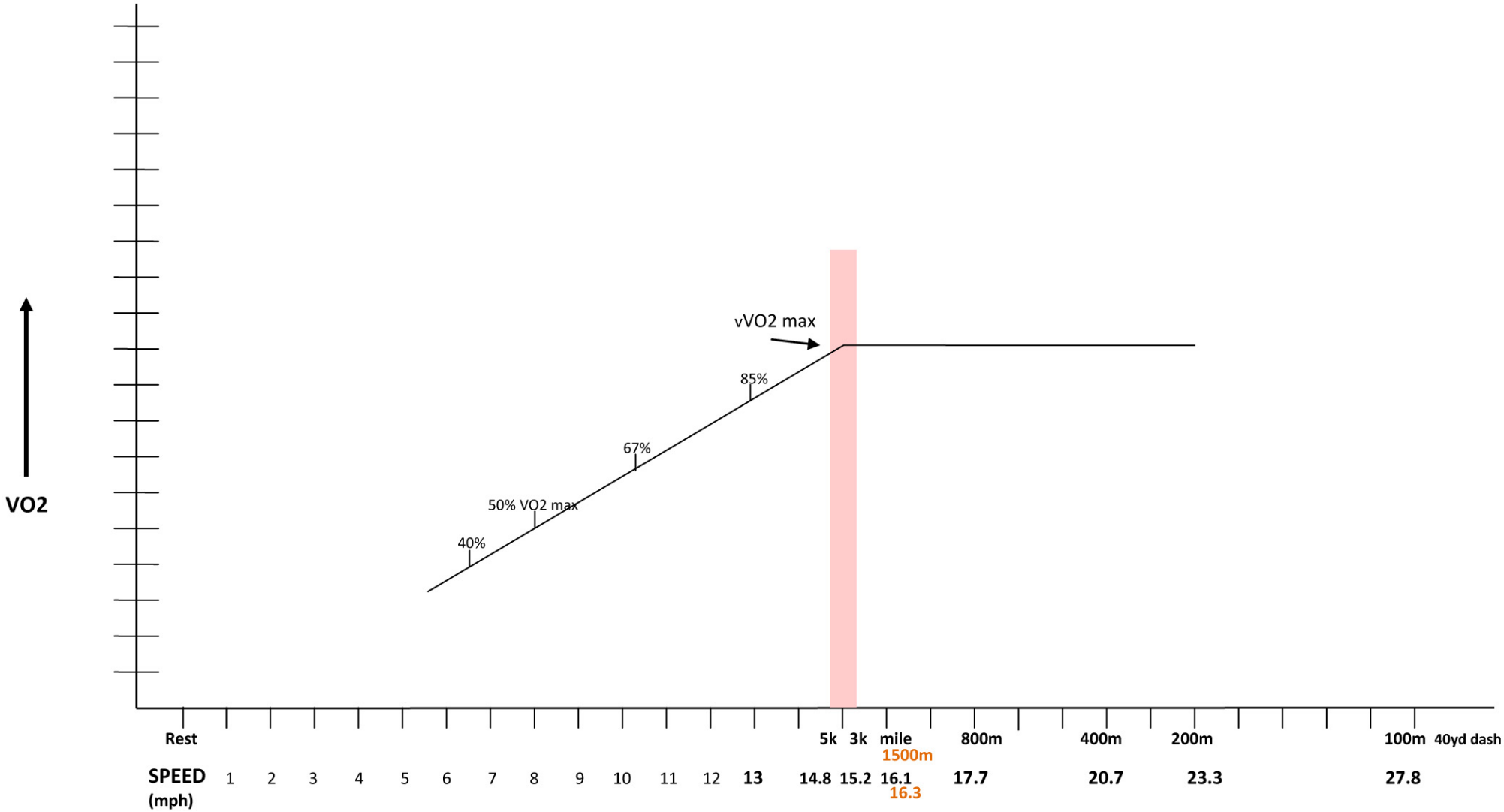
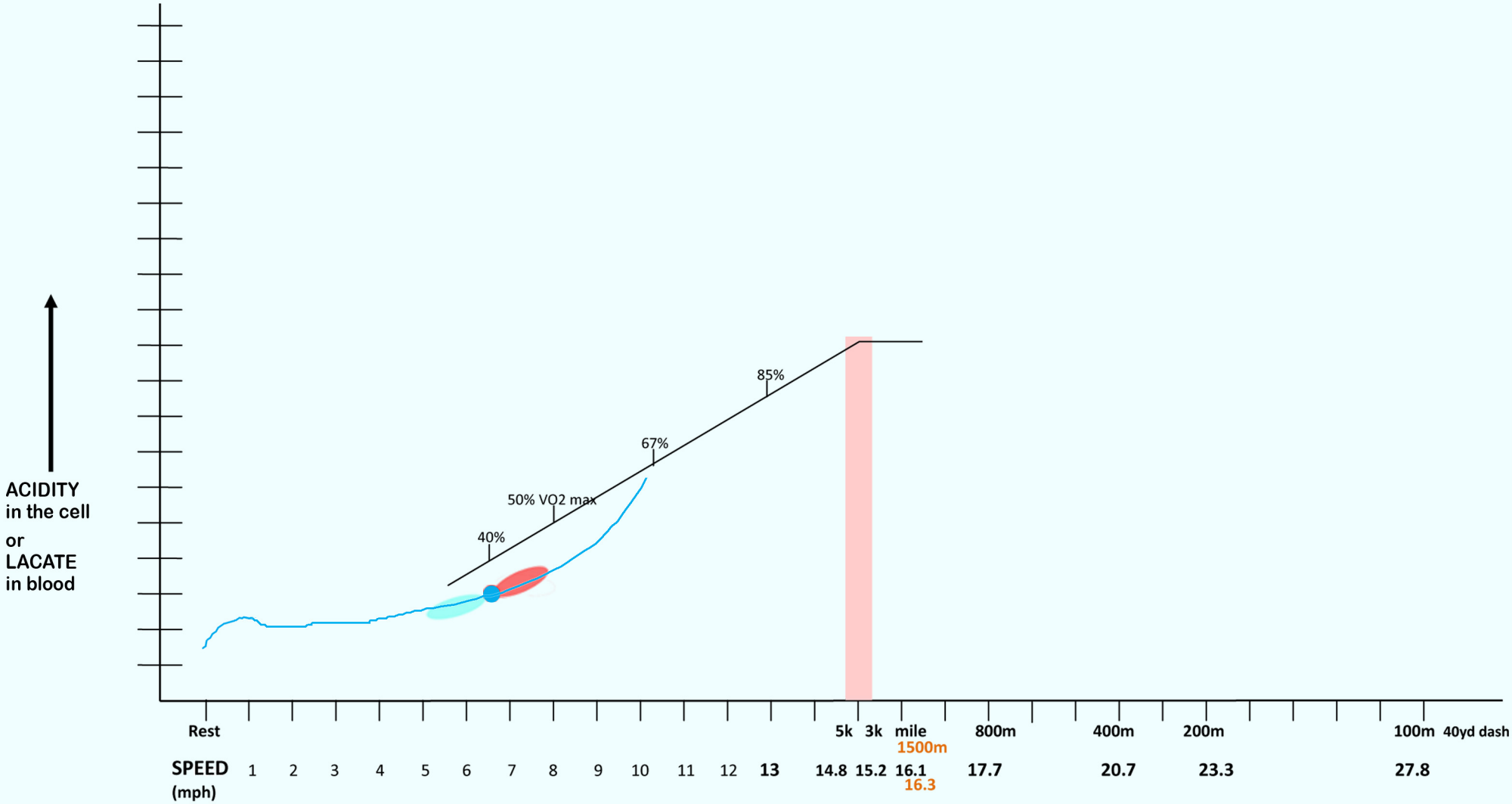
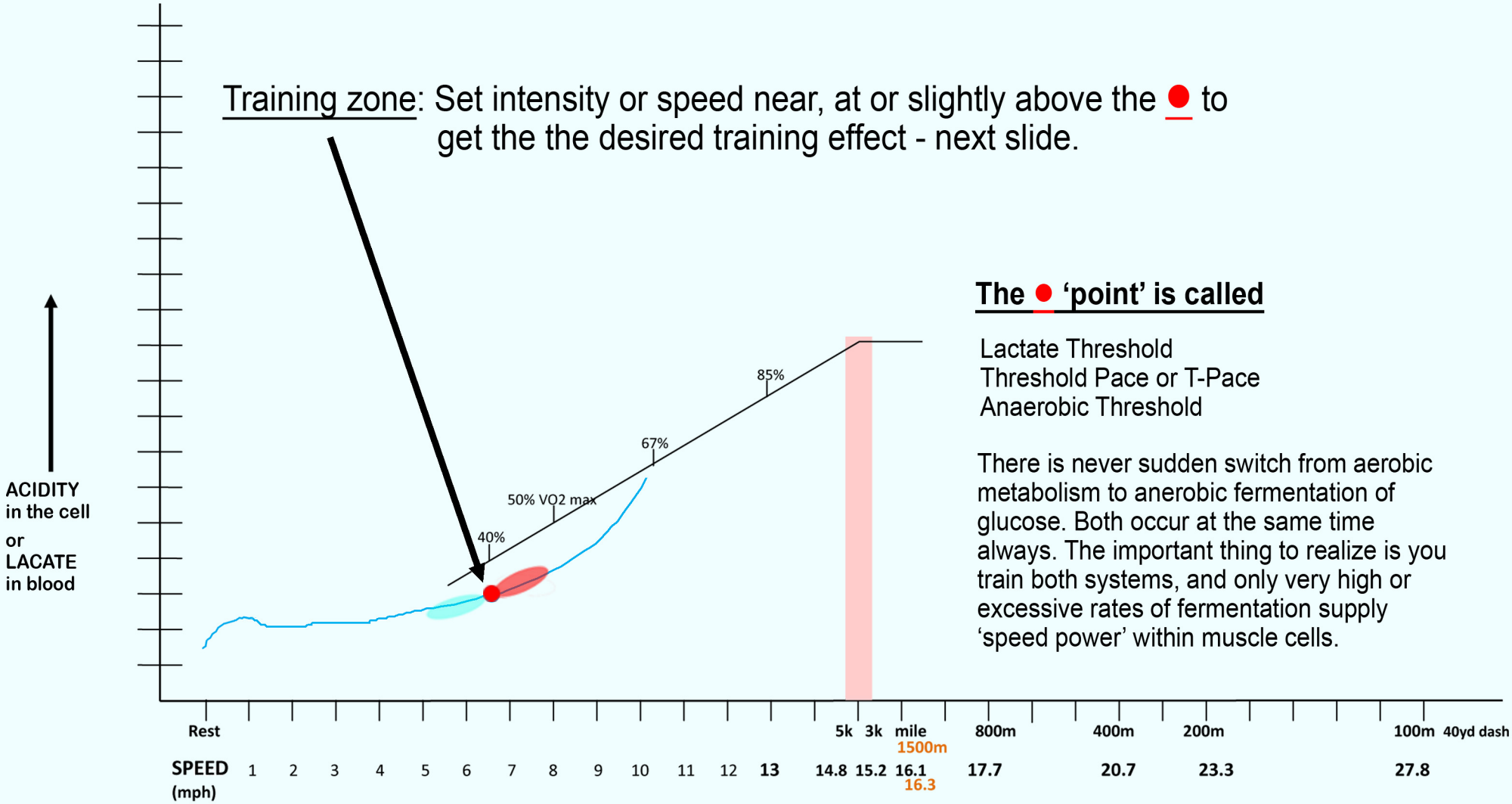

VO2
vVO2 max
85%
67%
50% VO2 max
40%
Rest
5k
3k
mile
1500m
800m
400m
200m
100m
40yd dash
SPEED
(mph)
1
2
3
4
5
6
7
8
9
10
11
12
13
14.8
15.2
16.1
16.3
17.7
20.7
23.3
27.8

‘Underneath’ oxygen power - lays acid production (fermenting glucose) at all times.



‘Underneath’ oxygen power - lays acid production (fermenting glucose) at all times.



The ● ‘point’ is called

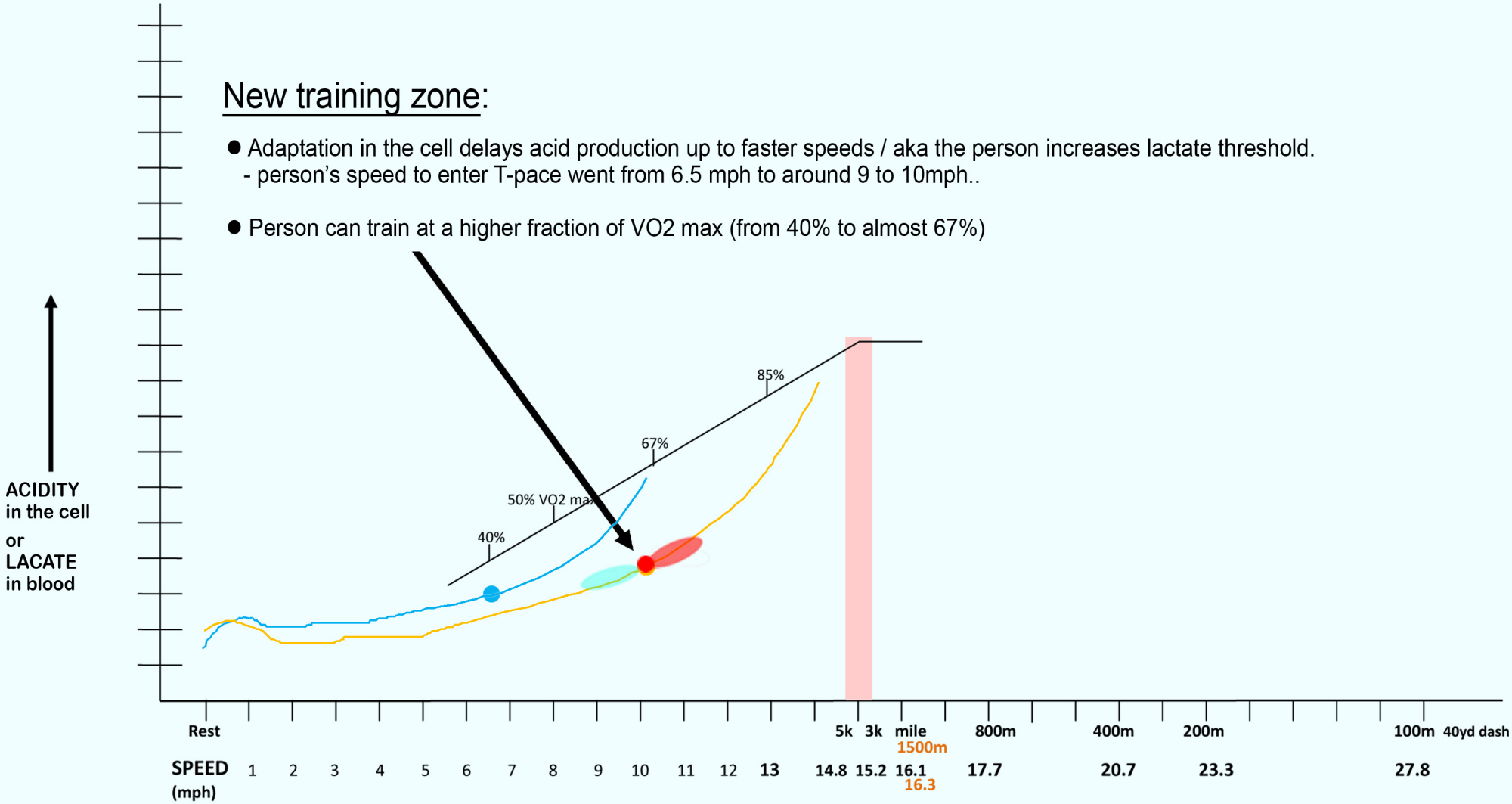
Lactate Threshold
Threshold Pace or T-Pace
Anaerobic Threshold

There is never sudden switch from aerobic metabolism to anerobic fermentation of glucose. Both occur at the same time always. The important thing to realize is you train both systems, and only very high or excessive rates of fermentation supply ‘speed power’ within muscle cells.

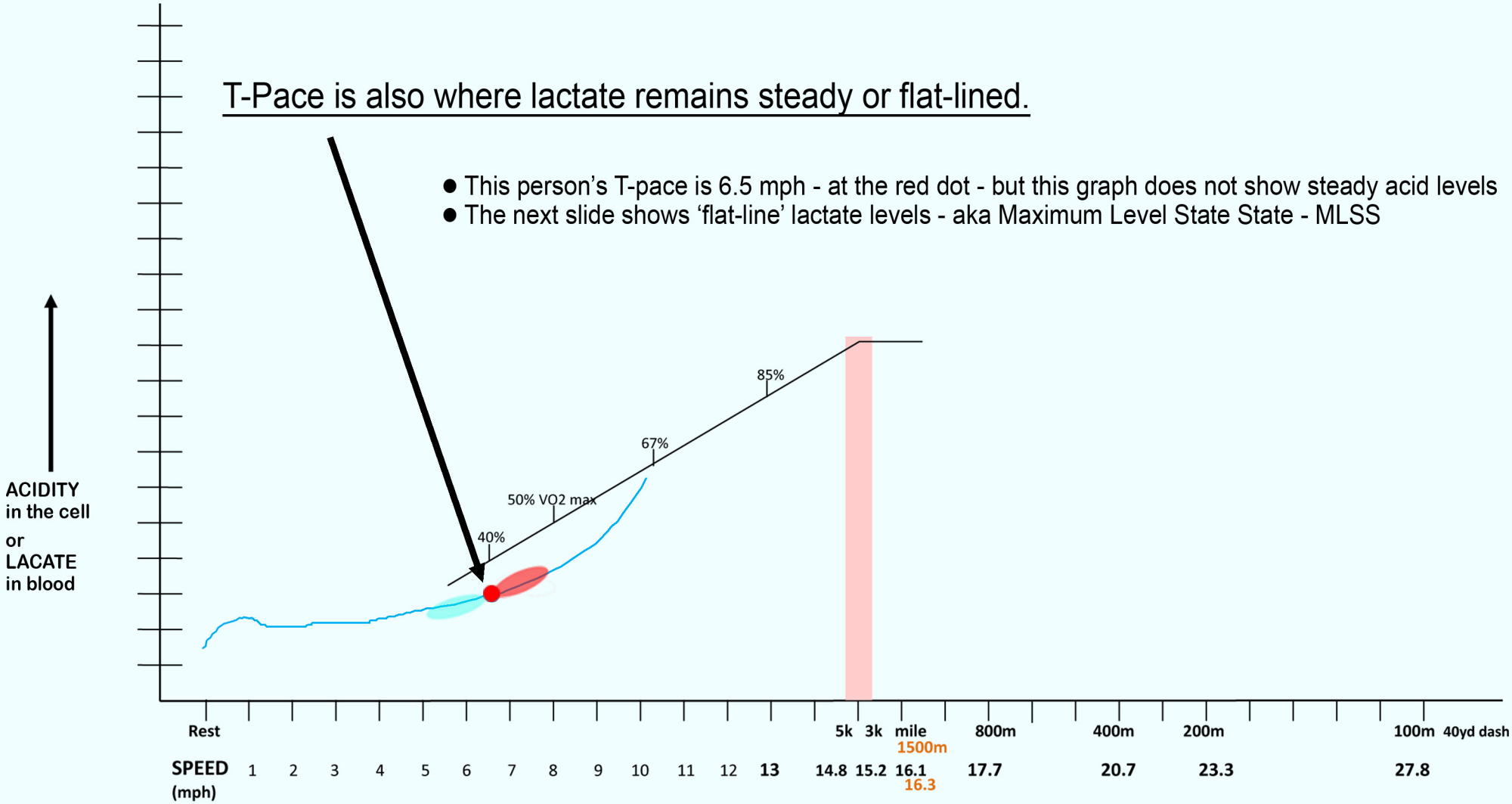
‘Underneath’ oxygen power - lays acid production (fermenting glucose) at all times.

New training zone:

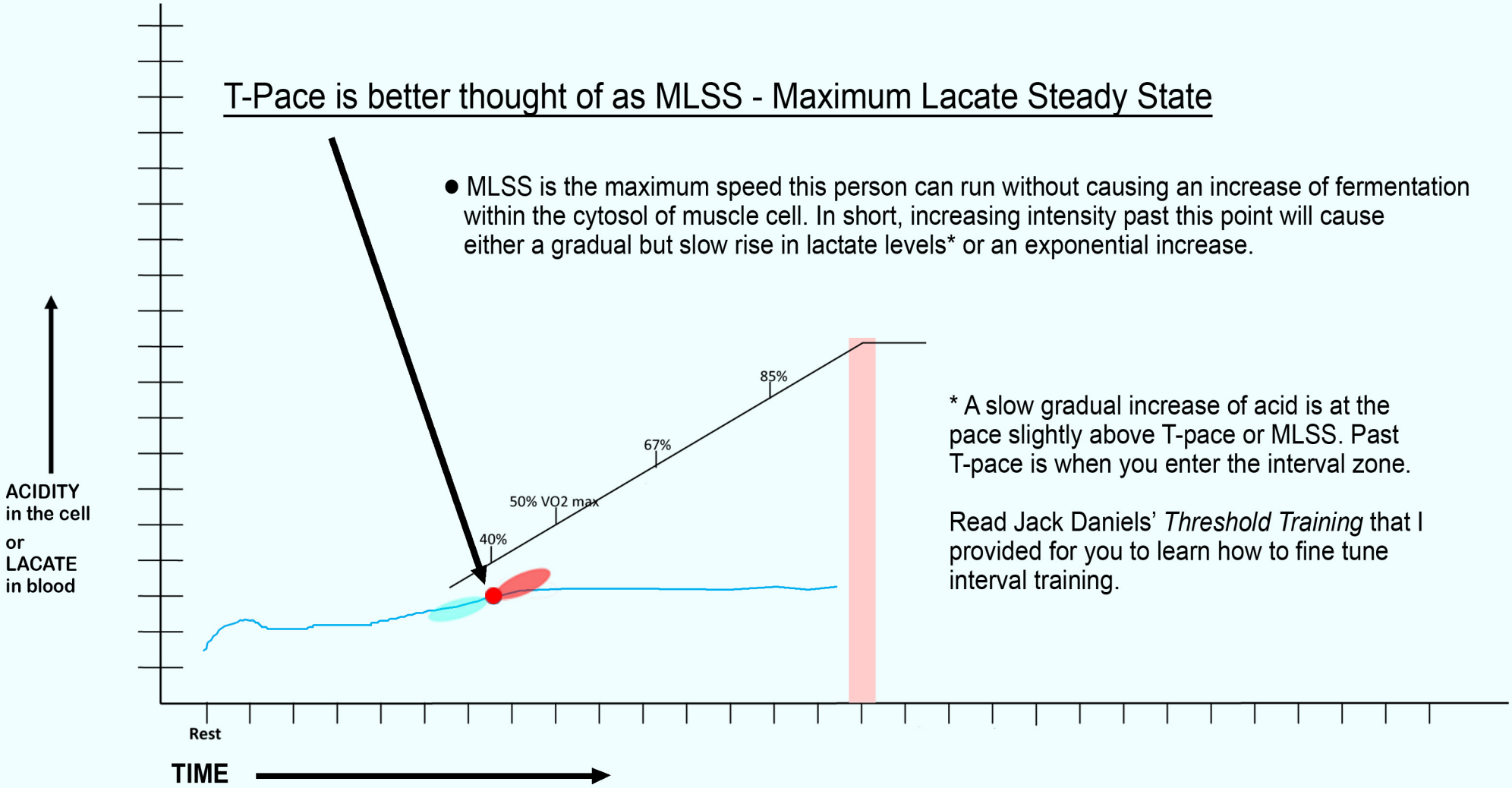
- Adaptation in the cell delays acid production up to faster speeds / aka the person increases lactate threshold.
  - person’s speed to enter T-pace went from 6.5 mph to around 9 to 10mph..
- Person can train at a higher fraction of VO2 max (from 40% to almost 67%)



‘Underneath’ oxygen power - lays acid production (fermenting glucose) at all times.



‘Underneath’ oxygen power - lays acid production (fermenting glucose) at all times.



NOTICE: Time is now the essence at the x-axis. This person may run, theoretically for many hours at this pace - if properly fueled and trained. This is what Dean Karnez does.

The challenge of setting the right pace becomes ‘how long/how far’ can you maintain running at the fastest pace possible - at MLSS!

‘Underneath’ oxygen power - lays acid production (fermenting glucose) at all times.

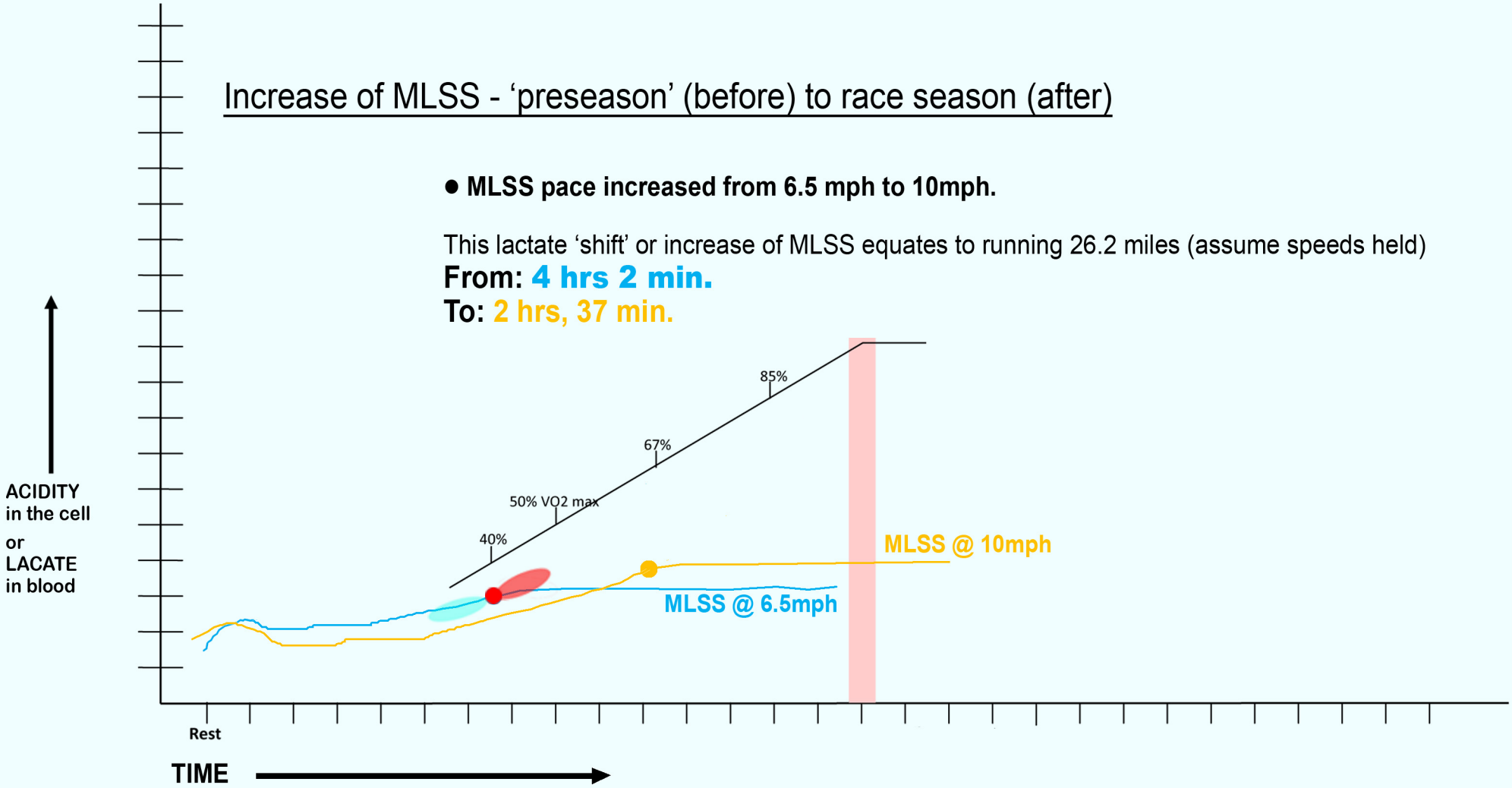
Increase of MLSS - ‘preseason’ (before) to race season (after)

- **MLSS pace increased from 6.5 mph to 10mph.**

This lactate ‘shift’ or increase of MLSS equates to running 26.2 miles (assume speeds held)

From: 4 hrs 2 min.

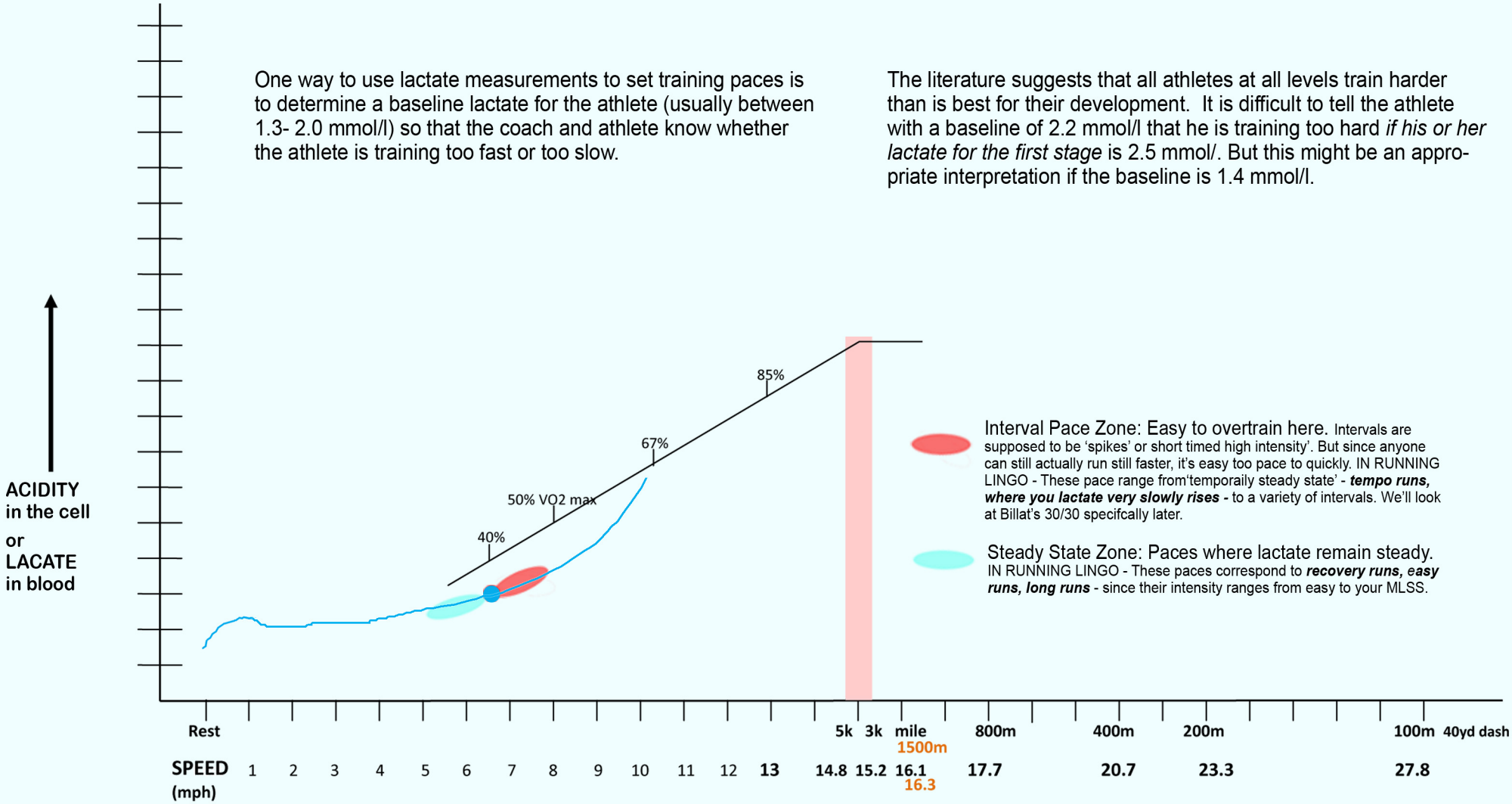
To: 2 hrs, 37 min.



‘Underneath’ oxygen power - lays acid production (fermenting glucose) at all times.

One way to use lactate measurements to set training paces is to determine a baseline lactate for the athlete (usually between 1.3- 2.0 mmol/l) so that the coach and athlete know whether the athlete is training too fast or too slow.

The literature suggests that all athletes at all levels train harder than is best for their development. It is difficult to tell the athlete with a baseline of 2.2 mmol/l that he is training too hard *if his or her lactate for the first stage* is 2.5 mmol/. But this might be an appropriate interpretation if the baseline is 1.4 mmol/l.

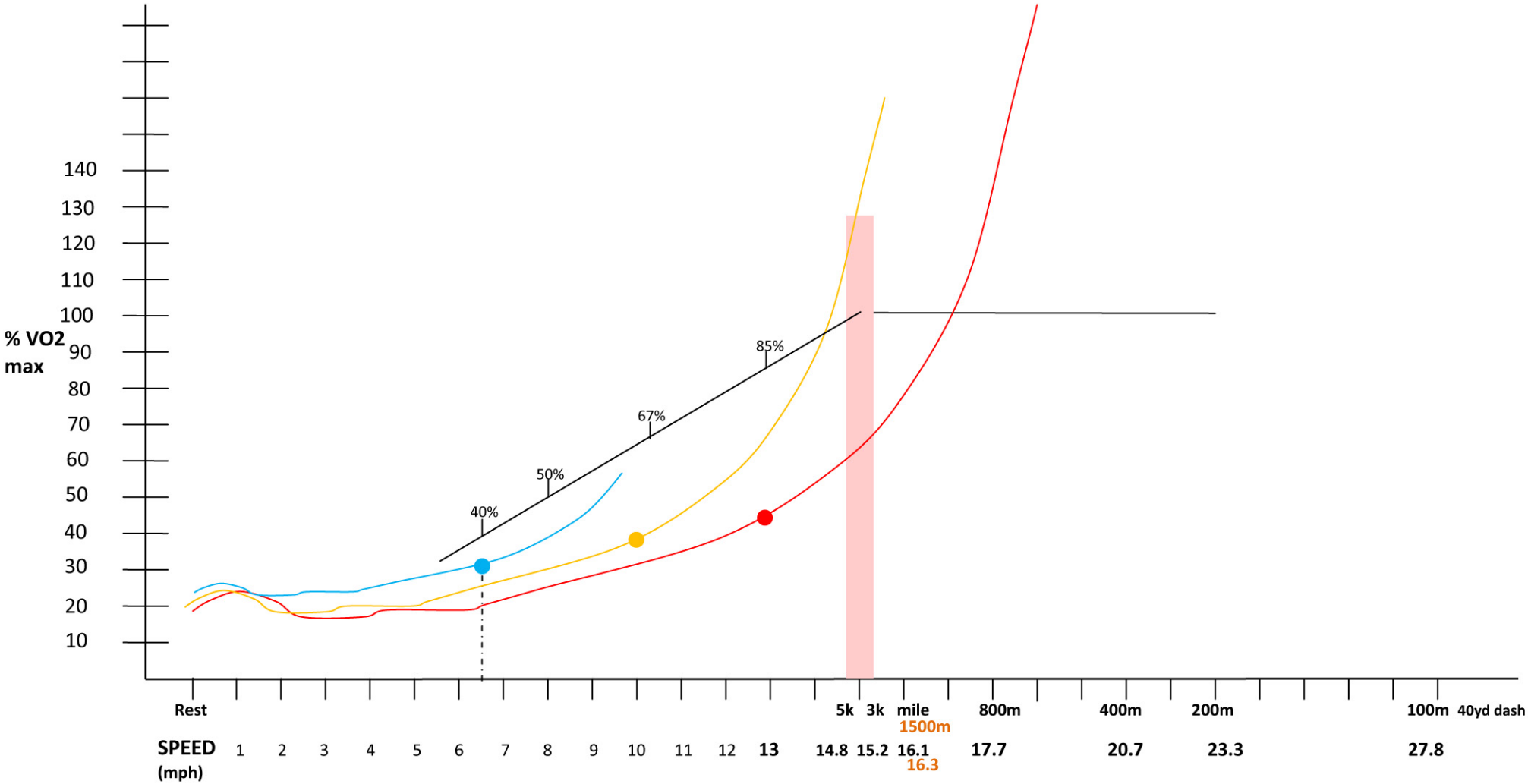


Interval Pace Zone: Easy to overtrain here. Intervals are supposed to be ‘spikes’ or short timed high intensity’. But since anyone can still actually run still faster, it’s easy too pace to quickly. IN RUNNING LINGO - These pace range from‘temporaily steady state’ - ***tempo runs, where you lactate very slowly rises*** - to a variety of intervals. We’ll look at Billat’s 30/30 specifcally later.

Steady State Zone: Paces where lactate remain steady. IN RUNNING LINGO - These paces correspond to ***recovery runs, easy runs, long runs*** - since their intensity ranges from easy to your MLSS.

All we care about is <u>the speed where before/after the inflection point occurs</u> – allowing a human to keep running as fast as possible over distance.

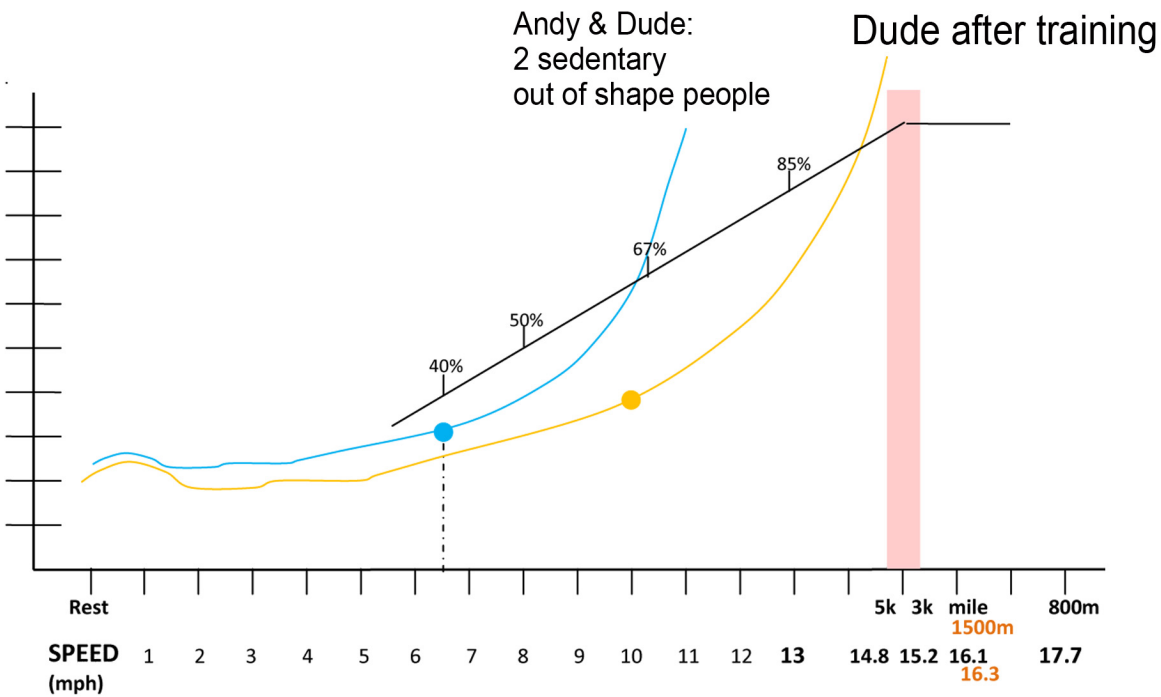
- Most VO2 max tests start ≈ 6.5 mph. An untrained human's acid levels approach inflection before spiking at slow speeds ≈ 40% VO2 max
- 'Dude'- a trained human with 'excellent VO2 max for his age' (54.2) may maintain his LAT pace ≈ 10mph – just short of 67% VO2max.
- Dennis Kimetto - world record marathoner – ran just under 13mph around 85% VO2 max. Lactate is near inflection point.

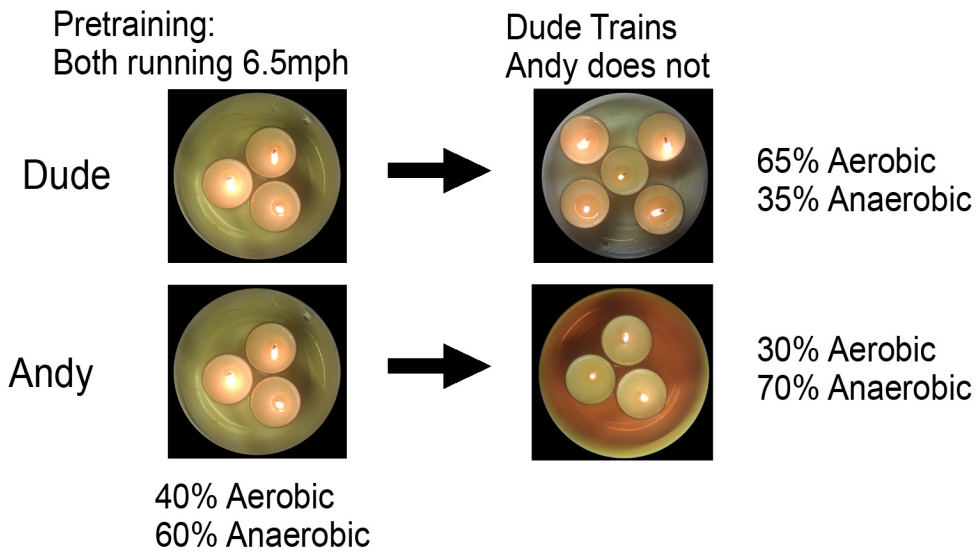


Running a 5k or 3k competitively demands running ≈ 15mph over the entire distance, which is near vVO2 max or 100% VO2 max. Hence the narrow purple zone from 5k to 3k spans this area. The only way to win races from the marathon (faster than 12mph avg) to 800m (17.7 mph avg) is possessing a high VO2 max, high lactate threshold, and excellent 'sprint' biomechanics – aka 'efficiency'. Weaker but trained runners with sloppy mechanics force 'running'- which wastes energy/glycogen, and in turn elevates their lactate levels – disallowing them to compete. The purpose of the mitochondria or aerobic system is to lower acid production/fermentation/glycolysis at ANY speed.

All the speeds listed in bold, 13mph plus - are average speeds ran from a marathon to the 100m dash - of the world record humans in their respective event *. Practically nobody can compete at these levels except the world record holders, <u>whose lactate levels remain low</u> – <u>while running over 80% of their VO2 max, i.e. at a higher fraction of VO2 max</u>. *27.8mph is Usain Bolt's absolute speed.

Lactate Shift as Seen in the Cell





CONCEPTS:

1. The purpose of the mitochondria / aerobic system is to decrease or minimize-acid powered metabolism at ALL times at any intensity.

2. Any unfit or detrained person produces 'more acid sooner' - i.e. at lower intensities.

3. Acid powered exercise eventually over-whelms the cell at high speeds; the best a human can delay this is around 85% VO2 max - as seen in top marathoners. Even in the world's best - this occurs just short of running 13mph.

Chris Carmichael, Lance Armstrong's coach, explains:

Power isn't the issue. Anyone can produce 400 watts for a few seconds. However, most riders can't produce 400 watts for a very long time without going anaerobic and slowing abruptly. What's key is the ability to produce significant power while re-maining under your lactate threshold (LT) and in control. ***All of Lance's training revolved around raising his power at LT. The secret is to do most of your hard training a little below, at, or slightly above your lactate threshold.***

See Lesson 24 **Crazy Glycolysis Provides the 'Equivalent Power'**