Scientific Literacy Essay

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The world is made up of various ecosystems that are full of life forms that fulfill many distinct roles. One of these roles being primary producers, which are any type of lifeforms that can produce its own food from either the process of photosynthesis or chemiosmosis. One example of an important primary producer that will be the focus of this study are diatoms, which are eukaryotic microalgae that can be found in aquatic environments and produce their own food via photosynthesis. They are particularly important in ecosystems because their photosynthetic activity is so vast that it equates to about 20-25% of the Earth's global primary production of energy, and carbon fixation/oxygen release into the atmosphere. (João Serôdio and Johann Lavaud, 2021) This is so much that the amount of carbon fixation that is being done by diatoms alone, equals the amount of all carbon fixed from all primary producers in terrestrial forest ecosystems combined. Despite to say, even though this organism is small, their impact is immeasurable.

While talking about diatoms, one specific type of diatom is a species called *Phaeodactylum tricornutum*; which is a species that has the same function as other diatoms, but these can change their morphology and cell shape based on certain environmental conditions to adapt and survive better. These three main morphotypes types are fusiform, triradiate and oval. As for where they can be found, *P. tricornutum* can commonly be found where other types of diatoms can be found. Now, *P. tricorntum* is an important type of diatom because they are found to be easier to culture and experiment with for biotechnology applications. In fact, out of all types of diatoms, *P. tricorntum* was the first one to be successfully genetically engineered for various purposes. (Borowitzka, 2018) In the article *Genome engineering empowers the diatom Phaeodactylum tricornutum for biotechnology*, the researchers set to find out whether they can genetically alter the genome of some *P. tricornutum* cells, to produce cells that can potentially have some biotechnological use. When the study was complete, they came to realize that these

cells do have a variety of uses that can be beneficial for biotechnology, with one of the main ways being a candidate for a viable biofuel source.

Now just like any other organism these days, diatoms can also be heavily affected by pollution. With the recent COVID-19 pandemic, the use of PPE and facemasks have been higher than ever, and therefore also contributes to pollution as well. Even before recently, PPE items have already become a major threat to aquatic ecosystems and the marine life that live in it. The endangerment of marine life from PPE can be from any one of the following: entanglement, entrapment, and ingestion. (Bull et al., 2022) This can be an issue because if the PPE that is used ends up in the ocean either as a whole or in fragments, like the types that are studied in the experiment, they can affect marine life by limiting their ability to survive.

Now in this experiment, the researchers seek to demonstrate how whole and fragmented face masks affect the life of diatoms, specifically *P. tricornutum*, and how it affects their ability to survive. This is because if PPE pollution affects marine life to even the smallest, essential player of marine ecosystems, diatoms, then the potential consequences could be catastrophic if things are not regulated. For example, if the amount of PPE masks finds itself in the oceans, and it starts to kill/inhibit diatoms in an unprecedented amount, that could shift the entire balance of ecosystems all over the world and even the way of life as we know it. Additionally, *P. tricornutum* is an excellent choice for the model organism of this experiment because based on other studies, this specific species of diatoms seems to be the most “resilient” to outside changes and environmental conditions. In other words, this species of diatoms would reveal the best indicators of how diatoms would be affected by the increase of PPE pollution.

When measuring the effects of how pollution affects marine life, the diatom Phaeodactylum tricornutum is the best organism to study due to its crucial role in overall marine

ecosystems. With the ever-increasing use of surgical facemasks, pollution of this item is one of the many varied factors that can affect the overall integrity of diatoms and marine life. The study "*Products released from surgical face masks can provoke cytotoxicity in the marine diatom Phaeodactylum tricornutum"* (Sendra et al., 2022) helps to investigate this issue by taking facemasks, whole and fragmented, and putting them in marine water within a controlled environment to see how the presence of these facemasks affect how diatoms live and function.

The researchers came to this conclusion using a detailed experiment with vigorous regulations in place, including even the materials that were used. First, the materials used included: commercial facemasks, surface marine water, and diatoms, specifically Phaeodactylum tricornutum. After the materials were collected, they did this experiment by having three sets of three beakers of marine water, one set with nothing in the water (the control), one set with the entire facemask in the water, and the last set with fragmented pieces of a facemask in the water. Afterwards, these sets of water samples were sat for about a month, where after the month, they were then filtered to separate the contaminated marine water from the facemasks into new beakers. Lastly, toxicological assays were made from different diatom samples being placed in each set of marine water samples to study how the resulting marine water environment would affect them.

In the discussion for this study, many other studies have also been researched to discuss many distinct aspects of what this study tried to complete. One major point was explaining how many studies tracked what was in the water that made facemasks so dangerous to diatoms. Some said it was the inorganic compounds while others said it was microscopic fibers. These microscopic fibers/nanofibers could be the result of secondary decomposition to make them so small that even in a laboratory setting, they would not be picked up by scientists. (Mishra et al.,

2019) This would then cause damage to the diatoms without anybody knowing what exactly happened.

In the end, this study did show that the number of diatoms had diminished dramatically and that they function less effectively in the presence of facemasks; more so when they are fragmented. One graph that helps to show this is figure 3A, which demonstrates the cell density between all the sets of toxicology assays between a 24–72-hour period. For the controlled/normal assay, it gave a standard number of around 400,000 – 1,000,000 cells per mL-1. However, between all the full facemask assays, it showed a similar number around the 24-hour mark but then lowered below normal as time went on. The same thing was seen with the assay of the fragmented facemask, but it was more profound by a substantial amount than the other assay.

This research study helped to show the significance of how pollution of facemasks affects diatoms and can also be applied to future research. One example of how these results can be applied is by measuring how other pieces of PPE pollution could affect the environment. There is even confirmed evidence that due to the COVID-19 pandemic, there has been an increase in PPE pollution in different marine environments that pose a potential threat to aquatic life through a variety of means of causing harm. (Bull et al., 2022) So not only does this study help to show how facemasks can affect the marine environment's primary producer, but it also serves as the basis for other studies that can show how pollution can affect other aspects of marine ecosystems.

# References

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