Joints

IB SEHS
STARTER – Flexion tests to assess range of joint movement

Shoulder joint -inwards

- Excellent = Fingers overlap
- Good = Fingers touch
- Average = Fingers are less than two inches apart
- Poor = Fingers are more than two inches apart

Shoulder joint -outwards

- Lie on your back on a firm surface. Knees bent, feet flat.
- Move your right arm out to the side to shoulder level.
- Bend your right elbow, keeping your upper arm in contact with the floor.
- Allow your hand and forearm to fall to the floor towards your head.
- Repeat this process with your left arm.
- Normal flexibility will allow your forearm to fall flat on the floor.
Learning Objectives

Everyone should
Define the term joint.
Identify the three different types of joint

Most will
Distinguish between the different types of joint in relation to movement permitted
## Key terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>joint</strong></td>
<td>- the physical point of connection between two bones</td>
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<tr>
<td></td>
<td>- the point at which two or more bones <em>articulate</em></td>
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<tr>
<td><strong>ligament</strong></td>
<td>- connect bone to bone and help to stabilize joints they surround.</td>
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<tr>
<td></td>
<td>- composed mostly of long, stringy collagen fibers that create bands of tough, fibrous connective tissue</td>
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<tr>
<td></td>
<td>- slightly elastic, so they can be stretched and gradually lengthen, increasing flexibility. - can become overstretched and compromise the integrity of the joint they are supposed to be stabilizing</td>
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<tr>
<td><strong>tendon</strong></td>
<td>- tough and flexible bands of fibrous tissue that attach skeletal muscles to bone</td>
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<tr>
<td><strong>to articulate</strong></td>
<td>- to form a joint</td>
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<tr>
<td><strong>motility</strong></td>
<td>movement</td>
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</table>
Introduction to joints

• When two or more bones come into contact or *articulate* with each other

**To articulate**: to form a joint

**Classified by:**

• Presence or absence of joint cavity (gap between articulating bones)
• Shape of articulating bones
• Types of tissue that connect bones together
Group Activity – Practising key terms
# Types of joints

<table>
<thead>
<tr>
<th>Joint type</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
</table>
| Fibrous         | - Thin layer of fibrous tissue connecting the edges of two bones  
                  - continuous with periosteum  
                  - no movement allowed at these joints                                                                 | ![Fibrous Joint](image1.png)                  |
| Cartilaginous   | - Bones separated by fibrocartilage disc or thick layer of *hyaline* cartilage  
                  - limited movement allowed                                                                                                                   | ![Fibrocartilaginous intervertebral disc](image2.png) |
| Synovial        | - Most commonly occurring joints  
                  - most important for *motility*                                                                                                               | ![Synovial Joint](image3.png)                 |
Fibrous joints

Fibrous connective tissue

Cartilaginous joints

Hyaline cartilage

Fibrocartilage

Synovial joints

Articular capsule

Articular (hyaline) cartilage
Structure of a synovial joint

- Muscle
- Enthesis
- Epiphyseal bone
- Articular cartilage
- Ligament
- Joint capsule and synovial lining
- Tendon
- Synovial cavity
- Bursa
- Enthesis
Group Activity - Synovial joint structure and function matching exercise

Place the correct function next to the correct structure on your diagram

Now label and annotate the diagram at the back of your workbook!

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
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</thead>
<tbody>
<tr>
<td>Synovial (joint) cavity</td>
<td>Space between the bones</td>
</tr>
<tr>
<td>Bursa</td>
<td>Small fluid-filled sacs found in areas of high stress</td>
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<tr>
<td></td>
<td>Found where two structures rub against each other e.g. ligament and bone,</td>
</tr>
<tr>
<td></td>
<td>tendon and bone</td>
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<tr>
<td></td>
<td>Lined by synovial membrane which provides lubrication thereby reducing</td>
</tr>
<tr>
<td></td>
<td>friction</td>
</tr>
<tr>
<td>Joint (articular) capsule</td>
<td>Flexible to allow joint movements to take place</td>
</tr>
<tr>
<td></td>
<td>Tensile strength prevents joint from dislocation</td>
</tr>
<tr>
<td>Synovial (membrane) lining</td>
<td>Secretes synovial fluid</td>
</tr>
<tr>
<td>Tendon</td>
<td>Attaches muscle to bone</td>
</tr>
<tr>
<td>Ligament</td>
<td>Attaches bone to bone</td>
</tr>
<tr>
<td>Articular cartilage</td>
<td>A smooth white layer that covers the articulating surface of bones</td>
</tr>
<tr>
<td></td>
<td>Reduces friction, absorbs shock and protects bones</td>
</tr>
<tr>
<td></td>
<td>Thickness depends on the amount of stress it is exposed to</td>
</tr>
<tr>
<td>Synovial fluid</td>
<td>Viscous fluid with the consistency and appearance of uncooked egg whites</td>
</tr>
<tr>
<td></td>
<td>Becomes more fluid with movement</td>
</tr>
<tr>
<td></td>
<td>Lubricates joint cavity thereby reducing friction</td>
</tr>
<tr>
<td></td>
<td>Provides nutrients to cartilage</td>
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</tbody>
</table>
Individual task

• Which of the sports below would cause the greatest thickening of articular cartilage? *(remember Wolff’s Law?)*

• Write your answer on a piece of paper and hand it in before you go!
STARTER – Finish the lyrics!
Learning Objectives

Everyone should
Identify the different ligaments in the knee

Most will
Describe how different injuries can occur to the knee

Some might
Outline steps that can be taken to help prevent knee damage
Ligaments of the knee

There are four major ligaments that surround the knee joint, keeping it in place when the leg is bent or straight:

- the anterior cruciate ligament (ACL) (center of knee)
- the posterior cruciate ligament (PCL) (center of knee)
- the lateral collateral ligament (LCL) (outer knee)
- the medial collateral ligament (MCL) (inner knee)

Meniscus – semi-lunar discs of fibrocartilage that allow bones to fit more tightly together. This provides greater cushioning and stability to the joint.
Individual task

• Move around the posters that show the various types of knee injury that occur the most commonly

• Complete the questions in your workbook using the information from the different posters to help you.
ACL Injuries

The anterior cruciate ligament is crucial in keeping the tibia from sliding beneath the femur; it is frequently injured among athletes who take part in skiing, basketball and football.

It can be torn or injured in a variety of ways:
- quickly twisting or changing direction
- slowing down while running
- direct hit (like a football tackle)
- landing after a jump

Men and women alike can suffer from sports related injuries like ACL tears, but according to data collected* since 1995 there is a difference between men and women in the same sport.

ACL injuries among women basketball players are twice that of their male counterparts. Women who play soccer are four times more likely to suffer from an ACL tear than men who play the same sport.

Part of the problem is the way many women jump, turn and pivot. They don't usually bend their knees as much as men do when landing from a jump. That puts increased pressure on the knee joint.

Many women also are in a more erect position when turning and pivoting. That also can strain the ACL. Learning to crouch and bend at the knees and hips, could take some of the stress off the ACL.

If you suffer from an ACL injury, you may not even realize it right away. You may just hear a popping noise and feel your knee give out from under you. Two to twelve hours later, there will be swelling accompanied by pain.

*American Academy of Orthopaedic Surgeons
If you suffer from a PCL injury, the tibia can sag backwards, disrupting the stability of the knee joint.

The ends of the femur and tibia will then rub directly against one another, weakening cartilage. This abrasion can lead to arthritis of the knee.

Once again, athletes are susceptible to PCL injuries though the PCL is not injured as frequently as the ACL.

PCL sprains usually occur because of:
- blow to the front of the knee
- misstep
- ligament was pulled or stretched too far

The PCL is the one injured most often by blows such as football tackles or auto accidents.
MCL injury

The medial collateral ligament (MCL) attaches the thighbone to the shinbone. This makes the inner side of the knee stable.

Those taking part in contact sports, like hockey and football, are most likely to suffer from an MCL injury.

The MCL is most often injured because of a blow to the outer side of the knee. That kind of hit can stretch and tear the ligament, on the inner side of the knee. So even though the hit is on one side the injury occurs on the opposite side of the knee.

The symptoms of an MCL injury include a popping and buckling sideways of the knee. Swelling and pain are also common.
Cartilage injuries

Cartilage cushions your knee, and acts to absorb shock during movement. Torn cartilage is experienced by many people.

When people talk about torn knee cartilage, they are usually talking about a meniscal tear. The meniscus is a wedge-like rubbery cushion where the major bones of your legs connect. The meniscus helps the knee carry weight, glide and turn.

Athletes who are involved in contact sports are at risk for this tear because of the amount of twisting, turning and decelerating involved.

The tear often happens in connection with other injuries like a torn ligament (ACL). The elderly are also at risk due to wear and tear of the cartilage over time.

A meniscal tear could begin with a popping sensation. When inflammation sets in you might feel:
• stiffness and swelling
• fluid (water on the knee)
• tenderness in the joint

Without treatment, part of the meniscus may loosen and drift into the joint causing your knee to lock.
Osgood-Schlatter Disease

Repetitive stress or tension on part of the growth area of the upper tibia can cause Osgood-Schlatter disease in growing children.

The disease may also be linked to an injury, in which a tendon is stretched so much that it tears from the tibia taking a bone fragment with it.

The disease most commonly affects active boys who are about 10 to 15 years of age.

People who have the disease may experience:
- pain below the knee joint that worsens with activity
- a painful bony bump below the knee cap
- a few months of pain which may recur

Motion of the knee is usually not affected and the disease almost always disappears without treatment.
Tendon injuries

Tendons are like rubber bands that can become worn and fragile when stretched too far.

Knee injuries involving tendons range from an inflammation of the tendons called tendinitis, to a ruptured tendon.

Athletes and older people whose tendons are weaker are more prone to these injuries.

People with tendinitis often have tenderness and pain while running or jumping.

A ruptured tendon could result in difficulty bending, extending or lifting the leg and swelling.
Treatment of knee injuries

Immediate treatment of injury

**RICE** - which stands for rest, ice, compression, elevation

**Resting** the knee gives it time to heal. If you have to walk, use crutches.

**Ice**, two to three times a day for about 20 minutes each time. It can control swelling.

**Compressing** the injury reduces swelling. You may have to do this with an elastic bandage or brace that fits snugly, but loose enough so that it doesn't hurt.

**Elevate** the knee whenever possible

Long term treatment of injury

Physical therapy can help people either avoid surgery or recover following surgery. It is made up of the following stages:

- **Evaluation** - identifying your condition and the factors that contributed to your injury.
- **Therapy** - an individual plan designed to restore motion and muscle performance.
- **Education** - your therapist might want to teach you some new habits to avoid another injury and overcome the one you have.
- **Aftercare** - Physical therapy is aimed at getting you back on your feet with the knowledge of how to prevent reinjury so you won't need to visit your therapist again.

A treatment plan may include a series of exercises like swimming, water walking, strengthening exercises and leg presses designed to help motion.
Different types of synovial joint
Types of synovial joints

In **ball and socket joints**, the rounded end of one bone fits inside a cup-shaped ending on another bone.

Ball and socket joints allow movement in **all directions** and also **rotation**. The most mobile joints in the body are ball and socket joints. Examples: Shoulders and hips.
**Pivot joints** have a ring of bone that fits over a bone protrusion, around which it can rotate. These joints only allow rotation.

Examples: The joint between the atlas and axis in the neck which allows you to shake your head.
Types of synovial joints

**In saddle joints**, the ends of the two bones fit together in a special way, allowing movement forwards and backwards and left to right, but not rotation.

Examples: The thumb is the only one.

**Hinge joints** – as their name suggests – only allow forwards and backwards movement.

Examples: The knee and elbow.
Types of synovial joints

**Condyloid joints** have an oval-shaped bone end which fits into a correspondingly shaped bone end.
They allow forwards, backwards, left and right movement, but not rotation.
Examples: between the metacarpals and phalanges in the hand.

**Gliding joints** have two flat faces of bone that slide over one another.
They allow a tiny bit of movement in all directions.
Examples: between the tarsals in the ankle.
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**Gliding joints** have two flat faces of bone that slide over one another. They allow a tiny bit of movement in all directions. Examples: between the tarsals in the ankle.
Starter – Pop Quiz!

Answer the following questions individually without using your notes

1. The ________ is frequently injured when an athlete receives a blow to the outside of the knee

2. Give two ways an athlete might damage the ACL and an example of a sport that carries a high risk for this

3. What are the steps for immediate treatment of a knee injury?
ANSWERS—Pop Quiz!

Answer the following questions without using your notes

1. The LCL is frequently injured when an athlete receives a blow to the outside of the knee.

2. Give two ways an athlete might damage the ACL and an example of a sport that carries a high risk for this:
   • quickly twisting or changing direction
   • slowing down while running
   • direct hit (like a football tackle)
   • landing after a jump

   Skiing, basketball, football

3. What are the steps for immediate treatment of a knee injury?
   • Resting
   • Ice
   • Compression
   • Elevation
Learning Objectives

Everyone should

List the different types of joint

Most will

Describe the structure of each joint is related to its mobility
During the butterfly stroke, the ball and socket joint of the shoulder allows the swimmer’s arm to rotate.

You might head a football using the pivot joint in your neck, which allows your head to rotate.

What type of joint allows a handball player’s fingers to spread apart so that they can control the ball with one hand?

Answer: The condyloid joints between the metacarpals and phalanges.
Movement analysis task

1. Each group member will carry out the motions associated with the following movements
   - a penalty kick in football
   - throwing a baseball
   - serving a tennis ball
   - skipping

2. Discuss the movements occurring at each synovial joint during four different types of physical activity with your partner

3. Fill them into the table in your workbook individually
Starter: Individual task

• Which of the sports below would cause the greatest thickening of articular cartilage? (remember Wolff’s Law?)

Lionel Messi  Naim Suleymanoglu  Frankie Dettori
Movement analysis task

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4. Try the Joints review individually when you have finished
Which joint is missing?

D
E
C
A
B
Learning Objectives

Everyone should

**Identify** the different parts of a synovial joint

Most will

**Describe** how each structure within the joint is related to its mobility
PAIRS ACTIVITY
Dissecting a chicken leg lab

• Follow the instructions in your workbook

• Make sure you complete all questions individually

Extension
Try the Joints review questions in your workbook