How do bicycles work?

The bicycle is the most efficient transport machine ever invented, turning the energy you supply into pure forward motion. So how does it work?

**WHEELS** do two jobs. First, the rear wheel transmits the pushing force from your legs to the ground, driving the bicycle forward. Second, both wheels reduce friction by rolling over a small point of contact. The thinner the wheel and the lighter the tyre, the less the friction and the faster you go.

**REAR SPOKES** cross each other rather than radiating straight from the hub. Being slightly off-centre helps them bear the twisting force that turns the wheel.

**GEARS** control the speed and force of the rear wheel. A high gear converts one turn of your feet into several turns of the rear wheel – ideal for speeding along the flat. A low gear turns the rear wheel slower but with more force – ideal for cycling uphill.

**HANDLEBARS** are levers that make it easy to turn the front wheel. The wider the handlebars, the easier it is to make fine adjustments to the wheel. Racing bikes have "drop handlebars" to help you keep your head down, which reduces drag.

**BRAKES** grip the wheel rims to create friction and slow you down. The bike's energy doesn’t just disappear though – it turns into sound (hence the squalling) and heat. Try touching the wheel rims after slamming on the brakes to see how hot they get.

If you pull, the front brake suddenly, your inertia can send you hurtling over the handlebars. The secret to safe stopping is to brake gradually and to keep the front and back braking balanced. In wet weather, brake slower and longer.

**TYRES** provide just enough friction to grip the ground. The air inside makes them elastic, helping absorb shocks.

**PEDALS** convert the up-and-down motion of your legs into rotation. They also work as levers, magnifying the force from the legs to push the chain.

A clever way to reduce drag is to cycle just behind another cyclist, where invisible whirlpools in the air give you an extra push. This is called "drafting" and it can cut your energy use by up to 40 per cent.

How was the bicycle invented?

- **1817** The world's first bicycle was the "dandy horse" – a wooden running machine used as a substitute for a horse. You sat in the middle and pushed the ground with your feet, steering the front wheel by hand.
- **1863** Pedals were added to the front wheel in 1865, resulting in the "velocipede". You could ride this without touching the ground, but you had to pedal constantly if you wanted to go fast.
- **1872** For more speed, people made the front wheel bigger. The "safety bicycle" was fast but dangerously unstable. It was all too easy to fall off, and riders tended to land headfirst. Don't try this at home.
- **1884** To make bikes safer, the front wheel was strung with the pedals attached to the rear wheel by a chain and gears, making pedalling easy. The result was the "safety bicycle", the design we use today.
- **1893** Invented more than a century ago, the recumbent bicycle has never been as popular as the standard bicycle, despite being more comfortable, more efficient, and faster since the low position reduces drag.
- **2006** For maximum speed, a bike has to weigh as little as possible. Professional track bikes have no gears, no brakes, no handlebars, simple as ropes, and a frame made of carbon composite. As a result they weigh as little as 5 kg.