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Skylab

40th Anniversary

1979-2019 Esperance WA

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Skylab was America's first space station and the world's first big space station.

Skylab could be considered the largest single recycling project ever, as the station itself was made from leftover Saturn 5 and Apollo hardware components. It consisted of five modules:

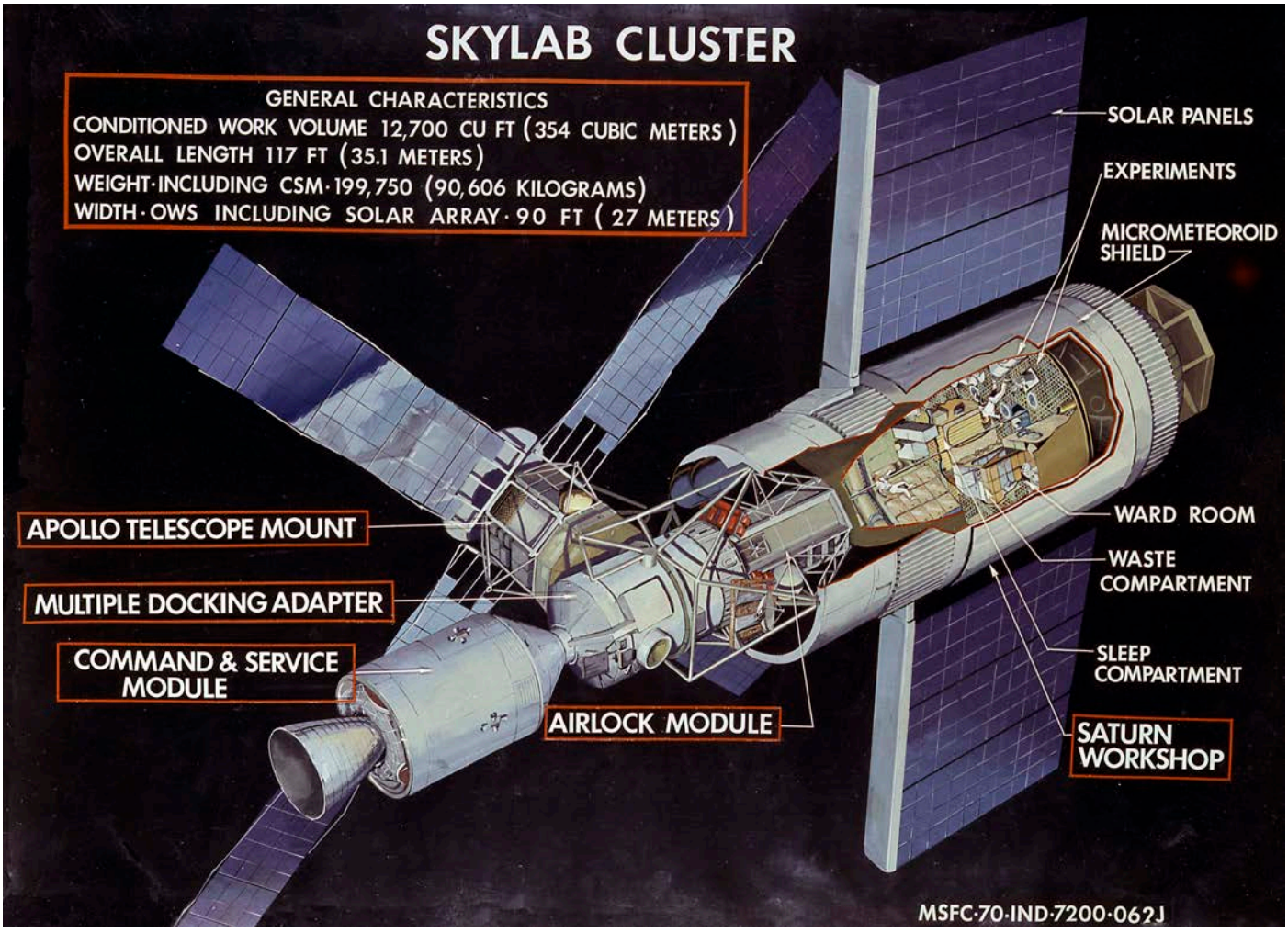
• **Orbital Workshop** - the living and working area for the crew.

• **Airlock Module** - used by the Astronauts to access the outside of Skylab for space walks.

• **Apollo Telescope Mount (ATM)** - attached to one end of the cylindrical workshop. It was used to study our sun, stars and earth with no atmospheric interference.

• **Multiple Docking Adapter** - allowed more than one Apollo spacecraft to dock to the station at once.

• **The Saturn Instrument Unit (IU)** - used by NASA teams in Huntsville to reprogram the space station using a massive ring of computers. The unit was used to guide Skylab itself into orbit. IU also controlled the jettisoning of the protective payload shroud and activated the on-board life support systems, started the solar inertial attitude maneuver, deployed the Apollo Telescope mount at a 90-degree angle and deployed Skylab's solar wings.



This illustration shows general characteristics of the Skylab with call-outs of its major components. Credit: NASA

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What was it like?

Skylab was big! About 36 meters long, 6.7 meters wide and weighed 90.6 tonnes.

Its large interior volume made Skylab spacious and crew had freedom to move

A wire mesh grid separated the interior into a workshop and living quarters, making it the first two-storey space habitat in space.

Launching from NASA's Kennedy Space Centre in Florida on 14 May 1973, it was launched in one piece rather than assembled from modules placed in orbit over years during space orbit.

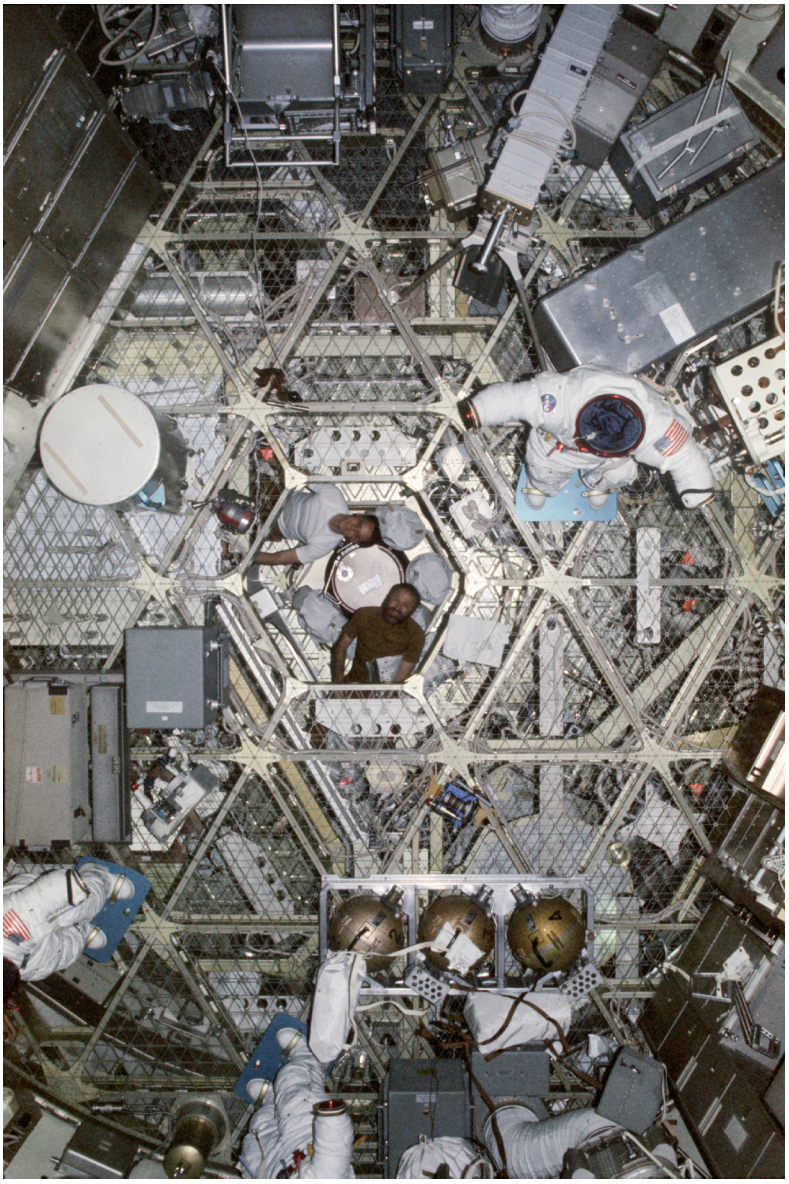
What was Skylab's purpose?

The goals of Skylab were to

- prove humans could live and work in space
- observe the Earth's surface (land and ocean)
- observe Earth's atmosphere
- observe the sun and stars above
- function as a laboratory in earth orbit and carry out medical, engineering, scientific and technological experiments

Skylab's legacy

Skylab will be remembered as an important part of space exploration. It laid substantial groundwork and helped to pave the way for the International Space Station through its science, medical and engineering achievements.



Inside the orbital workshop. Photo taken by astronaut William R. Pogue, Skylab 4 pilot. Astronauts Jerry P. Carr (right), commander, and Edward G. Gibson, science pilot, pose for the snapshot. Credit: NASA

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A Skylab Time Line

During the 1960's work commences on concepts for an orbital workshop and develops into feasibility studies, experiments and designs. During the ensuing years NASA formed an agency at the Marshal Space Flight Centre to focus on development of a manned orbital workshop.

17 February 1970 – NASA announces the approved name "Skylab" for the project that would result in America's first space station. NASA administration selected the name submitted by Lt. Col. Donald Steelman, an Air Force officer on duty with NASA in 1968. "Skylab" was a contraction for "laboratory in the Sky" and was quickly accepted within and outside of NASA.

14 May 1973 – Skylab was launched, unmanned, using a Saturn V rocket. It was the final launch of a Saturn V rocket. The launch is often referred to as **Skylab 1**. 63 seconds into the mission, a micrometeoroid shield accidentally opened. The shield and a solar array tore off, and another solar array was damaged.

Left: This photograph shows the launch of the SA-513, a modified unmanned two-stage Saturn V vehicle for the Skylab-1 mission. Its payload was the unmanned Skylab, which consisted of the Orbital Workshop, the Airlock Module, the Multiple Docking Adapter, the Apollo Telescope Mount and an Instrument Unit. Credit: NASA

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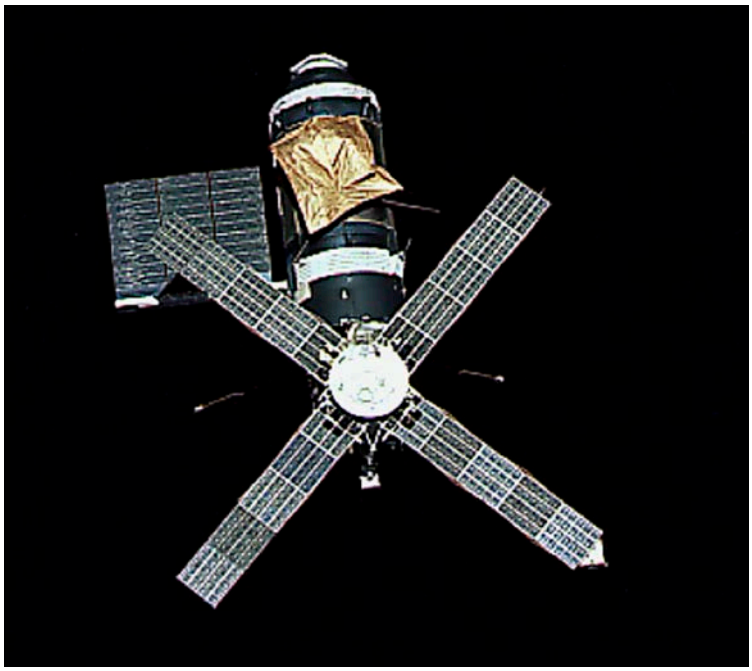
25 May 1973 – Launch of the first manned mission, referred to as **Skylab 2**. The crew consisted of Commander Charles Conrad, Pilot Paul Weitz and Scientist Pilot Joseph Kerwin.

7 June 1973 - Conrad and Kerwin conducted a record-breaking spacewalk to free the jammed solar array. The spacewalk lasted 3 hours and 25 minutes, the longest spacewalk in Earth orbit to that date.

18 June 1973 - the crew broke the 24 day endurance record set by the Soviet Soyuz 11 crew in 1971.

22 June 1973 - the crew returned to Earth after completing 404 orbits around the Earth. The crew were the new record holders for the longest human space flight of 28 days and 50 minutes which included 2 spacewalks totalling 5 hours and 41 minutes.

Left: This image shows astronaut Kerwin cutting the metal strap to free and deploy the Orbital Workshop solar array. Kerwin used special cutting tools developed by engineers at the Marshall Space Flight Center (MSFC). The MSFC had a major role in developing the procedures to repair the damaged Skylab. Credit: NASA



Left: This image of Skylab in orbit was taken by the Skylab-2 crew before departing for Earth. It shows the parasol sunshade, deployed by the crew, protecting the workshop. While unmarned, it operated at reduced power with many of its systems either inoperative or operating at reduced capacity. Credit: NASA

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28 July 1973 – Launch of the second manned mission, referred to as **Skylab 3**. The crew, Commander Alan L. Bean, Pilot Jack R. Lousma and Science Pilot Owen K. Garriott, experienced symptoms of space motion sickness when they arrived on Skylab.

6 August 1973 - Garriott and Lousma deployed a more permanent sun shade over the space station during a 6-hour 29-minute spacewalk, the longest Earth-orbital spacewalk up to that date.

25 September 1973 - the crew returned to Earth after completing 858 orbits around the Earth. The crew were the new record holders for the longest human space flight of 59 days and 11 hours and 9 minutes which included 3 spacewalks totalling 13 hours and 44 minutes.

16 November 1973 – Launch of the third manned mission, referred to as **Skylab 4**. The crew consisted of Commander Gerald Carr, Pilot William Pogue and Science Pilot Edward Gibson.

18 December to 26 December 1973 - a "space first" occurred when the Soviet Union orbited Soyuz 13 with 2 astronauts on board. Although the two spacecraft didn't approach each other or even have the capability to communicate, the three Skylab astronauts and two Soyuz cosmonauts also marked the largest number of people in space at the same time, a record that stood for nine years.

25 December 1973 – Carr and Pogue set a new record for the longest spacewalk at 7 hours and 1 minute.

1 January 1974 – Astronauts Carr, Pogue and Gibson were the first humans to celebrate the New Year in space.

8 February 1974 – the crew returned to Earth after completing 1214 orbits around the Earth. The crew were the new record holders for the longest human space flight of 84 days and 1 hour and 16 minutes which included 4 spacewalks totalling 22 hours and 21 minutes.

Left: Scientist-astronaut Edward G. Gibson has just exited the Skylab EVA hatchway in this frame taken from a roll of movie film exposed by a 16mm Maurer camera. Astronaut Gerald P. Carr, Skylab 4 commander, took this picture during the final Skylab extravehicular activity (EVA) which took place on Feb. 3, 1974. Carr was above on the Apollo Telescope Mount (ATM) when he shot this frame of Gibson. Note Carr's umbilical/tether line extending from inside the space station up toward the camera. Astronaut William R. Pogue, Skylab 4 pilot, remained inside the space station during the EVA by Carr and Gibson. Credit: NASA

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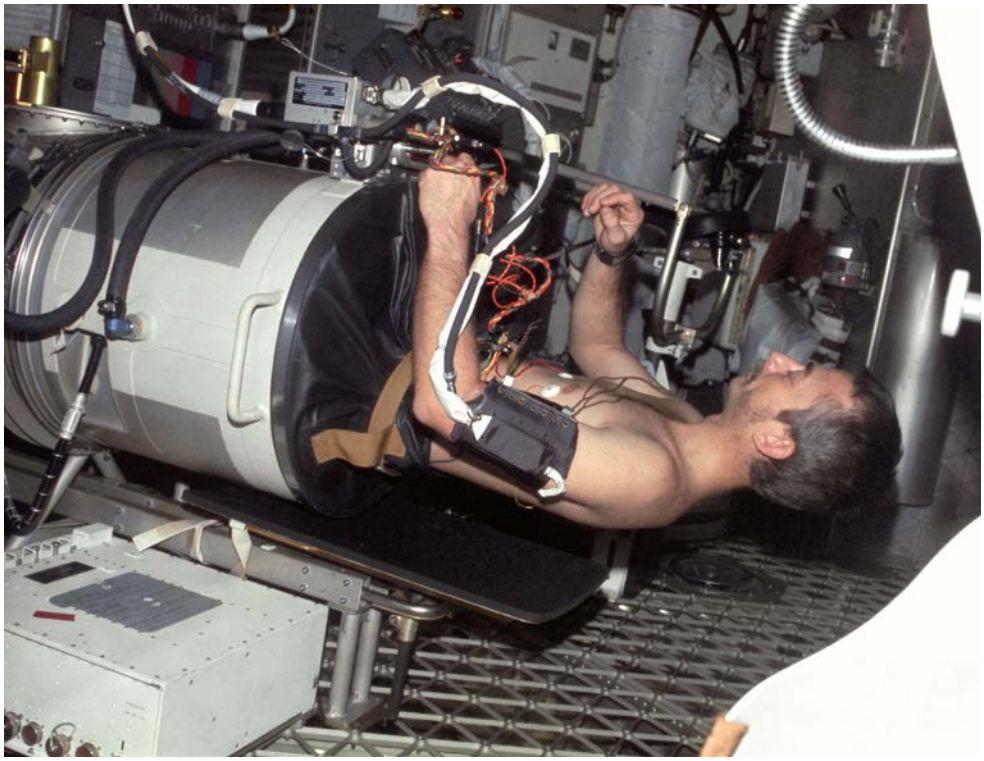

Left: Scientist-astronaut Owen K. Garriott, science pilot of the Skylab 3 mission, lies in the Lower Body Negative Pressure Device. This picture was taken with a hand-held 35mm Nikon camera. The LBNPD (MO92) Experiment is to provide information concerning the time course of cardiovascular adaptation during flight. Credit: NASA

Decommissioning Skylab

Though NASA hoped that the station would remain in orbit for ten years, by 1977, it became clear that it would not be able to maintain a stable orbit for that long. Plans for a shuttle mission to help keep Skylab in orbit failed due to lack of funding and in late 1978 NASA planned to conduct a controlled re-entry to occur in 1979.

In the hours before re-entry, ground controllers adjusted Skylab's orientation to try to minimize the risk of re-entry on a populated area. Examining the data after re-entry, it became apparent that a miscalculation of 4% had shifted the impact zone hundreds of kilometres further east than anticipated.

The debris of Skylab reached Earth, over the Esperance and Balladonia regions at approximately 12:37am on 12th July 1979 (in the USA the time was recorded as 11th July 1979, 12:37pm EDT).

Skylab's demise was an international media event. A San Francisco newspaper offered $10,000 for the first authenticated piece of Skylab brought to its office within 48 hours of re-entry. Esperance local, 17 year old Stan Thornton, found some remains and flew with his parents and girlfriend to San Francisco to collect the prize. Coincidently, the annual Miss Universe pageant was scheduled a few days later in Perth and a large piece of Skylab was displayed on the stage.

While the space station did not have the history of service that NASA initially hoped for, the development, deployment and crewed missions to Skylab were essential to the creation of the International Space Station, which began almost 20 years after Skylab came home.

Skylab Mission Numbering

The official numbering of Skylab missions has the launch of the orbital workshop as Skylab 1; and the three subsequent crew launches are designated Skylab 2, 3, and 4. A parallel, “unofficial” numbering scheme denotes the three crew launches as Skylabs 1, 2 and 3, leaving the OWS launch undesignated. The crew patches follow the unofficial numbering scheme.

In the book *Homesteading Space, a history of the Skylab Program*, the reason for the discrepancy is explained as follows:

The crews initially designed patches around the official 2-3-4 numbering scheme, but when they asked the Skylab Project manager to confirm this numbering, they were told to use 1-2-3.

They then re-designed the patches using the 1-2-3 scheme, had the artwork prepared, and sent it all to headquarters for approval.

The designs were rejected, on the basis that they should use the official 2-3-4 scheme. The crews had begun the process of having artwork prepared for the 2-3-4 scheme, when they were told “not to bother.”

The reason was simply practical: the complete crew provisions of food and clothing for the entire length of the 3 missions were to be stowed aboard the OWS prior to launch. Naturally, this required considerable lead time, and the process had gone ahead without waiting for official approval of the patch designs. So by the time headquarters vetoed the 1-2-3 designs, the clothing (complete with insignia) had already been produced and shipped to the Cape. NASA managers decided that the expense of having it all changed was prohibitive, and so they dropped the matter.

Left: This “Christmas tree” was created by the three crewmen of the third manned Skylab mission (Skylab 4) aboard the space station in Earth orbit. Food cans were used to fashion the tree. This photograph was made from a television transmission made from a video tape recording on Dec. 24, 1973. Credit: NASA

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Skylab Crews

Skylab Crew 1 (Skylab 2 Mission)

Left to right: Joseph P. Kerwin, Scientist; Charles Conrad Jr, Commander; Paul J. Weitz, Pilot. Credit: NASA

Launch: 25 May 1973, 9:00am
Recovery: 22 June 1973, 9:49am
Duration: 28 days, 49 minutes
Distance Travelled: 11.5 million miles
EVA's: 3, totalling 6 hours, 20minutes

Skylab Crew 2 (Skylab 3 Mission)

Left to right: Owen K. Garriott, Scientist; Jack R. Lousma, Pilot; Alan L. Bean, Commander. Credit: NASA

Launch: 8 July 1973, 7:11am
Recovery: 5 September 1973, 6:19pm
Duration: 59 days, 11 hours, 9 minutes
Distance Travelled: 24.5 million miles
EVA's: 3, totalling 13 hours, 43 minutes

Skylab Crew 3 (Skylab 4 Mission)

Left to right: Gerald P. Carr, Commander; Edward G. Gibson, Scientist; William R. Pogue, Pilot. Credit: NASA

Launch: 6 November 1973, 9:01am
Recovery: 8 February 1974, 11:17am
Duration: 84 days, 1 hour, 16 minutes
Distance Travelled: 55.5 million miles
EVA's: 4, totalling 22 hours, 13 minutes

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Skylab Mission Patches

This is the official emblem for the NASA Skylab Program. The emblem depicts the United States Skylab space station cluster in Earth orbit with the sun in the background. Credit: NASA

SL1 Mission patch. The patch, designed by artist Kelly Freas, shows the Skylab silhouetted against the Earth's globe, which in turn is eclipsing the sun, showing the brilliant signet-ring pattern of the instant before the total eclipse. Credit: NASA

SL2 Mission Patch. The symbolism chosen by the astronauts for this patch reflects the primary purposes of Skylab: to study human adaptation to spaceflight and to study the earth and sun from space. It shows an image based on Leonardo da Vinci's Vitruvian Man superimposed on a globe that is half Earth and half Sun. Credit: NASA

Imaged by Heritage Auctions, HA.com

SL2 - The Wives' Patch. A 'first' that was done without the astronauts knowledge. The wives of the crew secretly had an alternate graphic made of a 'universal woman' with their first names in place of the crew's. Stickers with this on them were put in lockers aboard the Command Module to surprise the crew. The artwork for the center of the patch was produced by artist Ardis Shanks, and journalist Jacques Tiziou put together the design and ordered a limited run of 320 patches, apparently from Cape Kennedy Medals.

SL3 Mission Patch. Artwork by Barbara Matelski from the Johnson Spacecraft Center Graphics Department. The triangular emblem features a large number 3 and a rainbow circling three areas of study the astronauts pursued. At the time of the flight, the astronauts issued the following description:

"The symbols in the patch refer to the three major areas of investigation in the mission. The tree represents man's natural environment and refers to the objective of advancing the study of earth resources.

The hydrogen atom, as the basic building block of the universe, represents man's exploration of the physical world, his application of knowledge, and his development of technology. Since the sun is composed primarily of hydrogen, the hydrogen symbol also refers to the Solar Physics mission objectives.

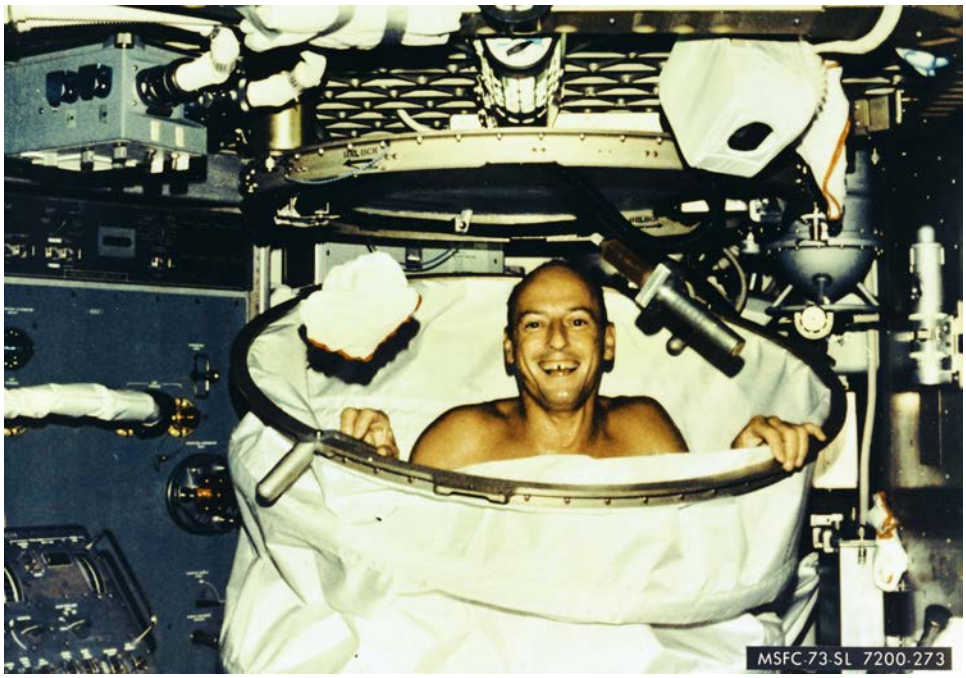
The human silhouette represents mankind and the human capacity to direct technology with a wisdom tempered by his regard for his natural environment. It also relates to the Skylab medical studies of man himself.

The rainbow, adopted from the Biblical story of the Flood, symbolizes the promise that is offered to man. It embraces man and extends to the tree and hydrogen atom, emphasizing man's pivotal role in the conciliation of technology with nature by a humanistic application of our scientific knowledge." Credit: NASA

Interesting Facts

• Crews visited Skylab and returned to Earth in Apollo CSM spacecraft launched by Saturn 1B rockets.

• On 8 June 1973 Astronaut Paul Weitz (not pictured) became the first astronaut to use a space shower. A Skylab shower took about two and a half hours, including the time to set it up and dissipate the used water.



Astronaut Charles Conrad, Jr., Skylab-2 (SL-2) commander, smiles happily for the camera after a shower in the crew quarters of the Orbital Workshop. In deploying the shower facility, the shower curtain was pulled up from the floor and attached to the ceiling. The water came through a push button shower head attached to a flexible hose. Water was drawn off by a vacuum system. Credit: NASA

• While on board Skylab, the typical day of an astronaut included 8 hours of experiment activities; 8 hours for sleeping; 8 hours for general housekeeping, mission planning, eating and off duty functions.

• Entertainment on Skylab consisted of an audio tape player with headsets and 48 tapes to listen to; playing cards; library of 36 paperback books; dart game (with velcro rather than a metal spike); exercise equipment (stationary bicycle and hand exerciser).

• EVA – Extravehicular Activity or “Spacewalks” were mainly for the purpose of changing cameras and film magazines on the telescopes.

• Skylab carried a highly successful computer system (quite a feat for the period of 1973 when practically no computers were flown onboard). Skylab used for the first time the ”off-the-shelf” IBM 4Pi series processors.

• More than 70 different types of food items were packed into Skylab’s freezer and food chests. All of it was taste-tested prior to flight by the crew members so that the food would be familiar. Nutrition, colour, aroma, texture and taste were the criteria used by the food planners.

This photo shows the three members of SL1, during training, eating a meal of specially prepared Skylab space food in the Skylab Orbital Workshop (OWS) trainer at the Johnson Space Center. Credit: NASA

Shown here is the Skylab food heating and serving tray with food, drink, and utensils. The tray contained heating elements for preparing the individual food packets. The food on Skylab was a great improvement over that on earlier spaceflights. It was no longer necessary to squeeze liquified food from plastic tubes. Skylab's kitchen in the Orbital Workshop wardroom was so equipped that each crewman could select his own menu and prepare it to his own taste. Credit: NASA

Comet Kohoutek Experiment

Comet Kohoutek was discovered by Lubos Kohoutek during a search for asteroid images on photographic plates taken in early March1973 at the Hamburg Observatory, in the Federal Republic of Germany.

This early discovery of a large comet in an orbit that would carry it close to the Sun prompted the NASA to initiate "Operation Kohoutek," a program to coordinate widespread observations of the comet from the ground and Skylab. A reschedule in Skylab's mission was undertaken to make best use of this opportunity to permit observations of the comet from Skylab.

A total of 156 hours was dedicated to viewing, astronaut response, and payload optimization, allowing Kohoutek to be monitored in the ultraviolet and visible light ranges regardless of its angular separation from the Sun.

Skylab Student Program

Through the Skylab Student Project, high school students of the United States were given the opportunity to participate in the Skylab scientific program. All students in the ninth through the twelfth grades in all United State's public, private, parochial, and overseas schools were eligible

The Project's purpose was to stimulate interest in science and technology by directly involving secondary school students in a space research program

In October 1971, the National Science Teachers Association, under the auspices of NASA, distributed announcements of the science opportunity and of the method of participating in the Skylab Program.

As a result, over 3,400 proposals for experiments were received. The National Science Teachers Association then selected 25 proposals as the national winners, announcing their names in April, 1972.

The 25 national finalists from 16 states took part in a week of preliminary design review at the Marshall Space Flight Center where they, their parents, and their teacher/sponsors were joined by Skylab scientists, engineers, technicians, and project officials.

After a detailed review by NASA, 19 out of the 25 experiments selected as national winners were approved for Skylab. The NASA review determined that, because of Skylab performance requirements and schedule restrictions, the other six experiments could not be accommodated.

This experiment evaluation and flight selection process involved NASA Skylab personnel from the Marshall Space Flight Center, the Johnson Space Center, and the Kennedy Space Center.

The 19 students whose experiments were selected for research participated closely in the development of necessary experiment instrumentation and in the detailed planning of their investigations including data retrieval and processing, flight planning, and crew training.

After the mission, the students evaluated their data and reported on their experiments. These student experiments, which were handled by Skylab project management in a manner very similar to the handling of main Skylab experiments, reflect remarkable technical abilities.

Every student involved was afforded a unique learning opportunity and contact with the world of scientific research that would have been otherwise impossible. In addition, the general public enjoyed a more personal identification with space exploration through exposure to the enthusiasm of these students.

This photograph is a group shot of the 25 winners in the Skylab student program when they met for the first time at the Marshall Space Flight Center in May 1972. Credit: NASA

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Skylab Summary

Time to orbit Earth	Approx 93 minutes
Orbital distance	42 768 km (26,575 miles)
Total number of days Skylab was in Orbit	2,249
Total number of revolutions of earth	34,981
Total distance travelled (manned)	113.5 million km
Total mission duration (manned)	171 days 13 hours 14 minutes
Number of Revolutions of earth while manned	2476
Total Extravehicular Activity (EVA or spacewalks)	41 hours 46 minutes
Housekeeping activities	560.9hrs
Physical training and personal hygiene	642.9 hours
Manned Solar viewing time	941.3 hours
Number of Biomedical investigations	922
Number of Engineering/technology investigations	245
Number of Material/space manufacturing investigations	32
Number of Astrophysics investigations	345
Number of Student experiment investigations	52
Number of Science demonstrations	11
Number of Solar observations	175,047 frames
Number of Earth observations	46146 frames
Length of Magnetic Tape	72725m

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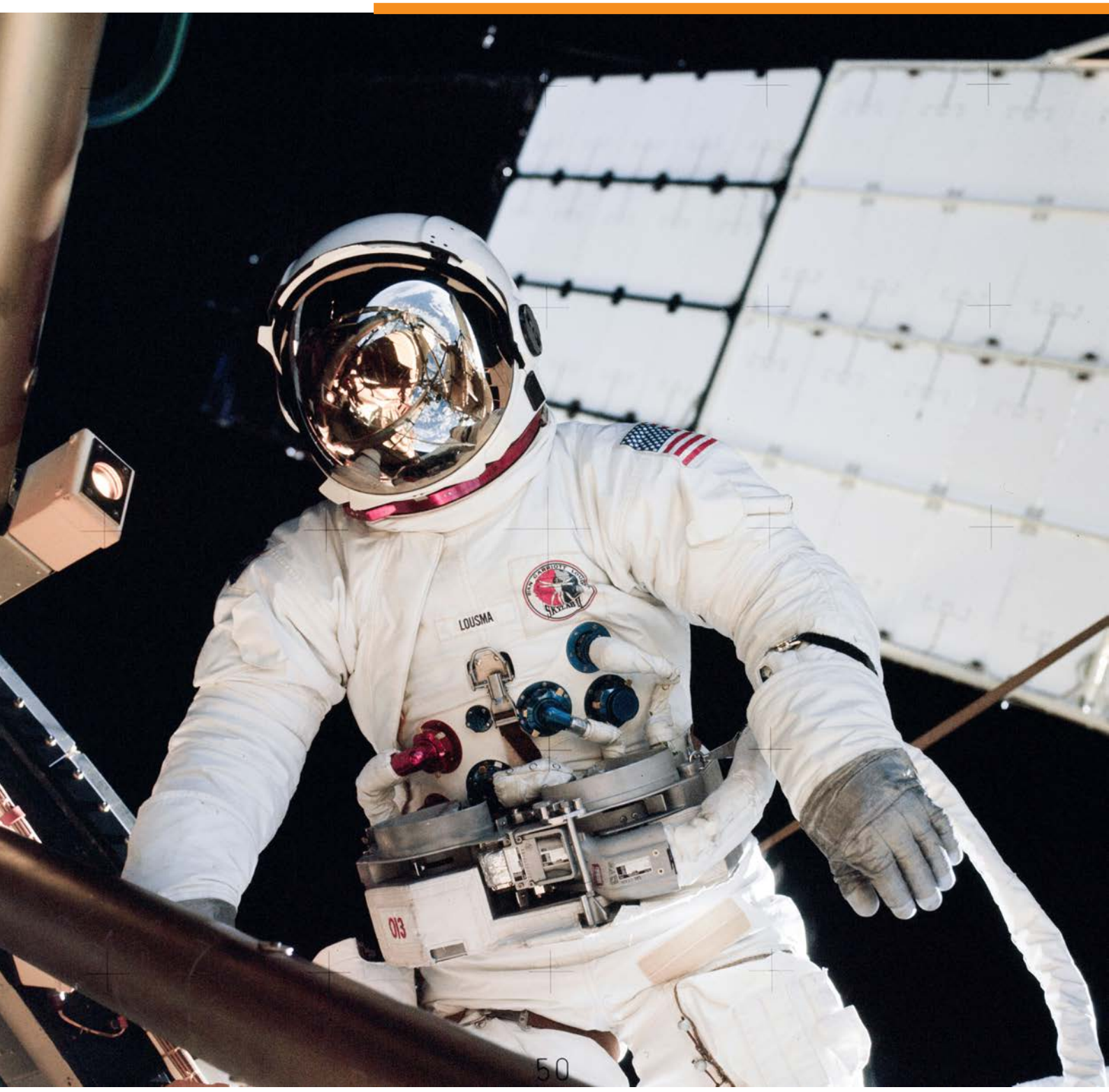

Above: Astronaut Jack R. Lousma, Skylab 3 pilot, participates in the Aug. 6, 1973, extravehicular activity (EVA) during which he and astronaut Owen K. Garriott, science pilot, deployed the twin pole solar shield to help shade the Orbital Workshop (OWS). Note the striking reflection of the Earth in Lousma's helmet visor. This photograph was taken with a 70mm hand-held Hasselblad camera. Credit: NASA

Resources:

https://history.nasa.gov/
https://www.nasa.gov/mission_pages/skylab
https://history.nasa.gov/EP-107/ch5b.htm
http://www.aerospaceguide.net/spacestation/skylab.html
https://earth.esa.int/web/eoportal/satellite-missions/s/skylab
https://phys.org/news/2015-06-history-nasa-skylab-america-space.html
http://www.armaghplanet.com/blog/skylab-everything-you-need-to-know.html
https://genedorr.com/patches/IndexSk.html

Books - accessed through https://archive.org/

Skylab: the story of man's first station in space, by Cromie, William J, Publication date 1975
Skylab: pioneer space station, by Holder, William G., 1937-, Publication date 1974

This resource booklet was compiled by the Esperance Museum in 2019.

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