# Conservation of Momentum

* A proof of the conservation of momentum can be thought of as… During a collision, X exerts a force on Y and vice versa. By Newton’s Third Law, these forces are equal and opposite and with both forces acting for the same time. Thus impulses the equal and opposite so cancel out and thus momentum is conserved.
* This provides a useful analogy: <https://www.youtube.com/watch?v=kA2vjXHnySU>.

# Entropy

I suppose it could be thought of as the likelihood of being in a state or a measure of boringness, a pile of sand has a high entropy as it’s highly likely to come across this whereas a sandcastle has low entropy as it’s unlikely you’ll find sand like this.

# Ferminions

These are composite particles (e.g., protons and neutrons) that give rise to structure. This is because you cannot have more than one ferminion at one point.

# Frames of Reference

* Frames of Reference (1960)
  + All inertial frames of references are equivalent. There's no experiment to distinguish between a ball falling on a cart moving at 20ms^-1 and 100ms^-1 without the background.
  + We don't always view motion from the Earth's frame of reference, if motion is simpler in the moving frame then you put yourself in that frame.
  + Inertial frame of reference is where the law of inertia holds. It doesn't in a non-inertial frame as you'd expect there to be some force which there isn't. (E.g., a fictitious force arises in this non-inertial frame of reference.)
  + A rotating frame of reference is a non-inertial frame. If you're in a merry-go-round and you take the merry-go-round to be your frame (you rotate together), you're in a non-inertial frame and would feel a fictitious force trying to throw you off so you must hang on tightly. Yet from the Earth's fame, there is no force, you're merely hanging on to make yourself go in a circle otherwise you'd move off in a straight line.
  + Smaller the acceleration of a rotating frame, the smaller the fictitious force.
  + We use the Earth as an inertial frame but it is only approximately one. We have a small acceleration with respect to the stars above. Thus a mass at the equator will accelerate less due to gravity alone as there would be a fictitious force due the the Earth's non inertial frame of reference.
  + Objects travel in straight lines in curved space-time. E.g., the moon is travelling in a straight line from its frame of reference OR you walking around the Earth from your frame of reference.
* Newton's Laws
  + Imagine a box in an elevator with a person named B and a stationary person A. Person A would see the box as Fnet = ma = N - mg so N = m(g + a) yet Person B would see the box as Fnet = ma = 0 (as they're in the lift with the box). Experimentally, we find Person A is right a Newton's Laws cannot be applied in non inertial reference frames.
  + So how do we deal with this when travelling in an accelerating frame? We introduce a pseudo force. This will mean we can apply Newton's Law to non inertial frames. It's a trick. It’s a force which acts opposite to the direction of acceleration. E.g., if you have an accelerating car then you will 'feel' a force of ma acting opposite to the direction of acceleration. Or in the lift, observer B will see a force of ma acting downwards on the box thus giving the same result.

# The Speed of Light

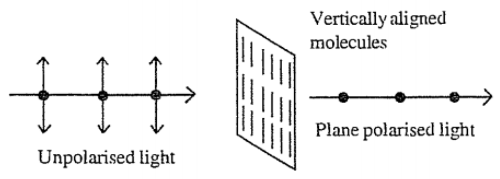
* Particles require energy to accelerate them. As mass is simply locked up energy, the mass of a particle increases the closer it gets to the speed of light and thus more energy is required to make it go faster. Eventually, its mass becomes infinite and infinite energy is required to accelerate it further. Ultimately, due to this, a particle can never reach the speed of light.
* Photons, however, can travel at the speed at light as they have no mass and thus don’t interact with the Higgs Field.

# Law of Inertia

* The earth spins due to the ‘Law of Inertia’. This states that every object with mass has a tendency to continue in that state unless acted upon by an external force. The matter which formed the earth was spinning leading to it still spinning today.
* Inertia is proportional to mass. It’s a measure of the resistance to changes in velocity.
* When riding a bike, the wheels provide the action force whilst the ground provides the reaction force. However, since the earth is so large, this horizontal force does little.

# Polarised Light

* The picket fence rope analogy is totally wrong, it only works for rope.



* If you have a metal grid and microwaves, vertically oscillating microwaves won’t travel between the vertical rods as they’d cause electrons in the grid to oscillate vertically instead which will re-radiate the waves equally in all directions with little emission going to the receiver. Whereas, if the metal grid was horizontal, it won’t move as much and thus little energy is absorbed and re-radiated so more microwaves get through to the receiver.

# Newton’s Third Law

* Imagine you’re standing on a large spring, your gravity would push you down yet it wouldn’t contract completely as it pushes back up on you. It wants to retain its original position.
* This is called the normal force. Normal means perpendicular and this is a perpendicular force to the ground.
* It can also be thought in terms of electron repulsion.