1
00:00:00,633 --> 00:00:02,869
[■]
[Blender blending]

2
00:00:02,902 --> 00:00:04,737
4th of July is coming up and
everyone's gonna have

3
00:00:04,770 --> 00:00:06,706
some nice ice-cold beverages.

4
00:00:06,739 --> 00:00:07,707
[Blender switches off]

5
00:00:07,740 --> 00:00:09,042
But do you know where it
won't be very sunny,

6
00:00:09,075 --> 00:00:11,911
is about a half a billion miles
from here near Jupiter.

7
00:00:11,944 --> 00:00:14,147
NASA's Juno spacecraft
will be arriving there

8
00:00:14,180 --> 00:00:16,883
this 4th of July, making it
humanity's most distant

9
00:00:16,916 --> 00:00:18,284
solar powered spacecraft.

10
00:00:18,317 --> 00:00:21,120
And all of its systems,
including keeping it warm,

11
00:00:21,153 --> 00:00:22,889
are powered by about the

same amount of power

12
00:00:22,922 --> 00:00:24,590
this blender currently uses.

13
00:00:24,623 --> 00:00:26,492
How is that even
possible so far away?

14
00:00:26,525 --> 00:00:29,496
Let's find out on this
episode of Crazy Engineering.

15
00:00:29,728 --> 00:00:37,270
[■]

16
00:00:39,405 --> 00:00:41,374
Right, we're here with
Tracy in this huge room.

17
00:00:41,407 --> 00:00:41,974
Hello Tracy!

18
00:00:42,007 --> 00:00:42,475
Hello!

19
00:00:43,476 --> 00:00:44,043
Can you tell us a
little bit about the room

20
00:00:44,076 --> 00:00:44,510
that we're standing in?

21
00:00:44,543 --> 00:00:45,678
Yes!

22
00:00:45,711 --> 00:00:47,447
We're here in High Bay
1, which is JPL's oldest,

23
00:00:47,480 --> 00:00:49,582
largest cleanroom, where
we assemble spacecraft.

24
00:00:49,615 --> 00:00:51,417
Ok and what are we
standing in front of today?

25
00:00:51,450 --> 00:00:54,454
We are standing in front of
one of the test units for a

26
00:00:54,487 --> 00:00:55,588
Juno solar array.

27
00:00:56,188 --> 00:00:58,324
Juno's a mission that is
going to Jupiter to learn

28
00:00:58,357 --> 00:01:00,493
more about the planet
and how it was formed.

29
00:01:00,826 --> 00:01:02,795
This is a full
scale test unit and

30
00:01:02,828 --> 00:01:05,264
it's one of three on
the Juno spacecraft.

31
00:01:05,297 --> 00:01:06,866
Why does it have
to be this big?

32
00:01:07,333 --> 00:01:09,102
Jupiter is five times
farther away from the sun

33
00:01:09,135 --> 00:01:12,505
than the Earth is, and the
amount of sunlight you get

34
00:01:12,538 --> 00:01:14,841
is decreasing by the
square of the distance.

35
00:01:14,874 --> 00:01:16,776
So, instead of 1/5th the
amount of power,

36
00:01:16,809 --> 00:01:18,878
we have 1/25th the
amount of power.

37
00:01:18,978 --> 00:01:21,514
So, we need to have a lot
of area on our solar arrays

38
00:01:21,547 --> 00:01:23,749
because the spacecraft is
so far away from the sun.

39
00:01:23,782 --> 00:01:26,452
And also over the last 20
years, we've had about a

40
00:01:26,485 --> 00:01:28,988
50-percent increase in
solar array efficiency.

41
00:01:29,021 --> 00:01:31,224
And that makes it easier
to do at that distance.

42
00:01:31,423 --> 00:01:33,960
If we had these solar arrays
here on Earth, they would

43
00:01:33,993 --> 00:01:36,863
actually generate about
14 kilowatts of power.

44
00:01:36,896 --> 00:01:39,398
But all the way out at
Jupiter, they only generate

45
00:01:39,431 --> 00:01:41,167
about 500 watts of power.

46
00:01:42,635 --> 00:01:45,338
These things are so huge and
heavy, I imagine it's a bit

47
00:01:45,371 --> 00:01:47,840
of a challenge to test ‘em on
Earth before you go to space.

48
00:01:47,873 --> 00:01:51,177
Yeah, these solar arrays weigh
about 250 pounds apiece.

49
00:01:51,210 --> 00:01:52,979
Here on Earth, when
we tested them,

50
00:01:53,012 --> 00:01:55,148
we only deployed one at a time
because we didn't have a

51
00:01:55,181 --> 00:01:57,116
clean room facility big
enough to do all three.

52
00:01:57,149 --> 00:02:00,553
And we also had to do them
sideways and support them

53

00:02:00,586 --> 00:02:02,121
on these posts with
wheels on the bottom,

54
00:02:02,154 --> 00:02:04,657
so you could gently roll them
out and make sure that the

55
00:02:04,690 --> 00:02:07,627
hinges and dampers and all of
that were working just fine.

56
00:02:08,828 --> 00:02:10,863
Juno is one of the largest
spacecraft I've ever seen.

57
00:02:10,896 --> 00:02:13,166
How do you package that
up onto a launch vehicle?

58
00:02:13,599 --> 00:02:15,635
Our spacecraft is
about 65 feet across,

59
00:02:15,668 --> 00:02:16,569
with the arrays deployed,

60
00:02:16,603 --> 00:02:18,004
and that certainly
wasn't gonna work.

61
00:02:18,170 --> 00:02:19,705
So, when we launch
the vehicle,

62
00:02:19,738 --> 00:02:21,574
it has to be folded
up small enough

63
00:02:21,607 --> 00:02:23,809

to fit into the nose
cone of the rocket.

64
00:02:23,842 --> 00:02:26,712
And you'll notice that the
cells are in the inside

65
00:02:26,745 --> 00:02:29,081
and so they wouldn't be getting
any power from the sun.

66
00:02:29,114 --> 00:02:31,117
That was a really interesting
time for the team

67
00:02:31,150 --> 00:02:32,685
during launch, just
knowing that we had to

68
00:02:32,718 --> 00:02:34,987
make sure the arrays were
deployed to get sun,

69
00:02:35,020 --> 00:02:37,190
or the spacecraft
would just have died.

70
00:02:38,190 --> 00:02:39,158
So, we're deployed.

71
00:02:39,191 --> 00:02:40,025
We're absorbing energy.

72
00:02:40,059 --> 00:02:41,661
When do we hope to
arrive at Jupiter?

73
00:02:41,694 --> 00:02:45,198
We're going to arrive on
July 4th of 2016,

74
00:02:45,231 --> 00:02:48,634
and the mission is gonna last
until February of 2018.

75
00:02:48,667 --> 00:02:49,902
Great! We'll be watching

76
00:02:49,935 --> 00:02:51,437
and you guys out
there stay tuned

77
00:02:51,470 --> 00:02:53,773
for that mission getting to
Jupiter and check back again

78
00:02:53,806 --> 00:02:55,208
for some other
Crazy Engineering.

79
00:02:55,241 --> 00:03:02,582
[■]

80
00:03:04,316 --> 00:03:05,451
If you guys like that,

81
00:03:05,484 --> 00:03:07,186
you can click over here to
watch more Crazy Engineering

82
00:03:07,219 --> 00:03:10,223
or click here to subscribe
to the JPL YouTube channel.

83
00:03:10,256 --> 00:03:11,324
If you wanna learn a
lot more about