ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 2

EO M340.02 – DISCUSS THE HISTORY OF MANNED SPACE EXPLORATION

Total Time: 30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Create slides of figures located at Annexes I to L.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for this lesson to orient the cadets, generate interest, present background material, and clarify the history of manned space exploration.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have discussed the history of manned space exploration.

IMPORTANCE

It is important for cadets to learn about the history of manned space exploration because in the near future, space exploration will become increasingly significant as developing technologies and resource depletion move humanity's focus beyond earth.

Teaching Point 1 **Discuss the Mercury Program**

Time: 5 min Method: Interactive Lecture

Show the cadets the early manned space exploration timeline located at Annex I.

On May 5, 1961, America's first astronaut, Alan Shepard, blasted into space on a Redstone rocket. His history-making suborbital flight was in a one-man capsule named Freedom 7, which was only two metres long and less than two metres in diameter.

Show the cadets Figure 15I-1.

OBJECTIVES OF THE MERCURY PROGRAM

Specific studies and tests conducted by the US government and industry, culminating in 1958, indicated the feasibility of manned space flight. The objectives of the Mercury program, as stated at the time of project commencement in November 1958, were:

- place a manned spacecraft in orbital flight around the earth;
- investigate man's performance capabilities and his ability to function in the environment of space; and
- recover the man and the spacecraft safely.

The 1983 movie *The Right Stuff* is based on the story of the Mercury program.

HISTORY OF THE MERCURY PROGRAM

The US' first manned space flight project was successfully accomplished in less than five years, which saw more than 2 000 000 people from major government agencies and the aerospace industry combine their skills, initiative and experience into a national effort.

In this period, six manned space flights were accomplished as part of a 25-flight program. These manned space flights were accomplished with complete pilot safety and without change to the basic Mercury objectives.

It was shown that man could function ably as a pilot-engineer-experimenter without undesirable reactions or deteriorations of normal body functions for periods up to 34 hours of weightless flight. Directing this large and fast moving project required the development of a management structure and operating mode that satisfied the requirement to mould the many different entities into a workable structure.

Timeline of the Mercury Program

- October 1, 1958 National Aeronautics and Space Administration (NASA) created

- November 26, 1958 Mercury program announced
- December 4, 1959 Launch of Sam (a monkey) on Little Joe 2
- April 9, 1959 NASA names the seven Mercury astronauts
- January 21, 1960 Launch of Miss Sam (a monkey) on Little Joe IB
- January 31, 1961 Launch of Ham (a chimpanzee) on Mercury Redstone 2
- May 5, 1961 Launch of Alan Shepard in Freedom 7 (suborbital)
- July 21, 1961 Launch of Gus Grissom in Liberty 7 (suborbital)
- November 29, 1961 Launch of Enos (a chimpanzee) on Mercury Atlas 5 (orbital)
- January 3, 1962 Gemini program formally conceived
- February 20, 1962 Launch of John Glenn in Friendship 7, first American human orbital flight
- May 24, 1962 Launch of Scott Carpenter in Aurora 7
- October 3, 1962 Launch of Walter Schirra in Sigma 7
- May 15, 1963 Launch of Gordon Cooper in Faith 7, the final mission of the Mercury program

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. Who was America's first astronaut to go into space?

Q2. Which movie portrays the Mercury program?

Q3. How many manned missions were there in the Mercury program?

ANTICIPATED ANSWERS

A1. Alan Shepard.

A2. *The Right Stuff*.

A3. Six.

Teaching Point 2 **Discuss the Gemini Program**

Time: 5 min Method: Interactive Lecture

Show the cadets the early manned space exploration timeline located at Annex I.

OBJECTIVES OF THE GEMINI PROGRAM

The Gemini program was a necessary intermediate step between the Mercury program and the Apollo program. It had four objectives:

- to subject astronauts to long duration flights – a requirement for projected later trips to the moon or deeper space;
- to develop effective methods for rendezvous and docking with other orbiting vehicles and to manoeuvre the docked vehicles in space;
- to perfect methods of re-entry and landing spacecraft at a pre-selected ground landing point; and
- to gain additional information concerning the effects of weightlessness on crew members and to record the physiological reactions of crew members during longer duration flights.

HISTORY OF THE GEMINI PROGRAM

On May 25, 1961, three weeks after Mercury astronaut Alan Shepard became the first American in space, President John F. Kennedy announced the goal to send astronauts to the moon before the end of the decade. To facilitate this goal, NASA expanded the existing manned space flight program in December 1961 to include the development of a two-man spacecraft. The program was officially designated Gemini on January 3, 1962.

Gemini, to a large degree, was the work of a Canadian – James Arthur Chamberlin of Kamloops, British Columbia, a mechanical engineer educated at the University of Toronto. Having served as the chief engineer for the Mercury program, Chamberlin was selected to be Gemini's Project Manager.

Show the cadets Figure 15J-1.

Gemini was named after the third constellation of the Zodiac and its twin stars, Castor and Pollux, because of its two-man crew.

Show the cadets Figure 15J-2.

Gemini consisted of 12 flights, including two unmanned flight tests of the equipment:

- March 23, 1965 — Gemini III – First manned Gemini flight completed three orbits
- June 03–07, 1965 — Gemini IV – First American Extravehicular Activity (EVA)
- August 21–29, 1965 — Gemini V – First use of fuel cells for electrical power
- December 04–18, 1965 — Gemini VII – First rendezvous in space, with Gemini VI-A
- December 15–16, 1965 — Gemini VI-A – First rendezvous in space, with Gemini VII

Show the cadets Figure 15J-3.

- March 16, 1966 — Gemini VIII – First docking with another (unmanned) spacecraft by astronauts Neil Armstrong and David Scott
- June 03–06, 1966 — Gemini IX-A – Three rendezvous and two hours of EVA
- July 18–21, 1966 — Gemini X – Rendezvoused with target vehicle and EVA
- September 12–15, 1966 — Gemini XI – Gemini record altitude of 1 189.3 km
- November 11–15, 1966 — Gemini XII – Final Gemini flight: rendezvous, docking, EVA

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. Who was the Gemini Project Manager?

Q2. How many astronauts were on a Gemini flight?

Q3. Which astronauts accomplished the first docking with another space vehicle?

ANTICIPATED ANSWERS

A1. James Arthur Chamberlin of Kamloops, British Columbia.

A2. Two.

A3. The Gemini crew of Neil Armstrong and David Scott.

Teaching Point 3 — **Discuss the Apollo Program**

Time: 5 min — Method: Interactive Lecture

Show the cadets the early manned space exploration timeline located at Annex I.

July 20, 1969: “Houston, Tranquility Base here. The Eagle has landed.” were the famous first words spoken from the moon.

OBJECTIVES OF THE APOLLO PROGRAM

The Apollo’s program objectives went beyond landing Americans on the moon and returning them safely to earth. The objectives also included:

- establishing the technology to meet other national interests in space;
- achieving pre-eminence in space for the United States;
- carrying out a program of scientific exploration of the moon; and
- developing man’s capability to work in the lunar environment.

HISTORY OF THE APOLLO PROGRAM

The Apollo program was the work of Owen E. Maynard of Sarnia, Ontario, chief of the systems engineering division in the Apollo Spacecraft Program Office. He was previously chief of the Lunar Module engineering office in the Apollo Program Office at the Manned Spacecraft Center in Houston. Maynard held an aeronautical engineering degree from the University of Toronto. His years at NASA were rewarded on July 20, 1969, when Apollo 11 commander Neil Armstrong stepped out of the lunar module (LM) and took one small step in the Sea of Tranquility, calling it a giant leap for mankind. Maynard remained in charge of Apollo systems engineering until he left NASA in 1970 following the successful achievement of Kennedy's lunar landing goal. Thereafter he returned to private industry.

Show the cadets Figure 15K-1.

The Apollo program used the Saturn family of launch vehicles. The command, service and lunar module made a small package, dwarfed at the top of the giant launch vehicle.

Show the cadets Figure 15K-2.

The command module (CM) was small for three men to spend 8 days, 3 hours and 18 minutes in it. On the *Apollo 11* journey of July, 1969, the three men were Neil Armstrong (commander), Michael Collins (CM pilot) and Edwin (Buzz) Aldrin Jr. (LM pilot).

Show the cadets Figure 15K-3.

Six of the Apollo missions, *Apollos 11, 12, and 14–17*, landed on the moon, studying soil mechanics, meteoroids, seismic activity, heat flow, lunar ranging, magnetic fields and solar wind.

Apollos 7 and 9 tested spacecraft in earth orbit; *Apollo 10* orbited the moon as the dress rehearsal for the first landing. An oxygen tank explosion forced *Apollo 13* to scrub its landing, but the can-do problem-solving of the crew and mission control – and Maynard's systems engineering group – turned the mission into what was called a successful failure.

The 1995 movie *Apollo 13* is based on the story of the 1970 mission to the moon.

Apollo Flight Summary

- October 1968 *Apollo 7* – Earth orbit

- December 1968 *Apollo 8* – Ten lunar orbits
- March 1969 *Apollo 9* – First manned flight of lunar module
- May 1969 *Apollo 10* – Dress rehearsal for Moon landing
- July 20 1969 *Apollo 11* – First lunar landing mission (on the Sea of Tranquility)
- November 1969 *Apollo 12* – Second lunar landing (on the Ocean of Storms)
- April 1970 *Apollo 13* – Mission aborted after an on-board explosion
- January 1971 *Apollo 14* – Third lunar landing (at Fra Mauro)
- July 1971 *Apollo 15* – Fourth lunar landing (in the Hadley Apennine region)
- April 1972 *Apollo 16* – Fifth lunar landing (on the Descartes highlands)
- December 1972 *Apollo 17* – Last lunar landing (on the Taurus Littrow highlands)

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. Which family of launch vehicles were used for Project Apollo?

Q2. Who was chief of systems engineering for the Apollo Project?

Q3. What was the date of Apollo's first manned moon landing?

ANTICIPATED ANSWERS

A1. The Saturn family.

A2. Owen E. Maynard of Sarnia, Ontario.

A3. July 20, 1969.

Teaching Point 4 **Discuss the Russian Manned Space Program**

Time: 10 min Method: Interactive Lecture

The Mir space station, which was shared by Russian cosmonauts and American astronauts, was a continuation of the Soviet space program. Construction of Mir began in 1986, before the Soviet Union was disbanded. Mir was preceded by many years of Soviet space development which included, among many other programs, the Vostok missions, the Soyuz missions and the Salyut space station.

VOSTOK

The Vostok program (Восто́к, translated as "East") was a Soviet human spaceflight project that succeeded in putting a person into earth's orbit for the first time.

Show the cadets Figure 15L-1.

Vostok manned record-breaking flights included:

- April 12, 1961 *Vostok-1* – First man in space (Yuri Gagarin)
- August 6, 1961 *Vostok-2* – First full day in space
- August 11, 1962 *Vostok-3* – First of two simultaneous manned spacecraft
- August 12, 1962 *Vostok-4* – Second of two simultaneous manned spacecraft
- June 14, 1963 *Vostok-5* – Longest solo orbital flight
- June 16, 1963 *Vostok-6* – First woman in space (Valentina Tereshkova)

SOYUZ

The Soyuz program (meaning “Union”) is a human spaceflight program that was initiated by the Soviet Union in the early 1960s. It was originally part of a moon landing program intended to put a Soviet cosmonaut on the moon. Both the Soyuz spacecraft and the Soyuz launch vehicle were part of this program, which later became the responsibility of the Russian Federal Space Agency.

The Soyuz program produced many experimental variants, but its development is commonly divided into three historical parts:

- Early era: *Soyuz-1 to Soyuz-9* (1966–1970),
- Salyut era: *Soyuz-10 to Soyuz T-14* (1971–1985), and
- Mir era: *Soyuz T-15 to Soyuz TM-30* (1986–2000).

Unlike the one-man Vostok spacecraft, the first three-seat Soyuz was able to conduct active manoeuvring, orbital rendezvous and docking. These features would all have been necessary for a flight around the moon or for a lunar expedition. In the early plans for circumlunar flight, the Soyuz was to be a three-part spacecraft assembled in the low-earth orbit from parts delivered by separate launch vehicles. This plan was later abandoned in favour of a two-launch and, later, a single-launch method.

In 1971, a three-seat Soyuz delivered two crews to the first Salyut space station. Disaster struck when the first Salyut crew returned from orbit. The sudden depressurization of the re-entry capsule killed all three cosmonauts. As a result of this tragedy, the designers introduced protective pressure suits, but at the expense of room for one crewmember. Two-seat Soyuz spacecraft then continued ferrying the crews to the Salyut and Almaz space stations.

SALYUT AND MIR SPACE STATIONS

First-Generation Salyut Stations (1964–1977)

First-generation Salyut space stations had one docking port and could not be resupplied or refuelled. The stations were launched unmanned and later occupied by crews. There were two types: Almaz military stations and Salyut civilian stations. To Western observers, both types were Salyut stations, including:

- 1971 *Salyut-1* – First space station (civilian)
- 1973 *Salyut-2* – First Almaz station (military, failure)
- 1974–75 *Salyut-3* – Almaz station (military)
- 1974–77 *Salyut-4* – Civilian space station
- 1976–77 *Salyut-5* – Last Almaz station (military)

Show the cadets Figures 15L-2 and 15L-3.

Second-Generation Stations (1977–1985)

Second-generation Russian space stations included:

- 1977–1982 *Salyut-6* – Civilian
- 1982–1991 *Salyut-7* – Civilian (last staffed in 1986)

With the second-generation stations, the Soviet space station program evolved from short-duration to long-duration stays. Visiting crews relieved the monotony of a long stay in space.

Salyut-6 Key Facts

Highlights of the *Salyut-6* era include:

- The station received 16 cosmonaut crews, including six long-duration crews. The longest stay time for a *Salyut-6* crew was 185 days. The first *Salyut-6* long-duration crew stayed in orbit for 96 days, beating the 84-day world record for space endurance established in 1974 by the last American Skylab crew.
- The station hosted cosmonauts from Hungary, Poland, Romania, Cuba, Mongolia, Vietnam and East Germany.
- Twelve freighter spacecraft delivered equipment, supplies and fuel.

Show the cadets Figure 15L-3 and 15L-4.

Salyut-7 Key Facts

Highlights of the *Salyut-7* era include:

- *Salyut-7*, a near twin of *Salyut-6*, was home to 10 cosmonaut crews, including six long-duration crews. The longest stay time was 237 days.
- Cosmonauts from France and India worked aboard the station, as did the first female Russian space traveller since 1963.
- Thirteen freighter spacecraft delivered equipment, supplies, and fuel to *Salyut-7*.
- Two experimental transport logistics spacecraft, Cosmos 1443 and Cosmos 1686, docked with *Salyut-7*. Cosmos 1686 was a transitional vehicle, a transport logistics spacecraft redesigned to serve as an experimental space station module.
- *Salyut-7* was abandoned in 1986 and re-entered earth's atmosphere, burning up over Argentina in February, 1991.

Mir

Mir was a third-generation Russian space station which, after 1992, was shared with the US.

Mir means peace and community in Russian. The Mir space station contributed to world peace by hosting international scientists and American astronauts. It also supported a community of humans in orbit and symbolized the commonwealth of the Russian people.

Mir was constructed in orbit by connecting different modules, each launched separately from 1986 – 1996. During the Shuttle-Mir Program, Russia's Mir combined its capabilities with America's space shuttles. The orbiting Mir provided a large and liveable scientific laboratory in space. The visiting space shuttles provided transportation and supplies, as well as temporary enlargements of living and working areas, creating history's largest spacecraft.

Show the cadets Figures 15L-5 and 15L-6.

Magnificent to behold through the windows of a space shuttle, *Mir* was as big as six school buses. Inside, it looked more like a cramped labyrinth, crowded with hoses, cables and scientific instruments – as well as articles of everyday life, such as photos, children's drawings, books and a guitar. *Mir* commonly housed three crew members, but it supported as many as six, for up to a month. Except for two short periods, *Mir* was continuously occupied until August 1999.

The journey of the 15-year-old Russian space station ended March 23, 2001, as *Mir* re-entered the Earth's atmosphere near Nadi, Fiji and fell into the South Pacific. Despite its inconveniences, many cosmonauts and astronauts grew to love *Mir*, comparing it to a living being with qualities, needs and eccentricities.

CONFIRMATION OF TEACHING POINT 4

QUESTIONS

Q1. Which Salyut space stations were considered to be second generation?

Q2. What does *Mir* mean in Russian?

Q3. Who were the first man and woman in space?

ANTICIPATED ANSWERS

A1. *Salyut-6* and *Salyut-7*.

A2. Peace and community.

A3. Yuri Gagarin and Valentina Tereshkova, respectively.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. Who was America's first astronaut to go into space?

Q2. When did *Apollo 11* land on the moon?

Q3. Who was chief of systems engineering for the Apollo Project?

ANTICIPATED ANSWERS

A1. Alan Shepard.

A2. July 20, 1969.

A3. Owen E. Maynard of Sarnia, Ontario.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Space exploration has taken great courage and ingenuity on the part of many people. Space exploration and the space race have changed the world for the better through international cooperation and promoting technological advancement.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

(ISBN 978-0-75662-227-5) Graham, I. (2006). *Space Travel*. New York, NY: DK Publishing, Inc.

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