Data Visualization for Biological Insights 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 explosion of omics data has created a critical need for life science professionals to master biological data visualization. Data Visualization for Biological Insights Training Course is specifically designed to equip biologists, bioinformaticians, and research scientists with hands-on programming skills in R and Python to transform complex, high-dimensional datasets into compelling visual narratives. We focus on applying the Grammar of Graphics and specialized bioinformatics packages to effectively discover patterns, validate hypotheses, and drive data-driven decision-making in research and development.

This training goes beyond basic charting, delving into advanced topics like interactive dashboards, single-cell data analysis, and biological network visualization. By integrating core principles of visual perception and data storytelling, attendees will learn to create publication-ready figures that clearly and rigorously communicate genomic variation, gene expression, and molecular pathways to both technical and non-technical audiences. Master the tools and techniques essential for accelerating drug discovery pipelines and unlocking profound biological insights from your large-scale data.

Programme Curriculum

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Course Objectives

1. Master the Grammar of Graphics framework using ggplot2 for aesthetic and effective plots.
2. Acquire proficiency in R and Python for biological data plotting and analysis.
3. Visualize and interpret complex genomic data, including RNA-seq and ChIP-seq results.
4. Create interactive dashboards for exploratory data analysis (EDA).
5. Apply dimensionality reduction techniques for visualizing high-dimensional data.
6. Design and customize publication-ready figures for scientific reports and journals.
7. Implement data wrangling and quality control (QC) visualization for high-throughput sequencing data.
8. Analyze and visualize biological networks using tools like Cytoscape and igraph.
9. Explore single-cell RNA-seq visualization techniques and specialized packages
10. Develop skills in data storytelling to communicate complex biological insights to diverse audiences.
11. Visualize and interpret population genetics and phylogenetic data
12. Apply visual design best practices to enhance data clarity.
13. Perform comparative analysis and visualization of heterogeneous biological datasets.

Target Audience

1. Biologists and Molecular Biologists
2. Bioinformaticians
3. Genomics and Proteomics Researchers
4. Life Science Professionals and Technicians
5. R&D Scientists in Pharma/Biotech
6. Computational Biologists
7. PhD Students and Postdoctoral Researchers
8. Data Scientists interested in Biomedical/Omics Data

Course Modules

Module 1: Fundamentals of Biological Data Visualization

- Data Types in a biological context
- Principles of Visual Perception and Gestalt Psychology.
- Introduction to the Grammar of Graphics framework.
- Selecting the right chart type for different biological questions
- Case Study: Visualizing and summarizing clinical patient data from a small cohort.

Module 2: R and the Tidyverse for Data Prep

- Setting up the R environment and RStudio.
- Data Cleaning and Wrangling using the Tidyverse ecosystem
- Working with common bioinformatics file formats
- Importing, subsetting, and transforming large biological dataframes.
- Case Study: Cleaning and normalizing raw gene count data from a public RNA-seq study.

Module 3: Core Visualization with ggplot2

- Mastering ggplot2 syntax: layers, aesthetics, geoms, and scales.
- Creating and customizing scatter plots, bar charts, and histograms.
- Visualizing distributions with box plots, violin plots, and ridge plots.
- Applying statistical transformations and adding annotations.
- Case Study: Generating a T-test comparison box plot of drug treatment groups.

Module 4: Advanced R Visualization for Scientific Figures

- Color theory and accessible palettes for biological data.
- Using facetting and grid layouts to compare multiple samples/conditions.
- Creating Volcano Plots and Manhattan Plots for statistical significance.
- Generating Heatmaps and dendrograms for hierarchical clustering.
- Case Study: Creating a high-resolution Volcano Plot to identify differentially expressed genes

Module 5: Genomic Data Visualization

- Visualizing RNA-seq results.
- Creating Genome Browser Tracks
- Visualizing peak data from ChIP-seq experiments.
- Comparative visualization of multiple genomes or genomic regions.
- Case Study: Displaying H3K27ac ChIP-seq peaks at a target gene locus with custom track annotations.

Module 6: Dimensionality Reduction for Omics Data

- Theoretical basis of PCA, t-SNE, and UMAP.
- Hands-on implementation of dimensionality reduction in R/Python.
- Visualizing clustering and sample similarity in 2D and 3D space.
- Interpreting and troubleshooting common visualization artifacts.
- Case Study: Using UMAP to visualize patient clustering based on their proteomic profiles.

Module 7: Single-Cell Data Visualization

- Introduction to the challenges of single-cell RNA-seq data.
- Creating feature plots to display gene expression in cell clusters.
- Visualizing cell-type annotations and marker gene expression.
- Generating spatial transcriptomics visualizations.
- Case Study: Exploring gene expression distribution in a single-cell dataset using Python

Module 8: Python for Biological Data Exploration

- Introduction to Python for data analysis
- Basic plotting with Matplotlib and advanced statistical visuals with Seaborn.
- Integrating plots with data analysis workflows using Pandas.
- Best practices for creating reproducible Python scripts.

- Case Study: Comparing expression distribution across different tissues using Seaborn's categorical plots.

Module 9: Network and Pathway Visualization

- Understanding different types of biological networks
- Using tools like Cytoscape and igraph to visualize networks.
- Highlighting key nodes and pathways
- Visualizing pathway enrichment analysis results
- Case Study: Mapping and visualizing a KEGG pathway enrichment result for cancer DEGs.

Module 10: Phylogenetic and Evolutionary Visualization

- Visualizing genetic diversity and population structure.
- Creating and annotating phylogenetic trees and dendrograms
- Representing evolutionary relationships and speciation events.
- Plotting allele frequencies and genetic distances.
- Case Study: Constructing and visualizing a phylogenetic tree to trace the evolution of a viral outbreak.

Module 11: Interactive Web Visualizations and Dashboards

- Introduction to Interactive Data Visualization principles.
- Building Interactive Plots using R/Python libraries
- Developing basic Shiny dashboards in R for dynamic data exploration.
- Incorporating filtering, zooming, and tooltips for user engagement.
- Case Study: Building a simple, interactive dashboard for exploring differential gene expression across multiple user-selected comparisons.

Module 12: Principles of Data Storytelling

- Understanding your audience and defining the core biological narrative.
- Structuring visualizations to guide the viewer?ÇÖs attention.
- Techniques for creating a "Figure 1" and multi-panel composites.
- Writing effective figure legends and titles.
- Case Study: Critiquing and redesigning a complex, published figure for maximum clarity and impact.

Module 13: Data Quality Control and Diagnostics

- Visualizing sequencing quality metrics
- Creating diagnostic plots to detect batch effects and outliers.
- Using correlation matrices and heatmaps for sample-to-sample comparison.
- Best practices for data and code reproducibility.
- Case Study: Identifying a potential batch effect in a multi-site genomics study using PCA plots.

Module 14: Advanced Customization and Annotation

- Mastering advanced ggplot2 themes and custom element modification.
- Using cowplot or patchwork to assemble complex, multi-panel figures.
- Integrating images, logos, and custom annotations into plots.
- Exporting visualizations in high-resolution formats for publication.
- Case Study: Finalizing and formatting a figure set for submission to a high-impact journal.

Module 15: Final Project and Peer Review

- Review of all visualization tools and techniques.
- Individual work on a personal or provided complex biological dataset.
- Developing a complete data story from raw data to final presentation.
- Peer review session and expert feedback on project visualizations.
- Case Study: Participants present their final project e.g., "A Visual Exploration of Cancer Driver Mutations."

Training Methodology

The course follows a hands-on, project-based learning approach, balancing theoretical concepts with practical application:

- Interactive Lectures: Concise sessions introducing core concepts and tools.
- Live Coding Demos: Step-by-step demonstrations of coding in R and Python.
- Hands-On Lab Sessions: Guided exercises with real-world biological datasets.
- Case Study Analysis: Deep-dive into publication-relevant visualization challenges.
- Personalized Feedback.

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

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