Cold War History of Human Space Flight

OBJECTIVE: Learn about the history and evolution of spaceflight during the Cold War between the United States and the former Soviet Union (1950-1990).

DISCUSSION:

A great space pioneer, Hermann Oberth (1894-1989) of Germany, published a book in 1923 about rocket travel into outer space. His writings were important. Because of them, many small rocket societies sprang up around the world. In Germany, the formation of one such society, the Verein fur Raumschiffahrt (Society for Space Travel), led to the development of the V-2 rocket, which the Germans used against London during World War II. In 1937, German engineers and scientists, including Oberth, assembled in Peenemunde on the shores of the Baltic Sea. There, under the directorship of Wernher von Braun, engineers and scientists built and flew the most advanced rocket of its time. The V-2 rocket (in Germany called the A-4) was small by comparison to today's rockets. It achieved its great thrust by burning a mixture of liquid oxygen and alcohol at a rate of about one ton every seven seconds. Once launched, the V-2 was a formidable weapon that could devastate whole city blocks. Fortunately for London and the Allied forces, the V-2 came too late in the war to change its outcome. Nevertheless, by war's end, German rocket scientists and engineers had already laid plans for advanced missiles capable of spanning the Atlantic Ocean and landing in the United States. These missiles would have had winged upper stages but very small payload capacities.

With the fall of Germany, the Allies captured many unused V-2 rockets and components. Many German rocket scientists came to the United States. Others went to the Soviet Union. The German scientists, including Wernher von Braun, were amazed at the progress Goddard had made. Both the United States and the Soviet Union recognized the potential of rocketry as a military weapon and began a variety of experimental programs. At first, the United States began a program with high-altitude atmospheric sounding rockets, one of Goddard's early ideas. Later, they developed a variety of medium- and long-range intercontinental ballistic missiles. These became the starting point of the U.S. space program. Missiles such as the Redstone, Atlas, and Titan would eventually launch astronauts into space.

On October 4, 1957, the Soviet Union stunned the world by launching an Earth-orbiting artificial satellite. Called Sputnik I, the satellite was the first successful entry in a race for

space between the two-superpower nations. Less than a month later, the Soviets followed with the launch of a satellite carrying a dog named Laika on board. Laika survived in space for seven days before being put to sleep before the oxygen supply ran out. A few months after the first Sputnik, the United States followed the Soviet Union with a satellite of its own. The U.S. Army launched Explorer I on January 31, 1958. In October of that year, the United States formally organized its space program by creating the National Aeronautics and Space Administration (NASA). NASA became a civilian agency with the goal of peaceful exploration of space for the benefit of all humankind.

Soon, rockets launched many people and machines into space. Astronauts orbited Earth and landed on the Moon. Robot spacecraft traveled to the planets. Space suddenly opened up to exploration and commercial exploitation. Satellites enabled scientists to investigate our world, forecast the weather, and communicate instantaneously around the globe. The demand for more and larger payloads created the need to develop a wide array of powerful and versatile rockets.

Scientific exploration of space using robotic spacecraft proceeded at a fast pace. Both Russia and the United States began programs to investigate the Moon. Developing the technology to physically get a probe to the Moon became the initial challenge. Within nine months of Explorer 1 the United States launched the first unmanned lunar probe, but the launch vehicle, an Atlas with an Able upper stage, failed 45 seconds after liftoff when the payload fairing tore away from the vehicle. The Russians were more successful with Luna 1, which flew past the Moon in January of 1959. Later that year the Luna program impacted a probe on the Moon, taking the first pictures of its far side. Between 1958 and 1960 the United States sent a series of missions, the Pioneer Lunar Probes, to photograph and obtain scientific data about the Moon. These probes were generally unsuccessful, primarily due to launch vehicle failures. Only one of eight probes accomplished its intended mission to the Moon, though several, which were stranded in orbits between Earth and the Moon, did provide important scientific information on the number and extent of the radiation belts around Earth. The United States appeared to lag behind the Soviet Union in space.

With each launch, manned spaceflight came a step closer to becoming reality. In April of 1961, a Russian named **Yuri Gagarin** became the first man to orbit Earth. Less than a month later the United States launched the first American, **Alan Shepard**, into space. The flight was a sub-orbital lofting into space, which immediately returned to Earth. The Redstone rocket was not powerful enough to place the Mercury capsule into orbit. The flight lasted only a little over 15 minutes and reached an altitude of 187 kilometers. Alan Shepard experienced about five minutes of microgravity then returned to Earth, during which he encountered forces twelve times greater than the force of gravity. Twenty days later, though still technically behind the Soviet Union, President John Kennedy announced the objective to put a man on the Moon by the end of the decade.

In February of 1962, John Glenn became the first American to orbit Earth in a small capsule so filled with equipment that he only had room to sit. Launched by the more powerful Atlas vehicle, John Glenn remained in orbit for four hours and fifty-five minutes before splashing down in the Atlantic Ocean. The Mercury program had a total of six launches: two suborbital and four orbital. These launches demonstrated the United

States' ability to send men into orbit, allowed the crew to function in space, operate the spacecraft, and make scientific observations.

The United States then began an extensive unmanned program aimed at supporting the manned lunar landing program. Three separate projects gathered information on landing sites and other data about the lunar surface and the surrounding environment. The first was the Ranger series, which was the United States first attempt to take close-up photographs of the Moon. The spacecraft took thousands of black and white photographs of the Moon as it descended and crashed into the lunar surface. Though the Ranger series supplied very detailed data, mission planners for the coming Apollo mission wanted more extensive data. The final two lunar programs were designed to work in conjunction with one another. Lunar Orbiter provided an extensive map of the lunar surface. Surveyor provided detailed color photographs of the lunar surface as well as data on the elements of the lunar sediment and an assessment of the ability of the sediment to support the weight of the manned landing vehicles. By examining both sets of data, planners were able to identify sites for the manned landings. However, a significant problem existed, the Surveyor spacecraft was too large to be launched by existing Atlas/Agena rockets, so a new high energy upper stage called the Centaur was developed to replace the Agena specifically for this mission. The Centaur upper stage used efficient hydrogen and oxygen propellants to dramatically improve its performance, but the super cold temperatures and highly explosive nature presented significant technical challenges. In addition, they built the tanks of the Centaur with thin stainless steel to save precious weight. Moderate pressure had to be maintained in the tank to prevent it from collapsing upon itself.

Rocket building was refining the United State's capability to explore the Moon. The Gemini was the second manned capsule developed by the United States. It was designed to carry two crew members and was launched on the largest launch vehicle available—the Titan II. President Kennedy's mandate significantly altered the Gemini mission from the general goal of expanding experience in space to prepare for a manned lunar landing on the Moon. It paved the way for the Apollo program by demonstrating rendezvous and docking required for the lunar lander to return to the lunar orbiting spacecraft, the **extravehicular activity (EVA)** required for the lunar surface exploration and any emergency repairs, and finally the ability of humans to function during the eight day manned lunar mission duration. The Gemini program launched ten manned missions in 1965 and 1966, eight flights rendezvous and docked with unmanned stages in Earth orbit and seven performed EVA.

Launching men to the moon required launch vehicles much larger than those available. To achieve this goal the United States developed the Saturn launch vehicle. The Apollo capsule, or command module, held a crew of three. The capsule took the astronauts into orbit about the Moon, where two astronauts transferred into a lunar module and descended to the lunar surface. After completing the lunar mission, the upper section of the lunar module returned to orbit to rendezvous with the Apollo capsule. The Moonwalkers transferred back to the command module and a service module, with an engine, propelled them back to Earth. After four manned test flights, Apollo 11 astronaut Neil Armstrong became the first man on the moon. The United States returned to the lunar surface five more times before the manned lunar program was completed. After the lunar program the Apollo program and the Saturn booster launched Skylab, the United

State's first space station. A smaller version of the Saturn vehicle transported the United States' crew for the first rendezvous in space between the United States and Russia on the Apollo-Soyuz mission.

During this manned lunar program, unmanned launch vehicles sent many satellites to investigate our planet, forecast the weather, and communicate instantaneously around the world. In addition, scientists began to explore other planets. Mariner 2 successfully flew by Venus in 1962, becoming the first probe to fly past another planet. The United State's interplanetary space program then took off with an amazing string of successful launches. The program has visited every planet except Pluto.

Since the earliest days of discovery and experimentation, rockets have evolved from simple gunpowder devices into giant vehicles capable of traveling into outer space, taking astronauts to the Moon, launching satellites to explore our universe, and enabling us to conduct scientific experiments aboard the Space Shuttle. Without a doubt rockets have opened the universe to direct exploration by humankind. What role will rockets play in our future?

The goal of the United States space program is to expand our horizons in space, and then to open the space frontier to international human expansion and the commercial development. For this to happen, rockets must become more cost effective and more reliable as a means of getting to space. Expensive hardware cannot be thrown away each time we go to space. It is necessary to continue the drive for more reusability started during the Space Shuttle program. Eventually NASA may develop aerospace planes that will take off from runways, fly into orbit, and land on those same runways, with operations similar to airplanes.

ACTIVITY:

Develop a time line to illustrate the cold war space race. Show significant events.