

## **CUBE Kishore Bharati Assistantship Report December 2024 (First half)**

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During the First half of December 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 Neural Communication and Pain Perception - The discussion focused on various aspects of neuronal communication. First, it explored how signals are transmitted between neurons through neurotransmitters across synapses, with calcium ions playing a crucial role in neurotransmitter release. Cubists then discussed reflex actions, noting that they occur faster than the brain's perception of pain due to the fewer neurons involved in the reflex arc. This was contrasted with more complex signal transmission that involves additional neurons, taking longer.

Cubists also compared neuronal communication in plants and animals. While plants lack traditional neurons, they use complex signaling mechanisms like thigmonastic movements in response to stimuli. Additionally, the interaction between skin and neurons in pain perception was explored, with a focus on spinal anesthesia, which temporarily blocks the nervous system to prevent pain during surgery.

2. Understanding Fruit Fly Behavior and Studies - The discussion covered various aspects of fruit fly behavior and their use as model organisms in research. Bhagwati Sahu, observed fruit flies and butterflies feeding on fallen ripe guavas, a typical behavior attracted to fermenting fruit. Negative geotaxis, where fruit flies instinctively move upward when confined, was explored, with an experiment by Batul showing that the flies prioritize gravity over light. The discussion also examined how flies exhibit negative geotaxis even in unconstrained environments, indicating a strong innate response to gravity. Genetic regulation was highlighted, noting how mutations could affect geotaxis,

and the use of Levodopa was mentioned for studying its impact on this behavior by altering dopamine levels. Recent studies, including Nobel Prize-winning research on fruit flies, were referenced to understand biological rhythms and sleep-wake cycles. These insights contribute to the understanding of fruit fly behavior and its connection to neurochemical processes.

3. Understanding Sleep Patterns and Behavior Across Species - The discussion covered various species' sleep patterns and behaviors, starting with observations of dogs in Govindpuri, Delhi, where dogs exhibited different states of wakefulness and sleep. Previous studies on dogs' sleep cycles revealed regional variations, with dogs typically being active at night and sleeping in the morning, though this varied by location. Fruit flies were cited as a model for sleep studies, with their sleep defined by immobility lasting over 5 minutes, followed by an increase in arousal threshold. Circadian rhythms, which govern sleep wake cycles in humans and other species, were also discussed, referencing Nobel winning research on this topic. The conversation also touched on sleep wake cycles in different species, including humans, wolves, and foxes, and questioned whether plants experience sleep or rhythmic actions like stomatal opening. A hypothesis was proposed that street dogs might follow similar sleep wake cycles to pet dogs, with more data needed to verify or falsify this idea.
4. Understanding Staphylococcal Infections and Food Poisoning - The discussion focused on Staphylococcal (Staph) infections, which are caused by *Staphylococcus aureus*, a bacterium that can lead to a range of conditions, from mild skin issues to severe infections like pneumonia, endocarditis, and osteomyelitis. *S. aureus* has several virulence factors, including surface proteins that allow it to adhere to tissues, immune evasion mechanisms, and toxins that damage host tissues. Treatment typically involves antibiotics such as penicillinase-resistant  $\beta$ -lactams.

Staphylococcal food poisoning occurs when food is contaminated with *S. aureus*, which produces heat resistant toxins that can cause illness even after cooking. Common sources of contamination include deli meats and cream filled pastries. Symptoms of food poisoning appear rapidly, within 2-6 hours, and include nausea, vomiting, and diarrhea. Diagnosis is based on symptoms and can be confirmed with stool cultures or toxin tests. Cubists also discussed fungal reproduction, noting the role of spores and mycelium in

fungi's nutrient absorption.

5. Understanding Fungal Growth on Onion and Potato Slices - The discussion focused on culturing fungi on onion and potato slices. After 24 hours, the white growth observed is likely fungal mycelium, which is the vegetative part of the fungus. Mycelium consists of branching filaments (hyphae) that spread out to absorb nutrients. After 48 hours, black spots appear, indicating the formation of fungal spores or fruiting bodies, while the surrounding white area shows the continued expansion of the mycelium or the development of new fungal colonies. This transition from vegetative growth to reproductive growth is a key part of the fungal life cycle.
6. Understanding Antibiotic Detection in Fungal Cultures - The discussion focused on detecting antibiotic production in fungal cultures, particularly in onion fungus, which is likely a type of *Penicillium* or another mold. The agar diffusion method is used for this purpose, where a bacterial culture, such as *E. coli* or *Staphylococcus aureus*, is applied to agar, and a fungal sample is introduced. If the fungus produces antibiotics like penicillin, a clear zone of inhibition will form around it, indicating suppression of bacterial growth. The size of the zone reflects the strength of the antibiotic activity.
7. Understanding Penicillin Discovery and Rosalind Franklin's Contribution - The discussion focused on the discovery of penicillin, which was first discovered by Ernest Duchesne in 1897 but gained widespread recognition when Alexander Fleming rediscovered it in 1928. This breakthrough revolutionized medicine by providing the first widely used antibiotic. The conversation also highlighted Rosalind Franklin's vital role in the discovery of the DNA double helix structure. Her X Ray diffraction images were essential to understanding DNA's molecular structure, though her contributions were not fully acknowledged during her lifetime. Later, her work was recognized as foundational to the Nobel Prize winning research of Watson and Crick.
8. Understanding Mango Flowering Mechanisms and Induction Techniques - The discussion focused on various factors influencing mango flowering, particularly the role of Potassium Nitrate ( $KNO_3$ ) in inducing bud break in quiescent floral buds.  $KNO_3$  stimulates flowering by breaking dormancy but does not convert vegetative buds into reproductive ones, making it a useful tool for off season flowering in mango farming. The

role of florigen, a protein encoded by the FLOWERING LOCUS T (FT) gene, was also explored, with its critical function in promoting flowering by transitioning the shoot apical meristem into a reproductive phase. Additionally, hybridization through grafting was discussed as a method of asexual hybridization, where plants can combine traits from different varieties. The technique leads to the creation of graft hybrids, which can be either chimeras or non-chimera hybrids. The use of plant growth regulators like KNO<sub>3</sub> and ethephon to induce flowering and fruiting in mango trees was emphasized, as these compounds help accelerate flowering, reduce the time to flowering, and increase fruit set, particularly when trees fail to flower naturally.

9. Understanding Population and Sample in Research - The discussion focused on the concepts of population and sample in research. A population refers to the entire group being studied, while a sample is a smaller subset selected to represent that population. The size of the sample is determined by factors such as research objectives, population diversity, and the required level of confidence in the results. Larger samples tend to yield more reliable results, but practical considerations like time, cost, and resources must also be taken into account.

## **B) Citizen Science Projects**

1. Understanding Mango Flowering Patterns Across India - The discussion focused on mango flowering across India, highlighting the role of environmental factors. In Bhandup West, only 1 out of 4 mango trees flowered by 4th December 2024, resulting in a 25% flowering rate. In comparison, Kozhikode showed 36% flowering in mid November. This suggests that local climate conditions, including temperature and rainfall, influence flowering times. Tropical regions see earlier flowering due to higher temperatures, while subtropical areas require cooler temperatures. Observations from Assam (no flowering by 6th December) and Bangalore (30% flowering by 9th December) support regional variations. Unusual rainfall in December may also have affected flowering patterns.

## **D) Homelab updates**

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.