We begin with multiplication of a vector by a scalar.

When you multiply a vector, \( A \), by a scalar, this multiplicative factor just rescales the magnitude or the length of the vector.

Let us look at the vector 2 times \( A \). This is in the same direction as the vector \( A \), but is twice as long.

This is vector \( B \). A vector is defined by its magnitude and direction.

So this vector \( B \) is the same anywhere in space, including at the origin.

If I want minus 0.5 times \( B \), this vector is in the opposite direction of \( B \) and is half the length.

Now let's look at vector addition.

Here's a vector \( A \). Here is \( B \). How do we add them graphically?

We slide the tail of \( B \) to the head of \( A \).

And their sum is a vector drawn from the tail of \( A \) to the head of \( B \). I could have also added \( A \) to \( B \) by sliding the tail of \( A \) to the head of \( B \).

You can see that this makes a parallelogram, and the sum, vector \( C \), is just the diagonal of this parallelogram.

Subtraction can be thought of as just multiplication and addition.

If I have \( C \) is equal to \( A \) minus \( B \), I just need to add \( A \) to the vector minus \( B \). Minus \( B \) is negative 1 times \( B \), which is this vector here.

Now I only have to add \( A \) to minus \( B \).

Let's do another example.

Here are my vectors \( A \) and \( B \) do not start at the origin.

But since vectors are the same anywhere in space, I can go through the process here.

I want \( A \) minus \( B \). So I first multiply \( B \) by minus 1 to find minus \( B \). And then I move the tail of minus \( B \) to the head of \( A \) and add the two like this.