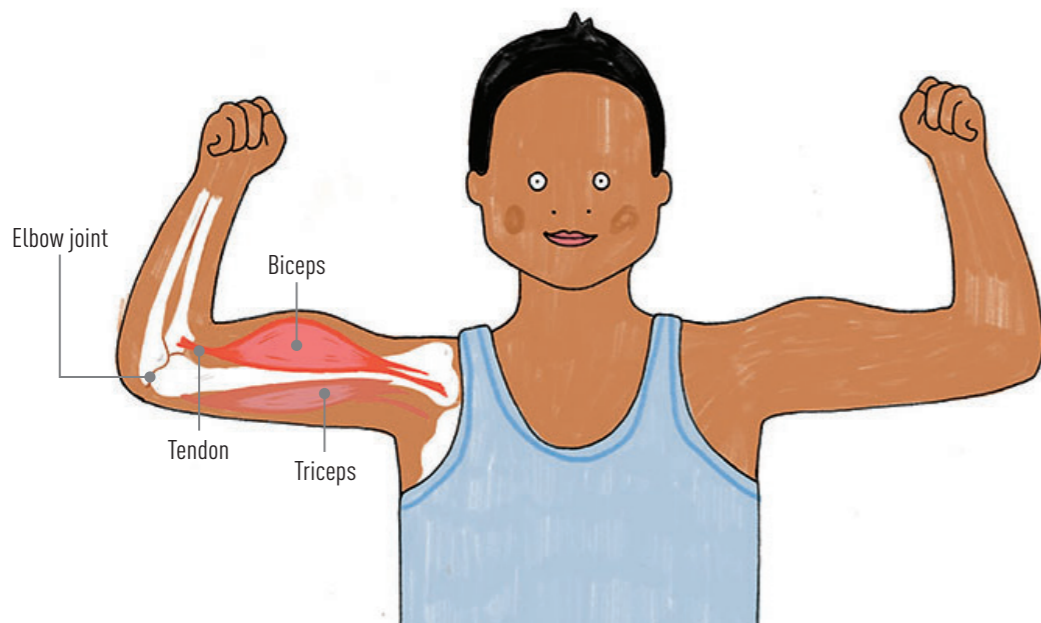


Muscles and motors

There are muscles all over the human body, more than 600 of them. So many are needed because they control every movement a human makes. Robots, however, move by using motors and other mechanical devices.

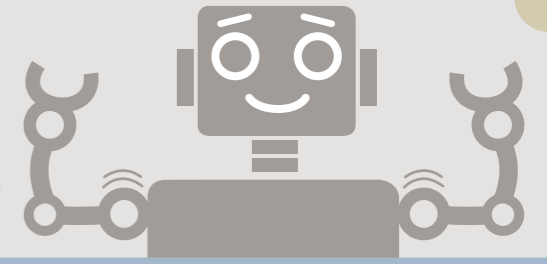
Whether a person is smiling, lifting a book, walking, dancing—any tiny or big movement of the body—they are using a muscle. People sit on their largest muscle all the time. The muscle in the butt—the gluteus maximus—is important for standing and walking. It’s also sometimes called the “main antigravity muscle” because it resists the force of gravity more than all other muscles. The smallest muscle, the stapedius, is only around 0.04 inches (1 mm) long. It’s tucked away inside your ear and helps reduce noise vibrations.

Muscles only work by contracting, or shrinking, and not by stretching. When the hand is brought to the shoulder, the biceps muscle in the arm shortens. If the hand is brought back down, the biceps relax, and the triceps muscle on the other side shortens. But how do muscles actually work? They are made of bundles of long, thin muscle tissue, called fibers, each thinner than a hair, and each fiber is made of lots of even thinner fibers. One type of fiber is called “actin,” and it’s like a long rope. Another type is called “myosin,” and that does all the real work. It has energy-storing coils and a pair of clamps. The



clamps grab the actin, and then chemicals in the coils make them tighten up. The myosin pulls the actin toward itself, as if it were climbing a rope. Lots of the fibers do this at the same time, making the muscles get shorter and plumper. That’s how arms and legs bend, and why the muscles get harder when they are flexed.

All robots move, but they don’t have muscles to help them do this. Instead, they use actuators, which are devices that turn energy into motion. Most actuators are motors, powered by electricity (see page 43), although there are also pneumatic actuators (“pneumatic” means “powered by air”) and hydraulic actuators (“hydraulic” means “powered by water”). Different actuators are used, depending on the movement the robot makes, such as pushing, pulling, or rotating. A computer inside the robot controls the actuators, switching them on to make the robot move



TRY THIS...

With one hand, hold on to a table. With the other hand, feel the muscles in your upper arm. There are two: the biceps on top and the triceps underneath. Try to pull the table toward you, and then push it away. Can you feel the way the muscles get hard and relax, depending on whether you push or pull?

and off to stop that movement. If a person wants a robot to carry out different actions, all they have to do is reprogram its computer. That can’t do that with a human body!

