

2018 DECEMBER - 2019 DECEMBER: An Apollo Memorial Year for the Planetary Science Education. I. Ságodi¹, Sz. Bérczi², P. G. Vizi (3)³, M. Szabó⁴, S. Hegyi⁵, ¹Szekszárdi Garay János High School, H-7100 Szekszárd, Szent István tér 7-9. Hungary, (sagodi62@freemail.hu), ²Eötvös University, Faculty of Science, Dept. of Materials Physics, Cosmic Materials Space Res. Group, 1117 Budapest, Pázmány P. s. 1/a. Hungary, (berczisani@caesar.elte.hu), ³MTA Wigner RCP H-1121 Budapest, Konkoly Th. 29-33. (vizi.pal.gabor@wigner.mta.hu), ⁴Petrik Lajos Szakgimnázium, H-1146 Budapest, Thököly út 48-54. Hungary. (dr.szabo.marianna@petrik.hu), ⁵Pécs University, Dept. Informatics, H-7624 Pécs, Ifjúság u. 6., (hegyis@gamma.ttk.pte.hu)

Proposal: We propose a memorial program in teaching planetary science on the 50 years anniversary of historical lunar flights of the Apollo program from the missions 8 to 12. [1] Covering the main events of these 5 Apollo flights between December 1968 and November 1969 we develop enthusiasm for the natural sciences, space science or STEAM project in teaching planetary and space science in high schools, by remembering the main events of Apollo mission before and after the first lunar landing, 50 years ago.

Introduction: During the school year term 1968 DECEMBER -1969 NOVEMBER (12 months) final steps were organized and accomplished at NASA for the lunar landing of Apollo-11 in July, 1969 and in continuing the program the historical visit at Surveyor-3 landing site of Apollo-12 in November 1969.

The LPSC conference is over the 50 years anniversary of first lunar visit of Apollo-8 at the Moon, and the terrestrial maneuver docking programs at Earth orbit of Apollo-9. Anyway, the whole school year term may be used to remember the events of the exciting events 50 years before [2]. This gives an occasion to refresh the memory about these historical events, and teachers may give several comparisons between the technologies, scientific view about the Moon, space science level in planetary research today, and those in the past 50 years ago. Even if the i-phones can be compared to the electronics of Surveyors and Apollos, the great steps forward become visible.

The 50 years anniversary is an excellent occasion to increase the enthusiasm of students in space science, STEAM programs of recent years, planetary science and space technologies. Therefore we shortly overview the 5 successful Apollo flights during that period and attach some points of discussion for teachers on the teaching at the specific missions.

The main events between December 1968 – November 1969 in the Apollo program.

Apollo 8. In December 1968 (bw. 21 and 27.). LUNAR ORBIT. The second 3 astronauts crew carried out a flight first farther than Earth orbit: they went to Lunar orbit and circled the Moon 10 times. The astronauts greeted the Christmas of 1968 from lunar orbit. For teachers it is an occasion to tell about the specific orbit the astronauts used to and back on this lunar mis-

sion. (the 8 shaped orbit). It is also increasing for enthusiasm to speak about the geology of the Moon in search for the landing sites [3].



Fig. 1. Apollo 8 crew at the Moon sees earthrising from lunar orbit (1968, NASA)

Apollo 9. In March 1969 (bw. 3 and 13). EARTH ORBIT. The crew tested the systems of Lunar module, Command and Service modules. It was the first use in flight of the Lunar module. The necessary docking maneuvers and simulations of some lunar landing maneuvers were carried out in a low Earth orbit. The teachers can explain the most important docking steps during the Apollo missions [4].

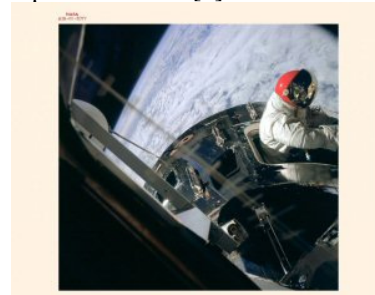


Fig. 2. Apollo 9 at Earth orbit (1969, NASA)

Apollo 10. In May 1969 (bw. 18 and 26). LUNAR ORBIT. The crew tested all maneuvers and all the systems of Lunar module, Command and Service modules on lunar orbit. During the maneuver of descending the astronauts approached the lunar surface for 15 kilometers height, but did not land on it. This mission was the final preparation to the historical lunar landing of the next Apollo mission. Teachers have the occasion to tell episodes about the selection of the landing sites, some historical aspects of lunar stratigraphy compared with that of the Earth, and they can initialize search for students space experiments on the lunar surface.

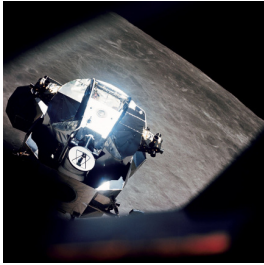


Fig. 3. Apollo 10 at Lunar orbit during a docking maneuver. (1969, NASA)

Apollo 11. In July 1969 (bw. 16 and 24). LUNAR ORBIT, LUNAR LANDING. The crew accomplished a historical flight with first manned landing on the Moon. The astronauts settled the first man-transported basis of measuring instruments, collected samples and returned them to the Earth for the first time. After almost a 1 year of studies the first Lunar Science Conference (LSC) had been organized in Houston. The 50th Lunar and Planetary Science Conference (LPSC) celebrates this historical scientific event. For teachers two main scientific topics are comfortable to explain: The role of lunar samples returned, and the garden of instruments settled on the Moon (Apollo Lunar Surface Instrumental Package – ALSEP) triggers activity of students to plan and build their experiments [5,6,7,8].

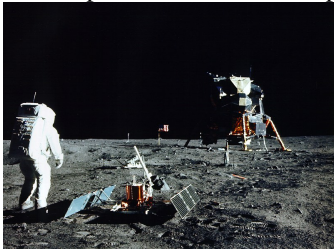


Fig. 4. Apollo 11 on the Moon. Emplacement of the seismic experiment. (1969, NASA)

The 4 main rock types were first collected: basalts (high Ti-basalts), anorthosites, breccias, and the lunar soil [9]. The most important instruments were: seismic (active and passive) thermal, solar wind (low and middle energy range), magnetometer. They can be compared to those instruments on Surveyor missions [5].

Apollo 12. In November 1969 (bw. 14 and 24). LUNAR ORBIT, LUNAR LANDING. The crew accomplished a historical flight by visiting the earlier Surveyor-3 lunar probe (2. soft landing US probe, [10]) with the second manned landing on the Moon.

The second lunar landing demonstrated the capability of landing on exactly the planned surface local point. 150 meter from the Surveyor-3, the astronauts visited the lunar probe and detached its TV camera to deliver it back to Earth. Collecting samples from another type of lunar mare basaltic and picritic rocks, the

first KREEP rock, and Tycho ejecta soil. Settling of the second Apollo Lunar Surface Instrumental Package - ALSEP.

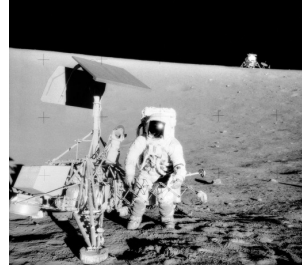


Fig. 5. Apollo 12 on the Moon. Astronauts visit Surveyor 3 space probe. (1969, NASA)

Summary: Teaching science topics through the Apollo historical events [1,2] is an excellent opportunity for the K-10-14 students in the recent school year. They can be introduced to the space technologies [4,5], to material science [3,10], to experimental construction [5,10], to planning creative space experiments [6,7,8] in the schools. The historical goals reached by planetary science gives useful aims and examples to teachers and students to increase their enthusiasm in advancing their studies in science, technology, math and engineering, but mainly in lunar science [11]. May we offer cooperation between schools all over the world to join our program? Observations of the Moon by telescope, construction of space probe models both give practical skills, and students may take first steps also in mapping of strata in the neighbor geological units. In Eötvös University, in Pécs University and in several High Schools we organized programs to increase the interest on these historical steps in science 50 years ago.

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