Horses/ Gears Why When

Horses

Let's look at the power output of an engine.
Imagine that the maximum power from my Fiesta is equivalent to 80 horses and that the car is actually a carriage. The higher the revs from the engine the more horses you will have access to.

In this weird example, at 1000rpm you have 20 horses available to you; 2000rpm will give you 40, 3000rpm gives 60 and 4000rpm gives 80. If you raise your revs above 4000rpm, you still only have 80 horses, you're just flogging them to death to the point that if you go too high, some of them will falter and you actually start losing power.

Now just because you have access to 80 horses doesn't mean that you use all the horses, that depends on how hard you press the accelerator. The harder you press the pedal the more horses you actually tie to the front of your carriage.

The engine is at idle at 1000rpm. We have access to 20 horses but if we only lightly press the accelerator we may only use 3 of them. Because of wind and tyre resistance and the weight of the carriage, it's always trying to come to a stop so we may need 3 horses just to maintain a steady speed.

We push the accelerator a little harder so we now use 4 horses; the carriage starts to accelerate and as a result, the revs start to climb. This is fine, we're slowly getting faster and as the revs climb more horses magically appear tied to the side of the carriage. Of course, the faster we travel, the more resistance there is so soon enough, we stop accelerating. We're now travelling at a higher speed but with higher revs (let's say 2000rpm), still only using 4 horses but now 40 of them are available. The other 36 horses are running alongside making a lot of noise, needing a lot of food to keep them going and farting a lot, hence putting out a lot of CO2.

We could have accelerated faster by pushing the accelerator harder. If you push the accelerator all the way down, you'll use all the horses you have around you. So at 1000rpm you'll be using 20 horses, 1500rpm will use 30 horses and at 2000rpm 40 horses.

Also bear in mind that when you take your foot off the accelerator, the more horses you have tied to the side of the carriage the more resistance you get, so the carriage will slow faster if you're not actually using those horses. A carriage with only a few horses on the side will maintain speed better than a carriage with lots of horses on the side. High revs = high engine braking; low revs = low engine braking.

So as you can see, the higher the revs you have, the more horses you have available to you, but it begs the question, why have access to a lot of horses if you're only going to use a few?

Gears

The gearbox holds a number of gears that take the rotational output from the engine (say 1000rpm), multiply it by an amount which subsequently relates to the number of times your wheels rotate. The more you rotate the wheels, the faster you go.

Revs	Gear	Multiplier	Wheel rotations	Speed (MPH)
800	1	0.5	400	5
800	2	1	800	10
800	3	1.5	1200	15
800	4	2	1600	20
800	5	2.5	2000	25

1600	1	0.5	800	10
1600	2	1	1600	20
1600	3	1.5	2400	30
1600	4	2	3200	40
1600	5	2.5	4000	50

Looking at the previous example, 10mph was attained by using 2nd gear at a low revs or 1st gear at a higher rev; It's simply taking a starting rev and multiplying it by the gear. If you double the revs at source, you get the same outcome as putting a low rev through a multiplier.

These number may help to clarify:
1000 x 2 = 2000 (1000 revs multiplied by 2 gives you 2000 rotations of a wheel)
2000 x 1 = 2000 (2000 revs multiplied by 1 still gives you 2000 rotations of a wheel)

Of course, if you have the engine and the wheels connected via the clutch and gear box then the number of wheel rotations will also affect the revs of the engine.

Speed (MPH)	Wheel rotations	Divider	Gear	Revs
30	2400	2	4	1200
30	2400	1.5	3	1800
30	2400	1	2	2400

As you can see, you can be driving at the same speed but depending on what gear you pick, your revs will be higher or lower.

Road Layouts

Scenario 1. You're stuck behind a car doing 30mph in a 60 limit. You need power to overtake. You pick 2nd gear which gets the revs up to circa 3000rpm. You still lightly press the accelerator to maintain 30. There's an opportunity to pass so you press the pedal into the carpet and utilise all that power.

Scenario 2. You're in a 30 zone, doing 30mph. The road is beautifully smooth and flat. You only need a small amount of power to maintain this speed so you pick 4th gear. 4th gear means circa 1100rpm, enough power to maintain the speed, low CO2, low fuel consumption.

Scenario 3. You're in a 30 zone doing 30 but this time there's a hill in front of you. Because you are in 4th gear, you have low revs. You don't have much power so you may find yourself slowing to 25mph by the top of the hill. As you go over the top of the hill, gravity will naturally try to speed you up. Because you don't have much engine braking the car may accelerate up to 35mph and hence you break the speed limit. By selecting 3rd gear, the revs will be circa 2000rpm at 30mph; this will give you a bit more power and more engine braking so it is easier to maintain 30mph going up and down the hill.

Summary

High revs give you engine power, lots of engine braking but burn more fuel and the car is louder.
Low revs give you low power, not much engine braking but is far more economical and quieter.
For a given speed, you can usually pick from a number of gears; picking a high gear gives low revs and a low gear gives high revs.
Simply put, pick the gear that gives you the control and power that you want from the engine.