



29 DAYS ON
THE EDGE

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00:00:00,042 --> 00:00:10,710

This is a science mission on par with the Apollo missions, the space shuttle, International Space Station and other missions. For nearly two decades, thousands

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00:00:10,710 --> 00:00:16,570

of people, around the world, many spending their entire careers built the James Webb

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00:00:16,570 --> 00:00:31,939

Space Telescope. And it all comes down to this. Once we launch the James Webb Space

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00:00:31,939 --> 00:00:41,720

Telescope there are no second chances. We have 300 single-point failure items and they all have to work right

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00:00:41,720 --> 00:00:53,850

million miles from the Earth, you can't send someone to fix it. We've never put a telescope this

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00:00:53,850 --> 00:00:59,760

large in space. We want to see distant parts of the universe humans have never seen before.

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00:00:59,760 --> 00:01:06,480

Looking back in time almost 14 billion years to see the first galaxies that formed after

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00:01:06,480 --> 00:01:11,760

the big bang. And, we want to search for the building blocks of life in the atmospheres

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00:01:11,760 --> 00:01:19,810

of planets orbiting distant stars. To unfold the history of the universe, we must first

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00:01:19,810 --> 00:01:27,871

unfold this telescope. This is the largest primary mirror, the largest sunshield, and

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00:01:27,871 --> 00:01:33,940

most powerful space telescope ever built.
And yet, this large telescope needs to fit

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00:01:33,940 --> 00:01:40,260

inside a 5.4 meter diameter rocket fairing.
That's the largest fairing size available

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00:01:40,260 --> 00:01:44,770

on any rocket, and it's the fairing size on
our ride to space, the Ariane 5 provided by

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00:01:44,770 --> 00:01:52,020

the European Space Agency is one of the world's
most powerful rockets. To cheat the fairing

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00:01:52,020 --> 00:02:00,071

size limit, we built Webb to fold like origami,
to fit inside the rocket fairing. And this

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00:02:00,071 --> 00:02:03,510

brings us to the
most challenging part of this mission: Unfolding

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00:02:03,510 --> 00:02:12,120

it in space.six. cinq. quatre. Think of what
you are doing. You're taking this extraordinarily

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00:02:12,120 --> 00:02:17,200

delicate, precise, state-of-the-art scientific
instrument, and you're slapping on a rocket

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00:02:17,200 --> 00:02:24,710

and for the next 8 minutes, the explosion
from that rocket is following you into outer space.

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00:02:24,710 --> 00:02:35,400

Vibrating you. Shaking you. Everything
that goes into space has to live through this

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00:02:35,400 --> 00:02:44,470

environment and work once it gets there, without having someone come to fix it.

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00:02:44,470 --> 00:02:54,209

Two weeks. That's how long it takes Webb to fully deploy the Webb Telescope. We can take longer if we need

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00:02:54,209 --> 00:02:59,250

to, but those two weeks after launch are going to be nail-bitters. This is the Mission

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00:02:59,250 --> 00:03:04,980

Operations Center at the Space Telescope Science Institute in Baltimore. Those 2 weeks after

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00:03:04,980 --> 00:03:10,090

launch will be like our Super Bowl, World Cup, you pick the analogy. Years of training

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00:03:10,090 --> 00:03:18,330

comes down to these moments. The Webb Observatory has about 50 major

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00:03:18,330 --> 00:03:24,860

deployments.50! depending on how you categorize them. And 178 release mechanisms must work

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00:03:24,860 --> 00:03:32,410

to deploy those 50 parts. Every single one of them must work. Unfolding Webb is hands

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00:03:32,410 --> 00:03:37,920

down, the most complicated spacecraft activity we've ever done. Then again, nothing about

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00:03:37,920 --> 00:03:44,160

Webb is easy, we've never done this before. There's nothing simple about sending anything

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00:03:44,160 --> 00:03:57,470

into space. You can't do it without taking risks. This mission is squarely in new spacecraft territory. Webb is the perfect example of science desire

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00:03:57,470 --> 00:04:04,510

driving engineering capability to new frontiers. Webb's unique design is born from

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00:04:04,510 --> 00:04:16,500

reasoned engineering to accomplish its science goals. Here is the plan. Shortly after launch,

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00:04:16,500 --> 00:04:24,270

we unfold Webb's solar panel for power, and a high gain antenna for communication. About 12 hours later, we

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00:04:24,270 --> 00:04:29,639

firing that sends Webb on the proper course toward its orbital destination, about 1-million

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00:04:29,639 --> 00:04:36,009

miles away. That's where it will do its science. Webb will be moving so fast, it passes the

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00:04:36,009 --> 00:04:40,620

Moon's orbit in one and a half days, half the time it took Apollo astronauts to reach

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00:04:40,620 --> 00:04:48,289

Lunar orbit. First, we lower the sunshield pallets, then raise Webb's primary mirror

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00:04:48,289 --> 00:04:53,009

and instruments away from the sunshield. The solar wind will push us around

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00:04:53,009 --> 00:04:58,419

with the sunshield open, so we'll unfold a trim tab to help keep us stable. We've got

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00:04:58,419 --> 00:05:03,819

this huge iconic golden segmented mirror that

will help us deliver amazing new images of

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00:05:03,819 --> 00:05:08,589
the cosmos. But in some ways the sunshield
is a lot more complicated, and it's just as

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00:05:08,589 --> 00:05:16,129
essential. Without it, nothing works. Here
we've got 5 sunshield layers, approximately 8900 square

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00:05:16,129 --> 00:05:20,499
feet, almost the size of 3 tennis courts of very thin Kapton

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00:05:20,499 --> 00:05:26,289
material about one to two thousandths of an
inch thick. Making them go where you want

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00:05:26,289 --> 00:05:33,279
them to go in zero-G, is extremely challenging.
The sunshield shades the telescope from the

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00:05:33,279 --> 00:05:38,349
heat of the Sun, Earth and Moon. The concept
is simple but, there's nothing simple about

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00:05:38,349 --> 00:05:44,960
the design or operation, especially when you
get in space. Webb's sunshield assembly includes

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00:05:44,960 --> 00:05:51,889
140 release mechanisms, approximately 70 hinge
assemblies, 8 deployment motors, bearings,

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00:05:51,889 --> 00:06:00,499
springs and gears, about 400 pulleys and 90
cables totaling 1312 feet. All this just to

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00:06:00,499 --> 00:06:07,680
keep the sunshield under control as it unfolds.
First, we release these special restraints

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00:06:07,680 --> 00:06:12,030

that protect the sunshield during launch.

They roll out of the way, but not all the

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00:06:12,030 --> 00:06:19,139

way until we are ready to deploy a side. Next,

we release a set of covers over the core region.

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00:06:19,139 --> 00:06:28,289

Now comes the critical point - All 107 sunshield

release mechanisms need to fire on cue. 107.

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00:06:28,289 --> 00:06:48,189

They free the five sunshield layers, allowing them

to extend as the mid-booms deploy.

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00:06:48,189 --> 00:06:53,490

With the sunshield fully deployed, we start setting

up the optics. First, the secondary mirror

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00:06:53,490 --> 00:06:59,020

is extended and locked into place. And a special

radiator behind Webb is extended which helps

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00:06:59,020 --> 00:07:04,639

further lower the temperature of the science

instruments. Finally, we open the primary mirror's

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00:07:04,639 --> 00:07:12,250

wings and lock them in place. With

that done, Webb is in its final configuration.

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00:07:12,250 --> 00:07:20,259

But we're not done yet. After 47 deployments,

and accomplishing the hardest spacecraft unfolding

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00:07:20,259 --> 00:07:26,449

NASA has ever done, Webb still won't be ready

for science. While the instruments cool, we'll

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00:07:26,449 --> 00:07:31,629
control motors behind each of Webb's 18 mirror segments, the secondary mirror and the in

63
00:07:31,629 --> 00:07:37,979
the fine steering mirror located inside the center of the primary mirror. We'll precisely align

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00:07:37,979 --> 00:07:44,479
the mirror segments to form a perfect mirror.
Then, Webb will be ready to explore the cosmos.