

# BEFORE LIFTOFF

## GLOSSARY OF TERMS

Here is a list of terms that will be helpful for you on your journey.

Wherever a pronunciation is not given for an acronym, the term is sounded out by letter.

**abort:** the unscheduled termination of a mission prior to its completion

**Apollo:** the program that resulted in American astronauts walking on the moon; twelve missions using three-man spacecrafts between 1968 and 1972, after Mercury and Gemini (Apollo 1 ended in tragedy with three astronauts dying. Four of the twelve flights tested the equipment. Six of the other seven flights landed on the moon.)

**Apollo spacecraft:** the CSM (command and service module) and LM (lunar module) when docked together

**CapCom:** capsule communicator

**CM:** command module; the part of the Apollo spacecraft that contained the crew during takeoff from and reentry to earth

**Columbia:** the name of the CM (command module) on Apollo 11

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**cryo:** hydrogen and oxygen fuel stored at extremely cold temps

**CSM:** command and service module; two distinct units, the CM (command module) and the SM (service module), when connected together

**Eagle:** the name of the LM (lunar module) on Apollo 11

**EECOM (pronounced *eeecom*):** electrical, environmental, and consumables manager; MCC (Mission Control Center) engineer responsible for electrical, environmental, and communications in the CSM (command and service module), including cryogenic, fuel cell, and structural systems

**EVA:** extravehicular activity; also called a space walk

**FDO (pronounced *fido*):** flight dynamics officer; a specialist in launch and orbit trajectories

**flight controller:** NASA personnel who oversee various aspects of a spaceflight in real time, interpreting telemetry at their stations in the MOCR (Mission Operations Control Room); they are involved before, during, and after the mission

**flight director:** manager of flight controllers; role in the MOCR (Mission Operations Control Room) is like a conductor of a symphony

**g-force:** the force exerted upon an object by gravity or in reaction to acceleration or deceleration

**Gemini or Project Gemini:** America's second human space program (after Mercury, before Apollo), which tested movements and maneuvers necessary to attempt Apollo; ten missions in a two-man spacecraft between 1965 and 1966

**go/no go:** the decision to continue to the next event or abort an activity

**GNC:** guidance, navigation, and controls system engineer; MCC (Mission Control Center) engineer responsible for managing propulsion, altitude control, guidance and navigation systems in the CSM (command and service module)

**Guido or Guidance:** MCC (Mission Control Center) specialist in navigation and computer software systems

**JSC:** Johnson Space Center in Houston, Texas

**KSC:** John F. Kennedy Space Center on Merritt Island, Florida

**LES:** launch escape system; the part of the rocket that can propel the astronauts and their capsule away from the launch vehicle or launchpad in the event of an emergency during takeoff or ascent

**LM [pronounced *lem*]:** lunar module (originally called lunar excursion module); the part of the Apollo spacecraft that landed on the moon

**MCC:** Mission Control Center in Houston, Texas

**Mercury or Project Mercury:** America's first human space program involving a one-man spacecraft traveling to space and then into orbit (There were six missions on Redstone and Atlas rockets between 1961 and 1963.)

**MOCR [pronounced *moker*]:** Mission Operations Control Room at the MCC (Mission Control Center) in Houston, Texas; front row of this room was nicknamed "the trench"

**NACA:** National Advisory Committee for Aeronautics; formed in 1915 and absorbed by NASA in 1958

**NASA [pronounced *nasa*]:** National Aeronautics and Space Administration; created on October 1, 1958, to oversee US space exploration and aeronautics research; led by an administrator nominated by the president and confirmed by the Senate

**pogo:** a rapid up-and-down shaking of a rocket that, if not corrected, will cause failure

**powered descent:** a maneuver that involves firing thrusters to assist a spacecraft in landing on the surface of a planet or moon

**reentry:** when a spacecraft reenters the atmosphere after flying above it

**retro:** MCC (Mission Control Center) specialist in reentry trajectories

**Saturn V:** three-stage launch vehicle that transported the Apollo spacecrafts from the earth toward the moon and carried Skylab, the United States' first space station, into orbit (Thirteen were launched.)

**SM:** service module; the part of the Apollo spacecraft that contained the

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main engines and most of the consumables (oxygen, water, helium, fuel cells, and fuel) jettisoned before reentry

**splashdown:** the process of landing a spacecraft in the ocean using multiple sets of parachutes that slow it down before it hits the water

**stage:** a section of a rocket that contains an engine or group of engines; the stages usually separate from the rocket when they have used up their fuel

**surgeon:** directs medical activities during the flight and monitors the health of the astronauts via telemetry

**TELMU [pronounced *telmu*]:** telemetry, electrical, and EVA (extravehicular activity) mobility unit officer; monitors LM (lunar module) electrical and environmental control systems

**thrust:** the force produced by the engines of a rocket or plane directed forward or upward

**TLI:** translunar injection; a maneuver to leave a parking orbit around the earth toward the moon

**Tranquility Base:** the name of Apollo 11's landing site on the moon

## CAST OF CHARACTERS

Though not exhaustive, this list includes some of the people you will meet in this book. Feel free to refer back to it to keep who's who straight in your mind.

**Alan Shepard:** first American in space on Mercury-Redstone 3; grounded due to inner-ear ailment; became chief of the astronaut office; returned to flight as commander of Apollo 14

**Charlie Duke:** air force test pilot; CapCom (capsule communicator) during Apollo 11 moon landing; lunar module pilot on Apollo 16

**Christopher Columbus Kraft Jr.:** the original flight director;

instrumental in developing the functionalities and procedures of Mission Control; at the helm of Mission Control from Mercury until the beginning of the Apollo program

**Donald K. “Deke” Slayton:** air force test pilot; Mercury astronaut grounded by a heart condition; became director of flight crew operations and was responsible for NASA crew assignments; returned to flight and was Apollo docking module pilot on the Apollo-Soyuz Test Project

**Edward White II:** air force test pilot; pilot on Gemini 4; made the first American EVA (extravehicular activity), or space walk, on Gemini 4 mission; command pilot on Apollo 1

**Edwin “Buzz” Aldrin Jr.:** air force pilot; first astronaut with a doctorate; nicknamed “Dr. Rendezvous”; pilot on Gemini 12; lunar module pilot on Apollo 11 (the first spaceflight to land humans on the moon)

**Frank Borman:** air force test pilot; command pilot on Gemini 7; commander on Apollo 8 (the Christmas flight)

**Gene Cernan:** pilot on Gemini 9; commander for Apollo 17; person who has walked on the moon most recently

**Gene Kranz:** air force pilot; long-standing NASA flight director throughout the space race; chief flight director for the Apollo 11 mission; wore iconic vests and flattop haircut

**Jack Garman:** computer engineer and specialist; part of Steve Bales’s “back room” support; enabled the Apollo 11 mission not to abort during the 1202 program alarm crisis by giving knowledge of NASA computer codes in split-second timing; chief information officer at JSC (Johnson Space Center)

**James [Jim] Lovell Jr.:** navy test pilot; pilot on Gemini 7; command pilot on Gemini 12; command module pilot on Apollo 8 (the Christmas flight); commander on Apollo 13; first person to fly to the moon twice

**James Webb:** NASA administrator during Mercury and Gemini programs

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**John Glenn:** navy test pilot; first American to orbit the earth on Mercury-Atlas 6; became a national hero; after a political career, returned to space at age 77 as a payload specialist on STS-95, becoming the oldest person to fly in space at that time

**Katherine Johnson:** American mathematician and human computer; one of the many women who were a vital part of the space program and without whom NASA would not have been able to get off the ground; provided calculations of orbital mechanics that were indispensable from Mercury all the way through Apollo; of her computations John Glenn said before his mission, "If she says they're good, then I'm ready to go."

**Michael Collins:** air force test pilot; pilot on Gemini 10; command module pilot on Apollo 11 (the first spaceflight to land humans on the moon)

**Neil Armstrong:** civilian; NACA test pilot; command pilot on Gemini 8; commander on Apollo 11; first person to walk on the moon

**Peggy Whitson:** biochemist; flight engineer on STS-111; first female commander of the ISS (International Space Station) on Expedition 16; commander of Expedition 51; current record holder for most cumulative days (665) spent in space; at age 57, oldest woman to go to space at the time of her mission; chief of the Astronaut Office

**President John F. Kennedy:** effortlessly cool, beloved visionary leader who threw down the gauntlet of the moonshot; was in office during Project Mercury and was the friend of several astronauts; was tragically assassinated in November 1963 before the dream of the moon landing was realized

**President Lyndon B. Johnson:** sworn in as president after President Kennedy was assassinated in Dallas, Texas; under his presidency Congress appropriated funds to fulfill President Kennedy's vision through Gemini and the beginning of the Apollo program

**President Richard M. Nixon:** president during the Apollo 11 moon landing; spoke to Neil Armstrong and Buzz Aldrin from the White House during their EVA and greeted them in person when they returned

**Robert Goddard:** father of modern rocketry; patented liquid-fueled and multi-stage rockets in 1914; postulated in 1920 that humans could reach the moon using rockets; was not recognized for his ideas or accomplishments in spaceflight until after he was dead

**Roger Chaffee:** navy pilot; pilot on Apollo 1

**Shane Kimbrough:** army helicopter pilot; mission specialist on STS-126; flight engineer on Expedition 49; commander of the ISS (International Space Station) on Expedition 50; commander of the NASA SpaceX Crew-2 mission (on which he flew with this book manuscript on a thumb drive)

**Steve Bales:** NASA engineer and flight controller; served as guido on Apollo 11

**Virgil “Gus” Grissom:** air force test pilot; pilot on Mercury-Redstone 4; command pilot on Gemini 4; commander on Apollo 1

**Walter Cronkite:** trusted CBS reporter whose narration was the soundtrack of the space race for the American people; known for his sign-off slogan, “And that’s the way it is.”

**Wernher von Braun:** German-born scientist who designed rockets in Germany during WWII; developed rockets for America’s space program, most notably the Saturn V used in the Apollo moon landings

**William [Bill] Anders:** air force pilot; lunar module pilot on Apollo 8 (the Christmas flight)

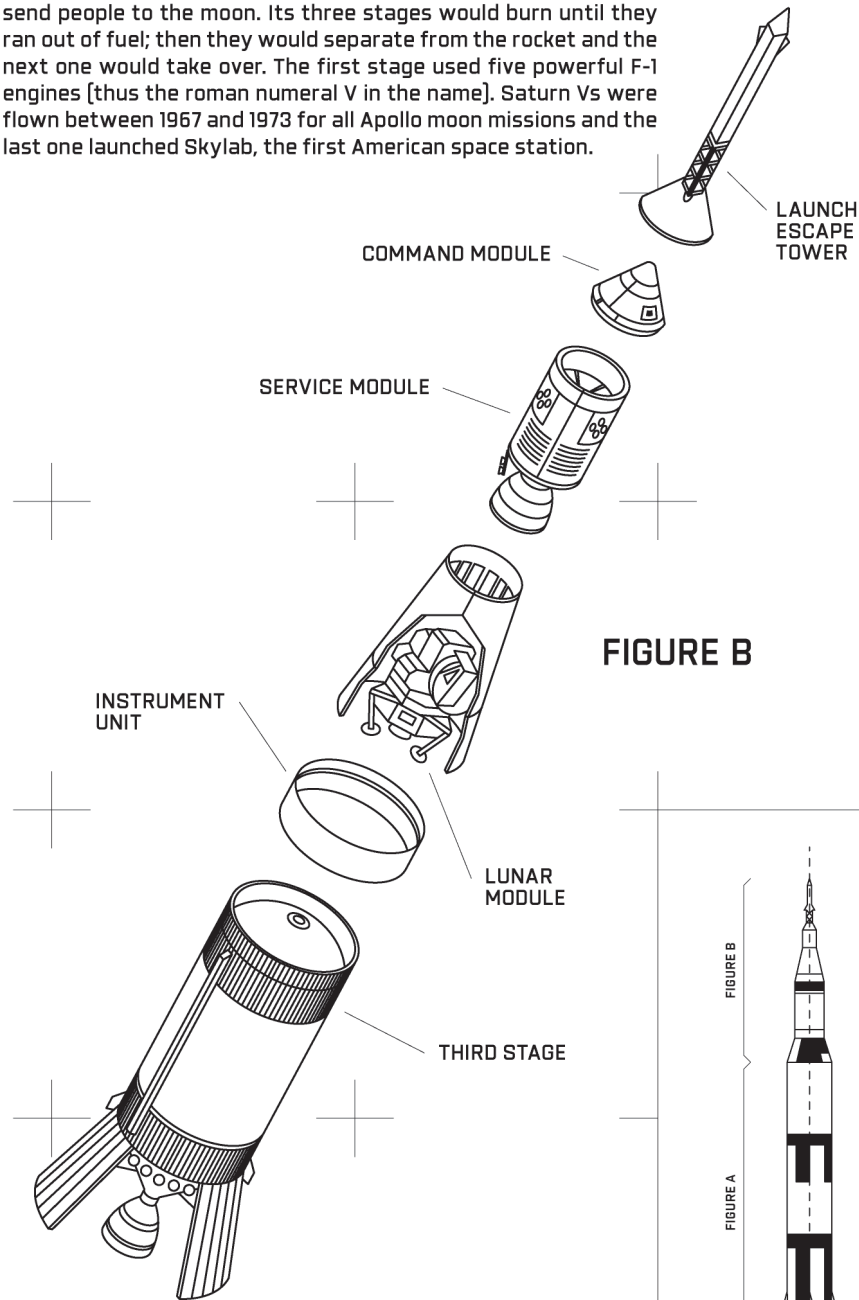
## HEAVY LAUNCH VEHICLE



## FIGURE A

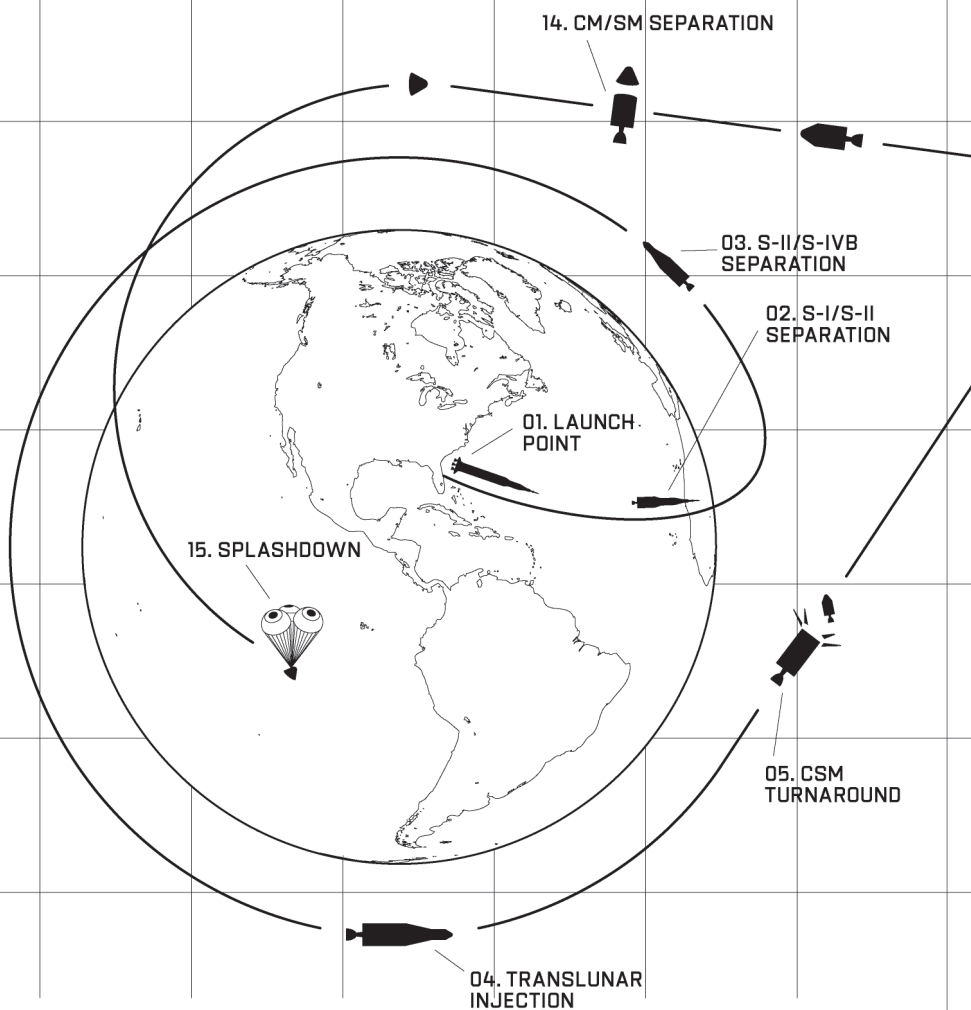


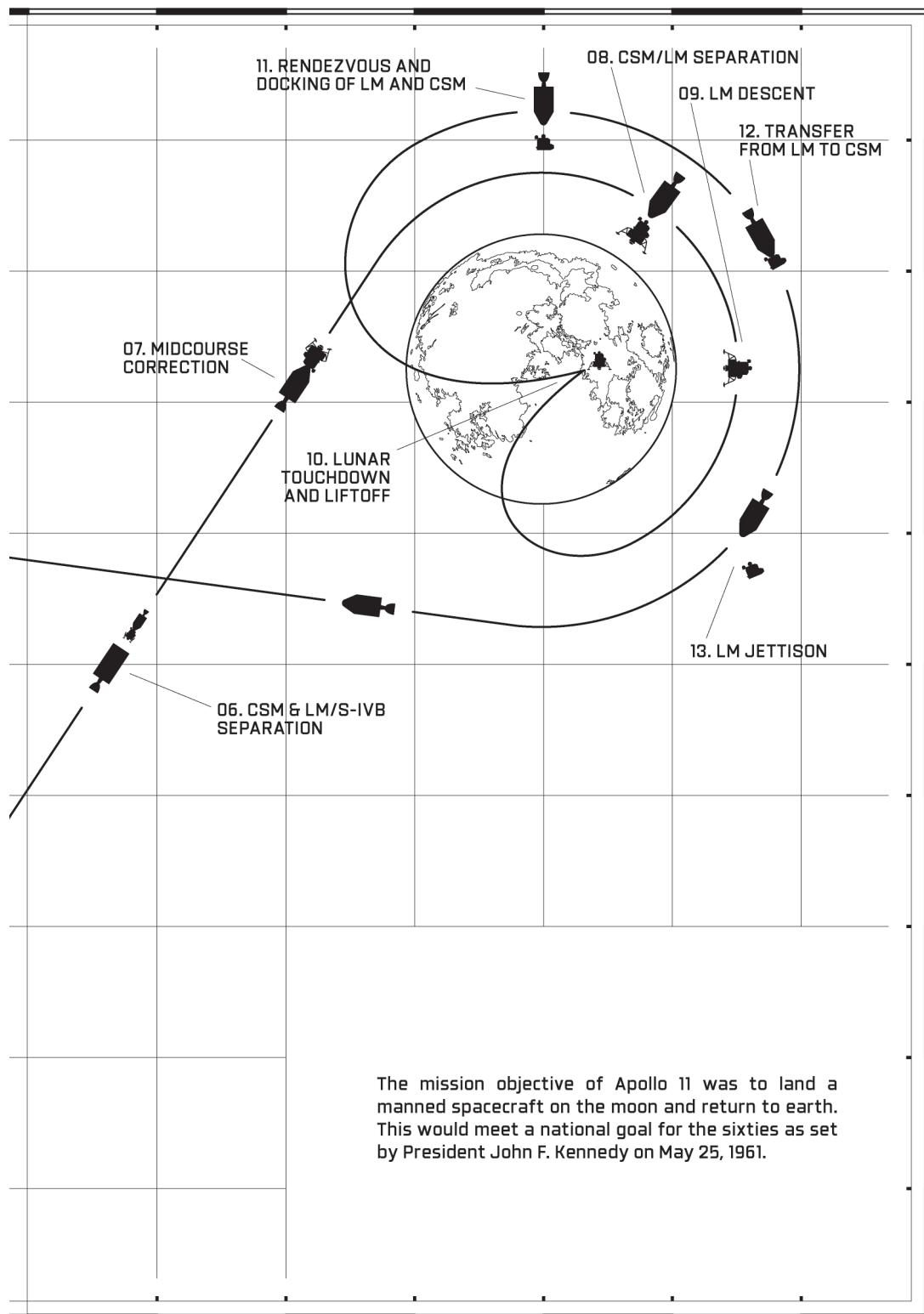
Saturn V was a powerful three-stage rocket built by NASA to send people to the moon. Its three stages would burn until they ran out of fuel; then they would separate from the rocket and the next one would take over. The first stage used five powerful F-1 engines [thus the roman numeral V in the name]. Saturn Vs were flown between 1967 and 1973 for all Apollo moon missions and the last one launched Skylab, the first American space station.



# APOLLO MISSION PROFILE

THE EAGLE HAS LANDED...





# APOLLO SPACECRAFT

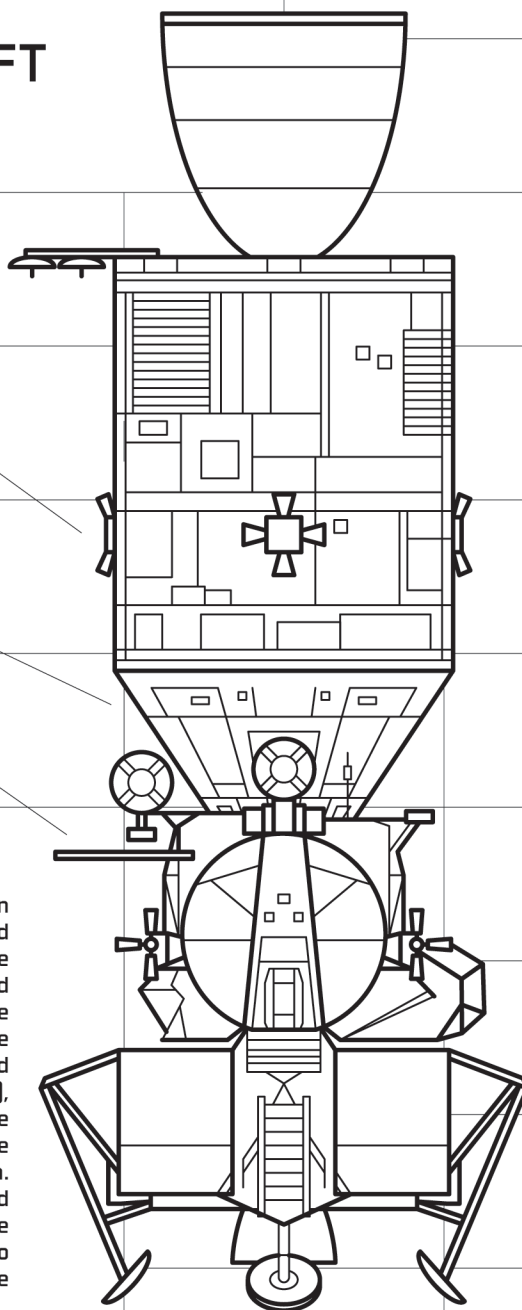
THE PAYLOAD

SERVICE MODULE (SM)

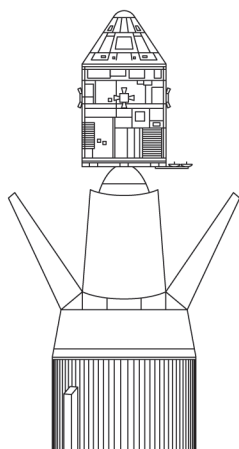
COMMAND MODULE (CM)

LUNAR MODULE (LM)

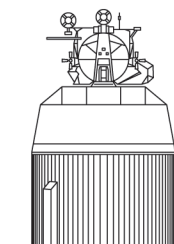
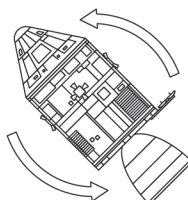
The Apollo spacecraft sat on the top of the Saturn V and was comprised of three modules: the command module, the service module (when these first two were connected they were called the command service module), and the lunar module. Above the command module was the emergency escape system. Only the lunar module landed on the moon, and only the command module returned to earth. Apollo was a single-use spacecraft.



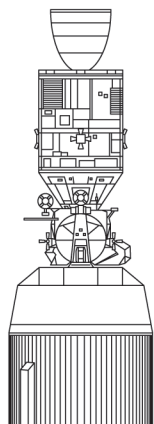
# TRANSPPOSITION, DOCKING, AND EXTRACTION



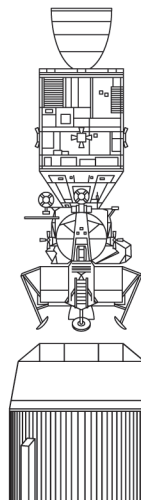
CSM SEPARATION



FREE FLY-AROUND



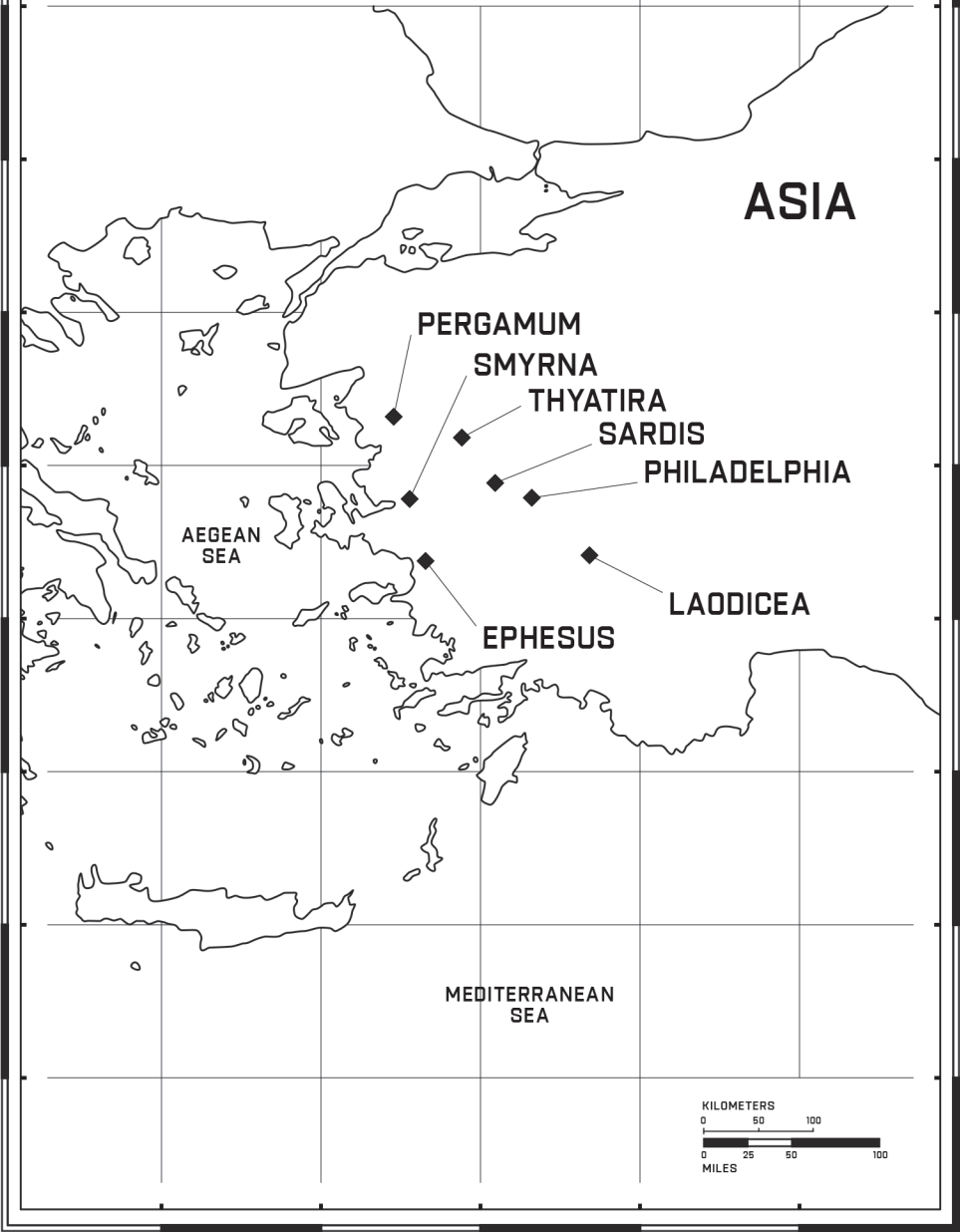
DOCKING



LM SEPARATION FROM  
S-IVB

Like a scene from a James Bond movie, the command service module separated from the third stage of the Saturn V rocket [S-IVB] three hours and seventeen minutes after launch. Then it spun around and docked nose to nose with the lunar module, which had been stored in a compartment behind four silver petals that had fallen away. Once they were docked, the LM was released from the third stage and the LM and CSM merged into the Apollo spacecraft.

# SEVEN CHURCHES OF REVELATION



## **JESUS' LETTERS TO THE SEVEN CHURCHES**

Letter #1 to Ephesus [Rev. 2:1-7]: "You have left your first love" (v. 4).

Letter #2 to Smyrna [Rev. 2:8-11]: "Be faithful until death, and I will give you the crown of life" (v. 10).

Letter #3 to Pergamum [Rev. 2:12-17]: "To him who overcomes I will give some of the hidden manna" (v. 17).

Letter #4 to Thyatira [Rev. 2:18-29]: "Hold fast what you have till I come" (v. 25).

Letter #5 to Sardis [Rev. 3:1-6]: "Remember therefore how you have received and heard; hold fast and repent" (v. 3).

Letter #6 to Philadelphia [Rev. 3:7-13]: "I have set before you an open door, and no one can shut it" (v. 8).

Letter #7 to Laodicea [Rev. 3:14-22]: "You are neither cold nor hot. I could wish you were cold or hot" (v. 15).

## **JESUS' SEVEN STATEMENTS FROM THE CROSS**

Last Words #1: "Father, forgive them, for they do not know what they do" [Luke 23:34].

Last Words #2: "Assuredly, I say to you, today you will be with Me in Paradise" [Luke 23:43].

Last Words #3: "Woman, behold your son! . . . Behold your mother!" [John 19:26-27].

Last Words #4: "My God, My God, why have You forsaken Me?" [Matt. 27:46].

Last Words #5: "I thirst!" [John 19:28].

Last Words #6: "It is finished!" [John 19:30].

Last Words #7: "Father, 'into Your hands I commit My spirit'" [Luke 23:46].

**JESUS' SEVEN "I AM" STATEMENTS**

"I Am" #1: "I am the bread of life. He who comes to Me shall never hunger, and he who believes in Me shall never thirst" [John 6:35].

"I Am" #2: "I am the light of the world. He who follows Me shall not walk in darkness, but have the light of life" [John 8:12].

"I Am" #3 and #4: "I am the door. . . . I am the good shepherd" [John 10:7, 11].

"I Am" #5: "I am the resurrection and the life" [John 11:25].

"I Am" #6: "I am the way, the truth, and the life. No one comes to the Father except through Me" [John 14:6].

"I Am" #7: "I am the vine" [John 15:5].