//SCIENCE AS A HUMAN ENDEAVOUR//

7.10 Forces are involved in sport

Many athletes dream of winning Olympic gold medals. They train for long periods, control what they eat and make sure they have the best equipment available. Having a good understanding of the forces involved in their sport can give the athlete an advantage over their competitor.

Forces in swimming

A swimmer must have a good understanding of how the water moves around them to maximise their speed. First, they must control how they dive into the water. Breaking the water's surface creates friction and can slow them down. So they must make sure that their whole body enters the water at the place where their hands originally broke the surface.

Many swimmers shave all their body hair before a big competition. A smooth surface allows the water to move along their body with less friction.

The swimmer's position in the water is important. If the body is straight, the water moves along without interruption. If the legs hang down, the moving water must change direction. This creates more friction and slows the swimmer down.

In 2012 FINA (Fédération Internationale de Natation), the international governing body of swimming, banned the use of full body smart suits (Figure 7.51). These suits were designed by scientists to reduce the friction between the swimmer and the water. The suits were made of a material that mimicked the small scales on a shark. This material repelled the water rather than absorbed it, making it lighter for the swimmer to wear. It also reduced the friction between the swimmer and the water. The suits were also designed to be very tight with smooth seams. This helped the swimmer be more streamlined in the water.

Figure 7.51 Smart suits provide an advantage to the wearer by reducing friction. They have been banned at major swimming competitions.

Many world records were broken when this suit was first used but FINA decided that it gave an unfair advantage to the countries that could afford this expensive technology. New rules were drawn up that limited the type of swimming costumes that could be worn in high-level swimming competition.

Forces in tennis

The human arm acts as a third-class lever for which the shoulder is the fulcrum, the muscle attached to the middle of the upper arm provides the effort and the load is usually near the hand. A tennis racquet acts as an extension of the player's arm. This increases the distance between the load (where the tennis ball hits) and the fulcrum. Third-class levers are speed multipliers as well as distance multipliers. When a player hits the tennis ball with a racquet, the speed of the ball is increased. If the tennis player's arm is bent, the end of the racquet is travelling more slowly, and therefore the ball will rebound more slowly.

Tennis players will often have longer tennis racquets, not to increase their ability to reach for the ball, but to increase the speed at which they can hit the ball.

Figure 7.52 Tennis racquets increase the distance between the load and the fulcrum.

Forces in golf

The benefit of a dimpled surface on a golf ball is now widely known. However, golf balls originally had smooth surfaces. When golfers noticed that their old and battered golf balls flew further than the newer, smoother balls, a group of scientists investigated why this occurred.

The dents and bumps in an old golf ball cause the layer of air next to the ball to stay close to the ball, moving in an organised way over the surface. This decreases the overall air resistance of the ball moving through the air, making it fly further. As a result, a golf manufacturer started making the 'pre-dented' golf balls that you see today.

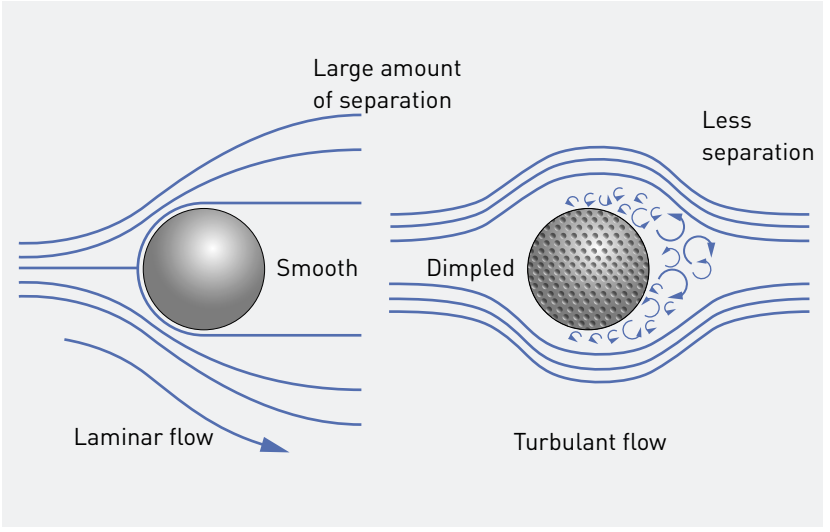

Figure 7.53 Air flows over a smooth ball differently from how it flows over a dented ball so that air resistance is decreased over the dented ball and it flies further.

Extend your understanding 7.10

1 Choose a sport in which you regularly participate.
2 List the forces and the machines involved in your sport.
3 Give an example of how these forces and machines interact in your chosen sport. When are the forces balanced or unbalanced? What evidence do you have that the forces are unbalanced?
4 Explain how you could maximise or minimise these forces in order to achieve better results in the sport.