Climb by Design

Compare joint models to explain how structure shapes movement.

HAP.4.1 "Use models to compare the structure and function of the skeletal system."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline one structural feature of each joint, circle the movement that feature allows, and draw an arrow connecting each feature to its effect.

Two Joints on a Climbing Wall

1. At an indoor climbing wall, a student pulls a hand toward the chest. The elbow acts mainly as a hinge joint where the upper-arm bone, the humerus, meets the forearm bones. The end of the humerus fits against the ulna so the forearm can bend and straighten in one main plane. This arrangement guides movement along a predictable path, but the elbow hinge cannot swing the arm in every direction. The forearm can also rotate, yet that rotation occurs at joints between the radius and ulna, not through the hinge action described here.

2. To reach a hold overhead, the climber moves the shoulder joint, where the rounded head of the humerus meets a shallow socket in the shoulder blade, or scapula. This ball-and-socket joint lets the upper arm move forward, backward, and sideways and rotate. Its shallow socket allows a wide range of motion, but the bone surfaces alone provide less stability than the closely fitting bones at the elbow. Muscles around the shoulder and ligaments connecting bones help keep the joint in place. The elbow also has ligaments, but its bone shapes guide motion more tightly.

3. To compare the joints, imagine two small models. In one, two straight wooden strips meet at a pin that lets one strip swing like a door; this represents the elbow's hinge action. In the other, a marble rests in a shallow cup and can turn in several directions; this represents the shoulder's ball-and-socket shape. The pin model shows guided motion, while the cup model shows a wider range and less support from bone shape alone. Neither model includes cartilage that cushions bone ends or the ligaments and muscles that help hold real joints together.

2 ANSWER WITH EVIDENCE

Use the passage

1. How do the bone shapes at the elbow and shoulder differ, and how does each arrangement guide movement?

2. A climber bends an arm to pull toward a hold, then reaches sideways for the next hold. Which joint is most important for each motion, and why?

3. Compared with the elbow, why does the shoulder rely more on muscles and ligaments to stay in place?

4. What difference between the joints do the pin model and cup model show? Name one important feature of real joints that both models leave out.

3 YOUR TURN

Your own words

Design your own two tabletop models to compare elbow and shoulder movement, using materials other than wooden strips, a pin, a marble, or a cup. In four sentences, describe how you would build the models, test their movement, compare the results, and identify one limitation.

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PART 1 · READ AND MARK

Underline one structural feature of each joint, circle the movement that feature allows, and draw an arrow connecting each feature to its effect. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How do the bone shapes at the elbow and shoulder differ, and how does each arrangement guide movement?	**The humerus fits against the ulna at the elbow, guiding bending and straightening in one main plane. At the shoulder, the rounded humerus meets a shallow socket, allowing movement in several directions.**
2	A climber bends an arm to pull toward a hold, then reaches sideways for the next hold. Which joint is most important for each motion, and why?	**The elbow hinge bends the arm for the pull. The shoulder's ball-and-socket joint lets the upper arm reach sideways.**
3	Compared with the elbow, why does the shoulder rely more on muscles and ligaments to stay in place?	**The shoulder's shallow socket provides less stability from bone shape alone than the closely fitting bones of the elbow.**
4	What difference between the joints do the pin model and cup model show? Name one important feature of real joints that both models leave out.	**The pin shows the elbow's guided hinge motion; the cup shows the shoulder's wider range of motion. Both leave out cartilage, ligaments, or muscles.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would crease a stiff cardboard strip to model the elbow hinge and nest a balled-up sock in a shallow ring of rolled towel to model the shoulder. I would try to move each model forward, backward, and sideways while keeping its parts connected. The cardboard should mainly bend and straighten at its crease, while the sock should move in several directions but slip from its ring more easily. These models do not show how living ligaments and muscles help hold the joints together.

Accept other workable models if the proposed test compares guided hinge motion with movement in several directions. Students should identify a real joint feature their models omit or represent poorly.