**PAN AFRICAN UNIVERSITY**



**INSTITUTE FOR BASIC SCIENCES, TECHNOLOGY AND INNOVATION**

**DEPARTMENT OF MOLECULAR BIOLOGY AND BIOTECHNOLOGY**

**MSc. MOLECULAR BIOLOGY AND BIOTECHNOLOGY**

**COURSE:**

**PUB 3120: Research Methodology and Proposal Development**

**LECTURER:**

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**ASSIGNMENT 1**

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**1-Look for one publication for each research type described:**

1. Exploratory research :

Title:

# Exploratory research on molecular communication between nanomachines

Abstract:

This paper describes the possibility of molecular communication as a solution for communication between nanomachines. Nanomachines are artificial or biological nano-scale devices that perform simple computation, sensing, or actuation. Existing communication technologies cannot be applied to nano-scale communication between nanomachines due to difficulty of scaling down and energy inefficiency of existing technologies. Molecular communication applies the communication mechanisms existing in biological cells to provide a mechanism for nanomachines to communicate over a short distance (adjacent nanomachines to tens of micrometers) by sending and receiving molecules as a communication carrier. Communicating nanomachines can spur the creation of entirely new applications such as communication among the computation gates of a molecular computer. This paper presents the framework of the molecular communication.

1. Describtive research:

Title:

# Application of case study to introduce medical students to molecular biology techniques used in HIV diagnostics

Abstract:

Diagnostic molecular biology is a fast developing discipline of laboratory medicine widely used in numerous medical branches such as oncology, hematology, immunology, internal medicine, or infectious diseases, which will certainly have a major impact on clinical medicine in the near future. Nowadays, educational process is forced to face the quickly growing overflow of easily accessible data and properly guide the students not to be lead astray in the information chaos. Hence, in view of the foregoing, it appears obvious that modern medical education should put particular stress on selective acquiring, interpreting, and applying integrated multidisciplinary knowledge rather than on just absorbing and memorizing huge amount of scattered information. The presented case study aims at familiarizing the students with basic molecular biology techniques such as enzyme-linked immunosorbent assay, Western blot, and quantitative reverse transcription-polymerase chain reaction. Importantly, it is not limited only to discussing and learning the principles of the assays mentioned earlier, but it also shows their practical application in a particular diagnostic process and give the guidelines on how to explain and interpret exemplary results. In parallel, the way the case study is constructed allows a tutor to lead students into discussion on clinical aspects related to HIV infection what should eventually create complete picture of a HIV diagnostic process, thereby integrating basic knowledge of molecular biology laboratory techniques, HIV biology, and immunological response.

1. Explanatory research:

Title:

Metabolomics Profile and Pro-Apoptotic Activity of Solanecio mannii Root Extracts Against Human Cervical Cancer Cell Lines

Abstract:

**Background**: Cervical cancer is the third most prevalent cancer globally, with high incidence and mortality rates. Current treatments

often result in severe side effects and drug resistance. While Solanecio mannii (S. mannii) roots have been traditionally used in cancer

treatment, there is a lack of scientific validation of their anticancer potential. Therefore, the present study sought to analyze the metabolomics

profile of the extracts and evaluate its anticancer and pro-apoptotic potential.

**Methods:** S. mannii roots were collected, freeze-dried, and extracted using diethyl-ether: methanol (v:v) for total extraction, and hexane

and ethyl acetate for fractionation. This study analyzed the metabolomic profiles of S. mannii root extracts using gas chromatography

coupled to mass spectrometry and evaluated their selective cytotoxic effect on human cervical cancer cell lines, specifically

Henrietta Lacks (HeLa) cell lines. Moreover, this study investigated the extracts’ potential to modulate autophagy and induce apoptosis.

The pro-apoptotic effect of S. mannii was evaluated by analyzing chromatin morphological changes, the expression of Bcl-2

homologous antagonist/killer (BAK) and BCL2-Associated X (BAX) genes, and the activity of caspases.

**Results**: S. mannii exhibited selective anticancer and anti-proliferative activities against HeLa cells, with IC50 values of 113±0.28 μg/mL

for the total extract, 38.94 ±0.87 μg/mL for the hexane fraction, and 12.16 ±0.52 μg/mL for the ethyl acetate fraction. Additionally,

S. mannii root extracts modulated autophagosome formation and autophagy-related genes. Furthermore, extracts exhibited an intrinsic

pro-apoptotic potential by upregulating BAK and BAX and increasing the activity of caspase-9, −3, and −7 in a time- and dosedependent

manner. These effects are attributed to the bioactive phytocompounds identified in the extracts, including syringic acid, 4-

coumaric acid, caffeic acid, vanillin, hydroquinone, oleic acid, beta-sitosterol, and stearic acid, among others.

**Conclusion**: This study showed the selective anticancer and pro-apoptotic activity of S. mannii root for the management of cervical cancer.

1. Predictive research:

Title:

Predicting potential target genes in molecular biology experiments using machine learning and multifaceted data sources.

Abstract:

Experimental analysis of functionally related genes is key to understanding biological phenomena. The selection of genes to study is a crucial and challenging step, as it requires extensive knowledge of the literature and diverse biomedical data resources. Although software tools that predict relationships between genes are available to accelerate this process, they do not directly incorporate experiment information derived from the literature. Here, we develop LEXAS, a target gene suggestion system for molecular biology experiments. LEXAS is based on machine learning models trained with diverse information sources, including 24 million experiment descriptions extracted from full-text articles in PubMed Central by using a deep-learning-based natural language processing model. By integrating the extracted experiment contexts with biomedical data sources, LEXAS suggests potential target genes for upcoming experiments, complementing existing tools like STRING, FunCoup, and GOSemSim. A simple web interface enables biologists to consider newly derived gene information while planning experiments.

**2- How else can research be classified?**

Research can be classified by purpose into:

1. Basic research.
2. Applied research.

Also can be classified by it is methods into:

1-Qualitative research.

2-Quantitative research.