Blood Doping:
Messing with Metabolism to Win Races

To win international bicycle races, you can’t just be in good physical shape—you have to be in AMAZING shape. Your metabolism has to work like a well-oiled machine. The world’s top cyclists work to perfect their muscles and body systems so that they process oxygen, glucose, and amino acids better than almost any other humans on Earth.

A Cyclist’s Metabolism

What’s so special about a top cyclist’s metabolism? Cyclists’ muscle cells contain unusually high numbers of mitochondria, where glucose and oxygen combine to release energy. That means their muscles can release more energy than most people’s muscles. To bring in more oxygen, top cyclists breathe hard: up to 75 breaths per minute. To bring in more glucose, they eat lots of carbohydrates, such as starch, even while they’re riding! Cyclists often slurp down special gels filled with glucose while they’re on their bikes, one hand on the handlebars and the other popping open the gel. To transport these molecules more quickly to their muscle cells, their hearts beat fast: up to 200 beats per minute. A faster heart rate pushes the molecules through the circulatory system more quickly and out to all the cells in the body sooner.

The problem for top cyclists is that even all that isn’t always enough to win. Every cyclist in the race is in perfect physical shape, and all of them are looking for an edge to help them win. Sadly, that means some decide to break the rules to help them get ahead . . . not by taking a shortcut on the racecourse or breaking a competitor’s bike, but by injecting themselves with extra blood from their own bodies—a practice known as blood doping. Blood doping is banned, meaning it’s not allowed in competition, but some cyclists secretly do it to improve their performance. The most famous example of an athlete who used blood doping is Lance Armstrong, who was known as the best cyclist in the world until he admitted to blood doping in 2013.

The world of international bicycle racing can be so competitive that some athletes cheat by blood doping.
What Is Blood Doping?

In most cases of blood doping, an athlete drains some of his or her own blood, chills the blood to keep it fresh, and stores it for several weeks or even months. The athlete’s body naturally works to replace the lost red blood cells. Then, just before a competition, the athlete injects the stored blood back into his or her body. Injecting blood increases the number of red blood cells in the athlete’s body.

How Blood Doping Works in the Body

Red blood cells carry oxygen from your lungs to every cell in your body, including your muscle cells. The red blood cells fill up with oxygen in the lungs and then are pumped out to the body cells, where they drop off the oxygen before returning to the lungs. Each red blood cell can only carry a certain amount of oxygen. Once your red blood cells are full, you can’t get any more oxygen into your blood with that breath, no matter how much air you take in. Blood doping improves the body’s ability to carry oxygen by increasing the number of red blood cells in the circulatory system. With more red blood cells, the circulatory system can deliver more oxygen to all the cells of the body. The extra oxygen delivered to the body’s cells can increase the rate of cellular respiration, which can help an athlete perform better and for a longer time without becoming tired. This happens because oxygen is necessary for the release of energy in the body.

The body’s cells release energy through a chemical reaction called cellular respiration. For cellular respiration to happen, cells need both oxygen and glucose. Oxygen enters the body through the respiratory system and is delivered to all the cells of the body by the circulatory system. At the same time, the circulatory system provides the cells with glucose produced when the digestive system breaks food down. Inside the cells, the glucose and oxygen react to produce carbon dioxide.
and water, and release energy for the body in the process. More oxygen in the body means a faster rate of cellular respiration and increased release of energy.

**Catching Blood Dopers**

Blood doping is very difficult to detect. Since the body always contains red blood cells, it is difficult to find evidence that an athlete has injected extra red blood cells into his or her bloodstream. One detection method involves testing the age of the red blood cells in a blood sample. The human body constantly produces new red blood cells to replace cells that have died. Blood doping means injecting stored blood, and the red blood cells in stored blood are older than the new red blood cells constantly being produced in the body. A blood sample with an unusually high number of older red blood cells can be evidence of blood doping.

Another method scientists use to detect blood doping is testing the amount of hemoglobin (HEE-moe-globe-in) in the athlete’s blood. Hemoglobin is a protein made by the body that carries oxygen in red blood cells. The more red blood cells a person has, the more hemoglobin you’ll find in his or her blood. If an athlete has a hemoglobin level that is higher on the day of a race than it was a week before the race, that provides evidence that the athlete might be blood doping. The athlete might even be disqualified from the race if his or her hemoglobin levels are too high.
Dangerous Side Effects

One serious potential side effect of blood doping is that increasing the number of red blood cells also increases the thickness of the blood. This unusually thick blood makes the heart work harder and can even cause heart failure.

An Alternative to Blood Doping

There is a legal way for athletes to increase the number of red blood cells in the body: high-altitude training. In the weeks leading up to a competition, some athletes train in the mountains. At high altitude, there is less oxygen in the air than there is at sea level. The athlete’s body adjusts to the lack of oxygen by producing more red blood cells: because the body senses that less oxygen is available, it produces more red blood cells so that more oxygen can be picked up with each breath. It takes the body several weeks to adjust and increase the number of red blood cells. High-altitude training takes a longer time than blood doping, but it has the same effect and is not considered cheating. However, high-altitude training may have the same harmful side effect of making blood thicker.

High-altitude training has similar effects to blood doping, but it’s legal.