1
00:00:00,229 --> 00:00:03,990
All right, so we've got lettuce over there,
peppers, now we've got tomatoes—looks

2
00:00:03,990 --> 00:00:05,760
like all the makings of a salad.

3
00:00:05,760 --> 00:00:06,960
Can I eat one?

4
00:00:06,960 --> 00:00:08,340
No.

5
00:00:13,340 --> 00:00:18,440
We're checked in here at Kennedy Space Center,
our nation's leading multi-user spaceport.

6
00:00:18,449 --> 00:00:21,630
And we're getting our passport stamped at
the plant research lab.

7
00:00:21,630 --> 00:00:23,960
I'm here with plant scientist Gioia Massa.

8
00:00:23,960 --> 00:00:30,050
So Gioia, what role does Kennedy Space Center
play in research and food production in space?

9
00:00:30,050 --> 00:00:34,910
Kennedy is the plant center for the agency,
which means we coordinate research that's funded

10
00:00:34,910 --> 00:00:38,030
by NASA and universities and we also do research
here.

11
00:00:38,030 --> 00:00:43,710
And we're doing research on food production
methods and types of crops to grow to feed

12
00:00:43,710 --> 00:00:49,020
the crew on future exploration missions, and
also strategies for hardware development.

13
00:00:49,020 --> 00:00:54,620
And we do develop some of the hardware here
or we work with companies, like the Veggie and

14
00:00:54,620 --> 00:00:57,640
the Plant Habitat hardware that's on the
International Space Station.

15
00:00:57,640 --> 00:01:02,260
So we do a lot of work on that hardware and
the other types of hardware that are coming

16
00:01:02,260 --> 00:01:03,260
for the future.

17
00:01:03,260 --> 00:01:05,560
So, Gioia, what is Veggie?

18
00:01:05,560 --> 00:01:09,410
Veggie is a small plant-growth chamber that
we have on the International Space Station.

19
00:01:09,410 --> 00:01:12,800
We actually have two Veggie units up there
right now.

20
00:01:12,800 --> 00:01:16,050
And it's kind of like an astronaut garden
in some ways.

21
00:01:16,050 --> 00:01:21,300
It uses LED lights and fans to move the air
around, but everything else in the environment

22

00:01:21,300 --> 00:01:24,190
is really input by the space station.

23
00:01:24,190 --> 00:01:28,340
The temperature, the atmosphere and the humidity
are controlled by the space station.

24
00:01:28,350 --> 00:01:32,100
So, Gioia, why is it important to grow produce
in space?

25
00:01:32,110 --> 00:01:34,620
The astronauts have a really good packaged
diet.

26
00:01:34,620 --> 00:01:38,880
They have over 200 foods and a fair amount
of variety.

27
00:01:38,880 --> 00:01:44,490
But over time, that diet will slowly degrade
if it’s stored, and the quality will decrease,

28
00:01:44,490 --> 00:01:46,540
and also the nutrients will decrease.

29
00:01:46,540 --> 00:01:48,920
Some of the vitamins will break down.

30
00:01:48,920 --> 00:01:52,050
And for the International Space Station this
isn’t really a big deal.

31
00:01:52,050 --> 00:01:54,090
They get fresh food very often.

32
00:01:54,090 --> 00:01:59,240
But when we’re on a long-duration mission
to Mars, the food may have to be sent ahead

33
00:01:59,240 --> 00:02:04,310
of time, and it may be very old by the time
the astronauts get to eat it.

34
00:02:04,310 --> 00:02:07,560
So we want to use produce to supplement this
nutrition.

35
00:02:07,560 --> 00:02:13,129
They can get fresh, bioavailable nutrients
from the plants that they eat, and this will

36
00:02:13,129 --> 00:02:14,750
help give them a balanced diet.

37
00:02:14,750 --> 00:02:19,959
OK, so Gioia, how do we grow plants in space
when you’re dealing with microgravity and

38
00:02:19,959 --> 00:02:20,959
no sunlight?

39
00:02:20,959 --> 00:02:21,990
How does that work?

40
00:02:21,990 --> 00:02:25,909
We control the environment of the plants so
that it mimics the environment that we have

41
00:02:25,909 --> 00:02:28,299
on Earth as much as we can.

42
00:02:28,299 --> 00:02:33,430
And so we’ll add LED lights, light-emitting
diodes, and we’ll put them in colors that

43
00:02:33,430 --> 00:02:37,120
the plants can easily utilize for growth.

44
00:02:37,120 --> 00:02:39,930
Watering is the biggest challenge that we
have.

45
00:02:39,930 --> 00:02:44,849
And so we have to provide both water and oxygen
to the plant roots.

46
00:02:44,849 --> 00:02:46,900
Plant roots breathe like we do.

47
00:02:46,900 --> 00:02:49,870
And without gravity, that becomes really difficult.

48
00:02:49,870 --> 00:02:54,390
Water behaves kind of strangely; it forms
blobs and it coats surfaces.

49
00:02:54,390 --> 00:02:57,000
And water and air don’t mix well.

50
00:02:57,000 --> 00:03:02,249
And so we’re looking at a lot of different
ways to water plants in space, to try and get

51
00:03:02,249 --> 00:03:04,459
not too little water, not too much water.

52
00:03:04,460 --> 00:03:07,670
We don’t want to drown the plants and we
don’t want to dry them out.

53
00:03:07,670 --> 00:03:11,840
We think with a little bit of gravity, like what
you might have on the Moon or Mars, maybe

54
00:03:11,860 --> 00:03:16,330
the fluids will behave much more like they
do on Earth and we’ll be able to water plants

55
00:03:16,330 --> 00:03:17,330
more normally.

56
00:03:17,330 --> 00:03:21,520
So, Gioia, what plants have been grown in
Veggie so far on the International Space Station?

57
00:03:21,520 --> 00:03:26,040
We've done a lot of work in Veggie with what
we call leafy green crops.

58
00:03:26,049 --> 00:03:32,660
This includes three different kinds of lettuce,
a Chinese cabbage variety, Mizuno mustard,

59
00:03:32,670 --> 00:03:35,389
and most recently, a red Russian kale.

60
00:03:35,389 --> 00:03:36,579
And they've all done pretty well.

61
00:03:36,579 --> 00:03:38,680
We've had some challenges with the watering.

62
00:03:38,680 --> 00:03:41,150
We've also grown flowers in Veggie.

63
00:03:41,150 --> 00:03:46,500
We grew the zinnias, and this was astronauts
Scott Kelly and Kjell Lindgren who grew these.

64
00:03:46,500 --> 00:03:51,920
You need flowering for producing things like
tomatoes and peppers, the small fruits that

65
00:03:51,920 --> 00:03:52,920
we want to grow.

66
00:03:52,920 --> 00:03:56,409
Okay, so are we going to be growing potatoes,
like in “The Martian,” anytime soon?

67
00:03:56,409 --> 00:03:59,080
Potatoes are a really good crop!

68
00:03:59,080 --> 00:04:02,520
But on the International Space Station right
now, we don’t have any way to cook anything.

69
00:04:02,529 --> 00:04:04,460
They don’t even have a microwave.

70
00:04:04,470 --> 00:04:08,840
So we really want to grow crops that you want
to just grow and eat raw.

71
00:04:08,840 --> 00:04:11,080
And raw potatoes don’t really appeal to
most people.

72
00:04:11,080 --> 00:04:16,530
All right, so I guess French fries and a freshly
grilled cheeseburger are out, at least for

73
00:04:16,530 --> 00:04:17,880
the astronauts right now.

74
00:04:17,880 --> 00:04:20,330
But hopefully they’ll be able to enjoy a
side salad soon.