

CUBE Kishore Bharati Assistantship Report February 2025 (Second half)

Dhanraj Bhaskar Tribhuvan

During the second half of February 2025, I joined 9 out of 15 days.

A) Developing Context to Curriculum by addressing Simple questions

1. Understanding Fruit Fly Trapping, Development, and the Legacy of CsBz Flies - The causerie explored fruit fly (*Drosophila melanogaster*) trapping in homelabs and the reappearance of flies post-setup. This led to a discussion on CsBz flies; *Canton Special Benzer*, a standard lab strain traced to a single gravid female collected by Seymour Benzer in the 1950s. We examined imaginal discs, which are clusters of undifferentiated cells in larvae that develop into adult structures such as eyes, wings, and legs during metamorphosis. These discs originate within embryonically established body segments, influenced by both maternal and paternal gene expression. A key insight (TINKE moment) was recognizing that the eye and antenna imaginal discs are physically connected.
2. Understanding Chemistry-Biology Interface in Immunity and Protein Function - Biological processes like blood clotting and immune responses are governed by underlying chemical reactions. For instance, clotting involves conversion of fibrinogen to fibrin through a cascade of enzymatic steps. In immunity, phagocytic cells (like macrophages) engulf pathogens, B cells produce antibodies, and T cells regulate or kill infected cells. Memory cells enable faster secondary responses, and plasma cells secrete antibodies. At the molecular level, proteins must fold correctly to function, errors in folding can lead to diseases. Tools like the Ramachandran plot help visualize allowed protein conformations.
3. Understanding Epiphytes: Non-Parasitic Canopy Dwellers - The causerie focused on Epiphytes, such as orchids and bromeliads, are non-parasitic plants that grow on trees for support, particularly in tropical rainforests. They use aerial roots or specialized leaves to absorb moisture from air and rainfall, while nutrients are acquired from organic debris. Their dispersal mechanisms often rely on wind or animal interactions due to narrow ecological niches.

4. Understanding Neurodegeneration and Disease Through Causerie - The discussions explored Parkinson's disease, a progressive neurodegenerative disorder affecting movement. It involves the gradual degeneration and death of dopamine producing neurons in specific brain regions, leading to tremors, rigidity, and balance issues. Shared references helped clarify the disease's biological basis, highlighting how protein misfolding and neuronal damage contribute to symptom progression.
5. Understanding Eukaryotic Cell Division and the Cell Cycle - Mitosis, distinct from binary fission, was examined in detail. It proceeds through prophase, metaphase, anaphase, and telophase, facilitated by the centromere. The eukaryotic cell cycle includes interphase (G1, S, G2) and mitosis (M phase), regulated by cyclins and cyclin-dependent kinases (CDKs). DNA replication machinery assembles during G1 and activates in the S phase. Molecular checkpoints ensure genomic integrity before progressing through the cycle.

B) Citizen Science Projects

1. Understanding Mango Flowering and Fruiting Trends Across India - Phenological observations across India revealed variation in mango flowering and fruiting, possibly linked to climate factors. In Chempazhanthi (Lat 8.68, Long 76.83), 70% of trees were flowering and 30% fruiting; in Varkala, 88% were flowering by late February. Overlapping stages, flowers and tender fruits on the same tree suggest asynchronous development.
2. Understanding Nail Growth as a Model for Biological Studies - Nail growth observations, initiated during recent election events (e.g., Maharashtra and Delhi Assembly elections), are being explored as a simple yet powerful model system in biology. By marking nails with indelible ink during voting and tracking their growth over time through photographs, participants can convert visual data into measurable growth rates. For example, a 27 year old individual (Athira) showed substantial nail growth within 7 days, suggesting age related variability in nail regeneration. This leads to the broader research question: *Can nail growth be used to estimate age or physiological health?* The discussion emphasizes developing research methodology from such everyday observations.

C) Homelab updates

Further plans - Culturing and Maintaining Chlorohydra and Moina in Homelab