

## NASA to Conduct Unprecedented Twin Experiment

Consider a pair of brothers, identical twins. One gets a job as an astronaut and rockets into space. The other gets a job as an astronaut, too, but on this occasion he decides to stay home. After a year in space, the travelling twin returns home and they reunite. Are the identical twins still ... identical?

**NASA is about to find out.**

The experiment harkens back to **Einstein's "Twin**

**Paradox,"** a thought experiment in which one of the twins rockets to the stars at high speed while the other stays home. According to Einstein's theory of relativity, the travelling twin should return younger than his brother—strange but true. But the paradox still leaves unanswered questions, such as: if time stops at the speed of light, how can a photon travelling to us from a distant source be affected by its passage through space to us, eg Redshift? Any change surely must involve a time-lapse. Or, what is it that causes the time dilation, is the speed or the acceleration? If it is the speed only then the process should be reflected on both parties, that is either one of the twins could relatively be considered stationary. **If it is the acceleration only then the duration of flight should make no difference and deceleration could actually cancel the effect.**

Anyway, astronauts Scott and Mark Kelly (identical twins) prepare to participate in this unprecedented study in the biology of space-faring twins. In March of 2015 Scott Kelly will join cosmonaut Mikhail Kornienko on a one-year mission to the International Space Station. His brother Mark, who is also an astronaut, stays home. While Scott, the test subject, **spends one year circling Earth at 17,000 mph**, Mark will remain behind as a control subject. "We will be taking samples and making measurements of the twins before, during, and after the one-year mission," says Craig Kundrot of NASA's Human Research Program at the Johnson Space Centre. "For the first time, we'll be able to do this with two individuals who are genetically identical."

Their lengthy stay is also aimed at exploring the effects of long-term space flight on the human body.

NASA's study won't test the flow of time. The ISS would have to approach the speed of light for relativistic effects to kick in. Just about everything else is covered, though. NASA's Human Research Program recently announced the selection of 10 research proposals to study the twins' genetics, biochemistry, vision, cognition and much more. "Each proposal is fascinating and could be a feature-length story of its own," says Kundrot.

**Here are a few examples to give the flavour of the research:**

"We already know that the human immune system changes in space. It's not as strong as it is on the ground," explains Kundrot. "In one of the experiments, Mark and Scott will be given identical flu vaccines, and we will study how their immune systems react."

Another experiment will look at telomeres--little molecular "caps" on the ends of human DNA. Here on Earth, the loss of telomeres has been linked to aging. In space, telomere loss could be accelerated by the action of cosmic rays. Comparing the twins' telomeres could tell researchers if space radiation is prematurely aging space travelers.

Another experiment will study what space travel does to our inner bacteria which, by the way, outnumber human cells by 10-to-1. There is a whole microbiome essential to human digestion.

Other proposals seek to discover why astronaut vision changes in space. "Sometimes, their old glasses from Earth don't work," notes Kundrot.

Another will probe a phenomenon called "space fog"—a lack of alertness and slowing of mental gears reported by some astronauts in orbit.

"These will not be 10 individual studies," says Kundrot.

"The real power comes in combining them to form an integrated picture of all levels from biomolecular to psychological. We'll be studying the entire astronaut."

If there are no serious side effects from spending a full year in space then Scott and Mark will have made it possible for future astronauts to travel farther than ever before, and still look forward to happy reunions when they return. AK

