One of the first things we must do to analyze or solve problems involving forces, is identify the forces in a particular situation as well as label them so we can get a complete picture. One tool we use is called the **Free Body Diagram, FBD.**

There are differences among free body diagrams within a physics course, but for the most part we just want to get a look at ALL the forces involved in a problem situation.

One way to think about this it to look at all the points where the surroundings, (universe) physically touch the object in the problem. At each of these points of contact there will be a force. Additionally, we need to consider any forces that act at a distance, without touching. The only one of these forces we are familiar with is the force due to gravity.

In the example below, a crate sits on a rough floor and will be pulled to the right using a rope that is parallel to the floor. The descriptor, “rough” implies that there will be friction involved. (“Smooth” would imply no friction).



To begin, we might want to draw a circle around the crate and floor near it. Anywhere the surroundings touch this circle will be a force. They are the force from the rope, tension, T. and friction, *f*, Ffr or Fr. Additionally, the floor must apply some force UP to support the crate and keep it from going into the ground. This supporting force from a surface is known as the Normal Force, FN or just N

After we have looked at all the contact forces, we need to put all the act at a distance forces, in this case the Force due to gravity, Fw which we call weight.

Fw is calculated from Newton’s Universal law of Gravitation

F = G ME mobj

(RE)2

When objects are on or near Earth they will experience an attraction toward Earth calculated by this formula. We call that attraction Weight, or Fw.

Since the Gravitational constant is a constant and neither the mass nor radius of Earth change, those things are calculated to give us another constant, g.

F = G ME mobj = (6.67 x 10-11) (5.97 x 1024 kg) (mobj)

(RE)2(6.37 x 106 m)2

Fw = 9.8 N/kg (mobj) = (g)(m)

The numbers for those constants yield 9.8 as a value every time we are dealing with a situation on Earth, so we just use 9.8 N/kg rather than having to plug in all those big numbers every time we want to know the weight. g is known as the gravitational field constant and would have a different value on a different planet or the moon.

This weight is then a force that acts on all objects, in every problem.



Next consider an object that has a force applied with the rope at an upward angle pulling to the right on the same rough floor. Draw the FBD for this object.



What about an object that is being pushed with a force parallel to the floor to the right?



Or an object being pushed to the right at a downward angle?

