SCIENTIFIC LITERACY ESSAY

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The world is full of a diverse range of biomes and ecosystems. Having organisms that help maintain a balance to their environments creates a suitable area of life for other organisms. When it comes to diatoms their role as primary producers in the ecosystem has a huge impact on life. Spaulding et al (2021) shows that “20-30%” of the air we breathe comes from these diatoms when oxygen is released through carbon fixation and photosynthesis. So, these organisms not only convert Carbon dioxide that's in the water into sugar for other organisms, but they release oxygen as a product for the earth around them. Diatoms play a major role in the ecosystem and can help show you the quality of the biome if present. Without diatoms aquatic environments wouldn't be as diverse and we would notice the difference in the quality of the air.

In aquatic environments a commonly found diatom species is named *Phaeodactylum tricornutum* and unlike others it can exist in different morphotypes depending on the environment. These different forms can be shaped as oval, triradiate, and fusiform. Being so unique it has a high aptitude for being used commercially with large scale cultivation methods. Butler et al (2020) shows these diatoms and how this species dominates other microalgae and has high tolerant levels when it comes to pH and light. Having all these qualities makes it a perfect candidate for synthetic research and biotechnology. Unlike diatoms, *P. tricornutum’s* cell wall is poor in silica, but instead has more organic molecules. Le Costaouëc et al (2017) explains how a large amount of these molecules is sulphated glucuronomannan which has glycosidic linkages in the polysaccharide’s backbone. Also, having its genome sequenced ***P. tricornutum*** becomes the perfect study in biotechnology as it is suitable in many ranges of culture and has a high cell chassis rate.

COVID-19 affected the whole world and was a detrimental pandemic. Without the use of PPE and helpful guidelines the spread could have been a lot worse. Almost

overnight, face masks became a priority to have as it was mandated throughout the state for good reason. With all the positive views of stopping the spread and taking control no one had yet focused on the negative impacts they also had. COVID-19 and the increased use of PPE has severely impacted pollution in marine ecosystems in a negative way. Diatoms are a very important microalgae that help provide nutrients and balance carbon dioxide levels. In an experiment face masks and face mask fragments were put in marine water with *P. tricornutum* to see the correlation. Sendra et al (2022) studies show that over a 72-hour period the cell density of *P. tricornutum* was 7.11 times lower than the controls within the fragmented solution. Therefore, now that COVID-19 has increased the use of PPE which has direct correlation to the increase of face mask litter which increases pollution you can see how it's hurting marine life and its ecosystem. Proving that it creates a disturbance and damage within the diatom shows how important it is to look out for the world and dispose of things properly. If not, you might not see the damage right in front of you but sooner or later the outcome will be irreversible with major alterations.

To properly inspect how these face mask effect the aquatic environment many methods were used in this experiment. First to show different stages of face mask disintegration, two methods were used by utilizing whole face masks, and face masks that were fragmented. The materials collected to start this experiment were commercial surgical face masks, surface marine water from a clean offshore area of Cadiz Bay, and Erlenmeyer flasks. The marine water was filtered two times and there were three groups, a control flask with no masks, a flask with a whole mask, and a flask with fragmented

mask pieces. At this stage the masks were submerged and set in agitation at 50 rpm. The photoperiod was 12 hours of light and 12 hours of dark at room temperature.

There were two tests undergone, one inspected for inorganic materials present in the water, and the other showed fiber release. This experiment helps to show the analysis of the behavior of face mask when present in marine water. Now that they have established ground data on how the face mask interacts with the aquatic environment different analysis were performed with the diatom *P. tricornutum.* These toxicology assays help show data like the cell density, and the percentage of intracellular ROS after 24, 48, and 72 hours. Observing the data it shows a significant difference in the three elements Mn, Zn, and Ni presented in the water containing mask fragments. It was only in the flask with fragmented pieces that showed traces of these elements. During the second experiment with the flasks containing *P. tricornutum*, multiply studies were carried out with most proving to show how this polluted environment had negative effects on the diatom when it comes to things like cell density, intracellular ROS, cell complexity, and chlorophyll a percentage. One major finding from these experiments is that even though these diatoms are affected, after 72 hours of this chronic exposure the population has a recovery and continues to produce.

Even though whole mask shows harder signs of releasing these elements the data proves significantly higher traces of these elements within the water with the fragmented mask. Besides the fact that this PPE releases these elements, they also are a source of microplastic fibers which are currently the main source of microplastic pollution in aquatic environments (Mishra et al., 2019). These microfibers are devastating and effect the entire world daily and cause damage including marine life like echinoderms (Mohsen

et al., 2020). Luckily these studies have also shown that these diatom populations can recover and detoxify which was also observed by *Chlorella pyrenoidosa* that was exposed to nano plastics (Yang et al., 2021). Overall, even though these face masks are not yet considered to be an emergent pollutant this recent pandemic has increased are need for this item which has in return increased its pollutant percentage.

Following the results from Sendra et al (2022) the first test was to understand face mask characterization and behavior within marine water. Providing details on the elements found within a mask and tested to see how these elements are affected when placed in these aquatic conditions. There was a significant difference regarding the marine water with the fragmented mask proving higher levels of these elements in the water. Starting at day three Mn showed higher concentrations and then was followed by Zn within the course of the third and fourth weeks. Finally, Ni concentration increased depending on the background levels between days 21 through 28. In this experiment the total fragments of fiber released between the whole and fragmented mask were similar. It was the number of fibers present that was significantly higher in the fragmented mask water (21.13 ± 13.19 fibres·mL−1) then (0.33 ± 0.24 fibres·mL−1). This means that due to the mask being fragmented the release of these fibers had a higher concentration than that of a whole mask. It was also shown that the length of these fibers was longer in the fragmented masks (0.93 ± 0.28 mm) then the whole mask (0.22 ± 0.3 mm). This research will help with future applications in many ways. For example, now that we know the behavior of these mask within aquatic environment maybe we can redesign them to help prevent the element and fiber release. You can even take this research and expand to see if there are any factors that would help speed up the recovery time of these diatoms to

help keep their roles as primary producers functioning. Overall, diatoms play a major role in the world and studying how we are directly affecting these organisms can help us find a solution moving forward.

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