1.5 The Musculoskeletal System & Analysis of Movement in Physical Activities

Name __________________________________

Class__________________________________
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</tr>
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<td>Joint actions in the sagittal plane/transverse axis.</td>
<td>Shoulder and hip (flexion, extension and hyperextension).</td>
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<td>Elbow and knee (flexion and extension).</td>
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<td>Ankle (plantar flexion and dorsi flexion).</td>
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<td></td>
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<td>Joint actions in the transverse plane/longitudinal axis.</td>
<td>Shoulder and hip (horizontal abduction and adduction).</td>
<td></td>
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<td>Types of joint, articulating bones, main agonists and antagonists, types of muscle contraction.</td>
<td>Isotonic (concentric and eccentric) and Isometric.</td>
<td></td>
</tr>
</tbody>
</table>
Planes & Axes:

Planes:

Planes are theoretical divisions that divide the body into sections. There are three planes of motion in the body.

1. The Sagittal Plane:
   Splits the body down the middle resulting in a _______ side and a _______ side.

2. The Frontal Plane:
   Divides the body so that there are _______ and _______ sections.

3. The Transverse Plane (AKA Horizontal Plane):
   Divides the body across the middle (horizontally), giving a _______ section and a _______ section.

Underneath each of the pictures shown above, write down one of the following phrases to describe the movement possible within the plane. Think about how the person could move and still keep the plane intact:

- Forward or backward
- Side to side
- Rotational
Use the table below to select the plane of movement for each exercise/sporting action:

<table>
<thead>
<tr>
<th>Exercise/Action</th>
<th>Plane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td></td>
</tr>
<tr>
<td>Side Bends</td>
<td></td>
</tr>
<tr>
<td>Side Stepping</td>
<td></td>
</tr>
<tr>
<td>Jogging</td>
<td></td>
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<tr>
<td>360 degree twist</td>
<td></td>
</tr>
</tbody>
</table>

**Axes:**

The joints in our bodies rotate around one of three different axes. These axes allow rotation to take place in one of the planes. There are three different axes:

1. **The Transverse Axis:**
   - Hip to hip

2. **The Longitudinal Axis:**
   - Vertical line - top to bottom

2. **The Sagittal Axis:**
   - Stabs through the body

Use the table below to state the plane and axes present during each movement/action.

<table>
<thead>
<tr>
<th>Movement/Action</th>
<th>Plane</th>
<th>Axes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Roll</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cartwheel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somersault</td>
<td></td>
<td></td>
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<tr>
<td>Twist Jump</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sample exam questions:

Identify the plane and axis shown in the figure on the left (1)

________________________________________

Give an example of a sporting action used at this plane and axis?

________________________________________
Sample exam questions:
Identify the plane and axis shown in the figure on the left (1)
________________________________________
Give an example of a sporting action used at this plane and axis?
________________________________________

Sample exam questions:
Identify the plane and axis shown in the figure on the left (1)
________________________________________
Give an example of a sporting action used at this plane and axis?
________________________________________
Joints:
There are two types of synovial joints in the body that you need to know about.

Hinge Joints allow only backward and forward motion, just like the hinge on a door. There are three hinge joints; the knee, elbow and ankle.

Give an example of how a footballer might use a hinge joint?

___________________________________________________________________________

___________________________________________________________________________

Ball and Socket Joints are when a long bone fit into a cup shaped hole, allowing circumduction. The shoulder and hip joints are examples.

Name two sports whereby a ball and socket joint is important.

___________________________________________________________________________

___________________________________________________________________________

Which joints are key to creating movement for the sporting actions shown below?
Joints and Movement:

Joints are what make it possible to move our body in certain ways. Each type of joint allows for a different type of movement.

1. Flexion: Movement decreasing the angle between body parts (bending).
2. Extension: Movement increasing the angle between body parts (straightening).
3. Dorsi-Flexion: Flexing the toes so that they move closer to the shin
4. Plantar-Flexion: Extending the toes down, away from the shin
5. Hyperextension – Increasing the angle beyond 180 degrees when extending
6. Adduction: Movement of a body part toward the body’s midline
7. Abduction: Movement of a body part away from the body’s midline
8. Horizontal Adduction: Moving the arm towards the body from a 90 degree position
9. Horizontal Abduction: Moving the arm away from the body at a 90 degree position

Useful Hint:

ADDuction = add to the body
Abduction = Take Away

Useful Hint:

PLANTar-Flexion = Plant your toes on the ground
What type of movements result in the following sporting actions?

Kicking a ball in football _____________________________
Serving in tennis __________________________________
Hand Stand ________________________________________
Ten Pin Bowling _____________________________________
Bowling a cricket ball _________________________________
Performing a bicep curl ________________________________
‘Pointe’ in Ballet (standing on toes) ______________________
Performing a squat _________________________________
Forehand shot in Table Tennis __________________________

<table>
<thead>
<tr>
<th>Type of Joint</th>
<th>Examples of this joint in the body?</th>
<th>Types of movement available?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>

Useful Hint:
Think about different exercises that you can perform in the gym. What type of movement does each exercise require?
Joint Actions in the Sagittal Plane/Transverse Axis:

Flexion, extension, plantarflexion, dorsiflexion and hyperextension are actions that take part in the sagittal plane/transverse axis. Under each heading, stick or draw a picture of the required action.

Flexion:  

Extension:  

Plantarflexion:  

Dorsiflexion:  

Hyper Extension:
Joint Actions in the Frontal Plane/Sagittal Axis:

Abduction and adduction are actions that take part in the frontal plane/sagittal axis. Under each heading, stick or draw a picture of the required action.

Adduction:  
Abduction:

Joint Actions in the Transverse Plane/Longitudinal Axis:

Horizontal abduction and horizontal adduction are actions that take part in the transverse plane/longitudinal axis. Under each heading, stick or draw a picture of the required action.

Horizontal Adduction:  
Horizontal Abduction:
The Structure of the Skeletal System
The Vertebral Column:

**Vertebral Column**

- Cervical vertebrae
- Thoracic vertebrae
- Lumbar vertebrae
- Sacrum
- Coccygeal vertebrae

**Cervical curve**

**Thoracic curve**

**Lumbar curve**

**Sacral curve**

**Useful Mnemonic**

Come
To
London
Sports
Club

Test a partner on the five groups of the vertebral column.

**Articulating Bones of a Joint:**

These are bones which connect to a joint. Using the skeleton that you have labelled above, fill in the following table:

<table>
<thead>
<tr>
<th>Joint</th>
<th>Joint Type</th>
<th>Articulating Bones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elbow</td>
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<tr>
<td>Ankle</td>
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</tr>
</tbody>
</table>
12 of the 13 muscles that you have labelled above, work as *antagonistic pairs*. Can you name these pairs?
<table>
<thead>
<tr>
<th>Muscle</th>
<th>Location in the body</th>
<th>Movement action used for</th>
<th>Attached to which joints</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Which muscle and what type of movement action is responsible for each of the following sporting examples?

<table>
<thead>
<tr>
<th>Sporting Example</th>
<th>Muscle used and movement action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performing a side plank in the gym</td>
<td></td>
</tr>
<tr>
<td>Lifting the knees high during sprinting</td>
<td></td>
</tr>
<tr>
<td>Throwing the ball up to serve in tennis</td>
<td></td>
</tr>
<tr>
<td>Pulling the arm back ready to throw a dart</td>
<td></td>
</tr>
<tr>
<td>Throwing a dart</td>
<td></td>
</tr>
<tr>
<td>Jogging</td>
<td></td>
</tr>
<tr>
<td>Performing a squat</td>
<td></td>
</tr>
<tr>
<td>Lifting the feet during a ski jump</td>
<td></td>
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<tr>
<td>Pulling the leg back before kicking a ball</td>
<td></td>
</tr>
<tr>
<td>Kicking a ball</td>
<td></td>
</tr>
<tr>
<td>Playing a forehand shot in tennis</td>
<td></td>
</tr>
</tbody>
</table>
Antagonistic Pairs

A muscle is only capable of pulling during a contraction. Muscles cannot push. Therefore some muscles work in twos, known as **antagonistic pairs**. Whilst one muscle **contracts** (pulls), the other muscle in the pair will **relax**. The muscle contracting is known as the **agonist**, whereas the muscle relaxing is known as the **antagonist**.

Explain how an antagonistic pair of muscles work together to perform a press up.

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

Explain how an antagonistic pair work together whilst performing a squat.

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

Explain how an antagonistic pair work together during a hurdles race?

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

**Hint:**
Think about the arms

**Hint:**
Think about the legs

**Hint:**
Think about the feet
**Isometric v Isotonic Contractions:**

An isometric contraction is where a muscle contracts but the length of the muscle does not change (therefore it doesn’t move). Sporting examples could include ____________________ or ____________________.

An isotonic contraction is where a muscle contracts and also lengthens. There are two types of isotonic muscular contraction:

**Eccentric contractions** occur when the muscle lengthen due to a greater opposing force.

**Concentric contractions** occur when the muscle shortens, therefore generating force.

At which stage of a bicep curl is an eccentric muscle contraction experienced? At which stage is a concentric contraction experienced?

___________________________________________________________________________  

___________________________________________________________________________  

___________________________________________________________________________  

___________________________________________________________________________  

**Sample Exam Questions**

**Which one of the following causes flexion at the elbow? (1 mark)**

A Tricep  
B Bicep  
C Deltoid  
D Pectorals

**Which bones are found at the knee joint? (1 mark)**

A Femur and Tibia  
B Pelvis and Femur  
C Tibia and Talus  
D Fibula and Ulna
Identify the type of joint, the joint action and the main agonist at the leading ankle, as an athlete clears a hurdle. (3 marks)

Type of joint:____________________________________________________________

Joint action:____________________________________________________________

Main agonist:____________________________________________________________

To clear a hurdle, hip flexion occurs.

State the plane and the axis around which hip flexion takes place. (2 marks)

Plane:________________________________________________________________

Axis:________________________________________________________________

Muscles often work in antagonistic pairs.

Explain the term antagonistic pair, using the elbow joint as an example. (4 marks)

_____________________________________________________________________

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_____________________________________________________________________
Key Terms:

**Sagittal Plane** – Divides the body into a left and right section

**Frontal Plane** – Divides the body into a front and back section

**Transverse Plane** – Divides the body into a top and bottom section

**Articulating Bones** – Where two or more bones meet to allow movement at a joint

**Tendons** – Fibrous tissues that join bone to muscle

**Ligaments** – Strong, flexible fibre that connects bones to other bones

**Flexion**: Movement decreasing the angle between body parts (*bending*)

**Extension**: Movement increasing the angle between body parts (*straightening*)

**Dorsi-Flexion**: Flexing the toes so that they move closer to the shin

**Plantar-Flexion**: Extending the toes down, away from the shin

**Adduction**: Movement of a body part toward the body's midline

**Abduction**: Movement of a body part away from the body’s midline

**Antagonistic Pair**: Two muscles working together. One contracts while the other relaxes.

**Agonist**: Muscle or group responsible for the movement.

**Antagonist**: Acts to produce the opposite action of the agonist.

**Isometric Contraction**: Where a muscle contracts but the length of the muscle does not change (therefore it doesn’t move)

**Eccentric Contraction**: Occurs when the muscle lengthens due to a greater opposing force.

**Concentric Contraction**: Occurs when the muscle shortens, therefore generating force.