

4-Week Online Workshop on Latest Protein Engineering Tools

For Undergraduate Students in Biology, Biotechnology, Biochemistry, and Life Sciences

Workshop Overview

This 4-week online workshop will introduce students to **cutting-edge tools and techniques in protein engineering**, including **rational design, directed evolution, CRISPR applications, molecular docking, and AI-driven protein design**. Through **theoretical sessions, hands-on computational training, and case studies**, participants will learn how protein engineering is revolutionizing **drug discovery, enzyme engineering, and synthetic biology**.

Workshop Structure & Study Design

Week 1: Fundamentals of Protein Engineering

✦ **Objective:** Understanding the principles and approaches in protein engineering.

Topics Covered

- **Introduction to Protein Engineering:**
 - Basics of protein structure and function.
 - Overview of **rational design vs. directed evolution**.
- **Recombinant DNA Technology for Protein Engineering:**
 - Site-directed mutagenesis techniques.
 - Expression systems (bacteria, yeast, mammalian).
- **Structural Bioinformatics for Protein Analysis:**
 - Protein folding and stability predictions.
 - Databases: PDB, UniProt, SwissProt.

Hands-on Activities:

- ✓ Exploring protein databases (PDB, UniProt) and analyzing protein structures.
 - ✓ Virtual demonstration of site-directed mutagenesis (Benchling/NEBaseChanger).
 - ✓ **Assignment:** Literature review on a protein engineered for industrial or medical applications.
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Week 2: Computational Tools for Protein Engineering

✦ **Objective:** Learning to predict and analyze protein modifications using bioinformatics tools.

Topics Covered

- **Molecular Docking & Drug Design:**
 - Introduction to molecular docking and ligand-protein interactions.
 - Docking tools: **AutoDock, PyMOL, SwissDock.**
- **Molecular Dynamics (MD) Simulations:**
 - Protein flexibility and stability analysis.
 - MD software: GROMACS, ChimeraX.
- **AI & Machine Learning in Protein Engineering:**
 - AlphaFold for protein structure prediction.
 - AI-based enzyme engineering and drug discovery.

Hands-on Activities:

- ✓ **Performing molecular docking using AutoDock.**
 - ✓ **Protein structure prediction using AlphaFold (Google Colab).**
 - ✓ **Assignment:** Analyze a protein's drug-binding site using PyMOL.
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Week 3: Directed Evolution & CRISPR-Based Protein Engineering

✦ **Objective:** Exploring laboratory-based evolution and genome editing for protein modification.

Topics Covered

- **Directed Evolution for Enzyme Engineering:**
 - Random mutagenesis techniques.
 - High-throughput screening for improved proteins.
- **CRISPR-Cas9 for Protein Engineering:**
 - CRISPR applications in synthetic biology.
 - Engineering proteins for therapeutic applications.
- **Case Studies in Protein Engineering:**
 - Industrial enzymes (e.g., engineered amylase in biofuels).
 - Engineered antibodies for targeted cancer therapy.

Hands-on Activities:

- ✓ **Simulating CRISPR gene editing using Benchling.**
 - ✓ **Case study: Engineering a fluorescent protein for biosensors.**
 - ✓ **Assignment:** Propose a directed evolution strategy to improve an enzyme's efficiency.
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Week 4: Synthetic Biology & Industrial Applications of Protein Engineering

✦ **Objective:** Understanding synthetic biology approaches and real-world applications of engineered proteins.

Topics Covered

- **Synthetic Biology & Artificial Protein Design:**
 - De novo protein design and computational tools.
 - AI-generated proteins (e.g., ProGen).
- **Industrial & Biomedical Applications of Engineered Proteins:**
 - Engineered insulin and monoclonal antibodies.
 - Industrial enzymes in detergents, biofuels, and food processing.
- **Ethical Considerations & Future of Protein Engineering.**

Hands-on Activities:

- ✓ Exploring de novo protein design using Rosetta and ProGen AI.
 - ✓ Analyzing industrial applications of engineered enzymes.
 - ✓ **Final Project:** Design a hypothetical protein for a medical or industrial application and present findings.
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Expected Outcomes of the Workshop

Technical & Computational Skills:

- ✓ Understanding **protein engineering principles (rational design, directed evolution, CRISPR applications).**
- ✓ Hands-on training with **AutoDock, PyMOL, AlphaFold, ChimeraX, Benchling, and Rosetta.**
- ✓ Experience in **protein-ligand interaction analysis and structure prediction.**

Research & Analytical Skills:

- ✓ Ability to **analyze protein structures and predict their modifications.**
- ✓ Understanding of **molecular dynamics simulations and AI-driven protein design.**
- ✓ Exposure to **real-world applications of protein engineering in biotechnology and medicine.**

Industry Readiness & Career Advancement:

- ✓ Training in **cutting-edge protein engineering tools used in research and industry.**
 - ✓ Certification for career enhancement in **biotechnology, synthetic biology, and drug discovery.**
 - ✓ Networking opportunities with **protein engineers, AI researchers, and industry experts.**
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How to Register?

- Submit an application via [**Your Institution/Organization Link**].
- Provide an updated CV and a statement of interest.
- Limited seats available! Apply before [**Deadline Date**].

For more details, contact:

✉ Email: [**Your Email**]

☎ Phone: [**Your Contact Number**]

🌐 Website: [**Your Website**]
