Physical Sci #1

How Soccer Can Help Us Understand Physics

by ReadWorks

Sports provide a great way to understand some concepts in physics. Physics, after all, is the study of matter, motion, force, and energy. And since sports like soccer, swimming and cycling involve bodies moving through space, they can help us understand how the principles of physics work.

Imagine that you're looking at a soccer ball on a grassy field. If you do nothing to the ball, it will stay motionless on the grass. If you kick the ball, it will roll along the grass before coming to rest again. Pretty simple, right?

For thousands of years, though, people thought that objects like this soccer ball come to rest because they have a natural tendency to stop. It took a famous physicist by the name of Sir Isaac Newton, who lived in the 1600s, to prove that this was not exactly correct.

Newton suggested that objects like the soccer ball have a natural tendency to keep moving. The only reason they stop, he believed, is because an unbalanced force acts on them. By an unbalanced force, Newton meant the force applied to the soccer ball by its environment. When kicked, the surface of the ball travels over the grass, creating friction. The taller the grass, and the rougher the surface of the ball, the more friction is created. And the more friction that exists between the ball and the grass, the less it will travel after being kicked.

Now, imagine that there is no grass. Instead, the ball is resting on a frozen lake. When you kick the ball on the ice, the ball will go much farther than it would have on the grass. This is because ice provides a lot less friction than the grass.

Even so, ice does cause some friction. The ball's interaction with the frozen water crystals on the surface of the lake eventually causes it to come to rest again. But now imagine that instead of ice, the ball is in a place where there's no friction at all. The ball is floating in a vacuum. If you remove friction

entirely, kicking the soccer ball would cause it to keep going and going at the same speed, until some force caused it to slow down and stop.

To paraphrase Sir Isaac Newton, a soccer ball on the grass will stay where it is unless acted on by a force. Similarly, once you kick the ball, it will remain in motion unless acted on by force. This, in so many words, is known as Newton's First Law of Motion.

The same principles apply for other sports. Take swimming. Olympic swimmers are in a constant battle with the force of water. Water slows them down. To increase their speed, swimmers often shave their entire bodies, reducing the amount of friction caused by hair. Since a swimming contest can be won or lost by a tenth of a second, anything they can do to remove friction will help-even if it means ridding their bodies of hair.

Recently, Olympic swimmers took to wearing full-body suits in the water, which made swimmers sleeker and reduced underwater friction. Swimmers wearing these suits began to break world records. They started winning all the races. Soon enough, Olympic officials, realizing that these suits posed an unfair advantage, banned the use of suits in Olympic competition. Swimmers had to fall back on their own, hairless skin.

The situation for professional cyclists is slightly different. Unlike the swimmer, who battles the water, the cyclist is confronted with forces from other sources that seek to slow him or her down: the force of the road and the force of the air. Like professional swimmers, pro cyclists are known to shave their body hair, to reduce the amount of friction caused by the wind. But the loss of body hair represents only a tiny reduction in surface friction compared to, say, wearing spandex shorts instead of baggy shorts with pockets that fill up with air as you ride.

To reduce friction and increase speed, cyclists adopt all kinds of techniques. They wear aerodynamic helmets. They crouch low over their bikes. They wear shirts and shorts that cling closely to their skin, preventing air from slipping inside and slowing them down. However, little can be done about the tires' interaction with the pavement. As in the case of the soccer ball, a bicycle wheel will eventually stop spinning if no force acts upon it to keep it moving. The rougher the road, the sooner that bike wheels will come to a stop.

For this reason, cyclists tend to have large, bulging thigh muscles. These muscles allow the cyclist to continue exerting force on the bicycle pedals, which cause the wheels to keep spinning despite their constant interaction with the road. Of course, other factors come into play, too. The heavier you are, the more work you have to do to keep the bike moving-that is, unless you're moving down a hill, in which case the gravitational force of your weight acts to your advantage.

Also, your ability to keep your legs pushing the pedals depends on how fit you are, not just how strong your legs are. Many people who are out of shape would run out of breath before they complete a mile-long bike ride, whereas a person who is fit and has a lot of stamina could travel two miles without much difficulty.

Whether you are in shape or not, what really matters when trying to kick a ball, swim a lap, or bicycle a 5 mile race are the forces of physics. Without them, every time you kicked a soccer ball, the ball would keep going, forever.

Name: _____ **Date:** _____

1. Once it is in motion, what does an object like a soccer ball have a natural tendency to do?

A

A. It has a natural tendency to keep moving.

B. It has a natural tendency to stop.

C. It has a natural tendency to change direction.

D. It has a natural tendency to slow down.

2. What does the author explain in this passage?

C

A. The author explains the force of friction, using different kinds of music as examples.

B. The author explains the sport of soccer, using examples of current teams and players.

C. The author explains the idea of motion, using different sports as examples.

D. The author explains the importance of bike safety, using helmets as an example.

3. Swimmers wearing full-body suits that reduced underwater friction were able to swim faster than other swimmers.

What evidence from the passage supports this statement?

D

A. Some swimmers shaved their entire bodies to reduce friction caused by hair and increase their speed.

B. After losing contests by a tenth of a second, some swimmers started ridding their bodies of hair to reduce friction.

C. Swimmers wearing full-body suits swam at the same speed as swimmers wearing shirts and shorts that clung closely to their skin.

D. Swimmers wearing full-body suits began to break world records and started winning all the races.

4. Based on the information in the passage, how can friction be described?

A. Friction can be described as a force that acts on an object in motion and can cause the object to stop.

B. Friction can be described as a force that acts on an object in motion and can cause the object to speed up.

C. Friction can be described as the path an object takes after a force acts on it and causes it to move.

D. Friction can be described as the path an object takes when a force acts on it inside a vacuum.

5. What is the passage mainly about?

A. why swimmers and cyclists move at different speeds

B. the motion of bodies and objects

C. the movement of an object inside a vacuum

D. the scientific discoveries of Sir Isaac Newton

6. Read the following sentence: "Newton suggested that objects like the soccer ball have a natural **tendency** to keep moving. The only reason they stop, he believed, is because an unbalanced force acts on them."

What does the word **tendency** mean?

A. a very small chance of something happening

B. a fifty-fifty chance of something happening

C. the fear of doing something or acting in a certain way

D. the way something normally behaves or acts

7. Choose the answer that best completes the sentence below.

Newton suggested that a ball has a natural tendency to keep moving _____ others believed that a ball has a natural tendency to stop.

A. although

B. because

C. before

D. later on

8. What are some things cyclists do to reduce friction?