Level 2 Fitness Instructor – Anatomy and Physiology for Exercise

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Course Start Date	July 2020
Course Location	Home based
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Statement of Achievement

Assessor, by signing this statement of unit achievement you are confirming that all learning outcomes, criteria and range statements have been achieved under specified conditions and that the evidence gathered is authentic.

This statement of unit achievement table must be completed prior to claiming certification.

Section	Pass/Refer	Assessor Full Name	Assessor Signature
Understand the structure and function of the circulatory system			
Understand the structure and function of the respiratory system and skeleton (and joints)			
Understand the muscular system			
Understand the life-course of the musculoskeletal system and its implications (special populations)	PASS	D FOSTER	
Understand energy systems and their relation to exercise			
Understand the nervous system and its relation to exercise			

Please complete 3 boxes below

Learner Name	Tanya Wallman	IQA Name	
Learner Signature		IQA Signature	
Date	17/01/2021	Date	

Understanding the structure and function of the circulatory system

Q1

Tick which statement is true from the two following statements.

	Tick one
The heart is located on the left-hand side of the chest cavity	yes
The heart is located on the right-hand side of the chest cavity	

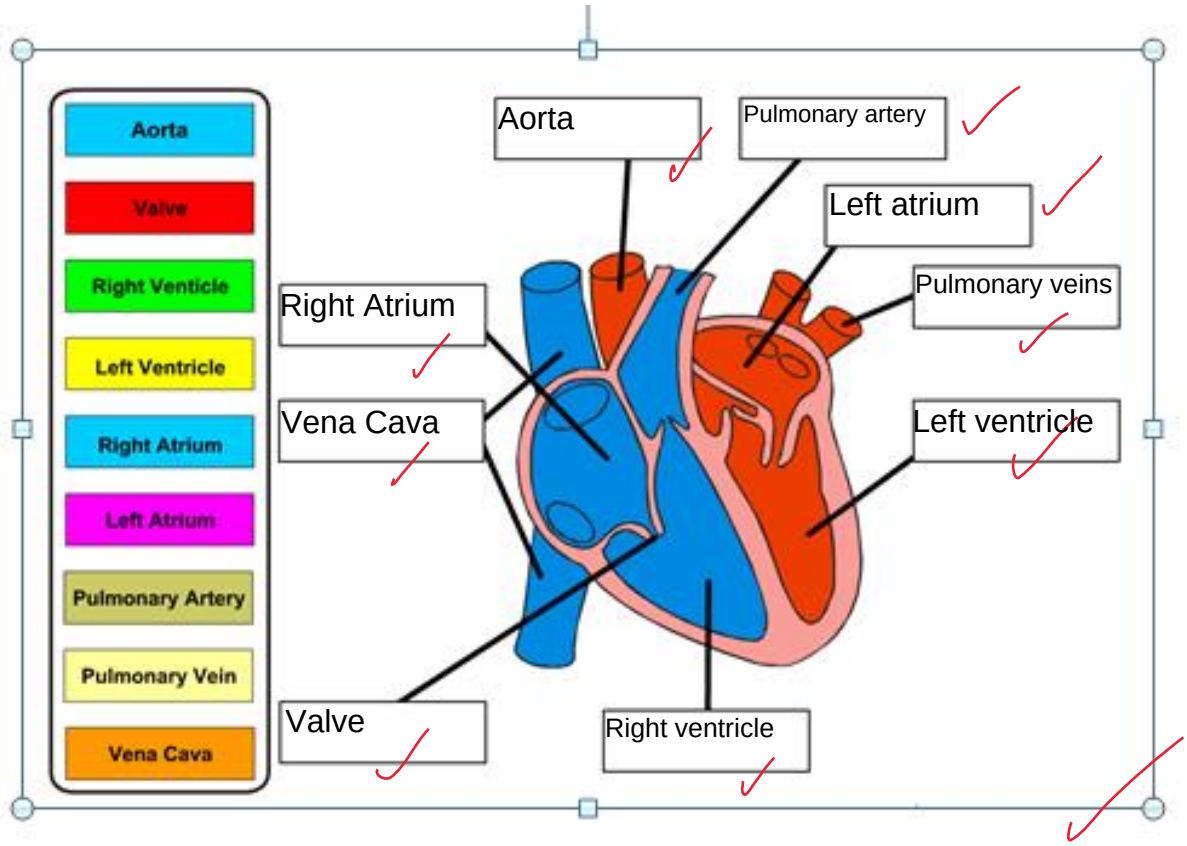
Q2

Describe the main function of the heart.

The main function of th heart is to pump blood round the body. This blood sends oxygen and nutrients to all parts of your body and carries away unwanted carbon dioxide and waste products.

Q3

Complete the diagram by identifying the different chambers and major blood vessels of the heart



Q4

Using all the answers given in the previous question complete the flow table of blood through the heart. You must provide a description of the functions of each of the structures.

Learner Guidance:

- You must describe where it receives blood from and transports it to
- Identify whether it carries oxygenated or deoxygenated blood

Structure	Function
Pulmonary Vein	Major vein that carries oxygenated blood from the lungs to the heart
Left Atrium	Receives oxygenated blood from the veins and pumps in down into the left ventricle.
Left Ventricle	Receives from left atrium and delivers oxygenated blood the aorta
Aorta	Receives from the left ventricle and carries oxygenaterd blood from the heart to the rest of the body.
Working Muscles	Oxygenated blood is delivered to the working muscles
Vena Cava	Receives deoxygenated blood from the head, neck, and upper body including upper limbs, upper part of the spine and chest wall back to the right side of the heart (the right atrium).
Right Atrium	Receives deoxygenated blood from the body through the vena cava and pumps it to the right ventricle
Right Ventricle	Receives deoxygenated blood from the right atrium and pumps it into the pulmonary artery
Pulmonary Artery	Carries deoxygenated blood from the right ventricle to the lungs.

Not directly from lungs

Not just the upper limbs

To which part of the heart?

Q5

Describe the role of the valves in the heart.

The valves prevent a backward flow of blood acting as one way inlets of blood on one side of the ventricle and one way outlets of blood on the other side of the ventricle.

Q6

Describe systemic circulation.

This is the circuit beginning from the left side and transports oxygenated blood to the body. Once the pulmonary circuit is complete, from the lungs the oxygenated blood flows into the left side of the heart, entering the left atrium where blood is sent to the left ventricle and pumped to the arteries.

More information required. See P49 of L2 manual

Q7

Describe pulmonary circulation.

This is the circuit beginning from the right side. The circuit begins when the veins deliver blood from the tissues to the hearts right atrium. This blood contains a high level of carbon dioxide and little oxygen as the veins have been exchanging gases with the blood. When the blood reaches the right ventricle it reaches the arteries leading to the lungs resulting in the oxygen being replenished and carbon dioxide being exhaled.

More information required. See P49 of L2 manual

Q8

Describe two differences between the <u>structure</u> of arteries and veins

Arteries dont have valves whereas veins do have valves

Arteries are made up of smooth muscle whereas veins have smooth muscle but also thin fibrous walls.

Q9

Describe two differences between the function of arteries and veins

Arteries carry oxygenated blood to all parts of the body whereas veins carry deoxygenated blood to the heart.

Veins experience less pressure than arteries and use the forces of gravity to get the blood from other parts of the body to the heart.

Think about which carries blood under high/ low pressure...

Q10

Describe the role of capillaries.

Capillaries exhange gases in the body

Q11

Describe one feature of a capillary that enable them to perform their role.

Their walls are thin to allow substances to easily and quickly diffuse or pass through them.

Q12

Define the following terms.

Blood Pressure	The pressure of the circulating blood against the walls of the blood vessels.
Systolic Pressure	The amount of pressure in your arteries during contraction of the heart
Diastolic Pressure	The amount of blood pressure when the heart muscle is between beats.
Hypotension	This is low blood pressure, when the pressure in the blood vesels is unusually low.
Hypertension	This is high blood pressure when the pressure in the blood is unusually high.

Q13

According to the NHS what range of blood pressure would be classified as normal?

Between 90/60 mmHg and 120/80mmHg

Q14

According to the NHS, at what reading or higher would classify as high blood pressure?

140/90mmHg or higher.

Pass/Refer

Really good try, please work on your corrections

Understand the structure and function of the respiratory system

Q1 Describe where in the body the lungs are located.

The two lungs sit either side of the heart.

Q2

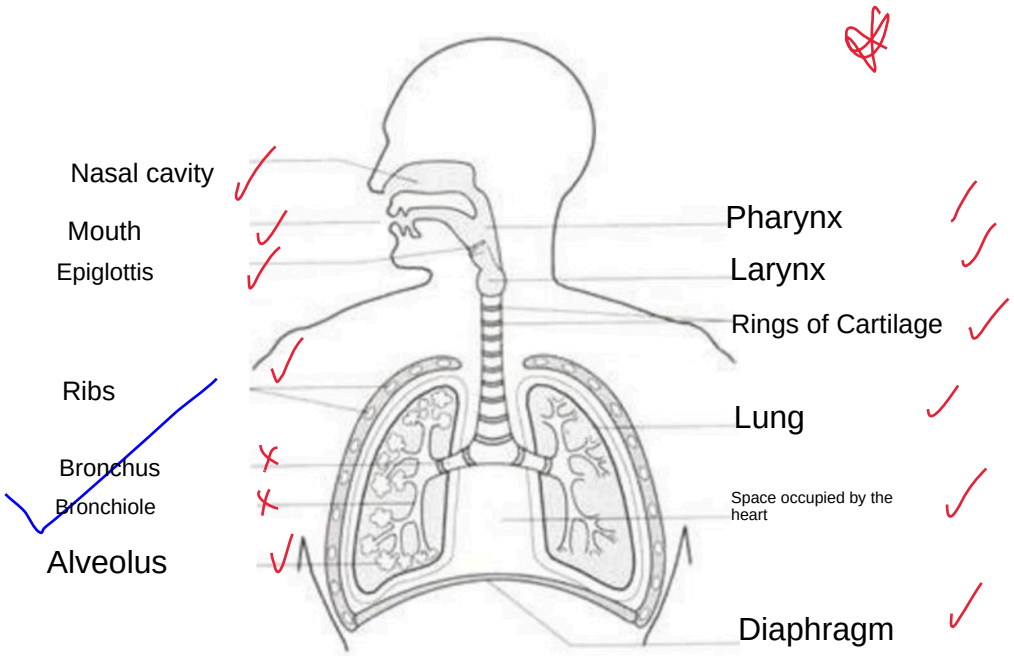
Describe the function of the lungs.

The main function is the process of gas exhange called respiration. The lungs bring in air from the atmosphere and pass oxygen into the bloodstream. It then circulates it to the rest of the body.

Q3

Complete the diagram below by filling in the boxes and identifying the different structures of the respiratory system.

Diaphragm
Lung
Pharynx
Bronchiole
Bronchus
Ribs
Mouth
Alveolus
Nasal Cavity
Rings of Cartilage
Space occupied by the heart
Larynx
Epiglottis



Q4

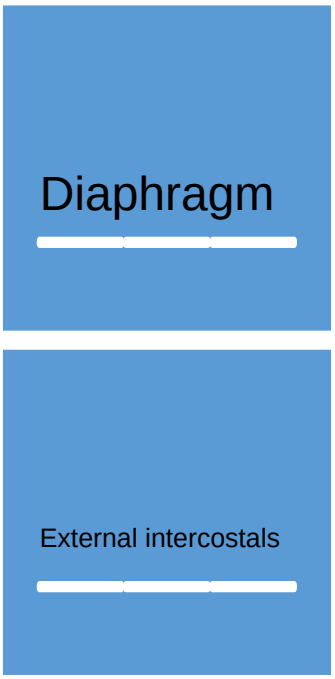
Using some of the answers given in the previous question complete the flow table of air through the respiratory system. You must provide a description of the functions of each of the structures.

Structure	Function
Nasal Cavity	Within the nasal cavity there are little hairs that filter the air that you breathe in, blocking dirt and dust from getting into the lungs.
Pharynx	The pharynx allows inhaled air entering the nasal cavity to make its way to the respiratiory tract
Larynx	The larynx protects the airways from choking on material in the throat, to regualte the flow of air into the lungs and the production of sound,
Epiglottis	This prevents food from entering the windpipe and lungs and directs air to the windpipe.

Bronchus	This passes air into the bronchiole.
Bronchiole	Carries oxygen rich air into the lungs and carry carbon dioxide rich air out of the lungs
Alveolus	They facilitate gaesous exchange of oxygen and carbon dioxide between inhaled air and the bloodstream.
Diaphragm	This is the main muscle used in respiration contracting continually as you breathe in and out.

Q5

Identify two major muscles involved in respiration.



Q6

Where in the lungs does gaseous exchange take place?

Between the alveoli and capillaries

Q7

Describe the movement of oxygen and carbon dioxide in the lungs during gaseous exchange.

Inhaled oxygen moves from the alveoli to the blood in the capillaries and carbon dioxide moves from the blood in the capillaries to the air in the alveoli.

Pass/Refer

Good work, section complete on 1st attempt

Understand the structure and function of the skeleton

Q1

Describe the five functions of the skeleton.

Function	Description
Structure	Provides the body shape and supports the weight of the muscles and organs
Movement	Enables the body to move with the help of muscles attaching to bones
Protection	It protects the vital organs
Storage	of minreals including calcium and phosphate ions
Production	of red and white blood cells

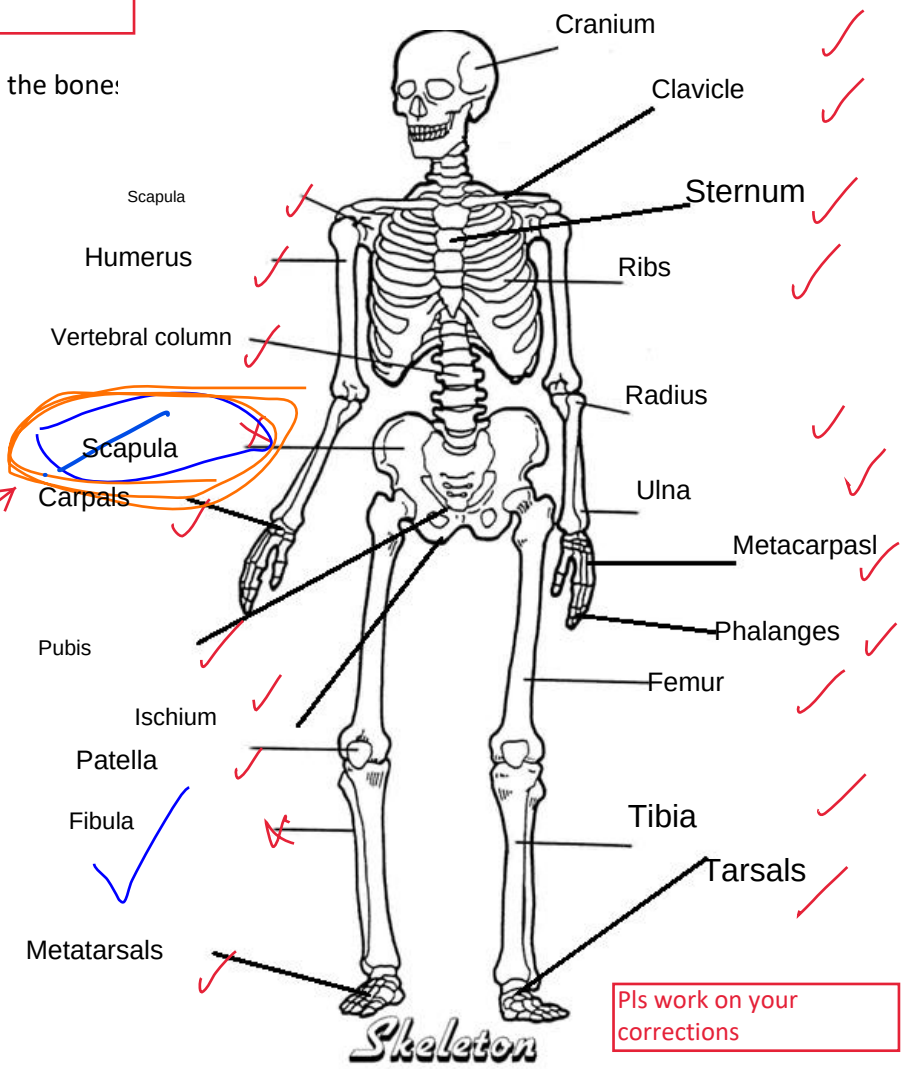
You have already used scapula - Please find the last bone of the pelvis from the list below

Q2 Correctly label the skeleton, use all the bones

- Cranium
- Clavicle
- Ribs
- Sternum
- Humerus
- Radius
- Ulna
- Scapula
- Ilium
- Pubis
- Ischium
- Carpals
- Metacarpals
- Phalanges
- Femur
- Patella
- Tibia
- Fibula
- Tarsals
- Metatarsals
- Vertebral Column

Ilium

Outstanding 23.5.21



Pls work on your corrections

Q3

Identify three bones that are part of the axial skeleton

Cranium

Ribs

Vertebral column

Q4

Identify four bones that are part of the appendicular skeleton

Tibia

Fibia

Carpals

Metatarsals

Q5

There are five different classifications of bone, complete the table below by providing an example and explaining its function.

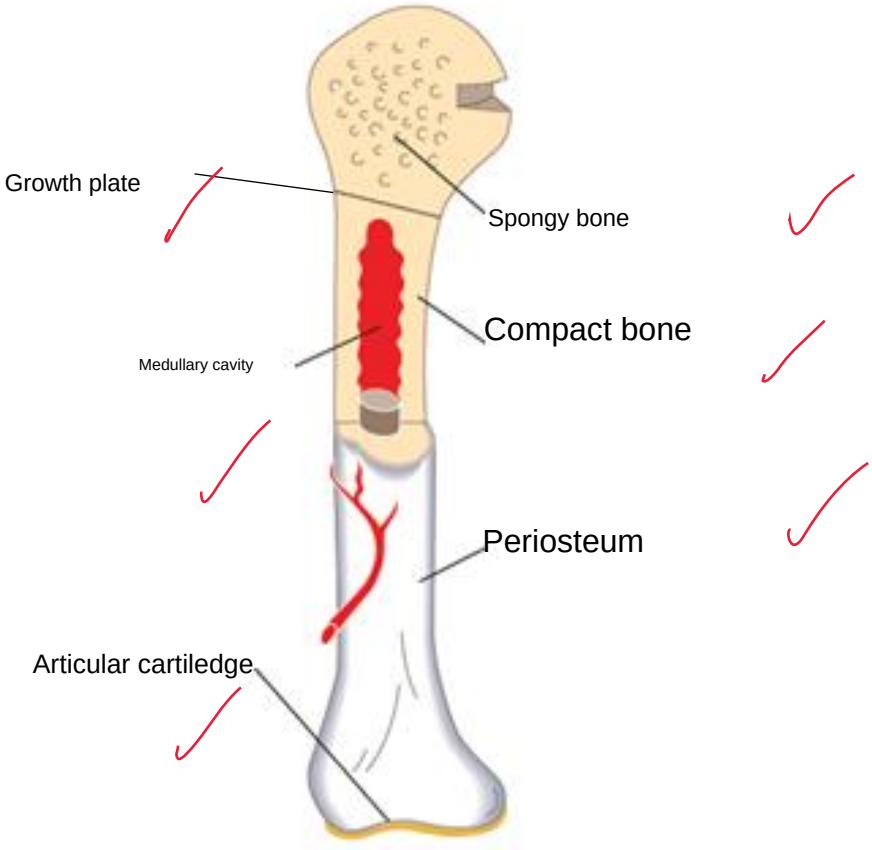
- Learner Guidance: Explain requires more analysis to demonstrate your understanding of the topic, short paragraph.

Type of bone	Example	Function
Long Bone	Femur	Long bones provide structure and mobility and act as levers.
Short bone	Metatarsals	Short bones are almost equal in length and width, alomst cube shaped and provide movement and stability.
Flat bone	Clavicle	Flat bones provide protection for internal organs and also allow muscle attachment.
Irregular bone	Vertebral column	Irregular bones are due to the function they perform in the body such as protecting an organ.
Sesamoid	Patella	Sesamoid bones improve leverage and protect joints from damage.

Q6

Identify the structure of a long bone by labelling the diagram.

Learner guidance: use structures of the long bone found on question 7 on the next page



Q7

For each of the structures of the long bone you have labelled in the previous question, complete the table below to explain their structure in more detail.

Structure	Explanation
Medullary Cavity	This is the hollow tube down the centre of the bone and where red and yellow bone marrow is stored.
Articular Cartilage	This is the connective tissue covering the ends of the bone.
Spongy Bone	This is very porous and less dense and often filed with marrow and blood vessels.
Compact Bone	Compact bone is a denser material used to create much of the hard structure of the skeleton. Compact bone forms a shell around cancellous bone (spongelike appearance with numerous large spaces) and is used in parts of the body that needs more rigidity such as the long bones in the arm.
Periosteum	It covers the outer surface of the bones and contains supply for blood vessels that brings nutrients for bones and removes waste
Growth Plate	This can be found in bodies that are still growing and once the body reaches full maturity the plate is replaces with a epiphyseal line.

More detail required for compact bone

Q8

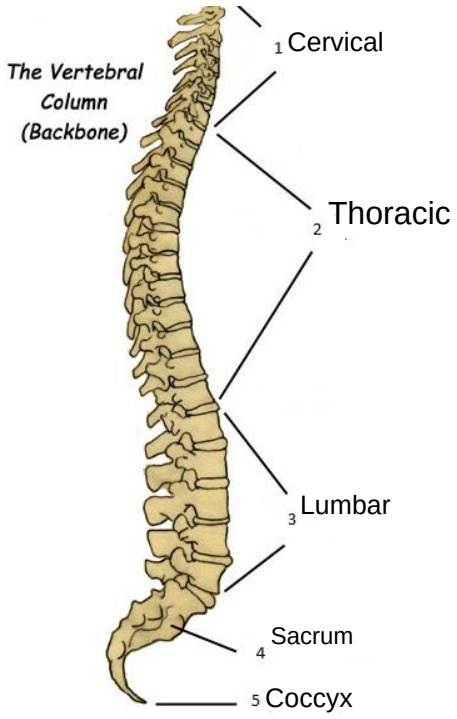
Explain the five stages of ossification (bone growth).

1	Foetus - no bones and instead there is only cartiledge
2	Periosteum - to begin the periosteum (outer covering of the bone) grows around the cartiledge.
3	Osteblasts occur which are cells that help to build bone. The osteblasts start to creat a primary ossification centre.
4	Primary ossification centres then divide creating secondary centres. The structure is then formed into a bone.
5	Osification concluded around the age of 25 years. The growth plate is eventually substituted with solid bone.

Q9

Label the different sections of the spine using all the sections in the box below.

Lumbar
Thoracic
Sacrum
Cervical
Coccyx



Q10

From the different sections labelled in the previous question, describe the potential ranges of motion of each section.

Section	Potential Ranges of Motion
Cervical	Rotation, flexion, extension, lateral flexion
Thoracic	Rotation, flexion, extension, laternal flexion
Lumbar	Flexion and extension
Sacrum	Fixed and does not allow movement
Coccyx	Fixed and does not allow movement

See p28 of L2 manual. MS 1.2.21

Range of movement incorrect for Sacrum and Coccyx... Check P28 of L2 manual

Q11

Describe what is meant by the term 'neutral spine'.

When the pelvis, rib cage and skull are all in alignment with each other.

Not quite... think about all of the curves in the spine.

Q12

Which area of the spine would you expect to see the following natural curves?

Kyphotic

Thoracic spine

Lordotic

Lumbar

Q13

Describe how a Lordotic spine affects the normal shape of the spine.

This is an inward curve of the lumbar region of the spine

Which region of the spine?

Q14

Describe how a Kyphotic spine affects the normal shape of the spine.

Kyphosis is an excessive outward curve of the spine resulting in an abnormal rounding of the upper back

Which region of the spine?

Q15

Describe how Scoliosis of the spine affects the normal shape of the spine.

This is an S shape of the spine so the spine is not straight down the back

Q16

Describe how pregnancy can affect the normal shape of the spine.

Pregnancy can result in an inward curve of the spine (lordosis) due to the extra weight from the baby).

Pass/Refer

Good effort, please work on your corrections

Understand joints in the skeleton

Q1

Complete the table below of the different classification of joints, include the potential movement available at each.

Classification of joint	Location of joint	Potential movement of joint
Synovial joint	Knee and shoulder	Freely moveable
Cartilaginious	Vertebrae	Movement between bones
Fibrous	Teeth and skull	Immoveable and interlocking bones

Q2

Describe the structure of the synovial membrane.

A layer of connective tissue that lines the cavities of joints and tendons. It makes synovial fluid which lubricates joints.

Q3

Describe the structure of the articular cartilage.

The surface of the synovial joints are called the articular cartiledge. It is made up of hyaline cartiledge which reduces friction between the synovial joints and acts as a shock absorber to the joints.

Q4

Describe the six different types of synovial joints and state the range of motion available at each.

Pivot - rotation on the axis

Ball and socket - the greatest range of movement which can be flexion/extension, abduction/aduction and circumduction

Hinge joints are joints between two or more bones where the bones can only move along one axis to flex or extend

Condyloid joints - some movement similar to the ball and socket i.e rotation, pronation and supination

Saddle joints are bones where one the joints is shaped like a saddle with the other bone resting on it. They provide stability and more flexibility than a hinge or gliding joint and allow flexion, extension, abduction and adduction and cicrumduction.

Gliding joint- they move past each other

Need to provide a better description of the joint... see P24 of the L2 manual

Q5

What joint actions are possible at the following joints?

What can we do at the elbow? Look at your answer above for hinge joints

Elbow

Flexion and extension

Elbow doesn't allow rotation... check the section on joints in your L2 manual

Spine Learner guidance: name at least 3 joint actions

Flexion, extension, lateral flexion, lateral extension

Hip Learner guidance: name at least 4 joint actions

Flexion, extension, abduction and aduction

Q6

Describe each of the following joint actions and provide an example of a joint where it can occur.

Extension

The angle of the joint increases and this can happen at the thoracic spine

Abduction

Moving away from the trunk and this can occur at the shoulder joint

Plantar Flexion

Bending the joint downwards and this can happen at the ankle

Pass/Refer

Good attempt, please work on your corrections

passed MS 23.5.21

Understand the muscular system

Q1

Complete the table below.

Different types of muscle tissue	Main characteristics	Main role
Skeletal (striated)	They are indirectly or directly attached to the bone, enable voluntary actions and are striated in shape.	The role can vary but in summary it provides support and movement to parts of the body.
Smooth	These are smooth in shape (not striated) and enable involuntary actions (such as swallowing food).	To move food through the digestive tract to the stomach
Cardiac	These are striated in shape and enable involuntary actions in the heart	To enable the heart to beat and pump blood around the body

Q2

Complete the table below by describing the main structural points of a skeletal muscle.

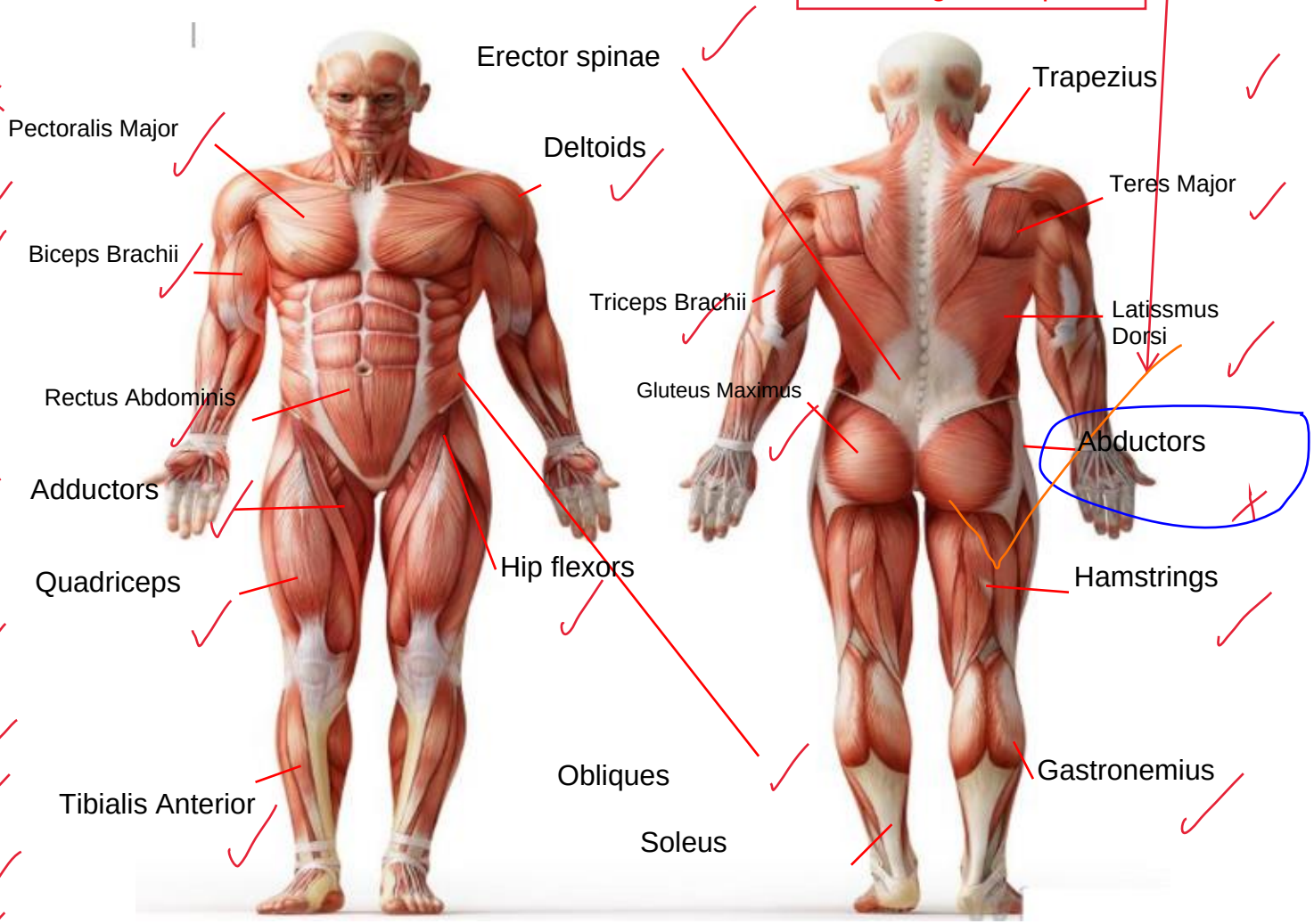
Structure	Description
Muscle Fibre	A muscle is made up of muscle fibres. Muscle fibres are made up of bundles of myofibrils and mitochondria
Fascicle	Contains fibres which contain the blood vessels (bundles of muscle fibres)
Fascia	The fascia is the sheath that covers the fasicle and muscles. It is connective tissue that surrounds and holds every organ, blood vessel, bone, nerve fibre and muscle.
Sarcomere	Each sacromere is made up of two main elements - actin and myosin which are responsible for muscular contractions.
Myofibril	Made up of mifilaments of actin and myosis that slide over each other which enable contraction of muscle.

Q3 Label the skeletal muscles using the muscles from the list below, and identify what joint action each one allows.

Learner guidance: when describing joint actions please identify the limb/body part moving

Muscle to locate	Action it allows
Rectus Abdominis	Flexion of the spine
Pectoralis Major	Adduction, inward rotation, horizontal flexion of the shoulder joint
Deltoids	Abduction, flexion, extension and rotation of the shoulder
Tibialis Anterior	Ankle dorsiflexion
Biceps Brachii	Supinates the forearm and flexes the elbow
Obliques	Rotation and lateral flexion of spine
Soleus	Planterflexion of ankle
Gastrocnemius	Planterflexion of ankle and flexion of knee
Teres Major	Medial rotation, adduction and extension and shoulder joint
Gluteus Maximus	Extend and laterally rotate the hip joint
Triceps Brachii	Extension of elbow and extension of shoulder
Trapezius	Elevation, retraction and depression of shoulder girdle
Erector Spinae	Rotates the thoracic spine and extends the spine
Latissimus Dorsi	Adduction, extension and inward rotation of the arm
Hamstrings	Flex the knee joint and extend the thigh to the back of the body.
Quadriceps	Flexes the thigh at the hip joint and extends at the knee joint
Abductors	Abduct the leg and help rotate the leg at the hip joint
Adductors	They aduct and outwardly rotate the hip
Hip Flexors	Flexes the hip

Pay attention to the body part... use P33 of your L2 manual



You have used obliques twice - please identify the last muscle from list on left. The muscle that abducts leg from hip

Erector Spinae used twice

Q4

Describe the structure of the pelvic floor muscles.

A double layered muscle of deep muscle tissue and connective tissue in a hammock shape.

Q5

Describe two functions of the pelvic floor muscles.

To contract the muscles to stop someone passing urine

To provide stability for the pelvic girdle

Q6

Describe an concentric muscle contraction.

Where the muscles shorten or contract overcoming gravity and load

Q7

Describe an eccentric muscle contraction.

Where the muscle lengthens resisting gravity

Q8

Describe an isometric muscle contraction.

An isometric muscle contraction are those that do not change length when contracted such as holding a glass of water

Q9

Identify the joint action occurring in a barbell bicep curl during the concentric phase.

Elbow flexion

What is the joint action? (flexion, extension, adduction, etc)

Q10

Identify the joint action occurring in a barbell bicep curl during the eccentric phase.

Elbow extension

What is the joint action? (flexion, extension, adduction, etc)

Q11

Complete the table below by identifying three different muscle fibre types and their main characteristics.

Muscle fibre types	Characteristics
Slow twitch (slow oxidiative glycolytic)	Red in colour as it contains red blood vessels
	Large number of mitochondria
	Slow oxidative fibres
Fast twitch (fast glycolytic)	White in colour
	Fast glycotic fibres
	Less mitochondria
Intermediary (fast oxidiative glycolytic)	Pink in colour
	Larger amount of mitochondria than fast twitch
	Fast oxidative fibres

Pass/Refer

Really good effort, please work on your corrections

Understand the life-course of the musculoskeletal system and its implications for special populations exercise

Q1

Describe two physical changes, and their implications for exercise, when training young people (in the 14-16 age range)

Leaner Guidance: Think about what effect training can have on tendons, ligaments, muscles, joint and bone mineral density changes.

Bones are still growing so weight resistance should be minimal
Bones grow faster than muscles so care should be taken when lifting weights as there may be 'clumsiness' and some co-ordination exercises could be included

Q2

Describe two physical changes, and their implications for exercise, when training older people (50 plus age range)

Leaner Guidance: Think about what effect training can have on tendons, ligaments, muscles, joint and bone mineral density changes.

Loss of power and strength so resistance training should be at a comfortable level for the client and a gradual increase in intensity for a program

Loss of co-ordination so co-orindation exercises

Q3

Describe two physical changes, and their implications for exercise, when training antenatal and postnatal women.

Leaner Guidance: Think about what effect training can have on tendons, ligaments, muscles, joint and bone mineral density changes.

More flexible as muscles and tendons are relaxed and therefore care needs to be taken not to over extend when exercising

Muscles are less pliable so could affect balance and co-ordination, therefore could incorporate some balance exercises

Pass/Refer

Good job... section complete on first attempt

Understand energy systems and their relation to exercise

Q1

What does ATP stand for?

Adenosine Triphosphate

Q2

Describe what the role of carbohydrates, fats and protein are in the production of energy.

Fats, proteins and carbohydrates are broken down by the body to produce ATP. All biological processes in the body require energy in the form of ATP. Carbohydrates are stored in muscle and liver cells in the form of glycogen. When energy is needed, glycogen is broken down to glucose which can be used by all tissues in the body.

Fats are stored beneath the skin where the energy is stored. Energy is released from fat by breaking down the triglyceride molecules into fatty acids.

Protein is different to carbohydrates and fats as it is not stored in the body. Excess protein from food is stored as fat under the skin. Proetin can be broken down into amino acids to produce energy which can be used for endurance events,

More information required on each... See P38 of your L2 manual

Q3

Explain the use of the creatine phosphate (CP) or phosphocreatine system during exercise.

Learner Guidance

- Include what nutrients or compound the energy system will use to resynthesis energy
- Explain the types of activity/exercise that the energy system will fuel.

This is used when the muscle needs to generate alot of force quickly but there is a lack of oxygen (anaerobic). It uses chemical energy to produce ATP and does not require carbohydrate, oxygen or fat during the production process. As soon as the ATP supply has been used by a muscle, it can be re-generated by a chemical substance called creatine phosphate. This compound has a high energy bond which when broken down by the enzyme creatine kinase releases enough energy to create an ATP molecule. The chemical reaction only lasts for a short period of time given the limited time the muscles can store creatine phosphate. Once the creatin phosphate is used, it must be replenished which means that other fuel such as glycigen and fat must be used to continue supplying energy for the regeneration of ATP.

Creatine phosphate is used for high intensity activities for short periods of time such as 100m sprints where muscles require high energy for a short amount of time.

More information required, see P40 of your L2 manual... Also give example of exercise/ activity

Q4

Explain the use of the lactic acid system/anaerobic system during exercise.

Learner Guidance

- Include what nutrients or compound the energy system will use to resynthesis energy
- Explain the types of activity/exercise that the energy system will fuel.

This is a waste product produced during exercise. It is a water soluble liquid produced during anaerobic glucose metabolism in muscles. The body converts glucose and at the same time removes lactic acid however if the production of lactic acid exceeds the body's ability to disperse it, there will be an accumulation of lactic acid which results in symptoms such as breathlessness, pain in the limbs and other sensations.

Lactic acid will fuel quick bursts of medium to high intensity exercise or when the other 2 systems cannot provide the energy for example a fast 5km run.

Give example activity/ exercise

Q5

Explain the use of the aerobic system during exercise.

Learner Guidance

- Include what nutrients or compound the energy system will use to resynthesis energy
- Explain the types of activity/exercise that the energy system

The body produces ATP by breaking down carbohydrates and fat within this energy system in the presence of oxygen. When the aerobic system produces ATP in the presence of oxygen using glycogen, it forms other by-products such as carbon dioxide and water rather than lactic acid. It can however be slow to engage this energy system due to the heart having to circulate oxygen rich blood to the muscles in addition to it requiring a complex series of chemical reactions.

This system supports exercise that is 90 seconds and not requiring fast muscle action so as a longer slower paced run which is more of a sustained pace.

Give example activity/ exercise

Pass/Refer

Please work on your corrections

Understand the nervous system and its relation to exercise

Q1

Describe three roles and functions of the nervous system.

Sensory input

Information processing

Motor output

Q2

Describe the principles of muscle contraction.

Learner Guidance – What are the role of nerves in muscle contraction? Think about nerve impulses

Muscle contraction is initiated by the nervous system. It starts when the nervous system generates a signal. The signal which is called an action potential travels through the type of nerve called a motor neuron. The neuromuscular junction is the name of the place where the motor neuron reaches a muscle cell. The chemical message, a neurotransmitter called acetycholine, binds to receptors on the outside of the muscle fiber. That starts a chemical reaction with the muscle.

More information required... See section on the nervous system in your L2 manual

Q3

Describe the 'all or none' law.

Learner Guidance – Think about motor unit recruitment

There are no big or small action potentials in any one nerve cell, all action potentials are the same size. So either the neuron does not reach the threshold or if the stumulus exceeds the threshold potential the nerve or muscle fibre will give a complete response.

Q4

Describe what determines whether or not a contraction takes place within a motor unit.

The number of motor units recruited depends on the force of the resistance of the excercise. With light intensity exercise Type 1 (slow twitch) motor units are recruited. When the load is increased the Type 2 (fast twitch) will be recruited.

Q5

Describe two adaptations that occur in the neuromuscular system with regular exercise that improves motor fitness.

Strengthening and growing new connections

Improved recruitment of motor units resulting in stronger muscle contractions

Pass/Refer

Only one question in this section requiring your attention.

Assessor Feedback

1.2.21 2nd Attempt (M SUGAI)

Really good second attempt here Tanya.

You knocked off a lot of the previous questions and I can see your understanding developing.

Please let me know if you need further assistance from my comments on your last handful of corrections.

Corrections require are:

• P11 Q2 - please identify one last bone
• P16 Q10 - Range of movement incorrect for Sacrum and Coccyx... Check P28 of L2 manual
• P19 Q5 - Elbow doesn't allow abduction/adduction see comment
• P23 Q3 1 last muscle (obliques used twice)
• P25 Q9 & 10 - What is the joint action? (you have named two) See my comment above and on p19

MS
1.2.21

Assessor Feedback

Hi Tanya,

Good job with your corrections, all of them have been made apart from 1 which was not attempted.

Please make your final correction, which is t \p identify the final bone in the skeleton diagram on p11.

Keep up the good work!

Matt
23.5.21