Name_______________________________   Date__________
Literacy Lab #5 – Sports Drinks                  Chemistry

Read more: http://pubs.acs.org/cen/science/87/8734sci2.html

Fact-finding: List three facts that you learned in this article.
1. 
2. 
3. 

Vocabulary: List and define three unfamiliar words in the space below.

Summarize: In 3-5 sentences on the back of this paper, summarize what you learned about this topic.
Sports Drinks
Balanced mixture of sugar, salt, and other additives keeps athletes going strong

Lauren K. Wolf

As a triathlete Ryan Smith prepares for his third Ironman competition—an endurance event that includes a 2.4-mile swim, a 112-mile bike ride, and a full marathon—the chemical composition of his sports drink is at the top of his mind. But his use of the beverage to stay hydrated, maintain consistent performance during the race, and speedily recover afterward is actually a reasonably new phenomenon.

As recently as the early 1960s, coaches typically advised their athletes to ignore thirst. But a 1965 study conducted by a group of scientists at the University of Florida changed everything: The researchers discovered that players on the school’s football team, the “Gators,” were suffering from heat exhaustion and suboptimal performance because of dehydration and a loss of electrolytes and carbohydrates from exercise. As a result, the scientists formulated a sugar-salt replacement beverage—eventually dubbed Gatorade—and administered it to the team, which went on to win the Orange Bowl in 1966.

Fluid replacement sports drinks have since grown to be at least a $3.5 billion market in the U.S., according to Chicago-based market research firm Information Resources. But they are still “essentially water, sugar, salt, and some flavoring and coloring,” says Edward F. Coyle, director of the Human Performance Laboratory at the University of Texas, Austin. It’s the relative concentration of these components that sports scientists have spent decades perfecting.

The salt and water help replace those same components lost in sweat, and the sugar gives athletes an energy boost. Dehydration causes a reduction in blood volume via osmosis, and decreased blood flow to the muscles and skin in turn leads to fatigue and impairs the body’s ability to dissipate heat. Carbohydrate, which is stored as glycogen in muscles, is burned during exercise, also causing fatigue.

Determining the ideal concentration of salt to put into sports drinks can be difficult because “there’s a compromise,” says George A. Brooks, a professor in the department of integrative biology at the
If you put too much salt in, it tastes bad,” he says. “If you don’t put enough in, it doesn’t replace what an athlete needs.” For this reason, sports drinks generally top off at about 20 mM sodium chloride—a concentration at the lower end of what people sweat out. Those endurance athletes who are “salty sweaters,” Coyle says, might even need to take supplemental salt tablets.

Salt intake becomes especially important when athletes sweat excessively. Taking in too much water and not enough sodium causes the blood to become dilute; excess water enters the body’s cells and tissues, including the brain, which can swell. Although this condition, known as hyponatremia, is rare, it can be life threatening, says Nancy J. Rehrer, an exercise metabolism expert at the University of Otago, in New Zealand.

Determining the optimal concentration and type of sugar to put into a sports drink is similarly challenging. “Putting sugar back into an athlete’s bloodstream often improves their performance,” Coyle says. But the more concentrated the sugar, the slower it leaves the stomach and enters the small intestines, where absorption primarily occurs, he explains. For practical purposes, most of today’s sports drinks are in the range of 4–8% carbohydrate, Coyle says.

So the “state of the art” in the sports beverage field “is to include as much energy solute in the drinks as possible without bogging the person down,” Brooks says. Because carbohydrate absorption is mediated through intestinal transport proteins, and there are different transporters for different sugars, investigators are now working to optimize various combinations of carbohydrates in their drink formulations. “You can saturate the transport capacity by loading up on a single metabolite,” Brooks explains.

Another way formulators are getting more carbohydrate into athletes’ systems is by adding glucose polymers, such as maltodextrins, to drinks. Brooks says, “That’s to keep the carbohydrate content high” while maintaining the beverage’s osmolality, or total solute concentration. Brooks himself has advocated this polymerization approach in developing his own energy substrate for sports drinks—polylactate. “Lactate is a major energy source for muscle,” he says. “It’s also a major substance that the liver uses to support blood sugar” and can help buffer the blood.

Because companies cram so much energy solute into their drinks, the average person doesn’t really need to use them during exercise—especially when trying to slim down. Sports drinks are great “for simple refreshment,” Brooks says, but as performance enhancers “these drinks really help athletes and people who are out there for an hour or more.”

Endurance athletes like Smith also need recovery sports drinks containing proteins and amino acids for muscle repair. Some commercial beverages endorse these ingredients for use during exercise, but there is controversy over their performance benefit. “Proteins and amino acids slow down gastric emptying and thus the rate of fluid delivery,” Otago’s Rehrer says.

Smith also likes to include small amounts of caffeine in his race-day beverage. “Caffeine is a drug, and it works,” Coyle says. A handful of commercial drinks contain caffeine, but Smith works with a custom manufacturer to add the optimum amount to his tailor-made concoction. And he’s constantly adjusting the levels of other components in his mix to get everything just right. “There’s nothing more
motivational than someone’s grandmother blowing past you at mile 24 of a marathon,” Smith says. “I’d like to know what’s in her sports drink.”

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