1.1.a – Skeletal and Muscular Systems

Name _____

Class_____

Planes of Movements:

Different sports often require different types of movement and positioning. For the following sports, in your own words describe the positioning of the body.

Tennis _____

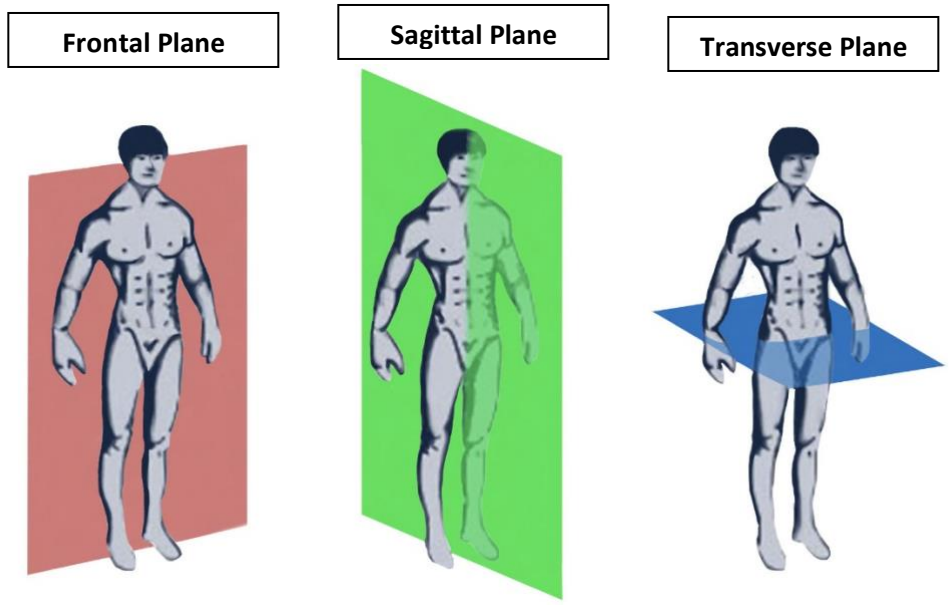
Swimming _____

Trampolining _____

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**:

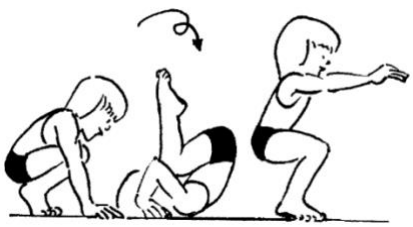
- Forward or backward
- Side to side
- Rotational

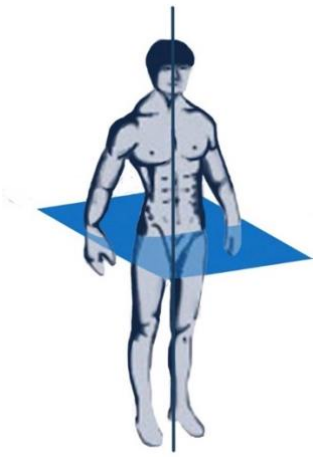
Use the table below to select the plane of movement for each exercise/sporting action:

Exercise/Action	Plane
Walking	
Side Bends	
Side Stepping	
Jogging	
360 degree twist	

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

Movement/Action	Plane
Forward Roll	
Cartwheel	
Somersault	
Twist Jump	





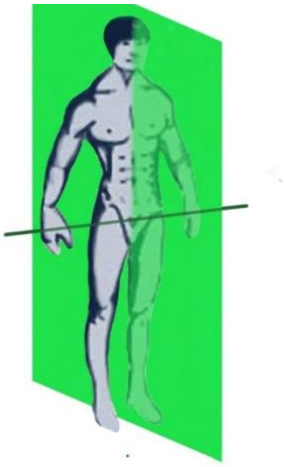
Sample exam questions:

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

_____

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

_____



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Joints:

There are three 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?

_____

In which plane of movement does this joint act? _____

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.

_____

_____

In which plane of movement does this joint act? _____

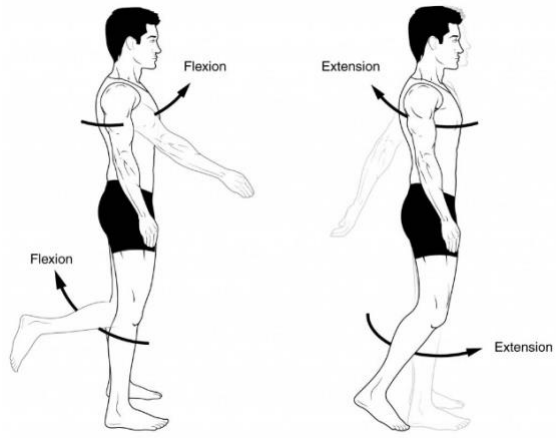
Condyloid Joints allow circular motion but don't allow full circumduction. The wrist is a condyloid joint. In which plane of movement does this joint act? _____

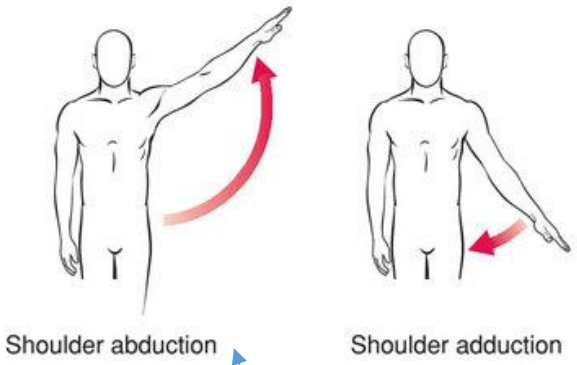
Which joints are key to creating movement for the sporting actions shown below?

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 Flexion: Movement decreasing the angle between body parts occurring on the horizontal plane (parallel to the floor)
9. Horizontal Extension: Movement increasing the angle between body parts occurring on the horizontal plane (parallel to the floor)
10. Medial rotation: rotational movement towards the midline
11. Lateral rotation: rotational movement away from the midline.





Useful Hint:
ADDuction = add to the body
Abduction = Take Away

Useful Hint:
PLANTar-Flexion = Plant your toes on the ground

Type of Joint	Examples of this joint in the body?	Types of movement available?

Kicking a ball in football - _____

Serving in tennis - _____

Hand Stand – _____

Ten Pin Bowling - _____

Bowling a cricket ball- _____

Performing a bicep curl – _____

'Pointe' in Ballet _____

Performing a squat- _____

Forehand shot in Table Tennis – _____

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

Flexion, extension, plantarflexion, dorsiflexion and hyperextension are actions that take part in the sagittal plane. Under each heading, stick or draw a picture of the required action, and write down the agonist muscle(s).

Flexion:

Extension:

Plantarflexion:

Dorsiflexion:

Hyper Extension:

Joint Actions in the Frontal Plane

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, and write down the agonist muscle(s).

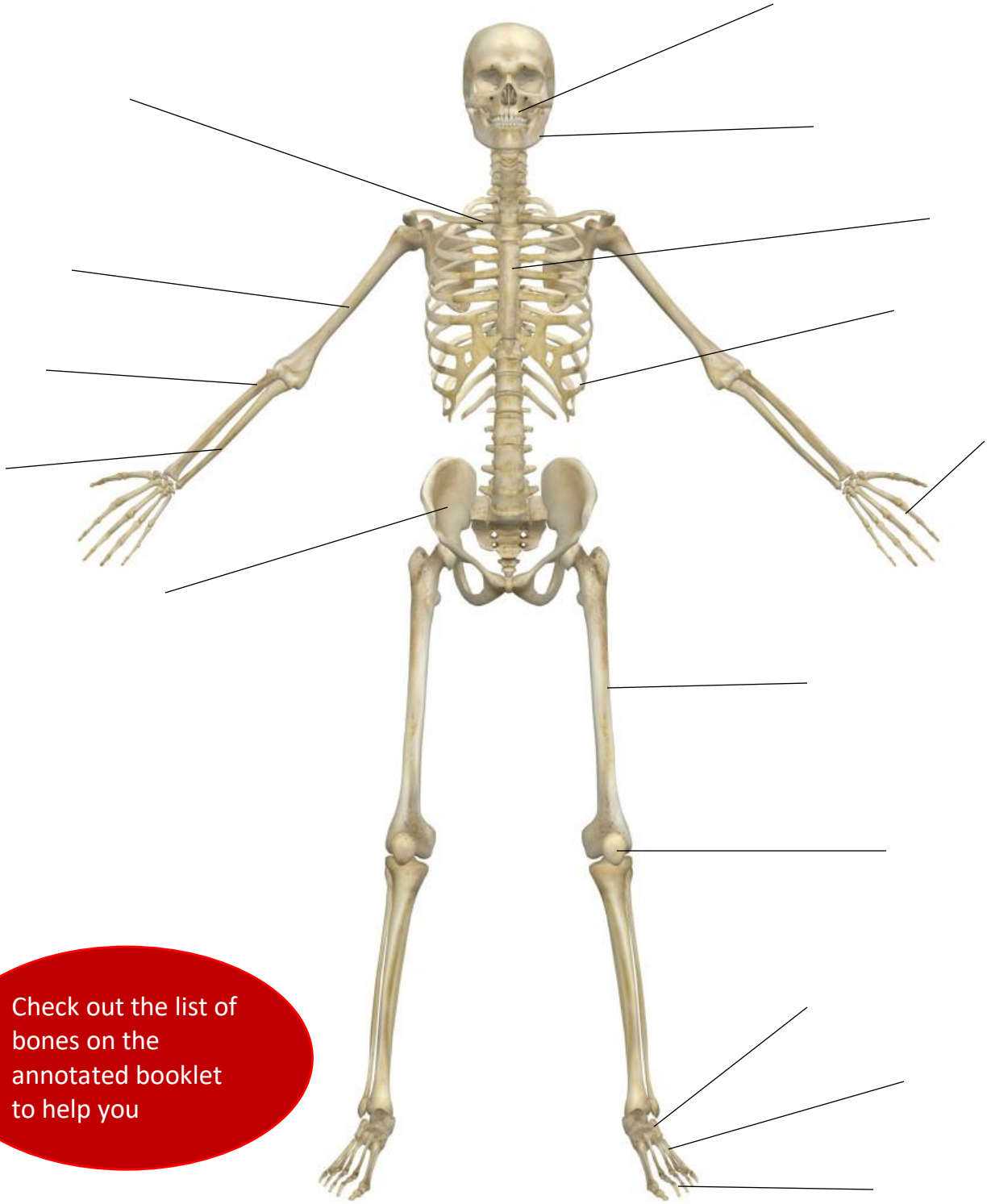
Adduction: **Abduction:**

Joint Actions in the Transverse Plane

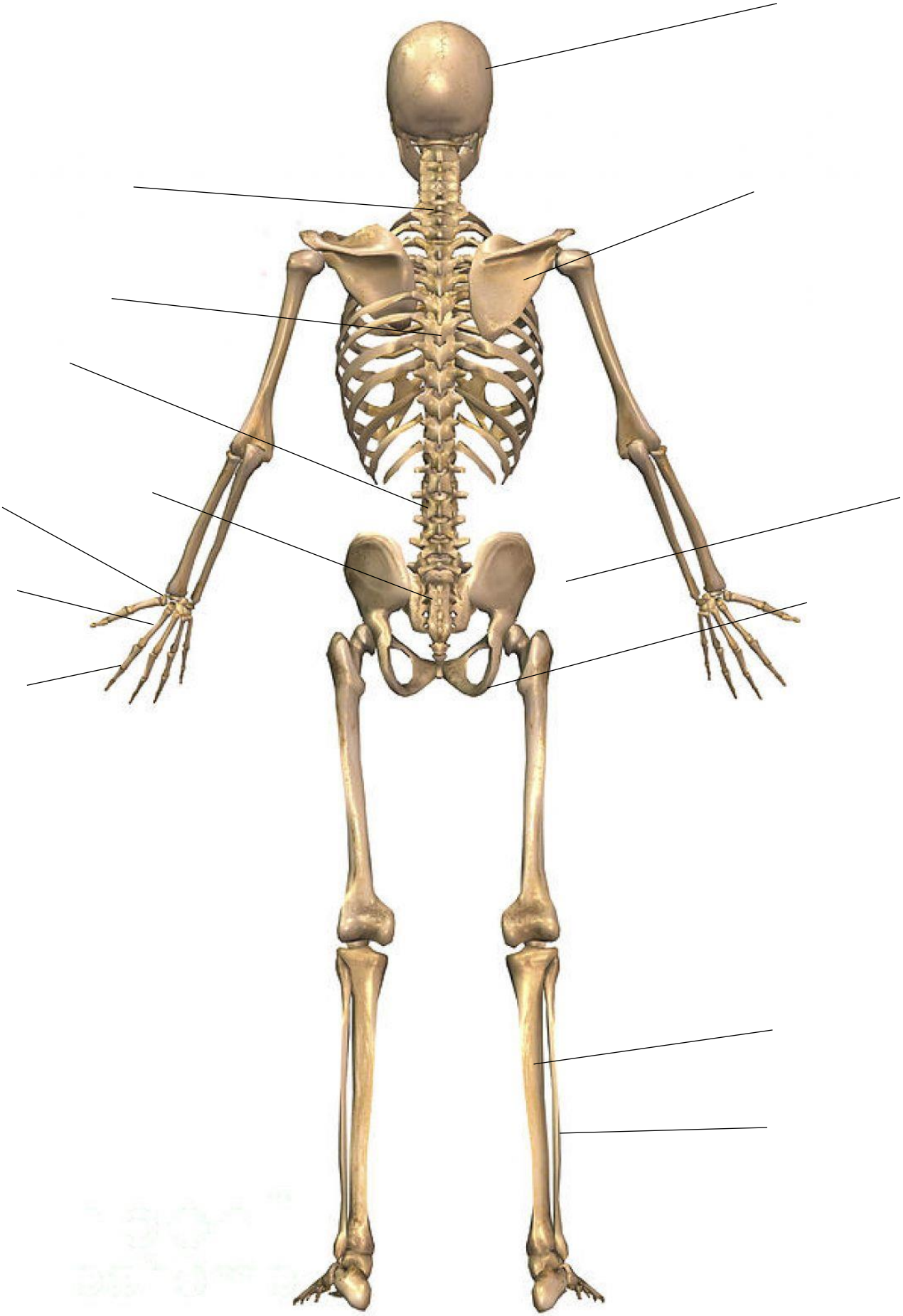
Horizontal abduction and horizontal adduction are actions that take part in the transverse plane/longitudinal axis. Under each heading, stick or draw a picture of the required action, and write down the agonist muscle(s).

Lateral/medial Rotation: **Horizontal flexion/extension:**

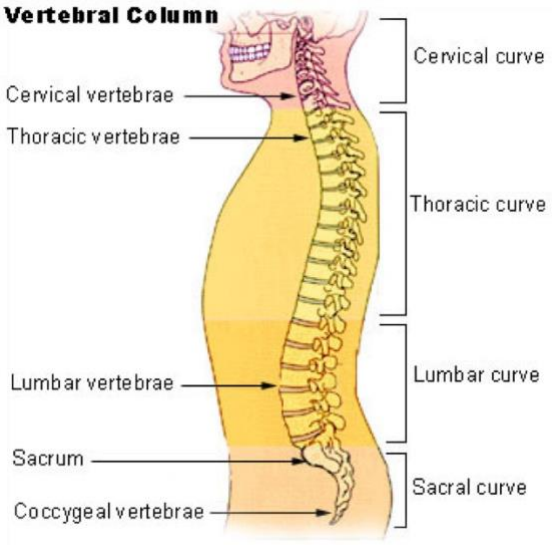
The Structure of the Skeletal System



Check out the list of bones on the annotated booklet to help you



The Vertebral Column:



Useful Mneumonic

Come
To
London
Sports
Club

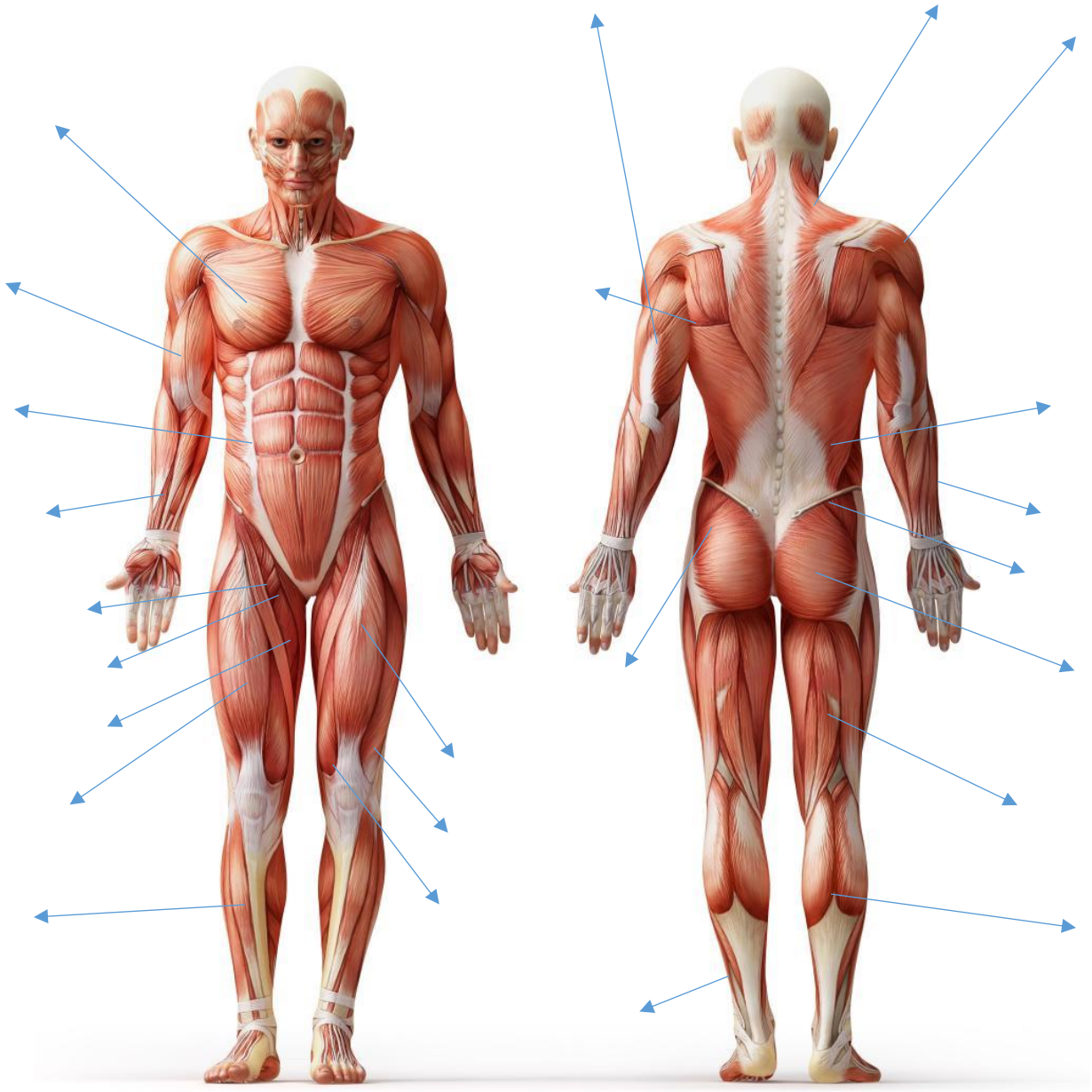
Test a partner on the five groups of the vertebral column.

<u>Articulating Bones of a Joint:</u>

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

Joint	Joint Type	Articulating Bones
Shoulder		
Hip		
Knee		
Elbow		
Ankle		
Wrist		

Voluntary Muscles of the Body:



The muscles that you have labelled above work as **antagonistic pairs.** Can you name these pairs?

Check out the list of muscles on the annotated booklet to help you

Muscle	Location in the body	Movement action used for	Attached to which joints

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

Sporting Example	Muscle used and movement action
Performing a side plank in the gym	
Lifting the knees high during sprinting	
Throwing the ball up to serve in tennis	
Pulling the arm back ready to throw a dart	
Throwing a dart	
Jogging	
Performing a squat	
Lifting the feet during a ski jump	
Pulling the leg back before kicking a ball	
Kicking a ball	
Playing a forehand shot in tennis	

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.

Hint:
Think about the arms

_____

_____

_____

_____

_____

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

Hint:
Think about the legs

_____

_____

_____

_____

_____

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

Hint:
Think about the feet

_____

_____

_____

_____

_____

Fixator Muscles

A fixator is a muscle that stabilises one part of the body while another part moves. The majority of fixator muscles are found working around the hip and _____ joints.

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?

_____
_____
_____
_____

Activity	Agonist	Antagonist	Fixator
Kicking a football			
Bicep curl			

Skeletal Muscle Contraction

Skeletal muscles only contract when stimulated by electrical impulses from the central nervous system (CNS).

A nerve impulse is initiated in the motor neuron

Motor neurons- specialised cells which transmit nerve impulses to muscle fibres.

The impulse is conducted down the axon of the motor neuron by a **nerve action potential**.

Action potential – **positive** electric charge in nerve and muscle cells which conducts the impulse

A **neurotransmitter** (acetylcholine) is secreted into the synaptic cleft to conduct the impulse across the gap.

Axon – branches off nerve cells to connect to muscle fibres (at the neuromuscular junction)

Synaptic cleft – gap between axon motor end plates and muscle fibre

ALL OR NONE law
If the electrical charge is **above threshold** = muscle fibre contracts
Either all muscle fibres give a complete contraction, or no contraction at all

Muscle Fibres

There are three types of muscle fibres in the body. Fill in the blanks for each muscle fibre.

Slow Oxidative (SO) Fibres contract relatively slowly and use aerobic respiration to produce ATP. They give a _____ force of contraction. Individual fibres _____ very quickly.

_____ athletes have the highest percentage of this fibre, e.g. _____.

Fast Oxidative Glycolytic (FOG) Fibres have fast contractions and mainly use aerobic respiration. However, they can sometimes switch to aerobic respiration (glycolysis), and can therefore _____ more quickly than SO fibres. They produce a _____ force quickly and have capacity to resist fatigue.

_____ athletes have the highest percentage of this fibre, e.g. _____

Fast Glycolytic (FG) Fibres have fast contractions and mainly use anaerobic respiration. They fatigue the quickest.

They are recruited in the last 2-10 seconds of contraction, when _____ efforts are needed quickly. This will cause muscle fibre _____ and DOMS felt 24-48hrs after exercise.

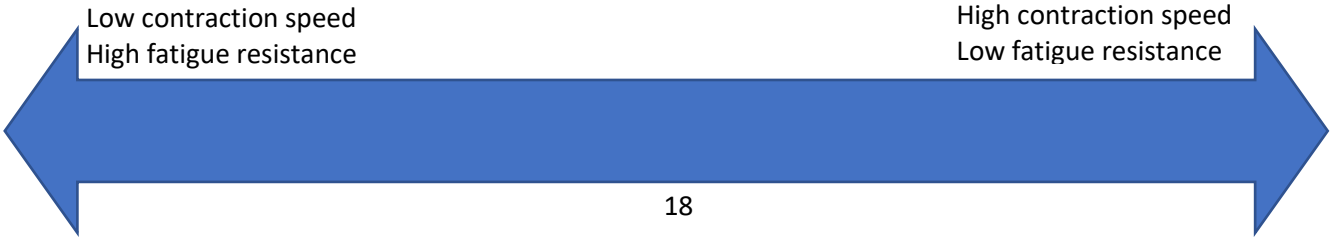
_____ athletes have the highest percentage of this fibre, e.g. _____.

Maximal	fatigue	recover	damage	800m runners	low
	long jumpers		high-intensity	marathon runners	
		explosive	large	endurance	

The speed of contraction of muscle fibres depend on various factors. Label the spectrum below with the 3 different muscle fibres according to their characteristics.

High mitochondria density
Low contraction force
Low contraction speed
High fatigue resistance

Low mitochondria density
High contraction force
High contraction speed
Low fatigue resistance



The Recruitment of Muscle Fibres

Every muscle contains a range of fast and slow twitch muscle fibres. The type of muscle fibre present in your muscles is largely down to genetics. However, over time training can affect the type of muscle fibres present in your body.

What types of training could result in an increase of fast Glycolytic fibres?

_____

What types of training could result in an increase of slow oxidative fibres?

_____

Recovery

Which muscle fibre would a weight lifter use during their session?

_____

Therefore, in order to **increase blood flow** and **enhance healing**, which muscle fibre would they be able to use in between heavy weight training sessions?

_____

Sample Exam Questions

1. Fig. 1 shows a net baller preparing to shoot.

Fig. 1

(a) Complete the table below to analyse the position of the right wrist.

Joint type	Articulating bones	Plane of movement	Movement	Agonist	Antagonist
.....	....	.....	.....	.....	.....

[6]

2. a) 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: _____

b) To clear a hurdle, hip flexion occurs. State the plane on which hip flexion takes place.

(1)

_____

3) Muscles often work in antagonistic pairs.

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

_____

_____

_____

_____

4) **Fig.1** shows a performer doing a sit up.

Fig.1

(a) Complete the table below to show the movements that take place at the hip joint during both the upward and downward phases.

Phase	Agonist	Movement produced	Type of contraction
Upward			
Downward			

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.

Fixator: a muscle that stabilises one part of the body while another part moves.

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.

Neurotransmitter: a chemical substance released at the end of a nerve fibre by a nerve impulse. It diffuses across the synapse (gap) to transfer the impulse to another fibre.