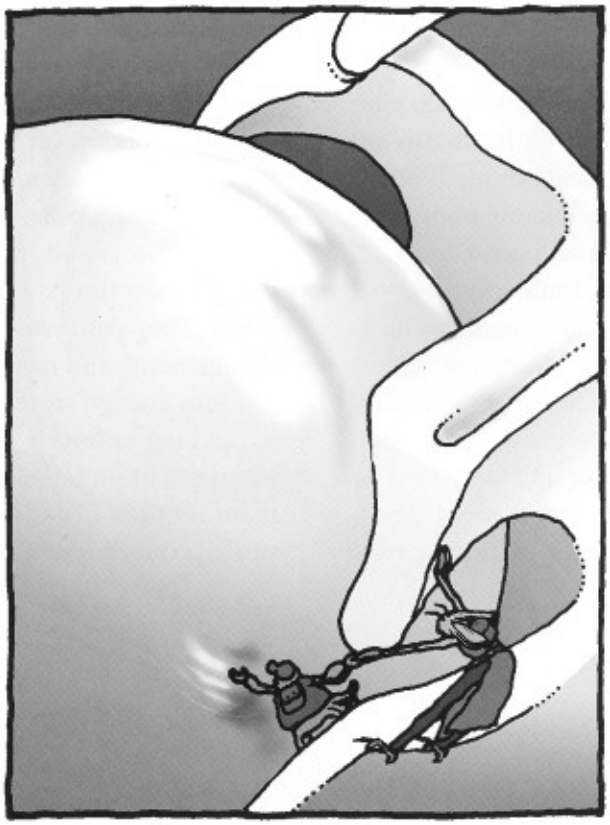
WHAT KIND OF JOINT IS THIS?

Peppi and Bollo re-enter Joanne's body (this time, they slip in through a pore in her skin) and head for the shoulder. The spies are ready to take an inside look at the musculoskeletal system.

"This is a joint—a place where bones meet," says Peppi. "The joints are held together by those thick, elastic bands, called ligaments. Joints make it possible for the human body to bend, twist, and reach—to be flexible. Some people have even greater flexibility at their joints, because their ligaments stretch more than normal. These people are sometimes said to be 'double-jointed.'

"There are several kinds of joints, and each permits a human to move an arm, leg, finger, or whatever—in a different way. But since we're at the shoulder, let's stop and take a look. This is a ball-and-socket joint. Its design allows humans to move their arms in just about any direction."

"Kind of slippery in here," says Bollo as he touches the shiny white end of a bone.



The slippery synovial fluid lubricates the joints.

"Many joints need to be 'oiled' in order to work well, just like the moving parts of a machine. The joints are oiled by the body's homemade lubricant, which is called synovial fluid. Humans also have a special substance called cartilage at the ends of bones. The cartilage is softer and smoother than bone tissue. The cartilage, along with the synovial fluid, helps reduce the friction between bones."

Bollo sneaks down into the space where the shoulder bone and the upper arm bone meet. "Do you know what this joint reminds me of? A computer joystick!"

"Great comparison. Now let's move on down the arm," says

Peppi. "Watch how this joint works. What could you compare it with?"

Bollo watches. "It works like a door that can swing open and shut."

"Good comparison. This is the elbow. It is a hinge joint.

"We don't have time to visit all the types of joints. If we could, you'd see many varieties. For example, the head swivels on a pivot joint. The feet have gliding joints that help the body keep its balance. Wrists have special joints that let them move back and forth and side to side."

Teamwork

"Next," says Peppi, "we're going to explore how the bones, muscles, joints, and nerves work together. Stay there in the elbow. Look up. What do you see?"

"I see bundles of muscles," says Bollo. Some are right under the skin. Others cover the bone. The muscles are tapered at the ends. The muscles are connected to the bones by thin tissue . . .

"Tendons," says Peppi.

"I see one especially big muscle on the front of the arm and another big one at the back," Bollo continues.

"Right. The biceps muscles are just above the crook of the arm. The triceps muscles are on the opposite side of the arm—above the elbow. Keep your eye on those two muscles. I think a message is coming from command central."

Suddenly, everything seems to be happening at once. The biceps muscles contract and get fatter and shorter. The triceps, which are right behind it, relax and lengthen. The lower part of the arm pulls upward.

Then everything happens in reverse. The biceps relax, and the triceps contract. The forearm is extended.

"Most skeletal muscles are like these two," says Peppi. "They work in pairs. They have to, because muscles can only do one thing—pull, or contract. They can't push."

"Can a muscle keep contracting forever? Does it ever need maintenance?" says Bollo.

"Muscles have endurance, but they cannot go on forever," says Peppi. "Muscles, like other body cells, need nutrients and oxygen from the blood. They convert the nutrients and oxygen into energy, store it, and tap into it when the brain tells them it's time to go to work. If muscles don't get enough oxygen during hard exercise or work, they may start to burn or ache."

Back to the Bones

"That's the story on muscles and joints. But before we file our final report, we need to take a closer look at bones," says Peppi.

"We already know what bones do. They support the body and protect organs," says Bollo, checking his notes.

"That's what the skeleton does. But now we're going to take a look at a single bone," says Peppi.

"Why bother? Nothing's going on inside a bone, is there? " says Bollo.

"That's what people once thought. But they were wrong. Bone is living tissue. About 10 percent of bone tissue is replaced every year."

Peppi and Bollo make their way inside the bone. They cross

a membrane that is covered by veins and arteries. Next is a hard layer of dense bone. Deeper inside is a smaller area of lighter, spongy bone. At the center of the bone is soft tissue.

"Marrow," explains Peppi. "This is where the body manufactures blood cells."

"Look at them go!" says Bollo, taking a close look with his high-powered hand lens.

"Every second, more than 2 million red cells leave the marrow and enter circulation. White blood cells are made here, too."

"The human body is a hard worker," says Bollo. "Every organ and cell is doing its part—in fact, a lot of them, like bone, are doing many things at once."

"Once again you've learned your lesson, Bollo," says Peppi. "Now why don't you take a few moments to review the illustrations of the joints in our anatomy book. Then we'll be ready for another investigation that will give us a closer look at the muscles." □

Bones might be hard on the outside, but not necessarily in the middle, Bollo discovers.