

## Handout:

- Apollo software timeline
- Lunar landing timeline/checklist

## Videos of test flights of LLRV

- Thrusters/servos are H<sub>2</sub>O<sub>2</sub>; generates a lot of steam when fired (reacts with air)
- computer sits on the opposite end of the craft; its weight balances the pilot's (this is delightfully metaphorical)
- flies pretty much like a helicopter (one main engine is centered underneath the craft; the rest of the flight is directional, and balancing (controlling attitude, etc))
- unlocking the gimble allows the computer to simulate the lunar environment; the craft pitches forward much more than a helicopter would because it's simulating 1/6 of the Earth's gravity

Armstrong didn't trust the velocity meter because in helicopters, when close the ground, you end up with a big bias because you're picking up the reflection of the motor blades. He realized that the LM didn't have blades, but still didn't trust the velocity meter.

## Lunar landing videos

- following along on the handout
- Armstrong noted that they'd tested a lot of things during the simulations, but not the fuzzy/static communications between the LM and ground control
- Note on the computer readout: the delta-H display took up a lot of processing power because the computer calculated in meters, but displayed in feet
- Once Armstrong said, "Picking up some dust," Garman really realized, finally, that this was real and not another simulation.

Watched the lunar landing scene in "From Long Island to the Moon"

## What went wrong/right about the landing?

- lack of communication between divisions when changes were made
- tests weren't realistic for actual LM flight
- "program alarm" made things seem more serious than they were; it was problematic because it distracted the astronauts
- Training program had obviously been effective, because Armstrong had the confidence to go ahead with the mission despite the alarms and problems (and he was correct in doing so)

## Why not test the LM landing on the moon automatically/unmanned, first?

- because if they had, they probably wouldn't have put a human on the moon before 1970
- Americans didn't have the same "test everything fully automated, first" like the Soviets did. On the one hand, this made NASA more successful at putting a man on the moon, but on the other, it did cause future problems (i.e. shuttle tragedies).

- Didn't seem "worth it" to send something to the moon just to make sure it worked.