

# Air Resistance



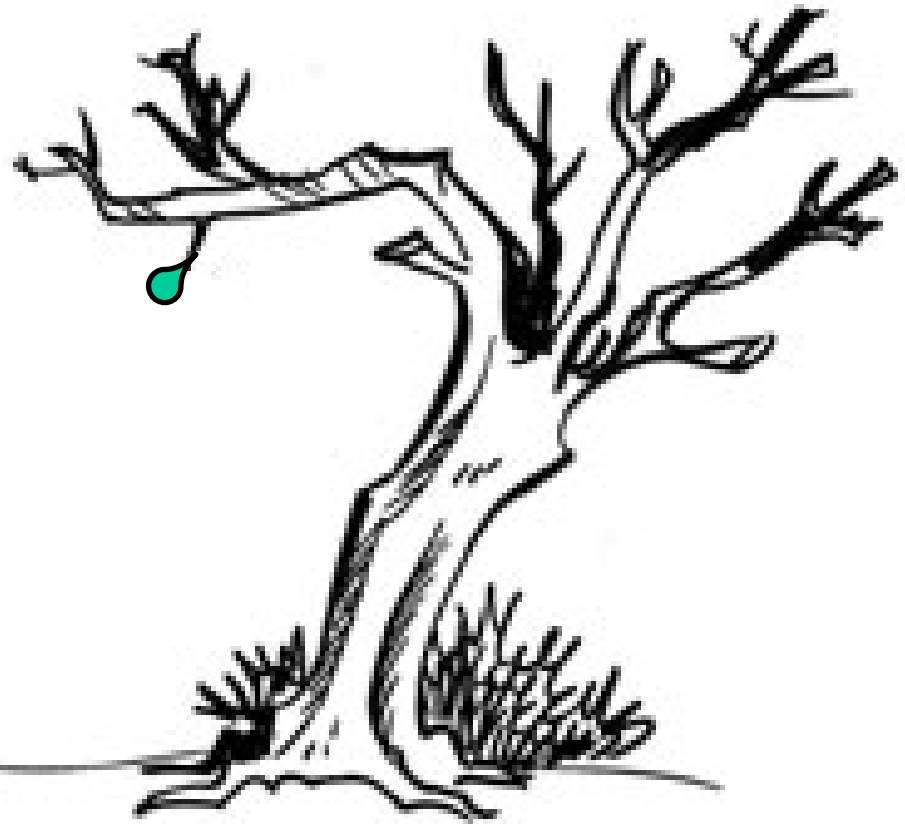
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# Leaf/Paper Drop Test

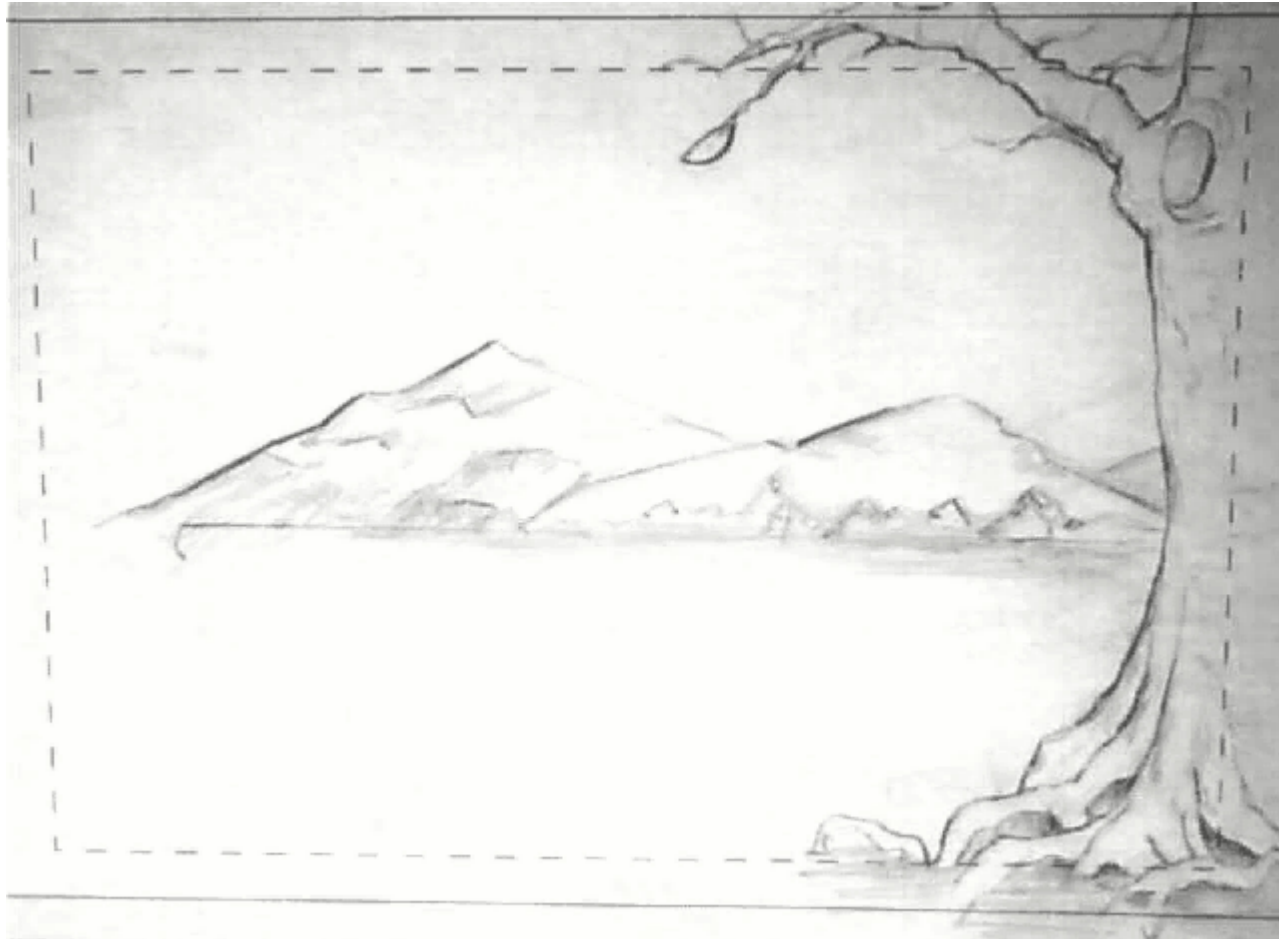
Animating a leaf or a piece of paper drifting slowly to the ground is a common animation exercise.

That was not a good leaf drop

Let's see some good ones by Gloria Cho and Katie Corna.

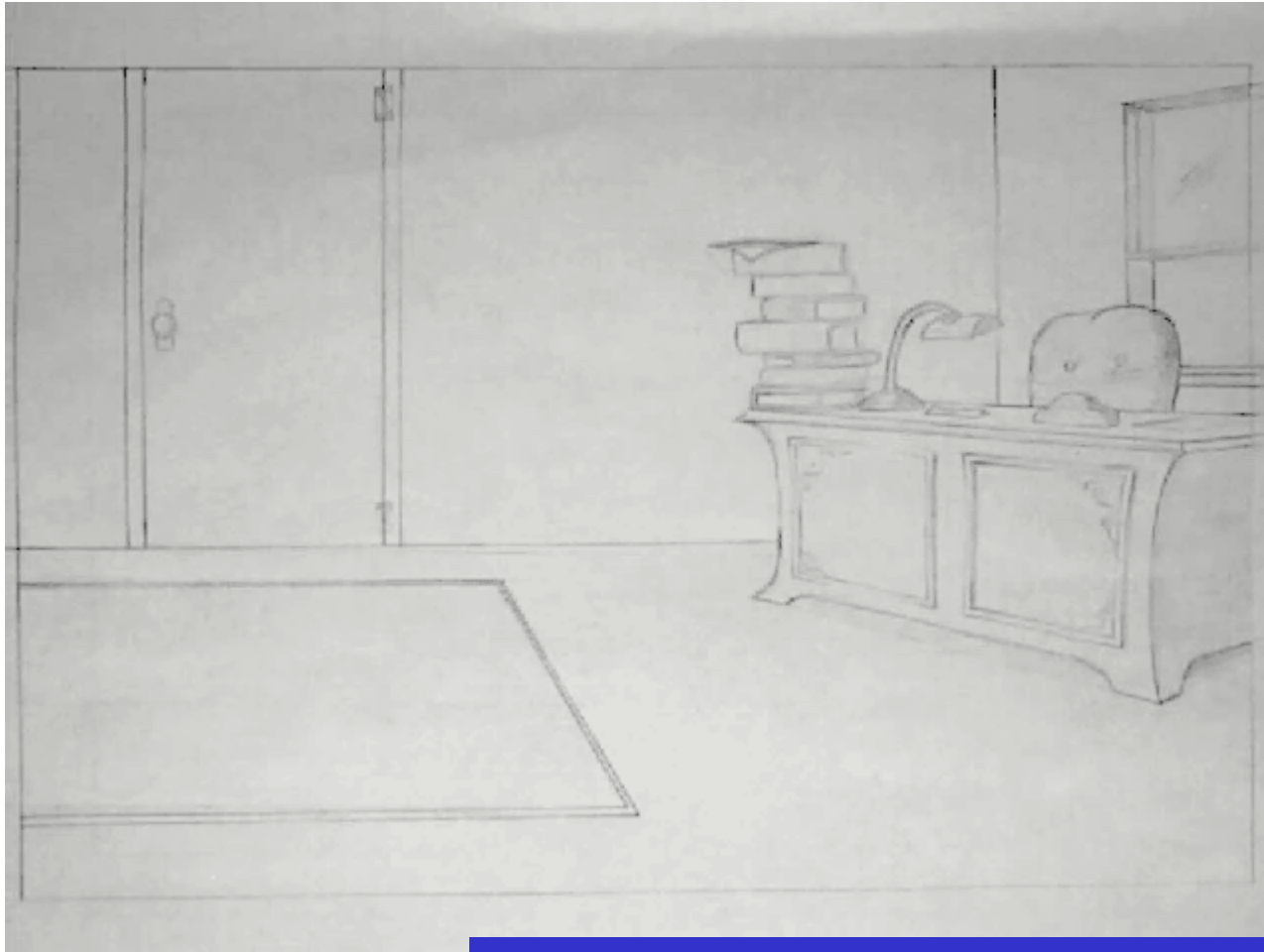


# Leaf Drop Test



<http://www.youtube.com/watch?v=mbMo4HFJC1Y>

# Paper Drop Test



<http://www.youtube.com/watch?v=vKf-vIDSlik>

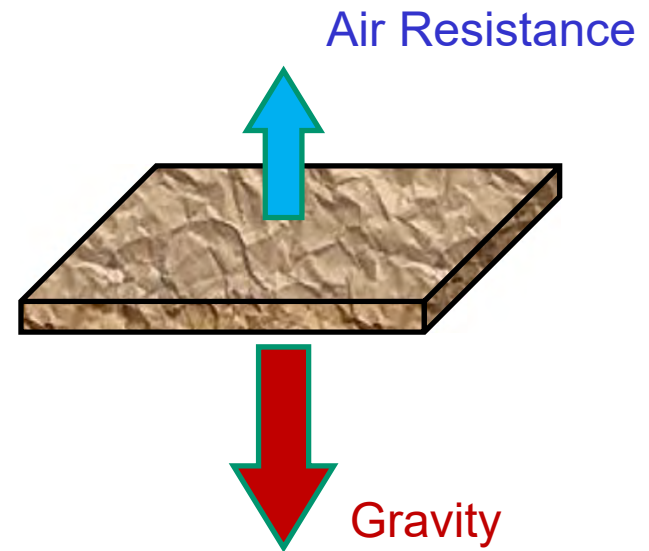
# Force of Air Resistance

Air resistance is a force created when an object moves through air.

Depends on:

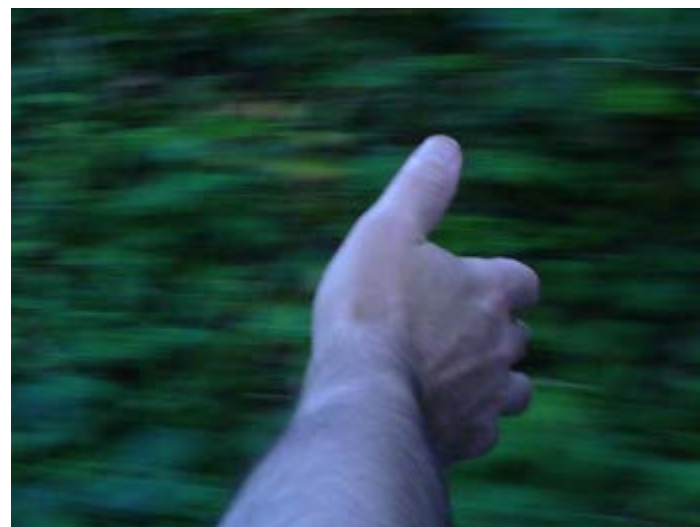
- Size (area) of the object
- Speed of the object

Larger the size or speed,  
larger the force due to  
air resistance.



# Feel the Force

Experience the force of air resistance by holding your hand out a car window.

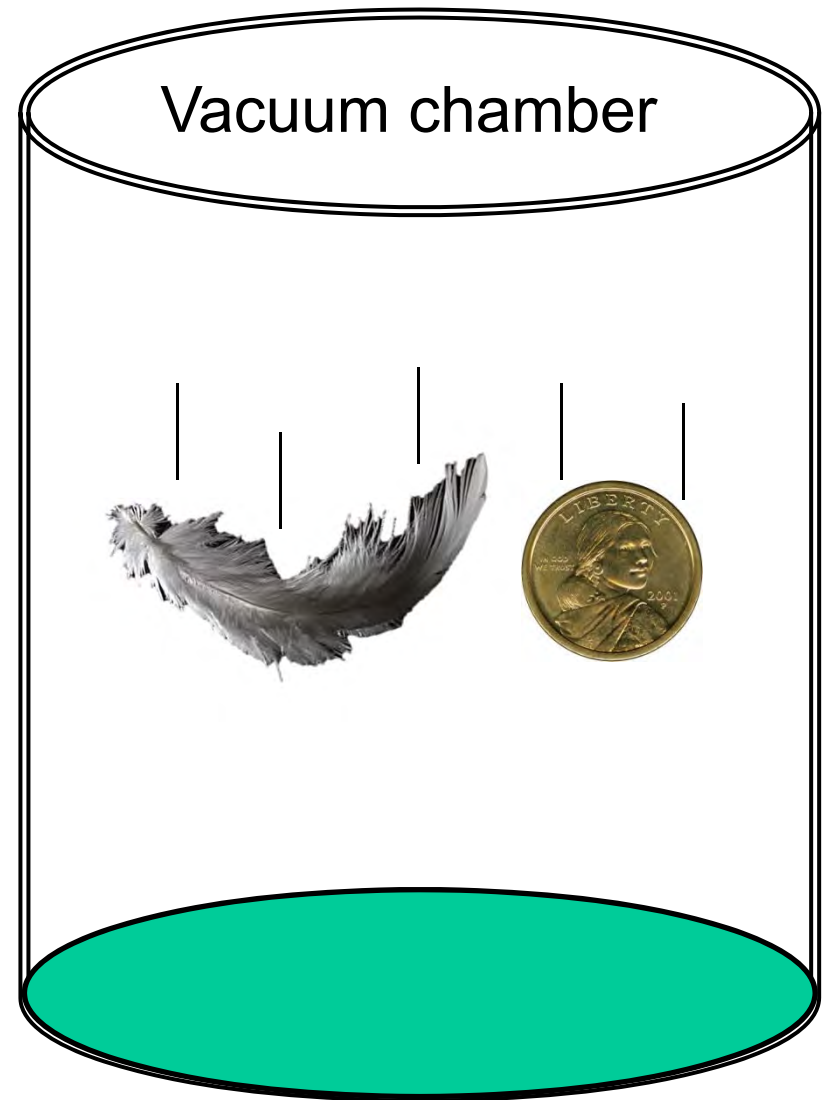


Resistance increases as speed increases.  
Resistance increases as area increases.

# Falling in a Vacuum

A feather normally falls slowly due to the force of air resistance.

If we remove the air (create a vacuum) then a feather and a coin fall together.



# Falling on the Moon

There's no atmosphere and thus no air resistance on the Moon.

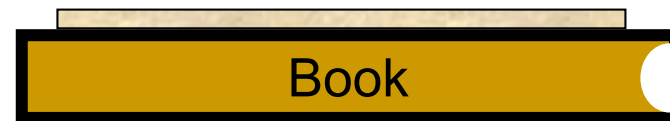
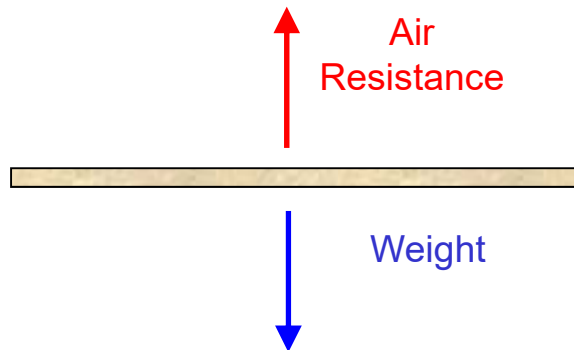


[http://www.youtube.com/watch?v=5C5\\_dOEyAfk](http://www.youtube.com/watch?v=5C5_dOEyAfk)



# Book & Paper Drop

A flat sheet of paper falls slowly because of air resistance force acting on the paper.  
What if we place it on top of a book?



*How does this fall?*

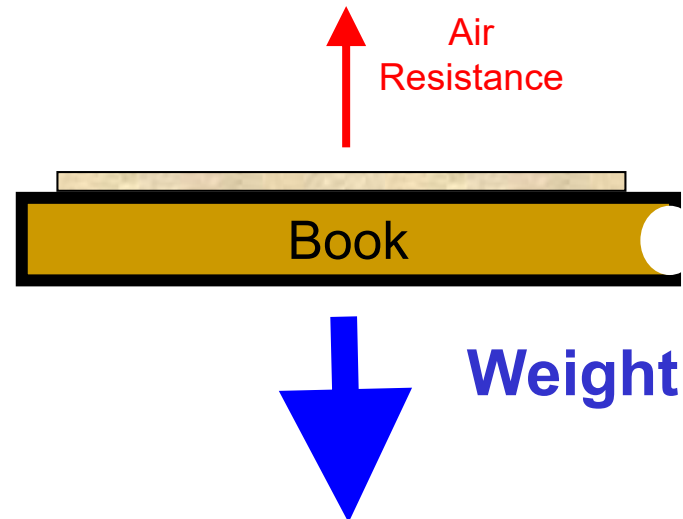
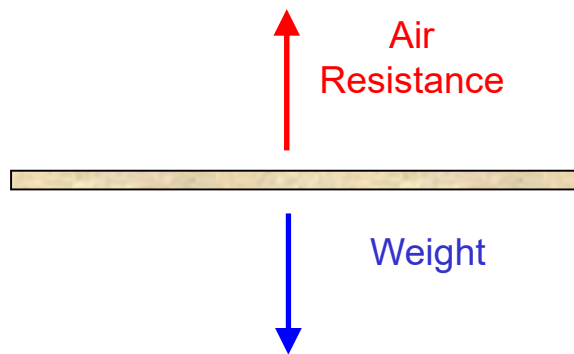
# Book & Paper Drop



# Air Resistance vs. Weight

The force of air resistance acts on both the sheet of paper and the book.

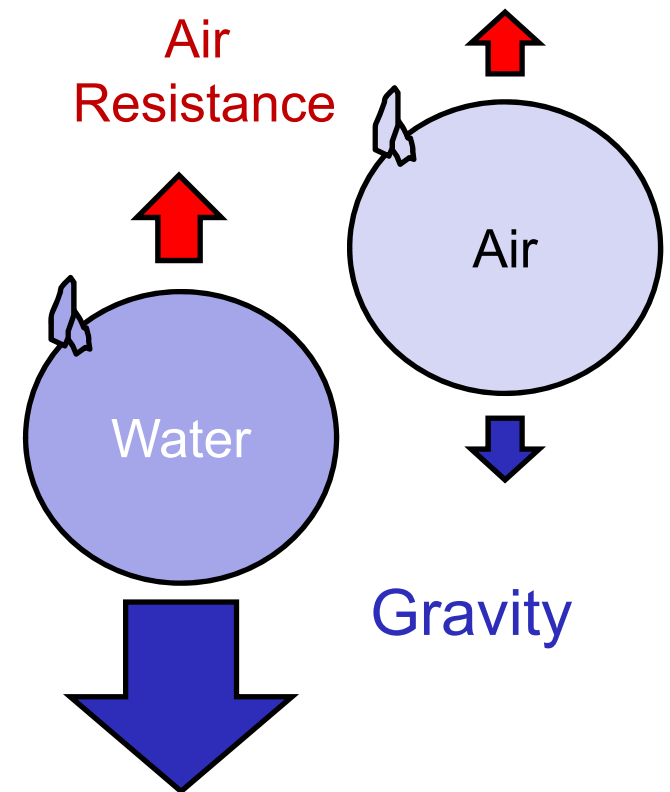
This force is negligible compared to the weight of the book.



# Balloon Drop Example

Because the water balloon falls faster, the air resistance force on a water balloon is **greater** than on an air-filled balloon!

*However*, a few ounces of air resistance force is **insignificant** for a water balloon weighing several pounds.

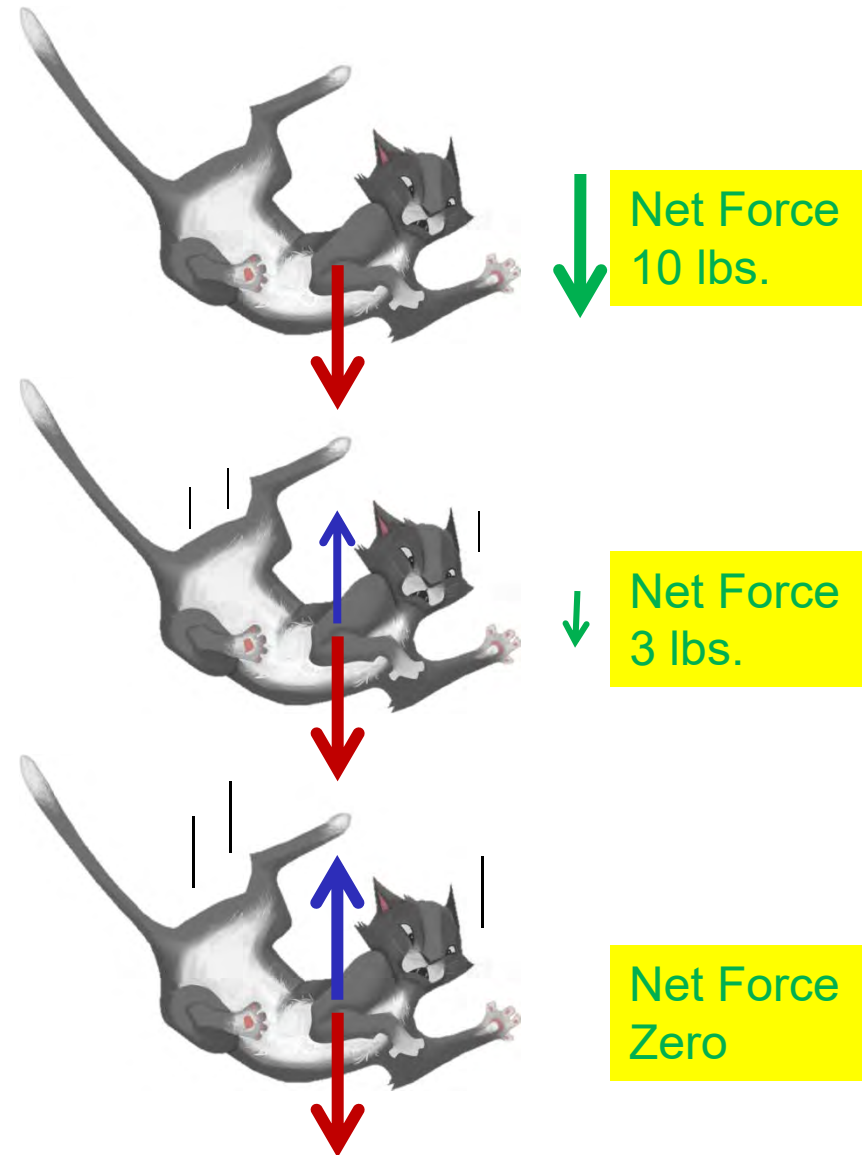


# Net Force on a Falling Object

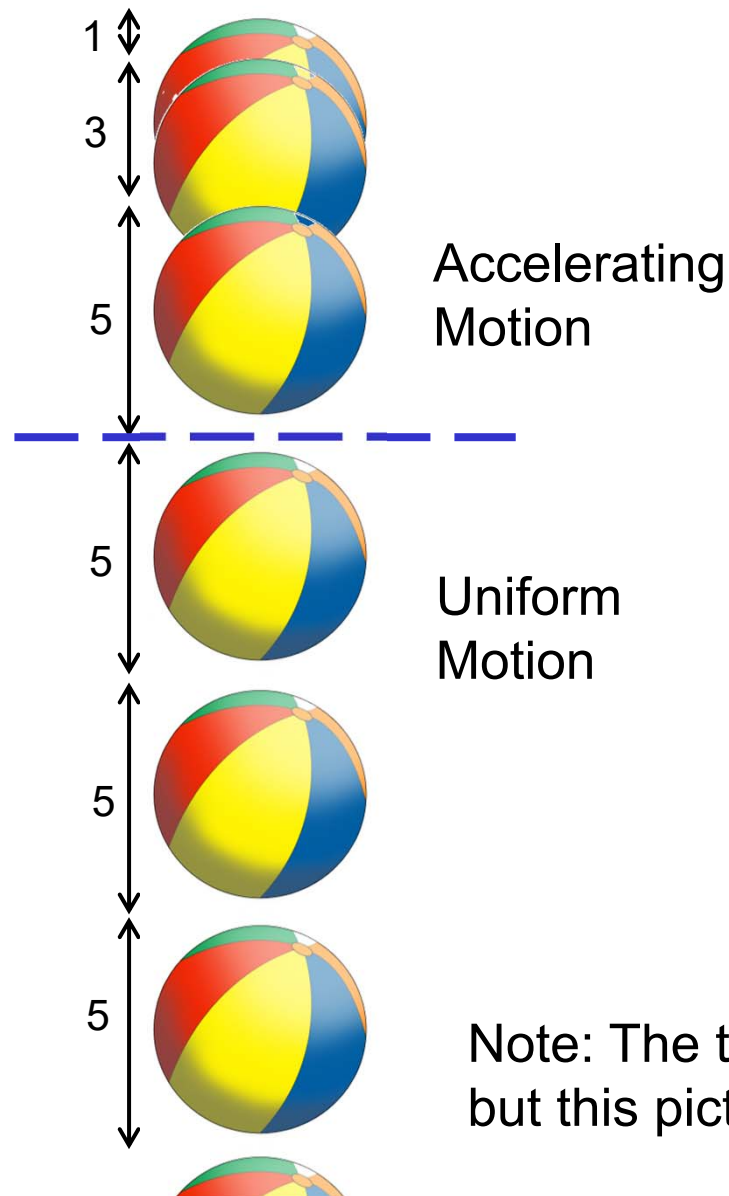
Gravity force on an object (i.e., weight) is constant but air resistance depends on an object's speed.

As a falling object gains speed, the resistance force gets larger so the net force decreases.

Net force is sum of:  
Resistance (upward)  
Weight (downward)



# Falling with Air Resistance



Light objects, such as a beach ball, initially fall with accelerating motion.

Due to air resistance, the motion transitions to uniform motion (constant speed) after falling a certain distance.

Note: The transition occurs rapidly but this picture is a bit simplified.

# Summary

- Force of air resistance on a moving object increases with the object's speed and size.
- Because air resistance is not a constant force, falling objects don't have a constant acceleration when air resistance is significant.
- Air resistance force is noticeable if it's at least comparable to an object's weight.
- When the upward force of air resistance balances the downward force of gravity the falling motion transitions into uniform motion (i.e., constant speed).