# GEOMETRY IN SOCCER

Tow can a pentagon and a hexagon make a sphere?



= hexagon



= pentagon

It turns out that a combination of pentagons and hexagons, when sewed together in the right way, make a nearly perfect sphere.

In the 1970s, scientists at Adidas came up with the classic black and white design for the World Cup soccer ball. (Adidas has made

every World Cup ball since.)

HOW MUCH AIR IS BEST?

What happens if you kick or drop a deflated soccer ball?

Why do you think that happens?

The well-inflated, nearly perfect sphere with a strong outside covering made for a good soccer ball. The pattern of black and white shapes helped players follow the the ball as it traveled down the field.

#### CLASSIC SOCCER BALL

To find out how many hexagons and pentagons are on a soccer ball, complete the following math challenges:

#### Number of hexagons =

the number of sides in a hexagon plus the number of sides in a nonagon plus the number of sides in a pentagon.

#### Number of pentagons =

the number of sides in a pentagon **plus** the number of sides in a triangle **plus** the number of sides in a square.

### **Engineering Soccer Footwear**

Soccer cleats are engineered to provide the best possible traction and directional control. There are different types of cleats for different weather types, such as slippery conditions, hard fields and turf.

Cleats were originally made with calf or cow leather. Later they were made out of kangaroo leather because it would stretch and fit better to the player's foot, giving better control. Cleats weigh about 7 ounces (200g).



### R SOCCERSOCCERS OCCERSOC

## WHAT MAKES A BALL BOUNCE?

A ball bounces because of the difference in the air pressure on the outside of the ball, and opposite the point of impact, and the pressure inside of the ball.



This causes the ball to take off in the direction of the lower pressure.

When a ball is bounced on a hard surface, it is deformed more than when it hits a soft surface. That is why a ball bounces more off a hard surface.





Ball inflated to a lower psi won't bounce as much, because the air molecules inside the ball have more room to move and absorb the impact.





The more air that is in a ball, the more air molecules are packed tightly together. The energy from a kick will send this ball a much greater distance than a less-inflated ball.

#### THE RULES OF INFLATION

FIFA, the international soccer governing body, makes the laws that govern international soccer competition. In its section on rules about "The Ball," it states that they must be spherical and inflated to a pressure between 8.5 psi and 15.6 psi.

When a soccer ball is inflated with less than 8.5 psi, it is more difficult to kick and send down the field and is considered too flat. Too much air pressure and the ball bounces more and is harder to control.



### AUTHORITIES SOUCH

## THE BIOLOGY OF SOCCER



ood nutrition and hydration can separate winners from losers on the soccer field.

The athlete that plays a sport is key to the game. Like the balls, shoes and clothing, the athlete needs to prepare and care for his or her body to get the best possible performance. Exercise and diet are important parts of keeping one's body in good shape. Drinking plenty of water to keep hydrated is essential.

essential.

Hydration: the addition of water; the replacement of

About what percentage of your body is made up of water?

13+13+4+30+5+5= %

Water is the main ingredient of most parts of the human body.

### The Thirsty Games

During a game, a soccer player can lose 2 to 3 quarts of body fluid through sweat – enough to fill a 2-liter soda bottle, or 8 cups.

Athlete Tip: Don't wait until you are thirsty to drink some water.
Grab a sip every time you pass the water fountain.



body fluids

The saliva in your mouth and mucus in your nose are made up of water.

#### Skin

The sweat that keeps you cool on hot days or when you exercise is made up of water.

#### **Stomach**

The fluids in your stomach are made up of water and help your body digest food.

#### **Joints**

The liquid around your joints helps them move smoothly.

#### Eyes

The tears in your eyes are made of water.

#### **Blood**

The blood that moves nutrients around your body and takes waste out of your body is mostly made up of water.

**Back:** During the 2006 World Cup, British soccer star David Beckham blamed his poor performance on dehydration, or a lack of water. All it takes is 1-percent dehydration for performance to suffer, and from there, it just gets worse.

**Dehydration** 

**Holds You** 

For instance, one study found that an athlete with 5-percent dehydration averaged a 30-percent decline in performance!



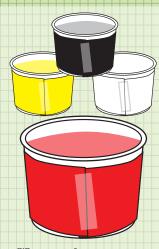
### SCIENTIST'S NOTEBOOK Color and Heat

#### MATERIALS:

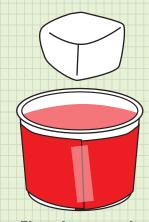
- sunny day or heat lamp4 ice cubes
- 4 clear plastic cups
- 4 sheets of different colored paper
- scissors
- clear tape

#### DO DIFFERENT COLORS ABSORB **HEAT BETTER THAN OTHERS?**

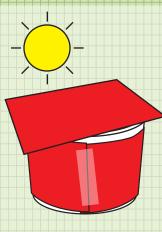
Investigate how the color of a material affects how much heat it absorbs.



Wrap each paper cup in a different color of paper.



Place the wrapped paper cups in a sunny spot. Place an ice cube in each cup.



Cover each cup with a piece of the same color paper.



Check the ice cube every few minutes and record which ice cube melts first, second, third and fourth. Then answer the question below.



# Well, What Do You Know?

- 1. A pentagon has six sides. OTRUE OFALSE
- 2. Soccer cleats weigh about 7 ounces. OTRUE OFALSE
- 3. When a ball hits a hard surface it changes shape. OTRUE OFALSE
- 4. PSI stands for "Puppies per Sandy Incline." OTRUE OFALSE
- 5. Your body is made up of about 70% water. OTRUE OFALSE
- 6. During a soccer game a player can lose 2 to 3 quarts of water.

OTRUE OFALSE

	FIRST	SECOND	THIRD	FOURTH	(MINUTES)
RED					
WHITE					
BLACK					
YELLOW					

How can this information help you decide what to wear on a very hot day?

> ON AIR: Studio C Become an on-air personality or a broadcast technician in the Chevron STEM ZONE. Use

technology and find out how a professional television studio works!

