Maintaining the Body's Immune System

Incidence of Latent Virus Shedding During Space Flight

Your body protects you from illness with its own security system — the immune system. This system keeps illness at bay not only by mounting a defense against foreign organisms, but also by controlling the population of bacteria and viruses that normally live in your body. But there's no need to panic: certain microbes can actually exist in your body without causing illness. Some bacteria are even beneficial—like the *E. coli* in the large intestine that are an important source of vitamin K.

Astronaut Frank Culbertson, Jr., exercises on a treadmill on the *International Space Station*. Exercise is one way to counter the negative effects of space flight.

While viruses are not exactly considered beneficial, they can also inhabit the human body without causing immediate harm or infection. A good example is the herpes simplex virus type 1 (HSV1), more commonly known as cold sores or fever blisters. This virus infects 70 to 80 percent of all adults but remains latent much of the time. While latent, the virus within cells remains dormant. Activation of the dormant virus causes it to make copies of itself (known as replication) constantly—detectable in body fluids such as urine or saliva in a process called shedding. When a person becomes sick or stressed, however, this weakened condition allows the virus to reactivate and multiply. These elevated levels may be enough to produce symptoms, but shedding can also occur without symptoms. This ability to shed without showing signs of infection, or asymptomatic shedding, is of great interest, as it increases the chances of infecting others.

The stresses associated with space flight — adapting to microgravity, isolation from family and friends, living and working in a confined space, sleep deprivation, and busy schedules, to name but a few — may weaken astronauts' immune systems, leaving them at greater risk of viral reactivation. Members of the STS–107 crew will participate in this experiment, Incidence of Latent Viral Shedding in Space Flight, to help scientists understand how reactivation works in space, and at what level replication reaches before symptoms begin to show. This study also promises more insight into the behavior of the larger virus family, herpesvirus, which will help us understand how to prevent infection in populations on Earth and reactivation in those already infected.

Principal Investigator: Dr. Duane Pierson, Johnson Space Center, Houston, TX
Project Scientist: Dr. Jacob Bloomberg, Johnson Space Center, Houston, TX
Project Manager: Angie Lee, Johnson Space Center, Houston, TX

Earth Benefits and Applications

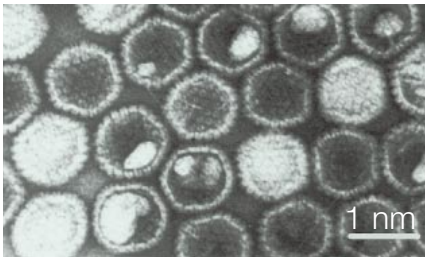
- Better understanding of latent virus shedding, which affects populations on Earth, will improve approaches for minimizing shedding and further infecting others
- This molecular approach may be a rapid and reliable tool for early detection of stress and diminished immunity
- This technology may provide clinically relevant data to help patients suffering from chronic and acute stress
- Viral monitoring may lead to early intervention that minimizes adverse health effects of acute and chronic stress.

Background Information

Science

Roughly 80 million people in the United States are infected with the herpes virus, which is the leading infectious cause of blindness. While we do not fully understand how viruses establish latency and later become reactivated, we do know that a weakening of the immune system increases the incidence (how often people are affected) and duration (how long they are affected) of viral reactivation and shedding. The results of this study will help develop treatments for fighting viruses and for reducing the spread of latent viruses on Earth as well as in space.

Additionally, scientists will consider other questions: What are the levels for latent shedding, and how much does it differ between individuals? At what level of reactivation does the virus produce symptoms? Since astronauts rely on medical care from physicians on Earth, finding answers to these questions and minimizing health risks are critical for success.



The varicella zoster virus, shown above, is the cause of shingles. This virus is a member of the herpesvirus group. Courtesy of Dr. Frank Fenner of the John Curtin School of Medical Research, and the International Committee on Taxonomy of Viruses Database (ICTVdb).

With this study, scientists will test their hypothesis that the incidence and duration of virus reactivation and shedding will increase in flight. Astronauts face any number of stresses before and during their mission, which can weaken their immune systems; scientists therefore expect to see a higher count of viruses during space flight as compared to before or after. In addition, scientists will compare the astronauts' data to data collected from a control group of people who remain on Earth to show whether the shedding in astronauts is different from the general earthbound population. Space flight may well be a major factor in viral reactivation and this study will help validate this hypothesis.

The viruses of interest in this investigation belong to the herpesvirus group, which is the most readily detectable of all latent viruses. The targeted strains are the herpes simplex virus types 1 and type 2, cytomegalovirus, varicella zoster virus, and Epstein-Barr virus.

Operations

For this study, astronauts give samples of saliva and urine, and blood—the body fluids into which viruses are shed—at various times before, during, and after flight according to the schedule shown in the following table.

Saliva and urine samples are analyzed for the presence of the four herpesviruses using an analytic process called the polymerase chain reaction (PCR), which allows the detection and counting of both symptomatic and asymptomatic virus shedding. To test blood samples, scientists use enzyme-linked immunosorbent assay. This test will reveal the levels of antibody generated against the four viruses, indicating how active or weak the immune system is. Antibody levels before flight can be compared to levels after flight, showing how each astronaut's immune system changed. These results are also compared to those from the ground-based population, to determine if space flight and its stressors played a detectable role.

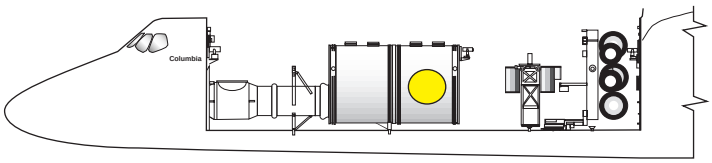
Earlier Results

Before Flight			In Flight	After Flight	
From 6 months to 5 months, every other day	50 days	10 days	Daily	Landing	14 days
saliva	blood urine	blood urine	saliva	blood urine saliva	saliva

Earlier studies from short-duration (Space Shuttle) and long-duration (Russian space station *Mir*) flights support the scientists' hypothesis of increased reactivation and shedding during space flight, in some cases increased by eight- to ten-fold. These results were also supported by findings from analogous environments on Earth, such as Antarctic winter excursions and closed-chamber studies. These data give an indication that space flight and analogous environments on Earth do indeed have some role in viral reactivation.

To yield accurate data, the astronauts must adhere to certain guidelines:

- No food or fluid for at least 15 minutes before saliva collection.
- All drug intake and stressful conditions should be logged.
- In the event of a cold sore, a sample swab should be taken for postflight analysis.
- Saliva collection should be taken at the same time during each mission day, after waking up and before brushing teeth.



Approximate location of this payload aboard STS–107.