# How Joints Move Lab: Teacher Guide

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**Driving question.** Your shoulder swings in a full circle. Your elbow only bends one way. Why?

## District section

BPS A&P Unit 2, Support and Movement, Section 7.13, Joints (Hole's Essentials pp. 269-278): identify the parts of a synovial joint and classify joints by movement. Used from the district list: Use the Practices 7.13 (Communicating Information), Labeling: Generalized Structure of a Synovial Joint (Tab 1), Labeling: Knee Joint (the Tab 1 knee X-ray), the APR Synovial Joint animation idea, and Vocabulary Activity 7.13 (the movement names). **Additions** beyond the district list: the slide test, the six-joint range-of-motion test with real X-rays, the biceps model, and this lab.

## NYSSLS alignment

**HS-LS1-2.** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms (bones, cartilage, ligaments and muscles working as one system). **HS-LS1-1.** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells (touched lightly, through cartilage and synovial cells).

**SEP 2** Developing and Using Models: Tab 1 parts, Question 11. **SEP 4** Analyzing and Interpreting Data: Questions 2, 3, 7, 8, 12. **SEP 6** Constructing Explanations: Questions 6, 13, 15. **CCC 6** Structure and Function: shape of the bone ends decides movement. **CCC 4** Systems and System Models: the joint as parts that work together. **CCC 1** Patterns and **CCC 2** Cause and Effect: Tabs 2 and 3.

## Opening: pick a phenomenon

| Option | What it is | Notes |
|---|---|---|
| **Activity** | Tape the Thumb: tape each student's thumb flat against the side of the hand, then try to write your name and pick up a pencil. 3 minutes. | Masking tape. Skip for anyone with a hand injury. |
| **Photos** | Same Arm, Two Joints: a gymnast holding an iron cross on the rings next to an elbow X-ray. | Ask which joint made the cross possible. |
| **Video** | See the slideshow menu slide. Checked to embed only, not watched end to end: preview first. | |

## Part by part

**Part 1, Tab 1.** Questions 1 to 3 are explore. The Learn It opens after every part is clicked and all four blocks are pushed. Questions 4 to 6 are apply. The misconception to watch: bone rubs on bone. It never does in a healthy joint.

**Part 2, Tab 2.** Questions 7 and 8 are explore, on real X-rays. The Learn It opens after all 24 tests. Questions 9 to 11 are apply. A second misconception: every joint moves. Fibrous joints barely move at all.

**Part 3, Tab 3.** Question 12 is explore. The Learn It opens after four records and the triceps. Questions 13 to 15 are apply. Say it plainly: muscles only pull.

## The model and its limits

Tab 1 is a drawing, not to scale; real joints are not all this shape. The friction for cartilage is a typical lab value, and real values run from about 0.002 to 0.02. Tab 2 ranges are normal adult values (AAOS 1965); people vary, and the gauge shows each test from one view only. Tab 3 uses round numbers for the arm and treats the biceps as a straight line; real muscle wraps over bone.

## Sources

Hole's Essentials of Human Anatomy & Physiology 3e, Section 7.13, Joints, and its teacher's guide. OpenStax Anatomy and Physiology, Chapter 9, Joints. American Academy of Orthopaedic Surgeons, Joint Motion: Method of Measuring and Recording (1965). The Engineering ToolBox, friction coefficients. Cartilage friction: reviews of articular cartilage lubrication report coefficients near 0.001 to 0.02. Pictures are credited on the lab page.