



INTERNATIONAL VIRTUAL **RESEARCH** **INTERNSHIP** PROGRAM ON GENOMICS AND BIOINFORMATICS

Embark on a Profound Exploration of Genomics and Bioinformatics, where you'll Master Essential Skills, Foster Global Collaboration, and Translate Your Research into Publishable Discoveries of Significance and Impact.

We envision inspiring and empowering life scientists to leverage **GENOMICS AND BIOINFORMATICS** to tackle critical challenges, drive innovation, and promote sustainable progress across the globe.

Research Domain: Human Genomics

Research Focus: Human Genomics Research

Research Topic: Genomic Studies of Parkinson's Disease: Identifying Genetic Variants and Pathways

Research Aim: To explore the genetic variants and pathways involved in the pathogenesis of Parkinson's disease, aiming to uncover key genetic factors and molecular mechanisms that contribute to the development and progression of the disease.

Research Objectives:

- **Identify Genetic Variants Associated with Parkinson's Disease:** Perform genomic sequencing and analysis to detect and catalog genetic variants that are linked to Parkinson's disease.
- **Elucidate Pathways Involved in Disease Pathogenesis:** Investigate the molecular pathways influenced by identified genetic variants to understand their roles in the development and progression of Parkinson's disease.

LEARNING OBJECTIVES

- **Master Genomic Sequencing Techniques:** Gain proficiency in whole genome and exome sequencing to identify genetic variants associated with Parkinson's disease.
- **Analyze Genetic Variants:** Develop skills in identifying, cataloging, and interpreting genetic variants using bioinformatics tools and databases.
- **Investigate Molecular Pathways:** Learn to analyze and understand the molecular pathways influenced by genetic variants, focusing on their roles in the pathogenesis of Parkinson's disease.
- **Integrate Genomic and Functional Data:** Acquire the ability to integrate genetic data with functional studies to derive meaningful insights into the genetic and molecular mechanisms underlying Parkinson's disease, ultimately aiming to inform potential therapeutic strategies.
- **Craft Research Papers for Publication:** Learn how to synthesize and present your findings coherently, culminating in the preparation of research papers suitable for publication, contributing to the broader understanding of the evolution and dissemination of cancer tumorigenesis.

EXPECTATIONS WHILE UNDERTAKING THIS FELLOWSHIP PROGRAM:

- **Knowledge of Genomics and Bioinformatics:** Develop a solid foundation in genomics and bioinformatics, including an understanding of key concepts, methodologies, and technologies used in the program
- **Proficiency in Data Analysis:** Gain proficiency in analyzing genomic data using bioinformatics tools and software. This includes skills in data preprocessing, quality control, data visualization, and statistical analysis.
- **Research Skills:** Acquire research skills necessary for conducting genomics and bioinformatics studies. This includes formulating research questions, designing experiments, collecting and analyzing data, and interpreting research findings.
- **Critical Thinking and Problem-Solving:** Develop critical thinking skills to analyze complex genomic and bioinformatics problems and propose creative solutions. You would be able to evaluate scientific literature, identify research gaps, and contribute to the advancement of knowledge in the field.
- **Computational Skills:** Gain proficiency in software and applications commonly used in bioinformatics, such as Geneious software, web servers etc. to analyze genomics data and interpret results
- **Communication Skills:** You would be able to effectively communicate your research findings and scientific concepts to both technical and non-technical audiences. This includes writing scientific reports, presenting research orally, and participating in scientific discussions and collaborations.
- **Collaboration and Teamwork:** Be able to develop skills in collaborating with peers and professionals in multidisciplinary research teams. This includes effective communication, teamwork, and the ability to contribute constructively to group projects.
- **Professional Development:** You would be able to develop a professional mindset, including skills in time management, organization, and project management. They should also be aware of current trends and advancements in genomics and bioinformatics, and actively seek opportunities for professional growth and development.
- **Publication and Dissemination:** Contribute to the scientific community by publishing their research findings in peer-reviewed journals

PROGRAM OUTLINE AND SCHEDULE

CLASSES	TOPICS/FOCUS	SCHEDULE & DELIVERABLES
General Classes	Overview of genomics, bioinformatics, and their applications in various fields	Week 1
	Understanding the central dogma of molecular biology	
	Introduction to genomics technologies and data generation	
	Data formats in Genomics and Bioinformatics (Practical)	
	Internet tools and Databases (Practical on data retrieval, Blast etc.)	
	Introduction to software tools and their installation, web servers, and pipeline tools (Practical), Basic Linux Command Line Interface	
	Genomics Data and its Analysis using cutting-edge tools (Practical DNA, RNA and Protein samples)	
Specialized Classes	Introduction	Week 1
	The experimental application of each of these in your field of study	
	Problem identification relative to the above area in the healthcare, industrial, and other life science research space	
	The use of critical thinking and problem-solving tools to design a hypothesis in solving identified problems	
PRACTICAL SESSIONS		
Data Acquisition and Preprocessing	Collection of DNA Data: Collect genomic datasets containing genetic information of the cancer case study in patients, including SNP data and clinical outcomes. (For both Reference and Query)	Week 2
	Table 1: Construction of General Sequence Properties: via data table based on genome information which includes accession number, raw data size, sources, geographical regions platform, genome type, layout, file types, etc.	
	Write Up 1: Data Collections	
DNA Sequence Alignment	Mapping to Reference: Aligning Reads to Reference Sample	Week 3
	Write Up 2: Mapping to Reference	
Comprehensive Genome Analysis	Variant Calling Analysis: Call variants (SNPs and INDELS) by comparing sequenced reads to the reference genome i.e., performing variant analysis to identify variants specific to identify relevant SNP-associated variations of the disease in the patients	Week 4
	Effect Prediction and Functional Analysis: Annotate SNP variants to determine their genomic location, potential functional effects, and allele frequencies (i.e., focus on variants affecting protein-coding genes, regulatory elements, and non-coding RNAs).	

	<p>Write Up 3: Variant Calling Analysis, Effect Prediction and Functional Analysis</p> <ul style="list-style-type: none"> • Table 3: Construction of SNPs or Indels • Figure 1: Mapping View • Figure 2: Variant Calling View 	Week 5
	<p>Molecular Pathways Analysis:</p> <ul style="list-style-type: none"> • Investigate the molecular pathways influenced by identified genetic variants to understand their roles in the development and progression of Parkinson's disease. <p>Statistical Analysis:</p> <ul style="list-style-type: none"> • Table 4: General information on all predicted SNPs • Table 5: Identify unique and shared variants, as well as those specific to each sample 	
	<p>Write Up 6: Variant Annotation and Functional Prediction</p> <p>Statistical Analysis:</p> <ul style="list-style-type: none"> • Table 6: Annotated SNPs and their functions • Figure 3: Percentage abundance of all SNPs covering nonsynonymous, synonymous, and regulatory regions. • Figure 4: Ratio of SNPs with effect on protein or functional genes • Figure 5: Classification of variants based on their effect types • Figure 6: Significantly enriched or depleted variants in both sample subtypes • Figure 7: Pathway enrichment analysis 	Week 6
RESEARCH PROJECT OUTLINE FOR PUBLICATION		
Research Outline	Finalizing Materials and Method	Week 7 - 8
	Result Writing	
	Discussion and Conclusion	
	References and Abstract	
Round Up	Certification and Recommendation Letter	Week 9
	Follow-up and Publication	