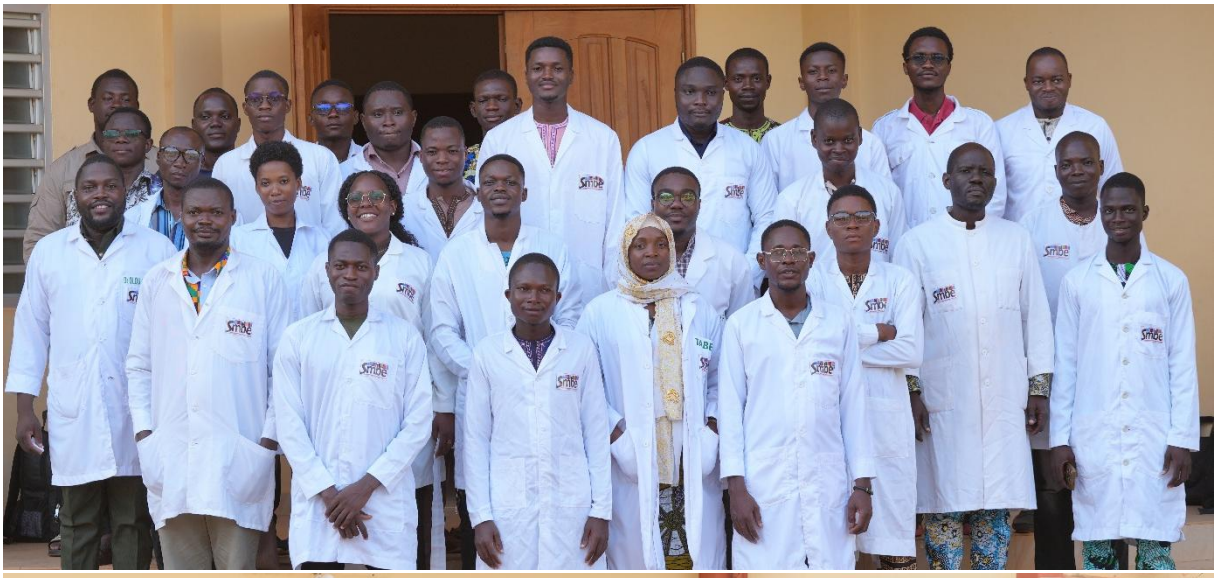
Final Report

Title: Bridging the gap: strengthening the capacity of African researchers in Molecular Biology and Bioinformatics

Dates: May 12–16, 2025

Location: University of Parakou, Benin (Hybrid format)

Funding: SMBE Non-Parachute Science Funding



May 2025

Introduction

With generous funding from the Society for Molecular Biology and Evolution (SMBE), we organized a five-day capacity-building training workshop at the University of Parakou (Benin), aimed at strengthening African researchers' skills in molecular ecology, bioinformatics, and scientific proposal writing (see the supplementary image showing the launch of the call). This initiative aligned with SMBE's Non-Parachute Science mission brought together researchers from 10 African countries, combining practical in-lab activities with live-streamed hybrid lectures and hands-on computational training.

Objectives

The main objectives of this project were:

- To provide practical skills in modern molecular ecology laboratory techniques.
- To introduce African researchers to SMBE's vision, opportunities, and pathways to global scientific participation.
- To build grant-writing and proposal development skills, increasing competitiveness for international funding.
- To deliver hands-on training in bioinformatics and data analysis relevant to microbial ecology and metabarcoding.
- To foster networking and sustainable collaborations among African and international scientists.

3. Training Modules Overview

Module 1: Molecular Biology Hands-On Training

- **Dates:** May 12–13, 2025
- **Format:** In-person only
- **Participants:** 33 Beninese researchers
- **Trainers:** Dr. Armel Boris Olou (Benin), Prof. Mohammad Bahram (Sweden)

The first module of the workshop, held on May 12–13, was designed as a fully practical, face-to-face session where 33 selected participants received immersive, hands-on training in modern molecular techniques. The training began with a comprehensive safety briefing and an introduction to the principles of molecular ecology. Participants were then guided through sample handling and preparation, followed by DNA extraction from fungal, plant, and soil samples. Trainers provided close supervision to ensure that each participant could confidently perform these techniques.

On the second day, the focus shifted to PCR amplification and library preparation, essential steps in preparing DNA for sequencing. This was followed by a live demonstration of Nanopore sequencing workflows, where participants observed the sequencing process in real time. Trainers carefully walked them through every step, allowing each trainee to practice and complete the processes independently.

By the end of the module, all 33 participants had successfully extracted DNA and amplified target genes, gaining valuable first-hand experience with advanced sequencing equipment. For many, this was their first direct interaction with sequencing technologies, significantly boosting their confidence to carry out similar work in their own laboratories. Beyond technical skills, the module also fostered a collaborative peer network, laying the groundwork for future

joint efforts in molecular ecology research (see the supplementary image for Module 1 activities).

Module 2: Introduction to SMBE and Grant Writing

- **Date:** May 14, 2025
- **Format:** Hybrid (in-person & online)
- **Participants:** 53
- **Trainers:** Prof. Nourou Soulemane Yorou, Dr. Armel Boris Olou, Mr. Hounwanou Basile

The second module, held on May 14, was delivered in a hybrid format, combining in-person and online participation, and brought together 53 participants from across Africa and beyond. The session was designed to introduce researchers to the Society for Molecular Biology and Evolution (SMBE) and to equip them with practical knowledge on writing competitive grant proposals for international funding opportunities.

The day began with Prof. Nourou Soulemane Yorou, who delivered an insightful lecture on the key components of a strong scientific proposal, highlighting common pitfalls and strategies for improving grant success rates. Following this, Dr. Armel Boris Olou presented an overview of SMBE's vision, mission, and membership benefits, outlining the various funding schemes and opportunities available for researchers interested in molecular evolution and ecology.

To bring theory into practice, Mr. Basile Hounwanou shared a real-world case study on fungal metabarcoding, illustrating the journey from field data collection to drafting a manuscript for publication. This provided participants with a concrete example of how molecular tools can support ecological research and conservation-focused projects. Interactive elements of the session included live feedback sessions, where participants pitched their own grant ideas and engaged in group discussions to refine their proposals. Trainers provided tailored advice, helping participants understand how to align their research with funding priorities and improve the clarity of their applications.

By the end of the module, participants reported a significant improvement in their understanding of grant proposal structures and funding processes. Many expressed interest in joining SMBE, subscribing to its funding alerts, and becoming more involved in its global scientific community. The session also reinforced the potential of molecular tools to secure funding for ecological and conservation initiatives, strengthening research capacity in the region (see the supplementary image for Module 2 activities).

Module 3: Bioinformatics and Data Analysis

- **Dates:** May 15–16, 2025
- **Format:** Hybrid
- **Participants:** 53 (33 from Module 1 + 20 new participants)
- **Trainers:** Dr. Jean Legeay (Morocco), Prof. Leho Tedersoo (Estonia), Dr. Vladimir Mikryukov (Estonia)

The third and final module, conducted on May 15–16, was delivered in a hybrid format, bringing together 53 participants from various countries. This two-day training was designed

to provide a comprehensive introduction to bioinformatics and data analysis, enabling researchers to process and interpret molecular data generated during ecological studies.

On the first day, the sessions introduced participants to the foundational concepts of metabarcoding and microbial community analysis. Trainers guided participants through sequence quality control and denoising using DADA2, followed by the creation of Operational Taxonomic Unit (OTU) tables. This was complemented by hands-on exercises in RStudio, where participants practiced importing and manipulating raw sequence data.

The second day shifted focus to microbial diversity analysis and visualization. Using Phyloseq and ggplot2, participants learned how to generate diversity plots and interpret ecological patterns in microbial datasets. Trainers also introduced basic machine learning approaches, such as random forest models, to help identify indicator taxa within ecological communities. Breakout sessions were organized throughout the module, allowing trainers to provide one-on-one assistance for software installation, troubleshooting R scripts, and refining participants' analytical skills.

By the end of this module, participants had gained practical, hands-on experience in running bioinformatics workflows, transforming raw sequencing data into meaningful ecological insights. Many trainees successfully processed example fungal datasets, producing diversity analyses and visualizations independently. The sessions significantly demystified bioinformatics for participants who had little prior coding experience, and numerous attendees requested more advanced, longer-duration training courses to build on this foundation (see the supplementary image for Module 3 activities).

Participants and Representation

The training successfully brought together ***53* participants** from **10 countries**, ensuring diverse representation across Africa and the African scientific diaspora:

- Benin
- Burundi
- Cameroon
- Democratic Republic of Congo
- Finland (African doctoral researcher residing there)
- Mali
- Nigeria
- Rwanda
- Togo

This diversity promoted cross-country networking, exchange of ideas, and strengthened regional research collaboration.

Outcomes and Impact

- Over 50 early-career scientists received practical, directly applicable training in molecular ecology, bioinformatics, and proposal writing.
- Increased awareness of SMBE's mission and resources in Africa, with several participants expressing interest in joining SMBE.
- ***33*** researchers acquired hands-on experience in DNA extraction, PCR, and sequencing workflows, skills rarely accessible in many African institutions.
- Participants developed competence in data analysis tools (R, dada2, phyloseq), enhancing their ability to process and interpret ecological data.

- Strong collaborations were established between African institutions and international trainers, setting the stage for future joint projects.

Conclusion & Future Outlook

The workshop successfully delivered on its promise to empower African scientists through local capacity-building in molecular and computational biology. Many participants expressed eagerness for future SMBE activities and a regional network is now being created to sustain collaborations. Through sustained investment in African research capacity, SMBE can help bridge global scientific disparities and empower a new generation of molecular ecologists.

Acknowledgments

We gratefully acknowledge the **Society for Molecular Biology and Evolution (SMBE)** for funding this project. We thank all trainers, facilitators, and participants for their active engagement and collaborative spirit.

Image Supplementary Section

Image 1. Call for applications for training

Image 2.1. Molecular Biology Hands-On Training (suite)

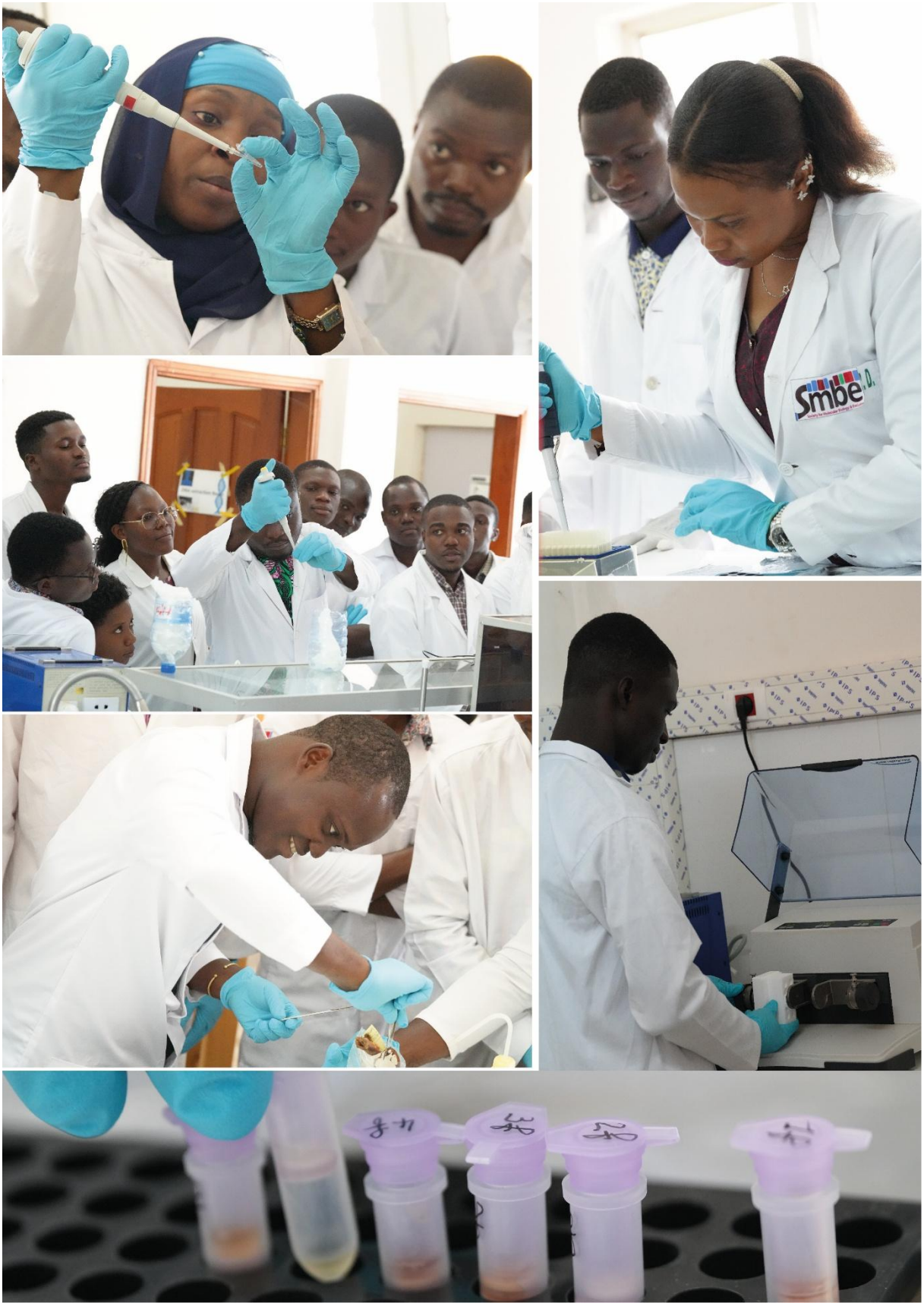


Image 2.2. Molecular Biology Hands-On Training

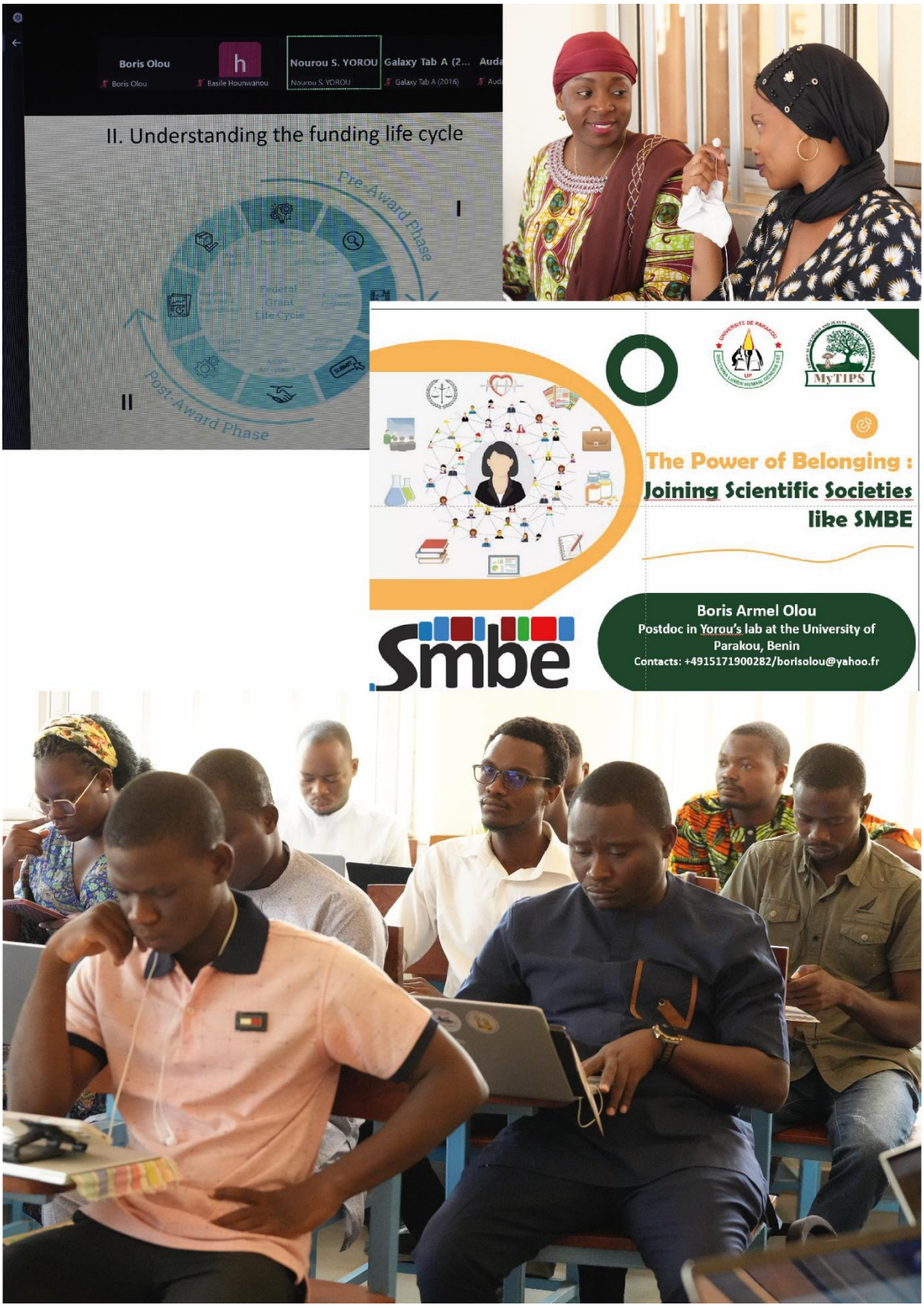


Image 3. Introduction to SMBE and Grant Writing

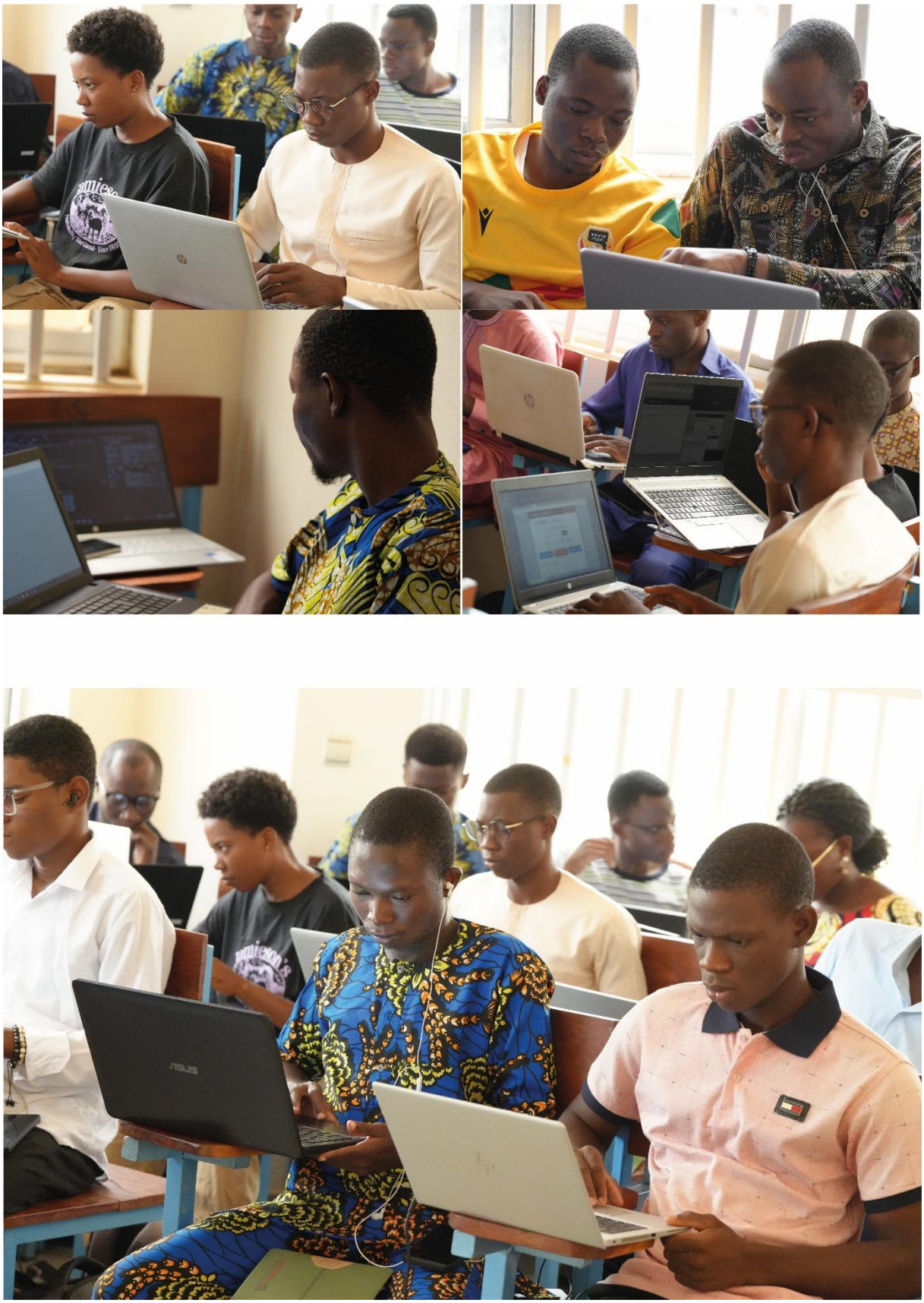


Image 4. Bioinformatics and Data Analysis

Image 5. Closing ceremony with certificate presentation to participants