Body in Motion

Focus Question 1:
How do the Musculoskeletal and cardiorespiratory systems of the body influence and respond to movement

The Major Bones
Bones have five main functions including:
• Support for the body, giving it shape, form and posture
• Protection of vital organs and soft tissue
• Assistance in body movement: Provide the attachment for muscles and serve as levers
• Manufacture of blood cells in the marrow cavities
• Provision of a storehouse for essential minerals such as calcium and phosphorus

Types of Bones
Long Bones: Function as levers, Eg Tiba, Femur, Humorous, Phalanges
Short Bones: Transfer forces eg: Tarsals, cartels and Patella.
Irregular Bones: Bones that are irregular in shape Eg Mandible, vertebra.
Flat bones: Provide protection for organs eg: Skull & sternum.

Types of Joints
There are 3 different types of Joints
Fibrous Joints Occurs where bone ends are joining by strong short band of fibrous tissue. No movement is possible eg: Cranium.

Cartilaginous Joints
The bone ends are separated by a disc or plate made up of tough fibrous cartilage. Allows minimal movement. eg: the Vertebra.
Synovial Joints (Know in detail)
Used in exercise and are freely movable, eg Hip, Knee and Elbow. A synovial joint is one that is freely movable and thus allows maximum movement. It consists of ligaments, tendons and synovial fluid.

<table>
<thead>
<tr>
<th>Ball and socket</th>
<th>Flexion and extension</th>
<th>Abduction and adduction</th>
<th>Circumduction</th>
<th>Shoulder</th>
<th>Hips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinge</td>
<td>Flexion and extension</td>
<td>Elbow</td>
<td>Knee</td>
<td>Fingers</td>
<td></td>
</tr>
<tr>
<td>Pivot</td>
<td>Rotation</td>
<td>Neck</td>
<td>Forearm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sliding</td>
<td>Slight sliding movements</td>
<td>Vertebreate</td>
<td>Bones of the wrist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saddle</td>
<td>Flexion and extension</td>
<td>Abduction and adduction</td>
<td>Circumduction</td>
<td>Thumb</td>
<td></td>
</tr>
</tbody>
</table>
**Muscles**

Muscles can produce movement to walk, run, jump, breathe, digest and excrete. Provide stabilisation of posture and internal organs. Generate heat to maintain body temperature. Over 600 muscles in the body.

**Types of Muscle tissue**

<table>
<thead>
<tr>
<th>Skeletal</th>
<th>Moves the skeleton, Stripped appearance. Contraction is under our control Voluntary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>Forms the majority of the heart Involuntary</td>
</tr>
<tr>
<td>Smooth</td>
<td>Located on the walls of our internal structures eg stomach and blood Vessels. Involuntary</td>
</tr>
</tbody>
</table>

**Muscle Movement**

Agonist: Primarily involved in movement eg: in flexion of the leg at the knee joint is the Hamstrings

Antagonist: The opposite muscles that relaxes during movement eg: in flexion of the leg at the knee joint is the Quadriceps

Stabiliser: To stabilise a bone or body segment so that the agonist can work more efficiently. *Look under Joint actions for flexion and extension.

**Muscle Contractions**

Concentric: produces enough tension to overcome gravity, muscles shorten. eg Bicep Curl

Eccentric: Produces enough tension by lengthening and allowing the pull of gravity of the resistance to overcome it in a slow manner. eg weight lifting

Isometric: produces enough force but there is no change in the length of fibres eg Planking.
FOCUS QUESTION 2:

What is the relationship between physical fitness, training and movement efficiency?

**Health related components of fitness**

aspects of fitness that enable us to maintain our health, perform daily tasks, perform well in sporting activities and help protect us from sickness.

<table>
<thead>
<tr>
<th>Component</th>
<th>Definition</th>
<th>Sporting example</th>
<th>Suitable test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiorespiratory Endurance</td>
<td>The ability of the working muscles to take up and use oxygen</td>
<td>Soccer, Netball</td>
<td>Beep test</td>
</tr>
<tr>
<td>Muscular Strength</td>
<td>The ability to exert force against a resistance</td>
<td>Weight Lifting</td>
<td>hand grip dynamometer test</td>
</tr>
<tr>
<td>Muscular Endurance</td>
<td>The ability of the muscles to endure physical work for extended periods of time</td>
<td>Rowing, NRL, AFL</td>
<td>Sit-up test, push-up test, pull-up test</td>
</tr>
<tr>
<td>Flexibility</td>
<td>The range of motion about a joint</td>
<td>Gymnastics, Dance</td>
<td>sit and reach test</td>
</tr>
<tr>
<td>Body Composition</td>
<td>The percentage of fat as opposed to lean body mass in a human being</td>
<td></td>
<td>BMI</td>
</tr>
</tbody>
</table>

**Skill related components of fitness**

related to the performance aspect of an activity. Allows us to perform in physical activities with greater skills.

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<th>Component</th>
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<th>Suitable test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>The ability to combine strength and speed in an explosive action</td>
<td>Shot Put</td>
<td>Standing long jump</td>
</tr>
<tr>
<td>Speed</td>
<td>The ability to perform body movements quickly</td>
<td>100m sprint</td>
<td>sprints over 20-60m</td>
</tr>
<tr>
<td>Agility</td>
<td>The ability to move the body from one position and direction to another with speed and precision</td>
<td>Tennis</td>
<td>Burpee test, shuttle run</td>
</tr>
<tr>
<td>Coordination</td>
<td>The ability to harmonise the messages from the senses with parts of the body to produce movements that are smooth, skilful and well controlled</td>
<td>Cricket, Rhythmic Gymnastics</td>
<td>alternate ball toss</td>
</tr>
<tr>
<td>Balance</td>
<td>The ability to maintain equilibrium while either stationary or moving</td>
<td>Beam, Gymnastics</td>
<td>one-foot balances</td>
</tr>
<tr>
<td>Reaction Time</td>
<td>The time taken to respond to a stimulus</td>
<td>Ping Pong, Boxing</td>
<td>Ruler Reaction test</td>
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</tbody>
</table>

CLAIRE STAFFORD
**FITT Principle**

**Frequency**
- Must train at least 3 occasions a week, but can increase to 5
- Aim to stress the body systems and cause an adaptation
- Resistance training: 3 sessions are sufficient while 4 is maximal to allow rest days in between for muscle fibre to regenerate

**Intensity**
- Amount of effort required to gain a fitness benefit
- Measuring intensity (aerobic activity): Use target heart rate zone as a guide
- Target HR zone: Area surrounding target HR; use percentages of MHR
- MHR = 220bpm subtract your age
- Poor fitness: Work at 50-70% of MHR
- Good fitness: Work at 70-85% of MHR
- Resistance training: Intensity is established by varying load, repetition, sets or the rest period

**Time**
- Good health: Last 20 to 30 minutes
- Can increase to 40 minutes
- 60 minutes+ can lead to overtraining and possible development of overuse injuries
- None of these times include warming up and cooling down
- Duration: 6 weeks is the minimal period for realisation of a training effect

**Type**
- Best type is continuous exercise that use large muscle groups
  - Eg. Running, cycling, swimming and aerobics
- These activities draw heavily on our oxygen supply
- Hence increases breathing rate, heart rate and blood flow to the working muscles
- Aerobic fitness improves as cardiorespiratory system adapts
- Resistance training: Low resistance with high repetitions is preferable
- Can be provided using many activities such as circuit training and resistance bands

### Aerobic and Anaerobic Training

<table>
<thead>
<tr>
<th>Oxygen needed</th>
<th>Aerobic</th>
<th>Anaerobic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Long distance</td>
<td>Short burst</td>
</tr>
<tr>
<td>Training Intensity</td>
<td>Low to moderate</td>
<td>High Intensity</td>
</tr>
<tr>
<td>Type of activity</td>
<td>Continuous exercise that utilises large muscle groups</td>
<td>Large Number of repetitions with low weights</td>
</tr>
<tr>
<td>Target fitness components</td>
<td>Cardiorespiratory Endurance, Muscular Endurance</td>
<td>Muscular Strength, Power, Agility</td>
</tr>
<tr>
<td>Example</td>
<td>Marathons in running, cycling, swimming, triathlons</td>
<td>Lifting dumbbells, resistance bands, circuit training, sprints</td>
</tr>
</tbody>
</table>
Focus Question 3:
How do Biomechanical principles influence movement?

Types of Motion

Motion: Movement of a body from one position to another

Linear motion: When the body and all parts connected to it travel the same distance in the same direction and at the same speed
- Eg. Skiing, swimming and sprint events

Velocity: Displacement/Time

Displacement: Movement of a body from one location to another in a particular direction

Speed: Distance/Time

Acceleration: Rate at which velocity changes in a given amount of time
- Positive acceleration: Increase in velocity
- Negative acceleration: Decrease in velocity

Momentum: Quantity of motion that a body possesses

Momentum = Mass x Velocity

Linear Momentum: When moving bodies travel in a straight line

Angular Momentum: When moving bodies generate momentum that does not travel straight

Conservation of Momentum: Moment is always conserved in a close system. Contraction and rebounds release heat and sound energy. Also pushes the ball forward.

The Principles of Motion

The centre of gravity

The point at which all the weight is evenly distributed and about which the object is balanced.

In the human body, position of centre of gravity depends on how body parts are arranged.

- Varying the centre of gravity in the execution of a skill can enhance performance.
- High jumping a Fosbury flop technique centre of gravity does need to clear the bar as it’s outside of the body.
- Scissor method a Jumper must propel their entire body over the bar as the centre of gravity must clear the bar.

Line of Gravity

Imaginary vertical line passing through the centre of gravity; extends to the ground.

- Indicates the direction that gravity is acting on the body.
- Most stable: Line of gravity falls through the centre of the base of support.

Base of Support

Imaginary base that surrounds the outside edge of the body when it’s in contact with a surface.

- Narrow base: Small force is needed to make the person lose their balance.
- Wide base: Essential for stability.
- Closer the centre of gravity is to the base of support, the more stable the body is.
- Together, they provide stability and explosive power to change directions quickly.

CLAIRE STAFFORD
Force
- The push or Pull acting on a body. It has the potential to cause, divert or slow the movement of an object upon which it acts.
- Internal forces: Muscles contracting exert force on bones cartilage and lira meets around a joint
- External forces: gravity, fiction
- Measured in Newtons.
- All forces have a magnitude, direction, point of application and line of action.

Newton’s Laws of Motion
An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force
- No force equal no movement

the acceleration of an object is dependent upon two variables - the net force acting upon the object and the mass of the object.

\[ F = ma \]

- The Body will experience a change in its motion in proportion to the force applied to it and the direction of the force.
- Eg Kicking a soccer ball
- As the mass of the body increases a greater force is required to produce the same acceleration
- Eg the greater the force when hitting a hockey ball will increase the acceleration of the ball blowing it to travel further

For every action, there is an equal and opposite reaction.
- Forces act in pairs
- Friction

Absorbing Force
- Forces that are exerted on the body are absorbed through the joints which bend in response to the impact.
- Force distributed over a large area has less impact than that applied to a smaller area
- Changing the impact from direct to oblique will lessen the force
- Joints bend or flex in response to the impact generated by the force

Applying Force
- Greater the force applied, the greater the speed and acceleration of that object
- Objects of greater mass require more force to move them than objects of smaller mass
- Centripetal force: Directed towards the centre of a rotating body
- Centrifugal force: Directed away from the centre of a rotating body