

## Factsheet on “Upwelling and Blue Whales” lab

- **Upwelling** is the movement of water from the deep ocean towards the surface. This deep water “wells” upwards because it is replacing the space left “open” by surface water that’s been pushed away by currents. It works a little bit like a **giant pump**.
- Areas where there is upwelling are very important, even to us humans, because of their **nutrient-rich** waters. Deep, cold and salty waters from the bottom carry lots of nutrients and when they reach the surface they “**fertilize**” the upper ocean, just like a farmer would do when he fertilizes his field with cow dung! Some of the most important fishing zones are in upwelling areas along the coast of North and South America.
- Tiny algae (plants that live in water) called “**phytoplankton**” can grow easily thanks to these nutrients and they form the basis of the food for all the other living things like shrimp, small fish, larger fish, dolphins all the way up to the mighty **blue whale**, the biggest animal on Earth. So where there is upwelling there is a concentration of marine life.
- **Upwelling starts in the atmosphere:** winds that blow continuously along the shore (imagine the coast of California) cause currents to flow. If the current flows away from the coast (In California it would mean a westward current) an “open space” is created. You will not see a “hole” or something like that, it is more like a conveyor belt. Nature likes things to be even, so if currents carry surface waters away, something else needs to replace the space left “open”. Because there is land on one side, the only place where water can come from is from below.
- **Coriolis force** is caused by Earth’s **rotation**. It deviates all loosely moving things (like a cannonball in the air or a current in the ocean) **towards the right in the Northern hemisphere**, and towards the **left in the Southern hemisphere**. Right on the Equator there is **no Coriolis force**.
- **Ocean currents are caused by the winds**. If wind blows over the ocean it will cause a current to flow on its surface. Now comes in the **Coriolis force**: the current does not simply flow in the same direction as the wind. It will flow **towards the right** of the wind direction in the **Northern hemisphere** and **towards the left in the Southern hemisphere**. If for example the wind in the Northern hemisphere blows towards the South (let’s say a wind that blows along the coast from Oregon towards Mexico) it will cause a current to flow towards the West (towards the right of the wind direction).

### Now relate everything to upwelling!

In order to get upwelling along the California coast, one needs to have winds that blow along the shore **towards the South**. This will create a current that will flow towards the West (towards the **right of the wind direction**). This current that flows away from the coast sets in motion the upwelling pump: deep, cold and rich water will flow upwards and, as soon as it reaches areas shallow enough so there is light, it will enable all kinds of algae and phytoplankton to grow... The Blue Whales will follow!