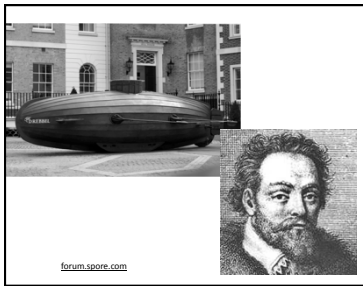
History of Undersea Exploration

- The 700s: Viking Sailors used sounding weights to determine ocean depth over distance. They also took samples from the seabed.
- The depth would be measured by the length of a Viking's outstretched arms (6ft) this nautical unit of distance is still used today and is called the fathom

History of Undersea Exploration

- 1620: Cornelius Drebbel (Holland) is credited with the first submersible.
- It was made of wood and bound in animal skin for water proofing.
- He propelled it with oars on either side through sealed holes.
- It reached a depth of 15ft.



forum.spore.com

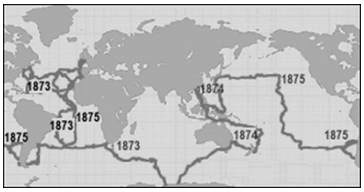
History of Undersea Exploration

- 1872-1876: The British sent the *HMS Challenger* on a 4 year expedition to explore the deep ocean.
- They discovered over 4,000 new species of animals
- Confirmed the general bathymetry of the sea floor to include features such as deep ocean basins.
- They did this using sounding weights similar to the Vikings.
- Today, SONAR is used to map bathymetry.

HMS Challenger

www.extremescience.com

Route of HMS Challenger



oceanexplorer.noaa.gov -

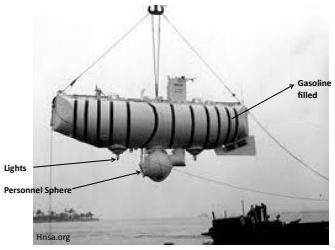
History of Undersea Exploration

- 1930s: William Beebe launches the Bathysphere.
- Traveled to 3,000ft
- The addition of a window made this the first time a marine biologist was able to observe marine life in its natural environment.

Wikipedia.org

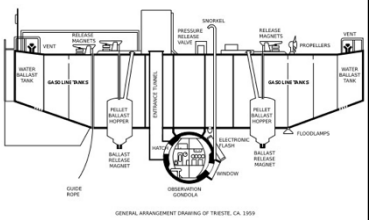
History of Undersea Exploration

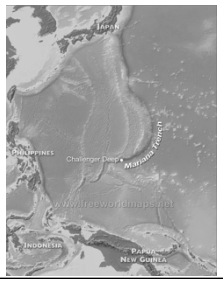
- 1960: Jaques Piccard and Don Walsh are the first to travel to the deepest part of the ocean.
- Located in the Mariana trench, the deepest point is called *Challenger Deep* over 6 miles down.
- The submersible was called the *Trieste* and is of the original submersible designs.
- It took them 5 hours to reach the bottom and they only spent 20 minutes there.
- No footage of the bottom was recorded.



Trieste

- The majority of the vessel was a series of floats filled with 85,000 liters (22,000 US gal) of gasoline.
- Water ballast tanks were included at either end of the vessel, as well as releasable iron ballast fore and aft of the crew sphere.
- *What function do you think the gasoline served?*
- *Why would they need a releasable iron ballast?*

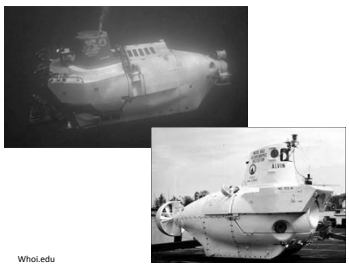


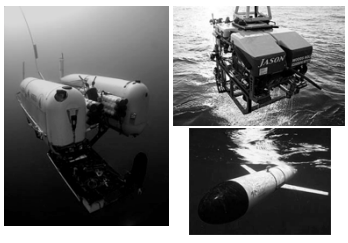


Modern Undersea exploration

- 1964: ALVIN is built and has since made over 4400 dives.
- Since the Trieste, ALVIN and similar HOVs have returned to the Mariana Trench and made amazing discoveries.
- Other submersibles used include: ROVs, AUVs, Towed vehicles and HROVs.

Each has its limitations and benefits over another.





A race to the bottom

- http://www.youtube.com/watch?v=0mBG0LbAoqk&feature=player_embedded
- http://www.virginoceanic.com/vehicles/submersible/

Building the technology

- **What variables must engineers consider when designing and building the underwater craft?**
- Pressure
- Buoyancy
- Data collection equipment: Filming, lighting, instrumentation, windows.
- Fitting inside

James Cameron's *Deepsea Challenger*

- Designers James Cameron and Ron Allum envisioned *DEEPSEA CHALLENGER* as a sleek underwater rocket ship to dive fast and ascend faster, allowing for more time to explore the deep seafloor.
- Nationalgeographic.com

CAMERON'S CHAMBER

- The 43-inch-wide pilot's sphere, made of 2.5-inch-thick steel, was built to fit Cameron's lanky six-foot-two-inch frame.
- Inside: oxygen tanks, thruster joysticks, a touch screen, an optical acrylic viewport (window), and three video monitors

Nationalgeographic.com

Pressure

- Pressure in the deep sea can be as high as 16,000 psi.
- This is like having 3 cars crushing each finger!
- Many materials can withstand this pressure.
- But the requirements of a submersible makes it difficult to use many of them.
- It must have a small window and house a chamber that can fit a human and lots of equipment.

Pressure

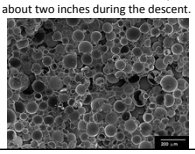
- What about the hull (pressure chamber)?
- Materials: Steel, Titanium, Pyrex, Ceramic?
- Research has been done on the effectiveness of a ceramic vessel with a glass dome at one end and of a vessel made of one continuous piece of glass.
- Steel is what has been used most recently by James Cameron.
- The *Nereus ROV* is a titanium/ ceramic hybrid.

Buoyancy

- What's The problem with steel?
- When the weight of the hull, equipment, pilots, batteries, instruments all adds up, the sub weighs in the tons.
- With out buoyancy assistance, the sub would sink rapidly and be difficult to control.
- What design considerations must there be to ensure buoyancy assistance ?
- http://www.hnsa.org/ships/trieste.htm

Buoyancy

- **SYNTACTIC FOAM**
  The sub's beam is made of a specialized foam developed by Australian engineer Ron Allum.
- Formed by suspending hollow glass microspheres in an epoxy resin, the flotation material is designed to survive the intense pressure of the Mariana Trench, which compressed the 24-foot beam about two inches during the descent.



Buoyancy

- So once the sub can float, how do the pilots control its location in the water column?
- The *Trieste* used steel shot to weigh down the sub.
- Held on by an electromagnet for quick release, to make it float up higher.
- There were also gas filled compartments to control buoyancy by releasing a little gas as the sub descends.