



JOINT FRICTION

Ramesh and Nidal are medical engineers. They look at forces acting on people's joints, particularly in people with joint diseases. Outside the body, joints work against forces such as weight when lifting a heavy shopping bag, or drag when swimming. Inside the body, muscles and tendons pull to move the joint, while the bones rub together and produce friction.

PUPILS MAKE A MODEL HINGE JOINT AND OBSERVE THE EFFECTS OF CARTILAGE AND SYNOVIAL FLUID ON THE AMOUNT OF FRICTION EXERTED ON THE JOINT

Equipment

Waxed paper or aluminium foil; Vaseline; paint brushes; plastic cups; split pins; scissors; cardboard; ruler.

Method

Cut the cardboard into two long, thin pieces (about 30 cm length) and use scissors to pierce a hole in the top of each piece. Insert a split pin through both holes, fold the pin out, and arrange the cardboard pieces at a 90 degree angle. Tighten with the pin, so that the friction between the cardboard pieces is evident when moving them against each other (in an opening/closing jaw motion). Take the pin out of the hinge joint and replace it, this time with some waxed paper or foil between the cardboard pieces. Are the pieces easier or harder to move? Take the pin out again and paint the foil or waxed paper with oil. Replace the pin. Are the pieces easier or harder to move?

Cartilage (represented by the foil/waxed paper) and synovial fluid (represented by the oil) reduce friction exerted within a joint, as bones rub over each other. Over time, losing cartilage can lead to a disease called osteoarthritis. Lubricated joints are not just important in the body. Much machinery relies on lubrication to keep mechanical joints working.

Extensions

Model a ball and socket joint – cut a tennis ball in half, roll some clay into a ball that will fit snugly in the tennis ball and put a lollipop stick in the clay. Use the stick to move the clay in all directions. Remove the clay ball and line the inside of the tennis ball with foil. Put the clay ball back in. Is it harder or easier to move around? Take the ball out again and paint both sides of the foil with oil. Put the ball back in. Is it harder or easier to move around?

The research link

Arthritis Research UK is an example of a research charity. Research charities are sometimes funded by the government, but mostly by donations. They conduct research into a specific area, and often fund university or industry-based scientists to carry out research for them.

Additional guidance notes

This could get rather messy! Have some paper towels on hand, and dispense the oil in small quantities using a plastic cup or similar. To increase the friction in the hinge joint model, try using fine sandpaper instead of cardboard.