There's another vector operation, which we call the vector product and sometimes this operation is called the cross product.

And this is taking two vectors A, the operation cross, B. And this will give a new vector C.

And now we want to define that new vector C.

So let's draw a three dimensional picture where we have a plane.

And on this plane, we have two vectors A and B.

And those vectors are forming an angle theta between them.

Now a plane defines two unit normals.

I'll draw one up, which I'm going to call n hat right hand rule.

And the reason for that right-hand rule is if we take A cross B, then our right hand thumb is pointing in the perpendicular direction to the plane.

Now I could have chosen a unit vector down, n hat left-hand rule.

And this would correspond to taking my left hand and having A cross B pointing down.

So the way we're going to define our cross-product is with the right-hand rule.

And so we define it like this.

That the vector C has magnitude, the magnitude of A times sine of theta, the magnitude of B, and its direction is given by the right-hand rule.

Now one of the reasons for this definition is let's draw a vector A and a vector B.

When you have two vectors, they define a magnitude in the following way.

That we can think about any two vectors define an area of a parallelogram.

And we can define that area as follows.

Let's drop a perpendicular.

And let's call this B perp.

Then the area, which is a positive quantity, is given by-- and by the way, our angle theta here will be always positive-- so we're going to make it 0 theta pi.

And that way sine of theta is always a positive quantity.

The area is the height, so that B perp times the base, which is the magnitude of A, and so we can write that as A, and the magnitude of B perp is B sine theta.

So this quantity, B sine theta, is precisely what's occurring there.

So the magnitude of C is equal to the area formed by the vectors A and B. And we have a choice of which way we want to pick C to point.

And that's where, as a convention, we're choosing the right-hand rule.

Now again, there is a symmetry here in that I can also define the area of that triangle in the following way.

Let's write this, theta.

Instead of taking how much of B is perpendicular to the direction of A, let's drop the perpendicular this way, and write that as a perp.

And then the same area can be expressed as the magnitude of-- well, we'll express it as A perp times B. And A perp is the magnitude of A sine theta times the magnitude of B.

And that's our same definition as before.

And so you see, a sine theta is appearing over here.

So in either choice, our vector operation says take any two vectors.

Any two vectors forms a parallelogram.

The area of that parallelogram is the magnitude of the vector product.

And the direction of this new vector C is given by the right-hand rule with respect to that parallelogram in that sense.