GETTING A GRIP ON GRAVITY

Gravity *n.*

A force that acts between all masses, pulling them together.

Is the definition helpful?

- ☐ Sort of.
- ☐ Not really.
- ☐ Seriously?

All through history people have asked the same questions, like “What's for dinner?” and “Why do things fall?” Aristotle, who lived in Athens almost 2,500 years ago, argued that the center of the Earth was the center of the universe. So naturally everything tended to fall in that direction! Wrong on TWO counts. He also thought that heavier things fell faster than lighter things. Well, you could see how he would think that. Try dropping a piece of paper and a book. The book hit the floor first, right? But not because of **gravity** and not because it is heavier.

WHAT?

Here is where Galileo comes in. He carefully dropped balls from towers and rolled them down inclines. He stated that the reason your book drops faster than your paper is not due to their difference in mass, but rather because air resistance (**friction**) affects the falls differently.

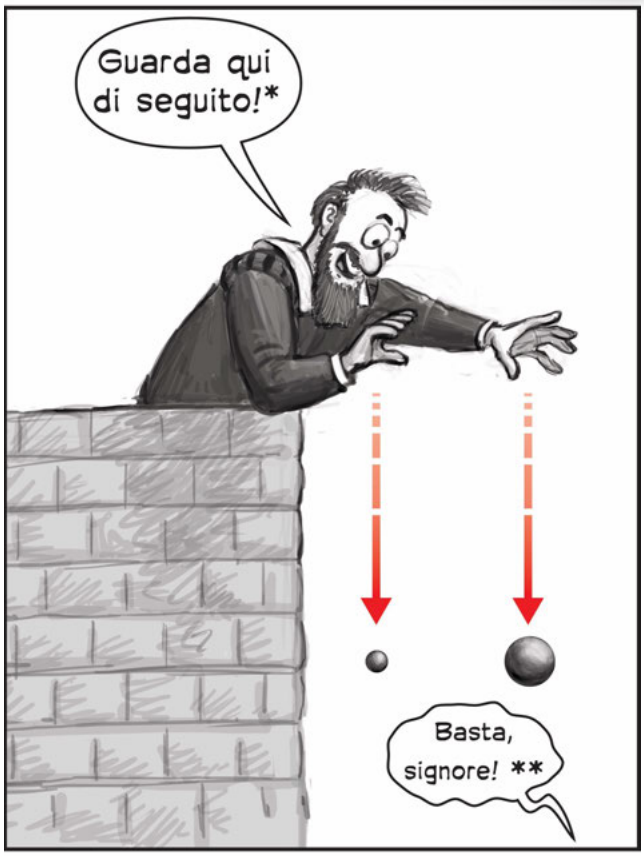
Explore Galileo’s idea.

Step 1: Go to the moon.

Step 2: Drop a feather and a hammer at the same time.

Oh, going to moon is not in your budget? Well, watch this video of an astronaut who tried it out:

http://serpmedia.org/scigen/e1.5c.html



* Look out below!

** Knock it off, mister!

As great as Galileo was, Isaac Newton was the one who really hit it out of the park with this idea: he said that **gravity** is not just about the Earth pulling things, but rather that everything that has mass creates a gravitational force.

Consider an apple and the planet Earth.

Newton said that the apple is pulling on the Earth in exactly the same way as the Earth is pulling on the apple.

Huh?

Then, you might ask, “Why doesn’t the Earth *fall up* to the apple?” Well, the answer to that is...

It does.

Huh??

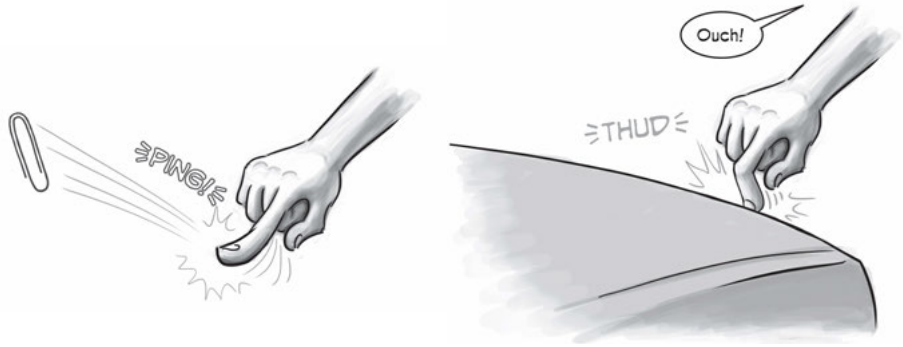
Just not very much. Actually, it’s an immeasurably small distance.

So, how can the apple and the Earth react to equal forces so differently?

To understand this, think about applying an equal force to two things with very different masses.

1. Think about flicking a paper clip with your fingers.

2. Think about flicking a parked car with your fingers.



Why wouldn't the car move as much as the paper clip??

INERTIA.

Massive things have more mass (duh!), more gravitational force, and more **inertia**. If you think that car was hard to move with a flick of your fingers, just imagine how tough it would be for the apple's gravitational field to yank the Earth up to it. Not gonna happen!

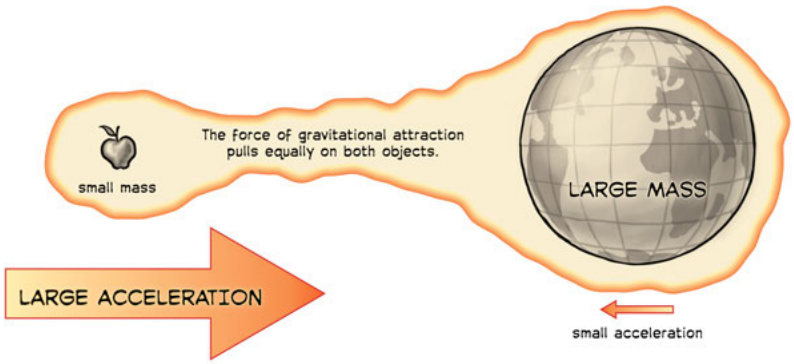
LAST question: The **acceleration** of the apple dropping to the Earth

- ☐ greater than
- ☐ less than
- ☐ about the same as

the **acceleration** of the Earth up to the apple.

Greater than, of course! You can definitely observe that. But why?

Gravity causes the apple to move toward the Earth and yes, the Earth to move toward the apple (good luck observing the latter). You can measure movement (of the apple at least) using **velocity**. If the **velocity** changed along the way, you can describe that as **acceleration**. The apple's fall to Earth started slow and got faster. There is all kinds of interesting math about the details of that. Ask your science teacher to explain more if you're interested. But don't get carried away. You have to save something for high school!!



mass · ACCELERATION = Force = MASS · acceleration

The important thing here is to remember that when we think about **gravity**, it's easy to think about it as the Earth pulling on things. And that's true. The Earth does, indeed, pull on things. But keep in mind that everything else that has mass pulls on things, too. The Earth tends to get our attention the most because it's the biggest thing around pretty much everywhere we hang out!

If you compare the Earth to the Sun, the Earth is a little more like the apple in that situation. The Earth is affected by the Sun's **gravity** in a major way, but also by all sorts of other interesting forces in the universe. (Good thing, too...or we'd be toast! Burnt toast at that!)