

CUBE Kishore Bharati Assistantship Report August 2024 (First half)

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Throughout August 2024, I attended ChatShaala for 13 days out of 15 days. During this time, I moderated discussions alongside Theertha M.D., Enas Shirin, Kiran Yadav.

Here are some of the key highlights from this period:

1600 Days of CUBE ChatShaala

On August 5, 2024, the CUBE (Collaboratively Understanding Biology Education) ChatShaala celebrated 1,600 days of continuous engagement and collaborative learning. This milestone highlights the program's commitment to cultivating a community of practice in biology education. It also serves as a testament to the CUBE program's success and impact in transforming biology education through collaboration and innovation.

A) Developing Context to Curriculum by addressing Simple questions

1. Understanding Plant Biology by Studying Seed Germination in Homelabs - The discussion centered on how Cubists are designing experiments to study seed germination using a variety of seeds, such as moong beans and mustard. By employing frugal methods and making informed predictions, Cubists aim to address several key issues like the time required for germination, the process of breaking dormancy, and the optimal conditions for seed germination and growth.
2. Understanding what is an Imaginal Disc - The discussion focused on how imaginal discs, which are specific regions in the pupal stage, develop into various organs such as wings, legs, and antennae. These discs undergo cell division and differentiation, guided by different proteins and enzymes, to form the adult structures. The development of imaginal discs plays a significant role in wing formation and has raised questions about the mechanisms involved, including the roles of cuticular proteins, functional proteins, and structural proteins. Cubists have proposed that wing synthetase like enzymes might be involved in wing development. This learning process has clarified the mechanisms involved in organ formation during metamorphosis.

3. Understanding the Developmental Stages in Butterflies, Polymorphism, and Host Plant Preference - The discussion focused on butterfly studies within the context of evolutionary biology. Cubists collected caterpillars from lemon and curry leaf plants to observe their developmental stages, from embryo through larval stages to adulthood. The conversation also highlighted the differences between moth and butterfly caterpillars. Additionally, the discussion explored the polymorphism observed in female butterflies, particularly noting how female Common Mormon butterflies mimic other species, such as the Crimson Rose and Common Rose, as a form of protective mimicry.
4. Understanding the Microevolution and Decision Making in Fruit flies - The discussion focused on fruit fly physiology and behavior, specifically examining the variation in the number of teeth on the sex comb and its impact on mating. Cubists noted that an increased number of teeth affects the comb's shape and functionality, influencing its effectiveness in grasping the female during mating. This variation, influenced by surrounding bristles, leads to different phenotypes.

*Additionally, a method was redeveloped at the Homelab Kolkata to study olfaction in fruit fly larvae. In the experiment, larvae were placed in a circular arena with a water drop at one end and a banana at the opposite end. Within 5 minutes, the larvae were observed congregating around the banana, demonstrating their olfactory response to the fruit.

The discussion then shifted to olfactory detection mechanisms in fruit flies. It was examined that volatile compounds, rather than sugars like glucose and fructose, are responsible for the scent of mangoes. Fruit flies detect these volatiles through sensory receptors on their antennae, which then relay signals to the brain where the scent is processed and interpreted. The decision to approach the mango is made in the brain, integrating sensory inputs received from the antennae.

5. Understanding the Culturing, Nervous and Muscular Systems, and Phototransduction in Chlorohydra - The discussion began with culturing techniques for Chlorohydra in the Homelab. We then examined its nervous system, noting that Chlorohydra possesses two distinct nerve nets: one between the epidermis and musculature, and another associated with the gastrodermis. These nets, which do not fuse but interact through synapse-like

connections, coordinate the organism's responses.

We also reviewed Chlorohydra's musculature, consisting of contractile fibers arranged in longitudinal and circular patterns. These fibers work with the nerve nets to enable various movements. Additionally, the discussion covered Chlorohydra's photo behavior, focusing on the molecular mechanisms of phototransduction, where light is converted into electrical signals by visual pigments in photoreceptors, initiating the visual process.

6. Understanding Culturing and Sensory Mechanisms in *Moina macrocopa JSK1* - The discussion compared the sensory functions of Moina's antennae with those of fruit flies. Moina's antennae are equipped with mechanoreceptors for detecting water currents and vibrations, chemoreceptors for chemical signals and food particles, and photoreceptors for light detection.

We reviewed a study on daphniidae that used the electroantennogram (EAG) method to assess antennal responses to amino acids. This research highlighted how small aquatic organisms like *Daphnia magna* and *Daphnia pulex* detect chemical signals in their environment.

B) Citizen Science Projects

1. Understanding Mosquito Identification - The discussion focused on understanding the identification of mosquitoes as a major citizen science project aimed at spreading awareness about Aedes and Non-Aedes mosquitoes.
2. Understanding Statistical Methods through Mango Tree Observations - The discussion focused on the application of statistical methods using observations of mango trees. Key topics included determining an adequate sample size and how to calculate it. The discussion also covered how sample size influences the effect size and the power of a statistical test, which affects the confidence in the results.
3. Understanding Nail Regeneration - The discussion revolved around understanding regeneration and growth and how by simply using mehndi/ ink we can track the nail growth and understand the role of hormones in nail growth.

C) Development through Discussion

1. To invite more Cubists in the ChatShaala whiteboard during the discussion along with a small summary was shared.
2. Screenshot of the whiteboard along with the summary and the leading question was shared alongside Theertha M. D; Enas Shirin to follow up the discussion.
3. Daily CUBE ChatShaala map of participants were shared in all the CUBE groups, for acknowledging them.

D) Homelab updates

As of now I don't have any Model system in my Homelab, but I am planning to get some Chlorohydra and Moina from Sophia Resource Centre with the help of Sakshi, a collaborator from Bhandup, Mumbai.

Further plans - Culturing and Maintaining Chlorohydra and Moina in Homelab

E) Future Plans for Enhancing CUBE Program Operations

1. Resolving issues on Documentation of Context to Curriculum Chat on STEM Games.
2. Joining through the microphone mode - Participants find it difficult to join through microphone mode.

Possible solution - We can have a screen recording of how to change the setting of the browsers so that Cubists find it easy to join through microphone mode.

3. Activation of CUBE groups - With the help of reliable Cubists, simple discussion can be carried out in small CUBE groups so that new Cubists find it easier to join the discussion.
4. Making celebration of Goof ups more streamline.