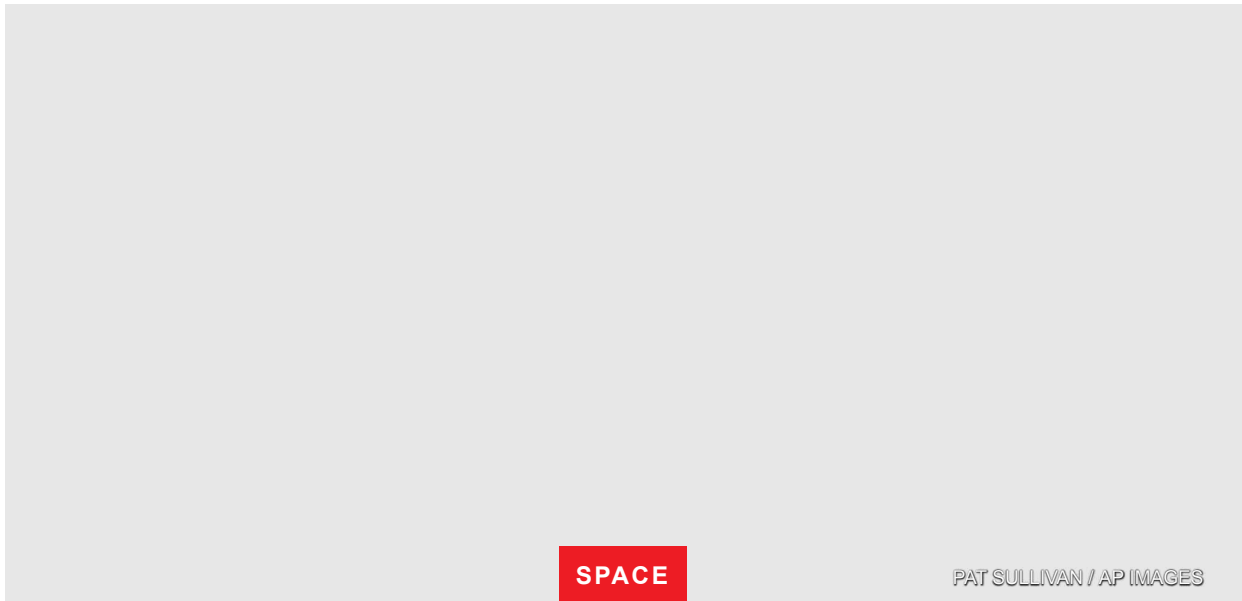


How Elon Musk Will Kill You, Mutate You and Give You Cancer With His Trips To Space

NASA sent one identical twin to space for a year, while the other stayed on Earth. Preliminary findings show changes in body mass, cognition, the immune system, and hundreds of gene mutations.



The Kelly brothers, Scott and Mark, are taking part in what NASA calls the **Twins Study**, a genetic experiment of sorts, meant to help humanity observe how our bodies change in space.

They are, according to *The Verge*, the only twins that have ever traveled to space.

The study is made up of 10 separate research projects, each of them focused on different aspects of the human body and mind.

Researchers from the University of California, Colorado State University, University of Pennsylvania, Johns Hopkins University, Stanford, Northwestern, and Cornell took part in this far-reaching and all-encompassing study.

Scott and Mark are identical twins. Scott was sent to the International Space Station in March 2016, and his brother Mark retired as an astronaut in 2011.

With one brother in space and the other Earth-bound, a groundbreaking study was born.

NASA scientists have decided to take advantage of the brothers' unique situation. Their aim was to learn as much as possible about the human body in space, by analyzing how each Kellys' biological markers evolved.

NASA said the following in a [press release](#).

“The Twin Study propelled NASA into the genomics era of space travel. It was a ground-breaking study comparing what happened to astronaut Scott Kelly,

in space, to his identical twin brother, Mark, who remained on Earth. The perfect nature versus nurture study was born.”

NASA will release its Twins Study summary paper later this year, but the largest astronomy magazine and website in the USA, *Astronomy*, published an insightful report on February 16, summarizing the preliminary findings of each of the 10 research projects.

What have we learned so far?

Artery walls thicken in space

How does space impact our arteries? [NASA Johnson Space Center's Cardiovascular and Vision Lab](#) researchers examined the twins' arteries using collected urine and blood samples, and ultrasound.

Scott, who was sent to the International Space Station in March 2016, experienced some changes. His carotid artery was thicker and his inflammation biomarkers were elevated.

 *twin study NASA artery walls*

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Flu vaccine works, even in space

Stanford University researchers introduced the flu vaccine to Kelly brothers during and post flight.

“This investigation studies how the immune system changes when an astronaut is exposed to a physically challenging environment and how immune response to a seasonal flu vaccination differs between the twin who was in space and the one who remained on Earth,” researchers wrote.

Mark and Scott displayed increased immune cell responses on both occasions, so it was concluded that the flu vaccine produces the desired immune system response, even in space.

Cognitive changes


University of Pennsylvania researchers were in charge of monitoring Mark and Scott's cognition.

Each brother performed cognitive tests; before flight, during flight, and post flight. Interestingly, Scott's time in space did not impair his cognitive abilities while in flight.

However, once he returned to Earth, researchers noticed decreased accuracy and speed on cognitive tests.

“Spaceflight causes several physiological and cognitive changes in humans, some of which could impact the health of crew members on long-duration missions,” researchers wrote.

Further study is needed to confirm, researchers claim, but the temporary cognitive decline could be a result of Scott readjusting to Earth's gravity.

 *NASA twins study cognition changes*

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Changes in body mass

NASA Johnson Space Center researchers found that Scott's body mass noticeably dropped during his time in space. On the other hand, his levels of folate increased.

This information was sourced from each brother's biochemical profile.

However, the changes in Scott's weight and folate levels could simply be a result of exercise and a healthier diet, researchers concluded.

Space affects gut microorganisms

Microorganisms known as the microbiome live in our gut. These microorganisms are crucial for our overall health.

Northwestern University researchers monitored the Kelly twins and found that their microbiomes were drastically different before flight, during flight, and post flight.

However, even though Scott's microbiome changed in space, the observed changes are similar to those scientists would observe if someone was to significantly modify their diet or change environments.

In space, telomeres lengthen

The caps that protect DNA strands from damage and shield our chromosomes are called telomeres – and they lengthen in space, [Colorado State University](#) researchers found.

Mark's telomeres remained stable, but Scott's significantly lengthened while he was in space. However, they underwent rapid shortening within two days of Scott landing back on Earth.

Inflammation increases in space

Space affects inflammation in the human body, [Stanford University](#) researchers discovered.

Evidence suggests that being in a microgravity environment increases inflammation, because Scott's lipid panel taken in space indicated inflammation, and he experienced an increase in proteins that regulate insulin activity.

nasa twin study gene mutations

Sergey Nivens / Shutterstock

Gene mutations

Arguably the most interesting and groundbreaking part of the Twins Study concerns gene mutations.

Not only do genes mutate in space, space impacts the way that genes express themselves. **Weill Cornell Medicine** scientists and researchers looked for medical changes in Mark and Scott's RNA and DNA.

As it turns out, Scott, who was sent to the International Space Station in March 2016, experienced hundreds of gene mutations.

Similarly, a Johns Hopkins University study concluded that the way that genes express themselves (epigenetics) differed between the two brothers.

Space impacts the body's ability to form and modify proteins

University of California researchers took urine samples from the brothers before, during, and after flight. This allowed them to identify changes in bones and muscles, as well as cardiovascular and metabolic changes.

While he was in space, Scott had elevated levels of aquaporin 2 – a protein which helps water transportation within the body and serves as an indicator of a body's hydration status.

This change is, researchers claim, a result of the fact that fluids tend to migrate to the head in a microgravity environment.