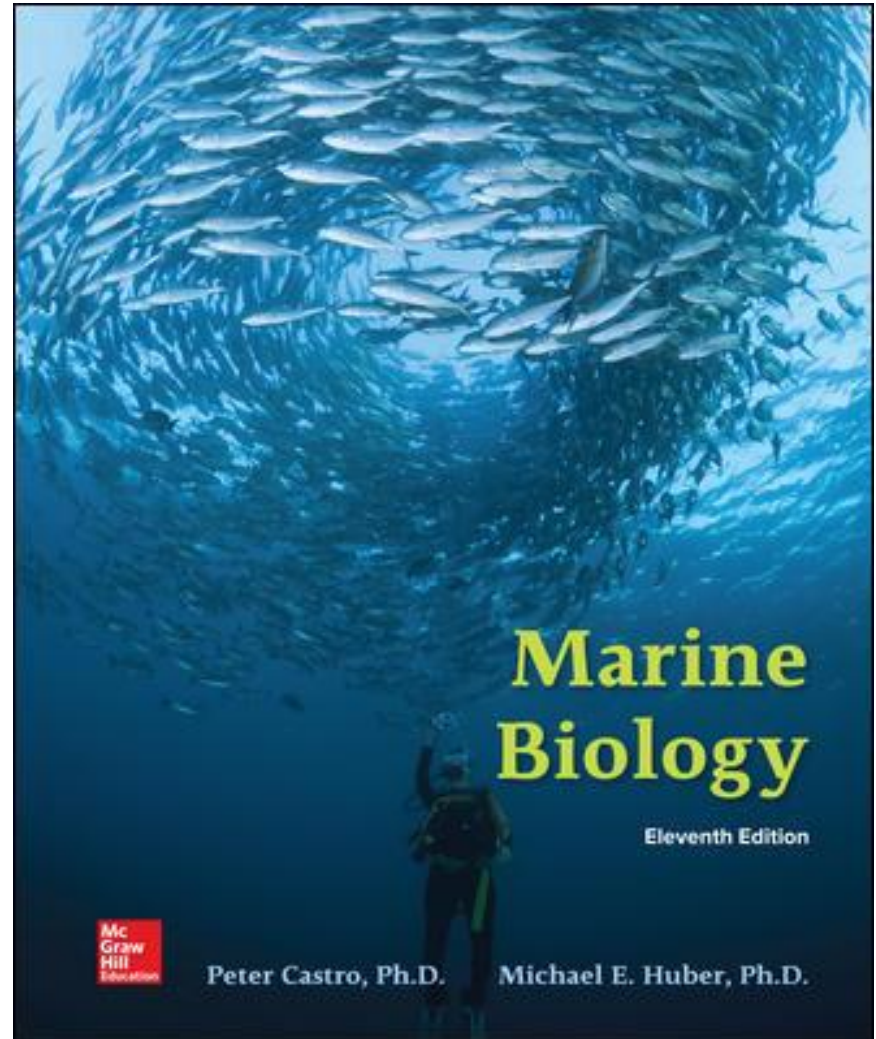


Dual Enrollment Marine Science

Chapter 1

Lecture Slides





Chapter One

The Science of Marine Biology

What is Marine Biology?

- **Marine biology** - the study of organisms that live in the sea (this includes all water that has some degree of salinity).



What is Marine Biology?

- Marine biology is not a separate science. It is an applied field of biology and incorporates many other sciences as well such as:
 - Geology
 - Chemistry (organic and inorganic)
 - Physics
 - Meteorology
 - Zoology

A Marine Biologist is not the same as an Oceanographer

- **Marine Biologists** study the organisms that inhabit the sea. (living things)
- **Oceanographers** study the physical aspects of the ocean including tides, currents, waves and the chemical make-up of seawater. (non-living environment)



Why Study Marine Biology?

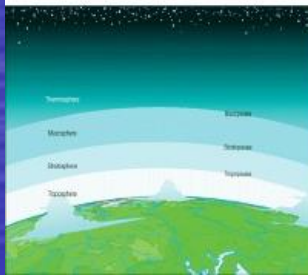
Why Study Marine Biology?

1. Some scientists believe **life has arisen in the sea**, studying marine life forms can provide clues into the validity of such a claim.

EVOLUTION OF LIFE ON EARTH



- About 4 billion years ago, the earth cooled sufficiently to permit water to condense and form rivers, lakes, seas.
- About 3.5 billion years ago, certain gases in the atmosphere came together and formed the first living form in water.



Why Study Marine Biology?

2. Many **products** come from the sea including medicines derived from marine species, food resources and other items used for human use (examples: the **agar** used to culture bacterial samples and **carrageenan** used to thicken dairy products are both derivatives of marine algae).



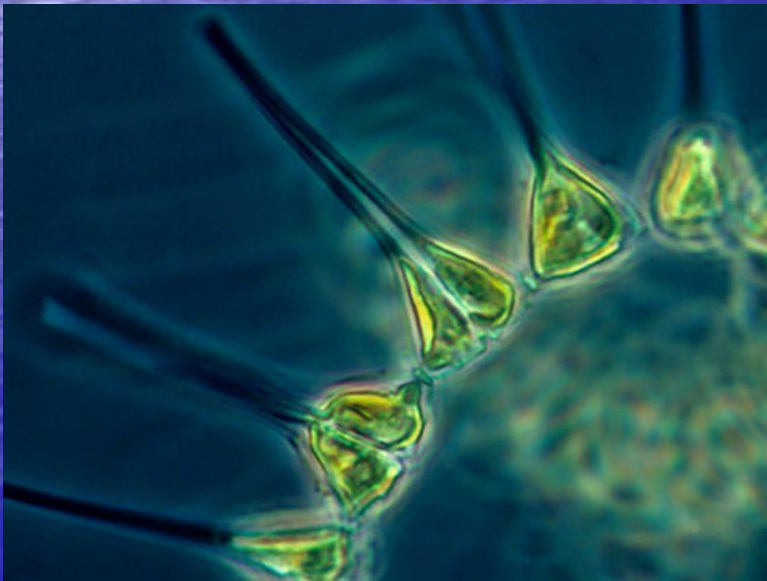
Why Study Marine Biology?

3. The marine environment and its habitats support **recreation and tourism** worldwide.



Why Study Marine Biology?

4. Marine organisms
produce oxygen
used by aerobic
organisms,
including humans.



Why Study Marine Biology?

5. Oceans help to **regulate climate**.

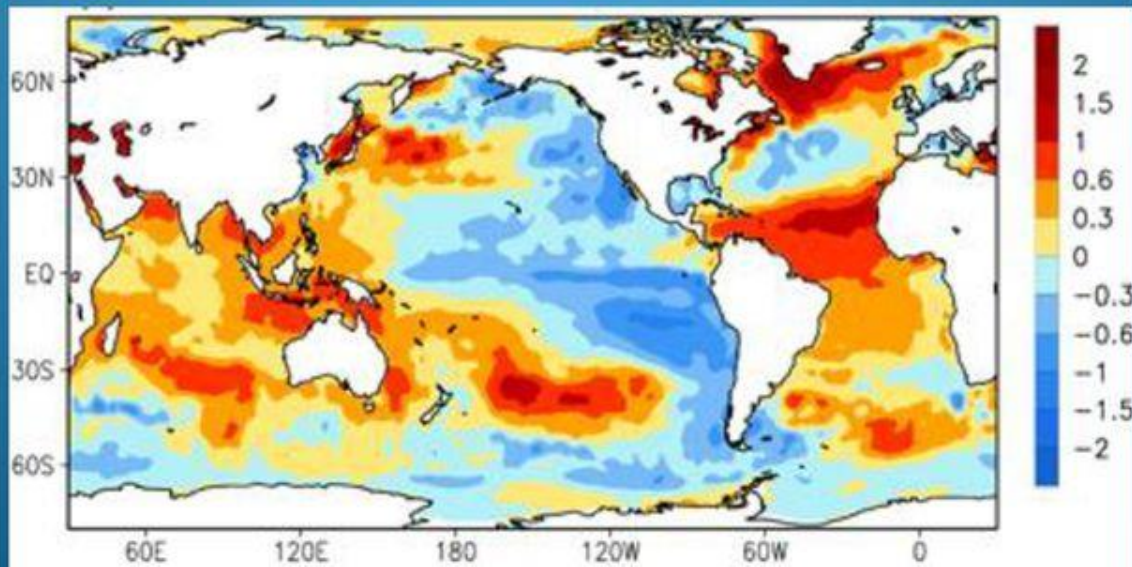
(Reason: The ocean is slow to change in temperature because of the sheer volume of water. This keeps land masses near the ocean more stable year-round)

Example: Ever notice how the temperature at the coast is 10-15 degrees warmer in the fall compared to inland, but also 10-15 cooler in the summer?

How do surface currents regulate the climate?

Ocean currents act like a giant conveyor belt:

- Transports warm water and precipitation from the equator toward the poles.
- Transports cold water from the poles back to the tropics.
- Regulates the uneven distribution of solar radiation reaching Earth's surface



Why study marine biology?

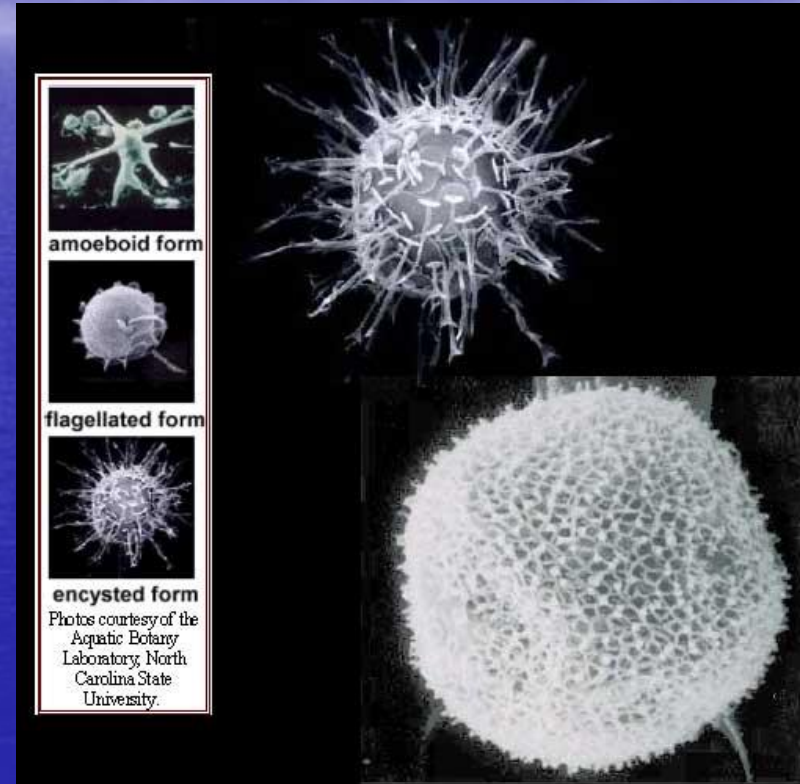
6. Marine organisms can cause **problems** directly to human life or their property.

- Harm humans directly by **attacking** them or causing diseases
- Harm human **indirectly by injuring** or killing other marine organisms that are use for food and other purposes



Why Study Marine Biology?

Another example: there are microorganisms that can directly affect human health or other organisms such as *Pfiesteria*.



Why study marine biology?

- Erode piers, walls, ship bottoms and pipes

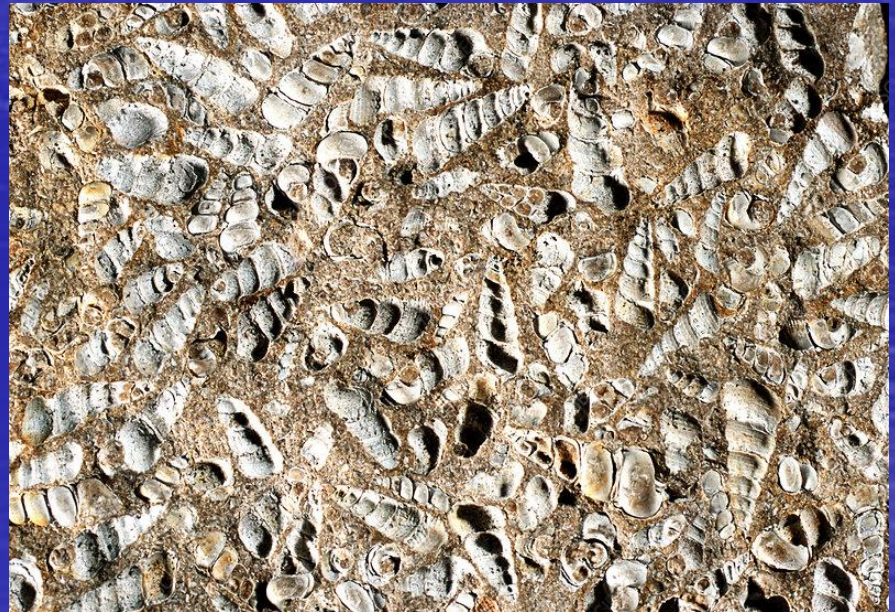


Why study marine biology?



7. **Shorelines** are protected and shaped by marine life

8. Marine organisms can **create new land**





The History of Marine Biology

History of Marine Biology

- Early people started learning about marine biology through observations.
- Piles of shells are found from the **Stone Age**.
- As people gained seamanship and navigation skills, they were able to gain more knowledge.



History of Marine Biology

- Stone blades and clam shells have been recently discovered in a cave in South Africa that are approximately 165,000 years old
- Additionally, shell harpoons and fishhooks have been found that are approximately 110,000 years old
- This shows that man has been using the sea for some time

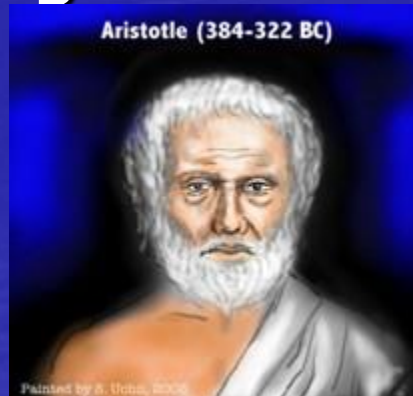
History of Marine Biology

- Early explorations were made by Pacific Islanders as well as the Phoenicians who extensively sailed the Mediterranean Sea, Red Sea, Black Sea, Indian Ocean and Eastern Atlantic Ocean.
- Ancient Greeks also had extensive knowledge of the near shore environment of the Mediterranean Sea.

History of Marine Biology

- Aristotle

- Greek philosopher
- Considered to be the first marine biologist.
- Described many forms of marine life.
- Recognized that gills are the breathing system for fish.



History of Marine Biology

- Much exploration stopped during the Dark Ages.
- An exception is the explorations of the Vikings in the Ninth and Tenth Centuries.
- During this time, **Leif Eriksson** discovered Vinland (in 995 AD), which is now known as North America.



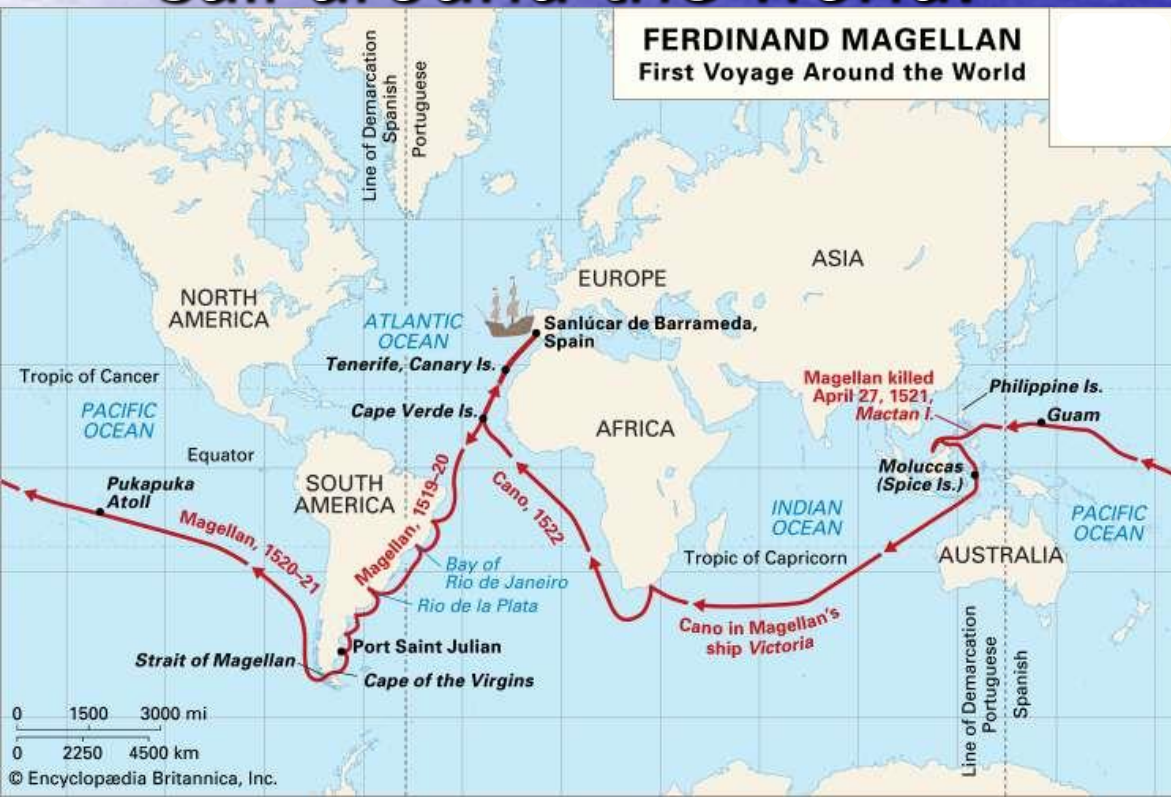
History of Marine Biology

- During the Renaissance, explorations began again.
- At this time, Columbus “rediscovered” the “New World” or North America in 1492.
(Note ... word hadn’t reached Europe about Eriksson’s findings)

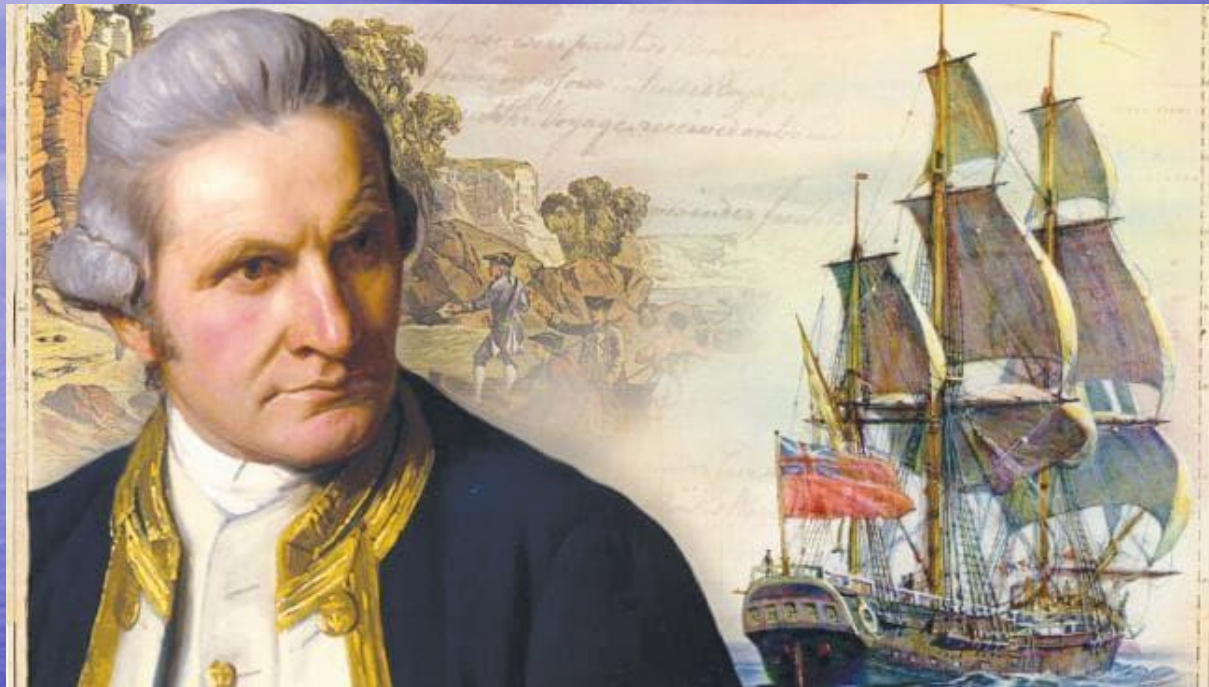


History of Marine Biology

- In 1519, **Ferdinand Magellan** embarked on the first expedition to sail around the world.



History of Marine Biology

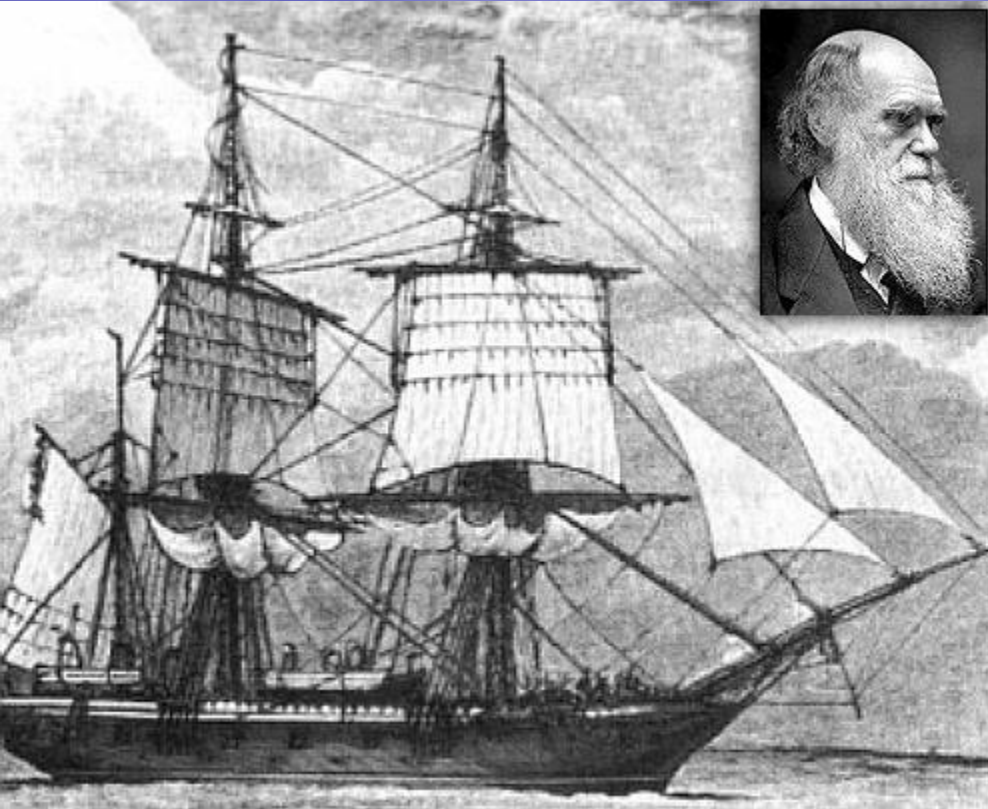


- In 1768 Cook began his first of 3 voyages to explore all of the oceans.
- **James Cook** was an English sea captain and began including a naturalist among his regular crew at sea.

History of Marine Biology



- Captain Cook and his crew sailed all the oceans and were the first Europeans to view the Arctic ice fields, land on Hawaii and Tahiti as well as many other Pacific Islands.
- His crew did extensive mapping and brought back many specimens.



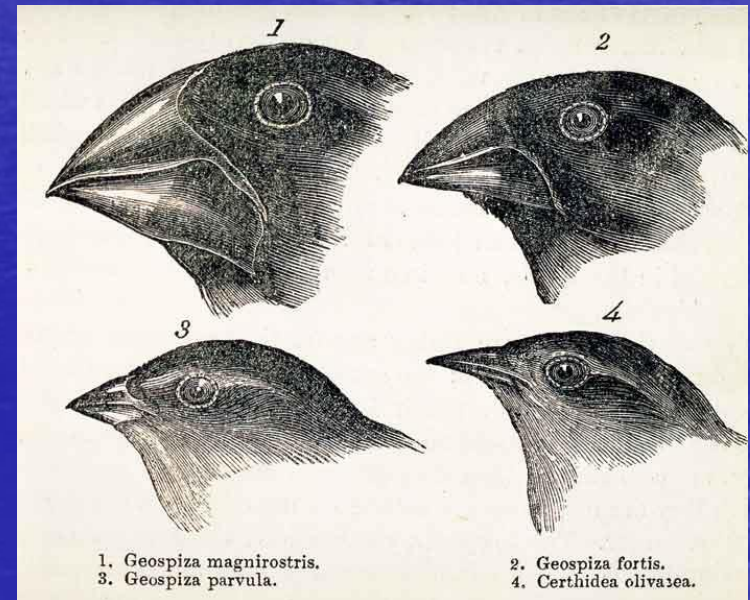
History of Marine Biology

- **Charles Darwin**

- Sailed on the HMS Beagle from 1831-1836 as a naturalist.
- While the primary goal of the expedition was to map coastlines, Darwin observed, collected and wrote detailed written descriptions of the organisms he observed.

History of Marine Biology

- Darwin described many organisms that were unknown to the scientific community until then.
- (Of course, you may also remember Darwin from his theories on natural selection and evolution.)



History of Marine Biology



- Explained the formation of distinctive rings of a coral reef called atolls.

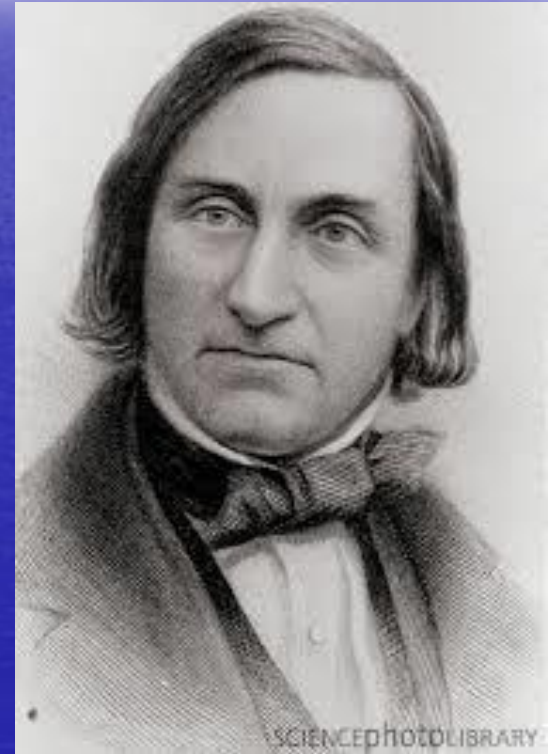


- Used nets to capture plankton (tiny, drifting organisms). This technique is still used today.

History of Marine Biology

- **Edward Forbes**

- Extensively studied the seafloor around the British Isles, Aegean Sea and other locales in 1840's and 1850's.
- His major contribution to the field of marine biology is the discovery that species on the seafloor vary greatly depending on depth.
- This discovery nicely illustrates a major underlying principle of marine biology- zonation.

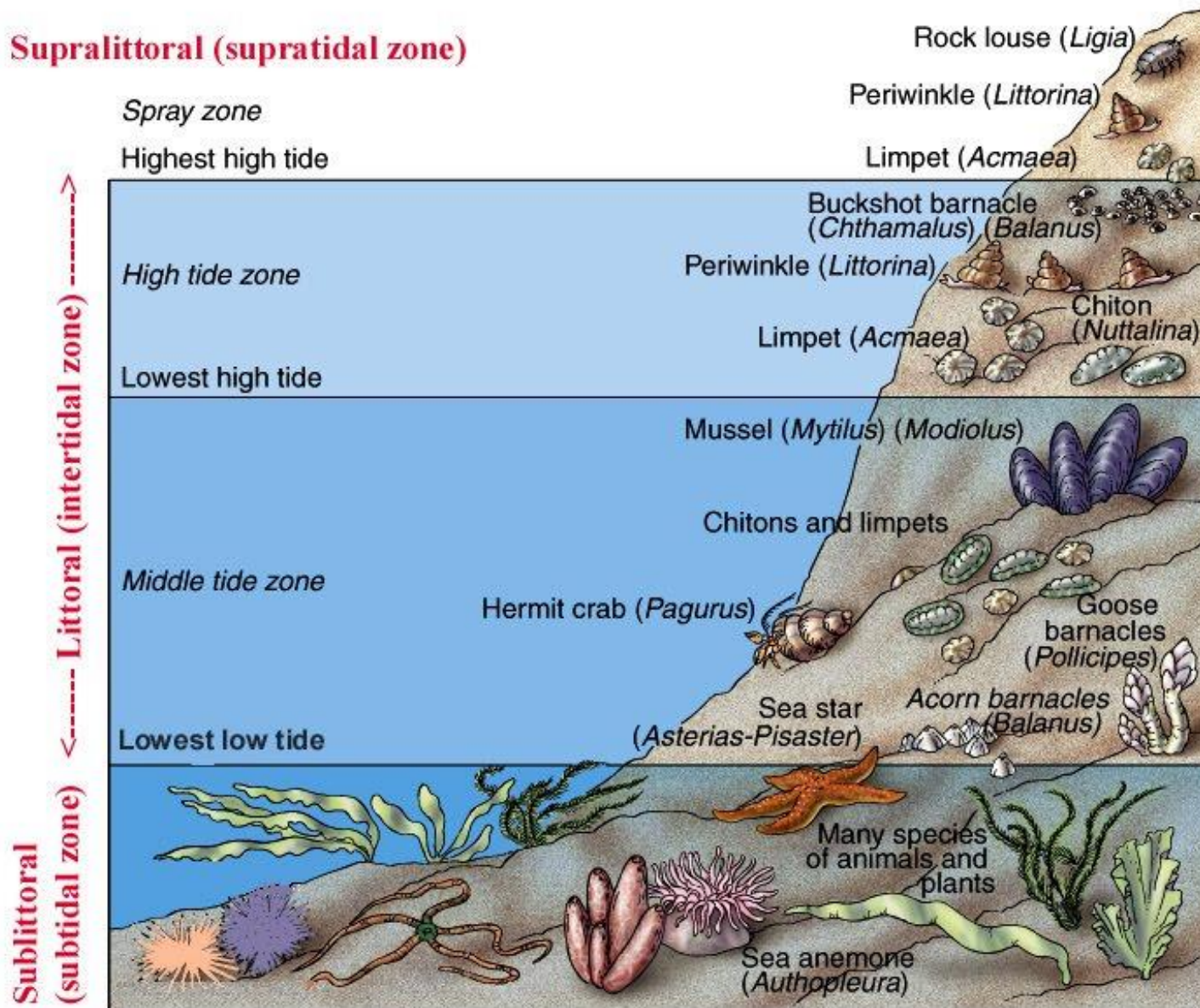


Zonation

- **Zonation** is defined as the presence of organisms in a particular range (or zone).
- In a nutshell, this means that organisms will be found in distinct zones based on their tolerance to the physical or environmental conditions found in that zone.

Zonation

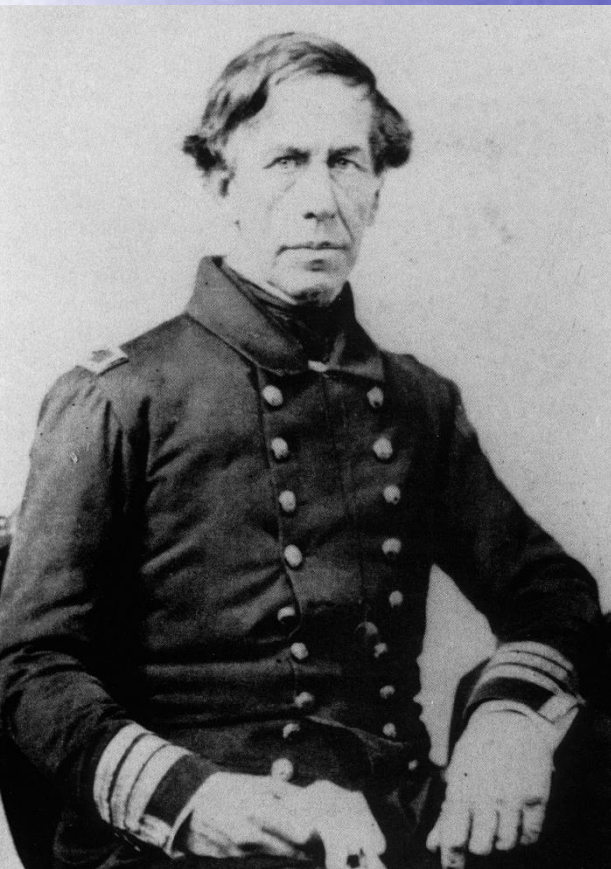
Supralittoral (supratidal zone)



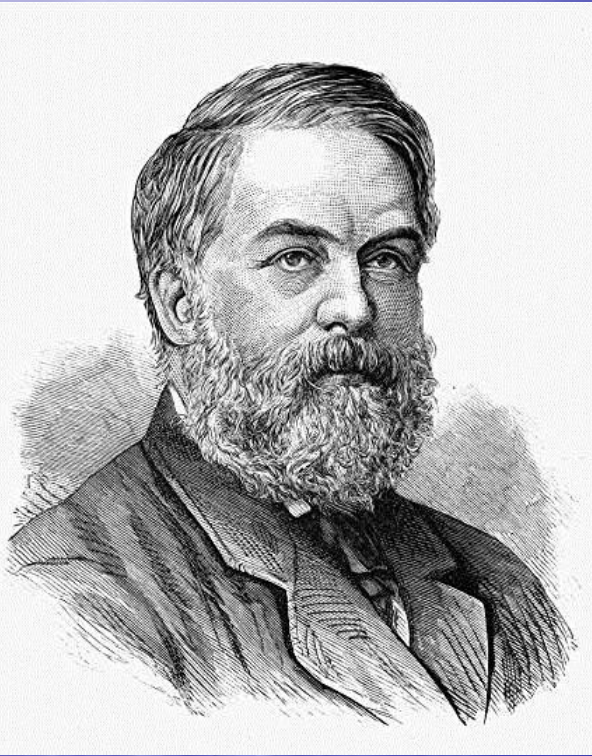
History of Marine Biology

- **Charles Wilkes** Expedition

- 1838 – 1842
- Charted 2,300 km (1,500 mi) of the coast of Antarctica
- This allowed Antarctica to be confirmed as a continent.
- Laid the foundation for government funding of scientific research.



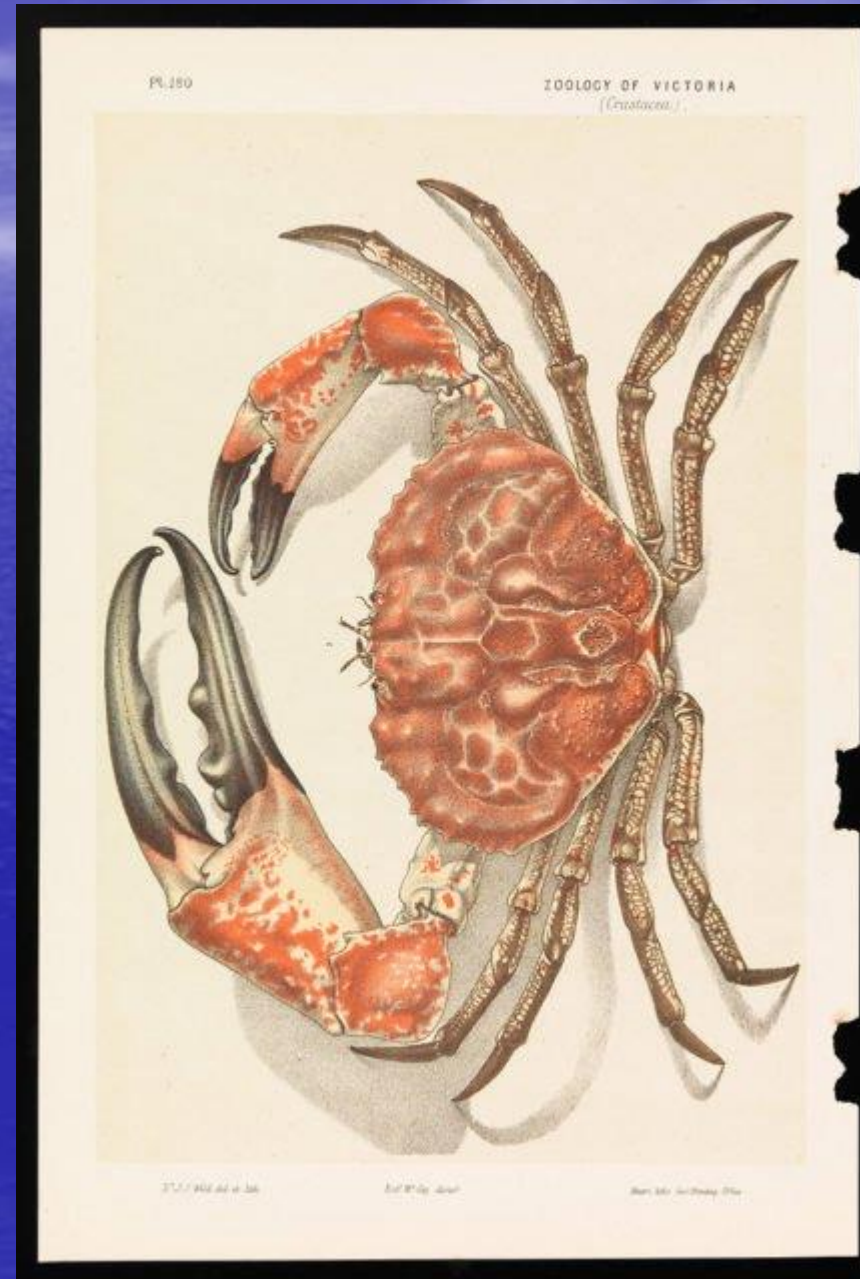
History of Marine Biology



- **Charles Wyville Thompson**
 - He was the scientific leader of the *Challenger* Expedition that sailed from 1872-1876.
 - This expedition was the first major exploration devoted to studying marine organisms and dredged the sea floor.

History of Marine Biology

- Thompson's crew discovered thousands of species never previously described and published 50 volumes of information from the data collected on the trip over the next 19 years!



History of Marine Biology



- Recognized that the sea floor life varies at different depths.
- Inspired new interest in the life of the sea floor.

Modern Marine Biology

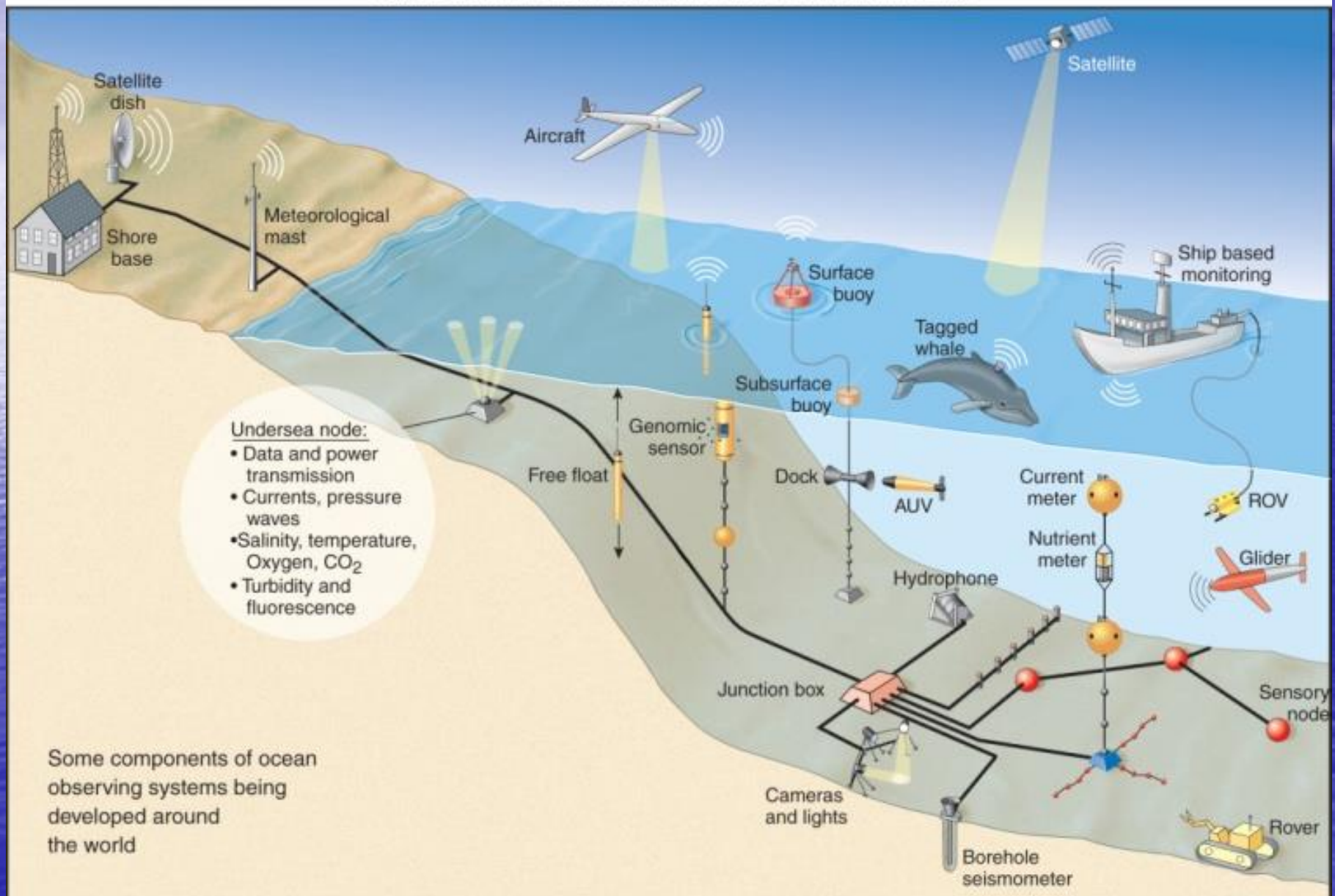
- Today, several marine biology research stations exist in locations around the world.
- In the United States, several facilities are considered to be among the best in the world, including:
 - Woods Hole Marine Biological Lab, MA
 - Scripps Institute - La Jolla, CA
 - Friday Harbor Labs, WA
 - Harbor Branch, FL



Tools of the Trade

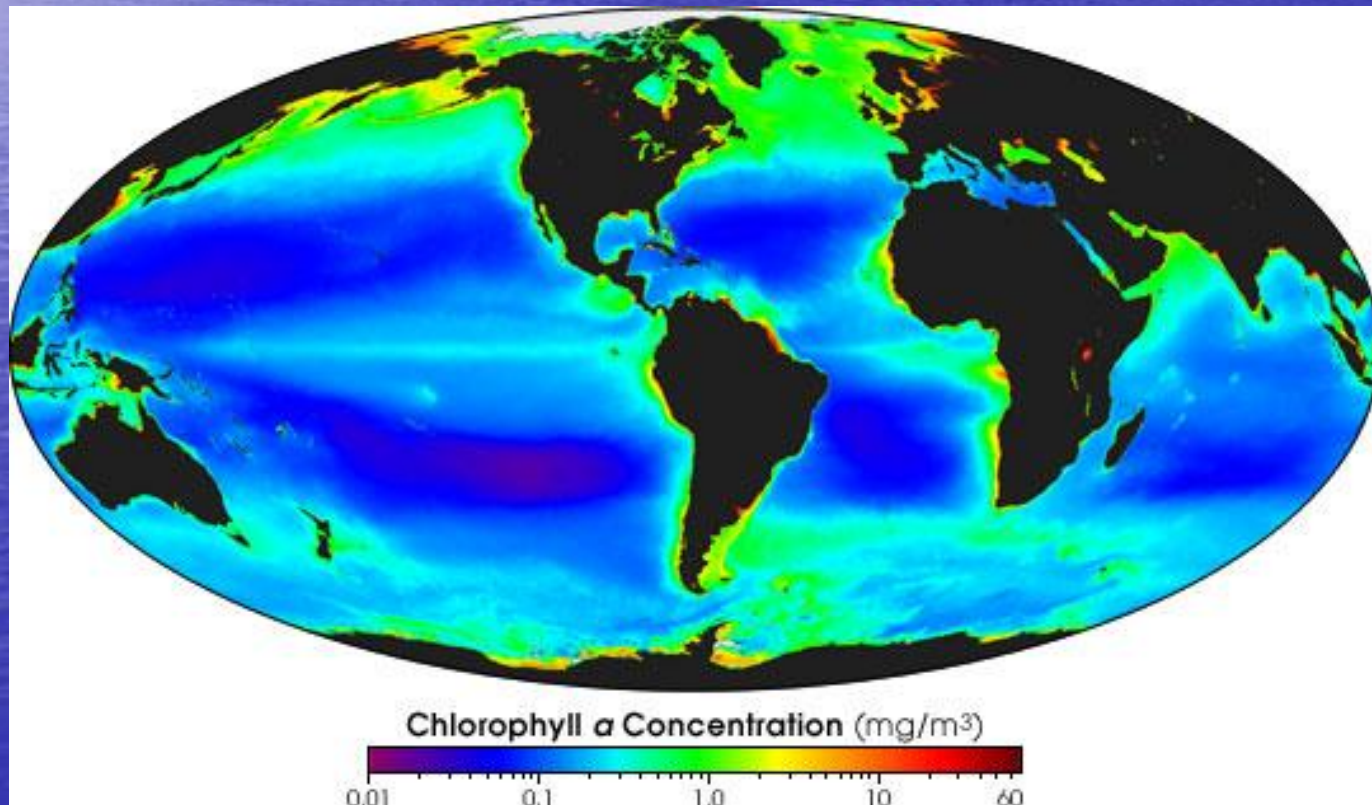
Important Tools of the Trade

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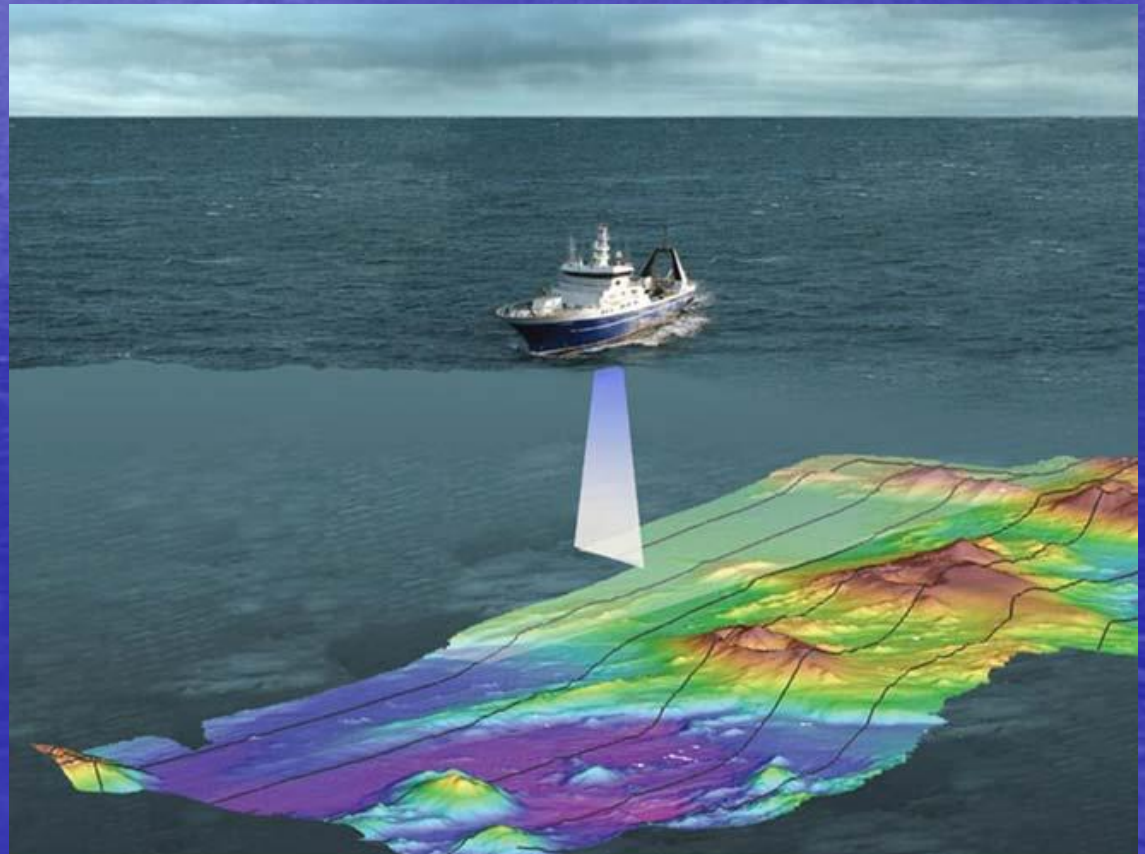
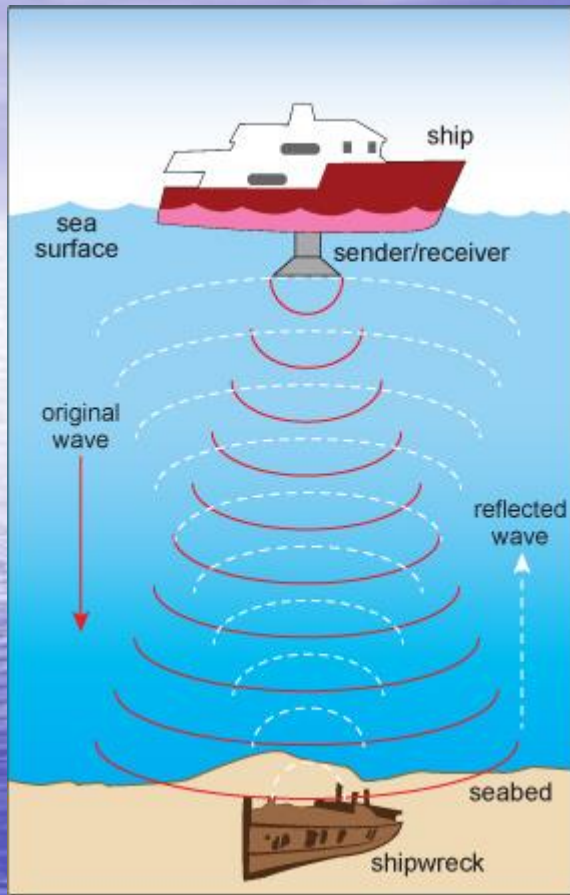
Important Tools of the Trade

- Remote sensing – satellites are used to view large expanses of ocean at the ocean's surface only.



Important Tools of the Trade

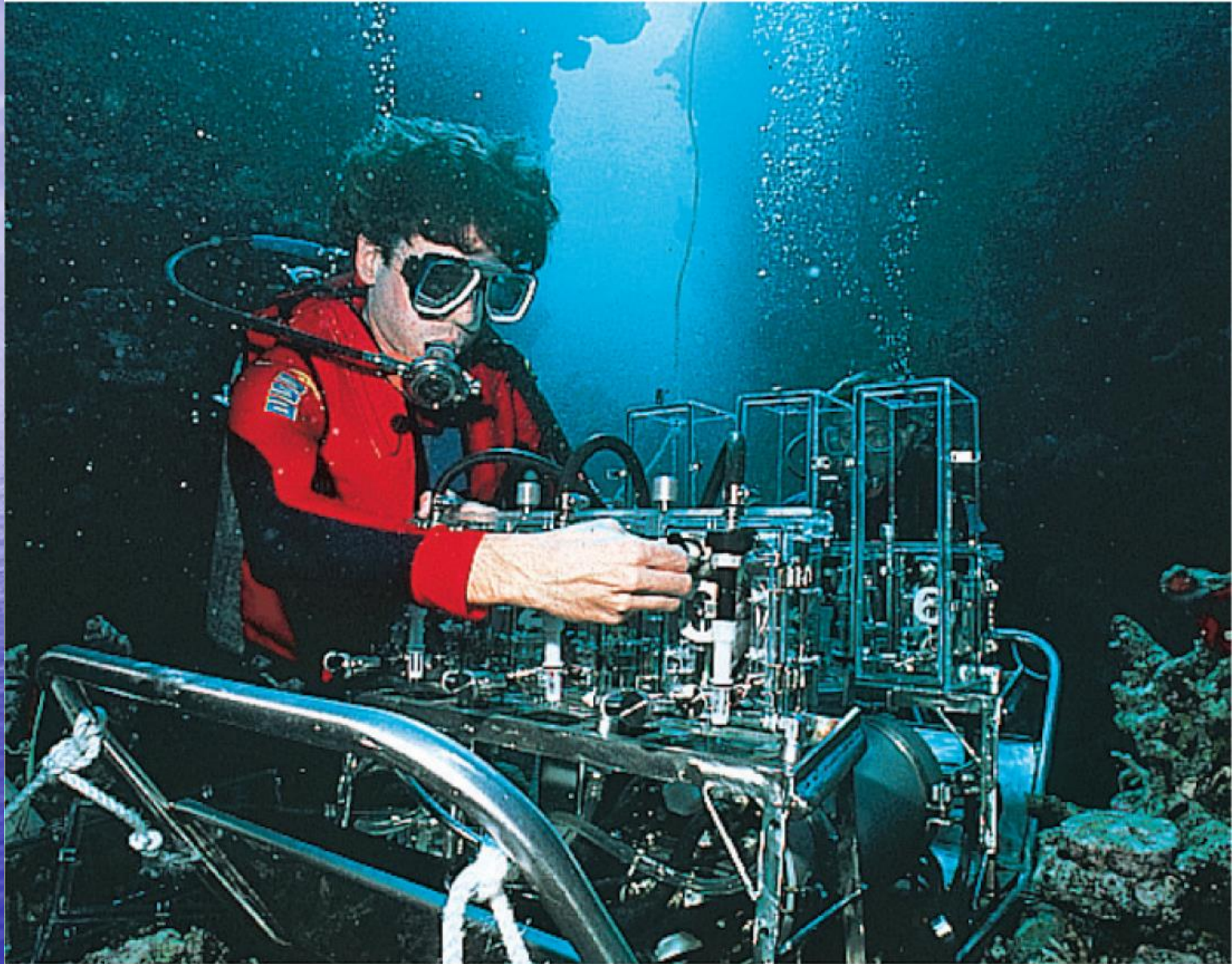
- Sonar – used to map seafloor depths and formations.



Important Tools of the Trade

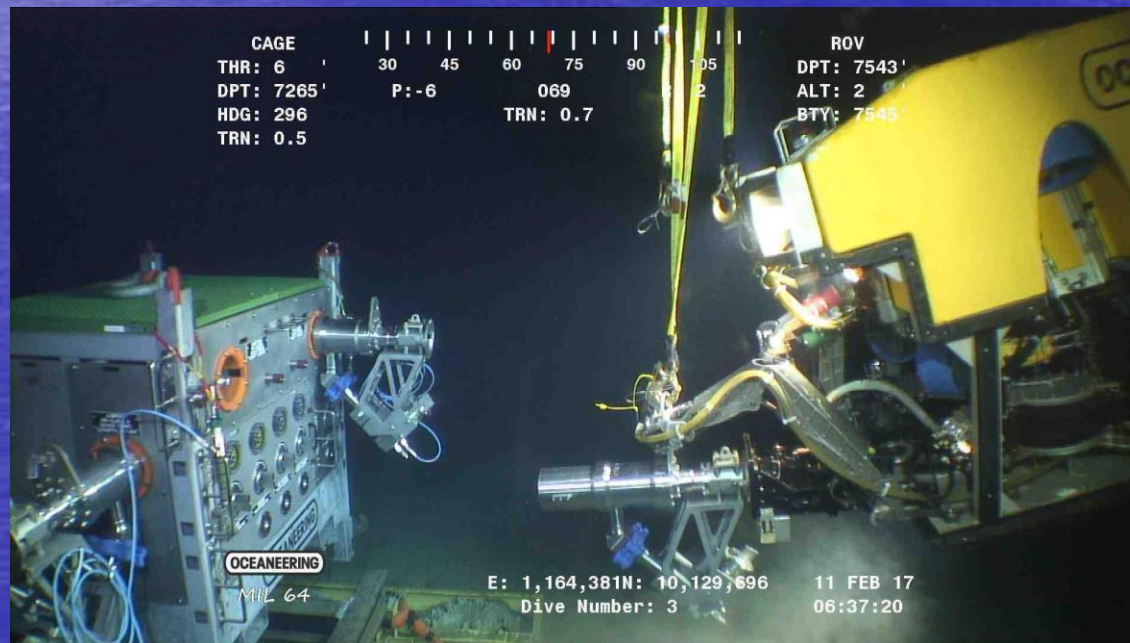


- Scuba – used for direct human exploration of oceanic environment for longer periods and at deeper depths than would otherwise be available to man.

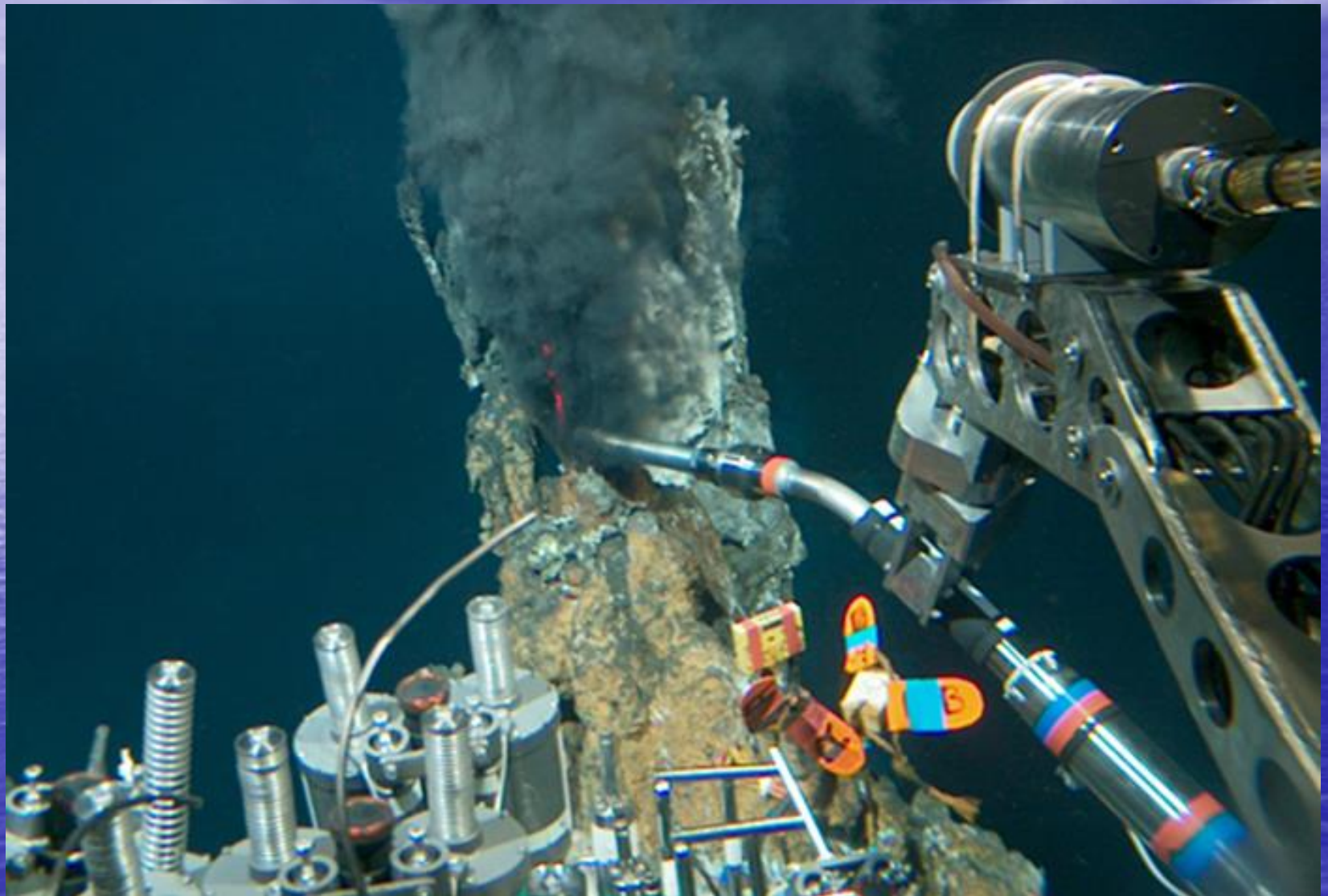


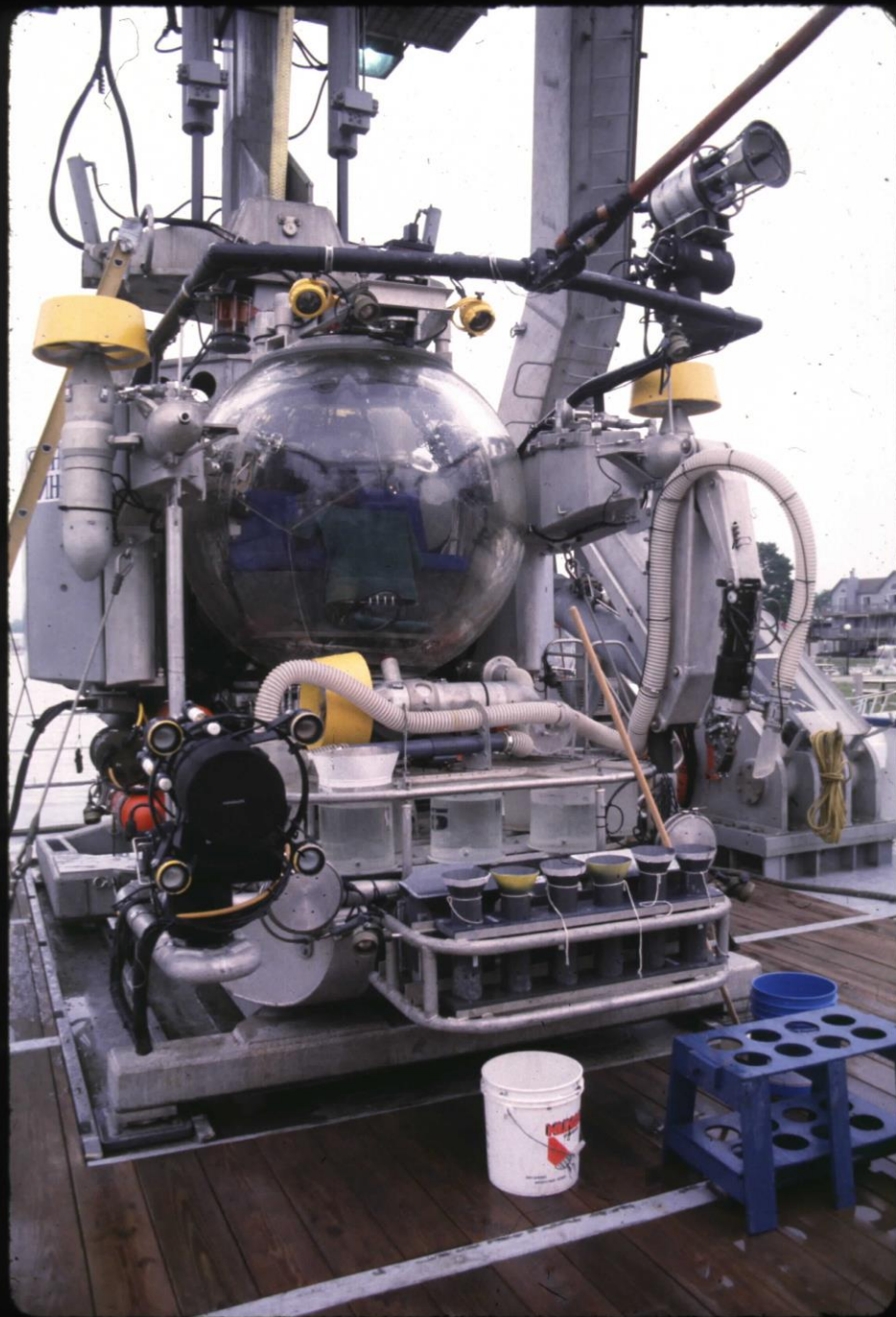
Important Tools of the Trade

- Remotely operated vehicles (ROV's) – allows for direct exploration of marine environment when scuba is not an option; these ROV's can be manned or unmanned.













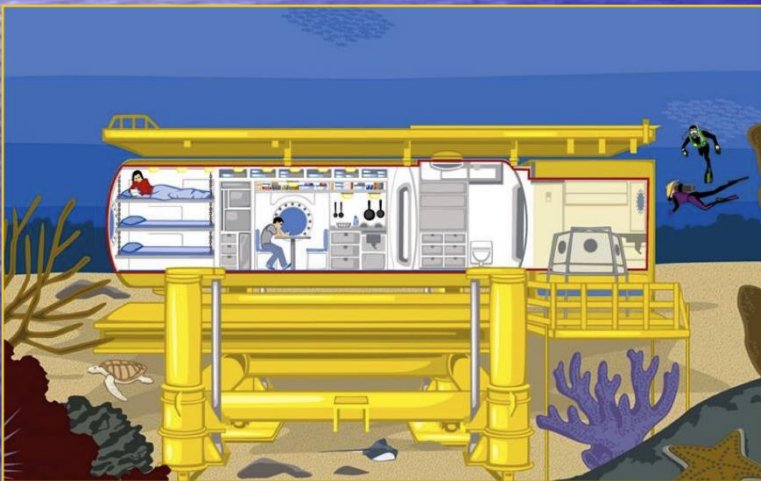
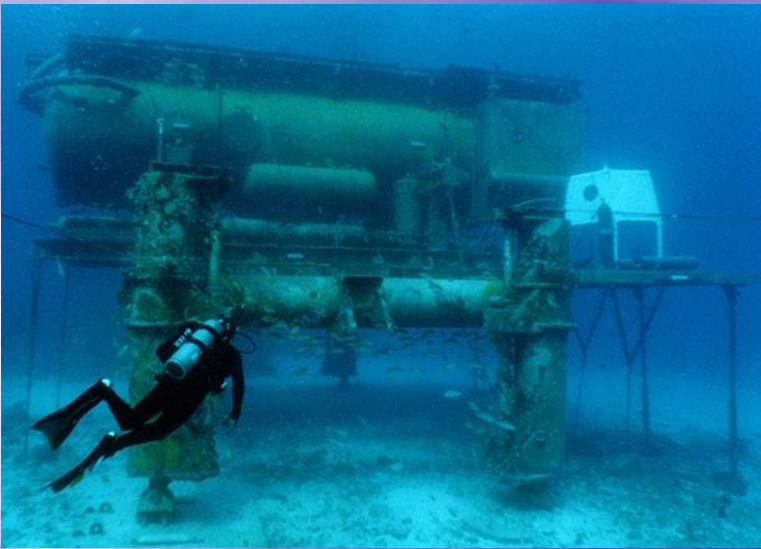


Important Tools of the Trade

- Research vessels – these floating laboratories allow oceanographers and marine biologists to explore the marine environments for weeks, months or even years without returning to a land-based facility.



Important Tools of the Trade



- Underwater Research Station - *Aquarius* – underwater research and residential facility located in the Florida Keys. This underwater lab is located approx. 60 feet underwater and allows researchers to stay at this depth for days or weeks without surfacing (eating, sleeping, laboratory work, etc. – everything is done here (think of it like an airtight Winnebago!) Read more about Aquarius at <http://www.uncw.edu/aquarius>

Important Tools of the Trade

- Research Station – R/P FLIP – Floating Instrument Platform ~ This is an open ocean research platform from Scripps Institution of Oceanography.
- It must be towed to open water, where it drifts freely or is anchored.
- The platform is designed to partially flood and pitch (rotate).
- It is designed to study wave height, acoustic signals, water temperature and density, and to collect meteorological data.



Scientific Method

The Scientific Method is Used to Perform All Scientific Research, Including Research in Marine Biology

- The scientific method is a systematic way of testing ideas.
- At the heart of the method is the need to OBSERVE nature.

The Scientific Method

- Begins with a hypothesis, or a testable statement constructed from observations and reasoning.
- The hypothesis must be worded so that it is testable by scientific means.

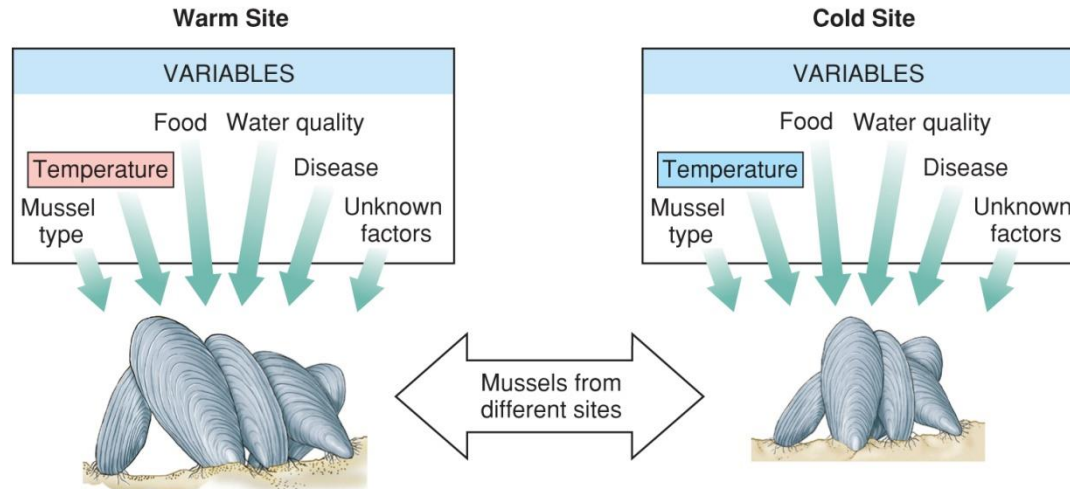
The Scientific Method

- One important aspect of science and the scientific method is that you CANNOT PROVE any hypothesis – you can only DISPROVE hypotheses based on the evidence you have.
- However, hypotheses that have been tested repeatedly and not disproved and considered to be true based on the available evidence.

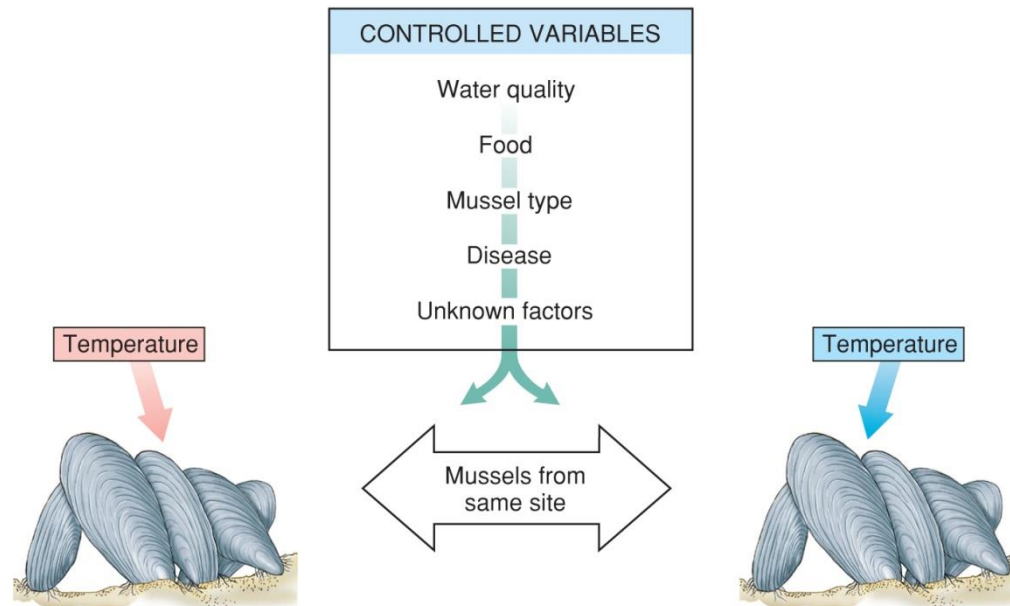
Considerations in Scientific Research

- Variables- a researcher must look at only one factor at a time – these factors are variables.
- For example, if a researcher wanted to study the effects of temperature on mussels, they could acquire similar specimens of mussels from different locations.

Field Observations



Controlled Laboratory Experiment



Considerations in Scientific Research

- If only temperature is being tested, all other factors must be kept constant (ex: amount of food given, mussel type, oxygen concentration, salinity, etc).
- If the two tanks are kept at different salinities AND different temperatures, for example, a researcher cannot attribute altered growth rates to only temperature (maybe it was the combination of salinity and temperature).

What is a Theory?

- In everyday language, a theory can be likened to a “hunch.” In this everyday use, it just means that it is what you suspect to be true.
- In scientific language, a theory is a hypothesis that has been tested repetitively over time by many people and has not been disproven.
- Mountains of evidence support the theory and it is regarded as truth in the scientific community.

Limitations of Scientific Method

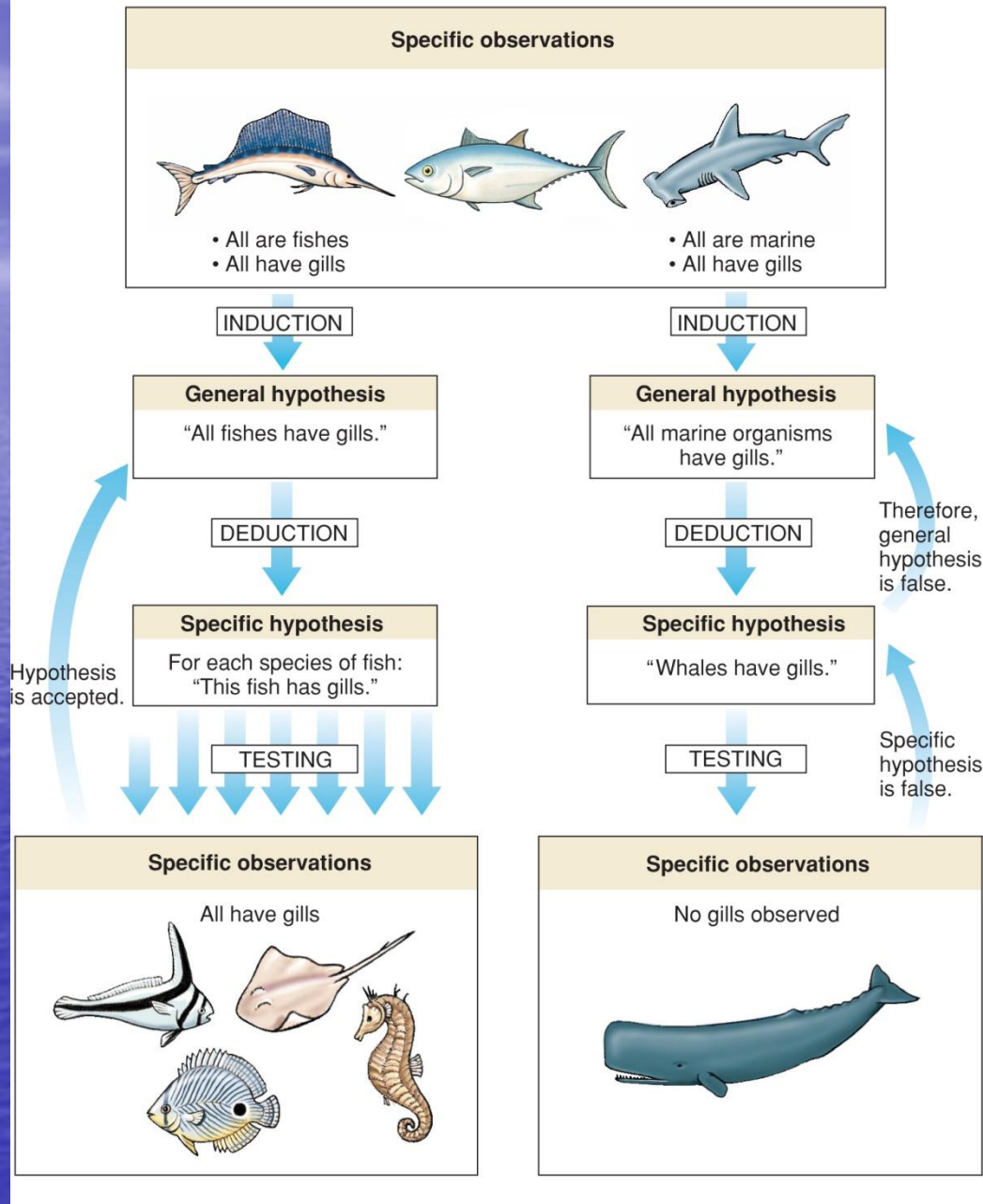
- Due to the requirements for direct observations or measurements and a testable hypothesis, not all questions can be answered.
- Science can offer no answers on values, feelings and beliefs. These are beyond the scope of the scientific method.



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Scientific Method in Action

If you don't have a smartphone,
get text notifications.

Text the message **@dual-bg** to the number
81010.

If you're having trouble with **81010**, try
texting **@dual-bg** to **(585) 300-4360**.

** Standard text message rates apply.*



My website

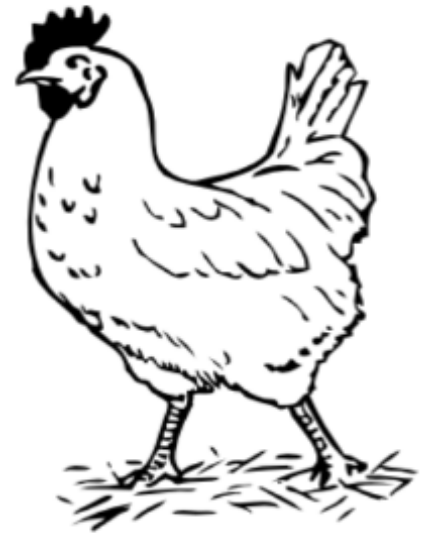
Google

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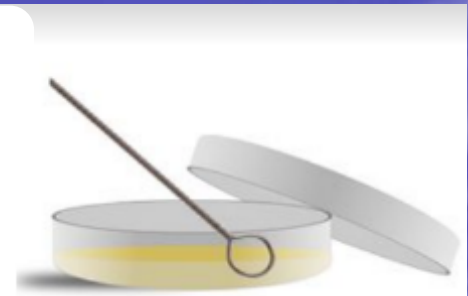
Scientific Method In Action - The Strange Case of BeriBeri

In 1887 a strange nerve disease attacked the people in the Dutch East Indies. The disease was beriberi. Symptoms of the disease include weakness and loss of appetite, victims often died of heart failure. Scientists thought the disease might be caused by bacteria. They injected chickens with bacteria from the blood of patients with beriberi. The injected chickens became sick. However, so did a group of chickens that were not injected with bacteria.

One of the scientists, Dr. Eijkman, designed a new experiment based on his own observations. Before the experiment, all the chickens had eaten whole-grain rice, but during the experiment, the chickens were fed polished rice. Dr. Eijkman researched this interesting case and found that polished rice lacked thiamine, a vitamin necessary for good health.



1. State the question or problem that Dr. Eijkman investigated.
2. What was the original hypothesis?
3. What was the **manipulated** (independent) variable and the **responding** (dependent) variable?
4. Write a statement that summarizes the results of the experiment.
5. How would Dr. Eijkman test his new hypothesis?



How Penicillin Was Discovered

In 1928, Sir Alexander Fleming was studying Staphylococcus bacteria growing in culture dishes. He noticed that a mold called Penicillium was also growing in some of the dishes. A clear area existed around the mold because all the bacteria that had grown in this area had died. In the culture dishes without the mold, no clear areas were present.

Fleming hypothesized that the mold must be producing a chemical that killed the bacteria. He decided to isolate this substance and test it to see if it would kill bacteria. Fleming transferred the mold to a nutrient broth solution. This solution contained all the materials the mold needed to grow. After the mold grew, he removed it from the nutrient broth and then added the broth to a culture of bacteria. He observed that the bacteria in the culture died. Fleming's experiments were later used to develop antibiotics.

6. State the question or problem that Fleming investigated.





7. What was Fleming's hypothesis?

8. How was the hypothesis tested?

9. Write a statement that summarizes the results of the experiment.





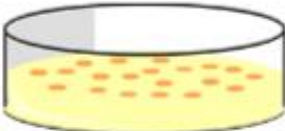
10. This experiment led to the development of what major medical advancement?

Independent and Dependent Variables Scenarios (Manipulated) (Responding)

Scenario		Independent	Dependent
1. A cow is given a growth hormone and then compared to another cow that was not given a growth hormone. Both cows were weighed at 2 years.			
2. Mosquito repellent is sprayed on one arm and the other arm is not sprayed. The number of mosquito bites is counted after 2 hours.			
3. One grape is placed in tap water and another grape is placed in salt water. The change in their mass is measured after a day.			
4. Two different cars are traveling at 60 mph. At a certain point, both cars slam on the brakes. The distance it takes for each car to stop is then measured.			

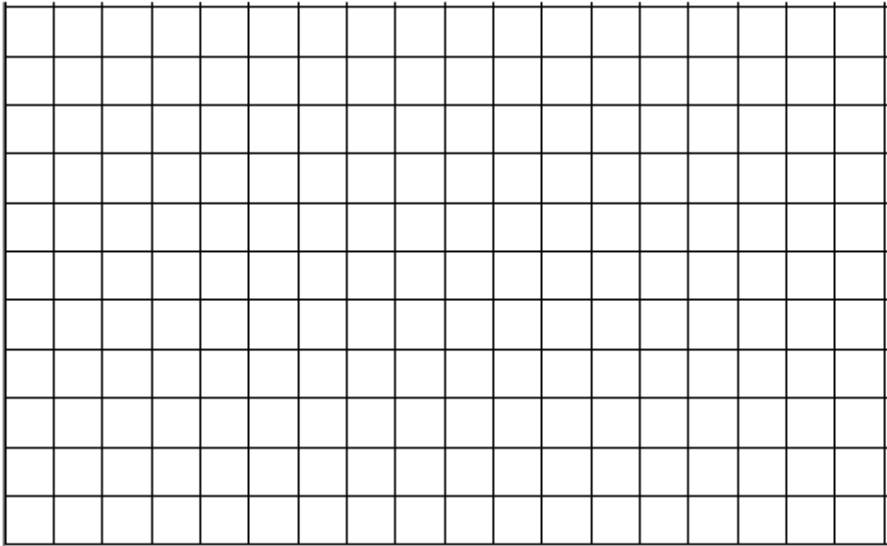
Independent and Dependent Variables Scenarios

(Manipulated) (Responding)

8. Two plants are grown using the same light and pots. One plant is given water that has been microwaved and the other plant is given regular tap water. Their height is measured after 2 weeks.			
9. The blood pressure of a soldier is measured while he is resting. The soldier is then exposed to a stressful environment and his blood pressure is measured again.			
10. An apple is cut into slices. Half of the slices are sprayed with lemon juice. All slices are stored in a sealed plastic bag. After 4 days, they are observed to see how brown they turned.			
11. The respiration rate of a goldfish is measured. The goldfish is then placed in cold water and the respiration rate is measured again.			
12. Bacteria are grown in a petri dish. One side of the dish is sprayed with an antibiotic. After a week, the number of bacteria colonies are counted on each side.			

7. Time Spent Studying

	Tim	J.R.	Sue	Pat	Jay	Red	Ben	Sam	Cat	Lex	Vic	Drew	Fin
Time Spent Studying (min)	30	5	60	30	5	20	40	10	15	25	10	70	20
Grade on Test (%)	70	50	90	80	60	70	90	60	70	80	50	100	80



Graph the "time spent studying" on the X axis and the grade on the Y axis. When you have plotted your points, draw a **LINE OF BEST FIT**. Summarize your graph in a single sentence.