Systems Biology and Network Pharmacology Training Course

Professional Development Training Course Outline

Category	Biotechnology and Pharmaceutical Development	**Duration**	10 Days
Base Fee	$4,000 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

The post-genomic era has fundamentally shifted the paradigm of drug discovery from the traditional ? Ç£one-target, one-drug?Ç¥ model to a holistic, systems-level understanding of disease complexity. Systems Biology and Network Pharmacology Training Course provides essential expertise in Systems Biology and Network Pharmacology (NP) two critical, synergistic disciplines. Participants will master the integration of massive multi-omics data using computational modeling and advanced bioinformatics to identify robust multi-target therapeutics. By leveraging network science, this course empowers researchers to decipher complex disease pathophysiology, predict drug-target interactions, and accelerate rational drug design for challenges like cancer resistance, neurodegenerative disorders, and emerging infectious diseases.

This hands-on program moves beyond theory, focusing on practical application through AI/Machine Learning (ML) workflows and modern data-driven drug discovery. Professionals will gain proficiency in analyzing Protein-Protein Interaction (PPI) networks, identifying hub genes, and executing drug repurposing strategies, ensuring their organization remains at the forefront of precision medicine and systems pharmacology. The ability to navigate and interpret complex biological data structures is no longer optional it is the cornerstone of developing more effective, safer, and personalized treatment strategies in the rapidly evolving biotech and pharmaceutical landscape.

Programme Curriculum

Systems Biology and Network Pharmacology Training Course

Introduction

The post-genomic era has fundamentally shifted the paradigm of drug discovery from the traditional?Ç£one-target, one-drug?Ç¥ model to a holistic, systems-level understanding of disease complexity. Systems Biology and Network Pharmacology Training Course provides essential expertise in Systems Biology and Network Pharmacology (NP) two critical, synergistic disciplines. Participants will master the integration of massive multi-omics data using computational modeling and advanced bioinformatics to identify robust multi-target therapeutics. By leveraging network science, this course empowers researchers to decipher complex disease pathophysiology, predict drug-target interactions, and accelerate rational drug design for challenges like cancer resistance, neurodegenerative disorders, and emerging infectious diseases.

This hands-on program moves beyond theory, focusing on practical application through AI/Machine Learning (ML) workflows and modern data-driven drug discovery. Professionals will gain proficiency in analyzing Protein-Protein Interaction (PPI) networks, identifying hub genes, and executing drug repurposing strategies, ensuring their organization remains at the forefront of precision medicine and systems pharmacology. The ability to navigate and interpret complex biological data structures is no longer optional it is the cornerstone of developing more effective, safer, and personalized treatment strategies in the rapidly evolving biotech and pharmaceutical landscape.

Course Duration

10 days

Course Objectives

1. Master the principles of Systems Pharmacology and Polypharmacology.
2. Develop proficiency in integrating multi-omics data for holistic network analysis.
3. Utilize AI and Machine Learning models to predict Drug-Target Interactions (DTIs).
4. Construct and analyze Protein-Protein Interaction (PPI) networks using advanced tools like Cytoscape.
5. Identify critical hub genes and functional modules associated with complex diseases.
6. Execute full Network Pharmacology workflows from data retrieval to pathway visualization.
7. Apply computational methods for effective drug repurposing and natural product discovery.
8. Understand the role of Pharmacogenomics in personalizing therapeutic regimens.
9. Implement Quantitative Systems Pharmacology (QSP) models for disease simulation.
10. Decipher mechanisms of action for Traditional Chinese Medicine (TCM) using network science.
11. Design rational combination therapy strategies to overcome drug resistance.
12. Conduct Pathway Enrichment Analysis (PEA) to uncover underlying disease mechanisms.
13. Integrate Structural Bioinformatics with network models.

Target Audience

1. Bioinformaticians.
2. Pharmaceutical Researchers.
3. Biotech Scientists.
4. Computational Biologists
5. Toxicology and Safety Assessment specialists.
6. Graduate Students in Pharmacology, Genomics, or Medicinal Chemistry.
7. Clinicians/Translational Researchers.
8. Data Scientists.

Course Modules

Module 1: Foundations of Systems Biology

- The transition from reductionism to the systems approach in biology.
- emergence, robustness, nonlinearity, and dynamic behavior.
- Overview of the central dogma in a network context.
- Case Study: Modeling metabolic flux in yeast using Constraint-Based Reconstruction and Analysis
- Introduction to mathematical modeling in biological systems.

Module 2: Introduction to Network Pharmacology

- The ?Ç£network-target, multiple-component?Ç¥ philosophy and Polypharmacology.
- Difference between systems biology and network pharmacology applications.
- Core workflow.
- Case Study: Analyzing the mechanism of action of Aspirin as a multi-target drug.
- Defining network topology concepts.

Module 3: Data Retrieval and Curation (Omics Data)

- Retrieving drug, compound, and target data from databases
- Accessing disease-related genes and pathways
- Data standardization and cleaning for heterogeneous multi-omics data sets.
- Case Study: Retrieving and filtering bioactive compounds from a natural product library
- Handling gene expression profiles for differential expression analysis.

Module 4: Protein-Protein Interaction (PPI) Networks

- Sources of PPI data and quality assessment.
- Methods for PPI network construction and visualization using Cytoscape.
- Identifying network metrics.
- Case Study: Building a PPI network for a specific type of cancer
- Recognizing limitations and biases in publicly available PPI data.

Module 5: Topological Network Analysis

- Identifying key structural features.
- Algorithms for community detection and functional module extraction.
- Applying centrality measures to prioritize targets.
- Case Study: Prioritizing targets in a neurodegenerative disease network by calculating centrality scores.
- Interpreting network diagrams and generating publication-ready visualizations.

Module 6: Pathway and Functional Enrichment Analysis (PEA)

- Utilizing KEGG, GO, and Reactome for pathway mapping.
- Statistical methods for enrichment
- Interpreting enriched pathways to understand drug mechanism and disease etiology.
- Case Study: Identifying the most significantly altered pathways impacted by an anti-inflammatory drug.
- Visualizing pathway results and mapping genes onto pathway diagrams.

Module 7: AI and Machine Learning for Drug Discovery

- Introduction to supervised and unsupervised ML algorithms.
- Feature engineering using compound descriptors and target properties.
- Predicting Drug-Target Interactions using Graph Neural Networks (GNNs) principles.
- Case Study: Building a predictive model to classify potential binders vs. non-binders for a viral protein.

- Understanding model validation metrics.

Module 8: Drug Repurposing and Novel Indications

- The concept and economic advantages of Drug Repurposing.
- Signature-based approaches
- Network proximity analysis for connecting existing drugs to new diseases.
- Case Study: Repurposing an FDA-approved drug for COVID-19 treatment based on host-pathogen network overlap.
- Designing rational drug combinations for synergistic effects.

Module 9: Quantitative Systems Pharmacology (QSP)

- Principles of pharmacokinetic (PK) and pharmacodynamic (PD) modeling.
- Introduction to constructing QSP models using ordinary differential equations
- Simulating dynamic drug response and dose-response curves in silico.
- Case Study: Developing a simple QSP model to predict drug concentration-time profiles in different tissues.
- Parameter sensitivity analysis and model refinement techniques.

Module 10: Systems Oncology and Cancer Networks

- Analyzing the hallmarks of cancer from a network perspective.
- Identifying resistance mechanisms and bypass pathways in tumor cells.
- Targeting tumor microenvironment and immune cell interactions.
- Case Study: Mapping signaling pathways to discover combination therapies that overcome drug resistance in breast cancer.
- Integrating somatic mutation data into network models.

Module 11: Application in Traditional Medicine and Natural Products

- Deciphering the multi-component mechanisms of herbal formulae
- Utilizing specialized databases for natural products
- Linking phytochemicals to molecular targets and resulting network perturbation.
- Case Study: Applying network pharmacology to determine the therapeutic mechanism of a specific herbal decoction for anti-inflammatory action.
- Challenges and standardization issues in natural product network studies.

Module 12: Structural Bioinformatics and Network Integration

- Fundamentals of ligand-protein interaction and molecular docking.
- Using docking results to validate predicted drug-target interactions
- Integrating 3D structural data (PDB) into network visualization.
- Case Study: Performing molecular docking of a predicted compound into a prioritized hub target.
- Introduction to molecular dynamics (MD) simulations for target stability.

Module 13: Pharmacogenomics and Personalized Medicine

- Analyzing Single Nucleotide Polymorphisms and their effect on drug response.
- Using network models to understand individual variability and adverse effects.
- Stratifying patients based on network biomarkers and genetic signatures.

- Case Study: Developing a personalized treatment plan for a patient with a known genetic polymorphism affecting drug metabolism
- Ethical considerations and data privacy in personalized medicine.

Module 14: Data Visualization and Reporting

- Best practices for effective network visualization and presentation.
- Generating high-impact figures for publications and reports.
- Statistical rigor and proper reporting of bioinformatics findings.
- Case Study: Presenting a complete network pharmacology project summary to a non-specialist audience
- Developing reproducible workflows and documentation standards.

Module 15: Final Capstone Project

- Participants select a disease, identify a target, and propose a therapeutic strategy.
- Data retrieval, network construction, and topological analysis.
- Validation using pathway enrichment and literature mining.
- Case Study: Comprehensive end-to-end project: Investigating novel targets for a neglected tropical disease.
- Peer review and final project presentation/defense.

Training Methodology

This course employs a participatory and hands-on approach to ensure practical learning, including:

- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.
- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.
- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call +254769199797

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	04 Dec 2026	Online	$2,000
23 Nov 2026	04 Dec 2026	Physical	$3,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$9,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$12,000

Ready to enroll or request a customized program? Book online or contact us:

Register Online Now

Email: info@fineskilltrainingcenter.com | Website: www.fineskilltrainingcenter.com