

# Short-Term Online Internship on Tools of Biophysics & Their Applications

## For Undergraduate Students in Biology & Chemistry

This **4-week online internship** is designed to introduce undergraduate students in **biology and chemistry** to fundamental **biophysical techniques** used for the study of biomolecules, their structure, and interactions. The program covers experimental and computational tools used in **molecular biophysics, spectroscopy, structural biology, and single-molecule analysis**, preparing students for research and industry roles.

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## Internship Structure & Study Design

### Week 1: Introduction to Biophysics & Key Experimental Techniques

✦ **Objective:** Understanding the role of biophysics in biological and chemical research.

- **Introduction to Biophysics:** Importance in molecular and structural biology.
- **Thermodynamics & Molecular Interactions:** Understanding protein-ligand and protein-DNA interactions.
- **Spectroscopic Techniques in Biophysics:**
  - UV-Visible Spectroscopy
  - Fluorescence Spectroscopy
  - Circular Dichroism (CD) Spectroscopy
- **Calorimetry in Biophysics:** Differential Scanning Calorimetry (DSC) and Isothermal Titration Calorimetry (ITC).
- **Applications of Spectroscopy & Calorimetry in Protein Folding & Drug Binding Studies.**

#### **Hands-on Activities (Online Tools & Simulations):**

- ✓ Virtual demonstration of UV-Vis and fluorescence spectroscopy.
  - ✓ Analyzing real spectroscopic data using Python/R.
  - ✓ Assignment: Understanding the biophysical properties of a given protein.
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### Week 2: Structural Biology & Molecular Biophysics

✦ **Objective:** Learning how biomolecular structures are studied using advanced techniques.

- **X-ray Crystallography:** Basics of crystal formation, data collection, and structure determination.
- **Nuclear Magnetic Resonance (NMR) Spectroscopy:** Principles & applications in protein structure analysis.

- **Cryo-Electron Microscopy (Cryo-EM):** Overview of single-particle reconstruction.
- **Atomic Force Microscopy (AFM) & Its Role in Molecular Imaging.**

#### **Hands-on Activities (Online Tools & Simulations):**

- ✓ Introduction to **PDB (Protein Data Bank)** for structure analysis.
  - ✓ Virtual demonstration of X-ray crystallography data processing.
  - ✓ Assignment: Retrieving and visualizing molecular structures using **PyMOL and Chimera**.
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### **Week 3: Biophysics of Biomolecular Interactions & Computational Simulations**

✦ **Objective:** Understanding the dynamics of biomolecular interactions using theoretical and computational approaches.

- **Molecular Docking & Drug Binding Studies:** Introduction to computational docking (AutoDock, SwissDock).
- **Molecular Dynamics (MD) Simulations:** Understanding protein stability & conformational changes.
- **Surface Plasmon Resonance (SPR) for Studying Biomolecular Interactions.**
- **Single-Molecule Techniques:** Introduction to Förster Resonance Energy Transfer (FRET) & Optical Tweezers.

#### **Hands-on Activities (Online Tools & Simulations):**

- ✓ Performing molecular docking of a drug molecule using **AutoDock**.
  - ✓ Simulating protein-ligand binding interactions using **MD simulations (GROMACS/AMBER)**.
  - ✓ Assignment: Predicting binding affinity of a ligand to a protein using computational tools.
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### **Week 4: Research Project & Final Presentation**

✦ **Objective:** Applying biophysical tools to solve a scientific problem.

#### **Choose One Research Project:**

- ✓ Predicting protein stability using molecular dynamics simulations.
- ✓ Analyzing protein-ligand interactions using docking software.
- ✓ Characterizing the structural properties of a biomolecule using spectroscopic data.
- ✓ Computational analysis of protein folding pathways.

#### **Final Presentation & Certification:**

- Students present their findings in a **virtual seminar**.
- Expert evaluation from academia/industry professionals.

- **Certificate of Completion** provided.
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## Expected Outcomes of the Internship

### 🔗 **Technical & Computational Skills:**

- ✓ Hands-on experience in biophysical tools for molecular research.
- ✓ Proficiency in spectroscopy, docking, and molecular simulations.
- ✓ Understanding of structural biology techniques (X-ray, NMR, Cryo-EM).
- ✓ Use of bioinformatics tools for analyzing protein structures and interactions.

### 🔗 **Research & Analytical Skills:**

- ✓ Ability to interpret spectroscopic and structural data.
- ✓ Experience in computational modeling of biomolecules.
- ✓ Knowledge of experimental techniques in molecular biophysics.
- ✓ Presentation of biophysical research findings in a scientific format.

### 🔗 **Industry Readiness & Career Advancement:**

- ✓ Exposure to biophysical methods used in biotech, pharma, and biomedical research.
  - ✓ Training in computational approaches relevant to drug discovery & protein engineering.
  - ✓ Certification for career enhancement in molecular and structural biology.
  - ✓ Networking opportunities with researchers and industry professionals.
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## How to Apply?

- 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**]

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