When we analyze the problem about putting two blocks along a frictionless surface and pushing one and asking, what is the maximum force such that block 2 does not slip?

We have three different systems.

And now I want to focus a little bit on what would happen if we just naively chose our systems as both blocks together.

So let's try to look at the types of issues that come up when we do that.

So once again, let's draw free body diagrams.

Now, we begin.

We're pushing block 1 with a force.

Gravitation is the sum of these two forces, because our system here is block 1 and block 2.

What about normal forces?

Well, the ground is acting on block 1.

And now, here's the significant thing.

What about all of those forces between blocks 1 and 2?

Well, the forces between blocks 1 and 2 are internal forces.

And we saw that they were friction forces, f12 and f21.

This was the friction force between the two blocks, on block 2 due to 1 and the friction force on block 1 due to 2.

There were normal forces between these two blocks, but these are interaction pairs.

And the sum of them are 0.

And so we see that all internal forces form Newton's third law interaction pairs and the vector sum of them are 0.

And that's why I don't need those internal forces on my free body diagram.

If I were to draw them, I would have different arrows.

For instance, I would have that arrow f21 and I would have the arrow f12.

And you can see that the sum of those cancel.

I would have the arrow n21 and I would have the arrow n12.

Arrows in opposite directions.

The interaction pairs sum to 0, because they are internal forces.

And again, this enables us now to just draw f equals m1 plus m2 times the acceleration of the system.

And so we have our i hat and our j hat directions.

Let's pick i hat and j hat.

And now, we didn't include the kinetic friction force of the ground in that system.

So let's make sure that that's there.

And what we have is f minus f kinetic equals m1 plus m2 times a.

And in the vertical direction, we have n ground 1 minus m1 plus m2 g equals 0.

That gave us our same result before.

Notice that f equals fk plus m1 plus m2 g.

We know this is mu km1 plus m2 g plus m1 plus m2 g a.

So we have the acceleration of the system depends on the force, mu k m1 plus m2g divided by m1 m2.

But notice because our static friction is an internal force in this system, it never shows up in Newton's second law, so we were never able to apply the condition that f static max was mu static n, what we call the normal force between the blocks.

And so we were unable to figure out what is the maximum force.

All we can say is if I push f, that's the acceleration.

But I cannot determine what maximum force will cause block 2 to slip with respect to block 1.

So when you pick your system like this, it's very quick to calculate a.

No problem about that.

But I am not able to answer any questions that require some type of information about the internal forces.

So the art to choosing systems and free body diagrams is to think about the types of questions you're asking.

If you have a question that involves something about a maximum condition on static friction, then you want to make sure that static friction is an external force to your system.

If it's an internal force, like in this case, you will not be able to apply that condition.