

Part 1: The Joints Work Sheet

1. Review Joints.
2. Overview the Activity.
3. Introduce the *Joints Work Sheet*.
4. Describe Taping Thumbs.
5. Tape Up.
6. Distribute Work Sheets.
7. Close Part 1.

Part 2: Joint Tasks

8. Introduce New Tasks.
9. Demonstrate Each Task.
10. Announce Taping Joints.
11. Form Groups.

12. Describe the Tape-Up Procedure.
13. Demonstrate Tape-Up Techniques.
14. Tape Up Thumbs and Fingers.
15. Start the Tasks.
16. Clean Up.

Part 3: Naming Joints

17. Review Tasks.
18. Introduce Hinge Joints.
19. Introduce Ball-and-Socket Joints.
20. Introduce Sliding Joints.
21. Find Joints on the Skeleton Photo.
22. Label the Skeleton.

JOINTS**ACTIVITY 2****STRAND**

Life Science

SCIENCE CONCEPTSArticulation
Joint**SCIENCE THINKING PROCESSES**Observing
Communicating
Comparing
Organizing**INTERDISCIPLINARY ACTIVITIES**

Language

PURPOSE

In *Joints* the students will

- Observe joints found in hands.
- Perform everyday tasks with hand joints immobilized.
- Investigate different kinds of joints in the human skeleton.
- Heighten their awareness of the exquisite design and versatility of the human body.
- Compare human skeletal joints to analogous mechanical structures.
- Learn concepts that will contribute to understanding of the following themes: **Pattern, Structure, and Interaction.**

THEMESPattern
Structure
Interaction**OVERVIEW**

In *Joints* the students investigate joints and discover the advantages of an articulated skeleton. In Parts 1 and 2 they work as individuals to complete several everyday tasks, such as writing, tying shoes, tracing a line, coloring a picture, etc. However, the twist to the activity is that the students first tape and splint their hands in various ways to immobilize certain

joints. As a result of their experience they acquire an elevated understanding of the versatility of movement afforded by joints. In Part 3 the students look at other joints in the body, categorize them by similarity of operation, and compare them to mechanical devices such as hinges and ball-and-socket connectors.

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The human body is constructed for action of all kinds. Actions that involve large bones and muscles, such as dashing about, climbing, carrying heavy objects, reaching, and throwing, are gross motor activities. Actions that involve small precise movements, such as tying knots, writing, using tools, and eating, are fine motor activities. The ability of the body to perform the multitudes of large and small actions required for these kinds of movements is attributable in part to the complex **articulation**, or jointing, of the skeleton.

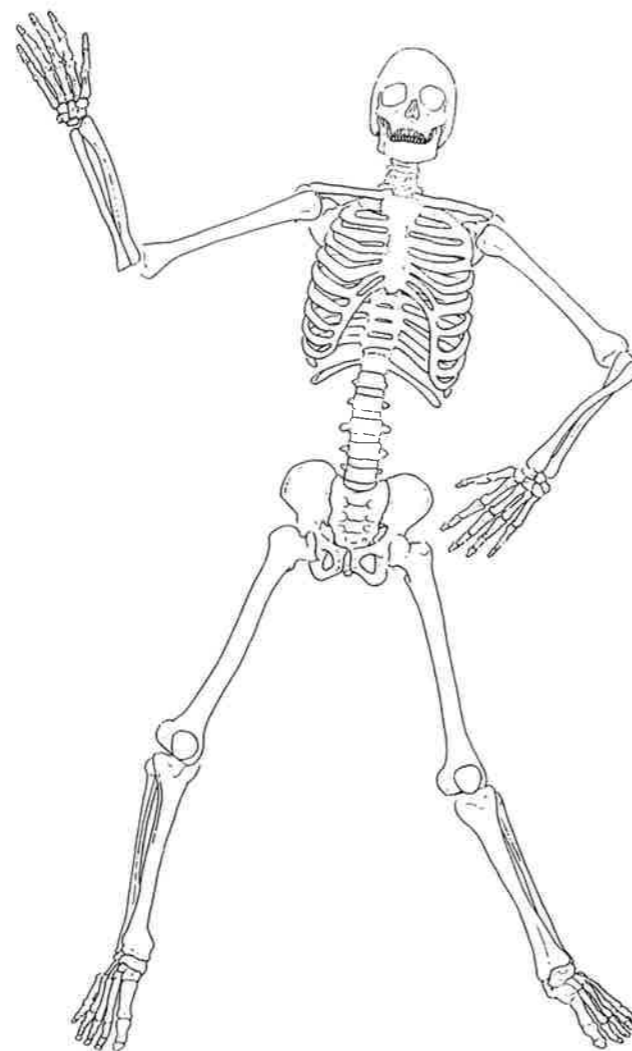
A **joint** is the location where two (or more) bones come together and move. The joint where the humerus (upper arm) meets the radius and ulna (lower arm) is the elbow. The femur connects to the pelvis at the hip joint. The locations where the phalanges meet are toe or finger joints. Some of the most intricate articulations of the body are found in the fingers and hand, making possible a seemingly endless variety of wonderfully expressive movements.

Bones meet at joints in several distinctive ways. The simplest kind of joint is found at the elbow, knee, fingers, and toes. This kind of joint is commonly called a **hinge joint** because the two bones move as if there were a gate hinge between them. The two bones can flex and extend in one direction, but cannot bend to the side or pivot. This is a strong joint that limits movement to one direction.

A second kind of joint is found at the shoulder and at the hip. The ends of the femur and humerus have large knobs that fit into cup-shaped cavities in the pelvis and scapula. This is often called a **ball-and-socket joint** because it is like the mechanical joint found on lamps and wheel assemblies that pivot in many directions. The ball-and-socket joint allows the arms and legs to extend forward, backward, up, down, and to the side, and to rotate as well.

The body has at least four other kinds of joints that are anatomically distinct. They include pivot joints (top of the spinal column that allows you to turn your head from side to side), saddle joints (ankle and wrist), ellipsoid joints (finger to palm), and gliding joints (backbones). For the sake of this activity, joints in which two bones slide past each other in some fashion will be lumped together and referred to as **sliding joints**.

As is often true, you never know how valuable something is until you lose it. This activity raises student awareness of the value of joints by temporarily denying them use of selected joints. Out of the frustration and fun will come a heightened awareness of one more aspect of the marvelous machine that is our human body.



1. Immobilize Knees and Elbows. Create a list of tasks that require knee and elbow mobility. Have the students immobilize one or more of these joints and attempt the tasks. Sheets of cardboard can be wrapped around the joints and secured with tape to form splints.

2. Research Articulated Machines. Machinery and appliances have joints allowing them to move. Have the students collect pictures of machinery, identify the locations of the machine joints, and identify the human joint that it most closely resembles. Make a class book.

3. Compare Dolls. Ask the students to bring dolls, robots, and other articulated toys to school. Have them investigate how the doll joints move compared to their own joints. What can dolls do that students can't? What can the students do that the dolls can't?

4. Compare Animals. Find books with skeletons of animals. Have the students discover how the joints of other animals compare to the joints of humans. Most mammals are quite similar to humans; birds, fish, and reptiles can be very different.

FOSS FOR ALL STUDENTS

Hands-on science provides opportunities for students to learn from each other. The experience will be enriched for students with disabilities and students from culturally and linguistically diverse populations by using specialized tools and procedures where appropriate.

Visually Impaired. Students with visual impairments will be able to participate fully in the activities. Slight modifications to the tasks (e.g., eliminate the writing) may make the tasks more universally appropriate.

Physically Disabled. Students with physical disabilities involving their hands may or may not want to tape their joints. Discuss this with them ahead of time so they can decide how they want to participate in the activity.

Students Learning English. There are many new vocabulary words in this activity. Be sure that students learning English understand the words and the questions posed in the activity.

NOTE: This icon alerts you to suggestions for working with diverse populations (see FOSS for All Students in the module *Overview*).

articulation: having joints or joined sections, such as the human skeleton.

compensation: to overcome; to do something another way.

immobilize: to prevent something from moving.

joint: the place where two bones meet and move.

ball-and-socket joint: the place where two bones meet, allowing movement in two directions plus rotation.

hinge joint: the place where two bones meet, allowing movement in one direction.

sliding joint: the place where two bones meet, allowing limited movement in two directions.

 **NOTE:** Be sure all students understand and can use these words:

- disability
- rigid
- satisfactory
- skeleton

LANGUAGE DEVELOPMENT

1. **Research Joint Disease.** Have the students look up *arthritis* and *bursitis* in the encyclopedia. Have them report to the class (or write) what part of the skeleton is affected by these diseases. They might want to use the skeleton photo to illustrate their report.

2. **Describe Compensations.** Ask students to think about life with certain joints immobilized. Let them take turns describing how they would compensate for the loss of flexibility in order to accomplish everyday activities.

3. **Increase Disability Awareness.** Students with disabilities often have difficulty getting to and around their classrooms. They also have a hard time getting to the board, getting books, writing their lessons, and reaching things they need. Discuss with the students how your classroom could be set up, or made accessible, to help a student in a wheelchair or with other immobilizations take part in all of the class activities.

4. **Write a Book.** Have the class write a book about a girl with both arms in casts from

shoulder to hand. Assign one aspect of daily life for each student to write about and illustrate. How does she sleep, dress, eat, go to school, and play?

5. **Find Out about Artificial Joints.** Injured or worn-out joints can be replaced in some cases. Ask the students to read to find out what joints have artificial substitutes.

6. **Play Twister.** If you have a Twister game, let the students play and focus on the joints that make it possible to assume some of the interesting positions. Let the students write Twister cards that describe positions for other players to match.

7. **Collect Bodies in Motion.** Have the students cut pictures from newspapers or magazines that show people in motion. Let them place the pictures on the bulletin board under headings describing the three basic kinds of joints: hinge, ball-and-socket, and sliding.

For each group of four students

- 1 Roll of masking tape
- 4 Popsicle sticks, no holes
- 4 Dowels, 18-cm
- 2 Post-It™ labels, small
- 4 Student sheets called *Joints Work Sheet**
- 1 Student sheet called *Bone Names**

For the class

- 1 Hinge
- 1 Mallet
- Δ 1 Spoon, 5-ml
- 50 Post-It™ labels, small
- 1 Human skeleton photo, front, life-size
- 8 Zip bags, 4-liter
- 8 *Joint Tasks* cards*
- 1 Duplication master for *Joints Work Sheet*
- 2 Duplication masters for *Joint Tasks (A and B)*

For the eight joint task packages

Newspaper

- 4 Sheets of newspaper*
- 8 Rubber bands, small
- 4 Plastic bags, no zip

Pennies

- 4 Zip bags, 1-liter
- 80 Pennies*

Letter writing

- 32 Sheets of writing paper*
- 4 Envelopes
- 32 Removable dots, 3/4"

Necklace

- 4 Pieces of cord, 100-cm
- 4 Paper clips, jumbo

Scissors

- 4 Pairs of scissors*
- 32 Index cards
- 32 Thumb tacks

Bracelet

- 24 Paper clips, jumbo

Screw-cap bottle

- 4 Large vials with lids
- Popcorn (unpopped)*
- 4 Screw-cap bottles

Tape

- 32 Index cards
- 1 Roll of transparent tape*
- Popcorn (unpopped)*

* Supplied by the teacher

Δ FOSS **Measurement** kit item

Schedule the Activity. This activity is in three parts. Parts 1 and 2 will each take one period of 45 to 60 minutes. Part 3 will take about 30 minutes.

NOTE: If possible, have a second adult available to help with tape management during the activity.

2. Practice Taping Joints. Use masking tape to practice the three joint immobilizations. Be prepared to demonstrate each technique (see Steps 4 and 13 of Doing the Activity).

In Part 1, all of the students will tape both of their hands, using method A.

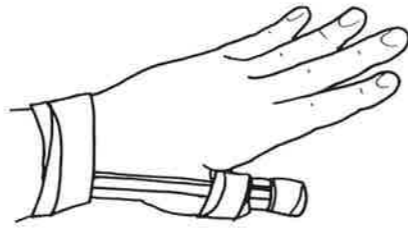
A. No Thumbs. Tape the thumb securely to the index finger. Make sure the tip of the thumb is taped.



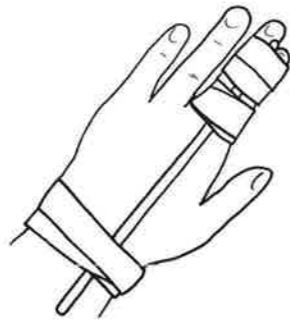
NOTE: Be sure to let the students know that they can take the tape off if it hurts or makes them feel too uneasy.

In Part 2 the students will perform tasks with new immobilizations. Half of the students will tape both of their hands using taping method B and the others will use method C.

B. Stiff Thumbs. Lay a Popsicle stick along the back of the thumb. Spiral a strip of tape around the stick and thumb, making sure that the tip of the thumb is taped to the stick. Tape around the wrist, binding the other end of the stick to the wrist.



C. Stiff Fingers. Tape around the index and middle fingers twice out near the tips. The tape should not be tight. Slide one end of a dowel under the tape in the space between the backs of the fingers. Tape around the wrist, securing the other end of the dowel to the wrist.



3. Prepare the Eight Task Packages. In Part 2 students work as individuals to perform manipulative tasks to develop awareness of the importance of joints. Four students share materials packaged in a large zip bag. After completing a task, the materials are repackaged and rotated to another group.

MATERIALS:
2 Labels
2 Bone Names sheets

NOTE: The students will probably need to use their Bone Names student sheets to locate the bones.

21. Find Joints on the Skeleton Photo. Hang up the skeleton photo. Tell the students that they can label a selection of the skeleton's joints with Post-It™ labels. One way to organize the activity is to assign a bone to a group. That group must decide what kind of joint is at each end of the bone and place labels on the skeleton photo accordingly. Interesting assignments include

Clavicle
Humerus
Tibia
Femur
Phalanges
Radius
Carpals
Tarsals
Scapula
Pelvis

22. Label the Skeleton. Let the students ponder the kinds of joints at the ends of the bones they have been assigned. If the students are stumped, help them make their decision. Here are the basic rules for joint typing:

- Hinge joints: knees, elbows, and the end two joints of each finger and thumb
- Ball-and-socket joints: hips and shoulders
- Sliding joints: all other joints

When the decisions are made, let the RECORDER from each group get two Post-It™ labels from the materials station and use them to label the skeleton's joints.

REFLECTING ON THE ACTIVITY

Good questions can motivate students to think about new ideas, and can help them realize connections to other areas of study. **Recall questions** get them to remember information, **integrating questions** get them to process information, **open-ended questions** get them to infer, create, and solve problems, and **thematic questions** help them realize connections among scientific ideas and processes. Below are examples of these types of questions.

1. What is a joint? [Where two bones meet and move] (recall)
2. What kinds of joints do we have in our skeleton? [Hinge, ball-and-socket, sliding] (recall)
3. Which joints in our skeletons move in similar ways? [Knees, elbows, fingers, and toes; hips and shoulders; ankles and wrists] (integrating)
4. What tasks would be difficult or impossible if your knee joints were immobilized? Elbows? Shoulders? Hips? (integrating)
5. If you could have more joints in your skeleton, where would you like to have them? (open-ended)
6. How does it feel to have some of your hand joints immobilized? (feeling)
7. Select an animal. Compare the joints in the animal's skeleton to those in a human skeleton. What movements do the animal's joints make possible? (thematic connection: Pattern, Structure)

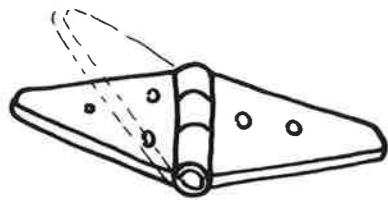
Part 3: Naming Joints

17. **Review Tasks.** Have the students review their experiences with taped fingers. Ask,

- Which immobilization generally made common tasks the most difficult?
- Which tasks were the most difficult?
- What made the tasks hardest?
- How were you able to **compensate** for (overcome) the problems you encountered?
- Was the compensation satisfactory?

18. **Introduce Hinge Joints.** Tell the students that there are several kinds of joints in the body, and two of them can be found in the hand. Hold up the gate hinge and tell the students,

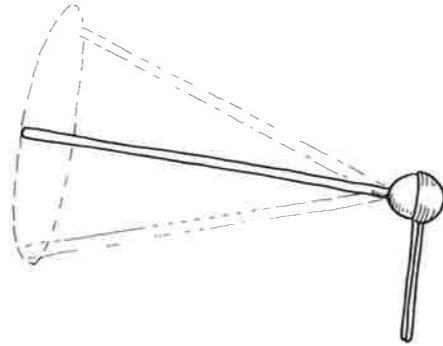
One kind of joint is called a **hinge joint**. A hinge joint operates just like a door hinge. It allows movement in one direction only—it flexes (closes) and extends (opens). Knees and elbows are hinge joints.



Ask the students to find hinge joints in their hands. [Fingers]

19. **Introduce Ball-and-Socket Joints.** Hold up the spoon and mallet. Tell the students,

Another kind of joint is called the **ball-and-socket joint**. Upper arms and upper legs have ball-like knobs on their ends, like the wooden mallet. These knobs fit into spoonlike cups, called sockets, in the shoulder and hip.

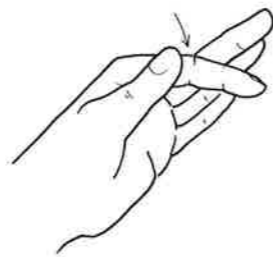


Demonstrate how ball-and-socket joints can move in all directions—front, back, up, down. In addition, the arm and leg can rotate in the socket. Have the students find and move their ball-and-socket joints.

20. **Introduce Sliding Joints.** Tell the students,

There are several other kinds of joints in the body that are called **sliding joints**. Sliding joints allow movement in two directions but do not rotate. The joint where the finger attaches to the palm is one such joint.

Show how the index finger can move back and forth as well as from side to side.



Prepare eight joint tasks packages in zip bags. Use the two duplication masters to make copies of the *Joint Tasks* cards and place a different task card in each of eight bags. Put the materials needed for each task (see materials list) into the zip bag too, and seal the bags.

4. **Look at Joints Work Sheet.** Part 1 of the activity is a free exploration of joint awareness and disability. The *Joints Work Sheet* is provided to give the

exploration a little structure and to ensure that all of the students will have shared experiences to talk about later.

5. **Copy Student Sheets.** Use the duplication master to make a copy of the *Joints Work Sheet* for each student. Copy and cut apart one set of *Joint Tasks A* and *B* for use in the task packages.

STUDENT SHEETS

Name _____ Date _____

JOINTS WORK SHEET

Color or shade the picture carefully.

Trace the maze from start to finish.

Action	Easy	Hard	Very hard
Tape your own fingers.			
Tape your partner's fingers.			
Hold a pencil.			
Shade the picture.			
Trace a maze.			
Work a zipper.			
Work a button.			
Tie a shoe.			
Turn pages in a book.			
Buckle a belt.			
Additional tasks			

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JOINT TASKS A

Newspaper

Roll up a piece of newspaper and put two rubber bands around it. Put the rolled newspaper in a plastic bag.

Then undo it and repack the materials.

Bracelet

Link six large paper clips to make a chain. Link them into a circle. Wear it like a bracelet.

Then take the paper clips apart.

Letter Writing

Get a piece of paper, write on it, fold it up three times, put it in an envelope. Put a sticker in the corner for a stamp.

Scissors

Get an index card and cut it into a circle. Thumb-tack the circle to the bulletin board.

Throw away the scraps.

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Part 1: The Joints Work Sheet

1. **Review Joints.** Review what was learned in activity 1.

- The hard internal parts of the human body are bones.
- Bones are organized into a structure called the skeleton.
- There are about 206 bones in the skeleton.
- The skeleton provides structure and protection.

Tell the students,

*The rigid (hard) skeleton bends because it is articulated. **Articulated** means jointed. The skeleton is made of many bones that are connected at places called joints.*

2. **Overview the Activity.** Tell the students,

The articulated skeleton is one of the marvels of (good things about) the human body. Joints allow us to perform intricate and complex operations (move in many different ways). It won't be possible to look closely at all of the joints in the body, so today we will focus on the joints in the hand. Each hand has 14 joints. Can you find them all?

3. **Introduce the Joints Work Sheet.** Hold up a copy of the work sheet. Point out the picture to color and the maze to trace. Read the list of everyday tasks. Tell the students,

This work sheet guides you through several tasks that require movement of the joints in your fingers. Observe carefully how your joints move as you perform the tasks.

4. **Describe Taping Thumbs.** Tell the students that there is one more detail. They are going to have all the joints in their thumbs immobilized (stiff).

Demonstrate on a student how to tape the thumb to the index finger, emphasizing taping the tip of the thumb (method A).



5. **Tape Up.** Tell the students that they should tape their own thumbs as much as they can, but at some point they will have to work with a partner to complete the job.

Have the GETTERS get a roll of masking tape to share in their collaborative group. Let the taping begin. Plan on 12 minutes to complete the job.

6. **Distribute Work Sheets.** When all of the students are securely taped, let the GETTERS get a copy of the *Joints Work Sheet* for each member of their group. Let them start working through the tasks.

7. **Close Part 1.** When the students have worked through the sheet, ask them to remove the tape and dispose of it. Have a discussion about the experience.

- Which tasks were hard to do?
- What made them hard?
- How did you solve the problem?
- How did you feel when you ran into a hard task?

CAUTION: Don't get the tape too tight.

NOTE: If adults or sixth graders are available to help with the taping, it will go more quickly.

MATERIALS:

- Masking tape
- 4 *Joints Work Sheets*

Part 2: Joint Tasks

8. **Introduce New Tasks.** Tell the students that you have selected eight tasks for them to perform in order to increase their awareness of joints in the hands. Hold up a task package. Tell the students that in each bag is a card explaining what they are to do and enough material for all four students to try the task at the same time.

Tell the students that when they have all completed the task, the materials should be returned to the starting condition so that the bag can be passed to the next group.

9. **Demonstrate Each Task.** Quickly demonstrate all eight tasks. Move rapidly; it will take about 10 minutes.

10. **Announce Taping Joints.** Tell the students,

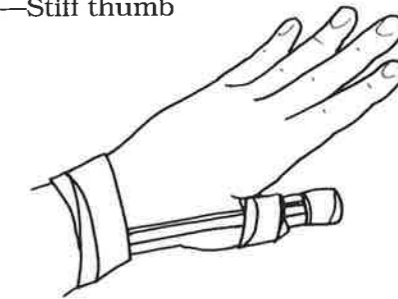
There is one more thing you need to know before starting the tasks. Some of your joints will be immobilized in one of two new ways. One or more joints will be stiff.

11. **Form Groups.** Have the students form their collaborative groups. Each group should then divide into two teams, 1s and 2s.

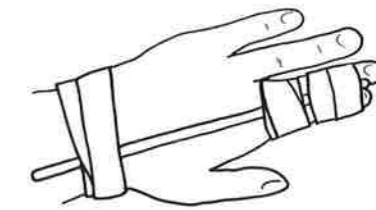
12. **Describe the Tape-Up Procedure.** Tell the students that the 1s will have stiff thumbs and the 2s will have stiff fingers. The 1s will help each other get taped up, and the 2s will help each other.

13. **Demonstrate Tape-Up Techniques.** Demonstrate the two immobilization techniques on a student.

B—Stiff thumb



C—Stiff fingers



14. **Tape Up Thumbs and Fingers.** Assign the stiff thumb to the 1s, and the stiff fingers to the 2s. Have the GETTERS get a roll of masking tape, dowels, and Popsicle sticks, and let the taping begin. Expect the taping to take 16 minutes.

15. **Start the Tasks.** When the taping is complete, deliver a task package to each group. Remind them to return the materials to their starting condition when they are through with a task, and to rotate it to another group.

Tell the students that the tasks are to be performed only with their hands; *no teeth or lips* should be used. Allow about 3 to 4 minutes for each task.

16. **Clean Up.** Have the students package the materials and return them to the materials station. Ask them to remove the tape and bring the sticks to the materials station.

MATERIALS:

- 4 Dowels, 18-cm
- 4 Popsicle sticks
- Masking tape

NOTE: The students will probably complete only about four of the tasks in one session. The students can share results, or another session can be conducted.