1
00:00:00,376 --> 00:00:02,116
[Astronaut Don Pettit:] The
bio-experiments have captured

2
00:00:02,206 --> 00:00:06,806
some alien virus, and we're
culturing it, and it's trying

3
00:00:06,806 --> 00:00:09,196
to climb out of its vat.

4
00:00:10,286 --> 00:00:15,386
Ok, well, here I have these
little laptop speakers

5
00:00:15,386 --> 00:00:21,486
that I used last week for
oscillating spheres of water,

6
00:00:21,976 --> 00:00:25,076
and this week I'm going
to use the same speakers

7
00:00:25,566 --> 00:00:28,636
with some cornstarch solution.

8
00:00:28,986 --> 00:00:30,796
There's my cornstarch solution.

9
00:00:30,796 --> 00:00:33,346
It came in my bonus
food containers.

10
00:00:33,876 --> 00:00:37,896
You just pump a little water
in there and knead it around,

11
00:00:37,896 --> 00:00:40,266
and now you have some

cornstarch solution that's

12
00:00:40,266 --> 00:00:42,816
about as thick as
pancake batter.

13
00:00:43,456 --> 00:00:46,736
And cornstarch is a
really unique fluid.

14
00:00:46,826 --> 00:00:48,926
It's a non-Newtonian
fluid which means

15
00:00:48,996 --> 00:00:51,176
that it doesn't behave
like water.

16
00:00:51,176 --> 00:00:54,786
Its viscosity changes with
the environment around it,

17
00:00:54,786 --> 00:00:56,676
and we'll see some
effects of that

18
00:00:56,966 --> 00:00:58,736
when we put it on the speakers.

19
00:01:00,116 --> 00:01:01,066
And there you go.

20
00:01:01,066 --> 00:01:03,736
If you start slowly it's just
about like pancake batter.

21
00:01:04,116 --> 00:01:07,016
You hit it fast, and it
effectively turns into a solid

22
00:01:07,236 --> 00:01:09,676
which is one of the neat
shear thickening properties.

23
00:01:10,196 --> 00:01:16,276
Now, I'm vibrating the speaker,
and this is around 50 to 65 Hz.

24
00:01:16,276 --> 00:01:17,726
I'm sweeping the frequency.

25
00:01:18,026 --> 00:01:21,136
And you get a whole
series of really neat lobes

26
00:01:21,986 --> 00:01:22,966
on the free surface,

27
00:01:23,356 --> 00:01:25,276
and at first order this
doesn't look much different

28
00:01:25,276 --> 00:01:26,486
than what water does.

29
00:01:27,236 --> 00:01:29,296
But just wait what happens here

30
00:01:29,716 --> 00:01:32,046
when I give this a little
disturbance, and you'll see

31
00:01:32,046 --> 00:01:33,986
that it doesn't behave
quite like water.

32
00:01:35,136 --> 00:01:36,216
So look at that!

33
00:01:36,216 --> 00:01:39,596
You get these structures
trying to climb up

34
00:01:39,596 --> 00:01:40,826
and out of the speaker.

35
00:01:42,216 --> 00:01:44,856
And what you see
here is a balance

36
00:01:44,896 --> 00:01:50,716
between surface tension force
and the shear force imparted

37
00:01:50,716 --> 00:01:54,206
into the fluid from the
speaker oscillating.

38
00:01:54,746 --> 00:01:57,596
And you could do this
on Earth, I understand.

39
00:01:57,856 --> 00:02:00,316
So here we don't have to worry
about the effects of gravity

40
00:02:00,316 --> 00:02:01,676
because we're on space station,

41
00:02:02,036 --> 00:02:04,906
and the gravity effects
have basically been nulled

42
00:02:04,906 --> 00:02:06,246
out by our orbital motion.

43
00:02:06,526 --> 00:02:08,506
Here, we're going

to poke it again.

44
00:02:08,506 --> 00:02:09,126
Look at this.

45
00:02:10,536 --> 00:02:13,266
And once you get this
perturbation going then you get

46
00:02:13,496 --> 00:02:14,706
these structures growing out.

47
00:02:14,976 --> 00:02:19,116
And the vibration from
the speaker is turning the

48
00:02:19,116 --> 00:02:23,126
cornstarch partly into this
solid material, and it starts

49
00:02:23,126 --> 00:02:25,496
to move up and out
of the speaker well,

50
00:02:25,966 --> 00:02:29,426
but as soon as it gets away from
the speaker well, it's insulated

51
00:02:29,426 --> 00:02:32,626
from the shear, and it starts to
turn back into a liquid again,

52
00:02:32,716 --> 00:02:35,276
and then surface tension pulls
it back into the speaker.

53
00:02:35,706 --> 00:02:38,386
That's my simple explanation
for what's going on there.

54
00:02:39,576 --> 00:02:41,886
I also think we might
be able to use this

55
00:02:41,886 --> 00:02:45,416
as the zero-gravity
equivalent of a lava lamp.

56
00:02:47,096 --> 00:02:49,496
Now, I'm changing the
frequencies around,

57
00:02:49,756 --> 00:02:51,406
and then I can vary
the amplitude.

58
00:02:52,006 --> 00:02:53,646
These are all played
back real time.

59
00:02:53,646 --> 00:02:56,986
These aren't slow-motion
or high-speed events.

60
00:02:57,306 --> 00:02:59,926
You're seeing this as
how it actually looks.

61
00:03:01,566 --> 00:03:03,596
Now, here we've turned the
frequency up a little bit.

62
00:03:03,636 --> 00:03:09,766
This is around 115 to 123
Hz, sweeping the frequency.

63
00:03:10,016 --> 00:03:13,236
And look at that drop!

64

00:03:13,286 --> 00:03:16,316
Boing! It actually
was able to escape.

65
00:03:16,716 --> 00:03:19,656
It zoomed off, and when it
zoomed off, it almost looked

66
00:03:19,656 --> 00:03:22,046
like a solid, but I caught
it there with my chopstick,

67
00:03:22,346 --> 00:03:25,836
and on the chopstick without
the shear, it turned back

68
00:03:25,836 --> 00:03:27,936
into a pancake batter
type fluid again.

69
00:03:31,776 --> 00:03:33,276
And look what happens here.

70
00:03:33,276 --> 00:03:34,516
Oops! There goes another blob.

71
00:03:34,516 --> 00:03:35,816
There goes another blob.

72
00:03:35,936 --> 00:03:37,466
This was all around 120 Hz.

73
00:03:37,466 --> 00:03:39,156
[CAPCOM:] Don, that
was absolutely amazing.

74
00:03:39,156 --> 00:04:06,006
I think there's also
consensus down here

75
00:04:06,036 --> 00:04:06,996
that you should not
show that to Robonaut

76
00:04:07,026 --> 00:04:08,556
because shape-shifting forms
combined with robot intelligence