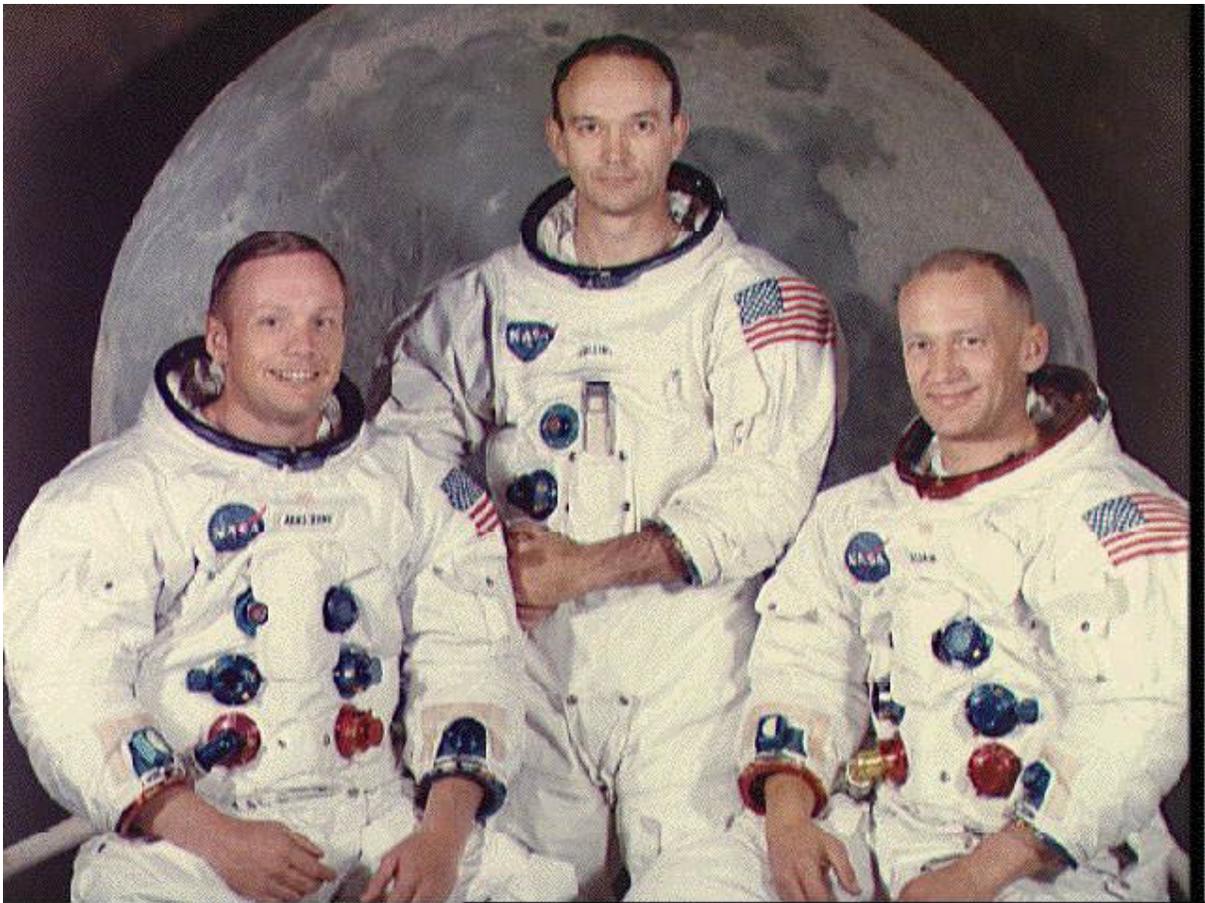


The Apollo 11 Mission

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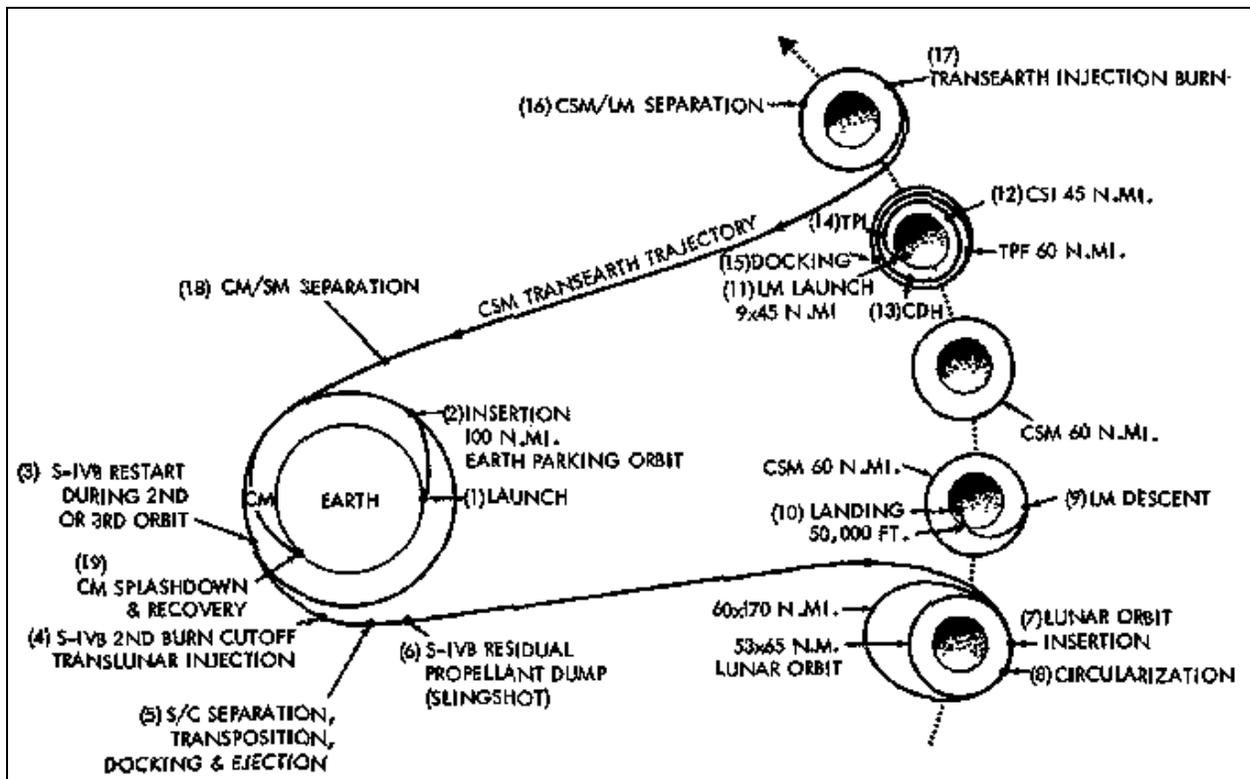
Crew

Mission Commander Neil Alden Armstrong
Command Module Pilot Michael Collins
Lunar Module Pilot Edwin Eugene Aldrin, Jr.

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Acknowledgments & Notes

- 1) All illustrations are published by NASA unless otherwise credited.
- 2) Supplemental information is obtained from Apollo By The Numbers, © 1996, Richard W. Orloff at URL
<http://www.floridatoday.com/space/explore/manspace/apollo/orloff.htm>
- 3) All distances are measured in statute miles (mi) units.
- 4) All speeds are measured in statute miles per hour (mph) units.
- 5) "Height" is distance from the earth's (assumed by default) or moon's center, minus the pertinent equatorial radius. "Altitude" is distance above an ellipsoid approximating earth's figure at mean sea level or distance above the lunar landing site.
- 6) Apogee/perigee and apocynthion/pericyynthion are maximum/minimum heights with respect to the earth and moon, respectively. Maximum/minimum heights for a spacecraft launched from the moon are related by apolune/perilune values.
- 7) "Speed" is magnitude of inertial velocity with respect to the earth's (assumed by default) or moon's center.
- 8) "Flight path angle" and "heading" pertain to inertial velocity referenced to true north in a local horizontal plane whose normal points from the earth's (assumed by default) or moon's center.



Apollo 11 Mission Summary

8 January 1969

LM #5 *Eagle* components begin arriving at KSC.

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15 January 1969

CSM #107 *Columbia* components begin arriving at KSC.

19 January 1969

Saturn IVB stage #506 arrives at KSC.

6 February 1969

Saturn II stage #6 arrives at KSC.

20 February 1969

Saturn IC stage #6 arrives at KSC.

5 May 1969

Spacecraft mating to launch vehicle is complete.

20 May 1969 EDT

12:30 PM launch vehicle and spacecraft leave the VAB aboard MLP #1.

07:30 PM launch vehicle and spacecraft arrive at LC-39A.

25 June 1969

Saturn IC RP-1 kerosene fueling is complete.

10 July 1969 EDT

08:00 PM countdown begins with first computer check of launch vehicle and spacecraft systems.

13 July 1969 EDT

05:00 AM countdown is suspended for a built-in hold.

09:00 PM countdown resumes.

14 July 1969 EDT

05:00 PM T-028:00 final countdown begins.

05:30 PM T-027:30 launch vehicle flight battery installation and LM cabin stowage activities commence.

09:30 PM T-023:30 launch vehicle flight battery installation is complete.

12:00 M T-021:00 LM super critical helium top-off operations begin.

15 July 1969 EDT

02:00 AM T-019:00 LM super critical helium top-off is complete.

05:00 AM T-016:00 launch vehicle range safety checks begin.

06:00 AM T-015:00 LM cabin stowage and launch vehicle range safety checks are complete.

09:30 AM T-011:30 installation of launch vehicle destruct devices is begun. CM pre-ingress preparations commence.

10:15 AM T-010:45 installation of launch vehicle destruct devices is complete.

11:00 AM T-010:00 service tower begins move from LC-39A.

12:00 N T-009:00 countdown is suspended for a built-in hold.

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11:00 PM T-009:00 countdown resumes. Pad A is cleared for launch vehicle cryogenic propellant loading.
11:30 PM T-008:30 backup crew arrives at CM for prelaunch checks.
11:45 PM T-008:15 launch vehicle cryogenic propellant loading begins.

16 July 1969 EDT

02:43 AM T-005:17 flight crew begins prelaunch preparations.
04:30 AM T-003:30 countdown is suspended for a built-in hold.
06:02 AM T-003:30 countdown resumes.
06:28 AM T-003:04 crew enters transfer van at the MSOB.
06:48 AM T-002:44 crew arrives at Pad A.
06:54 AM T-002:36 crew begins CM ingress.
07:25 AM T-002:07 CM hatch is sealed.
07:32 AM T-002:00 CM atmosphere begins transition to 60% oxygen; 40% nitrogen composition.
07:37 AM T-001:55 MCC spacecraft command checks begin.
07:42 AM T-001:50 abort advisory system checks begin.
07:46 AM T-001:46 space vehicle EDS test is performed.
08:02 AM T-001:30 booster protective cover is placed over the CM hatch.
08:32 AM T-001:00 final systems checkout begins.
08:37 AM T-000:55 white room crew begins Pad A departure.
08:49 AM T-000:43 320-ft-level walkway is partially retracted.
08:50 AM T-000:42 LES is armed.
08:52 AM T-000:40 final launch vehicle range safety checks commence.
08:57 AM T-000:35 final launch vehicle range safety checks are complete.
09:02 AM T-000:30 launch vehicle power transfer test is performed. LM is placed on internal power.
09:12 AM T-000:20 LM operational instrumentation powerdown begins.
09:17 AM T-000:15 CSM is placed on internal power.
09:22 AM T-000:10 LM operational instrumentation powerdown is complete.
09:26 AM T-000:06 space vehicle final status checks are performed.
09:27 AM T-000:05 320-ft-level walkway is fully retracted.
09:28:50 AM T-000:03:10 Launch Director activates the automatic sequencer.
09:30 AM T-000:02 launch vehicle propellant tanks begin pressurization.
09:31:10 AM T-000:00:50 launch vehicle is transferred to internal power.
09:31:43 AM T-000:00:16.968 launch vehicle is placed on internal guidance.
09:31:51 AM T-000:00:08.9 Saturn IC ignition sequence begins.
09:31:54 AM T-000:00:06.04 Saturn IC ignition.
09:31:58 AM T-000:00:01.6 all Saturn IC F1 engines running.
09:32:00 AM T+000:00:00.3 hold-down arms are released.
T+000:00:00.63 latitude = 28.4470° N, longitude = 80.6041° W, altitude = 0.037 mi, flight path angle = 0.06°, heading = 90°, speed = 914.1 mph, weight = 6398535 lbs. Soft release mechanism is deactivated. Saturn V liftoff.
09:32:01 AM T+000:00:01.7 tower clearance yaw maneuver is initiated.
09:32:09 AM T+000:00:09.7 tower clearance yaw maneuver is complete.

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09:32:13 AM T+000:00:13.2 Saturn IC engines clear LC-39A tower. Control is switched from KSC to MSC. Launch vehicle begins pitch maneuver and roll from 90° azimuth.

09:32:31 AM T+000:00:31.1 launch vehicle attains flight azimuth = 72.058°. Roll maneuver is complete.

09:33:06 AM T+000:01:06.3 altitude = 4.875 mi, range = 1.201 mi, speed = 1379.9 mph. Launch vehicle attains local sonic speed.

09:33:23 AM T+000:01:23.0 maximum dynamic pressure = 735.17 lbs/ft² encountered.

09:34:15 AM T+000:02:15.20 altitude = 27.344 mi, range = 28.847 mi, speed = 4426.9 mph. Saturn IC center engine shutdown.

09:34:40 AM T+000:02:40.0 pitch maneuver complete.

09:34:41 AM T+000:02:41.63 altitude = 41.084 mi, range = 58.148 mi, speed = 6183.1 mph. Saturn IC outboard engines shutdown.

09:34:42 AM T+000:02:42.30 altitude = 41.461 mi, range = 59.061 mi, speed = 6205.0 mph, weight = 1454014 lbs. Saturn IC jettison.

09:34:44 AM T+000:02:44.0 Saturn II ignition.

09:35:12 AM T+000:03:12.3 Saturn II aft interstage jettison.

09:35:17 AM T+000:03:17.9 LES jettison.

09:35:24 AM T+000:03:24.1 Initiate IGM.

09:36:59 AM T+000:04:59.1 maximum Saturn IC altitude.

09:39:40 AM T+000:07:40.62 altitude = 111.948 mi, range = 692.399 mi, speed = 12767.4 mph. Saturn II center engine shutdown.

09:41:03 AM T+000:09:03.70 latitude = 30.212° N, longitude = 74.038° W, range = 410.9 mi. Estimated Saturn IC splashdown.

09:41:08 AM T+000:09:08.22 altitude = 116.392 mi, range = 1005.650 mi, speed = 15471.0 mph. Saturn II outboard engines shutdown.

09:41:09 AM T+000:09:09.00 altitude = 116.430 mi, range = 1008.716 mi, speed = 15477.0 mph, weight = 367053 lbs. Saturn II jettison.

09:41:12 AM T+000:09:12.2 weight = 366957 lbs. Saturn IVB ignition.

09:41:21 AM T+000:09:21.0 Saturn IVB ullage case jettison.

09:41:47 AM T+000:09:47.0 maximum Saturn II altitude.

09:43:39 AM T+000:11:39.33 altitude = 118.763 mi, range = 1636.361 mi, speed = 17428.4 mph, weight = 299586 lbs. Saturn IVB shutdown.

09:43:49 AM T+000:11:49.33 latitude = 32.672° N, longitude = 52.6941° W, altitude = 118.733 mi, range = 1680.940 mi, flight path angle = 0.012°, heading = 88.848°, speed = 17432.59 mph, weight = 299562 lbs, apogee = 115.5 mi, perigee = 113.8 mi, period = 88.18 min. Earth parking orbit insertion at 32.521° inclination.

09:43:59 AM T+000:11:59.3 maneuver to local horizontal attitude is initiated.

09:52:13 AM T+000:20:13.7 latitude = 31.535° N, longitude = 34.844° W, range = 2729.4 mi. Estimated Saturn II splashdown.

12:16:16 PM T+002:44:16.20 speed = 17427.4 mph. Saturn IVB ignition for a 5 min 46.83 sec TLI burn.

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12:22:03 PM T+002:50:03.03 speed = 24251.1 mph, inclination = 31.386°. Saturn IVB shutdown.

12:22:13 PM T+002:50:13.03 latitude = 9.983° N, longitude = 164.8373° W, height = 207.809 mi, flight path angle = 7.367°, heading = 60.073°, speed = 24235.6 mph, apogee = 338792.6 mi, perigee = 140.2 mi. TLI into an earth free-return trajectory. Earth splashdown at latitude = 14.9° S, longitude = 174.9° E would occur about 10:37 AM EDT on 22 July with only SM RCS burns if the free-return option is exercised.

12:22:23 PM T+002:50:23.0 Saturn IVB initiates LVLH attitude hold.

12:26 PM T+002:54 height = 589 mi, speed = 23116 mph.

12:31 PM T+002:59 height = 1432 mi, speed = 21283 mph.

12:37:03 PM T+003:05:03.9 Saturn IVB initiates maneuver to spacecraft separation attitude.

12:39 PM T+003:07 height = 2742 mi, speed = 18716 mph.

12:41 PM T+003:09 Saturn IVB attains spacecraft separation attitude.

12:47:23 PM T+003:15:23.0 height = 4390.442 mi, speed = 17019.9 mph. CSM separates from the SLA at 1 mph relative speed with 3.3-sec RCS burn.

12:56:03 PM T+003:24:03.7 height = 6119.4 mi, speed = 15451.7 mph. CSM docks with LM.

01:01 PM T+003:29 SM high gain antenna is deployed.

01:49:03 PM T+004:17:03.0 docked spacecraft is ejected from Saturn IVB at 1 mph.

02:12:01 PM T+004:40:01.72 SPS ignition for a 2.93-sec evasive burn, imparting $V = 13.4$ mph and placing the spacecraft a safe distance from the Saturn IVB when it performs its propellant dump to target lunar gravity assist into solar orbit. Latitude after burn = 21.16° N, longitude 68.46° W, height = 19134.4 mi, flight path angle = 64.25°, heading = 113.74°, speed = 9997.5 mph, pericycneon = 193 mi.

02:23:07 PM T+004:51:07.7 weight = 38604 lbs. Saturn IVB propellant dump begins.

02:27 PM T+004:55 height = 22000 mi, speed = 9000 mph.

03:00 PM T+005:28 CSM initiates 10-min water dump.

03:14:27 PM T+005:42:27.8 weight = 34904 lbs. Saturn IVB propellant dump is complete.

05:32 PM T+008:00 height = 43795 mi.

06:53 PM T+009:21 speed = 7200 mph.

08:04 PM T+010:32 16-min telecast from CM begins.

10:32 PM T+013:00 height = 71262 mi.

17 July 1969 EDT

03:32 AM T+018:00 height = 93594 mi.

05:35 AM T+020:03 MCC updates LM APS thrust = 3478.46 lbs, flow rate = 11.2572 lbs/sec.

06:17 AM T+020:45 MCC updates CSM weight = 63059 lbs, LM weight = 33302 lbs.

10:32:53 AM T+025:00:53 equal heights from earth and moon = 120084 mi.

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12:16:58 PM T+026:44:58.64 SPS ignition for a 3.13-sec MCC-2 burn, imparting $V = 14.2$ mph. Latitude after burn = 6.00° N, longitude 11.17° W, height = 125984.1 mi, flight path angle = 76.88° , heading = 120.87° , speed = 3415.9 mph, pericytheon = 71.6 mi.

12:40:00 PM T+027:08:00 height = 127300 mi.

04:00 PM T+030:28 50-min telecast from CM begins.

05:32 PM T+032:00 height = 145357 mi.

07:20 PM T+033:48 height = 147696 mi, speed = 2982 mph.

07:31 PM T+033:59 36-min telecast from CM begins.

11:29:02 PM T+037:57:02 height = 159604 mi.

18 July 1969 EDT

12:52:00 AM T+039:20:00 height = 167287 mi.

03:32 AM T+042:00 height = 172613 mi.

09:45 AM T+048:13 CSM initiates 14-min water dump.

12:12 PM T+050:40 pericytheon = 72.36 mi.

01:07 PM T+051:35 height = 192000 mi.

02:32 PM T+053:00 height = 196147 mi, speed = 2246 mph.

04:40 PM T+055:08 height = 201000 mi, speed = 2120 mph. 96-min telecast from CM and LM begins.

05:02 PM T+055:30 Armstrong and Aldrin enter the LM for a preliminary inspection.

06:00 PM T+056:28 height = 203550 mi.

06:52 PM T+057:20 MCC updates CSM weight = 62727 lbs.

07:27 PM T+057:55 Armstrong and Aldrin return to the CM.

11:11:55 PM T+061:39:55 height = 214547 mi. Spacecraft enters lunar gravitation sphere of influence.

19 July 1969 EDT

03:54 AM T+066:22 MCC updates CSM weight = 62710 lbs.

08:32 AM T+071:00 pericytheon = 70.98 mi.

01:13:14 PM T+075:41:14 height = 244060 mi, speed = 5220 mph. First lunar occultation LOS.

01:21:50 PM T+075:49.50.37 height = 244930 mi, lunar latitude = 1.57° S, longitude = 169.58° W, height = 99.8 mi, flight path angle = -9.99° , heading = 297.20° , speed = 5625.0 mph. SPS ignition for a 5 min 57.53 sec LOI-1 burn, imparting $V = 1989.2$ mph. Lunar latitude after LOI-1 = 0.16° N, longitude = 167.13° E, height = 69.2 mi, flight path angle = -0.20° , heading = 293.11° , speed = 3735.7 mph, apocyntheon = 195.3 mi, pericytheon = 69.0 mi.

01:46 PM T+076:14 first lunar occultation AOS.

03:52 PM T+078:20 40-min telecast from CM begins.

04:14 PM T+078:42 lunar latitude = 6.98° N, longitude = 61.18° E, height = 2100.1 mi. Saturn IVB pericytheon. Subsequent ejection into a solar orbit

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occurs with inclination = 0.3836° , aphelion = 94.364 million mi, perihelion = 83.455 million mi, period = 342 days.

- 05:43:36 PM T+080:11:36.75 lunar height = 71.1 mi, speed = 3734.5 mph. SPS ignition for a 16.88-sec LOI-2 burn, imparting $V = 108.3$ fps. Lunar latitude after LOI-2 = 0.02° N, longitude = 169.16° E, height = 70.9 mi, flight path angle = 0.32° , heading = 293.23° , speed = 3639.8 mph, apocynthion = 76.1 mi, pericynthion = 62.7 mi.
- 06:42 PM T+081:10 Aldrin enters LM for systems checks.
- 09:07 PM T+083:35 Aldrin returns to CM.

20 July 1969 EDT

- 08:52 AM T+095:20 Armstrong and Aldrin enter LM for descent preparations.
- 11:17 AM T+097:45 LM systems checks begin.
- 12:15 PM T+098:43 LM landing gear deployed.
- 01:32 PM T+100:00 LM systems checks are complete.
- 01:44:00 PM T+100:12:00.0 lunar latitude = 1.11° N, longitude = 116.21° E, height = 72.4 mi, flight path angle = 0.16° , heading = 270.87° , speed = 3636.7 mph. LM undocks from CSM.
- 01:48 PM T+100:16 CSM and LM AOS.
- 02:11:52 PM T+100:39:52.9 CSM RCS ignition for a 9.0-sec radial-down separation burn, imparting $V = 1.8$ mph. CSM lunar latitude after burn = 1.05° N, longitude = 34.41° E, height = 71.9 mi, flight path angle = -0.16° , heading = 253.10° , speed = 3635.6 mph, apocynthion = 73.3 mi, pericynthion = 64.4 mi.
- 02:58 PM T+101:26 CSM and LM LOS.
- 03:08:14 PM T+101:36:14.0 LM lunar height = 64.9 mi, speed = 3657.9 mph. DPS ignition for a 30.0-sec DOI burn, imparting $V = 52.1$ mph. LM lunar latitude after burn = 1.16° S, longitude = 141.88° W, height = 66.5 mi, flight path angle = -0.06° , heading = 284.81° , speed = 3603.3 mph, apocynthion = 67.3 mi, pericynthion = 9.0 mi (48000 ft).
- 03:46 PM T+102:14 CSM AOS.
- 03:48 PM T+102:16 lunar altitude = 20.7 mi (109300 ft). LM AOS.
- 03:52:53 PM T+102:20:53 LM landing radar is activated.
- 03:54 PM T+102:22 LM lunar altitude = 78100 ft.
- 03:56:40 PM T+102:24:40 LM AGS is aligned to primary guidance.
- 03:57 PM T+102:25 LM lunar altitude = 64900 ft.
- 04:04:55 PM T+102:32:55 LM lunar altitude = 50000 ft.
- 04:04:58 PM T+102:32:58 LM ullage burn RCS ignition.
- 04:05:05 PM T+102:33:05.01 LM lunar latitude = 1.02° N, longitude = 39.39° E, altitude = 51700 ft, range = 299 mi, flight path angle = 0.03° , heading = 255.77° , speed = 3794.2 mph, pitch = 92° . PDI with DPS thrust = 985 lbs at a Landing Site 2 range 5 mi less than planned.
- 04:05:26 PM T+102:33:26 LM range = 240 mi. DPS throttle-up to thrust = 9850 lbs is initiated.

The Apollo 11 Mission: Compiled by Daniel R. Adamo

- 04:05:31 PM T+102:33:31 DPS throttle-up is complete.
- 04:07 PM T+102:35 LM lunar altitude $t = 47000$ ft, range = 190 mi.
- 04:08 PM T+102:36 LM lunar altitude = 43300 ft, range = 130 mi, pitch = 79° . Roll to heads-up attitude is initiated.
- 04:09 PM T+102:37 LM lunar altitude = 40000 ft, range = 95 mi.
- 04:09:10 PM T+102:37:10 LM lunar altitude = 39500 ft, range = 80 mi, pitch = 75° . Landing radar readings begin.
- 04:09:59 PM T+102:37:59 LM completes heads-up roll.
- 04:10 PM T+102:38 LM lunar altitude = 36000 ft. Landing aborts now require LM staging and APS thrust.
- 04:10:22 PM T+102:38:22 the first of five LM computer overload alarms tallied during powered descent annunciates with a #1202.
- 04:10:30 PM T+102:38:30 LM lunar altitude = 33500 ft.
- 04:10:45 PM T+102:38:45 LM landing radar updates to navigation are initiated.
- 04:11 PM T+102:39 LM lunar altitude = 27000 ft, range = 58 mi.
- 04:11:02 PM T+102:39:02 second overload alarm annunciates with a #1202.
- 04:11:31 PM T+102:39:31 LM lunar altitude = 24639 ft. DPS throttle-down to thrust = 5900 lbs is complete.
- 04:11:40 PM T+102:39:40 LM lunar altitude = 23200 ft, range = 25 mi, pitch = 67° . Landing radar altitude rate measurements begin.
- 04:12 PM T+102:40 LM lunar altitude = 21000 ft, range = 20 mi. Armstrong and Aldrin visually reacquire the lunar surface.
- 04:12:30 PM T+102:40:30 LM lunar altitude = 13500 ft, range = 18 mi.
- 04:13 PM T+102:41 LM lunar altitude = 7900 ft, altitude rate = -130 fps, range = 5.1 mi, speed = 370 mph, pitch = 55° . High Gate phase begins.
- 04:13:32 PM T+102:41:32 LM lunar altitude = 6500 ft, range = 4.4 mi, pitch = 45° . Approach phase begins as crew visually acquires the landing site targeted by guidance.
- 04:13:53 PM T+102:41:53 Armstrong initiates a 10-sec check of manual LM control.
- 04:14 PM T+102:42 LM lunar altitude = 5000 ft, range = 2.1 mi, pitch = 35° .
- 04:14:18 PM T+102:42:18 third overload alarm annunciates with a #1201.
- 04:14:19 PM T+102:42:19 LM lunar altitude = 2500 ft.
- 04:14:43 PM T+102:42:43 fourth overload alarm annunciates with a #1202.
- 04:14:58 PM T+102:42:58 fifth and final overload alarm annunciates with a #1202.
- 04:15 PM T+102:43 LM lunar altitude = 500 ft, altitude rate = -27 fps, range = 0.34 mi, pitch = 16° . Low Gate phase begins.
- 04:15:09 PM T+102:43:09 Armstrong has observed LM guidance is targeting landing near the center of a large crater with boulders 5 to 10 ft in size throughout the vicinity. He assumes manual LM control at this point and translates 0.21 mi farther downrange to smoother terrain.
- 04:15:13 PM T+102:43:13 LM altitude rate = 0.
- 04:15:22 PM T+102:43:22 LM vertical descent begins.
- 04:16:28 PM T+102:44:28 DPS low-level propellant quantity light illuminates.
- 04:16:35 PM T+102:44:35 DPS exhaust begins raising lunar dust.

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- 04:17:39 PM T+102:45:39.9 height = 235040 mi, lunar latitude = 0.6875° N, longitude = 23.4300° E, pitch = 4.5°, DPS propellant remaining = ~45 sec. LM touchdown at *Tranquillity Base*, located 4.3 mi southwest of Landing Site 2.
- 04:17:41 PM T+102:45:41.40 DPS shutdown.
- 04:18 PM T+102:46 LM is stay for T1.
- 04:26 PM T+102:54 LM is stay for T2.
- 04:29 PM T+102:57 LM is stay for one CSM orbit.
- 04:59 PM T+103:27 CSM LOS.
- 06:12 PM T+104:40 decision is made to move LM EVA from after sleep to before sleep.
- 07:43 PM T+106:11 Armstrong and Aldrin begin EVA preparations.
- 09:43 PM T+108:11 Armstrong and Aldrin are in their space suits and begin donning PLSSs.
- 10:26 PM T+108:54 LM cabin depressurization begins.
- 10:28 PM T+108:56 Armstrong and Aldrin switch from LM life support to their PLSSs.
- 10:36 PM T+109:04 LM forward hatch is unlocked.
- 10:39:33 PM T+109:07:33 LM forward hatch is opened.
- 10:51:16 PM T+109:19:16 Armstrong backs through the LM forward hatch and arrives on the egress platform or "porch".
- 10:53:18 PM T+109:21:18 Armstrong deploys the MESA, activating the black and white LM TV camera.
- 10:55:28 PM T+109:23:28 Armstrong reaches the LM forward footpad and begins a description of lunar surface appearance.
- 10:56:15 PM T+109:24:15 Armstrong steps onto the lunar surface and remarks, "That's one small step for a man; one giant leap for Mankind."
- 10:56:48 PM T+109:24:48 Armstrong assesses his lunar surface mobility and describes DPS effects on the lunar surface.
- 10:58:54 PM T+109:26:54 Aldrin begins sending Hasselblad camera to Armstrong via LEC.
- 11:02:53 PM T+109:30:53 Armstrong initiates lunar surface photography.



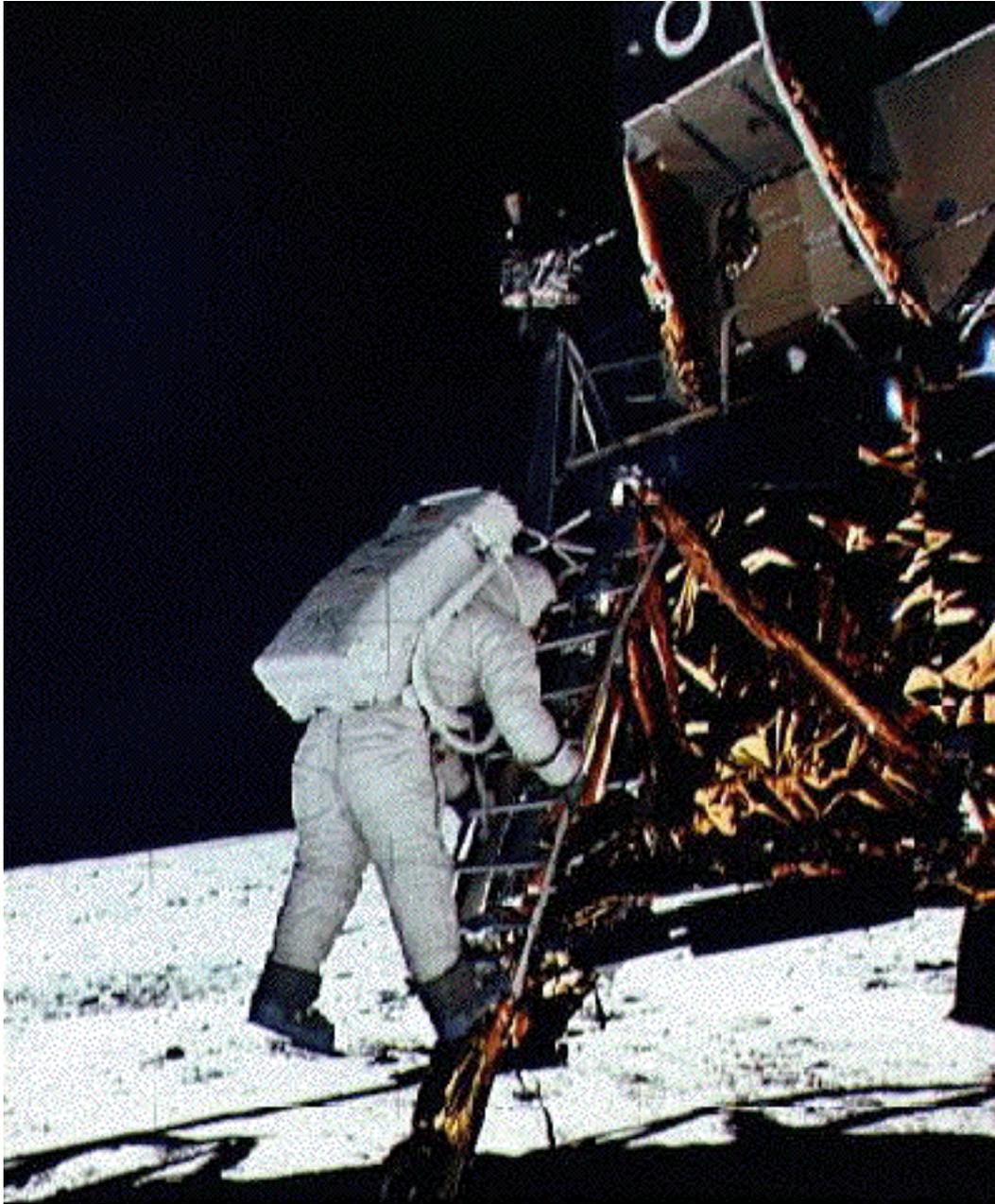
Armstrong's Boot and Footprint on the Lunar Surface

11:05:58 PM T+109:33:58 Armstrong initiates lunar contingency soil sample collection.

11:09:08 PM T+109:37:08 Armstrong stows contingency sample in his space suit.

11:11:57 PM T+109:39:57 Aldrin arrives on the LM porch.

11:13:56 PM T+109:41:56 Aldrin begins descending the LM ladder, while Armstrong photographs his progress.



Aldrin Descends the LM Ladder

11:15:16 PM T+109:43:16 Aldrin steps onto the lunar surface.

11:24:19 PM T+109:52:19 Armstrong unveils the LM plaque.

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LM Plaque and Ladder Rungs

- 11:26 PM T+109:54 Armstrong removes LM TV camera from the MESA.
- 11:31:28 PM T+109:59:28 LM TV resumes after Armstrong emplaces it at its panoramic site.
- 11:35:20 PM T+110:03:20 Aldrin deploys the Solar Wind Composition Experiment.
- 11:41:43 PM T+110:09:43 Armstrong and Aldrin implant the US flag in the lunar surface.
- 11:45:15 PM T+110:13:15 Aldrin begins assessing his lunar surface mobility.
- 11:48:30 PM T+110:16:30 Presidential message transmitted to Armstrong and Aldrin from the White House begins.
- 11:52:06 PM T+110:20:06 Armstrong begins collecting a 60-lb bulk lunar geologic sample, while Aldrin assesses soil mechanical properties.

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11:57:09 PM T+110:25:09 Aldrin evaluates effects of sun and shade on his space suit's thermal control.

21 July 1969 EDT

12:00:22 AM T+110:28:22 Aldrin describes lunar surface shadows and colors.

12:06:13 AM T+110:34:13 Aldrin photographs LM landing gear and the bulk lunar geologic sample site.

12:07:36 AM T+110:35:36 Armstrong completes bulk lunar geologic sample.

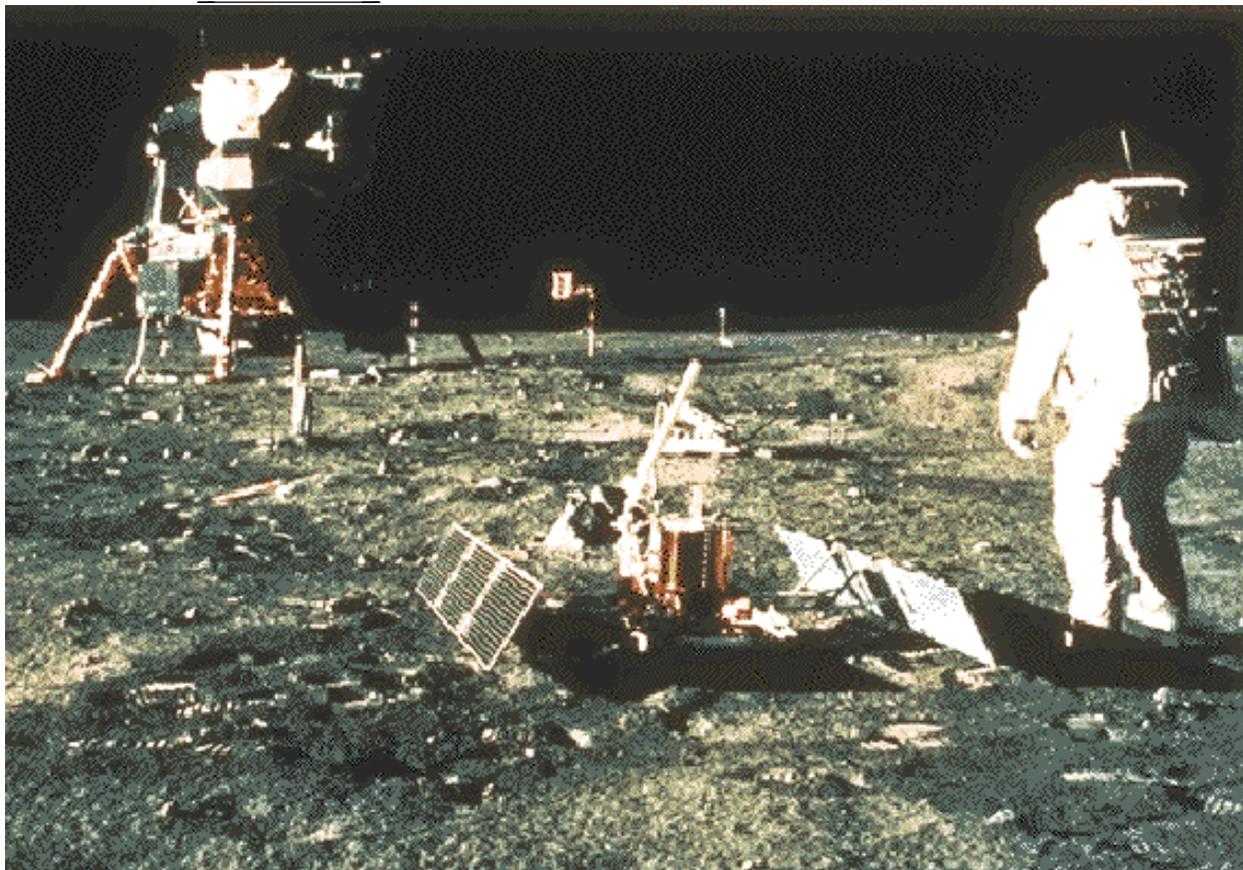
12:18:36 AM T+110:46:36 Armstrong and Aldrin inspect and photograph LM landing gear.

12:25:38 AM T+110:53:38 Aldrin opens EASEP stowage bay on LM.

12:27:42 AM T+110:55:42 Passive Seismometer is deployed.

12:35:57 AM T+111:03:57 Armstrong deploys the Lunar Ranging Retroreflector.

12:40:39 AM T+111:08:39 first Passive Seismometer data received on earth.



Aldrin and *Tranquillity Base*

12:43 AM T+111:11 Armstrong begins collecting a 20-lb selective lunar geologic sample.

12:46 AM T+111:14 Aldrin collects a 9-in lunar core sample.

12:47 AM T+111:15 Aldrin collects a second 9-in lunar core sample.

12:52 AM T+111:20 Aldrin retrieves the Solar Wind Composition Experiment.

12:57 AM T+111:25 Aldrin ascends the LM ladder.

12:59 AM T+111:27 Armstrong completes the selective lunar geologic sample.

01:01:39 AM T+111:29:39 Aldrin reenters the LM cabin.

The Apollo 11 Mission: Compiled by Daniel R. Adamo

01:02 AM T+111:30 Armstrong and Aldrin begin LEC transfer of 2 lunar sample containers to the LM cabin.

01:09:32 AM T+111:37:32 Armstrong begins ascending the LM ladder.

01:10 AM T+111:38 Armstrong reenters the LM cabin.

01:11:13 AM T+111:39:13 Aldrin closes and locks the LM forward hatch.

01:14 AM T+111:42 LM cabin repressurization is begun.

01:18 AM T+111:46 Armstrong and Aldrin switch from their PLSSs to LM life support.

01:40 AM T+112:08 Armstrong and Aldrin begin removing their PLSSs.

03:37 AM T+114:05 excess equipment is jettisoned from the LM cabin through the forward hatch.

12:54 PM T+123:22 final prelaunch LM systems checkout begins.

01:38 PM T+124:06 APS propellant tanks are pressurized.

01:54:00 PM T+124:22:00.79 APS ignition and LM liftoff.

01:54:02 PM T+124:22:02 LM lunar altitude = 10 ft, altitude rate = 10 fps.

01:54:04 PM T+124:22:04 LM lunar altitude = 40 ft, altitude rate = 20 fps.

01:54:06 PM T+124:22:06 LM lunar altitude = 90 ft, altitude rate = 30 fps.

01:54:08 PM T+124:22:08 LM lunar altitude = 170 ft, altitude rate = 40 fps.

01:54:10 PM T+124:22:10 LM lunar altitude = 250 ft, altitude rate = 50 fps. Pitch maneuver is initiated.

01:54:12 PM T+124:22:12 LM lunar altitude = 370 ft, altitude rate = 60 fps.

01:54:14 PM T+124:22:14 LM lunar altitude = 510 ft, altitude rate = 70 fps, pitch = 38°.

01:54:16 PM T+124:22:16 LM lunar altitude = 670 ft, altitude rate = 75 fps, pitch = 52°.

01:54:30 PM T+124:22:30 LM lunar altitude = 1000 ft, altitude rate = 80 fps.

01:55:00 PM T+124:23:00 LM lunar altitude = 2600 ft, altitude rate = 130 fps, range = 2.4 mi.

01:56:00 PM T+124:24:00 LM lunar altitude = 14000 ft, range = 11 mi, pitch = 60°.

01:57:00 PM T+124:25:00 LM lunar altitude = 18500 ft, range = 26 mi.

01:57:30 PM T+124:25:30 LM lunar altitude = 26400 ft.

01:57:40 PM T+124:25:40 LM lunar altitude = 32000 ft.

01:58:00 PM T+124:26:00 LM lunar altitude = 43800 ft, range = 49 mi, pitch = 72°.

01:59:00 PM T+124:27:00 LM lunar altitude = 49600 ft, range = 85 mi.

02:00:00 PM T+124:28:00 LM lunar altitude = 60200 ft, range = 122 mi, pitch = 84°.

02:01:00 PM T+124:29:00 LM lunar altitude = 60700 ft, range = 176 mi.

02:01:15 PM T+124:29:15.67 LM lunar latitude = 0.73° N, longitude = 12.99° E, height = 11.5 mi (60800 ft), flight path angle = 0.28°, heading = 251.85°, speed = 3775.8 mph, pitch = 92°, apolune = 55.2 mi, perilune = 10.8 mi, CSM/LM range = 313 mi. APS shutdown.

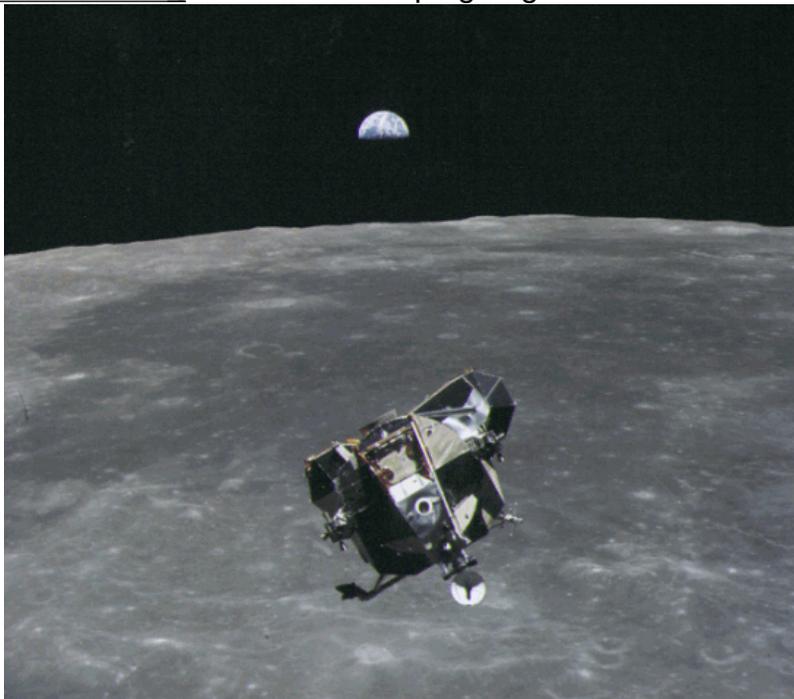
02:39 PM T+125:07 CSM LOS.

02:41 PM T+125:09 LM LOS.

02:51:35 PM T+125:19:35.0 LM lunar height = 54.5 mi, speed = 3632.8 mph. RCS ignition for a 47.0-sec CSI burn, imparting $V = 35.1$ mph. Lunar latitude after CSI = 0.91° S, longitude = 149.57° W, height = 55.7 mi, flight path angle = 0.09°, heading = 283.02°, speed = 3665.9 mph, apolune = 56.7 mi, perilune = 52.6 mi.

The Apollo 11 Mission: Compiled by Daniel R. Adamo

03:11 PM T+125:39 CSM/LM range = 152 mi.
03:18 PM T+125:46 MCC updates SPS thrust = 21580 lbs, flow rate = 68.5 lbs/sec.
03:26 PM T+125:54 CSM AOS.
03:28 PM T+125:56 LM AOS.
03:41 PM T+126:09 CSM/LM range = 115 mi, range rate = 68 mph.
03:49:49 PM T+126:17:49.6 LM RCS ignition for a 17.8-sec CDH burn, imparting $V = 13.6$ mph. Apolune after CDH = 54.5 mi, perilune = 48.4 mi.
04:07 PM T+126:35 CSM/LM range = 77.6 mi, range rate = 82 mph.
04:31 PM T+126:59 CSM/LM range = 41 mi, range rate = 95 mph.
04:35:51 PM T+127:03:51.8 LM lunar height = 50.7 mi, speed = 3676.0 mph. RCS ignition for a 22.7-sec TPI burn, imparting $V = 17.2$ mph. Lunar latitude after TPI = 1.17° S, longitude = 111.46° W, height = 50.6 mi, flight path angle = -0.03° , heading = 267.35° , speed = 3690.8 mph, apolune = 71.0 mi, perilune = 50.3 mi.
04:36 PM T+127:04 CSM LOS.
04:37 PM T+127:05 LM LOS.
04:50:30 PM T+127:18:30.8 LM RCS ignition for an MC-1 burn, imparting $V = 0.7$ mph.
05:05:30 PM T+127:33:30.8 LM RCS ignition for an MC-2 burn, imparting $V = 1.0$ mph.
05:18:09 PM T+127:46:09.8 LM lunar speed = 3640.7 mph. RCS ignition for a 28.4-sec TPF burn, imparting $V = 21.4$ mph. Apolune after TPF = 72.5 mi, perilune = 65.0 mi.
05:23 PM T+127:51 CSM and LM AOS.
05:24:05 PM T+127:52:05.3 LM stationkeeping begins.



LM Eagle from CSM Columbia Prior to Docking

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- 05:28 PM T+127:56 Collins initiates CSM docking procedures.
- 05:35:00 PM T+128:03:00 lunar latitude = 1.18° N, longitude = 67.31° E, height = 69.7 mi, flight path angle = 0.16° , heading = 272.37° , speed = 3641.9 mph. CSM docks with LM.
- 05:36 PM T+128:04 CSM/LM cabin pressure equalization begins.
- 05:47 PM T+128:15 MCC updates CSM weight = 36703 lbs.
- 06:52 PM T+129:20 Armstrong enters CM.
- 07:17 PM T+129:45 Aldrin enters CM.
- 07:41:31 PM T+130:09:31.2 lunar latitude = 1.10° N, longitude = 41.85° E, height = 70.9 mi, flight path angle = 0.15° , heading = 262.19° , speed = 3638.1 mph. LM jettison.
- 08:02:01 PM T+130:30:01.0 lunar height = 72.2 mi, speed = 3634.2 mph. CSM RCS ignition for a 7.2-sec LM final separation burn, imparting retrograde $V = 1.5$ mph. Latitude after burn = 0.19° N, longitude = 20.58° W, height = 72.2 mi, flight path angle = -0.02° , heading = 307.27° , speed = 3632.0 mph, apocynthion = 72.2 mi, pericynthion = 62.1 mi.
- 10:57 PM T+133:25 MCC updates CSM weight = 36655 lbs.

22 July 1969 EDT

- 12:29 AM T+134:57 CSM LOS.
- 12:55:42 AM T+135:23:42.28 lunar height = 60.3 mi, speed = 3665.5 mph, CSM/LM range = 20 mi with CSM ahead and 0.8 mi below LM. SPS ignition for a 2 min 31.41 sec TEI burn imparting $V = 2235.7$ mph. Lunar latitude after TEI = 0.50° N, longitude = 154.02° E, height = 66.9 mi, flight path angle = 5.13° , heading = 297.40° , speed = 5856.1 mph. Targeted flight path angle at EI = -6.50° , speed = 24677.8 mph.
- 01:06 AM T+135:34 CSM AOS.
- 02:12 AM T+136:40 MCC updates CSM weight = 26370 lbs.
- 07:36 AM T+142:04 height = 215600 mi, speed = 3018 mph.
- 10:32 AM T+145:00 height = 206900 mi, speed = 2958 mph.
- 11:32 AM T+146:00 height = 203900 mi, speed = 2947 mph.
- 01:02 PM T+147:30 height = 199500 mi, speed = 2934 mph.
- 01:39:24 PM T+148:07:24 height = 198100 mi, speed = 2723 mph. CSM exits lunar gravitation sphere of influence.
- 04:01:57 PM T+150:29:57.4 height = 194582.0 mi, speed = 2778.4 mph. RCS ignition for a 10.0-sec MCC-5 burn, imparting $V = 3.3$ mph. Latitude after MCC-5 = 13.16° S, longitude = 37.83° W, height = 194574.5 mi, flight path angle = -80.41° , heading = 129.30° , speed = 2777.7 mph.
- 05:32 PM T+152:00 height = 190389 mi.
- 09:02:15 PM T+155:30:15 height = 180528.0 mi, speed = 2930 mph, lunar height = 60465 mi, speed = 2932 mph.
- 09:08 PM T+155:36 18-min telecast from CM begins.

The Apollo 11 Mission: Compiled by Daniel R. Adamo

23 July 1969 EDT

01:16 AM T+159:44 MCC predicts EI flight path angle = -6.57° .
01:25:43 AM T+159:53:43 height = 167533.7 mi, speed = 3091 mph, lunar height = 73398 mi, speed = 2969 mph. CSM is midway between TEI and EI in time.
03:08 AM T+161:36 MCC predicts EI flight path angle = -6.56° .
04:47 AM T+163:15 MCC predicts EI flight path angle = -6.76° , speed = 24678.0 mph.
06:36 AM T+165:04 MCC predicts EI flight path angle = -6.74° , speed = 24678 mph.
08:42 AM T+167:10 MCC predicts EI flight path angle = -6.65° , speed = 24677.9 mph.
09:14 AM T+168:42 MCC predicts EI flight path angle = -6.55° , speed = 24677.9 mph.
11:00 AM T+169:28 height = 137000 mi.
12:00 N T+170:28 height = 132000 mi.
12:20 PM T+170:48 MCC predicts EI flight path angle = -6.48° , perigee = 23.8 mi at T+195:05:19.
01:02 PM T+171:30 3-min CSM water dump is initiated.
02:20 PM T+172:48 MCC predicts EI flight path angle = -6.50° , speed = 24678.0 mph.
02:50 PM T+173:18 height = 122454 mi, speed = 3823 mph.
03:56:07 PM T+174:24:07.50 height = 118401 mi. CSM reaches the point equidistant from earth and moon on its earthbound trajectory.
04:44 PM T+175:12 MCC updates predicted CM weight at EI = 12148 lbs.
04:48 PM T+175:16 MCC predicts EI flight path angle = -6.48° , speed = 24678.0 mph, perigee = 23.8 mi at T+195:05:19.
05:32 PM T+176:00 height = 108248 mi.
06:32 PM T+177:00 height = 104207 mi, speed = 4170 mph.
06:40 PM T+177:08 MCC predicts EI flight path angle = -6.48° , speed = 24678.0 mph, perigee = 23.8 mi at T+195:05:19.
06:42 PM T+177:10 3-min telecast from CM begins.
07:04 PM T+177:32 12-min telecast from CM begins.
07:05 PM T+178:33 MCC predicts EI flight path angle = -6.43° at T+195:03:07, perigee = 24.6 mi.
11:42 PM T+183:10 MCC predicts EI flight path angle = -6.44° .

24 July 1969 EDT

01:52 AM T+185:20 MCC predicts EI flight path angle = -6.47° , perigee = 24.1 mi.
03:36 AM T+187:04 MCC predicts EI flight path angle = -6.50° , perigee = 23.6 mi.
09:00 AM T+191:28 height = 34000 mi.
09:37 AM T+192:05 height = 29000 mi.
10:20 AM T+192:48 height = 22901 mi, speed = 9338 mph.
10:51 AM T+193:19 height = 18232 mi, speed = 10332 mph.

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10:54 AM T+193:22 MCC predicts EI flight path angle = -6.48° at T+195:03:06.
11:02 AM T+193:30 height = 16530 mi, speed = 10765 mph.
11:40 AM T+194:08 height = 9000 mi, speed = 15000 mph.
11:49 AM T+194:17 recovery aircraft are deployed from the USS *Hornet*.
12:04 PM T+194:32 height = 7000 mi, speed = 17000 mph.
12:05:06 PM T+194:33:06 height = 5321 mi.
12:08:41 PM T+194:36:41 height = 4588 mi. CM enters earth's shadow.
12:18 PM T+194:46 SM jettison attitude is achieved.
12:18:06 PM T+194:46:06 height = 2666 mi.
12:21:12 PM T+194:49:12.7 latitude = 35.09° S, longitude = 122.54° E, height = 2046.4 mi, flight path angle = -35.26° , heading = 69.27° , speed = 20192.4 mph. SM jettison.
12:28:59 PM T+194:56:59 height = 688 mi. Moonset.
12:32 PM T+195:00 speed = 23864 mph.
12:33 PM T+195:01 speed = 24258 mph.
12:35:05 PM T+195:03:05.7 latitude = 3.19° S, longitude = 171.96° E, altitude = 400000 ft, flight path angle = -6.48° , heading = 50.18° , speed = 24678.0 mph. EI.
12:35:18 PM T+195:03:18 altitude = 300000 ft. CM enters S and C-band radio blackout. Entry Roll phase is initiated.
12:36 PM T+195:04 altitude = 200000 ft, exterior temperature = 5000° F, acceleration = 6.6 Gs. Entry Steering phase is initiated.
12:37:17 PM T+195:05:17 CM achieves aero-capture.
12:38:45 PM T+195:06:45 altitude = 216500 ft. CM exits S and C-band radio blackout.
12:39 PM T+195:07 recovery aircraft acquire CM visually.
12:40 PM T+195:08 USS *Hornet* acquires CM radar contact.
12:43 PM T+195:11 altitude = 60000 ft. CM computer guidance is complete.
12:44 PM T+195:12 altitude = 24000 ft. Final CM landing sequence begins.
12:44:06 PM T+195:12:06.9 altitude = 23300 ft. Drogue parachutes are deployed and unreefed.
12:46 PM T+195:14 altitude = 10500 ft. Drogue parachutes are released. Pilot and main parachutes are deployed and unreefed.
12:47 PM T+195:15 CM radio antenna and flashing beacon are deployed.
12:50:35 PM T+195:18:35 latitude = 13.30° N, longitude = 169.15° W, weight = 10873 lbs. Splashdown 9 mi from the USS *Hornet* and 1.75 mi from the prime landing site. CM attains Stable 2.

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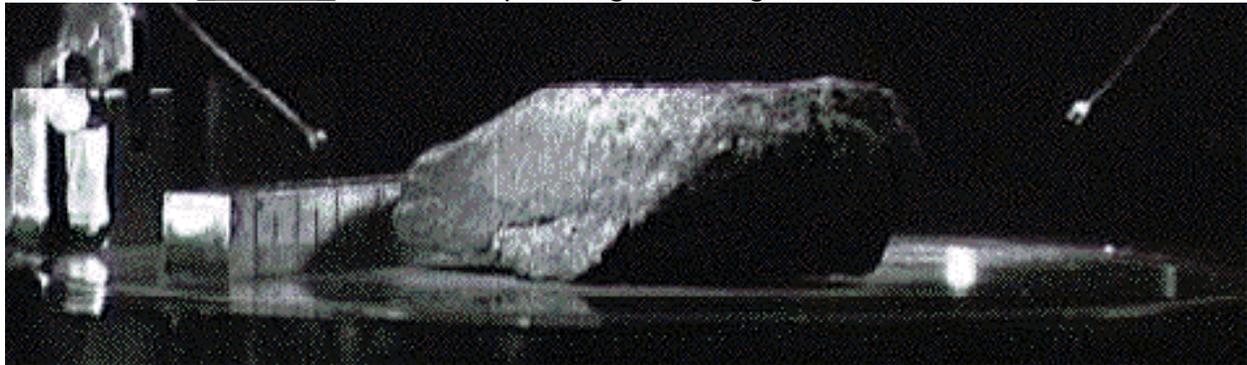
Post-Splashdown MCC Celebration

- 12:58:15 PM T+195:26:15 CM attains Stable 1.
- 01:53 PM T+196:21 crew arrives aboard USS *Hornet*.
- 01:58 PM T+196:26 crew enters MQF.
- 03:50 PM T+198:18 CM is hoisted aboard USS *Hornet*.

The Apollo 11 Mission: Compiled by Daniel R. Adamo

25 July 1969 EDT

12:15 PM T+218:43 lunar samples begin arriving at LRL.



Apollo 11 Lunar Sample at the LRL

26 July 1969 EDT

02:30 PM T+244:58 USS *Hornet* arrives at Pearl Harbor, where the MQF is transported to Hickam AFB and a C-141 transport.

05:29 PM T+247:57 C-141 departs Hickam AFB.

28 July 1969 EDT

06:00 AM T+284:28 MQF arrives at LRL.

30 July 1969 EDT

07:17 PM T+345:45 CM arrives at LRL.

3 August 1969 EDT

07:58:46 AM T+430:26:46 passive seismometer is deactivated. LM impact was never detected.

10 August 1969 EDT

10:04 PM T+612:32 crew completes quarantine and departs the LRL.

The Apollo 11 Mission Acronym List: Compiled by Daniel R. Adamo

AGS: Abort Guidance System
AOS: Acquisition Of Signal
APS: Auxiliary Propulsion System (Saturn IVB); Ascent Propulsion System (LM)
AS: Apollo-Saturn
CDH: Constant Delta Height
CM: Command Module
CSI: Coelliptic Sequence Initiate
CSM: Command-Service Module
DOI: Descent Orbit Insertion
DPS: Descent Propulsion System
EASEP: Apollo Early Scientific Experiments Package
EDS: Emergency Detection System
EDT: Eastern Daylight Time
GET: Ground Elapsed Time
GDS: GoldStone
IGM: Iterative Guidance Mode
KSC: Kennedy Space Center
LC: Launch Complex
LEC: Lunar Equipment Conveyor
LES: Launch Escape System
LM: Lunar Module
LOI: Lunar Orbit Insertion
LOS: Loss Of Signal
LRL: Lunar Receiving Laboratory
LVLH: Local Vertical Local Horizontal
MCC: Mission Control Center; Mid-Course Correction
MESA: Modular Equipment Stowage Assembly
MLP: Mobile Launch Platform
MQF: Mobile Quarantine Facility
MSC: Manned Spacecraft Center
MSOB: Manned Spacecraft Operations Building
NASA: National Aeronautics and Space Administration
PDI: Powered Descent Initiation
PLSS: Portable Life Support System
RCS: Reaction Control System
SM: Service Module
SLA: Spacecraft Lm Adapter
SPS: Service Propulsion System
TEI: Trans-Earth Injection
TLI: Trans-Lunar Injection
TPI: Terminal Phase Initiate
USS: United States Ship
VAB: Vehicle Assembly Building