CUBE Kishore Bharati Assistantship Report March 2025 (Second half)

Dhanraj Bhaskar Tribhuvan

During the second half of March 2025, I joined 10 out of 15 days.

A) Developing Context to Curriculum by addressing Simple questions

1. Understanding Circadian Rhythms and Photosynthesis in Plants - The discussion focused on circadian rhythms, our body's natural 24 hour clock, which are present in both animals and plants. In animals like humans and fruit flies (*Drosophila melanogaster*), these rhythms help regulate sleep and daily activities, and staying in sync with light-dark cycles improves overall fitness. In plants such as *Arabidopsis thaliana*, circadian rhythms control key processes like leaf movement, stem growth, and gene expression, with about 10% of plant genes influenced by these internal clocks.
   This was linked to photosynthesis, where light-dependent reactions produce ATP and NADPH, which are essential for the Calvin cycle (light-independent reactions). Although called the "dark reaction," the Calvin cycle doesn't actually happen in the dark. In CAM plants, this cycle is adjusted over time, showing how circadian rhythms also help plants optimize energy use during photosynthesis.

2. Understanding Parasites That Turn Insects into Zombies - The discussion focused on how certain parasites can manipulate the behavior of insects, essentially turning them into "zombies" to ensure their own survival and reproduction. Examples include the Cordyceps fungus in ants and *Entomophthora muscae* in flies like *Drosophila melanogaster*, which take control of the host's behavior before killing them and spreading spores. Similarly, baculoviruses make caterpillars climb to high places before dying, helping disperse the virus.
   The conversation also touched on whether such behavior altering pathogens affect plants, and included discussions on how to distinguish male and female insects like the Kudzu bug. Another interesting point raised was why females in many species are larger than males, linking this to reproductive and evolutionary roles.

3. Understanding Seed Formation Failure in Hibiscus - The discussion focused on the absence of seed formation in *Hibiscus rosa-sinensis*, commonly observed across India. A working hypothesis

proposed that the failure is due to a lack of effective pollination. It was noted that the male and female parts of the flower (stamen and carpel) mature at different times, a phenomenon called dichogamy, which may prevent successful fertilization. Additionally, anther dehiscence (release of pollen) lasts for only a short window (~5 hours), further limiting chances of pollination. The absence of cross-pollination was also considered a key contributing factor.

4. Understanding Earthworm Survival on Tissue Paper - The discussion focused on an experiment conducted by cubists at HBCSE, investigating whether earthworms can survive on moist tissue paper alone. In their natural habitat, earthworms consume soil enriched with plant matter, particularly leaves, which are high in cellulose. To simulate this, cubists replaced plant leaves with tissue paper, also cellulose based; to explore if it could serve as an alternative food source.

5. Understanding Toddy Fermentation and Basic Chemistry Concepts - The discussion focused on toddy (palm wine), formed through natural fermentation of palm sap by yeasts and bacteria. These microbes convert sugars into ethanol, making it alcoholic. When exposed to oxygen and *Acetobacter* bacteria, ethanol further turns into acetic acid, explaining how toddy can become acidic over time. This sparked questions on whether toddy is an acid or alcohol, clarified by understanding its transition from alcohol to vinegar like acidity.
   The conversation also included key chemistry concepts such as acids, bases, and alkalis. Sodium bicarbonate ($NaHCO_3$), a common alkali, was discussed for its roles as a pH buffer and leavening agent in food.

B) Citizen Science Projects

1. Understanding Biological Timekeeping Through Nail Growth - The discussion focused on using nail growth as a biological time marker. Cubists from Chaitanya College, Pamgarh, collected data by measuring the distance between a voter's ink mark (applied on voting day) and the nail base after several weeks. Two cases were shared: a 37 year old male with voting on 23/02/25 and a 36 year old male with voting on 20/02/25. Photos taken on 17/03/25 helped estimate nail growth over time.

2. Understanding Mango Flowering and Fruiting Patterns Across Regions - The discussion focused on tracking the flowering and fruiting stages of mango trees as part of a citizen science initiative. In Mumbai (Pedder Road, 19°N), 90% of observed mango trees (n=10) were in flowering stage as

reported on March 26, 2025. In Ranchi, Jharkhand, about 53% (7 out of 13 trees) had begun fruiting by March 29, 2025. These region wise updates contribute to understanding how climatic and geographic factors influence mango phenology.

C) Homelab updates

Further plans - Culturing and Maintaining Chlorohydra and Moina in Homelab.