Observation of live *Paramecium*: A simple teaching tool to study physiology at school level

Bhakti Mangaonkar, Dnyaneshwari Joshi, Uzma Shaikh, Anupama Ronad, Vikrant Ghanekar*

HOMI BHABHA CENTRE FOR SCIENCE EDUCATION (TIFR), AIM 2023 *Corresponding author Underlined - Presentor

ABSTRACT

Animal classification is introduced at class IX in NCERT textbooks. In most of the school setups, classroom teaching of animal classification highly depends on either pictorial representation or preserved specimens of the multicellular organisms. The unicellular microscopic protists are generally represented in the form of diagrams or images in all the textbooks. The lab specimens of this group are often restricted to chemically fixed slides. *Paramecium* is a single cell protist which can sustain and grow at normal room temperature with very little maintenance and can be cultured for extended duration without any sophisticated lab conditions. Here we present the observation of ingestion and digestion processes with minimal preparations and basic laboratory setup. The activity has been conducted regularly by cell members for students and teachers in various camps at different places. Considering the easy availability of experimental requirements and possibility to observe active life processes in live microorganisms, teachers as well as students find it a very attractive and effective way of teaching/learning physiology in invertebrates along with animal classification.

INTRODUCTION

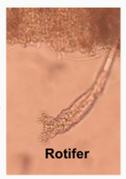
- Animal classification taught in class typically involves categorizing and organizing various groups based on their characteristics.
- Beginning from unicellular prokaryotes to unicellular and multicellular eukaryotes every organism can be classified in the following order of classification:

Kingdom-Phylum-Class-Order-Family-Genus-Species

- In classrooms animal classification is taught using pictures in the textbooks which makes it difficult and unattractive for students to understand the features of the organisms in the living world.
- Though the field visits have enhanced students enthusiasm to study the biosystematics, frequent visits to fields with large number of students become difficult due to constraints on resources.
- To overcome this, preserved specimens, videos and good quality of pictorial representation has helped understanding classification better. However this practice is limited to macroscopic multicellular organisms.
- When it comes to unicellular organisms instead of restricting the teaching to pictorial representations or preserved slides, it is possible to not only see the live microscopic world but to also observe a physiological process like digestion by taking advantage of its simple unicellular organization.
- Students can directly observe process of digestion in its preliminary form and can correlate it with complex metabolic activity in human body.
- The model organism chosen is *Paramecium*.

CLASSIFICATION

Domain : Eukaryota
Kindom : Protista
Phylum : Ciliophora
Class : Oligohymenophorea
Order : Peniculida
Family : Paramoeciidae
Genus : *Paramecium*



WHY *Paramecium*?

- Easily visible unicellular protist with a body size of 50 micron to 300 micron. Transparent, non infectious, non pigmented body that can be seen under 4X (objective) magnification of the compound microscope.
- All physiological processes like feeding, digestion, excretion etc. are easily visible due to transparent cell structure and single cell organization. A simple magnifying glass can also help if microscope is not available.
- Requires low maintenance as it can be cultured at room temperature also making it easier for the schools and labs to grow it with no ethics involved in its usage. Timely re-culturing can be done by the students themselves as it is safe to handle and does not need special lab setup.
- The setup can also be done at rural schools where there are resource constraints, still making it possible for students to study the microscopic world through live demonstrations.

HOW TO CULTURE *Paramecium*?

Setting the culture for first time :

Culture container :

- Take any container which can hold around 200-300 ml of water. The container can be of any material like metal, glass, plastic etc.
- Disposable plastic bottles of fruit juice, mineral water, soft drink etc. can also be used after thorough cleaning.
- 500 ml capacity conical flask can be ideally used if laboratory glass wares are available.

1. Cut 15-20 strands of dry grass into small pieces and boil them in 100 ml water for 10 minutes. Allow it to cool down.
2. Use muslin cloth or filter paper to filter boiled grass water.
3. Transfer filtrate into the container in which *Paramecium* is to be cultured.
4. Granular yeast is commercially available in the market.
5. Meanwhile mix some yeast granules in 10 ml water separately to prepare a yeast suspension.
6. 1ml of this yeast suspension is added to the above filtered grass water. Add 2-3 grams of garden soil in the container.
7. Additionally add few finely chopped dry grass strands into the liquid.
8. Collect around 50 ml of pond water from garden puddle which can be used as an inoculum of the culture.
9. Mix the pond water with the liquid medium prepared in culture container. Let it stand for 2-3 days. Do not keep it in direct sunlight.
10. Swirl the mixture gently once in a day.
11. The above method gives a large mixture of different animalcules predominated by *Paramecium.*


Dried grass


Yeast


Conical flask with water


Muslin cloth


Mud


Paramecia media

RE-CULTURING AND MAINTENANCE OF *Paramecium*

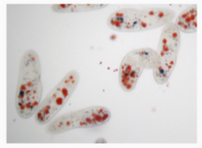
- Once the culture is established, it can be maintained for 10-15 days without adding anything to it.
- After 15 days you can re-culture by preparing fresh liquid medium same as above. But this time the existing culture itself can be used as inoculum. There is no need to add soil from the second batch onwards, that is when you begin to reculture.

EXPERIMENT

Observation of *Paramecium* feeding and digestion :

Procedure:

1. Try and identify *Paramecium* among the different invertebrates.
2. In order to slow down the movement of Paramecium, put a few strands of cotton fibres on a slide and take a drop of the culture on this.
3. Place a coverslip on the drop without trapping any air bubbles. The *Paramecia* get trapped in the cotton strands and hence can be observed easily. First focus on 4X and then on 10X. Carefully observe the various internal structures of the organism.
4. Around 2-3 ml 0.1% congo red solution is given in a test tube and yeast pellet is given in a small vial.
5. Now, add this yeast pellet in test tube containing congo red solution. Mix the pellet well by gentle shaking to make a suspension.
6. Label the tube and Keep it in a boiling water bath for 15 minutes.
7. The yeast granules will be stained red and will be easily visible under microscope.
8. Take a small drop of this yeast suspension on a slide and check under the microscope if cells are stained.
9. Add a drop of this stained yeast to the side of the coverslip so that the Paramecium can feed on them. Carefully observe the ingestion and digestion of yeast by Paramecium. (Congo red is a pH indicator and stains red at a pH of 5. At lower pH values, it turns blue)
10. Observe the colour of food vacuole initially and after a few minutes.



OTHER INQUIRIES THAT CAN BE MADE USING *Paramecium* AS A MODEL ORGANISM

1. To study the effect of external factors on the activity of contractile vacuole.
2. To study the response towards various external physical or chemical stimuli.
3. Estimation of doubling time.
4. To study the effect of various physical factors on the movement of *Paramecium*