The History of Animals in Space – Teacher Notes

Animals have been used in space science research since the very beginning of the space age. Both the United States and Soviet/Russian space programs relied heavily on animals to collect medical information and test the engineering concepts used to put humans into space. Animals were initially used to prove that complex biological organisms could live in space. Once humans began venturing into space they took animals with them as experimental subjects, this continues aboard the Space Shuttle and the International Space Station as animals continue to help us learn about the space environment in particular the cardiovascular, musculoskeletal and neurovestibular changes caused by microgravity exposure.

History of Animals in Space

During the 1930s and 1940s many ground based experiments were undertaken on both animals and humans to study the effect of high acceleration and altitudes. The first animals sent into space were fruit flies launched in 1947 aboard a United States V2 rocket. The purpose of the experiment was to test the effect of radiation at high altitudes.

The first sub-orbital rocket powered animal flight occurred in June 1948 when Albert, an anesthetized rhesus monkey was launched aboard a V2 rocket at White Sands, New Mexico in the United States. There were three more V2 flights in 1949 involving rhesus and cynomolgus monkeys named Albert II, Albert III and Albert IV unfortunately none of the animals aboard these four flights survived due to mechanical failures.

In 1950 the US launched a mouse into space aboard a V2 rocket reaching an altitude of 137 km but again a mechanical failure led to the loss of the biological payload. After this series of failures a new, more reliable rocket named the Aerobee was developed. In 1951 the first launch of the Aerobee rocket carrying a monkey named Albert V also crashed after a parachute failure. Finally in September that year an Aerobee rocket carrying a rhesus monkey named Albert VI, along with 11 mice survived a spaceflight, unfortunately Albert VI died 2 hours after landing. In May 1952 two Philippine macaque monkeys named Patricia and Michael were launched on the third Aerobee rocket launch. As with the previous launches the monkeys were given an anaesthetic to keep them calm during the flight. The launch was a resounding success and both monkeys were recovered in good health, a big step forward for the American space program.

While the United States were testing monkeys in their animal testing program the Soviets had decided to use dogs. In July 1951 the Soviet Union launched two dogs Tsygan and Dezik into space aboard the R-1 rocket. Both dogs survived the flight and became the first animals to survive a ride in a rocket. The Soviets learned a great deal from their first canine flights over 2 months in 1951 nine dogs flew on six

flights. Four of the dogs did not survive. A second series of flights began in 1954 with nine flights occurring over the next 2 years.

On November 3, 1957, just one month after the Soviets launched the Sputnik satellite showing the world the true capability of the Soviet space program they launched Sputnik 2 carrying a dog named Laika who became the first animal to orbit the Earth. Laika died during the flight a few hours after launch due to stress and overheating possibly due to a malfunction in the thermal control system, the cause of her death was not made public until decades after the flight. Although Laika did not survive, her flight proved that a living organism could be launched into orbit and survive microgravity. At the time of the launch the ethical problems associated with this experiment were not properly addressed largely due to the press reporting on the political implications of this achievement during the US/Soviet Space Race. The Sputnik 2 capsule was not designed to be retrievable meaning of course that Laika had been intended to die. The mission sparked a worldwide debate on the mistreatment of animals and the use of animals as testing subjects for the advancement of science.

Figure 1: Laika the first animal to orbit the Earth

Figure 2: Russian space dog capsule

In December 1958 the US launched a squirrel monkey named Gordo aboard a Jupiter rocket. Unfortunately the recovery parachute failed and Gordo was lost. Data sent back showed that Gordo had survived the 10 g launch, approximately 9 minutes of weightlessness and 40 g on re-entry at 16000 kilometres per hour.

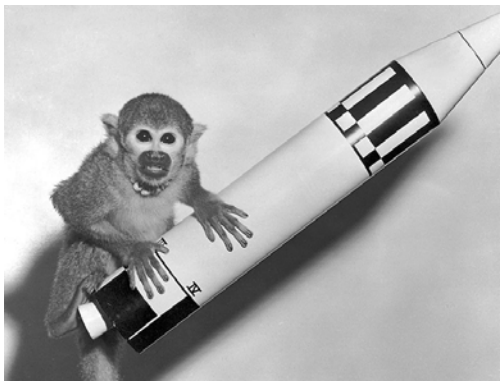

Figure 3: Squirrel monkey Baker that safely rode on a Jupiter rocket

After Gordo's flight two monkeys were selected for the next biological flight. These were a rhesus monkey named Able and a squirrel monkey named Baker. Able and Baker were launched aboard a Jupiter rocket on May 28, 1959. The flight went almost flawlessly with the monkeys experiencing 9 minutes of weightlessness before re-entering the Earth's atmosphere. As the forces of deceleration reached an enormous 39 g's Baker began to develop cardiac inhibition but exhibited little change in her respiration rate. Able's heart rate reached 222 beats per minute and she was breathing three times faster than normal. As the forces on the monkeys began to fall they both returned to regular readings. The capsule carrying the monkeys safely touched down in the ocean and both monkeys were retrieved safe and in good health. Able died just 4 days after the mission due to a reaction to anaesthetic during an operation to remove an electrode that had become infected.

Baker reached celebrity status receiving fan mail from children and even celebrating her 21st birthday with nearly a thousand guests where she was presented a cake made from jelly and topped with strawberries and banana. She lived to the ripe old age of 27, dying in 1984. Even today her grave at the US Space and Rocket Centre in Alabama is often adorned with a banana in remembrance to a well loved spaceflight pioneer.

The Russians continued to send dogs into space including Belka and Strelka who spent a day in orbit aboard Sputnik 5 on August 19, 1960 and were successfully returned to Earth. They were the first Earth born creatures to travel into orbit and return alive.

Figure 4: Strelka (left) and Belka (right) orbited the Earth and returned safely aboard Sputnik 5

On January 31, 1961 a chimpanzee known as subject 65 but affectionately known as Ham became the first chimpanzee to be launched into space. He was launched aboard a Mecury-Redstone rocket on a sub-orbital flight. He had been trained to pull various levers to receive rewards of banana pellets and avoid electric shocks. His flight demonstrated the ability to perform tasks during spaceflight. Ham grew old at the National Zoological Park in Washington where he had guest appearances on television and even a cameo in a movie, he died in 1983.

Figure 5: Ham the chimpanzee is greeted by the recovery ship commander after his flight

On 12 April 1961 Russian Cosmonaut Yuri Gagarin became the first human in space and the first to orbit the Earth. This was followed on May 5 1961 by American Alan B. Shepard's sub-orbital ballistic flight aboard a Mecury-Redstone rocket. This flight was successful largely due to the previous sub-orbital flight by Ham the chimpanzee.

A chimpanzee by the name of Enos became the first chimp to orbit the Earth when he was launched aboard a Mercury-Atlas rocket on November 29, 1961. Enos orbited the Earth twice before returning to Earth safely. This flight paved the way for American John Glenn's orbital flight.

In the Soviet Union, the dogs Veterok and Ugolyok were launched aboard Kosmos 110 on February 22, 1966. The flight was a test of the effects of long term exposure to the space environment in particular radiation. The flight lasted 22 days in orbit, this record breaking duration of spaceflight was not surpassed by humans until 1974. On September 14, 1968 the Soviet Union launched Zond 5 which carried two tortoises along with flies, worms, bacteria and plants on a circumlunar mission. On September 18 the spacecraft travelled around the moon it splashed down in the Indian Ocean on September 21 with the tortoises being recovered alive and in good health.

After the manned lunar landing of Apollo 11 in July 1969 during which Neil Armstrong and Buzz Aldrin walked on the moon the role of animals in space was downgraded to that of biological payloads for research of further aspects of spaceflight. They had already shown that living creatures could survive the space environment, the conditions experienced during flight and could perform tasks in space. Their role as the pioneers of spaceflight was at an end.

Continued Research on Animals in Space

Once manned spaceflight had been achieved the role of animals in space became more about understanding the long term health effects associated with the space environment. When the Space Shuttle was first launched in 1981 it provided the perfect platform for scientists and researchers to launch animal experiments into space. The use of animal payloads on the Space Shuttle has greatly advanced understanding the effect of gravity on physiology and improving the ability of astronauts to live and work in space. Numerous experiments have flown on the Space Shuttle one of the first were studies of whether bees can make honey in space. This was followed by studies of the behavior of rats and monkeys during space flight.

Figure 6: Astronuat Donald Thomas studies a newt aboard the Space Shuttle

After the loss of the Space Shuttle Challenger on January 28, 1986 flights of the space shuttle were postponed for several years but once flights resumed animals continued to travel into space. In 1990 the Space Shuttle Discovery launch of STS-41 carried a payload called the Physiological Systems Payload. This was the first commercial space project in the life sciences. By this stage many of the effects of space flight on biological systems were well known, such as the loss of bone density and muscle, decreased immune function, cardiac de-conditioning and others. The aim of the experiment was to study the use of potential therapies for bone and muscle wasting, organ degeneration and immune systems disorders on subjects in the space environment with the aim of using them for benefit of people back on Earth.

Throughout the 1990s research continued on a huge variety of animals mainly to study the effect of microgravity on the various systems of the body and to investigate medical technology and treatments for use back on Earth. The US launched crickets, mice, rats, frogs, newts, fruit flies, snails, carp, medaka, oyster toadfish, sea urchins, swordtail fish, gypsy moth eggs, stick insect eggs and quail eggs all aboard the Space Shuttle. In fact even Australia launched animals into space when, in 2003, a group of students from Glen Waverly Secondary College supported by RMIT University, Melbourne Zoo and the Department of Education launched spiders into space aboard the Space Shuttle Columbia. The aim of the experiment was to look at the composition of the spiders web spun in microgravity for investigating material developments on Earth. Unfortunately this was the ill fated flight in with the Space Shuttle was lost on re-entry to the Earth's atmosphere.

Throughout the early days of spaceflight animals played a vital role in testing the initial spacecraft and technology needed to put humans into space. They paved the way for the human space program and through both success and failure allowed humans to reach space with a relatively small loss of human life. They deserve to be remembered as the real pioneers of space flight. Even up to today animals continue to play a vital role in our understanding of the space environment and help us to perfect technology and medical advances that can be used back on Earth.