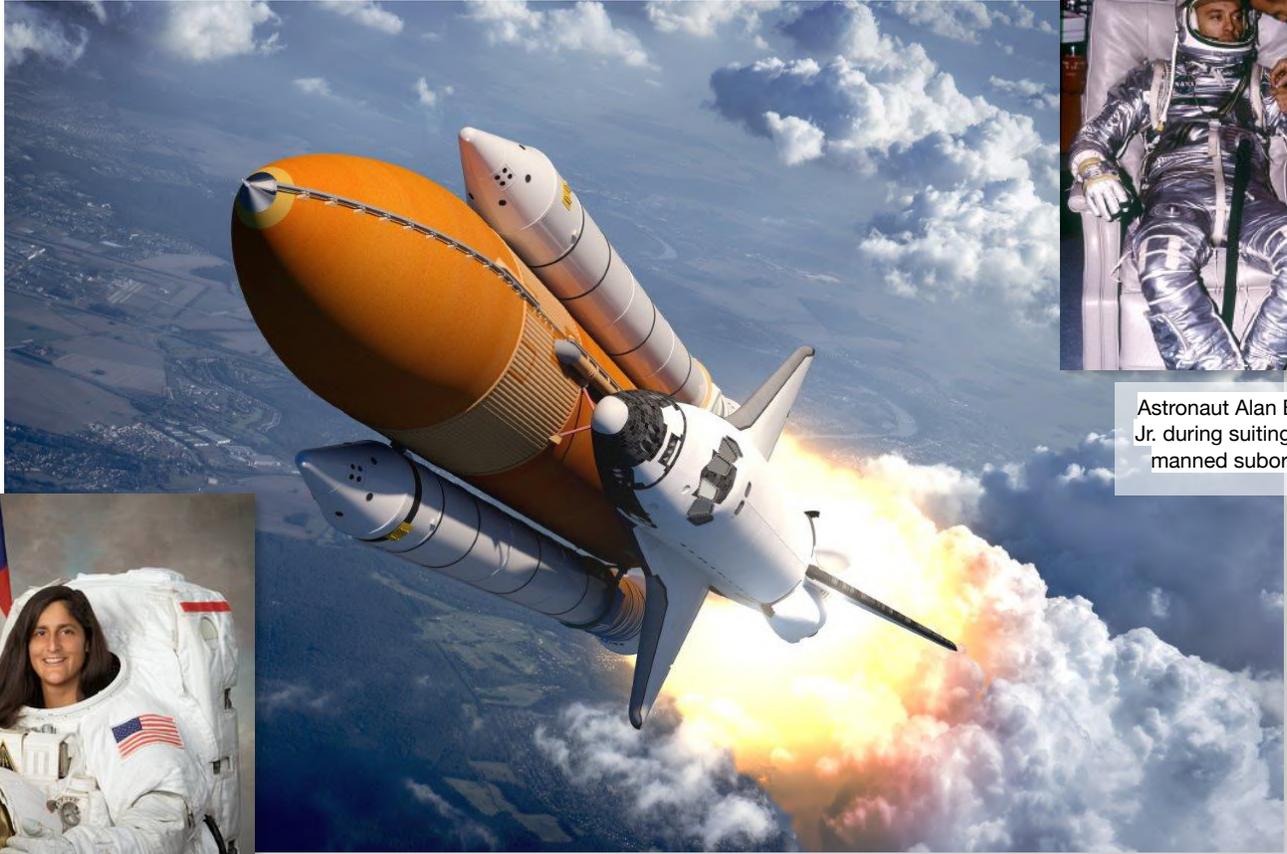


The U.S. Navy and Space



Astronaut Alan B. Shepard, Jr. during suiting for the first manned suborbital flight



Sunita L. Williams
U.S. Navy Captain and Naval
Academy graduate

In this packet, we will be learning about the important contributions the United States Navy has made in space exploration! We are then going to learn about **propulsion**, astronauts, and NASA today!

Contact the National Museum of the U.S. Navy
for Field Trip and School Visit opportunities!

*This packet is intended for elementary schools, to be used in groups of three or fewer and/or individually.



NATIONAL MUSEUM *of the*
UNITED STATES NAVY

History of Space Exploration and the United States Navy

The United States Navy has been at the forefront of space exploration since the beginning of its research. The Navy has helped in space exploration in both research and technology for almost 200 years! Our story begins in 1830, when the U.S. Navy started the Department of Charts and Instruments. We know this office now as the Naval Observatory, here in Washington DC. They still study **astronomy**, the study of the universe, and map out the stars. In early history of astronomy, we used this information and these maps to help ships navigate the seas!

Question: How would Sailors use stars to navigate the seas?

The United States Navy also helped to improve technology needed for future space flight. Famous inventor Thomas Edison actually suggested the U.S. Navy begin the Naval Research Laboratory (NRL) in 1923. One researcher who worked at the NRL, Robert Page, invented the pulse radar, and we still use that in space exploration today!

While the U.S. Navy did invent and discover a lot of technology to help future space exploration, Germany actually developed military grade rocket propelled missiles during World War II. The United States was worried that another country had more information than them, so they spent a lot of money to catch up with Germany. The Naval Research Laboratory worked with the United States government to develop engines so strong, they could launch a rocket into **orbit**.



Following World War II, the Soviet Union began intense research into rockets, **propulsion**, and satellites. They were the first country to launch a satellite into **orbit**, which further upset the United States. In response, the U.S. formed the National Aeronautics and Space Administration (NASA). NASA set to work, aiming to send the first person into **orbit**. The first American astronaut to achieve space flight was named Alan B. Shepard. He had served in the U.S. Navy and was a Naval Aviator. He would be the first of many Naval Aviators to later work as NASA astronauts. Seven of the 12 men who have walked on the moon previously served as Naval Aviators.

Neil Armstrong (above) is one of the most famous Naval Aviators to become an astronaut. Armstrong became a household name when he became the first human to walk on the moon. His training began when he joined the Navy in 1949. He flew over 80 combat missions over Korea.

Other key NASA moments have been marked out by astronauts who began their careers as Naval Aviators. When Columbia, the first space shuttle, launched on April 12, 1981, it was crewed entirely by Naval Aviators.

Women of the U.S. Navy served and continue to serve an important role in space research and exploration. The first American woman to complete a space walk was naval reservist Dr. Kathryn Sullivan. She was followed by fellow astronaut Sunita L. Williams, who at one time held the record for longest number of space walks by a woman. Williams also served as a Naval Aviator.

In the following pages, we are going to learn about some research conducted by the Naval Research Laboratory and what it takes to become an astronaut



Propulsion

Propulsion: the action of driving or pushing forward

The Naval Research Laboratory and NASA use **propulsion** to launch rockets, satellites, and shuttles into space. This type of research began just after World War II, when the United States collected rockets built by Germany and moved them to the American Southwest. From there, the Naval Research Laboratory began experiments on how to use **propulsion** to launch objects, and even people, into space.

Sir Isaac Newton discovered the Three Laws of Motion, and his Third Law states that for every action (force) in nature, there is an equal and opposite reaction. Take a look at the image to the right. The force of the fuel escaping at the bottom of the craft is the "action"; the movement of the craft upward is the "reaction".

We are going to recreate this law of motion using the force of air escaping a balloon!

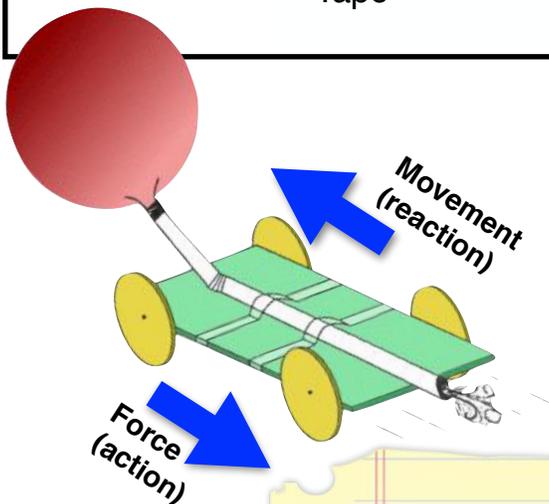


Let's make Balloon Rocket Cars!

What you'll need:

- 1 Car body
- 2 Axles
- 4 Wheels
- 1 Rubber band
- 1 Balloon
- Tape

Balloons releasing air follow the same Law of Motion as a rocket or shuttle launching into space!



1. Using the 2 axles (bars), connect the wheels to the body of the car.
2. As seen in the image to the left, tape your straw down onto the top of the body of the car.
3. Blow up your balloon to a medium size, and pinch the opening between your fingers.
4. Use the rubber band to attach the balloon to the straw. Make sure to continue pinching the balloon opening.
5. Move your car to the beginning of the track.
6. Release your fingers from the balloon, letting the air escape through the straw.
7. Watch your car go! How far can you go?!

Looking at the image above and following Newton's Third Law of Motion, what is the action and the reaction in this activity?

How far could you get your rocket car? What was most helpful to launch it?



Astronauts

About 79 NASA astronauts have served in the United States Navy, dating back to Alan Shepard, who was selected as one of the original NASA Mercury Seven astronauts in 1959. Below is a spotlight on a few of the many astronauts who utilized their training in the United States Navy to research and explore space!



Robert Curbeam

Robert graduated from the U.S. Naval Academy, and began Naval Flight Officer training in 1984. In 1986 he made overseas **deployments** to the Mediterranean and Caribbean Seas, and the Arctic and Indian Oceans on board the USS *Forrestal*. He also attended Navy Fighter Weapons School (Topgun). In August 1994, he returned to the U.S. Naval Academy as an instructor in the Weapons and Systems Engineering Department.



Wendy Lawrence

Wendy entered the U.S. Naval Academy in 1977; she served as Deputy Commandant of Midshipman in her senior year. After distinguishing herself as a flight school graduate she was designated an Naval Aviator in July 1982. After teaching physics for two years and serving as the novice women's crew coach at the Naval Academy, NASA selected Lawrence to become an astronaut in August of 1992. Of the 3,000 or so men and women applying every two years for the astronaut program, NASA chooses about 30.



Mark Kelly

Mark became a Naval Aviator in 1987 and received initial training on the A-6E Intruder attack aircraft. He was then assigned to Atsugi, Japan, and made two **deployments** to the Persian Gulf on the aircraft carrier USS *Midway*, flying 39 combat missions in Operation Desert Storm. After receiving his master's degree, he attended the U.S. Naval Test Pilot School. He has logged more than 5,000 hours in more than 50 different aircraft and has over 375 carrier landings. Mark has a twin brother who is also a NASA astronaut, Scott Kelly!

Would you want to explore space and become an astronaut?

Flip to the next page to see what it takes to train like an astronaut!

Why do some astronauts wear white suits and others wear orange?

The early and first NASA astronaut suits were silver and white. In 1994, NASA changed the color of the suits to International Orange. This makes astronauts easier to find when they return back to Earth!



Train like an astronaut!

Let's see if you have what it takes to become an astronaut. There will be two components to this training: a physical challenge and a math challenge. Astronauts must be very good at mathematics as well as strong enough to handle a space mission. First, we will test your physical ability! Follow the instructions below and record your times. **How fast can you go?**



Physical Challenge: Phase 1

Warm up:

- 20 Jumping Jacks
- 10 Push ups

Challenge:

1. Make sure to record your time!
2. Start laying flat on your stomach at the first marker.
3. At the signal, push yourself up and run to the second marker.
4. Touch the marker, then run back to marker one.
5. Repeat this, running to point three, then back to marker one.
6. Finish the final lap by running to marker 4 then back to marker one.
7. You're finished!

Record your time!



Trial Number	Recorded Time
1	
2	
3	
4	

Train like an astronaut!

Did you that a lot of astronauts study in science and mathematics? Astronauts study for years to be able to explore space. Test your skills below! Are you with a group? Race with your friends! Who can finish first?

$$\begin{array}{r} 9 \overline{)27} \end{array}$$

$$\begin{array}{r} 5 \\ + 1 \\ \hline \end{array}$$

$$\begin{array}{r} 9 \overline{)81} \end{array}$$

$$\begin{array}{r} 9 \\ \times 9 \\ \hline \end{array}$$

$$\begin{array}{r} 4 \\ \times 5 \\ \hline \end{array}$$

$$\begin{array}{r} 4 \overline{)4} \end{array}$$

$$\begin{array}{r} 4 \overline{)8} \end{array}$$

$$\begin{array}{r} 7 \\ + 3 \\ \hline \end{array}$$

$$\begin{array}{r} 6 \\ - 5 \\ \hline \end{array}$$

$$\begin{array}{r} 5 \\ + 5 \\ \hline \end{array}$$

$$\begin{array}{r} 13 \\ - 7 \\ \hline \end{array}$$

$$\begin{array}{r} 10 \\ - 5 \\ \hline \end{array}$$

$$\begin{array}{r} 4 \\ \times 3 \\ \hline \end{array}$$

$$\begin{array}{r} 8 \\ + 8 \\ \hline \end{array}$$

$$\begin{array}{r} 5 \overline{)35} \end{array}$$

$$\begin{array}{r} 2 \\ + 5 \\ \hline \end{array}$$

$$\begin{array}{r} 3 \overline{)18} \end{array}$$

$$\begin{array}{r} 2 \\ + 3 \\ \hline \end{array}$$

$$\begin{array}{r} 3 \\ + 2 \\ \hline \end{array}$$

$$\begin{array}{r} 1 \overline{)4} \end{array}$$

$$\begin{array}{r} 6 \overline{)18} \end{array}$$

$$\begin{array}{r} 7 \\ \times 8 \\ \hline \end{array}$$

$$\begin{array}{r} 3 \\ + 8 \\ \hline \end{array}$$

$$\begin{array}{r} 5 \\ \times 4 \\ \hline \end{array}$$

$$\begin{array}{r} 2 \\ + 7 \\ \hline \end{array}$$

NASA and the U.S. Navy's Partnership

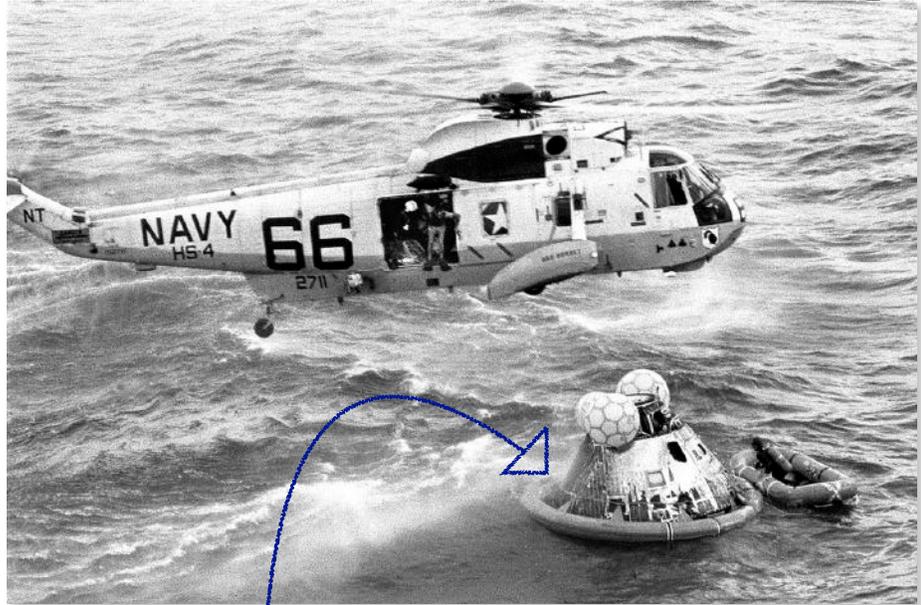
Retrieving NASA astronauts

NASA managed the Mercury, Gemini, and Apollo programs, and the U.S. Navy's role was to recover the **space capsules** and astronauts when they returned to earth.

When NASA decided to use water landings to bring back U.S. **space capsules**, they asked the Navy to support these missions. The Navy responded by forming Task Force 140 (TF-140), based in Norfolk, Virginia. Task Force 140 was a collection of ships and swimmers who were trained to **retrieve** astronauts!

Ships, helicopters, and swimmers had to train and then be ready in primary and secondary **retrieval** areas for both launch and landing. Some aircraft were even routinely sent from Guam and Newfoundland to provide **surveillance** and communications along the Atlantic and Pacific of the launch and return **orbits**. From 1961 through 1975, TF-140 supported 31 space flights! USS *Lake Champlain* and a Marine Corps helicopter, for example, picked up Alan Shepard after his Freedom 7 sub-orbital flight. USS *Hornet* greeted the Apollo 11 astronauts when they returned from the first moon landing, and USS *Iwo Jima* provided safe haven to the Apollo 13 astronauts following their famous mission.

Task Force 140 ended after completion of the Apollo program, but selected U.S. Navy units continued to support space operations.



Space Capsule

Quiz time!

Answer the questions below about the U.S. Navy's partnership with NASA

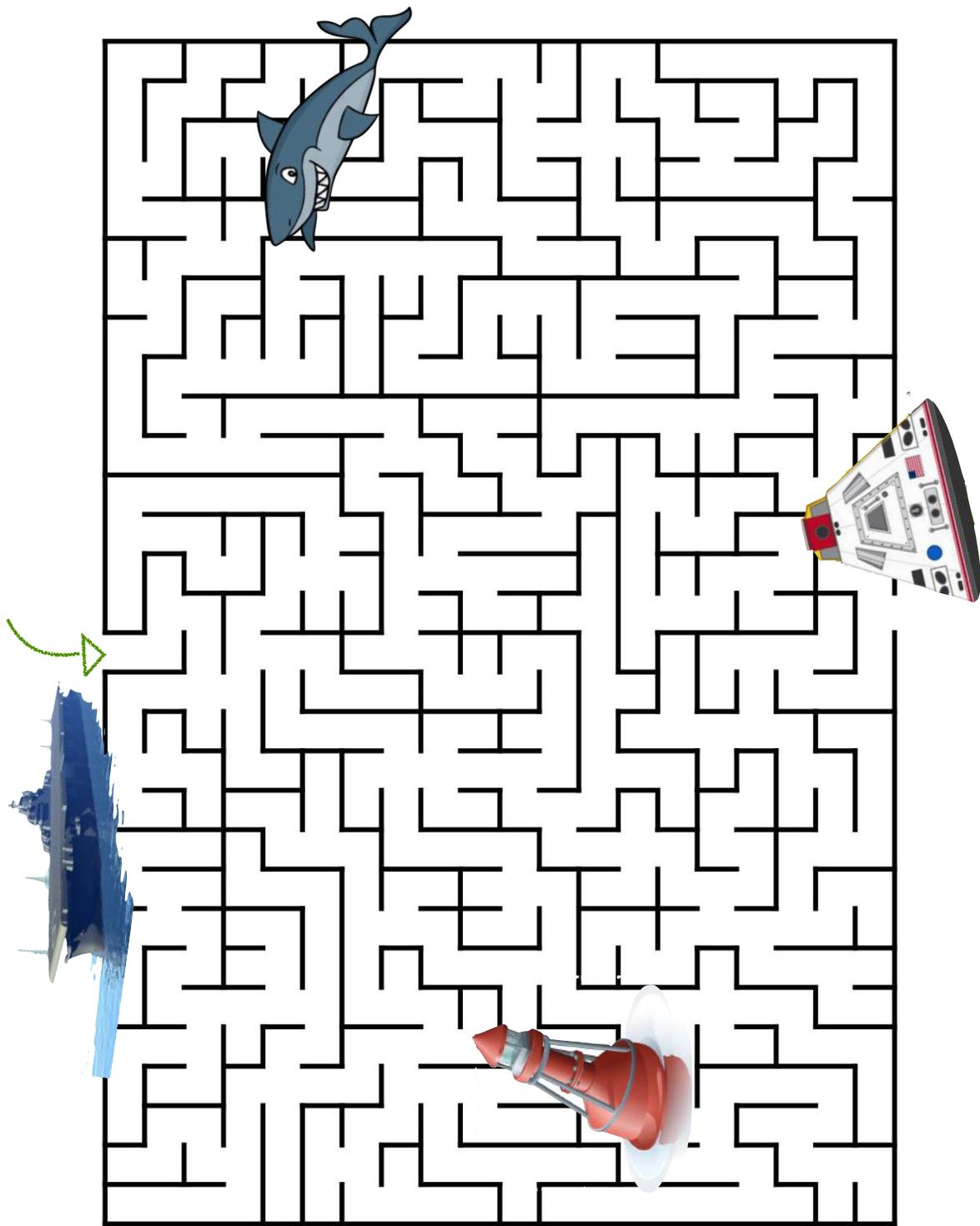
1. Which NASA programs worked with the U.S. Navy for astronaut launch and retrieval?

2. What years did Task Force 140 help NASA with these programs?

3. How many space flights did the U.S. Navy help **retrieve** astronauts?



Retrieve the crew of Apollo 11!



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Vocabulary

1. **Astronomy**: the study of science that deals with celestial objects, space, and the universe as a whole.
2. **Deployment/Deployed**: the movement of troops or equipment to a place for military action
3. **Orbit**: the curved path of a astronomical object or spacecraft around a star, planet, or moon.
4. **Propulsion**: the act of driving or pushing forward
5. **Retrieve**: get or bring something back
6. **Space Capsule**: a small spacecraft or the part of a larger one that contains the astronauts or crew.
7. **Surveillance**: close observation, especially of a suspected spy or criminal

Fill in the following sentences with the vocabulary words you just learned.
Use context clues to help:

The U.S. Navy has studied _____ since 1830.
NASA worked with the U.S. Navy to perfect the force of _____ needed to launch astronauts into _____. After we accomplished this in 1961, the U.S. Navy worked with NASA to _____ the Mercury, Gemini, and Apollo _____. Based in Norfolk, Task Force 140 were _____ for their launch and reentry _____, ensuring they closely observed and prepared for **retrieval**.

Bonus Question: Who did NASA send on its first suborbital mission in 1961? He was also a Naval Aviator!

