



Spin Cycle

Training Pilots to Deal With Acceleration



San Antonio, TX (Brooks City-Base)—Pilots are trained to withstand high gravitational forces in a human centrifuge. The centrifuge provides high G-forces which simulate the high acceleration of military aircraft. Pilots use different techniques to maintain consciousness and control of the plane.

"The 'G' in 'G-force' stands for 'gravitational.' This is what keeps us from floating into outer space."

James Christensen, research psychologist

Framework

Middle School

Standards

- NSES - B.ii.3 ➤ Unbalanced forces will cause changes in speed and direction.
- NSES - C.iii.1 ➤ Organisms maintain stable internal conditions.
- NSES - C.iii.3 ➤ Behavior is a response to stimuli.
- NSES - D.iii.3 ➤ Gravity is a force.
- STL - 4.D ➤ Technology affects human safety.

Content Illustrated

- Acceleration is a change in velocity (speed in a direction) over time.
- Centrifugal force is caused by a constant change in direction.



Content



Life Science

- The feeling of G-force is similar to the feeling you get when you're on a roller coaster. Pilots experience high G-forces when making turns.
- The experience of 6 Gs would be like trying to flip a switch if your 10-pound hand weighed 60 pounds.
- Pilots are trained to avoid gravitational loss of consciousness (G-LOC). Pilots can pass out when blood from the head is pulled down into the body due to gravitational forces.
- Pilots are taught the "straining maneuver"—a special way to breathe and contract their muscles to prevent G-LOC. This includes curling your toes and alternately holding and releasing to cause a pumping action on the heart. This helps the heart maintain blood flow to the brain during high-G conditions.

Physical Science

- Velocity is determined by speed and direction.
- Acceleration is change in velocity over time.
- G-force stands for gravitational force and is a measure of acceleration due to gravity.
- Normally on Earth, we experience 1 G all the time. When flying, Air Force pilots can experience up to 9 Gs.
- The pilot experiences a constant change in direction, which causes a centrifugal force, an outward force often referred to as "pulling Gs".
- G-forces are caused by acceleration. When turning, G-forces increase as turning gets tighter and faster.

Technology

- The human centrifuge allows pilots to train in high-G conditions.
- The anti-G-suit acts like a large blood-pressure cuff, preventing blood from pooling in the legs. With proper training a pilot can go up to 9 Gs using this suit.

Math

- $\text{Acceleration} = \frac{\text{change in velocity}}{\text{change in time}}$
- Centrifugal force is expressed as a multiple of G (or gravitational force). Example: 100 pounds at 1 G is 600 pounds at 6 G.

Guiding Questions

To think about as you watch:

- What factors does a human centrifuge match with a real airplane? What does the simulated environment have to have to best train pilots?

Suggested Activities

- Make a small centrifuge, using a spring scale, that simulates tight turns in a car.
- Research other uses for centrifuges in science and technology.

Keywords

acceleration
anti-G-strain
anti-G-suit
blood pressure cuff
centrifugal force
human centrifuge
gravitational force
gravitational loss of consciousness (G-LOC)
straining maneuver
velocity

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