SPLASHDOWN

On August 2nd, American astronauts Bob and Doug returned from the International Space Station in a process called splashdown! Splashdown is a water-based landing in which a re-entry capsule lands in a big body of water, like the ocean. The astronauts inside are brought to shore and safely returned home.

Crew Dragon capsule splashdown, August 2020.

HOW IT WORKS

In this activity, learners will design and build a model capsule to survive the challenges of splashdown and protect the astronauts inside. This activity is best for learners, grades K-5, but can accommodate all learners.

Background information can be found at the end of this activity guide.

ACTIVITY

1. Gather your materials.
2. Get thinking with some questions:
    a. How do you think astronauts return to Earth from space?
    b. How do you think astronauts are kept safe during return?
    c. What do you think are some of the challenges (or benefits) of landing astronauts in the ocean on their return?
3. Set up your "splashdown" site.
    a. This can be a bowl, bucket, sink, or tub filled with water.
    b. This represents the ocean that the astronauts will be landing in during their return to earth.
4. Select two objects to represent astronauts.
    a. Anything with a little weight – washers, figurines, toys, coins, etc.
    b. The size of the astronauts will influence the size of the build.

DESIGN CHALLENGE

Design and build a capsule that can survive a water landing and protect the astronauts inside.

CRITERIA

The capsule must stay together during landing.

The capsule must be able to float on the water's surface for one full minute after landing.

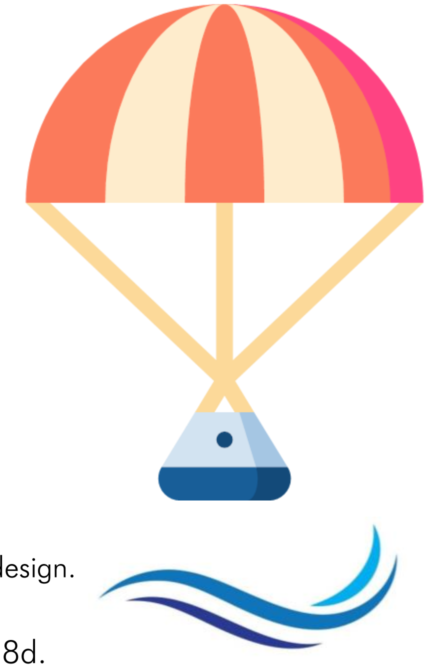
Two astronauts must be secured inside of the capsule at all times.

The astronauts must be kept dry throughout the landing and floating period.

SUGGESTED MATERIALS

Bucket, bin, sink, or tub
Two objects to represent astronauts
Containers or cups
Coffee filters
Pipe cleaners
Popsicle sticks
Glue or tape
Markers
Balloons
Rubber bands
Bubble wrap
Foil
Foam
Cardboard
Scissors
Water

5. Explain the design challenge and review the criteria (above).
6. Design and build the capsule.
7. Once it's ready, test the capsule in splashdown!
    a. Hold your capsule high above the splashdown site.
    b. Give a countdown and drop it into the water!
    c. Determine whether the capsule survived impact by staying intact.
    d. If so, wait 60 seconds to determine whether your capsule can float.
    e. After, remove it from the water and check if the astronauts stayed dry.
8. Discuss the results of your first round of capsule testing:
    a. What did you try in your design?
    b. What did you notice happen during landing?
    c. What worked well and what could be improved?
    d. What else would you like to try in the next round?
9. Re-design and re-build the capsule with improvements.
    a. If the capsule did not survive, start over using what you can.
    b. If it did survive, it is your choice to start over or improve from the current design.
10. Once it's ready, test the capsule again using steps 7a-7e.
11. Discuss the results of your second round of capsule testing using questions 8a-8d.
12. Repeat this process as many times as desired or until you've met all criteria.



SHOW US YOUR SPLASHDOWN

Share the results of your splashdown capsules with us by tagging @chabotspace on all social media platforms and using the hashtag #LearningLanunchpad. Become a member for more at-home STEAM activities and videos!

BACKGROUND INFORMATION

WHAT IS SPLASHDOWN?

Splashdown is the process of landing a spacecraft by parachute in a large body of water, such as the ocean. Landing, or re-entry, capsules can be found at the tip of most rocket ships. They are the part of the rocket that typically contains the crew and therefore, the only part of a rocket that actually returns to Earth from space.

Splashdown of Apollo 15 in 1971

IS SPLASHDOWN SAFE?

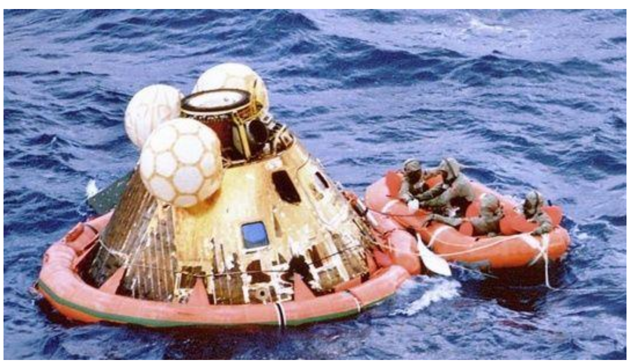
During re-entry, capsules can reach speeds of over 17,000 miles per hour. To safely land the crew aboard, parachutes are used to slow their descent before they officially splashdown into the ocean. Landing in water helps absorb some of the impact, since the properties of water provide more cushion than solid ground. This can reduce the need for an extra breaking system within the capsule and provides a safer method of landing for the crew inside. Even though splashdown is generally safe today, there are always risks to this method that engineers must test and design for. The biggest being the possibility of the capsule flooding and sinking while waiting for rescue teams to collect the crew from inside.

HOW OFTEN IS SPLASHDOWN USED TO GET ASTRONAUTS HOME?

Splashdown is common for American missions that launch off of the coast because of the agency's easy access to the ocean. Other space agencies, such as those in Russia and China, are restricted to returning crews over land. In those cases they must incorporate other safety measures, such as rocket boosters, to slow and reduce landing speeds even more.

Splashdown landings were used in the return of the Mercury, Gemini, and Apollo capsules. More recently, the SpaceX capsule, Crew Dragon, was added to the list as it successfully completed its first crewed landing in the Gulf of Mexico in early August, 2020. This marked history as astronauts Bob Behnken and Doug Hurley became the first astronauts to launch and land on American soil in over nine years due to the retirement of the Space Shuttle program. This mission's purpose was to serve as a test-run and has already revealed ways to improve the design for the next launch… Just like we practiced in this activity!

Crew Dragon capsule being retrieved, 2020.



Apollo 11 capsule with floatation devices visible, 1969.

HOW DOES THE CAPSULE FLOAT?

Landing capsules naturally float by design since the outer shell is already designed to create an air-tight seal that can withstand the vacuum of space. This prevents water from leaking in and flooding the ship, while also keeping it afloat. The rounded metal bottom (or top depending on how it lands), works like the hull, or bottom, of a ship and will bob on the surface of the ocean until rescue crews can reach the capsule. To ensure the safety of the crew, capsules are now designed with additional floatation devices, such as emergency rafts, that can inflate if needed to increase buoyancy or to up-right a ship that has landed top-down.

Capsules must be able to float for long periods of time, as the astronauts rely on boats or helicopters to collect them and the capsule to bring ashore. Each capsule that has been used in splashdown comes with its own unique features, methods, and flaws.

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Completing these activities and experiments will satisfy the following NGSS standards:

- K-2-ETS1-1: Questions are asked, observations are made, and information is gathered to define a problem that can be solved through the development of a new object or tool.
- K-2-ETS1-3: Data from tests of two objects designed to solve the same problem is analyzed to compare the strengths and weaknesses of how each performs.
- 3-5-ETS1-1: A simple design problem reflecting a need is defined and includes specified criteria for success and constraints on materials.
- 3-5-ETS1-2: Multiple possible solutions to a problem are generated and compared based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3: Tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved are planned and carried out.

NGSS: PRACTICES FOR K-12 CLASSROOMS

Throughout these activities, learners of all ages will practice skills such as:

- Asking Questions and Defining Problems
- Developing and Using Models
- Constructing Explanations and Designing Solutions
- Obtaining, Evaluating, and Communicating Information

NGSS: CROSS CUTTING CONCEPTS

Completing these experiments and activities will help children understand the following about cross cutting concepts:

- Cause and Effect: cause and effect relationships are routinely identified and used to explain change and that events have causes that generate observable patterns.
- Structure and Function: the way in which an object is shaped determines many of its properties and functions.