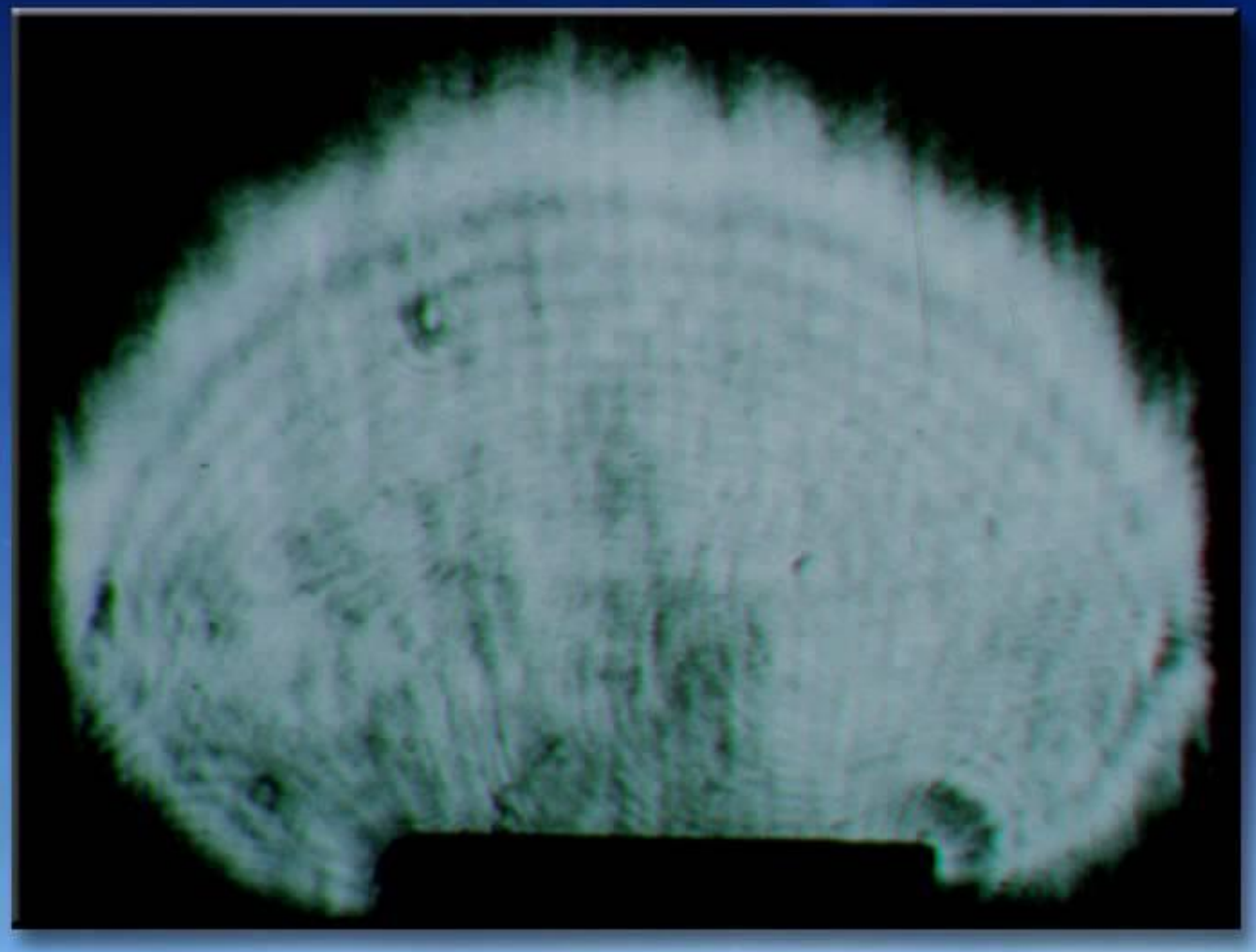
Crystal Growing in Microgravity



1
00:00:03,189 --> 00:00:01,990
the next

2
00:00:04,950 --> 00:00:03,199
shipment of supplies for the

3
00:00:07,190 --> 00:00:04,960
international space station is due to

4
00:00:09,350 --> 00:00:07,200
launch on sunday as mentioned and that

5
00:00:10,790 --> 00:00:09,360
dragon vehicle will be bringing supplies

6
00:00:14,789 --> 00:00:10,800
for the crew members plus station

7
00:00:18,630 --> 00:00:16,230
among those experiments are some

8
00:00:22,630 --> 00:00:18,640
focusing on protein crystal growth

9
00:00:24,550 --> 00:00:22,640
including one known as cpcghm

10
00:00:27,910 --> 00:00:24,560
for commercial protein crystal growth

11
00:00:29,910 --> 00:00:27,920
high density modified

12
00:00:31,830 --> 00:00:29,920
principal investigator is dr larry

13
00:00:34,069 --> 00:00:31,840

delucas the director of

14
00:00:36,950 --> 00:00:34,079
the center for structural biology at the

15
00:00:38,709 --> 00:00:36,960
university of alabama at birmingham who

16
00:00:40,630 --> 00:00:38,719
has a history of space-based research

17
00:00:42,150 --> 00:00:40,640
that includes his flight as a payload

18
00:00:44,630 --> 00:00:42,160
specialist on space shuttle mission

19
00:00:47,270 --> 00:00:44,640
sts-50 the first flight of the united

20
00:00:48,869 --> 00:00:47,280
states microgravity laboratory

21
00:00:50,709 --> 00:00:48,879
i spoke with him recently about this

22
00:00:53,029 --> 00:00:50,719
experiment and asked him to comment on

23
00:00:54,389 --> 00:00:53,039
the focus on membrane proteins in the

24
00:00:56,830 --> 00:00:54,399
human body we'll listen to that

25
00:01:00,549 --> 00:00:56,840
interview now this is mission control

26
00:01:04,070 --> 00:01:00,559
houston in our body in bacteria and

27
00:01:06,630 --> 00:01:04,080
viruses uh there's proteins that um

28
00:01:09,270 --> 00:01:06,640
exist in the membranes uh

29
00:01:11,910 --> 00:01:09,280
of of these uh organisms

30
00:01:13,830 --> 00:01:11,920
and in in the human system

31
00:01:16,070 --> 00:01:13,840
there's literally you know

32
00:01:19,429 --> 00:01:16,080
thousands of different membrane proteins

33
00:01:21,429 --> 00:01:19,439
and they play key roles uh biologically

34
00:01:23,749 --> 00:01:21,439
such as signal transduction when

35
00:01:25,350 --> 00:01:23,759
something happens outside a cell how

36
00:01:27,670 --> 00:01:25,360
does that information

37
00:01:31,190 --> 00:01:27,680
get imparted inside the cell to affect

38
00:01:32,789 --> 00:01:31,200

some other function within the cell

39
00:01:35,510 --> 00:01:32,799
they they

40
00:01:38,230 --> 00:01:35,520
they are critical in many many of the

41
00:01:40,870 --> 00:01:38,240
drugs that that we develop

42
00:01:42,230 --> 00:01:40,880
for different diseases um

43
00:01:45,590 --> 00:01:42,240
so

44
00:01:48,069 --> 00:01:45,600
the the unfortunate part of this is that

45
00:01:50,389 --> 00:01:48,079
if you look at how crystallography is

46
00:01:53,910 --> 00:01:50,399
used we crystallize the protein that

47
00:01:55,670 --> 00:01:53,920
we'd like to determine the structure for

48
00:01:58,630 --> 00:01:55,680
and membrane proteins are probably the

49
00:02:00,389 --> 00:01:58,640
most difficult ones of all to get

50
00:02:03,109 --> 00:02:00,399
not only to get a crystal but to get a

51
00:02:04,550 --> 00:02:03,119
crystal that is of high enough quality

52
00:02:06,830 --> 00:02:04,560
so that we can determine the

53
00:02:08,469 --> 00:02:06,840
three-dimensional structure using x-ray

54
00:02:09,910 --> 00:02:08,479
crystallography

55
00:02:12,150 --> 00:02:09,920
we have to make the crystals out of the

56
00:02:14,150 --> 00:02:12,160
proteins in order to study the structure

57
00:02:16,229 --> 00:02:14,160
itself and learn about how it functions

58
00:02:18,390 --> 00:02:16,239
exactly

59
00:02:20,710 --> 00:02:18,400
yeah and that's that's the you know kind

60
00:02:22,949 --> 00:02:20,720
of interesting and and it's fun to to

61
00:02:25,589 --> 00:02:22,959
crystallize the protein but the easy

62
00:02:27,350 --> 00:02:25,599
ones have been done in nature how do you

63
00:02:29,350 --> 00:02:27,360

grow these crystals in space and what's

64
00:02:31,350 --> 00:02:29,360
the station's uh the station cruise

65
00:02:32,630 --> 00:02:31,360
participation or the role in in growing

66
00:02:33,670 --> 00:02:32,640
these crystals while they're up there in

67
00:02:35,750 --> 00:02:33,680
space

68
00:02:38,710 --> 00:02:35,760
we know from previous experiments that

69
00:02:40,550 --> 00:02:38,720
the crystals grow much much more slowly

70
00:02:43,990 --> 00:02:40,560
because now the only thing that gets

71
00:02:46,070 --> 00:02:44,000
molecules to the crystal surface is

72
00:02:48,949 --> 00:02:46,080
just those natural vibration of

73
00:02:50,390 --> 00:02:48,959
molecules it's called free interface to

74
00:02:52,309 --> 00:02:50,400
well it's just called

75
00:02:53,830 --> 00:02:52,319
fixed law of diffusion they just vibrate

76
00:02:56,070 --> 00:02:53,840
bump into each other and make their way

77
00:02:58,070 --> 00:02:56,080
to the crystal but they grow literally

78
00:03:00,149 --> 00:02:58,080
in order of magnitude more slowly than

79
00:03:02,470 --> 00:03:00,159
they do here on earth which allows the

80
00:03:04,869 --> 00:03:02,480
molecule when it comes into the crystal

81
00:03:06,710 --> 00:03:04,879
to align itself more perfectly before

82
00:03:10,149 --> 00:03:06,720
the next one comes in and traps it in a

83
00:03:12,309 --> 00:03:10,159
misalignment wow that sounds fascinating

84
00:03:14,470 --> 00:03:12,319
that's what we're comparing is without

85
00:03:16,070 --> 00:03:14,480
you know buoyancy-induced convection

86
00:03:18,149 --> 00:03:16,080
which we get here on earth anytime we

87
00:03:20,470 --> 00:03:18,159
grow crystals by just letting the

88
00:03:22,790 --> 00:03:20,480

molecules slowly diffuse to the crystal

89
00:03:24,550 --> 00:03:22,800
you know not only we know we can get

90
00:03:25,430 --> 00:03:24,560
better crystals the question on this

91
00:03:26,949 --> 00:03:25,440
flight

92
00:03:29,670 --> 00:03:26,959
this is why we're flying a hundred of

93
00:03:31,110 --> 00:03:29,680
very difficult proteins to work with

94
00:03:33,670 --> 00:03:31,120
what percentage

95
00:03:36,710 --> 00:03:33,680
will be better and how much better will

96
00:03:38,710 --> 00:03:36,720
they be we want to statistically show

97
00:03:40,949 --> 00:03:38,720
you know once and for all the value of

98
00:03:42,710 --> 00:03:40,959
doing this and we have the advantage of

99
00:03:44,789 --> 00:03:42,720
a space station where the crystals will

100
00:03:47,509 --> 00:03:44,799
have plenty of time to grow to their

101
00:03:49,750 --> 00:03:47,519
full size so we have literally thousands

102
00:03:52,470 --> 00:03:49,760
of experiments going up so that each

103
00:03:55,030 --> 00:03:52,480
protein has multiple chances

104
00:03:57,429 --> 00:03:55,040
to try to get the very best crystals

105
00:03:59,830 --> 00:03:57,439
we're doing this also on the ground with

106
00:04:01,589 --> 00:03:59,840
ground controls using the same protein

107
00:04:04,630 --> 00:04:01,599
same batch everything everything's

108
00:04:07,589 --> 00:04:04,640
identical but we will not know when it

109
00:04:09,190 --> 00:04:07,599
returns in august which came from space

110
00:04:11,990 --> 00:04:09,200
and which are the ground controls

111
00:04:14,949 --> 00:04:12,000
everything has a barcode and only one

112
00:04:17,030 --> 00:04:14,959
engineer knows you know what's what

113
00:04:19,590 --> 00:04:17,040

it'll all be mixed together for each

114
00:04:20,949 --> 00:04:19,600
protein we'll do the entire analysis and

115
00:04:22,710 --> 00:04:20,959
when it's done

116
00:04:24,870 --> 00:04:22,720
only when we're completely finished will

117
00:04:27,350 --> 00:04:24,880
it be revealed which came from space and

118
00:04:29,510 --> 00:04:27,360
ground that way we eliminate any

119
00:04:31,110 --> 00:04:29,520
perceived bias that a scientist may

120
00:04:32,870 --> 00:04:31,120
choose a better crystal for space just

121
00:04:34,070 --> 00:04:32,880
to make it look better

122
00:04:35,830 --> 00:04:34,080
one

123
00:04:38,469 --> 00:04:35,840
other question that i would like to ask

124
00:04:39,990 --> 00:04:38,479
is uh why are the space grown crystals

125
00:04:41,830 --> 00:04:40,000
so important to have for research in the

126
00:04:43,189 --> 00:04:41,840
disease process and the drug development

127
00:04:44,150 --> 00:04:43,199
can you explain to

128
00:04:46,710 --> 00:04:44,160
um

129
00:04:48,230 --> 00:04:46,720
what the importance is for us

130
00:04:50,629 --> 00:04:48,240
and i want to point that out it's the

131
00:04:52,629 --> 00:04:50,639
one of the first steps the first step in

132
00:04:55,749 --> 00:04:52,639
drug development you know after you know

133
00:04:58,310 --> 00:04:55,759
the protein target is to design a a

134
00:05:00,550 --> 00:04:58,320
potential drug right that will interact

135
00:05:03,909 --> 00:05:00,560
with that protein by having the

136
00:05:05,670 --> 00:05:03,919
structure it makes it go much faster and

137
00:05:07,830 --> 00:05:05,680
usually you get a more

138
00:05:10,390 --> 00:05:07,840

effective drug with fewer side effects

139
00:05:12,150 --> 00:05:10,400
and there are many examples um not from

140
00:05:13,909 --> 00:05:12,160
space but from just ground-based

141
00:05:16,390 --> 00:05:13,919
research where drugs were developed

142
00:05:19,029 --> 00:05:16,400
using the structure of a protein

143
00:05:21,909 --> 00:05:19,039
it's sort of like if if you if you had

144
00:05:23,670 --> 00:05:21,919
to design a key right that would open my

145
00:05:26,390 --> 00:05:23,680
car door that's locked in the parking

146
00:05:28,790 --> 00:05:26,400
lot you know a locksmith has a key that

147
00:05:31,189 --> 00:05:28,800
will open all the car doors but if i

148
00:05:33,590 --> 00:05:31,199
showed him the structure of my lock he

149
00:05:36,150 --> 00:05:33,600
could make a key that would only unlock

150
00:05:39,270 --> 00:05:36,160
my car door by having the structure of

151
00:05:41,510 --> 00:05:39,280
the protein it helps you make a drug

152
00:05:44,230 --> 00:05:41,520
that's more specific so it interacts

153
00:05:46,230 --> 00:05:44,240
just with my protein and hopefully not

154
00:05:48,150 --> 00:05:46,240
others in our body because we literally

155
00:05:50,310 --> 00:05:48,160
have about a half million different

156
00:05:51,909 --> 00:05:50,320
proteins in our body when these drugs

157
00:05:53,830 --> 00:05:51,919
interact with proteins that you don't

158
00:05:58,309 --> 00:05:53,840
want them to that's how you

159
00:06:03,350 --> 00:06:00,390
very interesting again thank you larry

160
00:06:06,629 --> 00:06:03,360
for taking the time to talk with me

161
00:06:07,749 --> 00:06:06,639
good luck in the continued research and