Microgravity Orientation

Water

Microgravity is something most people are aware of in a superficial way, primarily through movies and television that depict space travel. Science educators, and students, can explain the concept of microgravity and free-fall using Newtonian physics. The purpose of this series is to increase your understanding of how microgravity effects the lives of astronauts during extended periods off the Earth, conducting science experiments, and working in space.

Water exhibits unique, and interesting, characteristics in microgravity primarily due to its high surface tension caused by the polarity of water molecules. This creates unique issues for daily requirements such as drinking, and bathing. It also posses' problems during scientific experiments, and medical care.

Drinking water involves the use of a collapsible bag with a straw and valve. Although this is effective it limits the enjoyment of consuming many beverages, especially those that are typically served hot like coffee or tea. Astronaut Don Pettit developed a cup that takes advantage of waters surface tension and allows for a more traditional way of drinking, but most astronauts on the ISS still rely primarily on the closed bag system. Bathing and shampooing hair involves a process analogous to a sponge bath with use of very little water and rinseless cleansers.

Plant and animal experiments require systems for watering that prevent droplets of water forming and floating freely. Droplets of water in a growth chamber do not provide hydration and may ultimately interact with electronics that can ruin the experiment. Despite more than 50 years of human space exploration there are no methods to effectively administer medicines and hydration by intravenous drip. Maintaining a regulated continuous flow and preventing air bubbles from forming in the IV bag and line prevent this form of medical treatment. On extended missions this will undoubtedly be a requirement to keep astronauts healthy.

At this time astronauts on the ISS still use clothing for limited periods of time and then jettison as trash because NASA and others are still trying to build an effective laundering system. Additionally, manufacturing, and industrial systems that use water on Earth are still unavailable in space. Obviously, there are numerous challenges to using water in space that HUNCH students can help to solve. Several suggested links to videos, primarily recorded on the ISS, are provided for you to further your understanding of how water behaves in microgravity.

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What happens to water in space? https://www.youtube.com/watch?v=5GqsE09uUuw

This four-minute video is a nice primer on the physics of surface tension and phase changes. The science is the basics covered in both chemistry and first year physics. It is a good visual to get students thinking about the behavior of water in microgravity.

Wringing out water on the ISS https://www.youtube.com/watch?v=o8TssbmY-GM

Canadian astronaut Chris Hadfield demonstrates what happens to water wringed out of a washcloth. Before watching record your own prediction on what will occur.

Approximately how much water was squirted into the washcloth?

What hydrophilic material would you recommend using for a washcloth or towel?

How to wash your hair in space https://www.youtube.com/watch?v=kOIj7AgonHM

One cup of coffee to go https://www.youtube.com/watch?v=pct3JhVFSLo

Don Pettit on Evolution of zero-G coffee cup
https://www.youtube.com/watch?v=ugQIivUuuXk

How to water plants in space https://www.youtube.com/watch?v=9PiZ7-tcrcg