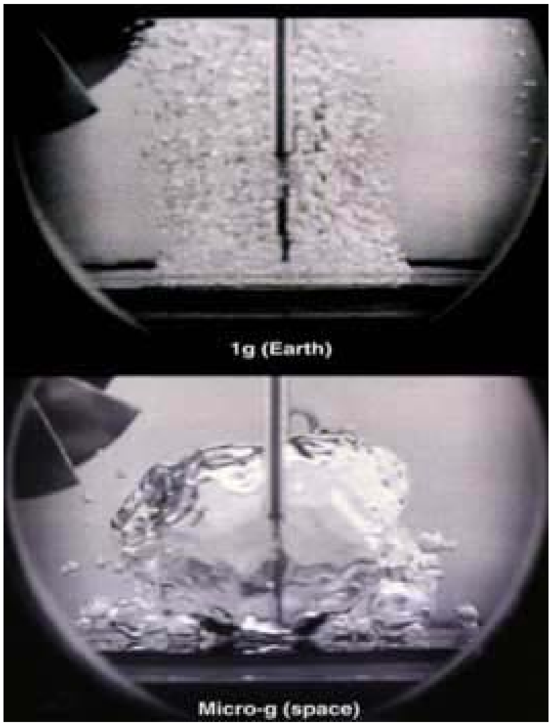
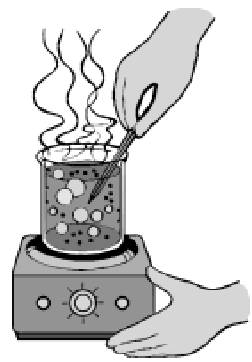
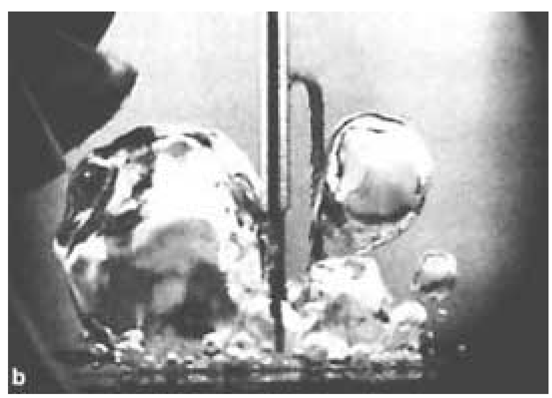
The Boiling Blob



In the near-weightless environment of space, dropped objects no longer fall, liquids don't pour, and flames form balls and float around. When it comes to weirdness in near-weightlessness, boiling is no exception—most of the time. Boiling water in microgravity behaves differently than boiling water on Earth. Scientists are working to understand why boiling sometimes behaves differently in space than on Earth.



Gravity plays an important role when boiling a substance on Earth. For example, when a liquid is heated in a pan on the oven, gravity causes the heated liquid on the bottom to rise to the top. The cooler, denser liquid at the top sinks to the bottom. This is known as convection. As the liquid is heated sufficiently to exceed the boiling point, vapor bubbles form at the heater surface. As the process continues, buoyancy causes the bubbles of hot steam to move upward through the boiling liquid.



Convection currents and buoyancy do not occur when there is little gravity. In space, the liquid near the heat source remains at the bottom. It continues to get hotter. Since the warming liquid next to the heater is not circulating, the liquid farthest away from the heating source remains cooler. Without that circulation, the liquid near the heat source becomes hot very quickly. It begins to boil sooner than it would on Earth. Just like in the gravity of Earth, this causes bubbles of hot steam to form. Unlike on Earth, those bubbles don't rise to the surface. Instead, they collect into a giant bubble that either remains near the heat source or floats in the middle of the liquid.

A scientist from the University of Michigan worked with a team of engineers and scientists from NASA to develop experiments on boiling. These flew on five Shuttle missions from 1992 until 1996. Researchers hope that their findings could be used to help design a power plant for the Space Station. It might be possible to use solar energy or nuclear energy to boil a liquid on the Space Station. There could even be benefits here on Earth. The findings could change the ways power plants on Earth are designed.

Expedition Six Science Officer Don Pettit performed his own experiments on boiling on the International Space Station. Pettit used a **soldering iron** for a quick science experiment. He squirted some water onto the hot soldering iron. **Surface tension** caused the water to form a quivering blob around the barrel of the tool. As the iron caused the water to heat up, something unusual happened. The water began to boil in a manner similar to the way it would on Earth. Rather than forming one giant bubble, tiny bubbles of steam began forming and "rising" to the surface of the liquid. The bubbles traveled outward from the iron. "The thing that just surprised me about this was how the boiling process appears to be almost like what you would see on the ground," Pettit said. Water could even be seen popping from the boiling liquid, just like in earthbound boiling.

One explanation is that air dissolved in the water was released. This air remains attached to the heater surface. The growth of the bubbles pushed the liquid next to the heated surface upward. This caused the motion in the droplet. Pettit could have also unintentionally done some thing to make the boiling appear as it does on Earth. For example, moving the soldering iron could have produced the back and forth motion of the droplet itself. It could also be possible that the bubbles formed near irregularities on the surface of the iron, and that the pressure of the hot water near the barrel pushed them outward. But, the phenomenon is not understood for certain. The "mystery" of boiling is typical of a lot of science in the weird world of near-weightlessness; we've learned a lot already, but we still have a lot more to learn.

Courtesy of NASA's
Space Flight Enterprise

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