistence of their diverse forms across the oceans.



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General Characteristics of Cnidarians

Beyond their mesmerizing beauty and stinging arsenal, cnidarians share several key characteristics. Like echinoderms, they are diploid organisms, meaning their cells possess two sets of chromosomes. Their bodies are composed of two distinct cell layers: the ectoderm on the outer surface and the endoderm lining the gastrovascular cavity. Between these layers lies a noncellular layer called the mesoglea, which can be thick and gelatinous in some species. Additionally, cnidarians lack circulatory and respiratory systems, relying on diffusion and their gastrovascular cavity for transport and gas exchange, respectively. These shared characteristics, along with their unique life cycle and stinging prowess, make cnidarians a

fascinating and ecologically significant group within the marine realm.

Comparison of Echinoderms and Cnidarians

Though both are classified as invertebrates, echinoderms and cnidarians exhibit distinct differences and similarities. Their most visible distinction lies in their symmetry. Echinoderms primarily display pentameral radial symmetry, while cnidarians exhibit both bilateral symmetry in their polyp form and radial symmetry in their medusa stage. Their exoskeletons also differ, with echinoderms sporting calcitic armour, whereas cnidarians lack a rigid external structure. Both groups utilize stinging cells for capturing prey, though the nematocysts of cnidarians are significantly more potent and diverse. Their reproductive strategies diverge, with echinoderms employ both sexual and asexual methods, whereas cnidarians predominantly utilize sexual reproduction with supplemental budding in some species. Despite these differences, both echinoderms and cnidarians play crucial roles in maintaining the health and balance of marine ecosystems, contributing to the vibrant tapestry of life beneath waves.

Ecological and Biological Role of Echinoderms and Cnidarians in the Marine Ecosystem

Echinoderms and cnidarians occupy diverse ecological niches, contributing to an intricate web of life within the marine realm. Echinoderms serve as efficient scavengers and predators, control populations of smaller invertebrates, and maintain balance within the food chain. Some species, such as sea cucumbers, act as detritivores, break down organic matter, and facilitate nutrient cycling on the seafloor. Their unique tube feet contribute to sediment aeration and bioturbation, thereby further enhancing the health of the benthic environment. Cnidarians play a key role in plankton grazing, controlling zooplankton populations, and contributing to the flow of energy through the marine food web. Their stinging tentacles not only provide them with sustenance but also deter predation, offering protection to themselves and other symbiotic creatures. Additionally, some cnidarians, such as anemones, provide a haven for fish and invertebrates, foster biodiversity, and enhance the richness of coral reef ecosystems.

National Marine Sanctuary Foundation

Threats Faced by These Organisms

Both echinoderms and cnidarians face a growing array of threats in the ever-changing oceans. Climate change, which causes ocean acidification and warming, disrupts their physiology and alters their food webs, negatively affecting their populations. Pollution stemming from agricultural runoff and plastic debris poses a serious threat. Cnidarians, for example, can mistake microplastics for prey, leading to internal blockage and starvation. Overfishing and habitat destruction further exacerbate these challenges, reducing food availability and disrupting breeding grounds. Additionally, some echinoderm species are targeted for commercial use, with sea urchins harvested for their roe and some starfish collected for curio trade. These unsustainable practices can lead to population decline and ecosystem imbalances.

https://www.newscientist.com/article/2256873-how-climate-change-impacts-the-great-barrier-reef-tourism-industry/

Conservation Efforts are Crucial to Safeguard Echinoderms and Cnidarians

Protecting echinoderms and cnidarians is essential for maintaining the balance of ecosystems and ensuring their long-term existence. These marine animals are vulnerable to threats from human activities and environmental changes.

Conservation of Habitats: Protecting the habitats where echinoderms and cnidarians live is crucial for their survival. This includes restoring and preserving coral reefs, seagrass beds, rocky shores, and other marine environments where these organisms thrive. Implementing marine protected areas (MPAs) can help safeguard these habitats.

Sustainable Fishing Practices: Overfishing can have detrimental effects on echinoderm and cnidarian populations. Implementing sustainable fishing practices, such as regulating fishing quotas, using selective fishing gear, and avoiding destructive fishing methods like bottom trawling, can help prevent the overexploitation of these organisms.

Pollution Control: Pollution poses a significant threat to echinoderms and cnidarians. Reducing pollution from land-based sources, such as agricultural runoff, industrial waste, and sewage discharge, can minimize the negative impacts on these organisms. Implementing stricter regulations on waste disposal and promoting the use of environmentally friendly practices can contribute to reducing pollution in marine environments.

Climate Change Mitigation: Echinoderms and cnidarians are vulnerable to the effects of climate change, including rising sea temperatures, ocean acidification, and extreme weather events. Taking measures to mitigate climate change, such as reducing greenhouse gas emissions and transitioning to renewable energy sources, can help minimize these impacts on marine ecosystems.

Education and Awareness: Educating the public, policymakers, and stakeholders about the ecological roles of these organisms and the threats they face can lead to increased support for conservation efforts. Promoting responsible tourism and encouraging sustainable practices among recreational divers and snorkelers can also contribute to protecting these marine organisms.

https://www.fisheries.noaa.gov/national/habitat-conservation/restoring-coral-reefs

Conclusion

From the spiky sentinels of the seafloor to the pulsating dancers of the open water, echinoderms and cnidarians weave an intricate tapestry of life within the vast oceans. These captivating creatures, despite their seemingly disparate forms, share a vital role in maintaining the health and balance of the marine ecosystem. As we face mounting challenges in our changing oceans, it becomes ever more important to understand, appreciate, and protect these enigmatic underwater marvels. Through concerted efforts towards conservation, research, and responsible stewardship, we can ensure that these fascinating creatures continue to grace the depths with their beauty and ecological significance for generations to come.

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GENDER IDENTITIES AND NORMS IN SHAPING HUMAN BEHAVIOR THROUGH SOCIALIZATION

Francess Dufie Azumah (PhD)
Institution: *Kwame Nkrumah University of Science and Technology (KNUST), Kumasi.*
Email: *fdazumah.cass.@knust.edu.gh or fazumah@hotmail.com*

Some Feminine and Masculine Characteristics

Masculine	feminine
Act as a leader	
Aggressive	Affectionate/ caring
Ambitious	Cheerful
Analytical	Childlike
Assertive	Compassionate
Athletic	Does not use harsh language
Competitive	Eager to sooth feelings
Defend own beliefs	Flatters
Domineering / bossy /autocratic	Submissive/ humble/ willingness to take orders
Forceful/ daring	Gentle
Independent / individualistic/ self reliant	dependent
brave	Shy/ fearful

Introduction

The word or concept 'gender' has gained much global and national attention over the last four decades, especially in relation to the word 'equality' that is 'Gender Equality'. International bodies and governments have and continue to make intentional efforts towards attaining gender equality as emphasized in the Sustainable Development Goals, SDG Goal 4. This is because of the effects it has not only on the personal development of individuals but also on the family, society, and nation as a whole. Gender equality promotes growth and sustainable development; however, gender inequality hinders or slows down growth and development as a result of inequality. On the individual's side, it affects their potential, opportunities, and behaviours, shaping their life patterns. Gender issues are complex and mutually interrelated, emanating from gender norms, stereotypes, and roles that are deeply rooted or embedded in our traditions, culture, and societal norms in Ghana. These gendered norms, stereotypes, roles, and expectations are handed to us from generation to generation through various institutions backed by reinforcements (positive-rewards; negative /reprimand – punishment). They, therefore, affect boys/men and girls/women differently as they govern their expectations, power relations, decision–making processes, distribution of resources, and relationships and influence the opportunities and choices (career) that the individuals make based on their interests and needs, thereby establishing their life cycle. It must be emphasized that gender issues are an integral and an inalienable part of fundamental human rights issues.

The questions one may ask are: in what ways does one's gender identity through gendered-related norms, roles, and stereotypes shape the person's behavior and life patterns; what role does gender socialization play in the pathways of choices and opportunities?

Understanding how gender identity determines socialization processes and its subsequent effects on life patterns is crucial for addressing gender-based disparities and promoting a more equitable society. This exploration delves into the mechanisms of what constitutes gender norms, gender roles, and gender stereotypes and how these gendered components play a role in the processes of gender socialization and its impact on individual life patterns, highlighting the ways in which gender expectations shape opportunities, behaviors, and identities. To enable one to have a

better appreciation of the above issues, there is the need to appreciate what constitute the word or concept 'gender clearly'. Hence the question: is 'sex' and 'gender' the same, or can they be used interchangeably? What does the term 'gender' mean? Does the word 'gender' necessarily refer to only 'girl or woman'?

Gender and Sex

Sex' and 'gender' are often used interchangeably. Still, they are distinct concepts having different meanings and implications for the individual as it defines what the person does and cannot do, attitudes, behaviours, roles and expectations, opportunities, choices, and many others. Hence, the questions are: What is sex? What is gender?

What is Sex?

Sex is in the domain of biology. It refers to a set of biological attributes or conditions that are primarily associated with physical and physiological features, including chromosomes (X/YY), gene expression, hormone levels and function, and reproductive/sexual anatomy (external and internal genitalia) (WHO, 2021, UNICEF, 2017) These sets of biological characteristics tend to differentiate humans as females or males. Sex is usually categorized as female or male, but there is variation in the biological attributes that comprise sex and how those attributes are expressed. Therefore, sex simply refers to the biological divisions into male and female.

The Sex Equation:
SEX (Male/Female) = Biological Conditions (BC) + Physiological Conditions (PC)

What is Gender?

The word 'Gender' is a social and cultural construct. It is the acquired notion of masculine and feminine traits, attitudes, behaviours, and expressions that determines a person as being a boy/man or girl/woman. Gender refers to the socially constructed behaviours, attributes, expressions, roles and identities of girls, women, boys, and men that a given society considers appropriate. It is a social, psychological, and cultural construct developed in the process of socialization, which changes over time and varies amongst societies, cultures, and history. This construct includes norms behaviours, roles associated with being a woman or man, girl or boy, and the relationship with each other. The construct 'gender' is, therefore, a learned behaviour, and it influences how people perceive themselves and each other, how they act and interact, and the distribution of power and resources in society. Gender identity is not confined to a binary (girl/woman, boy/man) nor static; it exists along a continuum and can change over time.

Anne Oakley, who first introduced the term' gender' into sociology, defined gender as the parallel and socially unequal division between femininity and masculinity (Oakley, 1972). In her view, gender is a concept determined by environment and culture via verbal and non-verbal signifiers (such as interpersonal relationships, media use), social values, and beliefs, and stereotypes (ibid pp.26, 27).

Different societies and cultures may, therefore, have different understandings of what is 'masculine' or 'feminine. The question is: what constitutes this masculine and feminine division, and how do these concepts affect or shape a person's life as a boy, man, girl, or woman? This question will be discussed blow.

From the discussion, gender can be equated as:

Gender Equation:
GENDER (man/boy and woman/girl) = SOCIO-CULTURAL PERCEPTIONS + PSYCHOLOGICAL CONDITIONS.

Thus, the term 'gender, is used to analyze the roles, responsibilities, constraints, opportunities and needs of women and men in all areas and in any given social context.

It is thus often understood as the cultural interpretation of sexed bodies embedded in the whole apparatus of a society's roles and norms. Thus, a sex /gender binary is set up parallel to that of nature /culture.
In line with the above, we can then draw a distinction between sex and gender.

Distinction between Sex and Gender

The distinction between the terms "sex" and "gender" has long been a subject of debate (Baden and Goetz, 1998). Considering the various definitions and characteristics stated above, it is clear that there is a vast difference between "sex" and "gender." A person's sex is biologically determined as female or male according to certain identifiable fixed physical features. In contrast, gender includes the social, psychological, cultural, and behavioral aspects of being a man, woman, or other gender identity. Gender is the structure of social relations that centers on the sets of practices governed by these structures that vary across cultures, society, and over time and, therefore, are dynamic and not static. Gender identities and responsibilities are changeable between and within cultures as they are society-specific and culturally determined.

In line with these differences, it can be clearly concluded that gender and sex are not the same and therefore cannot be used

interchangeably. It is also evident that the word 'gender' does not mean 'woman' or 'girl' only, but it is a construct that is used to represent both 'boy and girl,' 'man and woman.'

Femininity/ Masculinity

Femininity and masculinity or one's gender identity (Burke, Stets, and Pirog-Good 1988; Spence 1985) have to do with the degree to which persons are identified as masculine or feminine, given what it means to be a man or woman in society. Femininity and masculinity are rooted in the social (one's gender) rather than the biological (one's sex). In many African societies, gender is traditionally classified into Masculine(boy/man) and Feminine (girl/woman). These classifications come with distinct characteristics and responsibilities that reflect the cultural, social, and economic roles assigned to each gender.

What is Femininity?

Femininity (also called womanliness) is a term used to describe the traits and behaviors which are considered typically associated with a woman or girl. It is a set of attributes, behaviours, and roles generally characterized by culturally inscriptive qualities, which include but are not limited to being affection, nurturing and caring, modest, submissive, shy, weak, feebly, physically attractive or beautiful, compassionate, soft-spoken, fearful, emotional, sensitive, humble, working with greater dexterity, honest, less willing to face danger or take risk ...etc., that are ascribed to a woman or girl. These qualities and behaviors are judged by a particular culture to be ideally associated with or appropriate to women and girls. Femininity can be understood as socially and culturally constructed and is mostly often influenced by both the cultural and, to an extent, the biological factors (Cislaghi et al., 2019).

What is Masculinity?

Masculinity is a social construct that is defined as qualities, attributes, behaviours, roles and societal expectations that signify and validate a person's manliness as approved within a given society or culture and recognized in a particular way by other men of the same category and the opposite gender. Simply put masculinity is the societal expectations of being a man. The standards for masculinity as a social construct vary across different cultures, ethnic groups, historical periods, and periods (Cislaghi et al., 2019).

In contemporary African society, masculinity is used to describe characteristics that encompasses but are not limited to physical strength and bravado, courage, aggrieves, authority and leadership, competitiveness, daring, protector and defender of one's own beliefs, exclusive heterosexuality, suppression of "vulnerable" emotions such as remorse and uncertainty, economic independence, authority over women and other men, and intense interest in sexual "conquest". While most men do not embody all of these qualities, society supports hegemonic masculinity within all its institutions. Societal members decide what being a man or woman means (e.g., dominant or passive, brave or emotional), and men/boys will generally respond by defining themselves as masculine. In contrast, women/girls will generally define themselves as feminine. In many African societies, gender is traditionally classified into two main categories: Masculine (boy/man) and Feminine (girl/woman) (see table above). These classifications come with distinct characteristics and responsibilities that reflect the cultural, social, and economic roles assigned to each gender. As a result, these may define the gendered identity of the person in society. The gender identity of a person is the personal and internal sense of oneself or experiences that characterizes his or her self-sense of being a man or woman. Gender identity is not confined to a binary (girl/woman, boy/man), nor is it static; it exists along a continuum and can change over time. For instance, girls or women engage in certain occupational fields and sports that had previously been considered masculine fields, such as engineering, mining, metal, machinery and plant operators, soccer, and wrestling.

The questions are: Are these social or culturally constructed masculine and feminine inscriptive characteristics, as listed above, very rigid in that they can only be true in a particular gender type? The answer is generally no. This is because every individual has both masculine and feminine traits attitudes, and behaviours, and can demonstrate any of these at a given time, or space based on the context. However, through the processes of socialization, the community reinforces one of the traits while suppressing the other, as will be discussed later below.

The next section examines what are gender norms, gender roles, and gender stereotypes as these play a vital role in the ways a boy, girl, man, and woman in the patterns of life of each other.

Social Norms and Gender Norms

What are Social Norms?

Social norms are the perceived informal and mostly unwritten roles that define acceptable and appropriate actions within a given group or community, thus guiding human behaviour (Sod et al cited in UNICEF 2021); they consist of what we do and what we believe others approve of and expect as to do. These norms constitute the folkways, mores, and laws. They are descriptive and injunctive.

Understanding social norms matters in the scope of gender dynamics because they can have beneficial or harmful consequences for individuals' wellbeing. Social norms are also essential in the production and the maintaining of social order in every society.

What are Gender Norms?

Gender norms are derived from social norms as they are a subset of social norms that relate specifically to gender differences (UNICEF, 2020). Gender norms refer to the societal rules and standards that dictate appropriate behaviors and attributes for individuals based on their gender. These norms are often ingrained in cultural, religious, and social practices, and they guide how people are expected to act, dress, and interact based on their perceived gender (West and Zimmerman, 1987). According to UNICEF, it refers to the collective beliefs and expectations within a community or society, at a given point in time, about what behaviours are appropriate for women, girls and men, boys, and the relation and interaction between them. (UNICEF, 2017). They are ideas or 'rules' about how girls and boys, women and men are expected to be and to act. People internalize and learn these 'rules' early in life. (UNICEF,2019). This sets up a life cycle of gender socialization and stereotyping. Put another way, gender norms are the standards and expectations to which gender identity generally conforms within a range that defines a particular society, culture, and community at that point in time (UNFPA and UNICEF, 2019; UN Women, 2018). These norms are informal, deeply entrenched and widely held beliefs about gender roles, power relations, standards, or expectations that govern human behaviours and practices in a particular social context and at a particular time. "Gender norms sustain a hierarchy of power and privilege that typically favours what is considered masculine over that which is feminine, reinforcing a systemic inequality that undermines the rights of women and girls and restricts the opportunity for women, men, and gender minorities to express their authentic selves" (Heise et al.,2019)

Gender Roles and Gender stereotypes

What are Gender roles?

Gender roles are specific sets of duties, behaviors, and responsibilities assigned to individuals based on their perceived gender (Heise et al., 2019). Gender role is a set of socially accepted behaviors and attitudes deemed appropriate or desirable for individuals based on their gender. These roles are deeply embedded in cultural, social, and religious practices and are learned from a young age. Gender roles are not static; they evolve and can vary significantly across different societies and historical periods. They influence various aspects of life, including career choices, household responsibilities, social interactions, and shape behaviours. For example, traditional gender roles often expect women to take on caregiving and nurturing roles, while men are expected to be providers and protectors (Eagly and Wood, 2019). Gender-specific roles are often conditioned by household structure, access to resources, etc. Gender roles evolve over time but still trend toward traditional and stereotypical notions of masculinity and femininity. Gender roles can limit and restrict people's choices and prospects based on their gender, perpetuating gender inequality.

Gender stereotypes are oversimplified and widely held beliefs about the characteristics and behaviors of men and women. It is a generalized view or preconception about attributes or characteristics or the roles that are or ought to be possessed by, or performed by, women and men. These stereotypes often emerge from traditional notions of gender roles and are perpetuated by cultural, social, and media influences (Cislaghi et al., 2019). They can manifest in various forms, including the belief that women are naturally more nurturing and emotional while men are more rational and assertive. Such stereotypes can significantly impact individuals' opportunities, choices, and behaviors, often reinforcing systemic gender inequalities (Ellemers, 2018). The stereotypes can be both positive and negative and often do not reflect the true diversity and capabilities of individuals. Still, they tend to fit rigid ideas of masculinity and femininity. For instance, the stereotype that women are more emotional, and men are more rational can limit opportunities and create biases in various domains, including the workplace and education (Cislaghi et al., 2019). Again, stereotypical characteristics about men are that they are competitive, acquisitive, autonomous, independent, and confrontational, concerned about private goods. Parallel stereotypes of women hold that they are cooperative, nurturing, caring, connecting, group-oriented, and concerned about public goods (UN Women Training Centre ,2018). On the contrary, society may frown upon any person who acts or displaces any of the defined attributes or behaviours of the opposite masculine or feminine. For instance, a girl that displaces any acts of assertiveness, aggression, bravery, competitiveness, etc., faced with name calling such as 'Tomboy,' 'iron lady,' 'oba akokoniene' (translated as the cock), Obaa Yaa Asantewaa, etc. Again, a boy who depicts behaviours such as shyness,

weakness or even tends to be emotional is called a 'mummy's boy' etc. and regarded as a deviant. Thus, society reinforces these prescribed attitudes and behaviours with punishment and rewards. These stereotypes are created and reinforced by gender norms and can lead to biased judgments and discrimination against individuals who do not conform to them. Gender stereotypes are harmful when they limit women's and men's capacity to develop their personal abilities, pursue their professional careers, and/or make choices about their lives. Stereotypes about women both result from and are the cause of deeply engrained attitudes, values, norms, and prejudices against women. They are used to justify and maintain the historical relations of power of men over women as well as sexist attitudes which are holding back the advancement of women" (Council of Europe Gender Equality Strategy 2014-2017). Stereotypes are often used to justify gender discrimination more broadly and can be reflected and reinforced by traditional and modern theories, laws, and institutional practices (UN Women Training Centre ,2018).

From the above, it is evident that gender norms, gender roles, and gender stereotypes, although they are distinct and different concepts are interlinked and mutually reinforcing because they define and characterize the behaviors, attitudes and relations of men, women, boys and girls that are deeply rooted and perpetuated by social and cultural practices and influences toward traditional and stereotypical notions of masculinity and femininity. The question is: in what ways do individuals acquire these attitudes and behaviours in any given society? I will discuss socialization, how gender is assigned through socialization, and its effects in the next section.

Socialization

Gender, a social construct, is learned and performed through socialization, which is the lifelong process by which individuals internalize societal norms, values, behaviors, and social skills (Pearse and Connell, 2014). This process is crucial for developing and perpetuating gender identity. Socialization shapes human behaviour and identity by establishing gender norms, roles, and stereotypes. In Ghana, socialization serves key functions: it helps individuals develop a sense of self and identity by internalizing societal norms (Chow and Vivalt, 2016), transmits culture through the acquisition of knowledge, skills, and behaviors (Bingenheimer, 2019), and integrates individuals into society by teaching necessary social norms and expectations (WHO, 2021). Agents of socialization include the family, which is the first and most influential, teaching gender roles through daily interactions and cultural rituals (Cislaghi and Heise, 2018); schools, which provide formal socialization through education on societal norms (UNESCO, 2019); peers, who significantly influence behavior and social skills during adolescence (Cislaghi et al., 2019); religion, which reinforces traditional gender roles (Gelfand and Jackson, 2016); and community and culture, which shape socialization through traditional ceremonies and communal activities (Harper and Marcus, 2018).

How Gender is Assigned through Socialization and its Effects.

Gender assignment in Ghana is deeply rooted in cultural, social, and historical contexts. Early childhood socialization sees children dressed in gender-specific clothing and given gendered toys, establishing behaviors and attitudes considered appropriate for their gender (Hyde, 2014). Cultural norms in Ghanaian societies reinforce gender roles, with specific expectations for men and women, such as the Akan culture's distinct roles for men in farming and leadership and for women in household management and trade (Alesina et al., 2013). The family plays a pivotal role, in modeling gender-specific behaviors and setting expectations that align with cultural norms (Legros and Cislaghi, 2019). Media also reinforces traditional gender roles, often depicting men as dominant and women as caregivers (Parker et al., 2017). Schools and peer groups further reinforce gender ascription through educational materials and peer interactions (Markel et al., 2016). Gender norms shape human behavior and gender identity by establishing societal expectations. Cultural conditioning from a young age aligns children's behaviors with gender norms, and social reinforcement rewards conforming behaviors while discouraging deviations (Jewkes and Lang, 2015; Legros and Cislaghi, 2019). Over time, individuals internalize these norms, influencing self-perception and self-esteem (Legros and Cislaghi, 2019). Gender norms also influence career choices and workplace dynamics, leading to occupational segregation and affecting interactions in professional settings (Markel et al., 2016). In interpersonal relationships, gender norms dictate different communication styles and roles in family and society, perpetuating power imbalances and limiting opportunities (ibid).

How to Break Gender Norms and Stereotypes?

Breaking down gender norms is a complex but crucial endeavor for fostering a more inclusive and equitable society that supports children's well-being and growth. To challenge gender norms, parents can avoid stereotypes and

encourage children to pursue their interests and passions irrespective of gender. By offering diverse activities and toys, parents create an environment that nurtures free exploration and self-expression, helping children develop a well-rounded sense of identity. Additionally, fostering open communication and challenging their own biases can lead to a home environment where emotional expression is not restricted by gender (United Way NCA, 2023). Educators also play a pivotal role in challenging gender norms within the classroom. By using non-gendered language, avoiding stereotypes, and providing equal opportunities for all activities, teachers can break down traditional gender barriers. Incorporating diverse resources and fostering open discussions on gender and identity can cultivate a more understanding and supportive classroom community (United Way NCA, 2023). Media creators must strive for diverse and inclusive representations of gender, avoiding harmful stereotypes and challenging traditional norms. By creating characters that defy conventional expectations and collaborating with experts and marginalized communities, the media can promote gender equality and foster a more accepting society (ibid).

In Conclusion

Gender norms play a very important role in shaping human behavior and gender identity, influencing everything from personal identity and career choices to interpersonal relationships and societal roles. Sex is based on biology, while gender is a social construct influenced by culture, society, and history. In Ghana, socialization defines gender roles and expectations right from a young age to when one dies. The various agents teach different behaviors and roles for boys and girls, creating the characteristics and responsibilities linked to masculinity and femininity. Understanding the difference between sex and gender and how socialization works is important for challenging gender stereotypes and promoting equality.

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SOLAR COOKING IN GHANA: IMPROVING GARI ROASTING AND PROMOTING SUSTAINABLE FOOD SECURITY

Nehemiah Kweku Essilfie
Institution: *Department of Biochemistry, KNUST, Kumasi.*
Email: *kwekunehemiah@gmail.com*

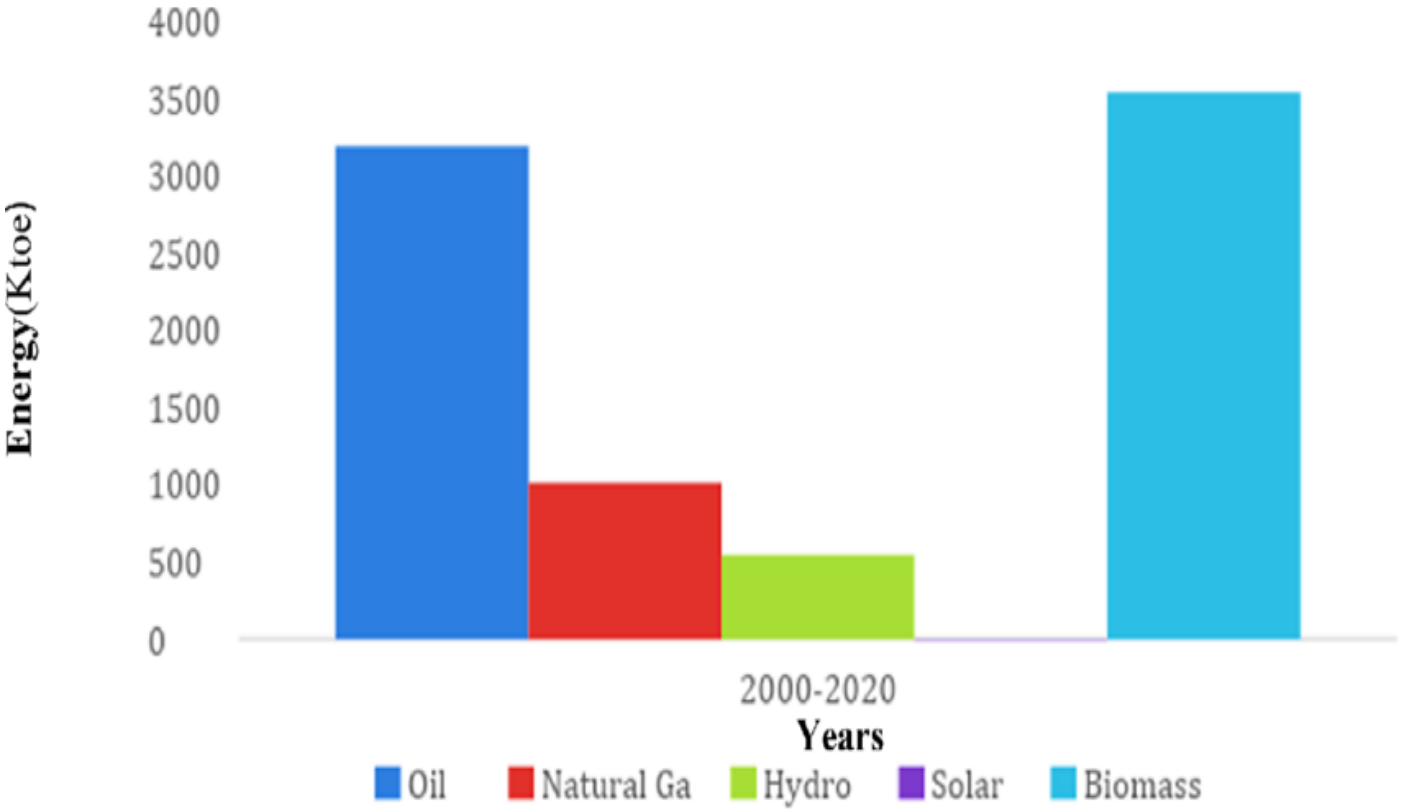

Figure 1.0: *Sum of the average energy supply of Ghana from 2000 to 2020*

Ghana has been endowed with renewable energy sources, non-renewable energy sources, and nuclear energy sources. In the energy sector, renewable energy sources like hydroelectric power, biomass, solar energy, and wind energy present in the country are critical to economic progress. Nonrenewable energy sources, like petroleum, are Ghana's primary energy source.

As Ghana's population continues to grow, ensuring food security is vital for the well-being of its citizens. Proper and efficient processing and storage methods are essential to maintain a steady food supply both domestically and internationally. Gari, a staple food in Ghana, is made from cassava, a drought-tolerant crop that thrives in the country's climate. Gari is a creamy white, partially gelatinized, roasted flour that is free-flowing and granular made from cassava roots. Cassava's resilience to adverse weather conditions makes it a reliable source of food, even in times of environmental stress, ensuring a steady food supply for the population. This makes gari not just a food item but a critical component of Ghana's food security strategy. In many communities, the preparation and consumption of gari are integral to social and cultural practices, making it a staple not only of the diet but also of Ghanaian life.

a.

b.

Figure 2.0: *a. Packaged gari; b. a bowl of white and yellow gari*

In Ghana, biomass is the major household energy source when cooking. The use of biomass fuels in

Ghana has severe environmental and health implications. Burning wood and charcoal releases significant amounts of carbon dioxide (CO_2) into the atmosphere, contributing to global climate change. Moreover, these practices are a leading cause of deforestation, as trees are continually harvested to meet the demand for cooking fuel. The smoke produced by burning biomass fuels is a major source of indoor air pollution, which poses serious health risks. This pollution can lead to respiratory diseases in poorly ventilated kitchens, particularly among women and children who spend significant time near the cooking area. In Ghana, respiratory infections are among the leading causes of morbidity and mortality, underscoring the urgent need to transition to cleaner cooking alternatives. This includes solar cooking, electricity, and gas cooking.

Figure 3.0: *Women roasting gari using thermal energy from firewood (biomass energy)*

Energy-intensive cooking like cassava processing into gari, a staple food in Ghana and Nigeria, needs a more efficient and affordable cooking method. Traditional cooking methods using firewood have been used in gari roasting for years. These traditional gari roasting methods are harmful to the health of women and children in rural communities who inhale the smoke and contribute to deforestation. Hence, there is an urgent need to replace this cooking method with a safer, more efficient, and environmentally friendly thermal energy source. Research by engineers from Nigeria, India, and Ghana has revealed that solar power perfectly fits as an alternative energy source for cooking. Solar cooking harnesses renewable solar power, offering a sustainable and cost-effective alternative to fossil fuels. Solar cooking technology, like solar box cookers and parabolic solar cookers, concentrates sunlight to generate heat, making them highly efficient. They convert solar energy directly into cooking heat without intermediary processes, ensuring minimal energy loss. Economically, solar cookers are advantageous as they require no fuel and have low maintenance needs, saving users money on traditional fuel costs like wood or gas.

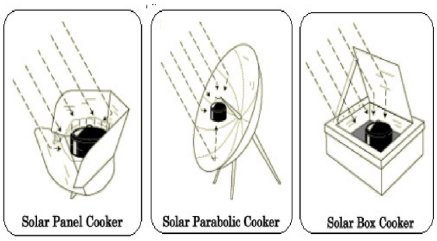

Figure 4.0: Diagram of the types of solar cookers: (a) solar panel cooker; (b) solar parabolic cooker; and (c) solar box cooker

In a work by Sobarasua et al. (2023), a solar-powered system designed for gari roasting, comprising a parabolic dish solar collector, thermal storage using gravel, and a frying pan, efficiently reached temperatures between 100°C and 120°C. It reduced the roasting time to 14–17 minutes per batch, although the total process, including heating, took 52 minutes. They succeeded with minimal challenges, which can be optimized in subsequent design and testing. The successful implementation of this solar-powered gari roasting system highlights the potential for renewable energy in food processing, which is crucial for Ghana's food security and environmental conservation efforts.

Transitioning to solar cooking addresses the immediate need for cleaner, more efficient cooking methods while contributing to broader efforts to combat climate change and reduce reliance on nonrenewable energy sources. By eliminating the use of firewood, solar cooking helps prevent deforestation and reduce carbon emissions, aligning with global sustainability goals. Additionally, it offers significant health benefits, particularly for women and children in rural areas, who are most affected by indoor air pollution from traditional cooking fuels. By leveraging abundant solar energy, Ghana can reduce its dependence on harmful cooking methods, protect public health (SDG 3), contribute to global climate change mitigation (SDG 13), and eliminate hunger (SDG 2), paving the way for a more sustainable future

a

b

Figure 5.0: *a. Parabolic solar cooker b. Hybrid solar roaster*

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MYTH: CARBS ARE THE ENEMY

Samuel Atta Tonyemevor (MPhil) and Marina Aferiba Tandoh (PhD)

Institution: *Nutrition Education and Communication, Human Nutrition and Dietetics, Department of Biochemistry and Biotechnology, KNUST*

Email: *s.a.tonyemevor@gmail.com / marinatandoh@knust.edu.gh* ***Tel:*** *0501656175/0248989545*

https://pharmeasy.in/

Introduction

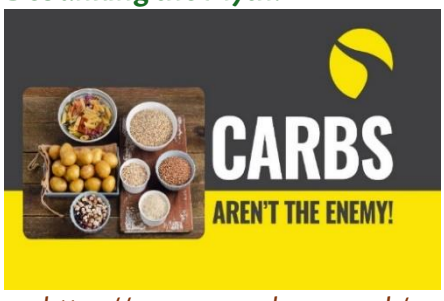
https://resyncproducts.com/

Many people think carbohydrates, often called "carbs," are not good for you. People believe carbs are the enemy and should be avoided. This simple idea has made carbs seem bad, but carbs are important for a healthy diet. Carbs, along with fats and proteins, are one of the three main nutrients our bodies need. They are our body's primary source of energy, providing fuel for physical activity and vital functions. Carbs are categorized into two main types:

i. **Simple Carbohydrates:** These are sugars found in foods like fruits, milk, and table sugar. They are quickly digested and provide a rapid source of energy.

ii. **Complex Carbohydrates:** These are found in foods like whole grains, legumes, and starchy vegetables. They contain longer chains of sugar molecules and take longer to digest, providing sustained energy.

Debunking the Myth:



https://www.snowdome.co.uk/

a. Carbs Fuel Your Body: Carbohydrates are essential for providing energy to your body and brain. When you consume carbohydrates, they are broken down into glucose, which is the primary fuel for your cells. Glucose powers your muscles, brain, and other vital organs (Clemente-Suárez et al., 2022).

b. Carbs Are Not Inherently Fattening: The myth that carbs lead to weight gain is a significant oversimplification. Excess calorie consumption, whether from carbs, fats, or proteins, can lead to weight gain. It's about the overall balance between calories consumed and calories burned.
c. Fiber and Nutrients: Many carbohydrate-rich foods, such as whole grains, fruits, and vegetables, are rich in fiber, vitamins, and minerals (Clemente-Suárez et al., 2022). Fiber, often referred to as roughage or bulk, is a type of carbohydrate found in plant-based foods that the body cannot digest or absorb. Unlike other nutrients that contribute calories to our diet, fiber passes through the digestive system relatively intact. It comes in two main forms: soluble and insoluble, each offering unique health benefits. Consuming a well-balanced diet high in whole grains, fruits, and vegetables providing ample fiber imparts the following health benefits:
    i. It slows glucose absorption, thereby reducing blood glucose spikes and insulin secretion.
    ii. It lowers blood cholesterol levels.
    iii. It promotes normal bowel function and prevents constipation.
    iv. It increases satiety, which helps with the prevention of obesity.
    v. It protects against disorders of the small and large intestines (e.g., irritable bowel syndrome, diverticulosis).

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d. Carbs Are Important for Athletes: For athletes and individuals with active lifestyles, carbohydrates are especially crucial. They help optimize performance, improve recovery, and maintain glycogen stores in muscles for endurance (Ludwig et al., 2018).
e. Balanced Diet: A balanced diet includes a variety of foods from all food groups, including carbohydrates. A diet that excludes carbs can lead to nutritional deficiencies and may not be sustainable in the long run.

Choosing the Right Carbohydrates

While it's clear that carbs are not the enemy, it's important to make smart choices when it comes to carbohydrates.

https://mind-muscle.co.uk/

Opt for Whole Grains: Choose whole grains like brown rice, quinoa, and whole wheat bread over refined grains. Whole grains offer more fiber and nutrients.

Embrace Fruits and Vegetables: Incorporate a variety of fruits and vegetables into your diet. They provide valuable nutrients and fiber.

Watch Sugary Snacks and Beverages: Limit your intake of sugary snacks, candies, and sugary drinks. These provide empty calories and can lead to weight gain.

Portion Control: Pay attention to portion sizes. Overeating any macronutrient can lead to weight gain.

In conclusion, carbohydrates are not the enemy, but they are an essential part of a balanced diet. When chosen wisely, they provide vital energy and nutrients for our bodies. Instead of demonizing carbs, focus on making informed choices and enjoying a well-rounded diet that includes the full spectrum of macronutrients. Remember, it's all about balance and moderation.

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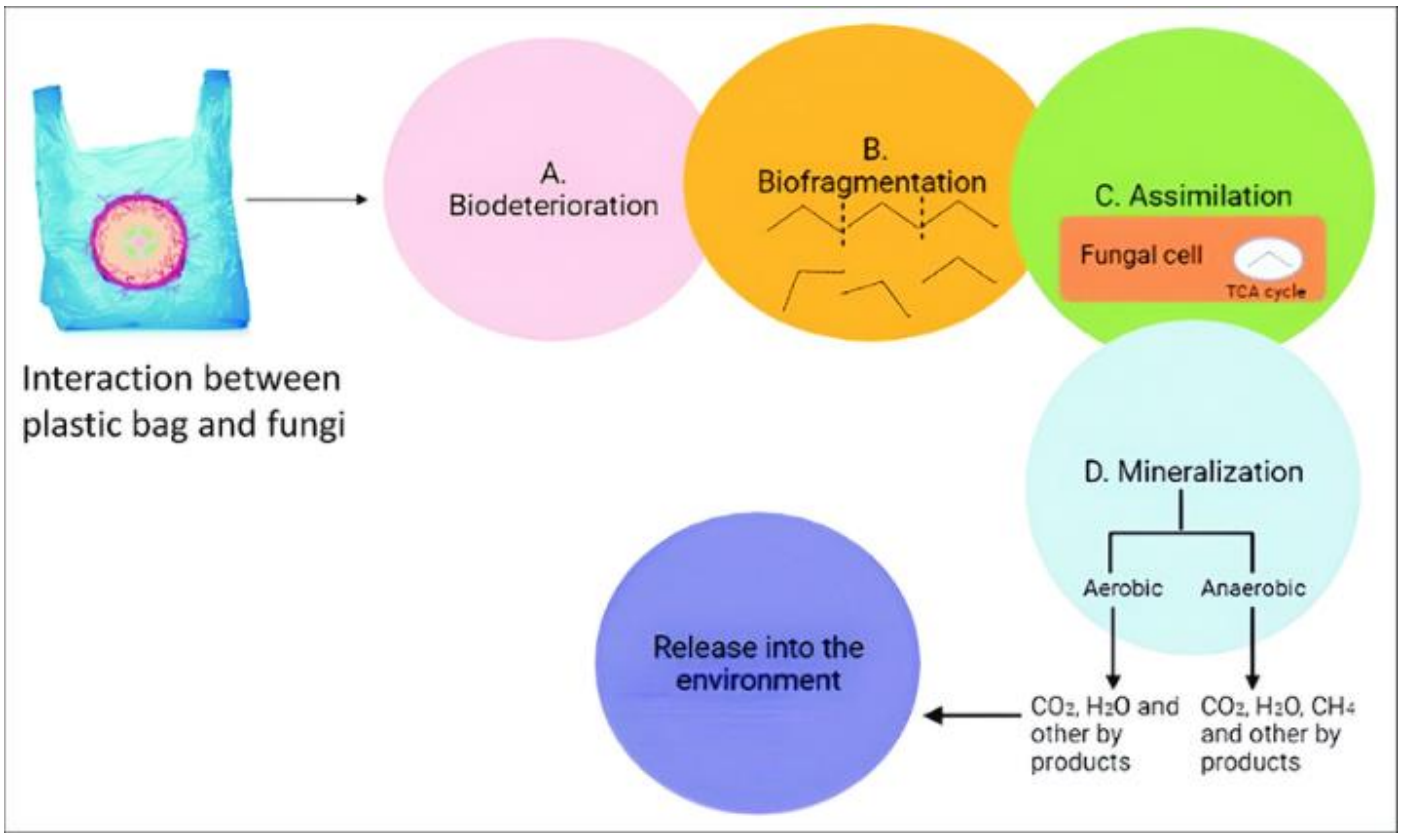
BIODEGRADATION BY FUNGI

Gyasi Kweku Foh

Institution: *Department of Biochemistry and Biotechnology, College of Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.*

Email: *kwekugyasi66@gmail.com (0588333955)*

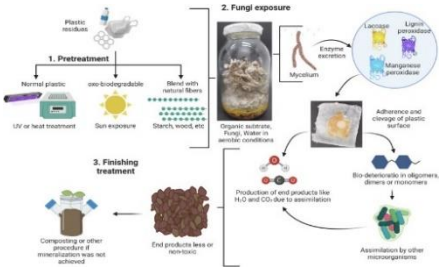


Large volumes of contaminating molecules are continuously created because of industrial activities. Many of these compounds are extremely persistent in the natural world because of their toxicity, low biodegradability, and stable chemical structures. Consequently, they build up in the environment to amounts that could affect naturally occurring populations of organisms. However, some microbes—mainly bacteria and fungi—have evolved the capacity to digest these contaminants and regularly do so to obtain nourishment or energy. Biodegradation is the process of changing organic materials, typically yielding more straightforward thermodynamic compounds. Biodegradation is typically used to refer to any change in a substrate mediated by biology. Almost all chemical compounds and materials biodegrade over time, with time being the most critical component. For example, vegetables can decompose in a few days, but glass and some polymers take thousands of years.

Burning plastics is the most widely used disposal method. However, this means getting rid of a ton of ash and slag that contains hazardous compounds, which can lead to additional severe environmental difficulties. The production of bioplastics has garnered significant attention in efforts to create a sustainable environment and prevent the possible disposal of resistant plastic trash in the environment. The plastics industry is under pressure to provide sustainable and biodegradable plastics due to the accumulation of plastic waste in the environment. One of the most promising approaches is to maximize the biodegradative potential of microorganisms and employ them to eliminate these contaminants.

Mechanism of Fungi Biodegradation

Since fungi are heterotrophic organisms with multiple enzyme systems and a diverse range of substrates to grow, they obtain their nutrition through either a parasitic or saprotrophic mode. To achieve this, they use a series of enzyme reactions on the substrate they grow. Because biomass, or the dead bodies of plants and animals, has a complex chemical composition, it must be converted to a simpler form before being made available to fungi for nutrition. Plant leftovers are often lignocellulosic, making it difficult for organisms to break down into simpler components. However, fungi can manufacture



the enzymes needed to break down these residues into simpler forms.

The enzymatic system and type of substrates used determine the mechanism of fungal degradations. For instance, phenol oxidases are essential enzymes in the oxidative process of lignin degradation by white-rot fungi, and other enzymes such as manganese peroxidases, lignin peroxidases, and laccase from the fungi have been found to play a significant role in lignin degradations. White-rot fungi break down lignin and use it as their only carbon and energy source. It is generally accepted that lignin degradations are required to access the substrates' cellulose and hemicelluloses.

The ability of fungi to naturally degrade organic materials into various simple products is used to produce valuable products for human use. These products are used under controlled conditions to produce goods humans desire, such as wine, bread, medicine, and other industrial applications. One example of fungal-mediated biodegradation is the cultivation of edible and medicinal mushrooms on organic residue. Since mushrooms are achlorophyllous, they develop on decomposed organic matter and are high in lignin, cellulose, and other vital carbohydrates. It can be cultivated anywhere in the world, is affordable, has a wealth of pharmacological qualities, is simple to grow, and needs little space or resources. There are several processes involved in turning lignocellulosic residue into valuable products.

These procedures include:

a. Pretreatment (chemical, biological, or mechanical).
b. Hydrolyzing polymers to create compounds that are easily metabolized (such as hexose) or sugars pentose.
c. Making chemical compounds or supporting microbiological development with these substances.
d. Purification and separation.

Each year, tons of agricultural residue are produced from cropland; some residues are used as animal feed, while others are used in industry. However, the majority of these residues are burned in the crop field, polluting the environment. However, using fungi, these residues can be turned into compost or used to grow edible mushrooms. Because fungi have an efficient hydrolytic system, they may transform lignocellulosic material into necessary metabolites, which are then transformed into mushrooms.

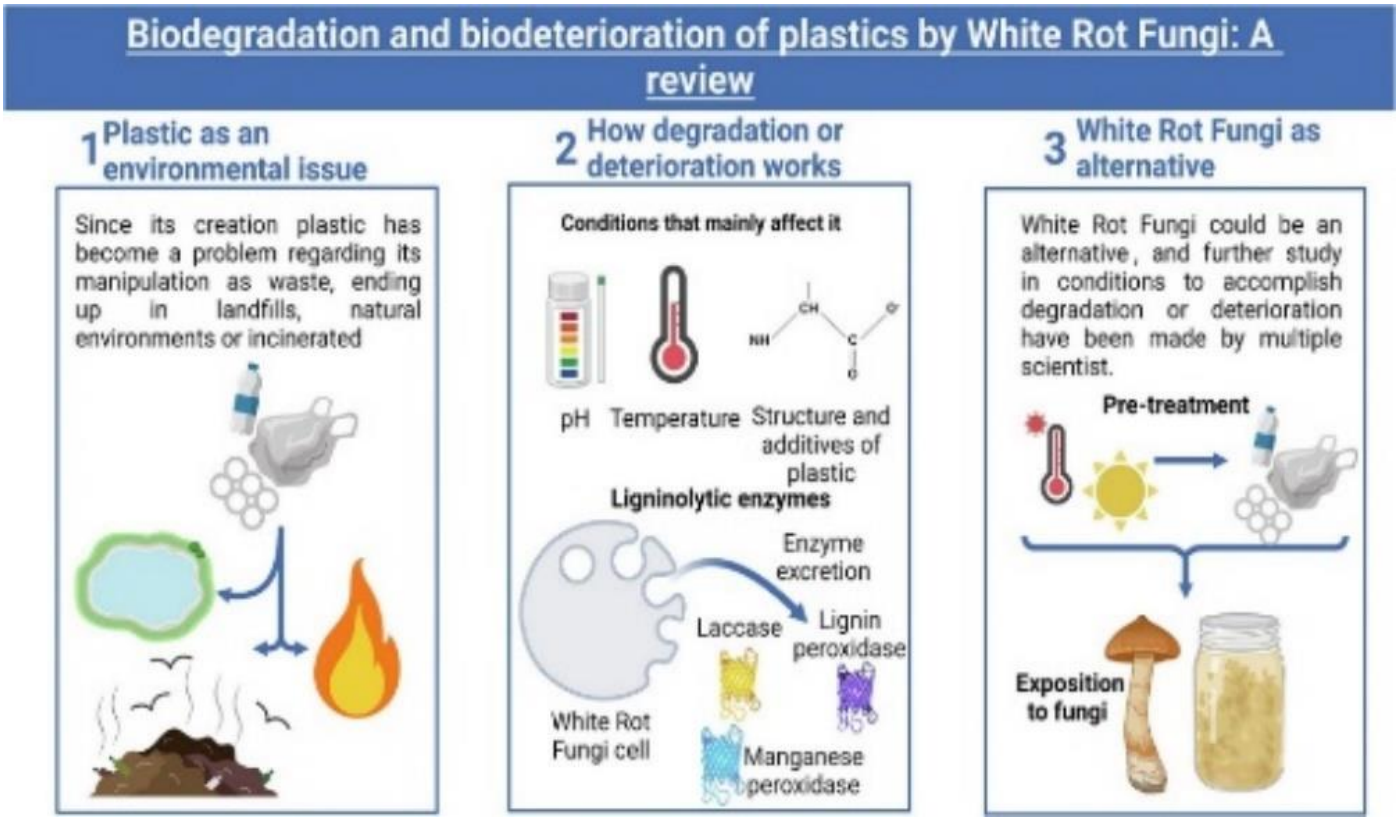
The fungus that breaks down dead or alive wood is known as xylophagous or wood-degrading fungi. These fungi decompose deadwood branch complex compounds in the wild and release their nutrients into the earth. With varying sets of enzymes, wood-degrading fungi are responsible for brown, soft, and white rot. They are categorized as brown-rot fungi, soft-rot fungi, and white-rot fungi according to the type of decay they induce. The cellulose in the wood is broken down by hydrogen peroxide, produced by brown-rot fungi, causing the wood to become completely brown in color.

In contrast to white-rot fungi, which break down both the cellulose and lignin of the wood, soft-rot fungus releases a cellulolytic enzyme that breaks down the cellulose of the wood. These fungi are also less aggressive. Higher quantities of laccase enzyme are produced by white-rot fungus, which is why their potential use in the mycoremediation, biofuel, and medical industries have been studied. Ascomycetes and basidiomycetes include fungi that are typically white rot fungi. These fungi are studied in detail because they can produce a variety of economically significant enzymes, which helps support human life. Nevertheless, these fungi can also cause damage to our wooden household appliances.

The primary component of the biomass found in wood and leaf litter produced by photosynthesis in plants is lignocellulose, which is the most abundant renewable resource in the soil. Lignocellulose is made up of three different types of polymers: cellulose, hemicellulose, and lignin. These polymers are bonded together strongly by covalent cross-linkage and non-covalent forces. A very small amount of lignocellulose is produced as a byproduct of agriculture or other industries, and the remainder is regarded as residue. While certain microorganisms break down leftovers to obtain carbon for energy, filamentous fungi have evolved to break down lignin into CO_2 and other chemicals, as was covered in the previous paragraph. The white-rot fungi not only break down lignin but also a range of other persistent environmental contaminants, including cyanide compounds, pesticides, fungicides, aromatic and aliphatic hydrocarbons, and others. Many fungi are the source of food for invertebrates in the forest, the organisms that feed on the fungi are termed fungivore.

Conclusion

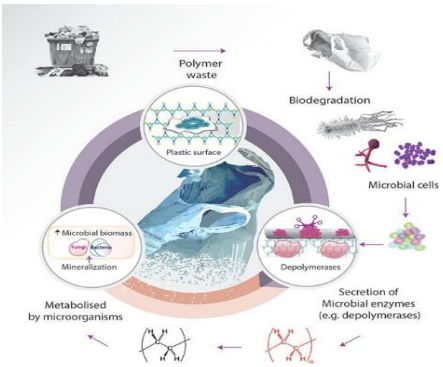
To sum up, the functions of fungus and bacteria in biodegradation are essential for waste management and



environmental impact reduction. These microbes are excellent at using natural processes to reduce complicated organic molecules into simpler, less dangerous compounds. Mycelia networks and enzymatic properties of fungi increase biodegradation, whereas bacteria contribute by metabolizing a variety of organic contaminants, such as hydrocarbons and industrial chemicals.

Compared to conventional waste disposal techniques, the advantages of utilizing fungus for biodegradation are substantial. In contrast to physical techniques like burning or landfilling, which can worsen resource depletion and pollution, biodegradation provides a sustainable and environmentally beneficial substitute. Using a biological method, trash is reduced in quantity and converted into beneficial byproducts like compost, which improves soil and encourages plant development.

Furthermore, it is frequently more flexible and economical because microorganism-mediated biodegradation may be adjusted to waste types and environmental circumstances. The adaptability of fungi in various environments increases their usefulness in waste management. Ultimately, biodegradation by fungi offers a viable route toward more environmentally friendly waste management techniques. We can handle the problem of waste disposal in an environmentally friendly way, lowering pollution and preserving resources for future generations by utilizing the natural functions of these microbes.



HEALTHY EATING DURING CHRISTMAS

Marina Aferiba Tandoh (PhD)
Institution: *Human Nutrition and Dietetics, Dept. of Biochemistry, KNUST*
Email: *marinatandoh@knust.edu.gh; mtandoh@yahoo.com*

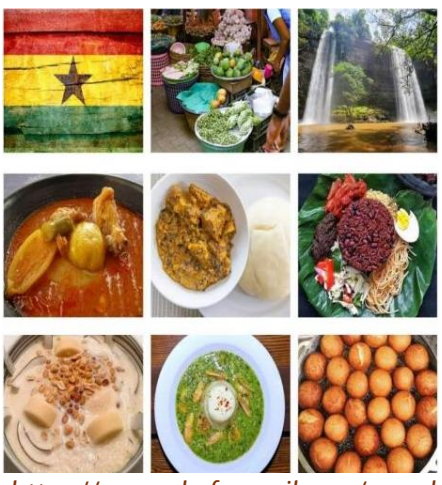
https://thehealthytart.com/healthy-christmas-foods-recipes

Healthy Eating Tips for the Christmas Holidays:

Christmas is here again. Hurray!!! All around the world, many Christians celebrate the birth of Christ. What a joy to the world! It is a season of feasts, parties, picnics, festivities, family re-unions and lots of food. From family dinners, to work Christmas parties, to end of year get-togethers, Christmas really is the season to be eating, drinking and being merry!

Not only does Christmas bring out the festive spirit in us all, for some, it can also be an anxious time, grappling with the thought of whether we are going to gain weight, whilst justified by the thought of it being ok to gain weight since it is Christmas time. We tend to let go of any restraint, which leads us to overeat and over drink. Research shows that with the extra calories consumed across all the celebrations during the festive season, we can gain on average around 1kg (roughly 2lbs) (Schoeller, 2014). But don't worry, it is possible to eat, drink and be merry without over doing it!

Christmas does not have to be the end to your healthy eating or weight loss efforts! If we implement a few golden rules over this festive season, it will roll past without the morning-after guilt.



https://www.chefspencil.com/popular-christmas-foods-in-ghana/

Here are a few golden rules to follow this Christmas holidays for healthy eating:

1. **Before attending the party: Never go to a party hungry!**
   - Do not skip a meal or a snack and go to a party hungry. Have a light snack, fruit or meal at home instead. This will reduce the likelihood of being very hungry if the food is late and then overeating or, indulging in unhealthy starters before the main meal even begins. Try having a small healthy snack, like a bowl of low-sugar wholegrain cereal, oatmeal, whole wheat snack with peanut butter, or a plain yogurt before you go, so you do not arrive hungry and dive straight into the high-calorie nibbles.
   - Add fresh fruit such as grated apple or pear, or sliced banana or pineapple to your favourite wholegrain cereal or porridge. To make breakfast a little bit festive, why not sprinkle on some cinnamon, a handful of nuts or dried fruits such as cranberries, dates or figs. Both fresh and dried fruit count towards your 5 A DAY!
   - Try keeping some mixed seeds or nuts (sesame seeds, sunflower seed, pumpkin seeds, cashew nuts, almond nuts, walnuts etc) in your bag or car, for a quick on the go healthy snack.
   - If you know there will not be many vegetable options at party you are invited to, why not offer to bring along a nice fruit or vegetable salad dish? Remember that salads do not have to be rich with salad dressings and corned beefs or tin fish, but you can make them healthier by incorporating your favourite fruits such as apples, mangoes, pineapples and pawpaws. Be adventurous!
   - If you have to pre-order for a sit-down meal (particularly if you are going for lots of festive meals), why not order healthy options like grilled fish or a vegetable-based dish, and have a soup or salad to start instead of a sweet dessert?
2. **During the party: Start with ½ plate of vegetables**
   - Fill your plate first with vegetables or salad, this leaves less room for other 'not so healthy food' choices. Vegetables and salads are packed with vitamins, minerals and fibre, which will help to incorporate bulk and volume to your plate, making it look and feel like you are eating a bigger meal (but without the extra calories).
   - You may not be able to control what food you are served, and you are going to see other people eating tempting treats. Meet the challenges armed with a plan:
     - Eat close to your usual times to keep your blood sugar steady. If your meal is served later than normal, eat a small snack at your usual mealtime and eat a little less when dinner is served.
     - If you have a sweet treat, cut back on other carbs (like polished rice, potatoes and bread) during the meal. Do not add extra salt to your food at table!
     - Do not skip meals to save up for a feast. You will be very hungry and more likely to overeat, making it difficult to stabilize your blood sugar level.
     - Also, plan to stay on top of your blood sugar. Check it more often during the holidays, and if you take medicine, ask your doctor if the amount needs to be adjusted.
     - Drink plenty of water (6-8 glasses). Make sure, as you go throughout your day, you are sufficiently hydrated. Even slight dehydration can trick us into thinking we are hungry, and, therefore, we are more likely to overeat and give in to those treats!

   If you slip on your healthy eating plan, get right back to healthy eating with your next meal.
3. **Outsmart the Buffet**
   - When you face a spread of delicious holiday food, make healthy choices easier. You don't have to pick up every food item on the buffet table.
   - Have a small plate of the foods you like best, and then move away from the buffet table. Healthy local options include boiled yam/plantain with Palava sauce/garden eggs stew, fried plantains and beans stew, waakye with hot sauce, Ga or Fante kenkey with hot sauce and fish, mpotompoto, acheke with fish and sauce, tatale with aboboi, fufu and light soup, banku with fish and pepper/ okro soup/vegetable soups etc.
   - Eat slowly. It takes at least 20 minutes for your brain to realize you are full.
   - Avoid or limit alcohol. If you do have an alcoholic drink, have it with food. Alcohol increases your appetite and makes you overeat.
   - You could choose to keep the sweets and candy bars off the tray this year – instead have smaller

portions of chocolate and sweet treats and serve them only occasionally.

- Sugar-sweetened soft drinks/beverages can be damaging for teeth, for adults and children, and on average are high contributors of sugars in our diet. So, limit the consumption of these. Opt for locally prepared drinks like ginger drink, sobolo etc.

https://www.pulse.com.gh/lifestyle/food-travel/5-ghanaian-christmas-recipes-that-are-not-rice-dishes/s79kffn

4. Stop eating when you are full

Over the festive season, we are confronted with delicious food and a lot of it too! Don't let this be an excuse to lose touch with your hunger. It is important to continue to listen to your body and stop eating when you are satisfied. By listening to your hunger cues, this can help reduce overindulgence. It is ok to save some extra food for later at home the next day rather than overindulging in one sitting.

https://www.hpepublichealth.ca/feeding-your-family/

5. After the party: Keep moving!

- Keeping active and fit over the festive season is a must. Break physical activity up into smaller chunks so it is easier to schedule, like walking 10 minutes several times a day.
- If you do not have time to follow your usual exercise pattern during the festive period, why not build activity into your daily routine;
  - Walk up the stairs rather than taking the lift or get off the bus a few stops early and walk the rest of your journey.
  - Rather than lots of screen time, why not go for a brisk walk in 30 minutes which can use up 150 calories.

Why not get family and friends together for some sport or activity – you could go outside and play football or stay indoors and play some active games like charades, musical chairs or even other games like 'oware', ludu, cards etc.

6. Get your sleep!

Going out more and staying out later often means cutting back on sleep. Sleep loss can make it harder to manage your blood sugar, and when you are sleep-deprived, you will tend to eat more and prefer high fat, high-sugar food. Therefore, aim for 7 to 8 hours of sleep per night to guard against mindless eating.

General Tips for cutting down on your fat intake this Christmas:

1. The skin on turkey, chicken or goose is where most of the fat is so remove before cooking and eating to reduce saturated fat and calories from your meat. Light meat has fewer calories than dark meat.
2. Try cutting your potatoes bigger for roasting - larger pieces absorb less fat during roasting. Parboil them first and then finish off in the oven!
3. Swap half of your regular potatoes for sweet potatoes, as a healthier alternative.
4. Bake, roast, steam, broil and grill more, stir-fry in a small amount of oil, seldom fry, and if you should fry, use only three teaspoonfuls of oils a day.
5. Cakes, pies, chocolates, chips, and biscuits are usually loaded with Trans-fats and oils as well as sugars, they are not healthy.
6. Oily foods contribute fat to the diet especially the "cook to thicken" types.
7. Deep fat fried foods absorb a lot of fat and should not be a preferred method of cooking.
8. Hard fried foods contain more fat, e.g. hard fried fish, all the water in the fish has been replaced with oil. Smaller fishes or smaller cuts of meats/fishes (e.g. one man thousand, keta schoolboys, small herrings) that have been deep fat fried absorb more oil than deep cuts: avoid or restrict their intake.
9. Serve a variety of vegetables, as different types provide different essential nutrients! Vegetables are what we call low-energy density foods – so you can eat lots for relatively few calories (provided they are not covered in fats and oils). Try steaming vegetables rather than boiling, as steaming retains more of the vitamins.
10. Use the cooking water from the vegetables to make the gravy, as this will contain some of the vitamins from the vegetables.
11. Season vegetables with herbs and spices, rather than with sauces, butter, stick margarine.
12. Use lemon juice on salads instead of oil-based salad dressing.
13. To reduce saturated fats, use vegetable oil or tub margarines instead of butter, stick margarines or hydrogenated

fats in baked foods.

14. Replace whole milk with non-fat milk, reduced fat or 1% milk. Substitute plain low fat yoghurt, blender whipped low fat cottage cheese, or butter milk in place of recipes that call for sour cream or mayonnaise.
15. Use non-stick pans for frying thus eliminating the needed excess fat, use vegetable spray for frying.
16. Chill meat or poultry broth to allow fat to solidify, and then remove fat before using broth in cooking.
17. Buy whole grain breads and rolls; they have more flavor and taste and do not require butter etc to taste good. The fiber in it is good for your health.
18. Christmas desserts, cakes, pudding and other festive desserts can be delicious, but also very rich – why not opt for a small portion and add additional fruit for a 5 A DAY contribution.
19. Set goals for yourself and have a support group. This is a great way to stay motivated and accountable during this particularly tempting time.
20. Do not be afraid to say 'No' to unhealthy options. Always remember that your health is in your hands!

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ZOONOTIC SCHISTOSOMIASIS: THE CROSSROADS BETWEEN ANIMAL AND HUMAN SCHISTOSOMES

Fatima Fordjour Amponsah[1,2]* and Alexander Kwarteng[2]

Institutions: *[1]Department of Microbiology, University for Developmental Studies, Tamale*
[2]Department of Biochemistry and Biotechnology, KNUST, Kumasi
Email: *ffordjour@uds.edu.gh**

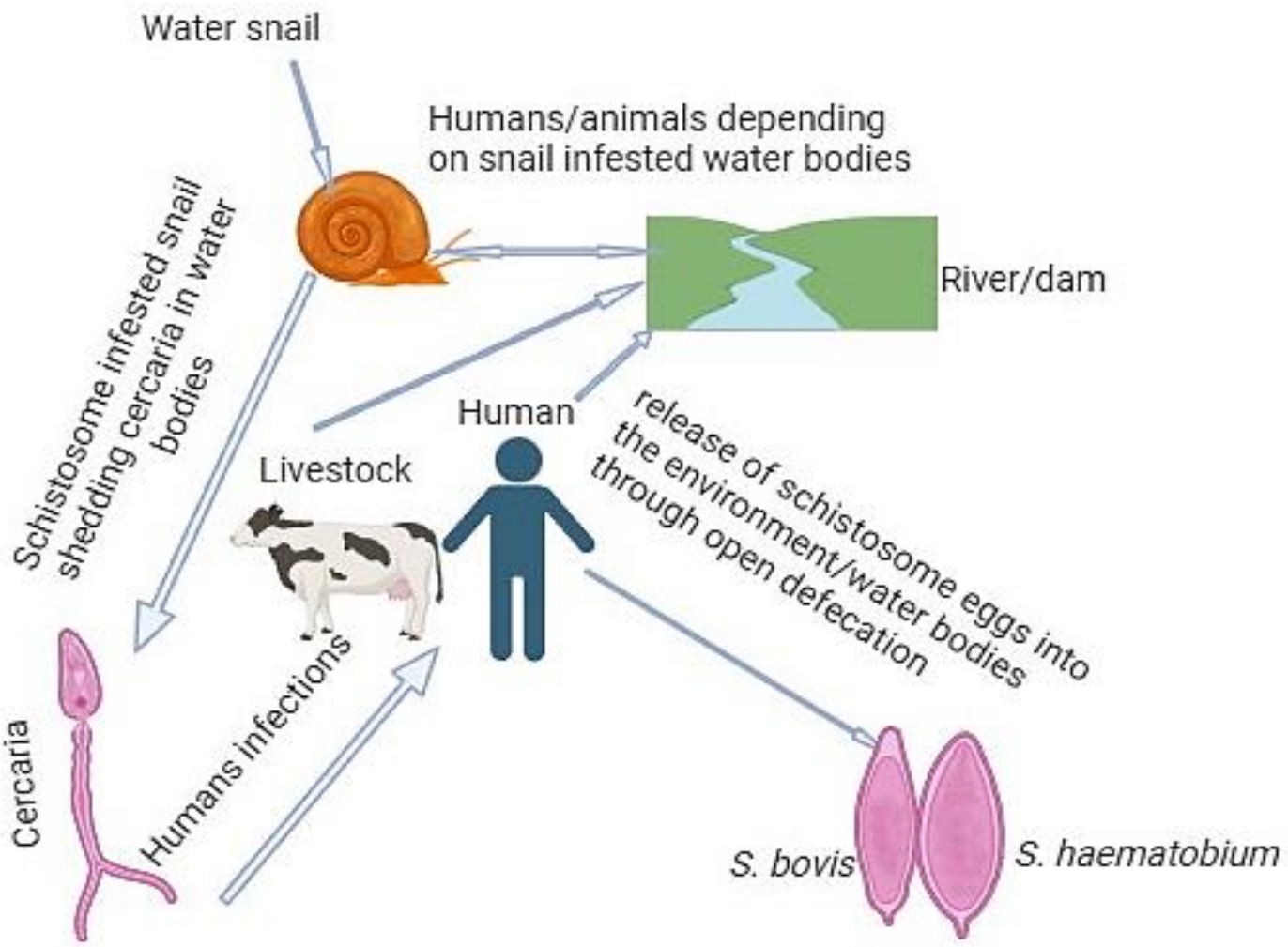

Figure 1: *Humans and animals depend on the same water source.*

Introduction

The World Health Organization (WHO) has targeted eliminating almost all neglected tropical diseases (NTDs) through chemotherapy, vector control, and other strategies. However, these elimination programs have mainly targeted human infections, with limited attention on infections in livestock that could be transmissible to humans. Recent empirical evidence suggests that in addition to Schistosoma species for which humans are the recognized mammalian host, livestock schistosomes are also infective to humans. This means there is a higher possibility of hybrid formation between animal and human schistosomes (Panzner & Boissier, 2021). Over the years, little or no emphasis has been placed on controlling schistosomes transmissible from livestock to humans (i.e., zoonotic schistosomiasis). As a result, this infection has an increased risk for transmission and recrudescence. This is particularly relevant to high transmission areas where the co-existence of people and livestock overlaps with the distribution of suitable snail intermediate hosts. For many years, Schistosoma species have been largely considered to have limited zoonotic potential. Nonetheless, studies have shown the possible zoonotic potential of animal schistosomes and their ability to form hybrids with human schistosomes (Borlase et al., 2018; Leger et al., 2020).

In Africa, and especially in Ghana, livestock and their owners stay close as these animals drink from the same water bodies the communities depend upon. Furthermore, there is an increasing number of reports on the presence of hybrid species, with characteristics between previously assumed human-specific and animal-specific schistosomes (Díaz

et al., 2022). Praziquantel is a safe and highly efficacious drug but could become ineffective if resistance emerges. To reach the revised WHO goal of eliminating schistosomiasis by 2030, new strategies should be implemented to counter the role of animal reservoirs in perpetuating transmission.

Schistosomiasis also affects dairy production and the general growth of livestock, and this has called for the inclusion of livestock in mass drug administration (MDA) using praziquantel as a measure of food security. Nevertheless, there is limited data on treating livestock with praziquantel, especially in Africa, as existing data on hybrid schistosomes is mainly found in species specific to another continent. However, limited attention has been paid to the role of livestock as reservoir hosts and the prevalence of transmission of schistosomes to humans via farmed animals. This review calls for opinions on the inclusion of livestock in MDA and to set strategies that could mitigate possible zoonotic schistosomiasis, especially in Africa.

Schistosomiasis transmission

Schistosomiasis is transmitted by freshwater-infected snails to humans or animals in contact with water (Aula et al., 2021). Schistosomiasis is endemic in 78 countries globally, with an estimated 236 million people infected, of whom 120 million are symptomatic and 20 million severely diseased (WHO, 2023). Individuals are infected upon daily contact (bathing, washing, swimming, and farming) with water infested with snails. Most endemic communities have limited or no access to safe water, sanitation, and proper hygiene; hence, there is the possibility of humans and animals depending on the same source of water. Indiscriminate defecation and urination in open water due to lack of proper hygiene conditions allow schistosome eggs to encounter snail hosts. Transmission ensues when humans have sufficient contact with contaminated water bodies containing schistosome infective larvae (cercariae).

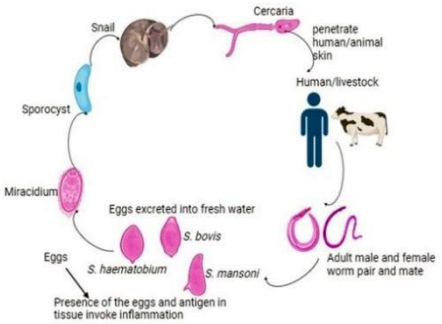

Figure 2: *Lifecycle diagram of Schistosoma species*

Praziquantel resistance

Praziquantel is the WHO-approved drug of choice for mass drug administration (MDA) against schistosomiasis in endemic countries. Praziquantel is a relatively safe, well-absorbed, and effective oral drug active against schistosome species (Kokaliaris et al., 2022). The drug usually acts within one hour of ingestion by paralyzing the worm and damaging the tegument (Kokaliaris et al., 2022). However, praziquantel has little or no effect on eggs and immature worms. It is taken annually or biannually in endemic countries as there is reinfection after treatment. There is the fear of resistance in individuals in endemic countries as the drug is repeatedly used over several years.

The main strategy of MDA is to interrupt the infection's transmission cycle in endemic communities over time. Globally (Brazil, Cambodia, China, Egypt, Mauritius, Islamic Republic of Iran, Oman, Jordan, Saudi Arabia, Morocco, Tunisia, Nigeria, Ghana, and others), schistosomiasis control has been successfully implemented for more than four decades now. Many countries have been able to implement scale-up programmes against schistosomiasis as others are still struggling with the disease.

In the sub-Saharan region, there have been scale-up interventions for over a decade now, with the introduction of transmission assessment surveys to certify the elimination of the disease. These treatment campaigns decreased the prevalence of schistosomiasis in school-age children by almost 60% (Kokaliaris et al., 2022).

Praziquantel is efficacious against S. mansoni, S. haematobium, and S. intercalatum using praziquantel 40 mg/kg/day. Treatment is usually curative. However, there is the possibility of reinfection if individuals continue to stay in endemic communities. The response of the drug may vary depending on parasite load. In treating S. japonicum and S. mekongi, a higher dose of 60 mg/kg/day in 3 divided doses for one day is usually effective. Although praziquantel has been proven to have no risk in pregnancy in animal studies, limited data is available in human studies, and as a result, WHO has declared praziquantel to be a pregnancy category B drug. The WHO, therefore, supports its use in pregnancy. Breastfeeding mothers are also allowed to take praziquantel. However, the benefit versus risk of the drug has not been assessed in children under four years.

Inclusion of livestock in MDA

Much attention was not given to livestock schistosomes until recently when the WHO goal of elimination by 2025 seemed impossible during transmission assessment surveys. To reach the revised WHO goal of eliminating schistosomiasis by 2030 (WHO, 2022), new strategies should be

implemented to counter the role of animal reservoirs in perpetuating transmission. Areas with lack of segregated water systems for both livestock and humans usually suffer this occurrence as the community and livestock all drink from the same source. Another phenomenon is the settlement type, whereby most farmers stay near their livestock. This settlement type is common in sub-Saharan Africa connecting the human and livestock schistosomes.

At the just-ended 2023 World Food Forum organized by the Food and Agricultural Organization of the United Nations, one key agendum was food security. Therefore, the impact of schistosomiasis on dairy production and the general growth of livestock is now a global concern. The infection has been reported to deteriorate dairy and meat production, and thus, there is a need to include livestock in MDA using praziquantel. Nevertheless, there is limited data on treating livestock with praziquantel, especially in Africa. Thorough scientific data is needed to validate the successful integration of livestock into MDA using praziquantel. To achieve this, experts and researchers on the continent must come together with a good funding system to actualize this goal. All these steps can be taken to mitigate the hunger on the African continent to achieve sustainable development goal 2 (SDG 2).

Outlook on hybrid schistosomes

Hybrid schistosome development has recently been hypothesized, and less field and laboratory data can be found. Transmission of livestock schistosomes to humans was among the least expected phenomena, not to mention the crossing of human and livestock schistosomes. Detrimentally, the situation results from livestock having more contact with humans, living together or towners visiting the farmers and spending most of their time on the farm.

Researchers have suggested that the formation of a hybrid could pose resistance to praziquantel treatment, and to even validate the ability of the drug against the hybrid, thorough and approved field investigations using the drug must be done on confirmed hybrid infections. This may further lengthen the schistosomiasis elimination program if this hypothesis is poorly evaluated and reported on time.

The WHO Outlooks on Schistosomiasis Elimination

Despite several rigorous studies that have been carried out on the development of a vaccine against schistosomiasis, there is no licensed vaccine yet. Thus, the available option is still using praziquantel to treat infected cases in all endemic countries. Besides praziquantel for MDA and a possible future vaccine, there are several strategies for tackling schistosomiasis: snail control, sanitation, and health education. The updated strategy to combat NTDs by the WHO is aimed at eliminating schistosomiasis as a public health problem in all endemic countries and interrupting its transmission (absence of infection in humans) in selected countries.

The WHO strategy for schistosomiasis control focuses on reducing disease through periodic, targeted treatment with praziquantel through the large-scale treatment (preventive chemotherapy) of affected populations. It involves regular treatment of all at-risk groups. In countries where the baseline prevalence is not alarming, there are usually targeted groups for treatment with a special focus on pre-school-aged children, school-aged children, adults considered to be at risk in endemic areas, and people with occupations involving contact with infested water, such as fishermen, farmers, irrigation workers and women whose domestic tasks bring them in contact with infested water; and entire communities living in highly endemic areas.

WHO recommends treatment of infected preschool-aged children based on diagnostic and clinical judgment and their inclusion in large-scale treatment using the pediatric praziquantel formulation. The frequency of treatment is determined by the prevalence of infection in school-age children. In high-transmission areas, treatment may have to be repeated every year for several years.

Monitoring and evaluation are essential to determine the impact of control interventions. The aim is to reduce disease morbidity and transmission towards the elimination of the disease as a public health problem. Periodic treatment of at-risk populations will cure mild symptoms and prevent infected people from developing severe, late-stage chronic disease. However, a major limitation to schistosomiasis control has been the limited availability of praziquantel, particularly for treating adults. Data for 2021 shows that 29.9% of people requiring treatment were reached globally, with a proportion of 43.3% of school-aged children requiring preventive chemotherapy for schistosomiasis being treated. A drop of 38% compared to 2019 due to the COVID-19 pandemic, which suspended treatment campaigns in many endemic areas (WHO, 2023).

WHO's work on schistosomiasis is part of an integrated approach to the control of neglected tropical diseases. Although medically diverse, NTDs share features that

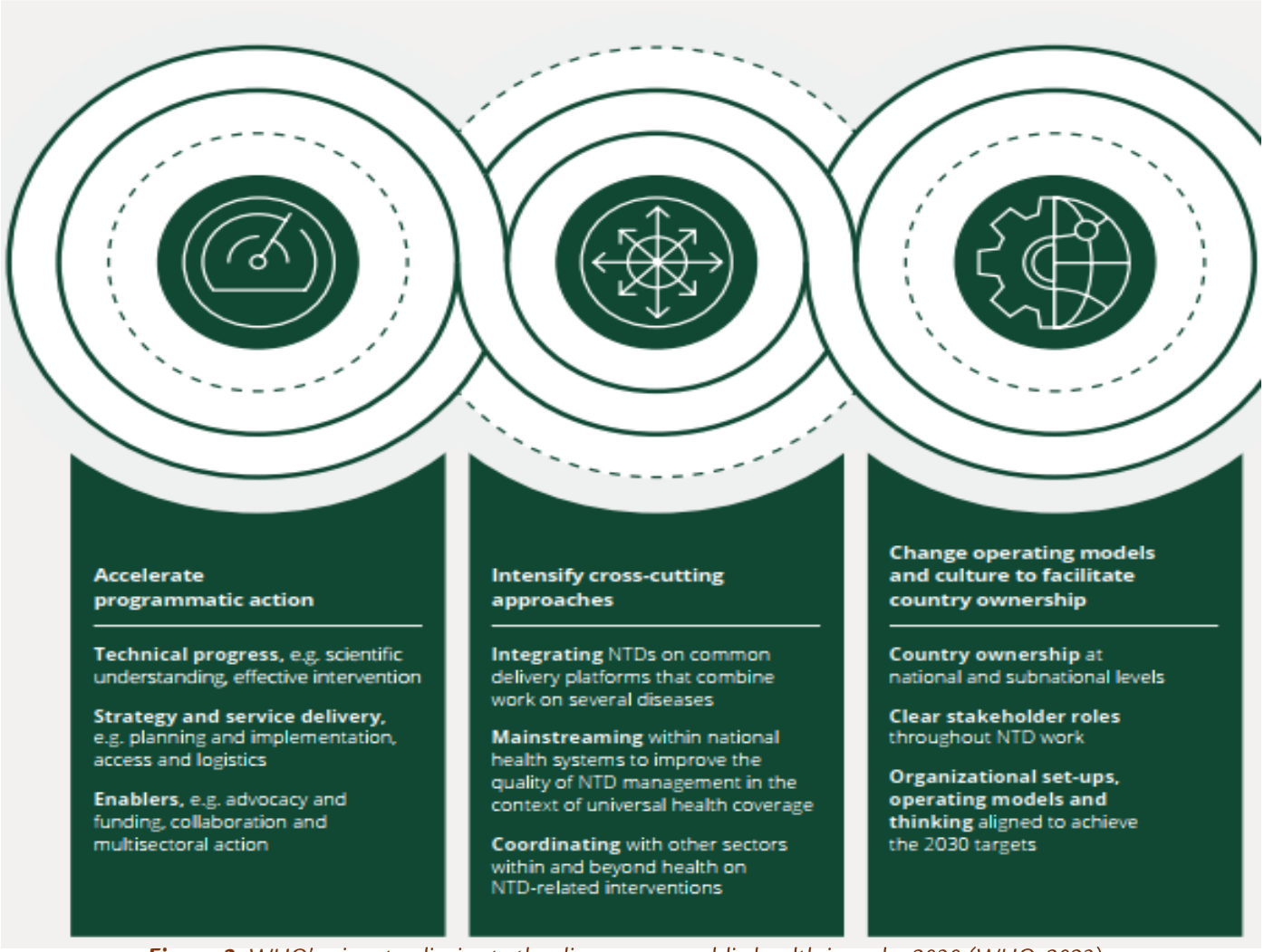

Figure 3: *WHO's aims to eliminate the disease as a public health issue by 2030 (WHO, 2023).*

allow them to persist in conditions of poverty, where they cluster and frequently overlap. WHO coordinates the preventive chemotherapy strategy in consultation with collaborating centers and partners from academic and research institutions, the private sector, non-governmental organizations, international development agencies, and other United Nations organizations. WHO develops technical guidelines and tools for use by national control programs.

Working with partners and the private sector, WHO has advocated for increased access to praziquantel and implementation resources. A significant amount of praziquantel – enough to treat more than 100 million children of the school-age per year has been pledged by the private sector and development partners.

Using the One Health Approach in Neglected Tropical Diseases Elimination

Neglected Tropical Diseases (NTDs) continue to cause hardship and harm to over one billion people worldwide, burdening individuals, families and communities who are already marginalized and disadvantaged. Taking a One Health approach that recognizes the relationship between human, animal, and environmental health is key to sustainably addressing NTDs. One Health is an integrated unifying approach that aims to sustainably balance and optimize the health of people, animals, and ecosystems. Most NTDs, especially schistosomiasis, have a complex lifecycle that usually involves an intermediate host and the environment. For a positive outcome in this approach, there is the need to support the implementation of a possible strategy to control and eliminate diseases.

Moreover, challenges arising from all these sectors can be solved using this integrated approach called One Health, especially in treatment strategies. In zoonotic schistosomiasis, there is the possibility of hybrid formation; using the One Health approach, all forms of the parasite should be considered (both human and animal forms) in treatment programs. To operationalize the use of the One Health approach, the Food and Agriculture Organization of the United Nations (FAO), the World Organisation for Animal Health (OIE), the United Nations Environment Program (UNEP), and

the World Health Organization (WHO) have recognized the definition of One Health, with each unit charging its members to formulate strategies that will help in the integration strategy.

In summary, incorporating One Health principles into NTDs elimination is essential for building resilient communities that can respond to and recover from disease outbreaks and disasters and ideally minimize future occurrences. In schistosomiasis infection, this approach will be a key factor in interrupting community transmission. By emphasizing interdisciplinary collaboration, comprehensive risk assessment, capacity building, and community engagement.

Conclusion

It has been over four decades since the fight against NTDs; however, assessment reports from field surveys still show a considerable percentage of infection persisting in endemic communities. This delay further prevents us from reaching most sustainable development goals (SDGs). The success of the One Health approach in this direction will eventually target about 4 of the SDGs (1, 2, 3 and 6). This approach supports resource-limited areas where funding for each goal is unavailable, as it interlaces the human, animal, and environment. To reach the set goal of schistosomiasis elimination by 2030, all endemic countries must revise their NTD structures and incorporate the One Health approach to hasten the process.

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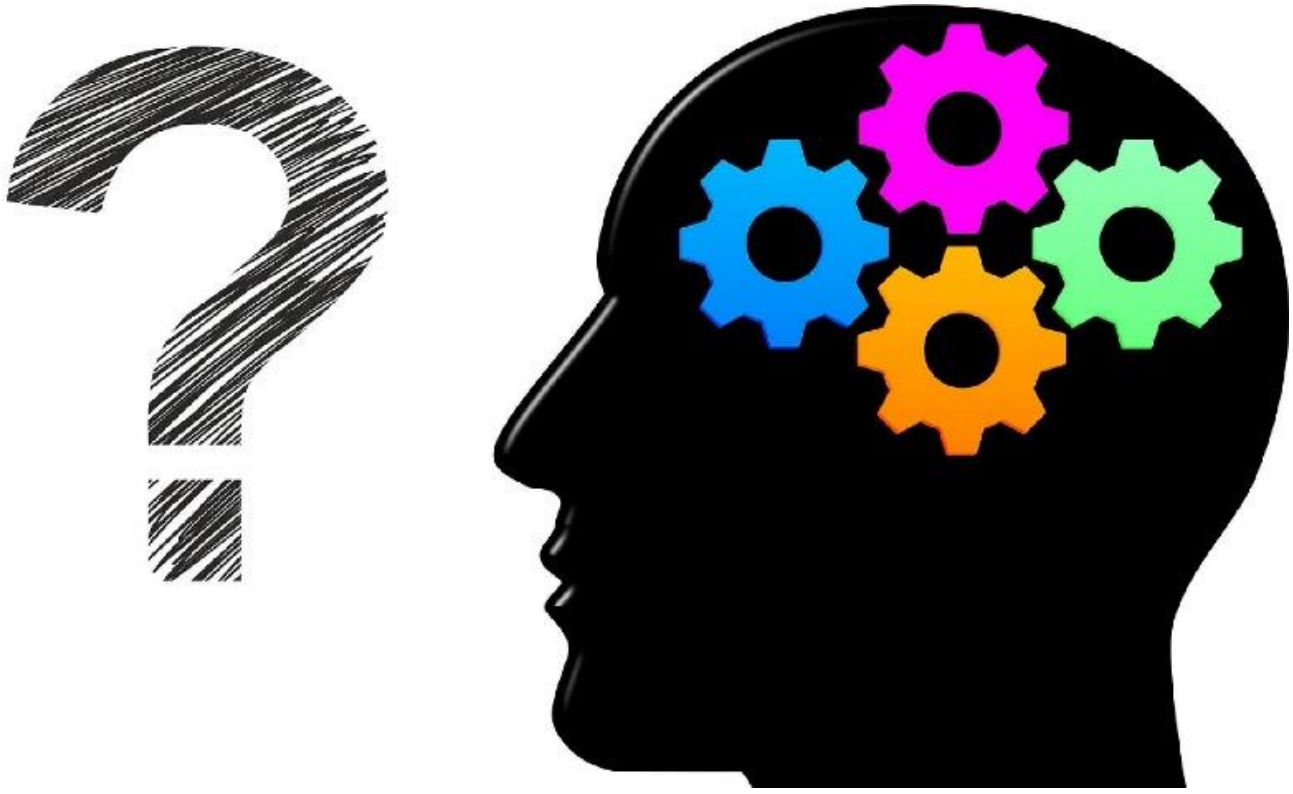
HOW MEMORY WORKS: CAN WE EVER "HACK" THE BRAIN?

Arnold Abakah, Benjamin Adu-Gyamfi

Institution: *Department of Biochemistry and Biotechnology, College of Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.*

Contacts: *abakaharnold@gmail.com (+233 593416328) / gyamfibenjamin88@gmail.com (+233 547071846)*



Have you ever wondered how your brain stores memories? From remembering your best friend's birthday to learning how to ride a bike, our brains perform the incredible task of encoding, storing, and retrieving information daily. But here's the cool part — scientists are uncovering ways to hack the brain to manipulate memory (Dresler et al., 2019) , and what they've found could change everything we know about our minds!

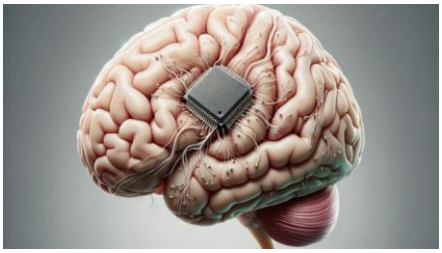
Memory is like the brain's filing system. When you experience something—whether it's the taste of your favorite food or the lyrics of a song—it gets stored in a part of the brain called the hippocampus. Memory storage in the brain involves encoding sensory information, consolidating it into long-term storage with the help of the hippocampus, and strengthening the neural connections between brain regions. The process is dynamic, and memories are constantly being updated and modified throughout our lives (Mujawar et al., 2021). But our brains are more complex than any computer. We don't just store memories; we categorize them, attach emotions to them, and even change them over time! Every time you recall a memory, it gets altered slightly, which is why some old memories may feel blurry or different from what happened (Sridhar et al., 2023).

Here's where things get cool; Scientists have begun experimenting with ways to boost, alter, or even erase memories in animals. Using techniques like optogenetics (where brain cells are controlled using light) or electrical stimulation, researchers have been able to implant false memories in mice and erase specific memories in snails. These experiments show that memories aren't permanent—they can be rewritten like code in a computer program (Nature, 2021).

What does this mean for the future? Well, imagine a world where students could "download" textbooks straight into their brains, or trauma survivors could erase

painful memories. It might sound amazing, but there are serious ethical questions to consider. What happens if someone abuses this technology? Should we really have the power to change what we remember?

Scientists are also working on ways to enhance human memory, possibly even restoring memories in people suffering from conditions like Alzheimer's disease. Brain implants, known as "neural prosthetics," are already being tested to help people with memory loss. These tiny devices could one day improve our ability to store and recall information—like giving our brains extra storage space.



However, with great power comes great responsibility. "Hacking" the brain to manipulate memories could have unexpected consequences. What if erasing memories affects who we are as people? Our experiences shape us, and changing or deleting them could alter our personalities in ways we can't predict.

So, can we hack the brain? Science is still in its early stages, but we're closer than ever to understanding how memory works and whether we can control it. One thing is for sure—memory is not just a record of the past. It's a key part of what makes us who we are. So, while the idea of hacking our brains might be tempting, we should think carefully before diving into a future where memories are just another thing we can control.

It's a fascinating world of discovery, and who knows? Maybe one day, you'll be able to remember reading this article perfectly, thanks to a brain hack!

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LIVING FOOD: THE AMAZING BACTERIA IN YOGHURT

Paa Kwesi Anfu (B.Sc.), Arnold Abakah (B.Sc.)

Institution: *Department of Biochemistry and Biotechnology, College of Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.*

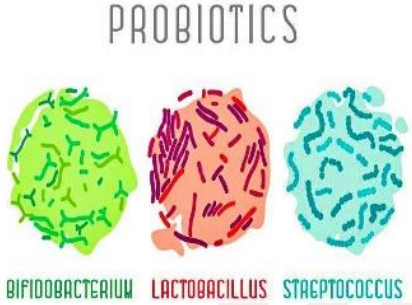
Contact: *pasda2@gmail.com (+233 50 390 8055)/abakaharnold@gmail.com (+233 593416328)*

It's a hot day, and you want something cool, tasty, and filling to help deal with the heat. Yoghurt is your snack choice, and with mouth-watering excitement, you hastily rush to the supermarket to grab a fresh bottle. You quickly put the bottled up against your lips to enjoy your favourite treat, without hesitation. A burst of flavor is sent through your mouth as your taste buds explode with the sweet and sour taste of yogurt.

After the delight, the yogurt follows the path traced by the gullet (oesophagus) and enters the stomach, where something marvelous is about to happen.

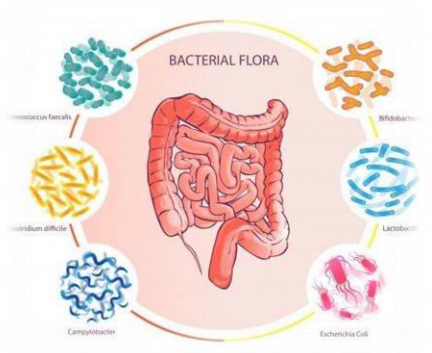
With a microscope magnified to about 1000x, let's dive into the microcosmos of our favourite treat. The microscope's lens reveals an astonishing fact that yoghurt is more than just a snack! It is a habitat for a cluster of beneficial bacteria commonly called Probiotics. But what exactly are they, and what do they do?

Probiotics are live bacteria that promote human health in many ways. Yoghurt is rich, teeming with these "friendly" bacteria, especially strains like Lactobacillus (rod-shaped) and Bifidobacterium ('V' or 'Y' shaped) (Hadjimbei et al, 2022). In the yoghurt, they act to ferment the milk sugars during the preparation process to produce the beloved texture and flavour.



However, their job doesn't end just yet, they have other superpowers that work wonders in the stomach. These miniature gut warriors have a profound influence on digestive health, helping maintain a good balance of gut this means they promote the growth of 'good' bacteria (those that promote health) and keep the harmful bacteria in check.

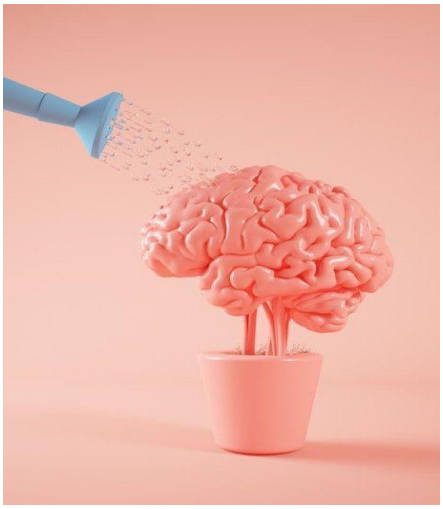
This sounds like a basic task, but it is, on the contrary, a very vital feat because this balance of gut microbiota promotes proper digestion in a variety of ways, with some species of lactobacillus producing short-chain fatty acids (SCFAs) used by the cells in the large intestine to produce energy to efficiently breakdown food substances. The balance in gut flora also prevents gastric issues like bloating, diarrhoea, and constipation thus, providing indirect protection against diseases such as haemorrhoids. Probiotics are sometimes prescribed as therapeutics to regrow gut flora after an antibiotic course since antibiotics can destroy the healthy balance. Sounds like a tasty way to recover after getting sick!



These protective benefits go as far as the immune system. A significant portion of the human immune system is located in the gut; for example, the Gut-Associated Lymphoid Tissue (GALT), which consists of structures such as Peyer's patches and lymphoid follicles, plays an important defensive role in response to pathogens that enter the gut. The probiotics found in yogurt boost immune function in many ways, including enhancing the activity of the body's immune cells like macrophages and T-lymphocytes, multiplying to take up more space, thus reducing the space left for harmful bacteria to thrive and even production of certain organic acids that act as bacteriocins (chemicals that kill bacteria). This helps the body respond more effectively to pathogens and reduces infection risk (Savaiano et al, 2021).

Even the brain and mental health are not left out of the beneficiary roster of these potent micro-warriors found in the delicious treat that is yoghurt. Recent studies suggest that the gut flora balance provided by probiotics enhances the function of enterochromaffin cells lining the gut, which are stimulated to produce serotonin, commonly called the "feel good" neurotransmitter because it significantly influences mood and emotional well-being; it also regulates our sleep-wake cycle. This is further enhanced by the secretion of short-chain fatty acids, which condition the cells for hormone secretion. This evidence proposes that indirectly eating yogurt can make us happy and mentally healthy.

So, the next time you reach for a yoghurt snack, remember these fascinating tiny helpers behind the scenes working not just to give a burst of flavour but also to make a wonderful contribution to your health, one mouthful at a time.



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THE FUNGI THAT CAN CONTROL MINDS: THE OPHIOCORDYCEPS FUNGUS

Benjamin Adu-Gyamfi, Arnold Abakah

Institution: *Department of Biochemistry and Biotechnology, College of Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.*

Contacts: *gyamfibenjamin88@gmail.com (+233 547071846) /abakaharnold@gmail.com (+233 593416328)*

Imagine walking through a lush rainforest when suddenly, you notice something strange. An ant, seemingly frozen in time, is clinging to a leaf high above the forest floor. On closer inspection, you see a bizarre, stalk-like structure growing out of the ant's head. It looks like something out of a Sci-Fi movie, but this is a real-life example of nature's most mind-bending phenomenon: the Ophiocordyceps fungus, or the "zombie-ant fungus."

The story begins when an ant comes into contact with a microscopic spore of the Ophiocordyceps fungus, specifically Ophiocordyceps unilateralis (Phylum: Ascomycota). This tiny spore attaches itself to the ant's body and starts to burrow into its exoskeleton. Once inside, the fungus doesn't just stop eating the ant from the inside out (Evans et al., 2018). It has a more sinister plan—it takes over the ant's brain!

As the fungus spreads through the body, it releases chemicals that hijack the ant's nervous system. Under the influence of the fungus, the infected ant behaves in ways it never would on its own. It leaves the

safety of its colony and climbs to a specific height on a plant or tree, which provides the perfect environment for the fungus to thrive. Then, the ant clamps down on a leaf in a "death grip", anchoring itself in place. It's almost as if the ant is being remote-controlled by the fungus (de Bekker et al., 2015).

Once the ant is securely in place, the fungus grows, eventually killing the ant. But it doesn't stop there. The fungus sprouts a long stalk, called a fruiting body, out of the ant's head. This stalk will eventually release spores that fall to the ground, where they can infect more ants, continuing this eerie cycle.

While the story of the zombie-ant fungus might sound like something out of a horror movie, it's a fascinating example of how life has evolved to survive and thrive in even the most unexpected ways. Scientists are particularly interested in how the fungus manipulates its host's behaviour. Understanding these mechanisms could lead to breakthroughs in neuroscience and even help us develop new medicines.

Moreover, the Ophiocordyceps fungus plays a crucial role in balancing ecosystems. By controlling ant populations, it indirectly affects other species, demonstrating the complex web of life in tropical rainforests. Who knew that deep in the jungle, a tiny fungus could teach us so much about the power of nature and the unexpected connections that make our world so fascinating?

The Ophiocordyceps fungus might sound terrifying, but it's also a reminder of the incredible diversity of life on Earth. It shows us that there is still so much to learn about the natural world and that sometimes, the truth is stranger—and more fascinating—than fiction. So next time you think of zombies, remember the real-life mind controllers lurking in the rainforests, turning ants into unwilling climbers on a one-way trip to their doom.

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UNLOCKING A WORLD OF POSSIBILITIES: THE BENEFITS OF EXPLORING DIVERSE UNIVERSITY PROGRAMS

Hlormenu Solace Aku

Institution: *Department of Biochemistry and Biotechnology, College of Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.*

Contact: *akorfa929@gmail.com (0551247582)*

Thousands of senior high school students attend universities each year hoping to pursue careers as doctors, lawyers, or engineers, sometimes ignoring the wide range of alternative academic options. Many of these students are unaware that their passion and maybe even greater success may lie in courses they have never explored, despite the pressure to follow these well-trod pathways.

While popular programs like engineering, law, and medicine frequently shape senior high school students' career goals, this article aims to draw attention to the unrealized potential of less well-liked university courses.

Many senior high school students attend higher education with a restricted emphasis, typically motivated by societal expectations and the perceived prestige of conventional courses like medicine, law, or engineering, despite the vast number of academic fields accessible at universities. Their capacity to investigate fields that could better correspond with their interests and talents is diminished, and their alternatives are more restricted because of this limited awareness.

The cultural standards that shape this restricted emphasis are primarily responsible for the perception that specific occupations are the ultimate indicators of success. Students are urged to seek jobs like engineering, medicine, and law from an early age, frequently due to the positive connotations of these professions with stability, respect, and financial security.

However, this pressure from society might obscure a student's interests and skills, causing them to ignore a plethora of alternative academic fields that may ultimately provide better success and more joy. Because of this, many students arrive at university knowing very little about the variety of courses

offered. They are ignorant that fields like data science, environmental policy, or digital arts offer opportunities to make a big difference in the world and cater to emerging job markets.

Think about the study of environmental science, which is sometimes neglected in favor of more conventional scientific courses like biology or chemistry. However, environmental scientists are becoming increasingly in demand as the globe struggles with climate change since they play vital roles in conservation, policymaking, and sustainability initiatives. Comparably, anthropology and sociology classes may not appear as glamorous as business or law. Still, they give students valuable training in cultural interpretation and social research, which opens doors to jobs in public health, international development, and human rights advocacy. Actuarial science, a subject that blends statistics, mathematics, and financial theory to evaluate risk in the insurance and finance industries—a highly sought-after and lucrative field—is another topic that is frequently disregarded.

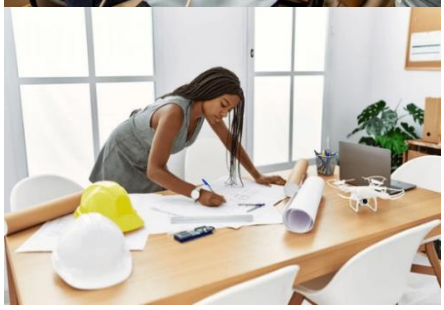
Consider the study of urban planning, which integrates public policy, architecture, and geography to plan and oversee the development of cities. Urban planners are crucial to building sustainable, effective, and livable cities, given the world's fast urbanization, making this a profession that is becoming more and more important. Another illustration is art therapy, a program that combines psychiatry and the arts to support people in using their artistic expression as a means of self-expression and healing. Art therapy is getting more and more recognition for its efficacy in treating and rehabilitating mental health issues, despite its niche position. Then there's the field of agricultural biotechnology, which is crucial to creating sustainable farming methods and enhancing food security in a world where general biology and agricultural studies are more popular.

Additionally, courses like digital humanities, which blend technology with the study of culture and history, prepare students for careers in emerging fields such as digital archiving, virtual reality content creation, and interactive museum exhibits.

Selecting a course that aligns with one's interests might result in extremely fulfilling professional outcomes. For example, a student who majored in marine biology because they have always been captivated by marine ecosystems may find tremendous success and joy in a job focused on ocean conservation and research. This enduring passion motivates not only academic success but also a fulfilling job. Like this, someone who loves to tell stories and majored in creative writing might succeed as an author or editor and enjoy creating stories and literary compositions.

For students to choose courses based on their interests, they should actively explore their hobbies through extracurricular activities, internships, and volunteer work. Having these experiences might assist to identify the areas that speak to you and offer insightful knowledge about a variety of professions. Furthermore, talking to mentors and professionals in related fields may provide advice and a clearer picture of possible career routes, enabling students to select a course that would satisfy them personally and help them achieve their long-term objectives.

Below is a vast array of courses that provide equally good careers you can pursue in universities in Ghana and beyond:



Thorough study and self-evaluation are necessary when choosing the appropriate university course, enabling students to navigate the vast array of academic alternatives and make decisions that align with their interests and professional goals.

To select and investigate the best university course, students must first perform in-depth research in a variety of subject areas. To understand the curriculum, necessary skills, and career objectives connected with various programs, start by perusing course catalogs and institution websites. To thoroughly understand what each program provides, look for comprehensive explanations of the elective options, course material, and possible specialties.

It's also essential to investigate possible job options associated with certain courses. Examine employment statistics, wage expectations, and job market trends for different areas to determine the program's possible long-term advantages. Use Internet resources such as job boards and industry reports to learn more about

employment prospects and industry demands.

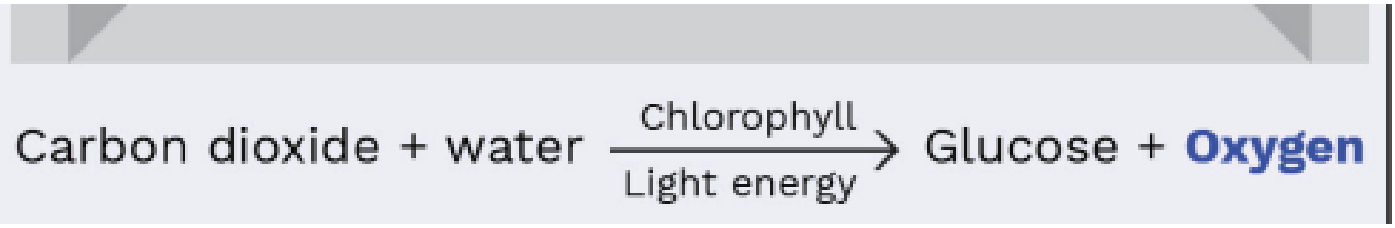
Finally, take the time to consider all alternatives when you are ready to select your university degree and be open to fields that might not be as well-known. Set your hobbies and interests as a top priority, and don't be scared to explore unconventional but genuinely meaningful fields. By doing this, you'll improve your academic experience and put yourself on the road to a lucrative and personally rewarding job. Your future may be shaped by your choices today, so consider them carefully and with faith in your path.

PHOTOSYNTHESIS MADE SIMPLE

Simpson Emmanuel Paa Kwesi (B.Sc.)

Institution: *Department of Biochemistry and Biotechnology, College of Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.*

Contact: *paakwesisimpson@yahoo.com (0202620233)*



Background

Photosynthesis is the process by which plants and bacteria, which are autotrophs, use simple inorganic resources such as water and carbon dioxide in their environment and sunlight as an energy source to synthesize organic food. It is represented chemically by the equation

Photosynthesis occurs in green leaves and other green parts of the plant in the cell organelles called chloroplasts. They are found mainly in the mesophyll cells of the leaves.

Adaptations of Leaves for Photosynthesis

1. Leaves have a large surface area for absorption of light.
2. The presence of stomata for gaseous exchange
3. The concentration of chlorophyll in the upper surfaces of the leave
4. The presence of a waxy cuticle minimizes water loss via transpiration.

These structural and functional adaptations enhance the efficiency of photosynthesis. The main photosynthetic pigment is chlorophyll a. Chlorophyll b, and carotenoids are accessory pigments. They assist with light absorption and protect chlorophyll from photooxidation. While plants absorb light between 400-700 nm, the best wavelength range is 425-460 nm and 600-700 nm

These pigments are arranged on the inner side of the thylakoid membranes of the chloroplast and organized into photosystems 1 and 11. Each photosystem comprises chlorophyll a, molecules that make up the reaction center, and accessory pigments bound by protein, which make up the light-harvesting complex. Photosynthesis occurs in 2 stages: light-dependent and light-independent.

The light stage occurs in the lumen of the thylakoid membrane. The photosynthetic pigment absorbs solar energy, which causes the excitation of electrons. The energy of the excited electrons is transferred to the reaction center. Solar energy splits water molecules into H+ and OH- ions at the reaction center. The electrons are transferred along a series of electron carrier intermediates to reduce NADP to NADPH + H+.

The protons produced during the splitting of water molecules accumulate and form a proton gradient in the thylakoid membrane. The energy released when the protons diffuse from the thylakoid membrane into the stroma is used to synthesize ATP.

In the light-independent stage, ATP and NADPH produced in the light-dependent stage reduce carbon dioxide into glucose in the Calvin cycle.

Photosynthesis requires light between 400 nm and -700 nm. The rate increases with an increase in light intensity. Still, at much higher intensities, its rate decreases, possibly due to photo-oxidation of chlorophyll or other factors that may be limiting.

The light stage is unaffected by temperature, but the light-independent stage, which involves the reduction of carbon dioxide, involves enzymes that may get denatured at high temperatures or inactivated at lower temperatures. The rate of photosynthesis increases with an increase in carbon dioxide concentration. Soil water availability influences the opening or closure of stomata and leaves surface area available for light absorption.

Importance of Photosynthesis

1. Photosynthesis is the only process that converts solar energy into chemical energy in plants
2. Photosynthesis is the primary source of organic carbon to heterotrophs
3. Plants replenish atmospheric oxygen supply through photosynthesis.

Light Reaction (Photochemical Phase)	Dark Reaction (Biosynthetic Phase)
It is directly dependent on sunlight (light).	It is not directly dependent on sunlight (light) but is dependent on the products of light reaction.
ATP and $NADPH_2$ are generated.	ATP and $NADPH_2$ are consumed.
Photolysis of water occurs and oxygen is liberated.	Reduction of carbon dioxide occurs and carbohydrate is formed.
It occurs in the grana of chloroplast.	It occurs in the stroma of chloroplast.

Ghana Science Association
P. O. Box LG 7, Legon
0302-732605/0500-456667
Email: info@ghanascience.gov.gh
https://www.ghanascience.gov.gh/