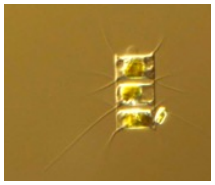
Students Name: _____ **Date:**_____ **Block:** _____

Chlorophyll Conundrum: Can factors affect chlorophyll levels in plankton samples?

Background Information:



The term **phytoplankton** comes from the Greek words *phytos* meaning "plant" and *planktos* meaning "wanderer" or "drifter." Phytoplankton are mostly microscopic, unicellular, photosynthetic organisms comprised of two major groupings: bacteria and protists. These organisms use light energy from the sun to create organic compounds (sugar) from carbon dioxide. Because they need light for photosynthesis, they must live near the surface of the ocean where sunlight can penetrate. Phytoplankton is the link between the energy from the sun and the usable form of energy that is transferred through food webs. In addition, they produce oxygen gas as a waste product of photosynthesis. They are responsible for about half of the oxygen production on Earth, and play an important role in removing carbon from the atmosphere to the deep sea when they die and sink. Phytoplankton may also form harmful algal blooms that lead to water discoloration, animal mortality, and human illness.

Chlorophyll occurs in several different forms including: *chlorophylls a, b, c, d*. Only chlorophyll ***a*** is common among all photosynthetic organisms. It is *the* photosynthetic pigment that facilitates the production of organic molecules. Chlorophyll pigments absorb specific wavelengths of light (blues and reds) and reflect green wavelengths of light. Chlorophyll levels found in phytoplankton can serve as a measurement of photosynthesis.

Guiding Question:
What factors influence the chlorophyll levels in phytoplankton samples?

Procedure/Methodology:

- Students will work in groups to create an incubation experiment to test factors that may influence the chlorophyll production (photosynthesis) in phytoplankton samples.
- Groups must create an experimental question, a hypothesis and a procedure for modifying test groups. All groups will follow the same protocol to extract chlorophyll and measure absorbance levels of the samples. A data table template must also be submitted for approval. The following list of materials is available for your investigation. If you require additional materials (including your independent variables), please include them in your proposal.

Materials (not all inclusive):

- Goggles and apron
- Gloves
- Water samples or macro algae samples. (Samples can be collected from local bodies of water during a field trip, purchased, or acquired through coordination with research scientists).
- 20% Ethanol in Acetone solution (solvent)
- Pipettes (disposable plastic pipettes work great)
- Centrifuge
- Centrifuge tubes
- Vortex
- Spectrophotometer
- Quartz or plastic cuvette for spectrophotometer)

- Incubation sample bottles (size varies based on water/plant sample sizes)
- Materials including but not limited to: growth lights (white or other wavelengths), air pumps, vitamins, etc. based on student experimental design.
- Ocean chlorophyll level maps (available for download)
- Student inquiry worksheet (available for download)
- Lab report rubric (available for download)
- Light microscopes (for optional extension)

Logistics

- Each group will have one to two days for sample collection and two to three days in the classroom to set up the experiment and for data collection at the completion of the incubation.
- At the end of each class period or field site visit, each student should complete an Exit Ticket to summarize the day's events, ask for clarification and plan for the next day. Exit tickets will be returned the following class period with comments/suggestions from the teacher.
- Each student is responsible for composing a lab report as a follow-up to the investigation. Lab reports will follow the guidelines and rubric. Please review this information and use the following sections to help in writing your report.

Data:

Student groups will create a data table and will develop graphs and/or models as part of their data analysis

Analyzing and Interpreting Data:

Use the following questions to guide your analysis process:

- Was the data consistent throughout your investigations?
- What other factors may have influenced your data collection?
- What is the best way to present your data? Graph? Model? Why?
- What is the relationship between the independent and dependent variable?
- What claim can you make based on the evidence?
- Do the results allow you to develop an explanation? Why or why not?

Constructing Explanations:

Use the following question to guide your arguments and explanations:

- How will you summarize your findings?
- What is the main idea you discovered during your investigation?
- If you were to redesign your investigation, what would you change?
- What background information applies to your conclusions?
- Do you require more knowledge about the subject? What else would you like to know?
- What other questions would you like to investigate?

Argumentation from evidence:

Remember to include evidence and background research as you write your discussion paragraph. Ask yourself these questions:

- What do I already know about phytoplankton?
- What do I already know about photosynthesis?
- What do I already know about factors that can influence photosynthesis?
- What conclusion did I draw because of the evidence collected?

Communication to other students:

Before you submit your lab report, students will peer-review ideas using a "speed-dating" activity. Instructions will be given at the beginning of the activity.