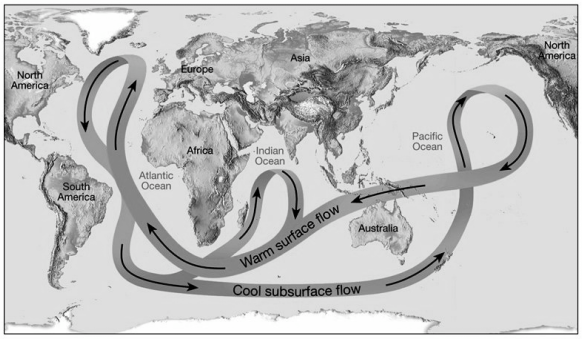
A Hastily Assembled Set Of Slides On The Oceans, With Lots Of Pictures, But You'll Have To Use Your Own Notes To Get The Full Background Material On A Lot Of This Stuff

by Dr. W.

Thermohaline circulation drives the "conveyor belt" circulation of bottom water over very slow time scales. . .



Gaspard Gustave de Coriolis (1792-1843). . .
using the Coriolis Force. . .

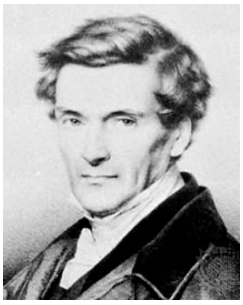
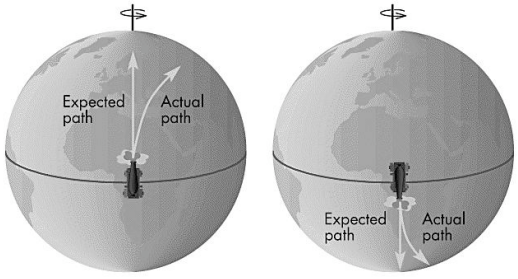
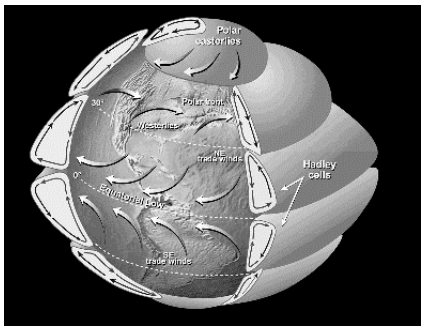


Illustration of the Coriolis force. . .

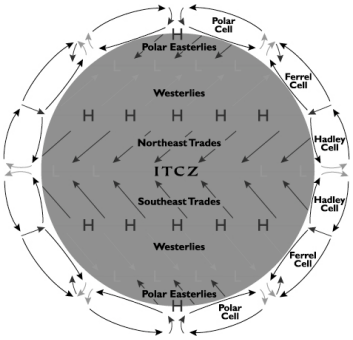


A Projectile fired northward **B** Projectile fired southward

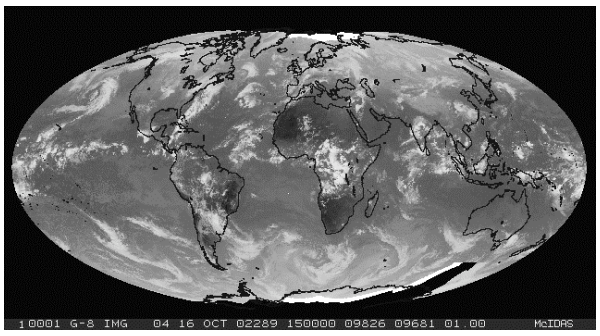
Solar radiation causes patterns of atmospheric convection -- air near the equator rises, circulates N and S, and sinks down at about 30 degrees N and S.



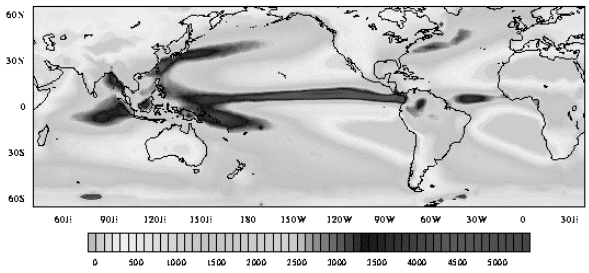
This convection plus the Coriolis effect sets up the global pattern of wind direction. The ITCZ (Inter-Tropical Convergence Zone) lies near the Equator. . .

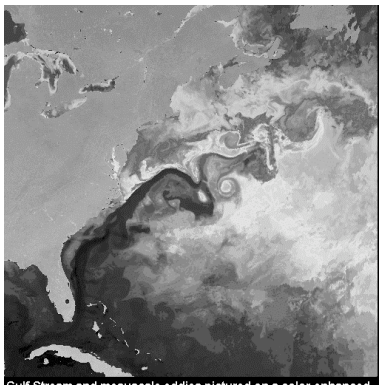


Global composite satellite image (October 2002)



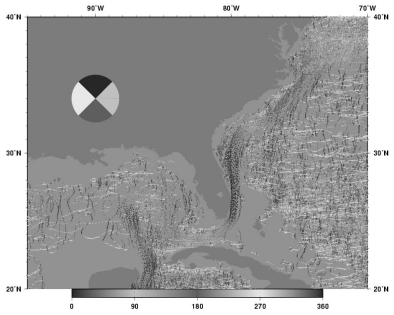
Global map of average yearly rainfall. The “thirty-degree deserts” and the equatorial rain belt are obvious. You can even see how warm water moving polewards (e.g. the Gulf Stream) brings moisture with it.





Gulf-Stream and mesuscale eddies pictured on a color-enhanced NOAA/AVHRR image (downloaded from http://seawifs.gsfc.nasa.gov/SEAWIFS/IMAGES/eastcoast.gif).

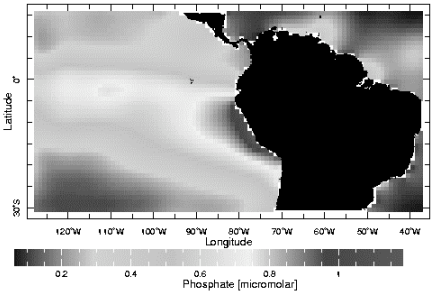
"False color" satellite image showing surface ocean temperatures in the North Atlantic. The Gulf Stream is obvious.

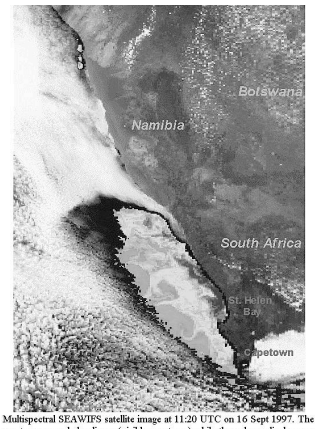


Another look at the Gulf Stream. Each dot on the map is the location of a free-floating buoy at a given moment; the color shows the direction each buoy is moving. The blue band off the Florida Coast and up the Atlantic Coast is the Gulf Stream.

Compare the previous maps with Benjamin Franklin's map of the Gulf Stream, and you'll see that Franklin was pretty accurate—he didn't discover the Gulf Stream, but he studied it, mapped it, and proposed that it could be useful to ships. (Here's more of the story.)

Satellite image showing concentrations of phosphate (a nutrient) in the ocean off the coast of South America (pink and red are highest, blue is lowest). The high nutrient levels are due to *upwelling* of cold ocean water as a surface current pulls away from shore.

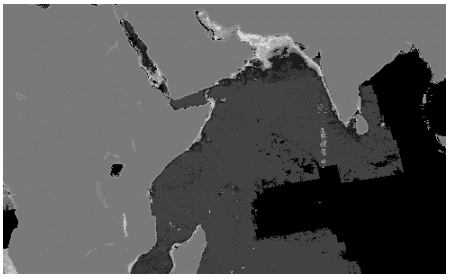




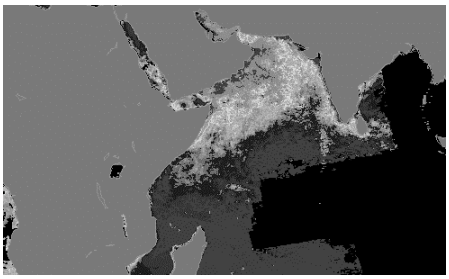
Multispectral SEAWIFS satellite image at 11:20 UTC on 16 Sept 1997. The greytones reveal cloudiness (visible spectrum) while the colours display sea surface temperature in cloud-free areas. Note: red is colder and blue warmer.

Satellite image showing ocean temperatures off the coast of South Africa. Oddly, red is *cold* in this picture—I don't know why—but the cold "plume" here is caused by upwelling of cold bottom water.

Upwelling results where winds push surface water away from a coastline, and thus can shift with weather patterns. Here is a satellite image of algal growth in the Arabian Sea in April-June 1979. . .



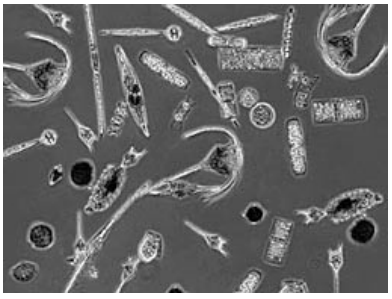
. . . and in July-September 1979, when prevailing winds blow from the land onto the ocean, pushing surface currents away from the coastline!



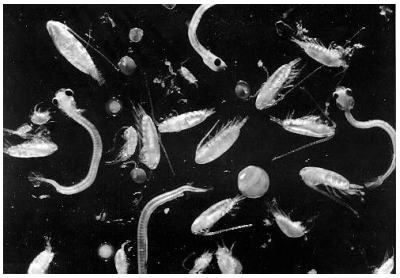
Marine Life

- Plankton—all organisms that float or drift with ocean currents
  - Some can't move; others can swim but do so only weakly
  - *Phytoplankton*: algae
  - *Zooplankton*: animals and animal-like protozoans

Typical phytoplankton: mostly single-celled algae



Typical zooplankton: mostly larval fish, small crustaceans



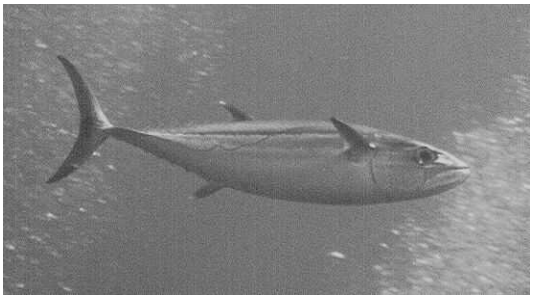
This small euphausiid crustacean, a.k.a. *krill*, is a food item for much larger animals such as whales. . .

But planktonic organisms can be much larger than that. . . such as this *Chrysaora achylos* jellyfish, only described by scientists in 1997.

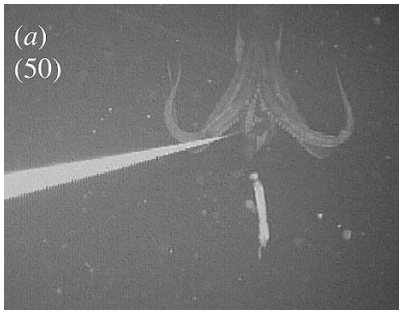
Marine Life

- Nekton—all organisms that actively swim independently
- Benthos—all organisms that live on or in the ocean bottom
  - Epifauna: animals that live on the surface of the sea floor
  - Infauna: animals that live buried in sediments
  - Nektobenthos: animals that live on the bottom but also swim

A member of the *nekton*: a tuna

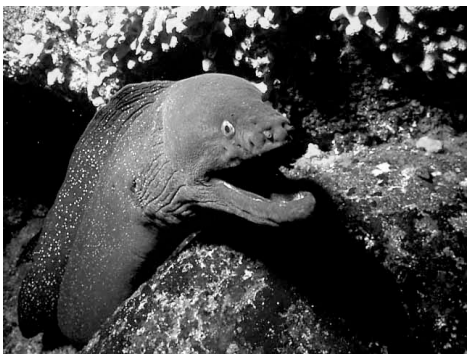


Another nektonic organism: *Architeuthis*, the giant squid, photographed attacking a baited line almost 3000 feet below the surface in September 2004.



A washed-up *Architeuthis*—these may get as long as 18 meters from tip of the body to tips of the tentacles, although 6-12 meters is more typical.

A member of the *epifaunal benthos:* a barrel sponge, caught in the act of spawning



A *nektobenthic* organism: a moray eel.

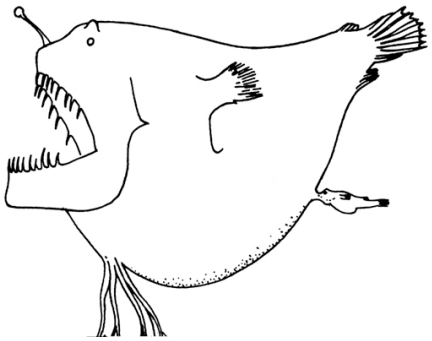
Marine Zones

- *Photic Zone*—zone of sunlight penetration
  - *Euphotic Zone*—zone of enough sunlight penetration for photosynthesis; up to 100 meters in clear water
- *Aphotic Zone*—zone with no light at all except for *bioluminescence* (light made by liviing things; begins as low as 1000 meters)

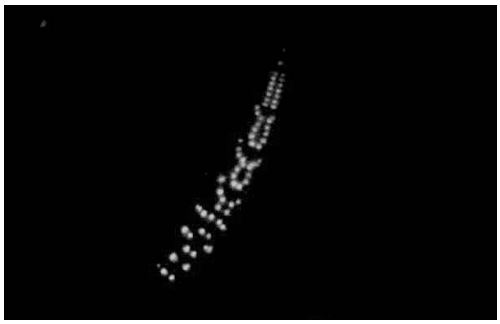
I couldn't find a picture of the bioluminescent ponyfish, but here's a deep-sea gulper eel. . .

. . . and a deep-sea anglerfish. . .

. . . and another deep-sea anglerfish, this one a female with an attached male whose tissues and blood vessels have fused with hers!



. . . and the bioluminescence of a fish I can't identify (photo taken in total darkness in the abyssal zone)!



Marine Zones

- *Intertidal zone*
- *Neritic zone*—low-tide line to continental shelf
- *Oceanic zone*—open ocean, generally very deep
- *Abyssal zone*