

Lesson Plan

Content:

Phytoplankton populations have evolved different physiological and behavioral traits in response to environmental drivers. These traits have trade-offs and community composition depends on the potential cost/benefit associated with such traits.

Learning Objective:

- “Formulate a cost/benefit argument for physiological and behavioral traits in phytoplankton with respect to fitness and evaluate the consequences of ‘decent with modification’ of said physiological characteristics in extant organisms”

Previous Knowledge:

Students would have some knowledge of ‘decent with modification’ as well as have some knowledge of physiological structures and behaviours in phytoplankton.

Activities:

1. Introduction - Figuring out the problem(s) (2 min)

Imagine you are a phytoplankton, you are in the ocean - all you have to do is you have to get food, survive and reproduce. But even for you - life is not without challenges. Considering what you need in order to achieve your life goals - what are some of the challenges that you will have to overcome.

Work with your group to identify at least three challenges

2. Reporting problems (2 min)

List the top three challenges that your group identified -

List them and add others:

Possible responses:

Food - light and nutrients

Buoyancy

Avoiding predation

Motility

Reproduction

3. How can we fix that? - Identifying solutions (3 mins) – Formative Assessment

Develop hypothesis in your groups to propose physiological or behavioral traits that might help address any one of these challenges

Report your hypothesis using the google form:

4. How does it actually work - class discussion (3 mins)

Discuss actual adaptations that phytoplankton have that help them deal with these challenges

Possible responses:

- a. *Buoyancy*
 - i. *Size - smaller is better*
 - ii. *Shape - non spherical*
 - iii. *oil/gas filled vacuoles*
 - iv. *Protrusions*
 - v. *Forming colonies*
- b. *Motility*
 - i. *Ability to sink/rise*
 - ii. *Structures that enable motility - flagella*
 - iii. *Knowing when to move - sensory features*
- c. *Avoiding predation*
 - i. *Ornamentation*
 - ii. *Multicellularity*
- d. *Food - light and nutrients*
 - i. *Light sensitivity*
 - ii. *Motility - move lower to nutrient rich waters at night and higher to get the light during the day*
- e. *Reproduction*
 - i. *Ocean is homogeneous so mostly asexual*
 - ii. *Sexual - survive foul environment or overcome functional limitations as in diatoms.*

5. Construct an explanatory model – Summative Assessment

Construct a consensus model in your group whose function is to explain the challenges phytoplankton face and the mechanisms they have evolved in order to face said challenges. Submit on D2L

6. Use model to make predictions about fitness – Next Class

Remember that a trait that solves one problem could in fact worsen another - there are always tradeoffs. Evaluate the tradeoffs - consider the circumstances in which it might be beneficial to have a trait despite its cost.

- Generate two predictions to illustrate how adaptations that are beneficial in one sense can be costly in terms of fitness
- Construct a hypothesis based on one of your predictions.
- Design an experiment that could help you test your hypothesis.