

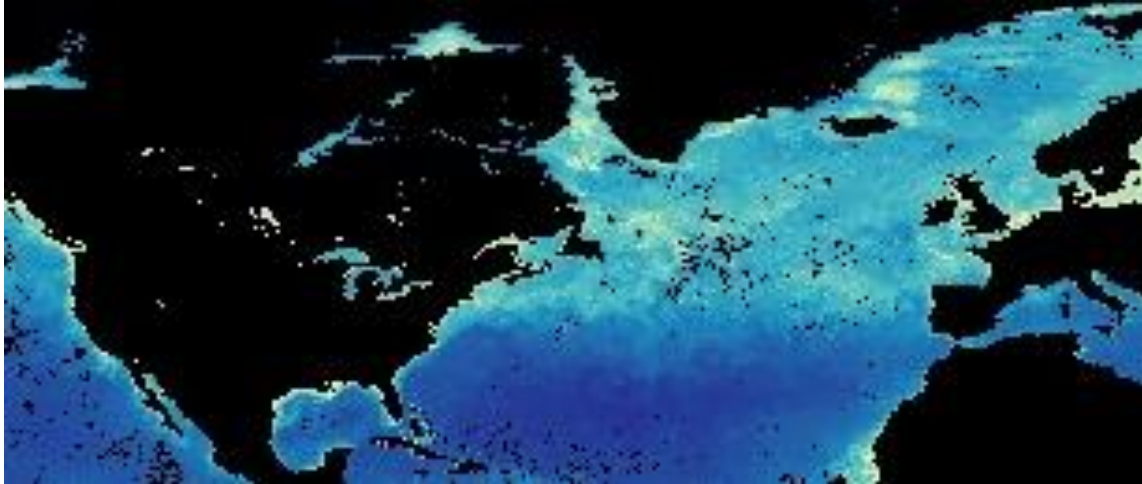
Mystic Seaport for Educators  
Science on the 38<sup>th</sup> Voyage of the *Charles W. Morgan*  
Lesson 5 of 6: The Whale Pump  
Student Worksheet

Name: \_\_\_\_\_

Questions:

1. Figure 1 in the reading shows a model of the whale pump created by scientists Joe Roman and James J. McCarthy. Use this figure to answer the questions below.
  - a. If whale populations decline, will nitrogen in the surface waters increase or decrease? Circle one.
  - b. What indirect effect will a decline in whale populations have on plankton? Explain your reasoning.
  - c. Plankton produce 4% of the oxygen that we breathe and remove carbon dioxide from the air when they photosynthesize. If plankton populations decline, there will be **more/less** (circle one) food for whales and **more/less** (circle one) carbon dioxide in the atmosphere.

2. Areas of the ocean that are highly productive, or have “high primary productivity,” possess large numbers of photosynthesizing phytoplankton, which in turn feed zooplankton and fuel the rest of the food web. The image below shows primary productivity (shown in lighter shades) in the North Atlantic in May, 2016.



*May, 2016 (Source: NASA)*

- a. Where would you expect to find whale species on this map – in areas of high or low primary productivity? Why?
  
  
  
  
  
  
  
  
  
  
- b. The Gulf of Maine is located in the northern Atlantic Ocean. Circle this area on the map.
  
  
  
  
  
  
  
  
  
  
- c. **Challenge Question:** Scientists Joe Roman and James J. McCarthy found that the “whale pump” in the northern Atlantic Ocean is more active in the summer and spring. Does this result make sense? Explain your reasoning.