Preliminary Core 2: *Body in Motion*

**Focus Questions:**
1. **How do the musculoskeletal and cardiorespiratory systems of the body influence and respond to movement?**
   - P7 explains how the body systems influence the way the body moves
   - P16 uses a range of sources to draw conclusions about health and physical activity

2. **What is the relationship between physical fitness, training and movement efficiency?**
   - P8 describes the components of physical fitness and explains how they are monitored
   - P10 plans for participation in physical activity to satisfy a range of individual needs
   - P11 assesses and monitors physical fitness levels and physical activity patterns

3. **How do the biomechanical principles influence movement?**
   - P9 describes biomechanical factors that influence the efficiency of the body in motion
   - P17 analyses factors influencing movement and patterns of participation

**Suggested Assessments:**
- Informal assessment – observation of students’ participation in activities
- Informal questions - Initiate discussion with students to assess current knowledge of topic
- Students record results on data sheet and devise a training program to improve in chosen area.
- New (or predicted) results are recorded at a later date to compare and contrast
- Formal assessment – Exam with questions regarding components

**Evaluation Ideas:**
- Revision at the end of the lesson, ask questions to students and get them to explain what they have learnt in class. This will allow teachers to gain an insight into level of understanding and new things learnt.
- Self reflection by teacher to analyse if lesson objectives were met as well as syllabus outcomes. Draw attention to things that worked well and were effective as well as how to improve upon aspects that did not go as well as planned.
How do the musculoskeletal and cardiorespiratory systems of the body influence and respond to movement?

**Key terms / Concepts**

*Skeletal System*- Long bones, short bones, flat bones, synovial joints, Extension, Flexion, agonist, antagonist,

*Muscular System* – contraction – eccentric, isometric, isotonic, concentric

*Respiratory System* – inspiration, expiration, diaphragm, lungs, trachea

*Circulatory System*– blood, plasma, systemic circulation, sphygmomanometer, systole, diastole

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

**Key terms / Concepts**

*Health related*: Cardio respiratory endurance, Muscular strength, Muscular endurance, Flexibility, Body composition

*Skill related*: Power, Speed, Agility, Coordination, Balance, Reaction Time

*FITT principle* – frequency, intensity, time, type, aerobic and anaerobic

*Physiological responses*– Heart rate, ventilation rate, stroke volume, cardiac output, lactate levels

How do the biomechanical principles influence movement?

**Key terms / Concepts**

*Motion* – linear motion, velocity, speed

*Fluid Mechanics* – buoyant force

*Balance and Stability*– gravity, line of gravity, base of support

*Force* – push, pull, Newton’s 1st law

**Resources / References**


Long Bones- Are longer than they are wide, consists of a shaft and 2 definite ends. Eg: Femur, Tibia, Fibula

Short Bones- Appear “cube-like”, with length, width and height all approximately the same. Easier to break in comparison to long bones due to lack of support and structure. Eg: Carpal, Tarsal Bones and Patella.

Flat Bones- Appear as broad, flat plates with a primary role of protection or covering muscles and ligaments. Eg: Cranium, Ilium, Sternum

Synovial Joints- Consists of A) Synovial Cavity- Space between the bones filled with fluid, B) Articular Capsule- Secretes Synovial Fluid which "lubricates" the joint. Consists of nerves C)Articular Cartilage- Lines the ends of the bones, absorbs shock and reduces friction during movement.

Extension- Involves the movement of a Joint which results in an increased angle between two bones or the joint and body surface. Eg: Kicking a football

Flexion- Involves the movement of a joint which results in a decreased angle between two bones or the joint and body surface. Eg: Scratching your head!

Most skeletal muscles work in groups these are known as:

Agonists - muscles primarily responsible for an action due to their contraction.
Antagonists - muscles that relax to smooth the action of the agonists.

In concentric contraction, the force generated is sufficient to overcome the resistance, and the muscle shortens as it contracts. This is what most people think of as a muscle contraction.

In eccentric contraction, the force generated is insufficient to overcome the external load on the muscle and the muscle fibers lengthen as they contract. An eccentric contraction is used as a means of decelerating a body part or object, or lowering a load gently rather than letting it drop.

In isometric contraction, the muscle remains the same length. An example would be holding an object up without moving it; the muscular force precisely matches the load, and no movement results.

In isotonic contraction, the tension in the muscle remains constant despite a change in muscle length. This can occur only when a muscle's maximal force of contraction exceeds the total load on the muscle.
Students learn about:

**The components of the blood:**
Blood - a fluid that circulates throughout the body, via the arteries and veins, providing a vehicle by which an immense variety of different substances are transported between the various organs and tissues. It is composed of **blood cells**, which are suspended in a liquid medium, the **plasma**.

**The anatomy and function of the heart:**
Heart - muscular **organ** that pumps **blood** through the body. In humans, the heart **muscle** is located behind the **sternum**. Divided longitudinally by a muscular wall, the right side contains only deoxygenated blood, the left side only oxygenated blood. The pulmonary **artery** carries deoxygenated blood from the heart to the lungs. Each side divides into two chambers, an atrium and a ventricle. The average heart beat rate for an adult at rest is 70–80 beats per minute.

Atrium - either of the two upper chambers of the heart. The left atrium receives arterial blood from the lungs via the pulmonary artery; the right atrium receives venous blood from the venae cavae.

Pulmonary circulation - a system of blood vessels effecting transport of blood between the heart and lungs. Deoxygenated blood leaves the right ventricle by the pulmonary artery and is carried to the alveolar capillaries of the lungs. Gaseous exchange occurs, with carbon dioxide leaving the circulation and oxygen entering. The oxygenated blood then passes into small veins leading to the pulmonary veins, which leave the lungs and return blood to the left atrium of the heart. The oxygenated blood can then be pumped around the body via the **systemic circulation**.

Systemic circulation - the system of blood vessels that supplies all parts of the body except the lungs. It consists of the aorta and all its branches, carrying oxygenated blood to the tissues, and all the veins draining deoxygenated blood into the vena cava.

Blood pressure - the pressure of blood against the walls of the main arteries. Pressure is highest during **systole**, when the ventricles are contracting (systolic pressure), and lowest during **diastole**, when the ventricles are relaxing and refilling (diastolic pressure). Blood pressure is measured – in millimetres of mercury (mmHg) – by means of a **sphygmomanometer** at the brachial artery of the arm, where the pressure is most similar to that of blood leaving the heart. The normal range varies with age, but a young adult would be expected to have a systolic pressure of around 120 mmHg and a diastolic pressure of 80 mmHg at rest. These are recorded as 120/80 mmHg.

**Inspiration**: the drawing of air into the lungs (breathing in) by elevating the chest walls and flattening the diaphragm.

**Expiration**: forcing of air from the lungs (breathing out) through the nose or mouth.

**Diaphragm**: The involuntary muscle in the chest cavity that expands and contracts to control breathing.

**Lungs**: The most vital organs in the respiratory system. Located in the chest cavity, the lungs remove carbon-dioxide and provide oxygen to the blood.

**Trachea**: The windpipe, where air breathed in is transported from the mouth and nose to the lungs.
The focus question (FQ) explores the concept of categorising physical fitness into health-related and skill-related components. The FQ examines aerobic and anaerobic training methods that utilise the FITT principle to improve fitness. The FQ analyses the immediate responses to physical activity such as heart rate, ventilation rate and lactate levels which are ultimately indicators of the body’s ability to perform movement efficiently.

The links within Core 2: Body in Motion are demonstrated by the diagram on the left. There is a relationship between anatomy (FQ1), physiology (FQ1 and 2), fitness (FQ2), biomechanics (FQ3) and efficient human movement (FQ1, 2 and 3).

The diagram on the right demonstrates the links with Option 2: Composition and Performance (factors influencing movement) and Option 3: Fitness choices (propose action that can improve and individual’s fitness)
**Health-related Fitness Components:**

- **Cardio respiratory endurance:** refers to the ability of the working muscles to take up and use the oxygen that has been breathed in during exercise and transferred to muscle cells. **Muscular strength:** is the ability to exert force against a resistance in a single maximal effort.
- **Muscular endurance:** is the ability of the muscles to endure physical work for extended periods of time without under fatigue.
- **Flexibility:** is the range of motion about a joint or the ease of joint movement.
- **Body composition:** refers to the percentage of fat as opposed to lean body mass in a human being.

**Skill-Related Fitness Components:**

- **Muscular Power:** is the ability to combine strength and speed in an explosive action.

**Speed:** is the ability to perform body movements quickly.

**Agility:** is the ability to move the body from one position and direction to another with speed and precision.

**Coordination:** is the ability to harmonise the messages from the senses (such as sight, feel and sound) with parts of the body to produce movements that are smooth, skilful and well controlled.

**Balance:** is the ability to maintain equilibrium while either stationary or moving.

**Reaction Time:** is the time taken to respond to stimulus.

**FITT principle:** is an acronym for frequency, intensity, time and type. It embodies a fitness principle that ensures a program has the quantity and quality of movement necessary to produce the desired physical improvement.

- **Heart rate:** is the number of times the heart beats per minute (bpm).
- **Ventilation rate:** refers to our breath and rate of breathing and is expressed in breathes per minute.
- **Stroke volume:** is the amount of blood ejected by the left ventricle of the heart during a contraction. It is measured in mL/beat.
- **Cardiac output:** is the amount of blood pumped by the heart per minute.
- **Lactate levels:** is a chemical formed during the breakdown of carbohydrates in the absence of sufficient oxygen.

**Health related Circuit**

- Cardio respiratory Endurance - Skipping
- Muscular Strength - 7 stage abdominal test
- Muscular Endurance - Push up test
- Flexibility - ROM tests

**Skill related Circuit**

- Power - Squat jump for distance
- Agility, Agility ladder
- Coordination & Balance - plank in 3 stages
- Reaction time - ruler drop
Intro:
This focus question focuses on how the body moves. This is often known as biomechanical principles. It is important for us to understand how biomechanical principles work for us to improve our performance. What is motion? Any form of movement is considered movement, whether it be moving our pinkie or swimming a lap.

Linear Motion:
Ask if anyone knows what linear motion is??
ANSWER: (Click answer up on ppt). When a body and all parts connected to it travel the same distance in the same direction, at the same speed.

Is running a 100 metre sprint a form of linear motion? ANSWER: Yes.

Velocity:
Velocity is a measurement which is used for calculations where the object or person is not travelling in a straight line. Velocity is measured as displacement / time.

What would be an example of a sport where velocity is measured? ANSWER: Cross Country.

Speed:
Speed is equal to the distance covered divided by the time taken to cover the distance. Speed = distance / time.

An object immersed in water experiences an upward forces as the water tries to stop it sinking, buoyant force. Flotation refers to a persons ability to use the buoyant force. The amount of buoyant force placed is dependant on the objects density. Density is a relationship between an objects mass and its volume. An object will float or sink depending on its density. When looking at a human being; muscle has greater density than fat. So generally speaking a person with greater fat free mass has a better ability to float.

One way we can use a buoyant force is by knowing where our own centre of buoyancy is. Every object has an absolute centre position, and this is where gravity acts, centre of gravity. Similarly, when in the water people have a central place where buoyant force acts upon them. It is slightly higher than the centre of gravity and anything above and below this point there is an even spread of displaced water.

3 types of resistance;
- Skin resistance – the friction that occurs between the skin of the body and the water.
- Frontal Resistance – The interruption in the smooth flow of water due to an object passing through it. It is essentially the water pushing against the front of the student.
- Eddy Turbulence – As an irregular body passes through water it creates a disturbance in the flow. This disturbed water tumbles behind the body creating eddies of swirling water. Have you ever heard of the technique drafting in road cycle races? Eddy Turbulence kind of has that effect, it pulls objects closer to it.

All these types of resistance are affected by 3 main areas
- The shape of the body – a greater the surface area moving through the water the greater the resistance and turbulence created. This is why streamlining is so important when swimming, it decreases the surface area.
- The smoothness of the body surface - referring to the texture. A rough surface creates more friction. This is why elite swimmers shave their bodies.
- Swimming technique – Completing the correct catch and pull technique gets swimmers to propel faster in the water. The catch is the most important part of a swimming stroke, because it determines the propulsive force generated by the whole stroke.
Balance is the even distribution of weight enabling someone to remain upright and steady.

Stability refers to the state of being stable. Where the body is able to keep itself still in a certain position and resist change of movement.

There are 3 factors that affect a person's balance and stability. These include center of gravity, line of gravity and base of support.

- The center of gravity refers to the point of the body where all weight is concentrated. It is the body's center of mass where the gravity force is equal.
- Body build, age and gender affect the location of where someone's center of gravity will be.

PUSH or pull that arises from an external or internal source to change the state of motion to the object to which the force is being applied.

The body applies force through muscular contraction (intrinsic force).

Extrinsic forces are Gravity, friction, another object contacting. For example I am pulling the table along the ground - what other forces are also acting on the table.

Newton's 1st law - "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 external force" Inertia's natural tendency is to resist change. Your book is resting on a sheet of paper on the table. You go away for several hours and when you return your book is still resting on a sheet of paper on the table. Why - Newton's 1st law.

Have you ever faced off to wrestle another person? You grab each other's hands and push as hard as you can and for just an instant you are locked in a motionless struggle. You are pushing against your opponent. Your opponent is pushing against you with an equal force.

Summation of force – the cumulative effect of a number of muscle groups being involved in a movement increases the force generated, large muscle groups to smaller muscle groups.

Increasing the time over which force is absorbed can reduce the impact of absorbing force.

Long levers that can be moved quickly to generate a great deal of force for example hitting a ball with arms straight, will generate more force than hitting with arms bent.

Yoga
The students will follow a yoga instructor by watching the YouTube clip. It is just a short 5min clip about the introductory to yoga. The students will be able to experience how different positions of the body and limbs affect somebody's balance and stability. Throughout the clip ask the students where the center of gravity would be in certain positions.
**Activities:**

**Health related Circuit**  Cardio respiratory Endurance - Skipping  
Muscular Strength - 7 stage abdominal test,  
Muscular Endurance - Push up test,  
Flexibilty - ROM tests

**Skill related Circuit**  Power - Squat jump for distance  
Agility, Agility ladder  
Coordination & Balance - plank in 3 stages,  
Reaction time - ruler drop

**Motion Activity:**

DEMONSTRATION: (6 cones)  
One volunteer.

There will be a 5metre (?) straight track set out using cones. The volunteer will need to run this track and will be timed. Their time will be recorded.  
There will be a 5metre (?) track set out with cones, however this track will not be straight, but the displacement will still be 5 metres. Their time will be recorded.  
As a group we will then calculate the speed of runner 1 and the velocity of runner 2.

**Yoga demonstration**

The students will follow a yoga instructor by watching the you tube clip. It is just a short 5min clip about the introductory to yoga. The students will be able to experience how different positions of the body and limbs affect somebodies balance and stability. Throughout the clip ask the students where the centre of gravity would be in certain positions.