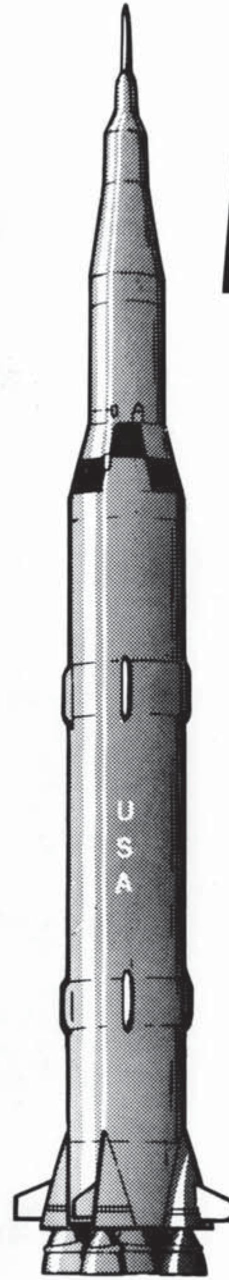
Apollo Mission Events Sequence

Event	Time hr:min:sec
Range zero—13:32:00 GMT, 16 July 1969	
Liftoff	00:00:00.6
S-IC outboard engine cutoff	00:02:41.7
S-II engine ignition (command)	00:02:43.0
Launch escape tower jettison	00:03:17.9
S-II engine cutoff	00:09:08.3
S-IVB engine ignition (command)	00:09:12.2
S-IVB engine cutoff	00:11:39.3
Translunar injection maneuver	02:44:16.2
CSM/S-IVB separation	03:17:04.6
First docking	03:24:03.1
Spacecraft ejection	04:16:59.1
Separation maneuver (from S-IVB)	04:40:01.8
First midcourse correction	26:44:58.7
Lunar orbit insertion	75:49:50.4
Lunar orbit circularization	80:11:36.8
Undocking	100:12:00.6
Separation maneuver (from LM)	100:39:52.9
Descent orbit insertion	101:36:14.6
Powered descent initiation	102:33:05.2
Lunar landing	102:45:39.9
Egress (hatch opening)	109:07:33.0
Ingress (hatch closing)	111:39:13.0
Lunar liftoff	124:22:00:8
Coelliptic sequence initiation	125:19:36.0
Constant differential height maneuver	126:17:49.6
Terminal phase initiation	127:03:51.8
Docking	128:03:00.0
Ascent stage jettison	130:09:31.2
Separation maneuver (from ascent stage)	130:30:01.0
Transearth injection maneuver	135:23:42.3
Second midcourse correction	150:29:57.4
CM/SM separation	194:49:12.7
Entry interface	195:03:05.7
Landing	195:18:35.0



APOLLO 18

MISSION TO THE MOON™

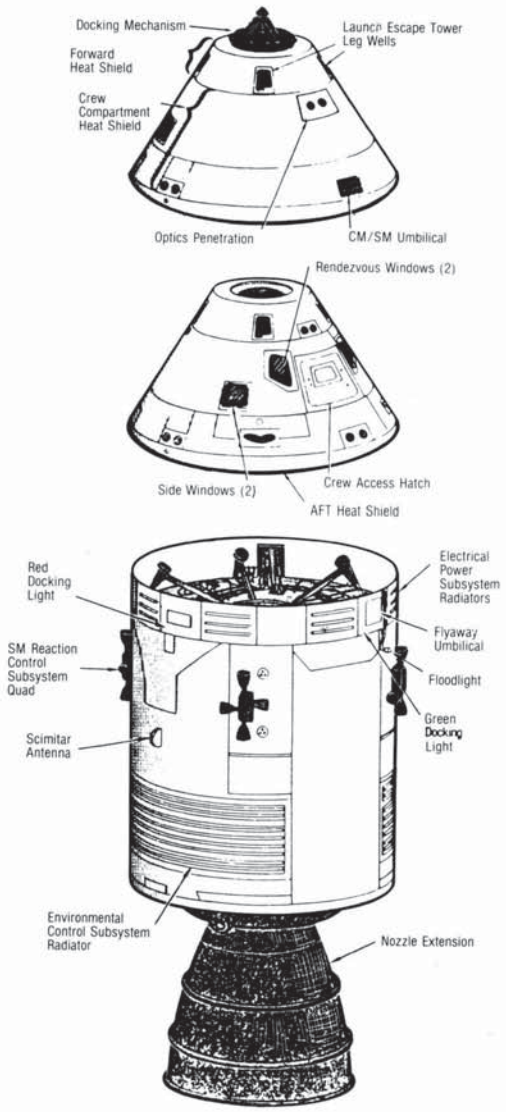
by

ACCOLADE™

Commodore 64/128

Designed by Artech Digital Entertainments, Inc.

Apollo Command/Service Modules



You are cordially invited to attend
the departure of the
United States Spaceship Apollo 18
on its voyage around the moon,
departing from Launch Complex 39A,
Kennedy Space Center.

r.s.v.p. *The Apollo 18 Crew*

INDEX

Credits

Design:	Rick Banks
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Producer:	Jon Correll

APOLLO 18: *MISSION TO THE MOON*

INTRODUCTION

The Apollo missions were one of the largest peace time undertakings of mankind.

The Apollo project spanned nearly a decade, involved billions of dollars and hundreds of thousands of people.

It accomplished untold advances in science and technology. It captured, held and inspired the emotions, imaginations and thoughts of the entire planet. It will be remembered forever.

It is our hope that this game sparks some interest in the space program — past, present and future. Libraries and bookstores are full of materials for those who are interested in learning and experiencing more than this disk can provide.

Designed and implemented by Artech Digital Entertainments, Inc.
Published exclusively by Accolade, Inc.

DOCKING

- Goal is to undock and redock the Command Module (CM) to the Lunar Module (LM).
- Use the joystick (left/right, up/down) to keep the approach vehicle centered on the cross hairs.
- Use the fire button to decelerate from the approaching vehicle.
- Your approach must be accurate and with a minimum velocity to be successful.
- Your score is based on the total time taken for a successful docking as well as the number of attempts, accuracy of the docking and velocity of the CM at docking.

MID-COURSE CORRECTION

- Goal is to fire rockets to correct course.
- Several mid-course corrections must be performed at various times during your journey to the moon.
- Your on-board computer will give you a count down from five to one. At the count, press AND HOLD DOWN the fire button to fire the engines.
- There will be a computer-calculated burn while the engines fire.
- Watch the burn panel carefully — when the numbers start to roll, RELEASE the fire button to shut down the engines. This will prevent over-correction. You are scored on your reaction time — release as soon as possible.
- Should numbers appear in the error overflow (over-correction) window, the burn will have to be repeated to get back on course.

LUNAR LANDING

- Goal is to land on the moon.
- There are three landing site approach windows. You will always start with site one.
- Use the joystick (left/right) to maneuver the lunar module in the OPPOSITE direction (joystick left makes the craft maneuver to the right).
- Use the fire button or joystick (down) to decrease the effects of your downward momentum (braking engine).
- Be sure to watch your altitude indicator, and to land with a minimum velocity.
- Your are scored on:
  - Your ability to stay on course (the green line between the red corridor lines)
  - The number of burns required (the fewer the better)
  - The time taken (the faster the better)
  - Velocity at landing (the slower the better)
- If you stray outside the corridor, the on-board computer will take over and abort you from the current window (score is lessened). You will be given the opportunity to try a different window (landing site), but only three windows in total. After that the craft crosses the terminator into darkness behind the moon with insufficient fuel to attempt further landings.

MOON WALK

- Goal is to reach the Surveyor III.
- Use the fire button to take your first jump.
- Lean forward to gain speed (joystick right).
- Lean back before you land (joystick left).
- If you land leaning too far forward for your current speed you will fall. The speed bar will be red if your lean is too far forward or backward to land without falling.
- You can gain height and speed by leaning back a little before you land. Leaning back too far for your current speed will result in a fall.
- Use the joystick (up/down) to keep on course (see the map lower left). If your position indicator is green you are on course. If it is red you are not.
- If you do stray too far off course you must stop, turn around and go back until you are again on course.
- You must make it back to the lunar module before you run out of oxygen.
- Your score is based on the time taken to complete the mission and total number of falls.

SPACE WALK

- Goal is to test the capture procedure on three satellites.
- Use the fire button to launch a satellite.
- Once elapsed time begins to count, use the joystick to accelerate in any direction.
- Use the up/down cursor key to move in and out of the screen.
- The graph at the lower left shows the three dimensions — the satellite is located at the center of the graph where the three lines meet. Each of the moving dots on the graph represents you in one of the three dimensions. When all of the dots are GREEN you are in capture range.
- To capture the satellite:
  1. FACE THE SATELLITE (¾ view, joystick up/left)
  2. PRESSING THE SPACE BAR will turn "ON/OFF" your "space hook".
- Now use the joystick (all directions) in order to line the end of your hook up with the rotating spot on the satellite. PRESS the fire button to capture.
- If you miss or the satellite drifts out of range, press the space bar to put away the hook and allow you to move around.
- When a satellite is captured press the space bar. Then travel off screen towards the CM.
- You are scored on the time/number of attempts taken for each satellite (number of times fire button was pressed while hook was out)

RE-ENTRY

- Goal is to get down to Earth without burning up.
- Press fire button to begin descent.
- Use joystick (all directions) to keep cross on "eight ball" centered. The more time the "eight ball" is off center, the higher the temperature rises. If your CM temperature rises above 5000 degrees F., your crew will perish.
- You are scored on your ability to maintain course.

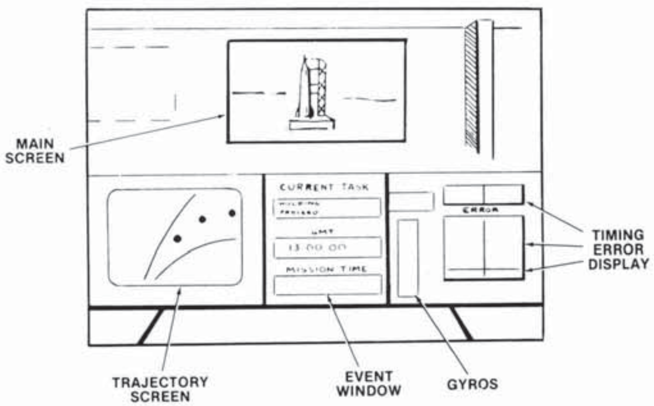
MISSION CONTROL

[day 1 00:00:00]

LAUNCH SCREEN

The player finds himself at the NASA Flight Director's control panel in the Mission Control Room.

LAUNCH · MISSION CONTROL



At "T-15 and holding" TELEM flashes in the status window. Type "T" to view the telemetry computer screen. Pre-launch sequences are initiated on the telemetry screen which displays the running status of all the on-board systems.

THE MISSION CONTROL TELEMETRY SCREEN:
Telemetry signals constantly echo all the instruments, systems and general vehicle readiness of both the rocket and the capsule. Cursor arrow up/down key move to the next highlighted selection on the display. Hit return to cycle through the various options (the correct one for the moment will be displayed in green). After all pre-launch sequences are completed the status at the bottom turns from "NO GO" to "GO". Fire button exits at any time after pre-launch completion.

FLIGHT CONTROL SYSTEM:
The Instruments Unit (IU) inertial guidance system was responsible for guidance and control during all phases of powered flight. As part of the pre-launch (T-17 secs) the guidance reference system and gyros platform had to be checked and reset.

PROPELLANT SYSTEM:
Hit the fire button to begin the complex sequence of purging and flushing out the tanks, pre-pressurizing, filling and final pressurization of the propellant itself. Ninety percent of the rocket's weight is fuel — 3,500 gallons per second is consumed, from a total of 534,000 gallons on board.

ENGINES:
Set engines from OFF to SYNChronized, to READY for ignition.

PROPULSION SYSTEM
Liquid oxygen (LOX) and liquid helium (LOH) in the tanks were pressurized at low temperatures. Sequencing turns on the Propellant Utilization system (PU) and the Auxilliary Propulsion System (APS) and displays the current status of the tanks.

PU: With two kinds of liquid propellant, designers wanted both tanks to run dry at the same time — residual amounts in either would subtract from the accuracy and stability of a desired trajectory or orbit. The PU system continuously monitored the conditions of the propellant in each tank and controlled the mixture ratio.

APS: The Auxilliary Propulsion cluster System during powered flight controlled the roll, pitch and yaw of the rocket.

HYDRAULICS SYSTEM:
The various pressure pumps were engine driven, electrical or auxilliary backup in nature.

ELECTRICAL SYSTEM:
Consisted of several 26-volt DC cells. The system could be switched to backup batteries, restore power procedures or main.

ACCELEROMETERS:
Measured different accelerations and stresses in parts of the rocket due to varying thrust from the engines, vibrations, turbulence and fuel imbalances.

THE STATUS LINE:

The current status is displayed as "GO" or "NO GO". If "NO GO" is displayed something has not been done in pre-launch or a fault has been detected in the equipment telemetry signals.

Beyond merely monitoring or pinpointing an equipment fault, the computer screen readout could indicate not only that a fault existed, but also the nature of the problem, its causes and possible solutions. When a problem occurs you will be informed via a message at the bottom of the screen and how to correct the problem using the controls and inputs on the telemetry screen.

LAUNCH:

At "T-15 and holding", "GO" flashes in the status window. Press the fire button to initiate the launch sequence "starting countdown". At precisely 8.9 seconds after ignition the five F-1 engines are generating 7.5 million pounds of thrust or the equivilent of 180 million horsepower. When the rocket is a mere three-quarters of an inch off the ground, the umbilical cables are retracted. If something goes wrong from this point on, the launch cannot be scrubbed. The engines reach 6,000 degrees Farenheit.

DURING LAUNCH:

The time-critical sequence of firing and jettisoning stages and the execution of various maneuvers is controlled by you. As each event in the sequence is encountered the red bar at the top of the timing error display begins to move. Hit the fire button when the bar reaches the center line. As each event is announced in the status window, the bar timing event is invoked. The maneuvers are divided into three groups of four. The accumulated error is shown as a sum at the bottom of the timing error display (in green) at the end of each group.

Try to keep the total error as close as possible to zero. For example, if the running error is −40 (the player was early overall on the events), the next timing error should compensate by +40 to reduce the error average to zero.

If the error is very small then the rocket is on schedule, on course and its position is plotted on the trajectory screen — centered in the flight path. The three divisions and the center line represent the ideal trajectory at each of the three stages. If the timing error is large then the rocket's course becomes dangerously steep or low and it strays from its planned trajectory path. Its altitude or velocity may be too low or it may not have enough fuel left to reach orbit (or even the next stage). The flight must be aborted.

GYROS:

After the vehicle clears the tower and performs the roll maneuver, the first stage is shut down and jettisoned. At stage two "GUIDANCE" flashes in the status window. With the path adaptive guidance on manual override, you control the analog flight computer. Center the gyros heading by bringing the red line to the center of the display and keeping it there as accurately as possible. The gyroscope is controlled by the joystick (left/right). A warning alarm sounds if the heading has strayed dangerously off course. Should the alarm sound be ignored the mission will be aborted.

Maintain the course heading at or near zero. At Max Q, the period of most intense atmospheric buffeting, the craft will feel most unstable. During the third stage, most of the oscillations will smooth out.

ABORT:

During launch type "**A**" at any time to enter the abort screen.

If a launch must be aborted, "ABORT" will flash in the status window. Press return to begin the sequence. If an abort occurs during the first stage, press the escape tower ejection system, for the astronauts must be blown first. Press return to start the sequence. "OK" appears when done. Move to the next sequence in the list. Once the Command Module with the astronauts is safely clear (OK) cut the engines (OK) before the Propulsion Dispersion System (PDS) explosives destroy the rocket and disperse the fuel into the atmosphere.

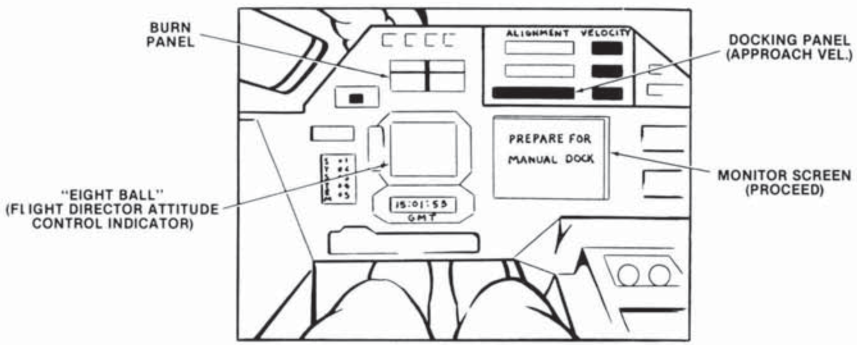
Non-critical aborts on the launch pad before ignition constitute scrubbed launches. Low altitude abort to orbits accur when the vehicle's thrust, fuel or altitude are too low to attain proper parking orbit. Abort to orbit means that you must proceed to the separation from the LM and S-IV-B third stage, re-entry splashdown and recovery to bring the astronauts back safely.

DECISION TO GO TO THE MOON

[day 1 01:26:00]

Once in a safe parking orbit, the command/service module makes several revolutions of the Earth while checking out the system — both for damage from the launch and for system readiness on the next phase. If there is sufficient fuel and no significant damage then the orbit is examined to determine its orbital characteristics. Calculations are made to compute the time and duration for re-igniting and shutting down of the third stage. The decision to go to the Moon has been made.

"COMMAND MODULE"



On the CM screen you will receive a yellow caution and "PROCEED" message on the monitor warning that you are coming up on systems checkout and Trans Lunar Injection (TLI) burn — go to the telemetry screen by typing "T".

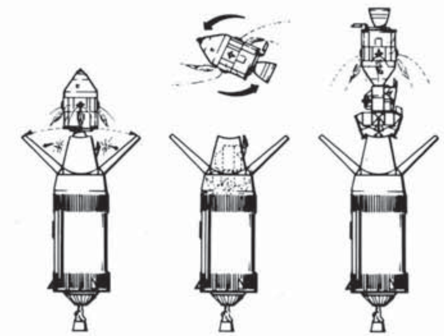
PROG #	ACTION and monitor echoes
1	CM/SM/LM system checkout Prepare for TLI

Once on the telemetry display screen you should begin by initiating program #1 which is a startup sequence for an auto checkout of both the Command and Service modules. To initiate a program enter the number on your keyboard followed by return.

PROG #	ACTION and monitor echoes
3	Fire S-IV-1 B TLI maneuver Shutdown S-IV-1 B

If there are no problems or damage then the status is GO and program #3 should be selected in preparation for re-igniting stage three. If there is a problem then the fault will be pinpointed and you will be directed to several possible solutions and sequences to follow in the event of an emergency.

The 200,000 pound thrust S-IV-B third stage fires briefly to take the rocket to a higher orbit in preparation for TLI. After achieving a speed of over 25,000 mph, escape velocity is reached and Apollo frees itself of the Earth. Communications with Earth are blacked out for the duration of the burn. The third stage is shut down.



DOCKING

[day 1 1:58:42]

Once the S-IV-B stage placed the spacecraft on a trajectory to the Moon, the LM adapter panels would blossom outward 45 degrees. The Apollo command and service modules would separate from the third stage, pull away, turn around, dock with the lunar module, and then pull the LM away from the stage.

PROG #	ACTION and monitor displays
23	Open adapter panels says "opening" (separation says "firing S-RCS" Watch from the window as program 23 rotates the command module and lines it up for docking with the service and lunar modules)
44	Extend probe (says "probe extended". The probe was used as a guide during the docking procedures)

The intricate maneuver of rotating 180 degrees until the nose of the spacecraft is head to head with the LM and in position for the docking, begins by selecting the program in the sequence. Program 23 initiates the move, opening out the panels like blossoms and firing the small Reaction Control System rockets of the Service Module (S-RCS) to separate and move away.

Finally the craft is rotated a full 180 degrees by the pre-docking auto sequence maneuver. "Proceed" to the telemetry screen and extend the probe.

The player is informed on the CM monitor that the probe is extended and the sequence is switched to "Manual" control. The monitor displays the docking "X" (vertical) and "Y" and approach velocities are displayed on docking control panel.

Use the joystick, like the astronauts' attitude control stick, to fire the rocket thrusters. Left and right gives yaw left or right. Pushing the joystick forward or pulling back gives the pitch up and down. Press the fire button to slow your ever-accelerating approach to the other vehicle.

Keep the approach velocity and the X, Y velocities low so as not to damage the LM on contact nor bump it and push it erratically into an unstabilized spin. Using too much fuel may jeopardize upcoming correctional maneuvers and even the mission itself. If either craft has been damaged then the warning panel will flash and the player should do a checkout of the system on the telemetry display screen.

If the approach velocity is too great the on-board computer may kick in and abort the docking. If the computer must abort more than three times or if too much fuel is expended the computer system will take over and the remainder of the mission will be altered to compensate for this failure.

If no problems exist then proceed with the securing of the system and removal of the LM. The CM monitor gives a "Proceed" when the LM is free and both the third stage and adapter have been jettisoned.

PROG #	ACTION AND monitor display
87	Lock the 12 latches and secure all systems
54	Pull LM out of the third stage and dump the stage LM adaptor
56	Burn SM to de-orbit. Use SM reactions control system

Once a successful docking has been made, the latches between the CM and LM are secured and the CM is used to gently pull the LM out of its resting place inside of the third stage. The third stage is now dumped, as well as the adaptor that had held it into space. The modules that will make the journey to the Moon are now properly positioned, checked out and the mission is ready to leave Earth orbit and go to the Moon.

MIDCOURSE CORRECTION

Day 1 [04:43:00]

About three or four hours after TLI has been made, a critical phase begins — the midcourse correction. Although the craft may be only a fraction off course this inaccuracy will be greatly magnified over the tremendous distance to the moon. Also the moon is a moving target so the craft must be put on a course to arrive at a point in space where the Moon will be in several days.

The Moon itself is a satellite. The Earth's speed of 67,000 mph relative to the Sun, the Moon's speed relative to the Earth (2,300 mph) as well as Apollo's slowest coasting speed of 3,000 mph between the two bodies — makes the timing of hitting this moving target critical!

If the computed correction is minor then the S-RCS is fired. If the correction is significant then the main propulsion system is employed. Choose program 98.

PROG #	
98	Midcourse correction

The CM monitor displays the midcourse correction timing screen.

Press the fire button when ready to begin. Wait for the exact moment when the craft approaches the window. The countdown to the window will be displayed on the CM monitor "Mark 5 . . . 4 . . . 3 . . . 2 . . . 1".

PRESS AND HOLD the fire button when the computer says "FIRING" at the exact calculated position in the flight path. As soon as that point has passed you must shut down the engines or risk over-correcting. The digits measure the response time. As soon as the 000 digit counter (on the burn panel) begins to move RELEASE the fire button. The digit counter stops moving. Its current reading is your timing reponse. If the error is insignificant then the in-flight alignment check displays "ON COURSE" on the monitor.

The window for this correction is critical. The timing error must be less than 300 or you will be directed to try this maneuver again. Any amount greater than 300 will be displayed in the overflow register of the burn panel. The amount of fuel used is being monitored as well as the number of attempts.

[day 3 51:40:40]

The second course correction is made in the same manner as before, as Apollo is approaching the Moon. Select program 99 on the telemetry command screen. The CM monitor screen announces that the SM-RCS (small reaction control system) is firing.

CM Prog #	ACTION
99	Lunar correction, second course correction S-RCS
12	OI firing SM propulsion system.
13	LO circularization then fire descent engine

Once the correction has been successfully made, the amount of fuel remaining is examined to determine if there is a "GO" for Lunar Orbit Insertion. (LOI)

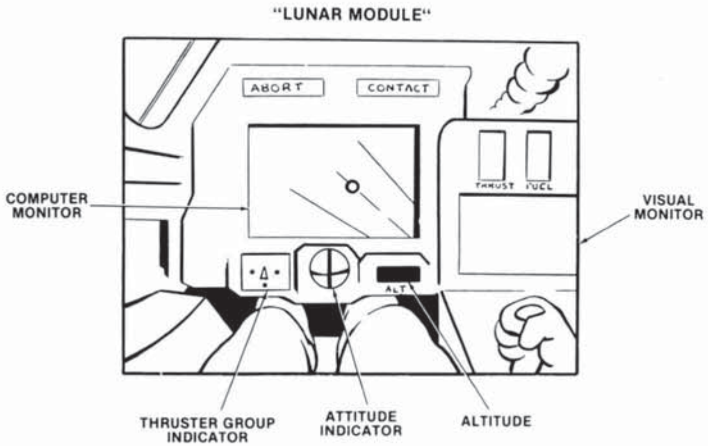
At approximately 200,000 miles from the Earth "GO FOR LOI" gives a go ahead for selecting program 12 — firing the Service Module main propulsion system engines. The gravitational attraction of the Moon is now stronger that distant Earth's and Apollo plunges quickly towards the moon.

At 80 miles above the Moon, Apollo fires the braking descent engine, decelerates and goes into a neat low circular orbit.

Apollo is now behind the Moon and radio contact is lost.

[day 3 69:28:00]

Apollo makes three revolutions of the Moon while ground trackers monitor the orbit and the movements of the craft. "GO" for lunar module descent is given as the craft approaches the first of several possible landing sites. Site 1 -Littron; Site 2 - Tranquility; Site 3 - Descartes. The astronauts enter the LM and begin the power-up sequence and system check readout. The LM screen gives a proceed and the yellow warning lights direct you to the telemetry screen.



The LM has two stages. The descent stage and the ascent stage for blast off. The descent stage will provide the blast-off platform and will be left behind on the Moon.

LM PROG #	ACTION
2	Power-up seq LM
4	Close CM hatches
34	Deploy LM landing gear
21	Undock detach LM/CM, LM reaction control sys
11	Inspect LM

If the power up sequence gives a GO status, then program 4 is executed to close the hatches and secure the system prior to separation. The craft is now operational and the various lights and dials are animated.

Program 21 detaches the LM from the CM/SM "FIRING REACTION CONTROL SYSTEM". The LM is inspected by the CM (it rotates around twice) and a "GO" is given if there are no problems. Any problems (e.g., gear not deployed despite computer message) will be dealt with on the LM telemetry screen.

LM PROG #	ACTION
33	Fire descent engine. Powered Descent Initiation (PDI) Turn on landing radar
24	Manual Highgate
97	CONTACT checkout LM for damage (if no prob GO)

Program 24 turns the control system on to "MANUAL" — visual for descent. "HIGHGATE" on the LM monitor is performed at the highest point on the approach to the landing site. Like a jet approaching the airport a nose-down operation to see the lunar surface is performed. This indicates that you should prepare to fire the braking engine and enter the descent path.

The re-entry trajectory is a cone shape defined by red lines on either side. The green line in the center indicates the "ON COURSE" ideal path. Try to stay on course and make as few corrections as necessary to save fuel.

The retro rockets thrust in the direction that the joystick is positioned. Joystick left fires the left engine cluster moving the craft to the RIGHT. Joystick right fires the right cluster of thrusters moving the craft to the LEFT. Pressing the fire button, or joystick down, slows the craft down if it is descending too fast, by firing the braking engine. Enough lift will slow its vertical descent velocity to zero. Continuing to hold the fire button down after this will cause its velocity to be negative and the craft will ascend.

Try to stay on the green line and make contact at or near zero velocity in both the vertical and the horizontal planes. As well as being on target, the landing has to be gentle. If the LM's total velocity is less than 50, the LM will not incur damage. If it is between 50 and 100, the LM will incur some damage. If more than 100, the LM will crash.

Too much velocity in the horizontal plane means that Apollo lands with a high speed which may damage the landing gear or push the craft over on its side. The craft could land at up to a 30 degree angle and still be able to perform the blast off. A very high impact velocity means that the LM will crash land. A very high vertical velocity implies that the craft has too much forward motion and drags across the ground ripping its undercarriage.

If at any point the LM gets outside of the red limiting lines of the descent cone, as displayed on the monitor screen, you must abort the landing.

Three landing sites are available, in order of importance. If the first landing at *Site 1* is aborted, the onboard computer will take Apollo to a safe height. Mission control computes a new landing site window based on the in-flight coordinates and the next site (2 or 3) is approached. Begin descent. After *Site 3* has been passed the LM passes the terminator and enters darkness on the far side.

Lunar landing after three attempts has to be aborted. Apollo will be instructed to fire the ascent engine and begin tracking the CM on the rendezvous radar. The status screen presents the astronaut's performance and system status on the landing.

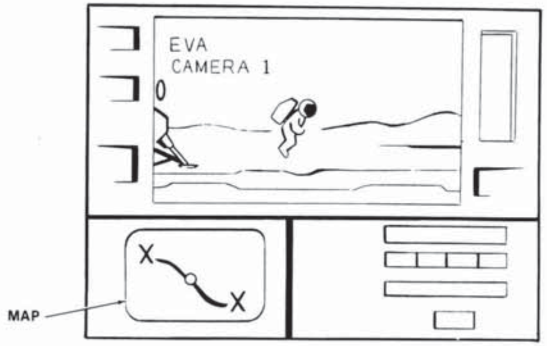
[day 4 80:20:20]

If a safe landing has been made and the LM and systems are performing properly then the astronauts get a "GO" for the Moonwalk. "PROCEED" on the monitor directs the player to the telemetry screen to depressurize the cabin and open the hatches. The egress sequence also makes the antennae and camera systems operational.

LM	PROG #	ACTION
	22	Egress sequence Depressurize cabin (before egress onto Moon's surface) Open hatch (Erect antennae - start cameras)

The object of the Extra Vehicular Activity (EVA) Moonwalk was to perform certain scientific operations and medical experiments on the astronauts themselves or in some cases to perform a mission-specific task. One of these tasks was to locate the Surveyor III.

"MOON WALK"



The course starts at the LM and ends at the landing site of the Surveyor III, an early picture-taking robot that had soft landed on the Moon in April, 1967. Parts of the Surveyor were taken back to Houston where a thorough inspection proved that it had never been struck by a meteor during its lunar stay. (The Intrepid LM actually landed only 600 feet away from the Surveyor!)

The map at the lower left of the screen displays the path that you (green dot, left side) must follow to safely reach the Surveyor III at the far right side.

If the astronaut is on course then the dot remains green. The dot turns red if you stray too far off course. The other displays are distance covered, oxygen remaining, and energy being used. The speed display has a four-color bar; blue (the slowest), green, yellow and red (fastest).

The Moonwalk is performed by pressing the fire button and moving the stick in the direction to move. As the astronaut jumps up in the air, move the stick forward (right) to tip him forward. This will increase his speed. As he descends,

tip him backward (left) to insure that he does not land too far forward and fall. Lean back a bit to give momentum and height to the next jump. If the astronaut is too far forward (or back) to land safely at the current speed, the speed bar will turn red. The velocity is shown as well as the aerobic energy level and subsequent oxygen used by the astronaut. If the motion is smooth and rhythmic, then the leaps will increasingly become higher and farther each time. Efficient motion uses less oxygen and optimizes the speed. The gravity of the Moon is one-sixth that of Earth's so expect some surprises! (A 150-pound man weighs only 25 pounds

The joystick (up/down) is used to keep the astronaut on the path. If the astronaut strays off course, then the position indicator on the map will turn red. The astronaut must retrace his steps until he is back on course.

This EVA locomotion experiment was termed the "Bunny Walk" in the press. Problems, or an abort EVA on this screen might include sudden radio detection of solar flare activity (announced by Houston Control) which would require the astronaut to put his newly learned skill to an immediate practical test by having to get back to the relative safety of the LM as fast as possible.

The status screen is presented at the end of the EVA and displays the performance of the astronaut.

Once the EVA has been completed *Program 25* repressurizes the cabin and secures the systems, selected on the telemetry screen.

LM	PROG #	ACTION
	25	Repressurize after ingress says "pressurized"

[day5 105:21:59]

Once inside the LM, all systems must be checked thoroughly and prepared for launch. This is a critical point in the mission. The redundancy safety factor (two of everything) did not exist for the ascent engine systems. There was no backup. The systems must fire perfectly or the astronauts remain forever marooned on the Moon. Set the Ascent stage to ON to get the LM Ascent stage telemetry operational.

If a "GO" is received then PROCEED to *Program 34* to enable blast off of the non-throttle ascent engine. On the LM monitor screen the message "ALIGNED" appears just before blast off when the Command Module is in position above the lunar surface. The various phases of the launch pitch are announced on the LM screen as the blast is in progress. The altitude and Moon's scrolling surface give an indication of the relative velocity as the vehicle lifts off.

LM	PROG #	ACTION
	34	Prepare LM for blast off Blast off Moon - align guidance says "ALIGNED" Straight up 10 seconds main ascent engine 50 degrees pitch over climbing angle

Once in lunar orbit the LM tracks the CM on the rendezvous radar to determine its position (350 miles away) and eventually a visual sighting can be made. Both crafts are being tracked by Earth stations. This is accomplished by initiating Program 56.

LM	PROG #	ACTION
	56	CM coelliptic sequence initiation
		Rendezvous radar on
		Now tracking CM
		CM and LM aligned - radar lock (on CM rendezvous radar
		Differential height maneuver
		Visual sighting of the red beacon

Docking is accomplished in the same manner as before once the auto "ALIGNED" message is given on the LM monitor.

LM	PROG #	ACTION
	66	Manual dock with CM

Once "DOCKED" appears, the system must be locked and secured. Program 78 deactivates the LM.

PROG #	ACTION
78	Open 12 latches
	Deactivate LM
	Power down sequence executing

Once safely in the Command Module, initiate the return home sequence below. System readiness and data exchanges with Earth are performd. In the darkness behind the Moon the Service Module Main Propulsion system fires (eating four tons of propellant) and Apollo breaks free of the Moon. Apollo is in Earth Orbit Insertion (EOI) phase.

PROG #	ACTION
79	Jettison LM ascent stage
	Align for EOI
	De-orbit SM propulsion system

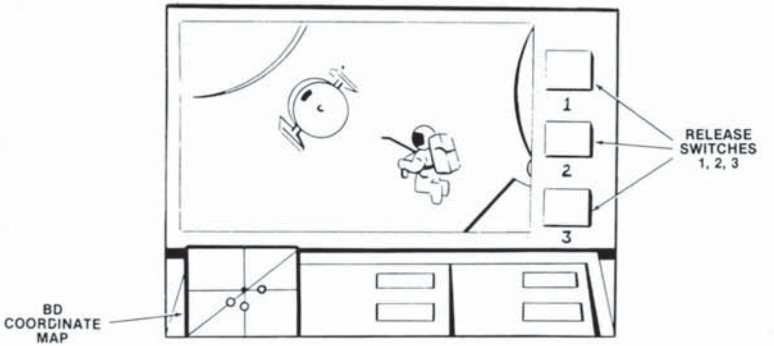
[day 7 136:00:00]

Spacewalks were performed as a routine function on the return home to either place satellites in orbit around the Moon (Apollo 15) or to retrieve the film canisters on the outside of the CM and SM. EVA experiments were done to test the astronaut's ability to launch, capture and retrieve satellites in space for repositioning or repair if necessary.

The panel displays the satellite release bay switches, the game timer, jet pack fuel remaining, the current satellite number and the number of attempts the astronaut has made with the grappling stick to ensnare the object. The

coordinate system at lower left shows the satellite (depicted as a yellow dot) centered in a three-dimensional display on an X, Y, Z axis. The astronaut's position is in all three dimensions. A position guide is given as a red dot on each axis.

"SPACEWALK"



The red flashing light below the satellite release switch indicates satellite ready. When you hit the fire button the light changes to green. The timer is set to zero and the satellite appears. You should first adjust your Z position using the left/right cursor key to move out towards the satellite (away from CM) and the up/down cursor key to move in towards the satellite (closer to CM). The Z dot on the coordinate system changes to green when the player is in range. Once lined up, all adjustments are made in the X and Y axis only.

When the satellite is released the digital counter begins and measure the astronaut's retrieval time. Move slowly toward the floating satellite (fire button depressed and joystick in the direction to move) at the same speed and in the same direction as the satellite.

When the astronaut is positioned at 11 o'clock (three quarters view facing left away from the player!) hit the space bar. A stick-like gaff appears and is used to catch and stabilize the spinning satellite — touch the purple spot near the nose of the spinning satellite (move the joystick around to control the arm movements) and THEN press the fire button to "catch" the object. The astronaut then moves it away off screen.

If the player "misses' or the satellite moves out of reach then the player must hit the space bar again to retract the stick and activate the jet pack. The astronaut cannot manipulate the stick and the jet pack at the same time.

This procedure is repeated three times and the performance time is tallied. The status screen at the end of the EVA compiles the results for the player.

The sequence of pressurizing and depressurizing the cabin is outlined below.

CM PROG #	ACTION
34	Depressurize cabin "DEPRESSURIZED" Open hatch Repressurize cabin "REPRESSURIZED"
35	Depressurize cabin "DEPRESSURIZED" Open hatch (gets in) Repressurize cabin "REPRESSURIZED"

[day 7 138:30:00]

Ten hours after EOI, the first course correction was computed and executed in the same exacting fashion as the Moonward mid-course corrections. Choose Program 37 to execute the maneuver.

CM PROG #	ACTION
37	Mid-course corrections 1 & 2

[day 9 199:00:00]

At 2,500 miles from the Earth and two hours before re-entry, the second and final course correction is made. Program 12 executes the sequence of firing. Next the SM itself is jettisoned after the spin-up operation. Spinning up the craft (much like a bullet spirals from the barrel of a gun) greatly increases the accuracy of an aim. The target in this case is the Earth re-entry window. Program 33 to jettison SM.

CM PROG #	ACTION
12	Final course correction Spin up
33	Jettison SM

The re-entry corridor was a narrow 300 mile wide and 40 mile deep cone shape. If the approach angle was not exactly right then one of two possibilties existed. If the angle was too steep then the abrupt deceleration in the ever-thickening air would crush the Apollo craft and cause it to burn up. If the angle of descent was too high then they would miss the re-entry window and skip off the atmosphere into space in a perpetual circular orbit around the Sun.

Unlike the early, slower-moving craft, Apollo did not make a direct re-entry. Instead it intentionally skipped off the atmosphere several times to decelerate more slowly.

Program 89 fires the C-RCS to zero the angle for re-entry. "Manual" puts you in control of the CM. When "PROCEED" is given, go for re-entry check and initiate the Earth landing systems and heat shield. If no faults exist, re-entry begins.

CM PROG #	ACTION
89	CM reaction control system - set angle attitude re-entry Switching to manual sequence
99	Checkout heat shield, chutes

The object of re-entry is to keep the CM on course and at a set angle to the re-entry. This angle was only between 5.5 and 7.3 degrees.

If the angle is not maintained as the craft skips in and out of the atmosphere then the danger exists that the CM will burn up or that the heat shield itself may be damaged. At seven miles per second the temperature could soar to 5,000 degrees Fahrenheit (twice the speed of the earlier Ranger craft). The ionization imposes a complete radio blackout and all communication with the craft is lost for the next two minutes.

To keep Apollo oriented, the "eight ball" gyro of the CM (flight director attitude control indicator) must be maintained in the center of the display. Joystick left and right for horizontal movements — up and down for vertical positioning. The vibrations will increase and decrease as the tiny ship bounces in and out of the atmosphere starting at 400,000 feet. The heat shield is automatically jettisoned once the final re-entry phase has been reached.

At 24,000 feet the monitor directs the astronauts to start the last series of events for splashdown and recovery. Program 90.

CM PROG #	ACTION	
90	Fire drogue chutes	@ 24,000 feet
	Pilot chutes	@ 11,000 feet
	Main chutes	@ 10,000 feet
	Turn on beacon	

After re-entry the status screen is displayed with the performance and mission score to date.

The final status score gives the overall Mission Success Score and itemizes the main events. The splashdown and subsequent recovery sequence depends on the re-entry performance and the overall Mission Success Score.

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APOLLO MANNED MISSIONS

1967 JAN. 27 APOLLO 1:
Gus Grissom, Edward White, Roger Chaffee
Fire inside spacecraft during ground testing resulted in death of astronauts

1968 OCT. 11 APOLLO 7:
Wally Schirra, Donn Eisolo, Walt Cunningham
163 orbits
10 days, 20 hours
— *First Apollo Earth Orbit Mission*

1968 DEC. 21 APOLLO 6:
Frank Borman, James Lovell, William Anders
10 lunar orbits
6 days, 3 hours
— *First Manned Orbit of Moon*

1969 MAR. 3 APOLLO 9:
James McDivitt, David Scott, Ruccol Sohwoiokart
151 orbits
10 days, 1 hour
— *First Test of Lunar Module (Earth Orbit)*

1969 MAY 18 APOLLO 10:
Thomas Stafford, Eugene Sernan, John Young
31 lunar orbits
8 days
— *First test of Lunar Module (Lunar Orbit)*

1969 JULY 16 APOLLO 11:
Neil Armstrong, Buzz Aldrin, Michael Colins
22 hours on the moon
2 hours, 35 minutes EVA
— *First Manned Lunar Landing!*

1969 NOV. 14 APOLLO 12:
Pete Conrad, Richard Gordon, Alan Bean
32 hours on the moon
7 hours, 45 minutes EVA
— *Second Lunar Landing - Returned Parts of Surveyor III*

1970 APRIL 11 APOLLO 13:
James Lovell, Fred Naise, Jack Swigert
5 days, 22 hours, 53 minutes
— *Aborted Mission - Safe Return of Crew*

1971 JAN. 31 APOLLO 14:
Alan Shepard, Stuart Ronsa, Edgar Mitchell
34 hours on the moon
0 hours, 24 minutes EVA
— *Collected 96 lbs. of Lunar Soil*

1971 JULY 26 APOLLO 15:
David Scott, Alfred Warden, James Irwin
67 hours on the moon
18 hours, 35 minutes EVA
— *First Use of Lunar Rover*

1972 APRIL 16 APOLLO 16:
Charles Duke, Ken Mattingly, John Young
71 hours on the moon
21 hours, 15 minutes EVA
— *213 lbs. of Lunar Rocks*

1972 DEC. 7 APOLLO 17:
Eugene Sernan, Ronald Evans, Harrison Schmitt
76 hours on the moon
23 hours, 12 minutes EVA
— *Last Manned Trip to the Moon*
243 lbs. Lunar Samples Returned to Earth

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