EVOLVE

COACHING

TRAINING SCIENCE GUIDE

What actually makes a cyclist fast, in plain English.
The evidence-backed companion to your Evolve plan.

CONTENTS

A plain-English tour of what actually makes a cyclist fast, and why the sessions in your Evolve plan are built the way they are. Read it once and every zone, every interval and every recovery week will make more sense. It sits alongside your plan user guide and nutrition guide.

SECTION 01

WHY THE SCIENCE MATTERS

You do not need a physiology degree to get fast. You do need to understand roughly what is happening under the bonnet, because a rider who understands the why trains with more patience, more precision and far less wasted effort.

Most riders who stall are not lazy and they are not lacking talent. They are simply doing the right things in the wrong proportions, or the wrong things with great commitment. They smash every ride, skip the easy days, chase a number on a screen, and wonder why the fitness never quite arrives. Understanding the machine you are training fixes almost all of that.

This guide sits alongside your plan user guide and the Foundations First principle. It explains the engine your plan is building, the fuel it burns, the zones it uses and the recovery that turns hard work into fitness. Where a claim rests on research, you will find a small marker like this [2] that links to a real, published paper in the reference list. Nothing here is invented. You can follow every link and read the source yourself.

> **How to use it.**
> You do not have to read it in order. Skim the contents, jump to whatever you are curious about, and come back to the rest over time. Keep it as a reference for when your plan asks you to do something and you want to know exactly why.

One honest line before we start. This is general education for healthy riders, not medical advice. If you have a health condition, or anything feels wrong, see a qualified professional before pushing on.

SECTION 02

THE AEROBIC ENGINE

Cycling performance is not one number. It is a handful of qualities working together, and endurance is overwhelmingly an aerobic sport. Get the big aerobic pieces right and everything else has something to sit on.

Decades of research point to four qualities that decide how fast you can ride over anything longer than a few minutes [1][2][3].

VO2max, your ceiling. VO2max is the maximum rate at which your body can take in, transport and use oxygen. Think of it as the size of your engine at full throttle. It is set by how much oxygen-rich blood your heart can pump and how well your muscles extract oxygen from it [1]. A bigger VO2max lifts the roof on

everything below it. It matters most in short, savage efforts and on steep climbs.

Threshold, the useful fraction. You never race at VO2max for long. What matters far more day to day is the fraction of that ceiling you can hold for a long time. This is your threshold, and in cycling we usually track it as FTP. Two riders with the same VO2max can be minutes apart over an hour because one holds a much higher percentage of the ceiling [2].

Efficiency, free speed. Efficiency, also called economy, is how much power you produce for a given amount of oxygen burned. A more efficient rider goes faster on the same engine. It is one of the quietest but most powerful differences between good riders and great ones [2][3].

Durability, the modern piece. The newest addition to the list is durability, your ability to hold those qualities together deep into a long ride when fatigue is mounting [23]. Fresh numbers are nice. Numbers you can still produce after three hours win races and sportives. We come back to this in Section 11.

> **The big idea.**
> Fast cycling is a bigger ceiling (VO2max), a higher useful fraction of it (threshold), less waste (efficiency) and the durability to keep all three late in a ride. Your plan is built to develop every one of them, in the right order.

SECTION 03

YOUR ENERGY SYSTEMS

Every pedal stroke is paid for by one universal currency, a molecule called ATP. You have three ways to make it, and the length and intensity of the effort decides which one leads. They are never fully off. They blend.

The phosphocreatine system, instant power. For all-out efforts lasting a few seconds, a jump, a bike throw, the first surge of a sprint, your muscles use stored phosphocreatine to make ATP almost instantly. It is enormously powerful and runs dry fast, in roughly ten seconds. It then needs rest to recharge.

The glycolytic system, the burn. For hard efforts from around ten seconds up to a couple of minutes, you lean heavily on glycolysis, breaking down carbohydrate quickly without needing much oxygen. It produces a lot of power but also the metabolic by-products behind that deep leg burn. This is the system doing most of the work in a thirty second to two minute maximal effort [4].

The aerobic system, the endurance workhorse. For anything longer, the aerobic system takes over, burning fat and carbohydrate with oxygen inside your mitochondria. It is slower to ramp up but almost limitless in capacity, and it powers essentially all of your endurance riding.

The important truth is that these systems overlap. Research quantifying their relative contribution shows the aerobic system contributes more, and sooner, than most riders assume. It supplies roughly half the energy of an all-out effort by around the seventy five second mark, and is dominant in anything longer than about two minutes [4]. That single fact is why a strong aerobic engine helps even efforts that feel purely anaerobic.

Energy system by effort duration

Effort	Lead system	Feels like
0 to 10 sec	Phosphocreatine	Explosive sprint, standing jump
10 sec to 2 min	Glycolytic (anaerobic)	Deep leg burn, gasping, a hard attack
2 min to hours	Aerobic	Sustainable, controlled, rhythmic

Why it matters to you.
Different sessions train different systems. Sprints top up phosphocreatine power, short hard intervals stress glycolysis and VO2max, and long steady rides build the aerobic base that everything else draws on. A complete rider trains all three, in sensible proportions.

SECTION 04

THE ZONES AND WHAT THEY BUILD

Your Evolve plans use a seven-zone model throughout, anchored to your FTP. Each zone is not an arbitrary band on a chart. It is a lever that pulls on a specific set of adaptations.

Here is the model your plans use, expressed as a percentage of FTP, alongside the main thing each zone develops.

Evolve zone model and primary adaptation

Zone	% of FTP	Primary adaptation
Zone 1 · Active Recovery	0 to 55%	Blood flow, recovery between hard efforts, technique
Zone 2 · Endurance	56 to 75%	Mitochondria, capillaries, fat oxidation, aerobic base
Zone 3 · Tempo	76 to 90%	Aerobic power, muscular endurance, lactate handling
Zone 4 · Lactate Threshold	91 to 105%	Threshold, lactate clearance, sustainable power (your FTP)
Zone 5 · VO2 Max	106 to 120%	Maximal oxygen uptake, raising the aerobic ceiling
Zone 6 · Anaerobic Capacity	121 to 150%	Lactate tolerance, repeatable high-power efforts
Zone 7 · Neuromuscular Power	151%+	Sprint and standing-start power, nervous-system drive

The low zones are where the deep structural changes happen. Steady Zone 2 riding drives your muscles to build more mitochondria, the tiny power stations that burn fat and carbohydrate aerobically, and to grow more capillaries feeding the working muscle [6][9]. It also trains your body to burn a higher proportion of fat at a given pace, sparing precious carbohydrate [9][10].

Zone 3 and Zone 4 sharpen your ability to produce and clear lactate at higher intensities and to sustain hard power without falling apart [12]. Zone 5 pushes the whole oxygen-delivery system to its limit and is the primary driver of VO2max gains [16], while Zones 6 and 7 sit above it, building the anaerobic capacity and the raw neuromuscular power behind the shortest, sharpest efforts. Each zone has a job. A good plan visits them all, but not equally, and not at once.

> **Zones are tools, not trophies.**
> The goal is never to spend as much time as possible in the highest zone. It is to spend the right time in each zone for the adaptation you are chasing this week. That is the whole craft of training.

SECTION 05

BASE AND THE AEROBIC FOUNDATION

This is the section that reinforces Foundations First. Before the sharp stuff, you build the base, and the base is built almost entirely at low intensity with volume.

When you ride steadily in Zone 2 for long enough, week after week, three big things happen inside the muscle. You build more mitochondria, so each fibre can process more oxygen and burn more fuel aerobically [6][7]. You grow more capillaries, so more oxygen-rich blood reaches the muscle and more waste is carried away [9]. And you shift your fuel mix towards fat, which preserves your limited carbohydrate stores for when you really need them [10].

None of these adaptations require suffering. They reward time and consistency far more than intensity. This is why volume comes first, and why your easy rides should be genuinely easy. Recent expert consensus on Zone 2 training confirms the same picture, that steady sub-threshold riding is the anchor of aerobic development and the platform on which higher-intensity work becomes effective [10].

The mitochondrial machinery is trainable at surprising speed but also fades if you stop, which is exactly why the base phase and consistency matter so much [8]. You are not just getting fitter in the moment. You are building the biological hardware that everything later in the plan will exploit.

> **The short version.**
> Base is not junk miles and it is not a waiting room before the real training. It is the real training. Intervals raise your ceiling, but a big aerobic base is what gives that ceiling a room to sit above.

SECTION 06

THRESHOLD, FTP AND CRITICAL POWER

FTP is the number your plan is anchored to, so it is worth understanding what it actually represents, and where the science says it is a good guide and where it is a rough one.

FTP, functional threshold power, is a practical estimate of the highest power you can sustain in a quasi-steady state, often described as roughly what you could hold for around an hour. Physiologically it sits near a landmark researchers call the maximal metabolic steady state, the highest intensity at which lactate production and clearance stay in balance. Ride above it and lactate climbs relentlessly and you fade. Ride just below and you can hold on for a long time [12].

Sports science describes this true physiological ceiling with terms like maximal lactate steady state and critical power [13]. These are not identical to each other, and FTP is a field estimate rather than a lab-measured value, so it will not line up perfectly with any of them [14][15]. That is fine. FTP does not have to be physiologically perfect to be useful. It gives you a stable, repeatable anchor to set your zones and to measure progress, which is exactly what a training plan needs.

Why threshold work raises the ceiling. Training at and around threshold teaches your body to produce less lactate at a given power and to clear what it does produce more effectively. Over weeks, the power you can hold in that steady state creeps upward. In practice this is what people mean when they say their FTP went up, the whole useful ceiling has moved, and every intensity below it becomes more comfortable [12].

> **Test it, then trust it.**
> An FTP number is only as good as the test behind it and only stays accurate for so long. Retest when your plan tells you to. A stale FTP quietly makes every zone wrong, so the honest number is always better than the flattering one.

SECTION 07

VO2MAX: RAISING THE CEILING

If threshold is the useful fraction, VO2max is the ceiling that fraction sits under. Lift the ceiling and you give every other quality more room to grow.

VO2max improves when you spend meaningful time riding at or very close to it, which means hard, structured intervals in Zone 5 [16]. The stimulus is not just the effort itself but the total time you accumulate near your maximal oxygen uptake across the session. That is the single idea that ties all good VO2max training together [18].

Short versus long intervals. There are two main ways to bank that time. Longer intervals, think four to eight minutes near your limit, drive you deep into the VO2max zone and hold you there. Shorter intervals, for example thirty seconds hard with short recoveries repeated many times, let you accumulate a lot of time near VO2max while feeling slightly more manageable, because the micro-recoveries keep you from

blowing up [17]. Both work. Well-trained cyclists often respond very well to short-interval formats, which is why your plans use both across a block [17].

Even low-volume, high-intensity interval work produces meaningful aerobic and mitochondrial adaptations, which is reassuring news for time-crunched riders, though it does not replace the base, it builds on it [19].

> **Why it feels so hard.**
> VO2max efforts hurt because you are asking your oxygen-delivery system to run flat out. That discomfort is the point. The goal is quality time near the ceiling, so pace the early reps so you can still hit the last ones. Fading badly at the end means you started too hard.

SECTION 08

ANAEROBIC AND NEUROMUSCULAR POWER

Above VO2max sits the top end, the short, explosive efforts that decide sprints, bridge you to a break and get you over a punchy rise. This is anaerobic and neuromuscular territory.

Neuromuscular power is your raw, brief maximum, the few seconds of a full sprint driven mostly by phosphocreatine and by how well your nervous system recruits muscle. Anaerobic capacity is the slightly longer well, the fifteen second to one minute efforts where glycolysis is screaming and the legs are flooded.

Repeated-sprint ability. In real racing you rarely get one clean sprint. You get sprint, recover a little, sprint again, over and over. The ability to repeat high-power efforts with incomplete recovery is its own quality, and, importantly, a big part of how well you recover between sprints is aerobic. A stronger aerobic engine helps you restore power faster between efforts [5]. This is another reason the base underpins even the sharpest end of the sport.

For most riders, anaerobic and neuromuscular work is the seasoning, not the meal. Time trialists and long-distance riders need very little of it. Criterium racers, track riders and anyone who sprints for results need a good deal more. Your plan dials the amount to match what you are training for.

> **Match the top end to the target.**
> Do not bolt heavy sprint work onto a plan aimed at long steady events, and do not neglect it if you race crits. The right amount of anaerobic training is the amount your event actually demands. More is not better, relevant is better.

SECTION 09

INTENSITY DISTRIBUTION

Once you know the zones, the next question is how much time to spend in each. This is intensity distribution, and it is one of the most studied questions in endurance sport.

Three broad models come up again and again.

- Polarised. The large majority of riding is easy, a small slice is genuinely hard, and very little sits in the middle. Often summarised as the 80/20 idea, roughly eighty percent easy, twenty percent hard [11].
- Pyramidal. Most riding is easy, a moderate amount is at tempo and threshold, and a smaller amount is very hard. The volume tapers as intensity rises, like a pyramid.
- Sweet-spot / threshold. A larger share of time is spent at moderately hard, sub-threshold to threshold intensity. Time-efficient, but demanding, and easy to overcook.

What does the evidence say? Across many studies, keeping the bulk of your training easy and reserving true intensity for a minority of sessions produces excellent results, and polarised or pyramidal approaches tend to compare well against grinding away in the middle all the time [20][21][11]. No single distribution wins for everyone in every phase, but the common thread is clear, do not let your easy days drift hard.

Evolve plans apply this by protecting your easy riding fiercely and concentrating quality into a small number of key sessions. Some plans lean polarised, some pyramidal, some use sweet-spot blocks when time is tight, and the mix shifts across the season. The distribution is a deliberate choice, not an accident.

> **The trap to avoid.**
> The classic mistake is the grey zone, riding your easy days a bit too hard and your hard days a bit too easy. You end up moderately tired all the time and never truly stress either end. Easy days easy, hard days hard.

SECTION 10

PERIODISATION

Periodisation is simply the art of organising your training over weeks and months so that you arrive at your goal fit, fresh and peaking, rather than tired and flat.

The classic structure moves through phases. Base builds the aerobic engine with volume. Build adds intensity and event-specific work on top of that base. Peak sharpens the specific qualities your event needs. And a taper sheds fatigue in the final week or two so your fitness can finally show itself on the day.

Traditional versus block. Traditional periodisation develops several qualities at once, gradually shifting the emphasis over months. Block periodisation concentrates one quality into a short, focused block before moving to the next, which can be a potent way to drive a specific adaptation in well-trained riders [22]. Neither is universally superior, and your plan uses whichever suits its length and goal.

Progressive overload and recovery weeks. Underneath every model sits progressive overload, gradually asking a little more of the body so it is forced to adapt. But you cannot climb forever. That is why plans include lighter recovery weeks, typically every third or fourth week. They are not lost time. They are when the fitness you have been stimulating actually gets built, as we explain next.

The taper. A good taper reduces volume while keeping some intensity, so you lose fatigue faster than fitness and turn up primed. Done well it can add a genuine, measurable chunk of performance on race day [24]. Done wrong, by simply stopping, you go stale. Trust the plan through the taper even when it feels like too little.

> **Structure beats heroics.**
> A well-sequenced plan will always beat a pile of random hard rides. Overload, recover, sharpen, taper. The order is what turns effort into form on the day that matters.

SECTION 11

DURABILITY AND FATIGUE RESISTANCE

Here is the frontier of modern endurance science, and the quality that separates riders who look strong on paper from riders who are strong at the finish.

Durability is your resistance to fatigue over a long ride. It is the difference between your fresh numbers and the numbers you can still produce after two, three or four hours of riding [23]. Two riders can have identical FTPs when rested. The one whose threshold barely drops after three hours is, in every way that matters for a road race or sportive, the fitter rider.

Why does power fade late in a ride? Fuel is a big part of it. As carbohydrate stores deplete, your ability to hold high intensities erodes, which is one reason fuelling and durability are so tightly linked. The good news is durability is trainable. Long steady rides, well-fuelled endurance work, and the deep aerobic adaptations from Section 5 all push your fade later and later into the ride.

This is also why base volume pays off far beyond the base phase. All those steady miles are building the fatigue resistance that lets your threshold and VO2max show up when they count, at the sharp end of a long event rather than only in a fresh twenty minute test.

> **Train it on purpose.**
> If your event is long, some of your key sessions should come after you already have hours in the legs, hard efforts late in a long ride, so you practise producing power tired. That is durability training, and it is one of the highest-value things a long-distance rider can do.

SECTION 12

ADAPTATION, OVERLOAD AND RECOVERY

Here is the most misunderstood truth in training. You do not get fitter while you train. You get fitter while you recover from training. The ride is the stimulus. The adaptation happens afterwards.

The cycle is simple. You apply a training stress that temporarily makes you tired and slightly worse. Then, given rest and fuel, your body repairs and rebuilds a little stronger than before, ready for next time. This rebound above your starting point is called supercompensation. Train again at the right moment and you ratchet upward. Train too soon, too often, and you dig a hole instead.

Reading fitness, fatigue and form. Many riders track three numbers that put maths on this idea. Fitness (often shown as CTL) is your accumulated training load over the long term, a slow-moving measure of how much work you are used to. Fatigue (ATL) is your recent, short-term load, which rises and falls quickly. Form (TSB) is fitness minus fatigue, a rough gauge of how fresh you are.

These come from a long line of research modelling performance as the balance between a positive fitness effect and a negative fatigue effect from every training session [25]. The practical reading is intuitive. When fatigue is high, form is low and you are loaded but tired. Shed some fatigue and form rises, which is exactly what a taper engineers before a big day.

One important caveat from the science, the response to a given dose of training varies between people and over time. The same week that builds one rider can flatten another [25]. Numbers are a guide, not gospel. How you actually feel, how you are sleeping, and your enthusiasm to ride are data too. Listen to them.

> **Recovery is training.**
> Rest days and easy weeks are not the absence of training. They are the part of training where the fitness is actually built. Skip them and you keep applying stress to a body that never gets to adapt. The hard work only counts if you let it land.

SECTION 13

STRENGTH TRAINING FOR CYCLISTS

Lifting weights will not make you slow or bulky, and it is one of the most evidence-backed additions a cyclist can make. Done sensibly, it makes you a more efficient, more durable and more powerful rider.

Heavy resistance training improves cycling economy, so you produce the same power for less oxygen, and it lifts your sustained and sprint power without necessarily adding much bulk [26]. It is especially valuable late in long events. Strength-trained cyclists hold power better when fatigued, one study showing improved performance in a five minute all-out effort taken after three hours of prior cycling [27]. That is durability, delivered from the gym.

The benefits hold for female cyclists too, with strength work improving cycling performance and related qualities in women [28]. And there is a wider health case, particularly with age. Resistance training

supports bone density and helps preserve the muscle and power we naturally lose as we get older, which cycling alone does not fully protect. For a masters rider, the gym is not optional extra credit, it is close to essential.

> **Keep it simple and heavy-ish.**
> A small number of big compound lifts, done with good form and progressed sensibly, delivers most of the benefit. You are training for cycling strength and durability, not to be a bodybuilder. General guidance here, not medical advice, if you are new to lifting or returning from injury, get qualified coaching on technique first.

SECTION 14

REFERENCES

Every claim that rests on research links to a paper below. These are real, published, peer-reviewed sources on PubMed or via DOI. Follow any link and read the original for yourself.

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UNDERSTAND THE MACHINE, TRAIN WITH PATIENCE, GET FASTER.

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