



ORBIT



1
00:00:00,000 --> 00:00:05,160
(Music)

2
00:00:05,180 --> 00:00:09,470
Narrator: Like other commuters in the South Bay, the people who work at Ames Research Center

3
00:00:09,490 --> 00:00:13,620
have to navigate the same earth-bound traffic as everyone else.

4
00:00:13,640 --> 00:00:18,660
But between the hangar that once housed a 1930s airship, and the largest wind tunnel,

5
00:00:18,680 --> 00:00:22,160
is a world that takes them to the boundaries of human exploration.

6
00:00:22,180 --> 00:00:24,250
(Music)

7
00:00:24,270 --> 00:00:33,010
(Mission Control: 4..3..2..1..We have booster ignition and liftoff of the space shuttle Atlantis..)

8
00:00:33,030 --> 00:00:40,040
(Roar of rockets and radio chatter)

9
00:00:40,060 --> 00:00:46,030
(Music)

10
00:00:46,050 --> 00:00:50,920
Narrator: In the 1960s, the concept of a space shuttle was pure science fiction

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00:00:50,940 --> 00:00:58,960
until NASA and President Nixon announced the Space Transportation System in early 1972.

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00:00:58,980 --> 00:01:04,850
This space vehicle would launch like a rocket to low earth orbit.

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00:01:04,870 --> 00:01:09,450

Its crew would release satellites and deliver parts for the space station.

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00:01:09,470 --> 00:01:14,780

A fiery plunge back into the atmosphere would turn the vehicle into a glider

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00:01:14,800 --> 00:01:19,660

that could be piloted to a controlled landing on a runway.

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00:01:19,680 --> 00:01:24,020

It would be the most complex machine ever built.

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00:01:24,040 --> 00:01:31,360

On April 12, 1981, NASA successfully launched STS-1, the first shuttle mission.

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00:01:31,380 --> 00:01:40,360

Safely accelerating this machine to 17,500 miles an hour required years of sophisticated aerodynamic tests.

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00:01:40,380 --> 00:01:44,620

Over half of all wind tunnel tests for the shuttle were done at Ames.

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00:01:44,640 --> 00:01:49,680

These facilities provided an unmatched range of sizes and speeds.

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00:01:49,700 --> 00:01:55,470

In the 1970s, Ames tunnels allowed scientists to actually see complex shock waves

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00:01:55,490 --> 00:02:00,270

created by the shuttle before the first orbiter, Columbia, ever flew.

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00:02:00,290 --> 00:02:05,730

The same wind tunnels conducted safety tests of new fuel tank features in 2005

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00:02:05,750 --> 00:02:09,830

before the shuttle returned to flight status.

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00:02:09,850 --> 00:02:15,760

Ames computer simulations began in the 1970s and then improved exponentially.

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00:02:15,780 --> 00:02:20,830

Today they can simulate speeds and conditions no wind tunnel could match.

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00:02:20,850 --> 00:02:26,750

Work done on the Columbia supercomputer helped put the shuttle back into flight in 2005.

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00:02:26,770 --> 00:02:31,820

(Music)

29

00:02:31,840 --> 00:02:36,100

The shuttle has performed many transportation tasks while in orbit.

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00:02:36,120 --> 00:02:40,450

Dozens of satellites and spacecraft were launched from the payload bay.

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00:02:40,470 --> 00:02:44,030

One was Galileo, developed in part by Ames.

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00:02:44,050 --> 00:02:49,470

It eventually spent years orbiting Jupiter, collecting new data and images.

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00:02:49,490 --> 00:02:54,730

More recently shuttles have carried components of the International Space Station.

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00:02:54,750 --> 00:03:03,580

(Music)

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00:03:03,600 --> 00:03:07,740

All astronauts agree the perspective from orbit is breathtaking.

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00:03:07,760 --> 00:03:11,040

But not all of them are comfortable in zero gravity.

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00:03:11,060 --> 00:03:14,030

Now that humans are spending more time in this environment,

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00:03:14,050 --> 00:03:19,030

the study of how it affects living organisms is critical for the future of spaceflight.

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00:03:19,050 --> 00:03:24,170

Ames' Life Sciences division explored this subject for over 40 years.

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00:03:24,190 --> 00:03:29,110

Some experiments were done on the ground, and others were conducted on the shuttle.

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00:03:29,130 --> 00:03:35,570

Flight experiments were installed in specifically designed lab modules carried in the shuttle's payload bay.

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00:03:35,590 --> 00:03:40,070

Starting in April of 1991, Ames participated in shuttle missions

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00:03:40,090 --> 00:03:49,100

such as Spacelab Life Sciences 1 and 2; International Microgravity Labs 1 and 2; Spacelab J and Neurolab.

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00:03:49,120 --> 00:03:55,030

These studied the effects of space flight conditions on plants, animals, and humans.

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00:03:55,050 --> 00:04:00,720

Now we have a much better understanding of how zero gravity affects our balance and visual perception;

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00:04:00,740 --> 00:04:07,790

how muscles, bone, and blood are affected; how immune systems change; and how plants grow.

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00:04:07,810 --> 00:04:16,040

Results have already helped astronauts adapt to different gravity levels on missions, and recover faster after la

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00:04:16,060 --> 00:04:21,680

(Music)

49

00:04:21,700 --> 00:04:25,890

Next to launch, reentry is the most dangerous part of a shuttle's flight.

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00:04:25,910 --> 00:04:32,690

Ames developed a technique in 1953 that has since been used by all American spacecraft since then.

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00:04:32,710 --> 00:04:38,360

Ames scientist Harvey Allen rendered 1950s spaceplane designs obsolete.

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00:04:38,380 --> 00:04:42,780

He showed that a blunt body, not a pointed one, could survive reentry better

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00:04:42,800 --> 00:04:46,990

by creating a shock wave that would act as another heat shield.

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00:04:47,010 --> 00:04:54,250

This idea was used to create the shapes for Mercury, Gemini, Apollo and every other American space vehicle.

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00:04:54,270 --> 00:04:59,220

Although the shuttle uses the same principle, it still needs insulation from extreme heat.

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00:04:59,240 --> 00:05:05,080

Starting in the 1970s, Ames scientists developed featherlight insulation tiles.

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00:05:05,100 --> 00:05:08,340

Ames also developed the largest Arc Jet wind tunnel.

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00:05:08,360 --> 00:05:14,060

This high-speed blowtorch allowed them to test tile materials at 3,500 degrees,

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00:05:14,080 --> 00:05:18,960

the same temperature as the outer surface of a shuttle during re-entry.

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00:05:18,980 --> 00:05:26,350

These reusable tiles were so successful, they were incorporated into most of the shuttle's main heat shield sur

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00:05:26,370 --> 00:05:30,490

After a shuttle lands, the stress on the tiles is obvious.

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00:05:30,510 --> 00:05:33,420

To help technicians check thousands of tiles for damage,

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00:05:33,440 --> 00:05:39,950

Ames developed a hand-held laser scanner that speeds the process considerably.

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00:05:39,970 --> 00:05:43,960

After debris damaged the leading edge of Columbia's wing in 2003,

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00:05:43,980 --> 00:05:48,050

the Arc Jet was tasked with testing proposed patch materials.

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00:05:48,070 --> 00:05:54,920

The resulting test data was fed into the Columbia supercomputer, which further predicted reliability on reentry.

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00:05:54,940 --> 00:05:58,510

(Music)

68

00:05:58,530 --> 00:06:00,080

(Mission Control on Radio: You're go for landing, over)

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00:06:00,100 --> 00:06:04,760

A shuttle during descent has been described like a brick with wings.

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00:06:04,780 --> 00:06:08,910

An early question was how to give it effective flight control.

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00:06:08,930 --> 00:06:13,460

Ames' earlier innovations provided a foundation for the shuttle's basic concept.

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00:06:13,480 --> 00:06:19,170

Starting in 1957, Al Eggers and Sy Syvertson developed and tested lifting bodies:

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00:06:19,190 --> 00:06:23,910

simple shapes that could survive re-entry and provide just enough lift and control

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00:06:23,930 --> 00:06:28,920

so they could glide unpowered to safe landing.

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00:06:28,940 --> 00:06:37,390

High altitude drop tests at Edwards Air Force Base in the 1960s proved their airworthiness.

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00:06:37,410 --> 00:06:43,680

Before the orbiter Enterprise was flight tested in 1977, Ames did extensive wind tunnel tests

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00:06:43,700 --> 00:06:48,650

of the shuttle perched atop its 747 carrier aircraft.

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00:06:48,670 --> 00:06:54,500

Starting in 1970, long before a final shuttle design, a flight simulator at Ames

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00:06:54,520 --> 00:06:59,080

allowed astronauts to fly approaches while testing prototype flight controls.

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00:06:59,100 --> 00:07:04,580

Astronauts Gordon Fullerton and Fred Haise practiced in a larger and movable simulator at Ames

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00:07:04,600 --> 00:07:07,640

before climbing into the Enterprise.

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00:07:07,660 --> 00:07:17,300

Minor control problems on the first flight were ironed out in the same simulator to improve later tests in 1977.

83

00:07:17,320 --> 00:07:19,560

(Sound of jet engines)

84

00:07:19,580 --> 00:07:23,850

The commuters who come the farthest to Ames are the shuttle pilots and commanders.

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00:07:23,870 --> 00:07:28,620

Starting with the crew of the first mission, STS-1, every shuttle pilot and commander

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00:07:28,640 --> 00:07:32,820

has practiced hundreds of landings in Ames' Vertical Motion Simulator.

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00:07:32,840 --> 00:07:35,580

It offers the most realistic flight movement available.

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00:07:35,600 --> 00:07:42,580

The head-up display developed here was incorporated into Columbia's cockpit before the first flight in 1981

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00:07:42,600 --> 00:07:48,490

and is a part of every orbiter today.

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00:07:48,510 --> 00:07:52,390

Ames wind tunnel tests also proved the safety of the long-distance carrier

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00:07:52,410 --> 00:07:57,940

that returned the shuttle to Florida after landings in California.

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00:07:57,960 --> 00:08:01,820

Today, NASA is developing the Multi-Purpose Crew Vehicle.

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00:08:01,840 --> 00:08:08,150

This Apollo-shaped capsule will be used for exploration missions beyond low-earth orbit.

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00:08:08,170 --> 00:08:16,000

Ames will contribute the highest level of scientific expertise and innovation to create this new space vehicle.

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00:08:16,020 --> 00:08:22,630

And like they have for over 50 years, the Ames staff is still working with one foot in Silicon Valley