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8.01 Physics I: Classical Mechanics, Fall 1999
Transcript – Lecture 7

So far in these lectures we've talked about mass, about acceleration and about forces, but we never used the word "weight," and weight is a very nonintuitive and a very tricky thing which is the entire subject of today's lecture.

What is weight? Here you stand on a bathroom scale.

Gravity is acting upon you, the force is mg, your mass is m.

The bathroom scale is pushing on you with a force F scale and that F scale--

which in this case if the system is not being accelerated is the same as mg--

that force from the bathroom scale on you we define as weight.

When I stand on the bathroom scale I could see my weight is about 165 pounds.

Now, it may be calibrated in newtons but that's, of course, very unusual.

If I weigh myself on the moon where the gravitational acceleration is six times less then I would weigh six times less--

so far, so good.

Now I'm going to put you in an elevator and I'm going to accelerate you upwards and you're standing on your bathroom scale.

Acceleration is in this direction and I will call this "plus" and I will call this "minus." Gravity is acting upon you, mg and the bathroom scale is pushing on you with a force F.

That force, by definition, is weight.

Before I write down some equations, I want you to realize that whenever, whenever you see in any of my equations "g" g is always plus 9.8.

And my signs, my minus signs take care of the directions but g is always plus 9.8 or plus 10, if you prefer that.

Okay, it's clear that if this is accelerated upwards that F of s must be larger than mg; otherwise I cannot be accelerated.

And so we get Newton's Second Law: F of s is in plus direction...

minus mg--

it's in this direction--

equals m times a and so the bathroom scale indicates m times a plus g.

And I have gained weight.

If this acceleration is five meters per second squared in this direction I am one and a half times my normal weight.

If I look on the bathroom scale, that's what I see.

Seeing is believing--

that is my weight.

If I accelerate upwards, with 30 meters per second squared 30 plus 10 is 40--

I am four times my normal weight.

Instead of my 165 pounds, I would weigh close to 700 pounds.

I see that--

seeing is believing.

That is my weight.

Now I am going to put you in the elevator--

here you are--

and I'm going to accelerate you down.

This is now a.

And just for my convenience I call this now the plus direction just for my convenience--

it doesn't really matter.

So now we have here mg--

that is gravity acting upon you.

And now you have the force from the bathroom scale.

Clearly, mg must be larger than F of s;

otherwise you couldn't go being accelerated downwards.

So if now we write down Newton's Second Law then we get mg minus F of s must be m times a.