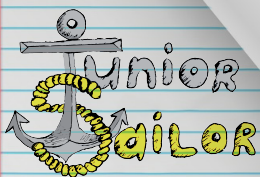


Family & Children Guide



NATIONAL MUSEUM *of the*  
UNITED STATES NAVY

# TRIESTE



Bathyscaphe  
[bath-uh-skaf]  
means "deep ship."

Trieste [tree-est]  
is named after the  
seaside Italian  
town where she  
was constructed


The Crew survived  
on 15 chocolate  
bars during the  
deep dive!



## Trieste History:

On January 23, 1960, the U.S. Navy's *Trieste* reached the ocean's deepest point: Challenger Deep in the Mariana Trench. *Trieste* was the first craft to make the journey! During the nearly nine-hour adventure, U.S. Navy Lieutenant Don Walsh and scientist Jacques Piccard observed marine life from inside a spherical gondola. The explorers descended to over 35,000 feet, where they spent 20 minutes studying the ocean floor with the help of a searchlight. This remarkable voyage continues to inspire scientific innovation and marine research to this day.

Swiss physicist Auguste Piccard and his son Jacques, using the buoyancy technique from balloons, developed a deep-sea submersible vehicle known as a bathyscaphe, meaning "deep ship." Jacques worked with his father to improve the bathyscaphe design and prove its potential for deep water dives without being attached to a cable. They built three bathyscaphs between 1948 and 1955. In 1953 they tested a new vehicle called Trieste and reached a depth 10,168 feet in the Mediterranean off the coast of Italy, demonstrating its uses for exploration and research.



Named after the seaside Italian town where she was constructed, *Trieste* completed nearly 50 dives off the coast of Italy between 1953 and 1957. During her dives in the Mediterranean Sea, Trieste's pilot Jacques Piccard spotted marine worms, clusters of deep-sea burrows on the sea floor, and sand waves, which were likely formed by underwater currents.

In 1958, the U.S. Navy acquired *Trieste* and transported her to San Diego, California, where a stronger observation sphere was installed. While on the west coast, *Trieste's* crew conducted many Naval-sponsored experiments, including: underwater sound testing, photography, and biological and geological studies.

In October 1959, *Trieste* began a series of U.S. Navy-sponsored dives in the western Pacific Ocean. This collection of deep dives, titled Project Nekton, culminated on January 23, 1960 when *Trieste* touched the bottom of the Mariana Trench, 36,000 feet.

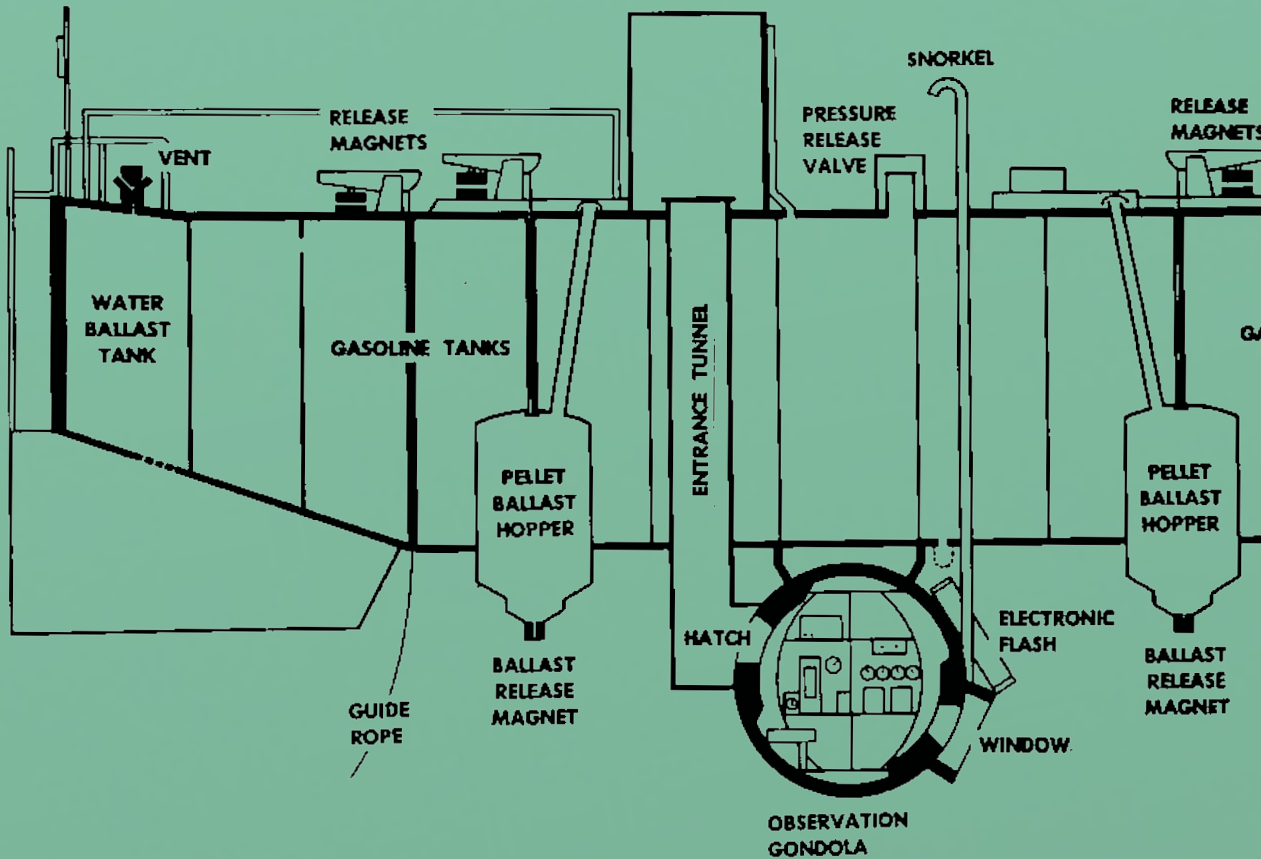
Oceanographer Jacques Piccard and U.S. Navy Lieutenant Don Walsh successfully piloted *Trieste* seven miles down – and back to the surface – for a total of nine hours. Surviving on 15 chocolate bars and heated canisters to keep warm, the team focused on controlling the vessel's buoyancy and conserving energy. At a depth of 32,400 feet, a startling burst in the observation window caused cracks to form.

This unexpected setback shortened *Trieste's* stay at the bottom to 20 minutes. The crew wasted no time. They watched flatfish and shrimp swim above the sea floor, tested the area for radiation, and called the surface ships to report that, for the first time, mankind reached Challenger Deep.

After *Trieste's* retirement in 1963, she was partially disassembled and relocated. Many of her components, including the original observation gondola, were used to build *Trieste II*. The vessel was transported to the Washington Navy Yard and is currently the highlight of the National Museum of the U.S. Navy's Undersea Exploration exhibit. The design of *Trieste* paved the way for other submersibles – manned and unmanned – to reach the deepest parts of the ocean.

# How *Trieste* Operated:

Separate tanks in the bathyscaph's body held gasoline and water to provide buoyancy. To descend, Trieste's water tanks were filled and gasoline was released. Iron pellets, acting as ballast, were emptied out of two hoppers, causing her to rise to the surface. A delicate balance between floating, sinking, and speed control was needed to keep the vessel steady.



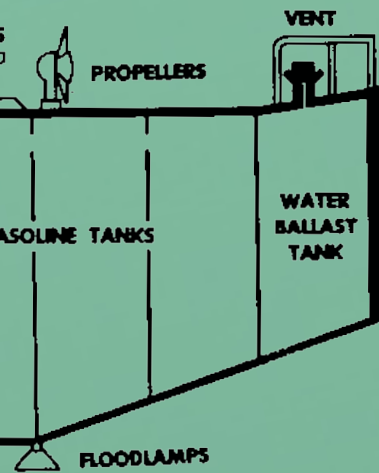
Look closely at the diagram to answer the following questions:

In what part of Trieste did the crew sit?

Which part of Trieste propelled the Bathyscaphe forward?

Which part of Trieste made it possible to see in the deep dark ocean?

Would you want to travel to the deep in this?



# Soda Can Crushing Experiment:

## WARNING! IMPORTANT SAFETY RULES

*This experiment requires the use of a burner on a stove to heat water. Children should not perform this experiment without adult supervision and adults should not conduct this experiment unless a really smart kid is watching over their shoulder.*

**1**

Start by rinsing out the soda cans to remove leftover soda.

**2**

Fill a bowl with cold water (the colder the better).

**3**

Add one generous tablespoon of water to the empty soda can (just enough to cover the bottom of the can).

**4**

Place the can directly on the burner of the stove while it is in the "OFF" position. With an adults help, turn on the burner to heat the water. Listen for a bubbling sound. That's the water boiling. You'll see the water vapor rising out from the can. Continue heating the can for one additional minute.

**5**

Use the tongs to lift the can off the burner, turn it upside down, and plunge the mouth of the can into the bowl of cold water. To do this, get a good grip on the can near its bottom with the tongs, and hold the tongs so that your hand is in the palm up position. Using one swift motion, lift the can off the burner, turn it upside down, and plunge it into the cold water.

**6**

What happened? The can imploded, or crushed in upon itself. Before you jump ahead to the explanation, stop to ponder how this works. What force is great enough to crush the can?

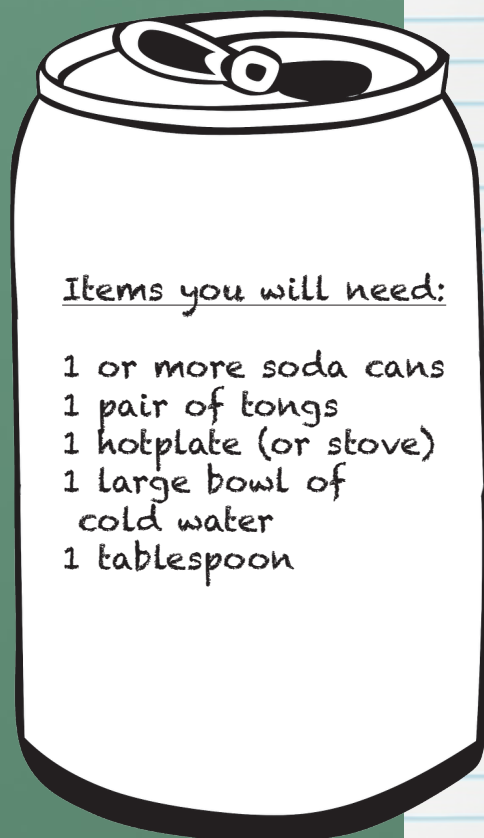
**7**

Try the experiment again! Each time you repeat the experiment, carefully observe what is happening.

Here's the scoop on the science of the imploding can. Before heating, the can is filled with water and air. By boiling the water, the water changes states from a liquid to a gas. This gas is called water vapor. The water vapor pushes the air that was originally inside the can out into the atmosphere. When the can is turned upside down and placed in the water, the mouth of the can forms an airtight seal against the surface of the water in the bowl. In just a split second, all of the water vapor that pushed the air out of the can and filled up the inside of the can turns into only a drop or two of liquid, which takes up much less space. This small amount of condensed water cannot exert much pressure on the inside walls of the can, and none of the outside air can get back into the can. As a result, the pressure of the air pushing from the outside of the can is great enough to crush it.

The sudden collapsing of an object toward its center is called an implosion. Nature wants things to be in a state of equilibrium or balance. To make the internal pressure of the can in balance with the external pressure on the can, the can implodes. That's right, air pressure is powerful!

One more thing . . . you probably noticed that the can was filled with water after it imploded. This is a great illustration of how air is pushing all around us. Specifically, air pressure inside the can was less than the pressure outside the can, water from the bowl was literally pushed up and into the can.



The "Walsh Spur" ridge near Cape Hallett, Antarctica is named after him!

Don has given lectures in over 60 different countries!

Walsh was awarded the Legion of Merit by President Eisenhower for the Trieste dive!



## Don Walsh

Captain Don Walsh USN (ret), PhD, is an oceanographer, explorer and ocean engineer. During his 24-year naval career he served in submarines at sea including command. He worked in ocean-related research while ashore.

From 1959 to 1962, Walsh was officer-in-charge of the bathyscaphe *Trieste* at the Navy Electronics Laboratory in San Diego. In January 1960, he and Jacques Piccard dove *Trieste* to the deepest place in our ocean: nearly 36,000 feet deep in the Marianas Trench. Life Magazine wrote that this was one of the greatest explorations of the 20th Century. In 1975, Walsh retired to become a professor of ocean engineering at the University of Southern California. There he founded the Institute of Marine and Coastal Studies. He left USC in 1984. In 1976 he founded his consulting practice, International Maritime Incorporated and is still active with it.

Walsh has always retained the heart of an explorer. He has participated in diving operations with over 24 manned



submersibles, piloting seven of them. He has also been active in the design, manufacture, and operation of manned and unmanned submersibles. In 1999, using a Russian Mir submersible, he dove nearly 8,000 feet to the Mid-Atlantic Ridge's Rainbow vent field. In 2001 and 2002, he made dives to the R.M.S. Titanic (12,500 feet) and World War II German battleship Bismarck (15,500 feet).

Moreover, it is not just exploring under the surface that has interested Walsh. He has also worked in the Arctic and Antarctic regions, making three trips to the North Pole and one to the South Pole. His first Arctic expedition was in 1955 and his first Antarctic expedition was in 1971. He has participated in over 70 polar expeditions. From November 2002 to February 2003, Walsh circumnavigated Antarctica onboard a Russian icebreaker, which was only the 11th time this voyage had been made. The "Walsh Spur" ridge near Cape Hallett is named after him, in recognition of his contributions to the U.S. Antarctic Program.

In February 2001, Walsh was elected to the National Academy of Engineering for his contributions to deep sea engineering. He received the Explorers Club Medal from the Explorers Club in 2001 and was their Honorary President until 2018. That same year the Jules Verne Adventures organization awarded him its "Etoile Polaire" medal celebrating "The Greatest Explorations of the 20th Century." In 2010, Walsh was awarded the National Geographic Society's highest award, the Hubbard Medal, for distinction in exploration, discovery, and research.

An active author, he has written more than 200 contributions published in magazines and books. As a lecturer, Doctor Walsh has given programs in 60 countries in the past six decades.

What would you ask Walsh about the historic dive?

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"The more people discover the sea, the greater the chance of bringing marine issues into public view and the better off we will all be." - Piccard



## Jacques Piccard

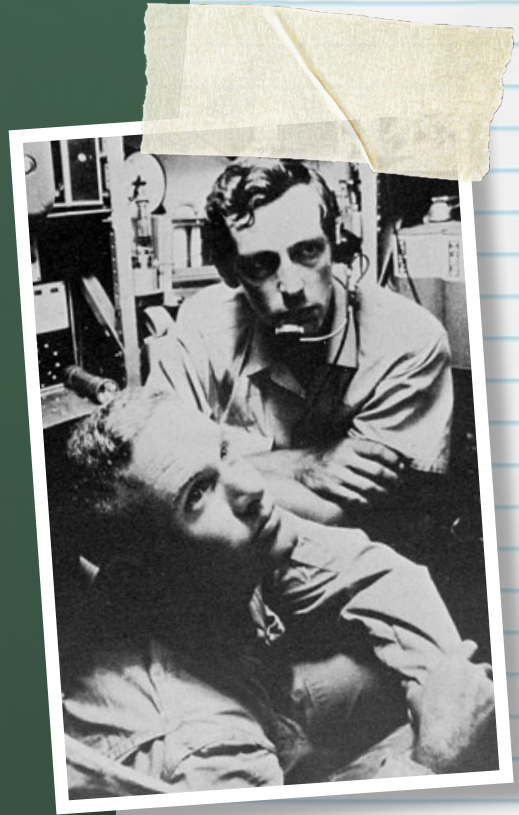
Jacques Piccard was an oceanographer and engineer. His father, Auguste Piccard, was an adventurer who had set two records for reaching the highest altitude in a balloon in 1931 and 1932.

In 1956, Jacques Piccard went to the United States to seek funding for further research. At the time, the U.S. Navy was working on submarine designs for underwater research. Piccard demonstrated the capabilities of the bathyscaph to the Navy. They liked the design and saw its potential for underwater salvage and rescue missions. The Navy purchased *Trieste* and hired Piccard as a consultant. At this time, the *Trieste* was capable of reaching depths of up to 24,000 feet. However, Piccard was planning a much more daring dive. On January 23, 1960 Jacques Piccard and Lt. Don Walsh took *Trieste* to the Mariana Trench in the Pacific Ocean. Their goal was the Challenger Deep, the deepest known place in

the world. They descended for nearly five hours and reached a depth of nearly 36,000 feet. At this incredible depth, they observed fish and shrimp. This discovery surprised the scientific community because scientists were convinced that no life could survive the intense pressure this deep in the ocean. After a 20-minute stay, *Trieste* dumped its ballast. The journey back to the surface took a little over three hours, and led them into the imagination of the world.

After the success of the Challenger Deep mission, Piccard and his father designed a new submersible called Ben Franklin, which was used for scientific research. On July 14, 1969, *Ben Franklin* was towed to the center of the Gulf Stream off the coast of Palm Beach, Florida. A six-member crew led by Jacques Piccard spent more than four weeks in the vessel studying the currents for the U.S. Navy. They also provided valuable data about long duration travel in confined spaces for the U.S. space program. This data was useful for the upcoming Apollo and Skylab projects. The crew of Ben Franklin drifted northeast for 1,444 miles and surfaced near Nova Scotia.

Piccard's work with the oceans showed him the dangers posed by human activity. In the 1970s, he founded the Foundation for the Study and Protection of Seas and Lakes. He died on November 1, 2008 in La Tour-de-Peilz, Switzerland, leaving behind a legacy of research and inventions which contributed to our understanding of the world's oceans.



Exploration is in his family....

His son, Bertrand, along with Brian Jones, was the first to complete a non-stop balloon flight around the globe, in a balloon named Breitling Orbiter 3.

# Creatures of the Deep



## Dumbo Octopus

A Grimpoteuthis is also known as the Dumbo Octopus. The name “dumbo” originates from its resemblance to the title character of Disney’s 1941 film Dumbo, having a prominent ear-like fin which extends from the mantle above each eye. The Dumbo Octopus is around twelve inches long and may look dainty, but it’s actually durable enough to make its home between 9,800 and 13,000 feet. It’s the deepest dwelling octopus known to science.

(Image courtesy of NOAA)



## Deep-sea Dragonfish

The Deep-sea Dragonfish is a fierce predator, despite its size. With oversized teeth and a hideous face, the dragonfish is able to strike anywhere in the deep! Although it’s a fish, it has no scales, but instead a slippery, slimy skin that resembles an eel’s. Dragonfish, which are about six inches long, prefer to swim between 700 and 6,000 feet under the surface, where the waters are lightless and cold. Like many deep-water creatures, this species relies heavily on bioluminescent body parts, which use internal chemical reactions to produce an eerie glow. The fish may use this glow to communicate with other fish or to provide camouflage. It also dangles a lighted, whisker like protrusion from its lower jaw. Other fish are attracted to the light, mistaking it for an easy meal. (Image courtesy of NOAA)

The Deep-sea Dragonfish dangles a lighted, whisker like protrusion from its lower jaw.

With its huge, gaping jaws, the Seadevil can actually devour creatures larger than itself.

### Seadevil Anglerfish

It's not hard to look at the Seadevil to figure out how it received its name. It has an oddly misshapen body, razor-like teeth and cold stare. Although they're bizarre and scary looking, Seadevils aren't huge: females generally top out at eight inches long. The males are much smaller, around an inch long. Like other anglerfish, the Seadevil doesn't dart after its prey. Instead, it has a protrusion from its forehead that dangles a glowing lure to attract other creatures. With its huge, gaping jaws, the Seadevil can actually devour creatures larger than itself. (Image courtesy of NOAA)



### Goblin Shark

Goblin sharks have a protruding snout that looks like a pointy sword. Just below the snout are a set of bulging jaws, and its skin has a distinct pink hue. They can grow as big as 18 feet in length. These sharks typically are found in the deep ocean at 3,000 feet, and the older they get, the deeper they dive. (Image courtesy of NOAA)



### Deep-sea Hatchetfish

There are more than 40 species of Hatchetfish. All of them have skinny bodies, and many of them have shiny scales, too, which add to their metallic, hatchetlike appearance. They're small fish, growing only to about six inches long. These fish are found in depths pushing nearly 5,000 feet. Hatchetfish have bioluminescent bodies, and they can alter the brightness of their glow depending on how much light is filtering from above. In doing so, they illuminate their bodies in a clever camouflage technique. Their dim, self-produced light reduces their silhouettes, making it much more difficult for predators to spot them from below. (Image courtesy of NOAA)



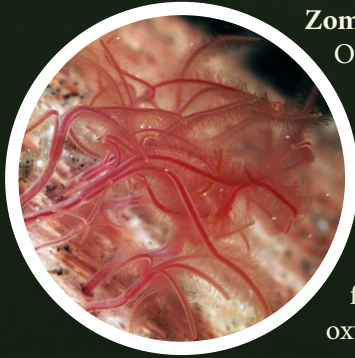
Fripped sharks probably spend most of their lives near the ocean's bottom, liking waters more than 4,000 feet deep.

The "zombie worm", can consume bones of some of Earth's biggest animals, including whales!



### Frilled Shark

The shark derives its name from six rows of frilly gills and wields more than 20 rows of wicked, trident-shaped teeth that will tear into any bit of flesh that passes near them. They can grow up to six feet long. Frilled sharks probably spend most of their lives near the ocean's bottom, liking waters more than 4,000 feet deep. On the rare occasions that people snag them and bring them to the surface, the sharks almost always perish immediately, making it very difficult for us to observe their behavior and lifecycles. (Image courtesy of NOAA)

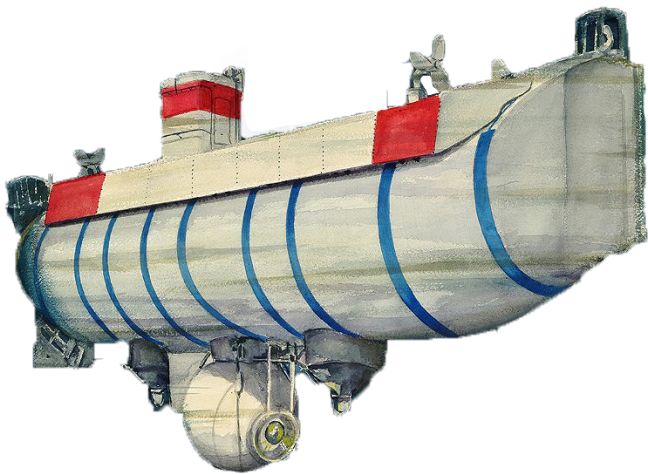


### Zombie Worms

Officially, this type of worm is called the osedax. However, this worm also goes by tougher names, such as “bone worm” or “zombie worm”, and it can consume bones of some of Earth's biggest animals, including whales. The zombie worm secretes acids to help it access the inner contents of dead whale bones. Then, the worm uses bacteria to convert the bone's proteins and fats into nutrients that serve as its food. Its feathery “branches” wiggle in the water, pulling in oxygen to keep the worm alive. (Image courtesy of NOAA)

What kinds of creatures would have surrounded Trieste at Challenger Deep? Draw them on the next page!

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