Flipping Physics Lecture Notes:
Introduction to Free-Fall and the Acceleration due to Gravity

An object is in Free-Fall when the only force acting on the object is the Force of Gravity, however, we haven't defined Force much less the Force of Gravity, so, until we have defined the Force of Gravity, we have a slightly different definition.

An object is in Free-Fall when:

- It is not touching any other objects♥
- There is no air resistance (it's in the vacuum we can breathe)

We are now in the vacuum that we can breathe and will be for the remainder of this class, unless otherwise stated.

Common Misconception: For some reason people think the word "fall" in Free-Fall means that the object must be going down. This is absolutely, not true. An object thrown upward is in Free-Fall from the moment it leaves the persons hand until it touches the ground.

When an object is in Free-Fall (on planet Earth):

- $$a_y = -g = -9.81\frac{m}{s^2} = 9.81\frac{m}{s^2}down$$
- g is the acceleration due to gravity and on earth, $g_{Earth} = 9.81\ m/s^2$.

The acceleration due to gravity, g, is different on different planets and moons. For example, $g_{moon} = 1.6\ m/s^2$ which is roughly 1/6th of the acceleration due to gravity on the Earth.

It is *very* common for students at this point to assume that g is negative because $a_y = -g$. It is not. g is positive.

Please remember that. Please.

g is positive.

When an object is in Free-Fall we know the acceleration is constant, therefore:

An object in Free-Fall is an object experiencing Uniformly Accelerated Motion.
We can use the UAM equations and we know $a_y = -9.81\ m/s^2$.

FYI: Mass is irrelevant. All objects, regardless of mass, will have the same acceleration.

When we look at the whole earth, the acceleration due to gravity will not be the same for each location. However, when we look at a specific location, the acceleration due to gravity is constant and therefore we can use the UAM equations. So little g is constant from a local perspective, however, when you look at it globally, the acceleration due to gravity varies from location to location.

♥ We will get to some examples where we have two objects in free-fall together and those two objects will be touching. This is a good definition, for now.