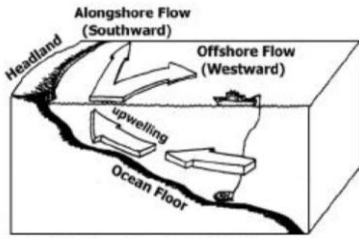


Coastal Upwelling Practice

Name: _____



Coastal upwelling is the upward movement of water along a coast. This rising water is usually cooler and more nutrient-rich than the surface water it replaces.

Let's look at California for an example. The upwelling of nutrient-rich water has made Monterey Bay, on the coast of California, a favorite with fishermen. The strongest upwelling occurs when Monterey Bay experiences winds from the northwest that blow parallel to the coast of California.



When these winds are weak or the winds are from the south, the upwelling tends to stop and the warmer waters of the California current move into Monterey Bay. The very large California Current travels southward along the California coast from the North Pacific. Observations of sea surface temperature from satellites show that upwelling is not uniform along the central California coast, but is strongest at the major headlands.

In the northern hemisphere the rotation of Earth causes surface water to move to the right of the wind. This movement to the right is known as the **Coriolis Effect**. In the Monterey Bay area, winds out of the northwest cause water to flow to the southwest, away from the coast. The water flowing offshore is replaced by the cool, nutrient-rich water, which rises up into the coastal area below, resulting in the upwelling phenomena.

The upwelling water can be tracked by measuring its cool temperature, high nutrient content, high salinity and high density. The nutrients brought to the surface encourage the high plankton productivity of the Monterey Bay area, which is why it is an excellent fishing locality.

QUESTIONS FROM THE READING:

1. Define "Upwelling":
2. List **two (2)** ways in which cool, nutrient-rich water may reach the surface:
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 -
3. List **two (2)** impacts of having cool, nutrient-rich water reaching the surface of the ocean:
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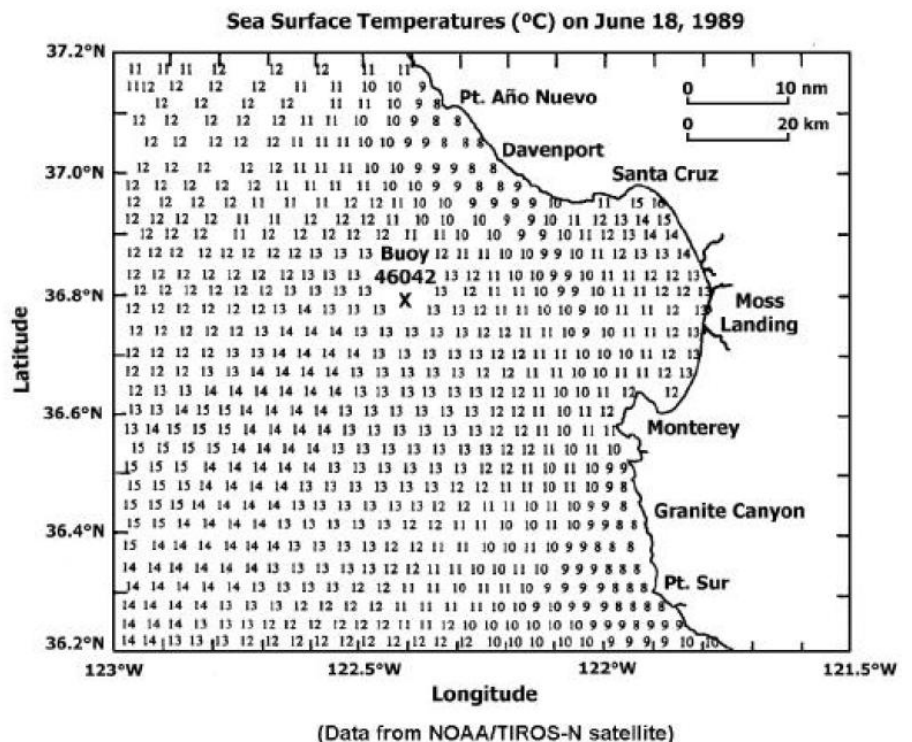
Surface Temperatures and Upwelling:

We can see the upwelling effect if we change the numerical sea surface temperature satellite data into a color image for ease of interpretation.

COLOR in the areas of sea surface temperature using a different color for each temperature.

Move through the color sequence (Red, Orange, Yellow, Green, Blue, Indigo, Violet) color sequence, with **red being the warmest water**.

Place a key to the colors you have chosen and their matching temperatures in the margin. It may be easier if you first outline an area with a specific temperature and then fill it in with color.



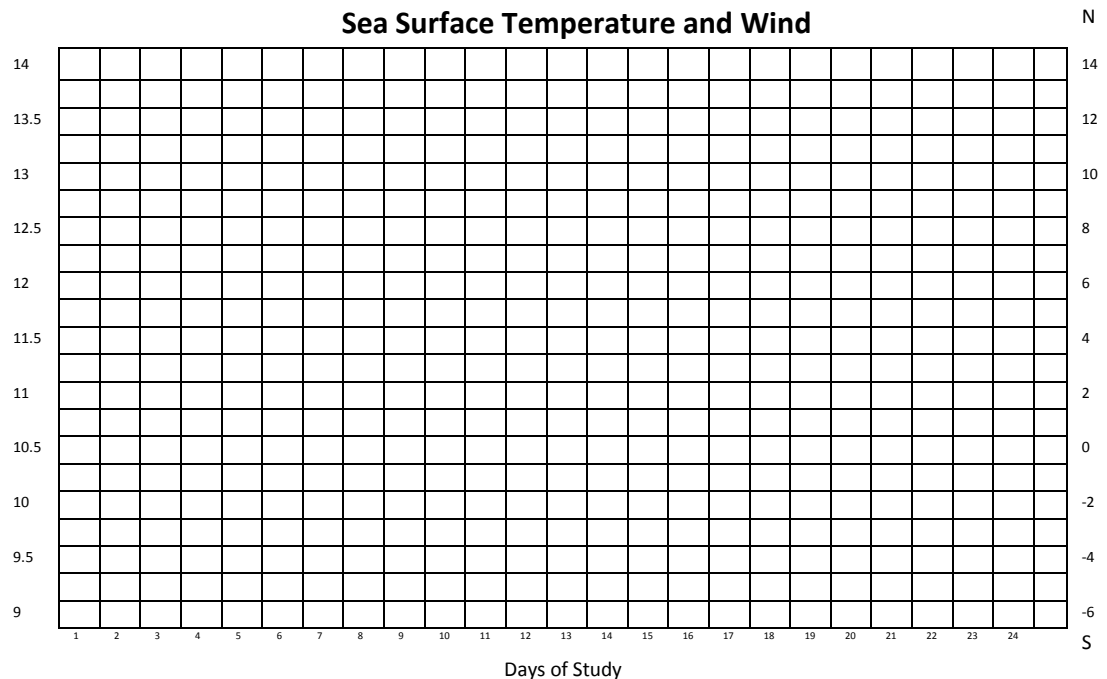
Wind Speed and Upwelling:

Plot both sea surface temperature and wind speed with time. Using the sea surface temperatures at Granite Canyon near Monterey Bay and the wind speed and direction information from buoy 46042 in Monterey Bay, **plot** the following data on the graph provided.

NOTES:

1. Notice that the scales for plotting temperature and wind speed are on opposite sides of the graph.
2. Wind direction is the direction the wind is blowing **FROM**.
3. Be especially careful when plotting the southerly winds.
4. **NEGATIVE** numbers on the table indicate winds from the **SOUTH**.
5. **Left-side "y-axis"** represents **temperature (°C)** and **right-side "y-axis"** represents **wind speed (mph)**
6. Use two **different colors** when plotting temperature and wind speed.
7. **CONNECT** the dots of each set of marks (temperature and wind speed) to make **two lines** on the graph.

Date	Temp (°C)	Direction	Speed (mph)
5/23	10	N	3
5/25	10	N	8
5/27	9	N	10
5/29	9	N	8
5/31	9	N	4
6/2	10	S	-1
6/4	12	S	-4
6/6	13	S	-3
6/8	12	N	7
6/10	11	N	5
6/12	10	N	8
6/14	10	N	7
6/16	10	N	7
6/18	9	N	9
6/20	9	N	11
6/22	11	N	4
6/24	12	S	-4
6/26	13	S	-6
6/28	13	-	0
6/30	14	S	-1
7/2	13	N	6
7/4	11	N	9
7/6	9	N	10
7/8	9	N	10



ANALYSIS & CONCLUSIONS:

1. Besides water temperature, list two other measurable items that you could use to track the path of upwelling:
2. Suppose you are leading a whale watching trip to see plankton-eating blue whales. Where would you take your boat? **Why?**
3. The Monterey Bay Aquarium Research Institute has a new remotely operated vehicle that can go down into the canyons of the ocean. During most of the trip down, the video shows "marine snow" (tiny particles of dead and decaying organic matter) gently drifting to the bottom. Upwelling will recycle some of this material. During which days in June would you expect **maximum** marine snow? **EXPLAIN** why?
4. There is a large gas burning electrical power plant at Moss Landing that releases warm water, used for cooling its turbines, into Monterey Bay. How will the warm water impact the area? (**Cite specific data points from your graph**)