

Become a HAB Expert

Foreseeing the Future

Monterey is known for having unpredictable algal blooms. In the past, researchers could tell when there was a harmful bloom only when hundreds of sea lion carcasses and dead seabirds washed up onshore. But today, there are easier ways to actually predict a HAB event.

MISSION # 1: SAVE THE SEA LIONS

Can you save the sea lions from the next HAB event? Try your hand at predicting the next algal bloom!

Below is an important forecasting tool you'll need to predict when the next event might occur. In fact, this is the same raw data chart scientists use to catalog their weekly phytoplankton samples and determine bloom trends.

At the top of the chart you'll notice two harmful species. The first is *Pseudo-nitzschia*, which releases a poison called domoic acid (DA). *Pseudo-nitzschia australis* and *Pseudo-nitzschia multiseries* are two types of *Pseudo-nitzschia* species that cause harmful blooms during certain months. The second is *Alexandrium*. *Alexandrium* makes saxitoxin, also known as paralytic shellfish toxin, that can cause death if people eat contaminated clams, mussels, or oysters.

TASK: Take researchers' data and create a times-series plot, which is basically a graph that shows the number of individual *Pseudo-nitzschia* and *Alexandrium* cell counts over an entire year. Your x-axis should be the date each sample was taken and your y-axis should be the species you're interested in predicting. Here's an example of how your graphs might look. (Note: NaN means Not Analyzed)

[View the excel spreadsheet and graphs](#) (provided by UCSC Kudela Lab)

QUESTIONS:

1. Do *Pseudo-nitzschia* blooms occur the same time as *Alexandrium* blooms?
2. Can you tell when HABs generally occur?

ANSWERS:

1. *Pseudo-nitzschia* are diatoms and *Alexandrium* are dinoflagellates so you will generally see one species bloom at a time since certain environmental conditions allow dinoflagellates to eventually out-compete the diatoms for resources. For more information regarding this species shift from diatoms to dinoflagellates, check out [Time Traveling with HABs](#).

2. Dinoflagellate blooms such as *Alexandrium*, generally occur in the fall for Monterey Bay, although smaller blooms can occur whenever there are calm, warm waters. Diatoms usually occur in the spring, particularly after El Niño events (when there's lots of nutrients and warmer temperatures.)

Assuming your powers of prediction have gotten stronger, can you tell if these blooms are affected by the moon? Find out if you're the next Sherlock Holmes .

MISSION # 2: SOLVE THE MYSTERY OF THE FULL MOON

Here's your chance to play detective. It's the night of full moon and evil is afoot. Find out if algal blooms vary according to the moon cycle.

In 2004 there was a mysterious shift in phytoplankton species. Even though diatoms grew faster and were more common, dinoflagellates proved to be better swimmers and found more nutrients at lower depths. The problem today is that the dinoflagellates are now running amuck in Monterey Bay!

TASK: Use the observational data from the researchers and figure out when there are lots of dinoflagellates --in this case an Alexandrium bloom. Use the [StarDate Website](#) to test your mystery-solving skills.

QUESTIONS:

Does the bloom mirror certain periods of the moon cycle? For instance, after figuring out when an Alexandrium bloom occurred, do you see an increase or decrease when there's a full moon? How about when there is a new moon?

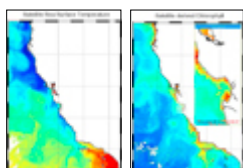
ANSWER: There should be a pattern of more blooms occurring when the moon is full. The moon cycle does not directly affect blooming events, but it does strongly influence the tides. During the full moon, there are higher tides that help to stir up more nutrients from colder waters. As a result of more nutrients, there's sometime a bloom that co-occurs when there's a full moon.

Now that you've solved the mystery of the full moon, you're an expert and on to bigger and better things. But can your newfound talent help to save your friends a trip to the beach?

MISSION # 3: SWIM OR NOT TO SWIM

Your friends are super excited to go to the beach in Monterey Bay tomorrow, but you're feeling a little hesitant because you've heard rumors that it's a "hot spot" for HABs (Harmful Algal Blooms). Is this a good day to be heading out to the bay? Take a look at live data.

TASK: To see if a bloom is occurring, study the following weekly composites (8 days worth of data compiled to make one image). Both images are updated daily which is perfect for your task since all you need to look at are the Sea Surface Temperature (SST) and Chlorophyll Concentrations.



[Click to view Temperature/Chlorophyll maps](#)

Sea Surface Temperature is the water temperature at the ocean's surface. The image on the left represents the most up-to-date information on sea surface temperature in Monterey Bay. This area is known for its upwelling system, which is basically the process of bringing cold, nutrient waters up from the ocean depths to the surface. Just looking at this image can you figure out under what conditions a bloom would most likely occur? (Note: Red means warmer and Blue means colder)

Researchers also use **chlorophyll concentrations** or the amount of chlorophyll detected in the water to measure the number of algal species. Because algae need chlorophyll in order to photosynthesize, do you think there would be an increase or decrease in phytoplankton numbers if a majority of this map was red? (Hint: Red means a higher chlorophyll concentration and Blue means a lower chlorophyll concentration)

QUESTIONS:

1. Now, looking at the two maps together, would you say that tomorrow is a good day to visit Monterey Bay?
2. Would you say there are other environmental conditions that are needed to create a HAB event? Besides temperature and chlorophyll, come up with some other things your friends should consider before swimming in the Bay.

ANSWERS :

1. Cooler surface temperatures generally indicate more upwelling which makes available nutrients for the phytoplankton to grow. Higher chlorophyll concentrations mean there's more algae because they have chloroplasts which use chlorophyll to undergo photosynthesis. So when there's colder sea surface temperature (i.e. when you see lots of blue in the image to the left) blooms are more likely. However, blooms can also occur with warm ocean temperatures!
2. Algal blooms proliferate when a combination of environmental factors come into play:
 - high nutrient levels
 - calm waters
 - little to no wind
 - minimal circulation
 - limited number of grazers or predators

Additional Activity Links:

Find lesson plans, activities and explanations at [Bigelow's Laboratory](#)