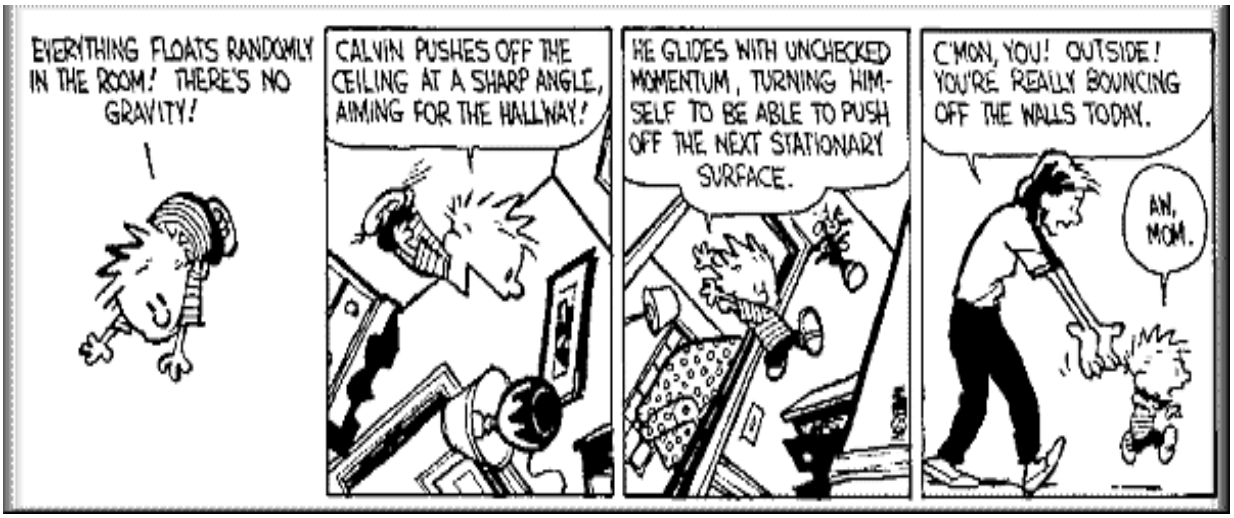
Microgravity

The term **microgravity** is synonymous with the terms **weightlessness** and **zero-G**. It refers to any situation where the gravitational force acting on an object is very small (on the order of $10^{-6}\ N/kg$).

Absence of Gravity

A "stationary" microgravity environment would require traveling far enough into deep space to reduce the effect of gravity to almost zero. While this is simple in conception, it would require traveling an enormous distance, making it impractical. For example, to reduce the gravity of the Earth by a factor of one million, one must travel a distance of 6 million kilometers from the Earth.



Free Fall

A more practical way to simulate a microgravity environment is free fall in a vacuum. Under such conditions, the only force acting on a falling object is gravity. If you recall from our discussions of apparent weight in previous topics, the net force acting on a falling object is typically the vector sum of the drag force and gravity.

$$\sum F = F_N + F_g$$

where F_N represents the apparent weight of the falling object. When an object is falling in a vacuum chamber, however, there is no drag force. Thus,

$$F_N = 0$$

and the object has no apparent weight. In other words, the object seems to be weightless (even though it truly isn't). This is known as apparent weightlessness, or simply weightlessness.

Microgravity by free fall is typically accomplished in facilities called drop towers. These are basically very large buildings with long (100 meters or longer), vertical vacuum chambers in their centers. Experiments can be done in closed containers that are dropped inside the tower.

There are also other methods, such as in a “parabolic aircraft,” or during orbital motion. Orbital motion has the advantage of creating a more-or-less indefinite period of microgravity, where free fall last only as long as the object is falling (about 10 seconds max in existing drop towers).