Gregory Jarvis

Fluid Behavior in Microgravity

PAYLOAD SPECIALIST, FLUID DYNAMICS

Jarvis was an engineer at Hughes Aircraft Company, specializing in how fluids behave in microgravity—essential for fuel, water, and biological systems aboard a spacecraft.

OBJECTIVE

Investigate how water moves differently in space.

STUDENTS WILL:

1. Learn about fluid experiments in microgravity.
2. Set up a capillary action demonstration.
3. Observe and record how water climbs the paper towel.
4. Relate findings to water movement in space.

MATERIALS

- Clear cups
- Paper towels
- Colored water
- Pipettes or straws
- Capillary action demo worksheet

STEP BY STEP INSTRUCTIONS

1. **Introduction:** Teach about Jarvis's work in fluid dynamics in space.
    a. On board the Challenger, one of his NASA assigned mission goals was to study fluids in space, in particular, the effects on liquid-fueled rockets (he was to test how fluids (like liquid-fuel) move in an orbiting spacecraft during normal space maneuvers).
    b. See Biographical Data Sheet for his work experience with NASA

STEP BY STEP INSTRUCTIONS (continued)

a. Notable works of Jarvis -
    i. He studied how liquids react to zero gravity (i.e. how spacecraft fuel sloshes in tanks). This was important because improper fluid movement could throw the shuttle off balance or cause it to rotate.
    ii. He developed baffles and damping systems to minimize the movement of the liquid fuel during spacecraft maneuvers based upon his experiment findings.
    iii. As a payload specialist, he used his fluid-handling knowledge to assist in designing communication satellites to ensure its propulsion and thermal systems would be efficient and reliable.

2. **Gravity vs Microgravity:** Discuss how gravity affects fluids and how space changes this.
    a. Access students' background knowledge by having them complete the first question on the Microgravity Student Worksheet.
    b. Liquids on Earth follow the rules of gravity. It causes things like pressure difference, buoyance, and flow patterns. In space, fluid patterns change due to the lack of gravity acting on the liquid.
        i. On Earth liquids are pulled down by gravity therefore the pressure in a liquid increases with depth ---- in space fluids do not settle. There is no change in pressure and bubbles no longer rise. Therefore, bubbles within a liquid stay suspended right where they are no matter the location.
        ii. Instead of gravity controlling liquids on Earth, surface tension takes over in space. Therefore, capillary action is used to guide fluids where they need to go since they are not pourable.
3. **Experiment Setup:**
    a. Fill a small cup with 8 ounces of water
    b. Add two drops of food coloring to the water and stir
    c. Cut a paper towel into a long strip
    d. Dip one end of the paper towel strip in the colored water
    e. Observe water climbing the towel over time and discuss findings
    f. Have students complete the remaining questions on the front of the Microgravity Student Worksheet regarding the experiment.
4. **Comparisons:** Try with different liquids or container shapes.
5. **Draw Conclusions:** Why does water behave this way? What would happen in space?
    a. Review all data gathered during the experiment. Remind students of the importance of controlling all liquids in space so it does not cause a catastrophe (liquids into electronics, orientation problems, etc.). Have students complete the first question on the back of the Microgravity Student Worksheet.

Optional Extension: Draw or write about how you would design a water system for astronauts in the space provided on the back of the Microgravity Student Worksheet.

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Microgravity Student Worksheet

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Jarvis was an engineer at Hughes Aircraft Company, specializing in how fluids behave in microgravity—essential for fuel, water, and biological systems aboard a spacecraft.

What do you know about fluids in space?

Describe your experiment setup:

Water Amount: _____ Material Used: _____

What did you observe during the experiment?

Why is this important for astronauts?

What design would YOU build for fluid use in space? Sketch below.