

# Re: the apex of a trajectory versus free fall

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- *From:* Andy Resnick <[andy.resnick@xxxxxxxxxxxx](mailto:andy.resnick@xxxxxxxxxxxx)>
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mm wrote:

When I was little and first heard about weightlessness training for astronauts, I thought they put them in a plane, flew the plane at a steep climb and the weightlessness occurred when the astronaut in training was at the apex of the plane's climb, when he stopped going up and before he started going down.

Almost the same thing I experienced when I was on a playground swing, at the highest point of its travel.

I couldn't understand how this could take the 20 or 30 seconds they said it lasted, as in the case of Steven Hawkings today.

Eventually I learned that the plane would dive and the passengers would dive with it, and they were falling but the plane was falling at the same speed, so it seemed to an observer, including the person himself, that there was no gravity.

Not counting the length of time each lasts, is there any difference between these two kinds of "weightlessness", reaching the apex of a trajectory versus free fall?

I am one of the lucky ones to have flown on the Vomit Comet, and here's how it goes:

Each day consists of about 40–50 parabolic arcs, and the total flight lasts for about 2–3 hours. IIRC, it was 10 arcs in one direction, the plane turns around, 10 arcs back, the plane turns around again... etc.

Each arc lasts about 3 minutes– a 2+ minute climb which is experienced as a 2–g acceleration followed by 30 seconds of reduced gravity. The climb is when most people actually vomit– moving your head confuses your brain. Sometimes the turn is combined with a climb.

When the apex of the climb is approached, the engines are cut back and the plane goes nose–down. "reduced gravity" begins here, and the pilot has three basic options, decided on prior to the flight. The plane can go for 0–g, 0.16–g (lunar) or 0.3–g (Martian). There's an accelerometer and readout, and the pilot controls the rate of downward fall (the engines are cut back, not off) to keep the desired acceleration within bounds. This period lasts for about 30 seconds, at which point the engines are brought back up, and the plane begins to climb. Total vertical distance covered is about 20k feet. My personal experience is that "lunars" are more

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disorienting than free-fall.

The misconception that 0-g is achieved for part of the climb and through the apex is normal, but incorrect due to air drag on the plane. The transition from 0-g to 2-g (and back) occurs within a second or so, so safety is a concern- people like to goof around in free fall, but one should not be upside-down, over electrical equipment, or otherwise misoriented at the end of the dive. Apparently, the russians have a version of the Super Guppy for cosmonaut training, and it's a problem if someone shoots 'up' toward the top of the cabin, a good 30 feet above the floor, and can't get back down in time.

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