

CUBE Kishore Bharati Assistantship Report October 2024 (First half)

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During the first half of October 2024, I was scheduled to attend ChatShaala but was unable to participate due to health issues. Although I had the opportunity to moderate discussions alongside Theertha M.D., Enas Shirin, and Kiran Yadav, I struggled to coordinate effectively with my fellow interns. This impacted my ability to fully engage in ChatShaala and support the team as intended. Despite these challenges, I still had some key highlights during my time there:

A) Developing Context to Curriculum by addressing Simple questions

1. Understanding Fruit Fly Experimentation and Observations - The discussion centered on Seethalakshmi's fruit fly experiment at NITK, which monitored flies attracted to decaying tomatoes. Initially, no flies were observed until the bait was moved outside, leading Batul to suggest that fermentation produced ethanol, significantly increasing fly numbers, with pairs hatching every five hours. Batul also reported successful breeding of *Drosophila bipectinata* in her homelab. The conversation raised important questions about biological mechanisms, including ganglions, glioblastoma, and the distinctions between neurons and ganglions, emphasizing the relevance of fruit fly nervous systems in cancer research.
2. Understanding Plant Cell Biology - In a recent Chatshaala session, we discussed key topics in plant and cell biology, focusing on earthworms and plant cell diversity. Theertha noted that plant cell shapes vary due to the cell wall's influence on expansion rates and directions, leading to forms like isodiametric cells and puzzle shaped pavement cells. We contrasted starch, a storage molecule, with cellulose, which provides structural support; humans cannot digest cellulose due to the lack of cellulase, unlike some ruminants. This connects to earthworms, which feed on decomposing matter, including cellulose rich greens, suggesting that Cublsts could provide tissue paper in their cultures.
3. Understanding CUBE at NIRRCH - During the preparation for the poster presentation at NIRRCH in Mumbai, Sakshi raised a question about how earthworms can survive by feeding solely on tissue paper in home labs. This led to a discussion about whether they

consume their own castings as part of their diet. Additionally, Priti explained the CUBE homelab movement to the audience, highlighting the innovative practices and research being conducted. The session emphasized the importance of understanding the dietary habits of earthworms and their role in soil health, while also showcasing the collaborative efforts within the CUBE community to enhance scientific exploration and education.

4. Understanding Butterfly Life Cycles and Host Plant Relationships - In our recent discussions, we focused on butterfly biology, particularly the life cycle of the Common Crow butterfly, observed by Anusree and Sneha as it transitioned from caterpillar to pupa to butterfly in early October. We raised questions about how butterflies select host plants and the sensory mechanisms involved. The effects of feeding larvae non-host plants were also examined, alongside the distinct features and mimicry behaviors of Common Mormon butterflies, including variations among female specimens. Amritha shared her observations of Blue Mormon larvae, noting differences from Common Mormon larvae. Batul invited Roshan Upadhyay, the Butterfly Man of Arunachal Pradesh, to enhance our understanding, highlighting the collaborative spirit of the CUBE.
5. Understanding the Nobel Prize Work on microRNA in Gene Regulation - The discussion focused on the groundbreaking work of Victor Ambros and Gary Ruvkun, who were awarded the 2024 Nobel Prize for their discovery of microRNA's role in post-transcriptional gene regulation, particularly in the model organism *C. elegans*. Ambros and Ruvkun's research revealed that microRNAs, such as lin-4, can inhibit the expression of target genes like lin-14 by binding to complementary sequences in their mRNA, thereby blocking protein production. This discovery challenged previous notions of gene regulation and introduced a new mechanism that is fundamental across multicellular organisms. The implications of this work extend to understanding how various cell types, despite sharing the same genetic material, can express distinct proteins and functionalities.
6. Understanding Cardamine Hirsuta and Its Ecological Significance - The discussion centered on *Cardamine hirsuta*, or hairy bittercress, a plant native to Europe and parts of Asia that thrives in damp, disturbed soils and is often introduced via nursery plants. Its establishment can be difficult to reverse, and it attracts early butterflies like the spring azure and falcate orange-tip. We explored its global distribution, from Argentina to the

U.S., and its significance as a model organism for genetic engineering. Key topics included the possibility of conducting genetic engineering experiments at home, the cultivation requirements for Cardamine, and its ecological importance. We also connected the contributions of geneticists like Mendel and T.H. Morgan to plant genetics, linking mustard and Cardamine to Arabidopsis.

7. Understanding the Genetics and Cultivation of Moina and Chlorohydra - The discussion centered on specimens sent by Sakshi from Mumbai to Uttarakhand, focusing on the taxonomy of Moina, specifically *Moina macrocopa* JSK1, and the role of genetic sequence differences in identifying strains. We compared Moina and Daphnia, noting their rapid movements in freshwater. The cultivation of Chlorohydra was explored, including its reproductive methods and visual characteristics in bottles, as well as its symbiotic relationship with Chlorella algae, which supplies essential nutrients through photosynthesis. Additionally, we examined Hydra's nervous system, comparing its nerve net to that of humans and confirming the presence of synapses in Hydra's neural architecture.
8. Understanding Snails and Their Learning Behavior - The discussion focused on the beneficial role of snails in aquariums as detritivores, consuming decaying matter like fish waste to aid tank maintenance. Their shells provide protection and calcium storage. We explored Eric Kandel's Nobel Prize winning research on memory formation in the sea slug *Aplysia californica*, emphasizing habituation, the decrease in response to repeated stimuli. Questions included the types of snails, their local names, predator evasion strategies, and their role in aquariums. We also examined how snails respond to different stimuli, contrasting gentle touches with stronger ones.

B) Citizen Science Projects

1. Understanding Mosquito Identification - The recent discussions highlighted the identification of mosquitoes, specifically noting the differences between Aedes and Armigeres species. It was pointed out that the absence of white bands on the legs indicates these are non Aedes mosquitoes, likely Armigeres, as they have distinct white bands on their abdomens. Sneha also raised a question about a larger mosquito found in Bhandup West, which was confirmed to be non Aedes, emphasizing that Aedes

mosquitoes typically appear larger and have white bands on both their abdomen and legs.

2. Understanding Mango Tree Phenology - During recent travels, Prithviraj documented significant vegetative growth in mango trees. On October 2, he observed 56 mango trees along the route from Chaverkodu to Ayiroor, noting that 32 of them had tender leaves, indicating a vegetative growth rate of over 57%. On October 5, Prithviraj reported flowering activity in the mango trees at Palayamkunnu, where out of 17 observed trees, 6 were found to be flowering, resulting in a flowering percentage of 35.29%. These observations contribute valuable data on the seasonal growth patterns of mango trees in the region.
3. Understanding the Sleep-Wake Cycle of Dogs - Observations of street dogs at Chaverkodu Junction revealed distinct patterns in their sleep-wake cycles. Over several days, many dogs were seen napping in the late afternoon and early morning, often returning to preferred resting spots. Notably, on October 12th, all the dogs suddenly disappeared, suggesting their daytime rests are brief and possibly influenced by their urban environment. These findings highlight the dogs' adaptive behaviors and routines, offering insights into their daily rhythms.

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 maps 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.