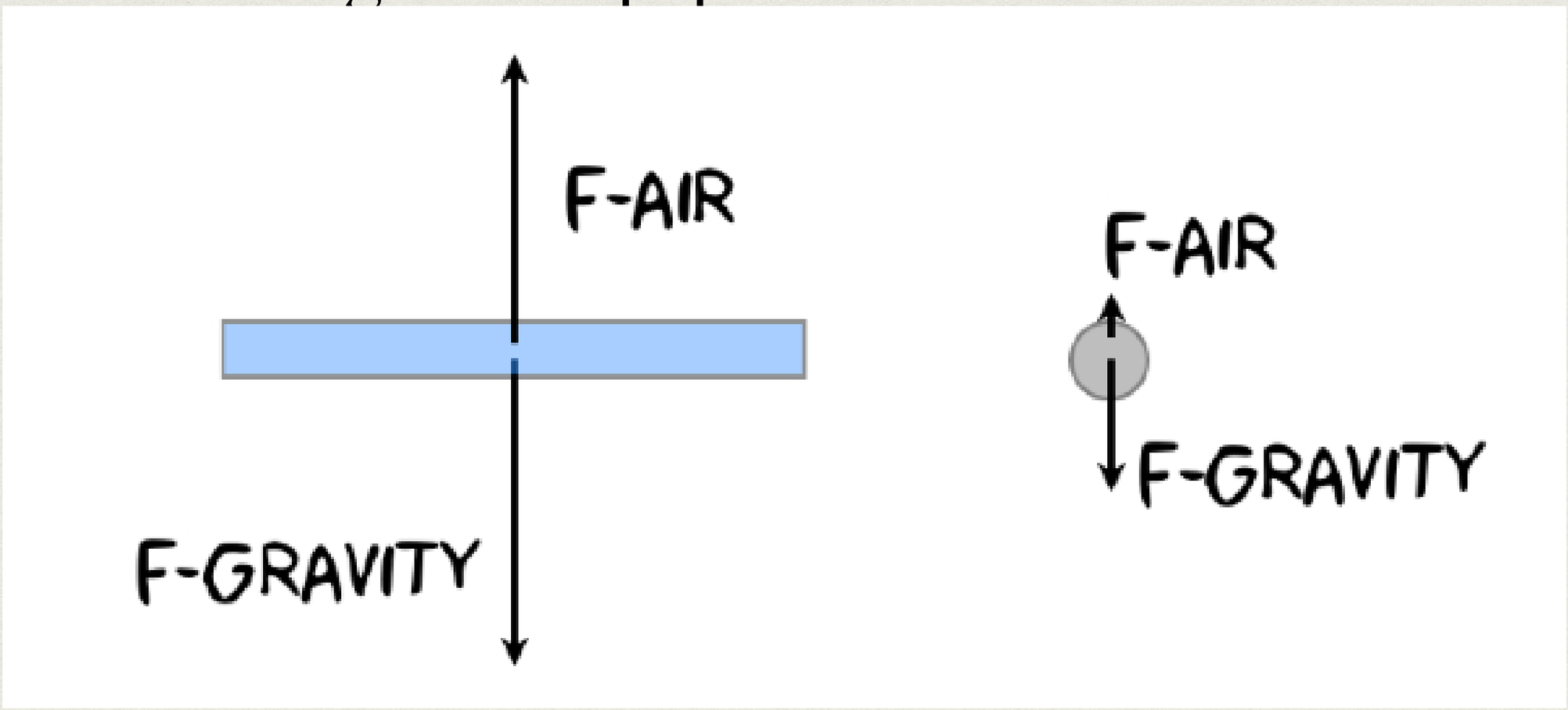
KILLER CARDS

FROM JAMIE AND ADAM...

- https://www.youtube.com/watch?v=PxB5CseJqDg

The air around us – even if we can't really see it – is made up of **atoms** and takes up space. Try waving your arms back and forth – you can feel it as your arms collide with the air molecules around them. You are experiencing a force called **air resistance** – the opposition to an object's motion through the air.

Size and **shape** are two factors that affect air resistance. The more **surface area** an object has, the more air resistance it will encounter. Imagine dropping two pieces of paper – one flat and one crumpled into a ball. The crumpled one falls **faster** because there is **less** air resistance acting on the paper.



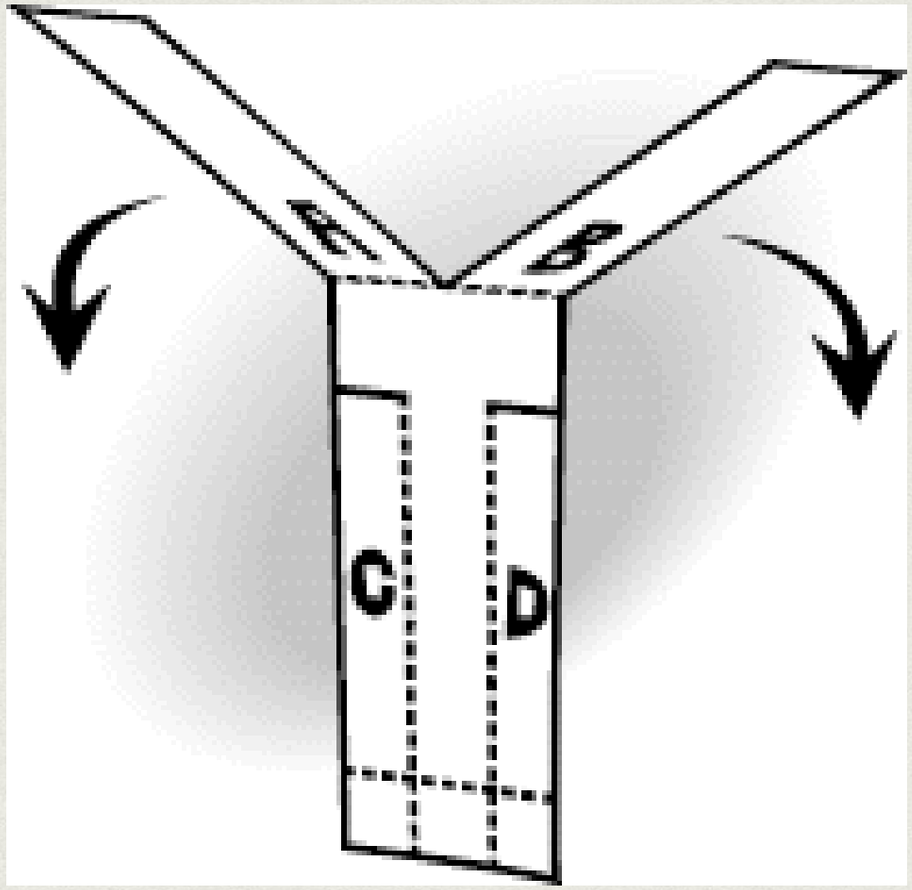
The two forces acting on the helicopter are **gravity** and **air resistance**.

As the helicopter falls, air molecules colliding with it cause an opposing **force** that slows the helicopter down. The pressure of the air pushes the blades up into a slanted position. Because there is no forward movement, gravity **pulls** the helicopter downward, but the moving winds act against this force. The air under one blade is pushing one way and the air under the other blade is pushing the opposite way. These two forces of air push the blades around and make it **spin**. The faster the blades spin, the **less** the air can get by and the **slower** the helicopter falls.

By experimenting with the **weight**, **shape** and **position** of the blades, you can change how fast and how much air is pushed out of the way. In other words, you're changing how the air resistance is hitting your helicopter. This affects how it moves.

Air Resistance

You can imagine the helicopter as having a force pulling down (**gravity**) and a **force** pushing up (air resistance). The force of gravity causes a constant acceleration, regardless of mass. Air resistance **increases** as the velocity increases. Initially as you drop the helicopter, air resistance is low. As the velocity increases, due to the acceleration from gravity, the air resistance increases. The force on the helicopter due to the air resistance at some point **equals** the force on the helicopter due to gravity. The velocity at this point is known as the **terminal** velocity. At that point, the net forces on the helicopter are zero, so the helicopter experiences no further **accelerations**.



The force on the helicopter due to gravity **increases** as the mass of the helicopter increases (either with more paperclips or a longer shaft). Therefore, a large force due to air resistance is necessary to counter-act the force due to the extra mass. Since air resistance increases as the velocity increases, helicopters with a **larger mass** will have a higher **terminal velocity** and therefore hit the ground faster.

A helicopter with **larger** blades will have more surface area to resist air. Therefore, at a given velocity, that helicopter will experience more air resistance. The air resistance of helicopters with longer blades will counteract the force of gravity at a lower velocity.