CARLA: Hi, everyone. Good morning. My name is Carla. I'm going to be talking about a very fundamental concept in aerodynamics. But before I start, have you all gone in planes before? Yeah? OK. Have you wondered, how does the pilot land the plane? A little? All right.

I'm going to explain two concepts that will help you understand how you actually land the plane. And these concepts are the concepts of lift and angle of attack. So I want you to picture a plane going through the skies. And in real life, the planes don't fly perfectly horizontal. They actually fly at an angle. And we're going to draw a little plane going at an angle.

And this angle between the horizontal and the plane-- it's going to be known as alpha, the angle of attack. And it's usually about 10 degrees. So that's why it seems that you're going uphill when you walk across a plane.

Now, there are two forces acting on the plane. You're going to have gravity-- the weight of the plane, pulling the weight down. And you're going to also have a force upwards that's keeping the plane afloat. And that force is called lift, which we're going to note by L.

Lift is generated as air rushes through the wings. The wings are designed in such a way that as air goes through them, they're going to generate a force upwards. So that's what keeps the plane uplift.

Now, there's a relationship between lift and the angle of attack. And I'm going to illustrate it in the following plot. So we're going to have-- on the x-axis I'm going to have the angle of attack, in degrees. And then for the y-axis, I'm going to have the lift, which is a force and therefore has units of Newtons.

Now, it is known that at small angles of attack, if you increase the angle of attack a little bit, you're going to get more lift. So if you increase it a little bit, you're going to get more lift. So you're going to get an upwards trend in the first part of the plot.

Now, it might be that you have a very high angle of attack-- that the plane's going actually really steep. The flow is going to be quite adverse to the wings and they're going to stop generating lift. So if you make the angle even steeper, you're going to get even less lift.

So that means that in this part of the plot, at very high angles of attack, you're going to get even less lift as you increase the angle. Yes there's a question.

STUDENT 1: By extreme angles, do you mean like, greater that 45 degrees or like 10 degrees?

CARLA: Greater than 15 actually-- greater than 15. So you have these two regimes. And there's this mode of transition in between. And the maximum occurs at 15 degrees. And this condition at which the plane starts to lose lift is known as a stall. So when an airplane starts to lose lift, it stalls.

Now airplanes usually fly about 10 degrees. You want the angle of attack to be high, so that you get a lot of lift, but not so high that you will stall. So to land the plane, what does a pilot actually do? Here approaches the runways at 10 degrees, the normal angle.

And when he's about to hit the ground, he changes the angle of attack to 15 degrees and stalls. So they lose a lot of lift and they actually crash the plane, gently to the ground. All right. Are there any questions? Yes.

STUDENT 2: Do the aerodynamics of the plane affect the stall point?

CARLA: They do. The stall point depends on the velocity of the plane-- which the plane's going at, and the shape of the wings. But it's usually around 15 degrees for any sort of plane. There are planes-- the one that actually can fly vertical, those ones have other sorts of control. The winds are stalling but they have fancy motors that can hold that angle. There was another question. No? Yes. Yes, what's the question?

STUDENT 3: Are the wings also angled with respect to the plane?

CARLA: Sorry. Could you be a little louder please? Could you repeat the question please?

STUDENT 3: Are the wings also angled with respect to the plane?

CARLA: Yes, yes, yes. So the question is if the wings have an angle with respect to the plane. And yes they do. The plane moves something like this, and the wings are at a small angle of 2 to 3 degrees with respect to the horizontal of the plane. I'm exaggerating it, but it is at a small angle. But then the cross-section actually changes. And if you look at the airplane from the front, the wings are actually doing something like this here. So there's a number of angles going on with the plane.