BIOL 159. PRINCIPLES OF SYSTEMATICS

1st year Biological Sciences (2020/2021 academic year)

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KNUST COVID-19 AWARENESS

COVID-19: Caused by a virus known as Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2). Spreads very **easily** from person to person.

Signs and symptoms: Fever or chills, cough, difficulty in breathing, cold, headache, diarrhoea, loss of taste/smell, and several non-specific symptoms.

Transmission: Respiratory droplets, airborne, contaminated surfaces.

Prevention: Adhere to the KNUST COVID-19 safety protocols

- Respiratory hygiene: Wear a nose mask, cough etiquettes
- Hand hygiene: Frequent hand washing, hand sanitizing
- Maintain 'safe' physical distancing
- Avoid crowds and confined/poorly ventilated spaces

Virus is changing itself with even more serious ramifications, so it is important we all adhere to the safety protocols

1st Semester Program. 3 credit Course

COURSE OUTLINE

1. Systematics and its principles
2. Importance of systematics
3. Classification and its principles
4. Taxanomy
5. Taxanomic rankings
6. History of taxanomy
7. Nomenclature; principles and application
8. Acceptance of scientific names
9. Identification

REFERENCES:

1. Stace, Clive A. (2010). Plant Taxanomy and Biosystematics. 2ed.
2. Monger, G & Sangster, M (2000). Systematics and Classification
3. Gupta, R.K (2006). Introduction to Plant systematics
4. Kershaw, R.D (1983). Animal diversity.
5. Pichenik, J.A (1996). Invertebrate Zoology
6. Jeffrey, C. (2001). Introduction to Plant Taxanomy
7. Pandey, S.P & Chand, S. Botany for Degree Students.
8. Purves, Orians & Heller (2000). Life (science of biology).
9. Any related /appropriate literature is acceptable.

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Systematics and its importance

Systematics is the study of biological diversity and its origins.

Systematics is the branch of biology that deals with the diversity and inter-relationships of living things through time, of both current organisms (neontology) and prehistoric ones (palaeontology), ie. extinct and extant organisms.

*It is therefore the study of biodiversity and its historical (evolutionary) and modern patterns and processes, which involves the comparative study of living and fossil species.
*Systematics thus, involves taxonomy and phylogenetic analysis. The relationships are illustrated by a phylogenetic or evolutionary tree.
***Phylogenetics** is the science of reconstructing the evolutionary history of the organisms.

*Biological **systematics** is therefore, the study of the diversification of life on the planet earth, both past and present, and the relationships among living things through time.

*Relationships are visualized as evolutionary trees **(**cladograms, phylogenetic trees **or phylogenies).**

* Phylogenies have two components, branching order (showing group relationships) and branch length (showing amount of evolution).

*Phylogenetic trees of species and higher taxa are used to study the evolution of traits (e.g., anatomical or molecular characteristics) and the distribution of organisms (biogeography).
*Systematics make use of classification and taxanomy.
*C**lassification** focuses on placing organisms within hierarchical groups that show their relationships to other organisms while,
***Taxonomy** is the identification, description, and naming (i.e. nomenclature) of organisms.

HISTORY OF SYSTEMATICS

*The study of systematics started with Phenetic systematics which was an attempt to determine the relationships of organisms through a measure of similarity, considering plesiomorphies (ancestral traits) and apomorphies (derived traits).

*From the 20th century onwards, it was superseded by cladistics, which considers plesiomorphies to be not enough for resolving the phylogeny of Earth's various organisms through time.
*Today's systematists generally make extensive use of molecular biology and computer programs to study organisms.

Importance of Systematics

a) Contributions of systematics to biology . Systematics is fundamental to biology because it is the foundation for all studies of organisms, by showing how any organism relates to other living things.

b) *Biodiversity conservation;* It helps to prevent the extinction of unknown species. Much of life on Earth is still unnamed and undescribed. In the face of the ever increasing exploitation of forest resources, there is the need to discover and describe the species before they are lost.

*Extinction and loss of biodiversity cannot be prevented unless its basic units, the species and their relationships, are known.

*Systematics therefore needs to explain the biodiversity of an area which could be useful in allocating limited means to preserve and protect endangered species.

*One way of achieving this is to look at the genetic diversity among various taxa of plants or animals and decide how much of that it is necessary to preserve.

There is also the need to establish ‘germplasm’ banks for all the threatened plants. (taxanomy).

c) Identifying invasive alien species. Invasive alien species have been identified as one of the major causes of biodiversity loss worldwide.

*These species are able to reproduce and spread more rapidly than their native counterparts. They therefore threaten native species and their habitats, and are capable of causing damage to economic interests such as forestry, agriculture and infrastructure.

*Taxonomists play a crucial role through identification of new species that have appeared and assess whether they have the potential to become invasive.

d) Monitoring climate change

*When taxonomists collect specimens they note down information on where the organisms are collected from.

*Thus, comparing information on where a specimen of a particular species was found in the past, with where it is found now, ie. the shift.

*This can help determine whether **(i)** the global distributions of species are changing as a result of climate change, and (**ii**) how fast species are shifting their distributions.

e) *Pest and disease control.*

*Pest species and their natural enemies must be correctly identified before adequate control measures can be applied. Identification of pest species provides knowledge about the biology and distribution of the pest organisms.

*Identification can help us determine the original home of the species and the area where foreign exploration for parasites, predators or pathogens is likely to be most productive.

*Systematics play an important role in the control of some diseases by identifying which individual species of a group of similar species are responsible for spreading disease(s), e.g. which species of mosquito spreads malaria.

f) *Plant and animal breeding (GMO's).*

*The ever increasing human population has necessitated an increase in agricultural production.

*This demand has lead to vigorous research in many areas of study including genetics and plant breeding.

*This also inform them of their probable wild relatives which are essential in crop improvement programs, enabling them to breed for desirable qualities such as disease resistance

g) *Medicine*

*Pharmaceutical industries depend on taxonomists for the correct identification and classification of species which have medicinal value.

*For example, when a chemical suitable for a pharmaceutical product is found in one species, biochemists can quickly learn from classifications of the close relatives;

* (e.g., other species in the same genus or the 'sister-species') that might contain similar or even better chemicals.

*All species in the same genus should share many behavioral, biochemical, ecological and biological properties because they are closely related evolutionarily.

*Taxonomists have a unique role in identifying the wild relatives of medicinal plants and helping to conserve them.

h) *Agriculture*

*Modern agriculture together with urbanization has created the disappearance of many genetically varied strains of crop plants and their wild relatives.

*Farmers have been induced to rely solely on standard genetically uniform strains leading to the narrowing of the genetic base of crop plants to an alarming degree.

*Majority of the traditional varieties that have gone extinct possess desirable characteristics that can not be fond in GMO's.

*such as disease- and pest-resistance, high yielding ability and photosynthetic efficiency.

*Systematicists have been instrumental in solving this problem of genetic erosion of crop plants through gene-banks and in situ conservation as well as discovering and identifying their wild relatives.

i) Common Language

Systematists provide taxonomic nomenclature which serves as the most fundamental building block for information sharing on biological resources (the scientific name).

*Name given to an animal can be given to different plant but cannot be given to any other animal.

THANKS