

What is the basic premise of altitude training?

When the partial pressure of oxygen is lower than what is found at sea level, it stresses the ability of an athlete's cardiovascular system to deliver oxygen to the muscles for aerobic performance (events lasting longer than approximately two minutes). The primary responses to the stress of lowered oxygen are twofold.

The first is an increase in hemoglobin, the molecule found in red blood cells that carries oxygen in the blood. This increase allows each liter of blood to carry more oxygen to the cells than it could before. The second response is an increase in the enzymes and efficiency of the metabolic pathways that extract oxygen from the blood and use it to produce energy. This change better enables the cells to work in an environment of lowered oxygen.

"If your event lasts longer than two minutes in duration and you're not using hypoxia in some form or fashion, you are not competitive at the elite level."

*Jim Stray-Gundersen, MD
Altitude Researcher*

Since prolonged activity makes great use of hemoglobin and aerobic enzymes, any method by which we can increase these components (like altitude training) will result in an improved ability to perform aerobic exercise.

Is there an ideal altitude at which to train?

As we go up in altitude, we lessen our ability to exercise because of the decreased oxygen availability in the air. This can translate into less intense training for the athlete, and little or no improvement in athletic performance as a result of altitude training. Therefore, the altitude at which one trains is important. At altitudes of 2000 to 2500 meters (6500 to 8200 feet), the decreases in performance are not usually so dramatic that they lead to detraining of the athletes. Thus, these altitudes are often used and recommended for training.

Flagstaff, Arizona, is situated at an altitude of 2134 meters (7000 feet), and provides what many consider to be an ideal location for altitude training.

How much of an increase in performance can take place?

Generally, sport scientists place the increase in performance gained from altitude training in the 3-5% range. It should be clearly understood that in the world of athletic competition, particularly elite-level competition, even the smallest of margins can mean the difference between a gold medal and last place. For example, in the 2000 Olympic Games, the difference between getting the gold medal and finishing last in the Men's 100m Breaststroke was a mere 1.42 seconds (a difference of only 2.4%).

How long does it usually take in order to adjust to a higher altitude?

Generally speaking, as elevation increases, the time for acclimatization to occur is also increased. It takes about 2 weeks to acclimatize to altitudes of 2000 to 2500 meters (6500 to 8200 feet), during which time an athlete may go through a period of general weakness and tiredness.

In order to capitalize on the relevant metabolic and cardiovascular adaptations, a stay of at least 2 weeks is usually recommended (although more recent research is pointing toward the need to stay closer to 4 weeks in order to maximize red cell mass). This will also allow time for the reestablishment of normal ventilation, thus preventing the fluctuations in acid-base balance, which are common with acute exposure to altitude.

Does everyone respond the same to altitude?

No - responses to altitude are extremely individual. While one person may respond and adapt quite easily and quickly to increases in elevation, another may experience more difficulty with more pronounced symptoms over a longer period of time, including headache, insomnia, nausea, and general weakness. There is also a category termed "non-responders" for those individuals who do not appear to respond at all to the stressors of altitude in a beneficial manner.

What steps can be taken to better prepare for and adapt to altitude?

1. The body's metabolic rate will be increased upon exposure to higher elevations. Therefore, eating plenty of food, as well as making sure iron intake is sufficient to help produce extra red blood cells, can be useful for supplementing the body's greater needs. Sport science research has clearly shown that adequate levels of iron stores are crucial to adapting well to an altitude environment.
2. In addition to the decrease in oxygen, the relative humidity at altitude is extremely low, resulting in air that continually draws moisture out of the body and speeds up breathing, causing the body to lose moisture more rapidly. Therefore, it is important to consume 40 to 50% more water than you would at sea level throughout the entire day. (Consistent and continual water intake is more effective than consuming a large amount of water intermittently). Avoid alcohol and caffeine to avoid dehydration as well.
3. Closely monitor how the body feels during the first few days at altitude. Adjusting activity levels during the time when the acclimatization process is at its most active level can help ease feelings of being tired, sick, and weak. Overexertion during this critical period of adjustment can make altitude-related symptoms worse.
4. Due to the increased amount of stress placed on the body at altitude, adequate amounts of sleep (afternoon naps and longer periods of nighttime rest) can be very beneficial.