

## FOOTBALL FOR THOUGHT (LEVEL 3)


<b>Description</b>	In this project, learners use examples of football to practice math skills and learn about physical education and nutrition.
<b>Leading Question</b>	What do I need to learn in order to form my dream football team?
<b>Total Time Required</b>	~5 hours over 3 days
<b>Supplies Required</b>	Paper and pencils
<b>Subjects</b>	Science, Mathematics, Physical Exercise
<b>Learning Outcomes</b>	Learners will be able to: <ul style="list-style-type: none"> <li>• Understand heart rate and how to measure it</li> <li>• Identify the differences between aerobic and anaerobic respiration</li> <li>• Describe the main characteristics of a football team</li> <li>• Explain a balanced diet recommended for football players</li> <li>• Use combinatorics to calculate possible formations in a football team.</li> </ul>
<b>Previous Learning</b>	None
<b>Supervision</b>	Low supervision (Learner is required to read text)

### DAY 1

Today you will learn about your heart rate and how your body converts food into energy.

<b>Suggested Duration</b>	<b>Activity and Description</b>
<b>15 minutes</b>	<ul style="list-style-type: none"> <li>• First let's learn about Heart Rate (HR) since an athlete needs to pay attention to it to keep his/her heart healthy and efficient.</li> <li>• The Heart rate is the number of times the heart beats in one minute. Can you feel your heart beating right now?</li> <li>• HR when we are resting is different from HR when we are moving or exercising. Can you think of reasons or examples to support this claim? (i.e When we run for example, HR increases to supply the muscles with the necessary energy and oxygen.)</li> </ul> <p>Here is a list of key terms to know. You can refer to appendix 1 as well:</p> <ol style="list-style-type: none"> <li>Maximum Heart Rate (MHR)</li> <li>Target Heart Rate Zone (THRZ)</li> <li>Resting Heart Rate (RHR)</li> <li>Heart Recovery Time</li> </ol>

<p><b>10 minutes</b></p>	<p><b>Numeracy Extension</b></p> <p>Complete the Age-based Maximum Heart Rate (MHR) and Target Heart Rate Zone (THRZ)</p> <p>Use the equations below:</p> <p>Maximum Heart Rate (MHR) = 220 – Age</p> <p>Target Heart Rate Zone (THRZ) = 50% to 85% of the Maximum Heart Rate (MHR)</p> <table border="1" data-bbox="467 724 1409 1060"> <thead> <tr> <th>Age (years)</th> <th>Maximum Heart Rate (Beats per minute)</th> <th>Target Heart Rate Zone (Beats per minute)</th> </tr> </thead> <tbody> <tr> <td>10</td> <td></td> <td></td> </tr> <tr> <td>15</td> <td></td> <td></td> </tr> <tr> <td>20</td> <td></td> <td></td> </tr> <tr> <td>25</td> <td></td> <td></td> </tr> <tr> <td>30</td> <td>190</td> <td>(95-162)</td> </tr> <tr> <td>35</td> <td></td> <td></td> </tr> <tr> <td>40</td> <td></td> <td></td> </tr> </tbody> </table>	Age (years)	Maximum Heart Rate (Beats per minute)	Target Heart Rate Zone (Beats per minute)	10			15			20			25			30	190	(95-162)	35			40		
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<p><b>5 minutes</b></p>	<p><b>Activity 1: Measuring the Resting Heart Rate</b></p> <ul style="list-style-type: none"> <li>• In this activity, you will measure resting heart rate.</li> <li>• Resting Heart Rate (RHR) is the number of times your heart beats per minute when you're at rest. When you are at rest, your heart is pumping the lowest amount of blood to supply oxygen for your body needs.</li> <li>• Locate your pulse points either on your wrists or necks.</li> <li>• If necessary, make use of Appendix 2: Taking your pulse (Heart rate).</li> <li>• Rest quietly before measuring your Resting Heart Rate (RHR)</li> <li>• Gently place your index and middle fingers of your hand on the inside of your opposite wrist just below the thumb. Don't use your thumb because it has its own pulse that may affect the accuracy of your results.</li> </ul>																								

	 <ul style="list-style-type: none"> <li>● Once you feel your pulse, count how many beats you feel in 15 seconds.</li> <li>● Practice taking your pulse rate several times for 15 second intervals and calculate the average pulse rate.</li> <li>● Multiply this number by 4 to get your heart rate in beats per minute (bpm) and note it down,</li> <li>● Measure the resting Heart rate of one or more other family members and note that down.</li> </ul> <p>Learners discuss:</p> <ul style="list-style-type: none"> <li>● Can the heart rate change or is it always the same?</li> <li>● Why would a slower resting heart rate indicate a healthier heart?</li> <li>● What kinds of situations might cause heart rate to change?</li> </ul>
<p><b>25 minutes</b></p>	<ul style="list-style-type: none"> <li>● In order to keep your heart healthy, one needs to regularly exercise, but also learn not to over-exercise.</li> <li>● Maximum Heart rate (MHR) is usually the limit that one must not exceed. Usually it is calculated as 220 minus your age, formula:</li> <li>● <math>MHR = 220 - \text{Age}</math></li> <li>● Example, for a person of 25 years.</li> <li>● Maximum Heart Rate (MHR) = <math>220 - 25 = 195 \text{ bpm}</math></li> </ul> <p><b>Calculate your Maximum Heart Rate (MHR.)</b></p> <p><b>Target Heart Rate Zone (THRZ):</b> Target Heart Rate Zone is a healthy range that represents the number of times your heart should beat per minute during physical activity.</p> <p>Target Heart Rate Zone (THRZ) is equal to 50% to 85% of the Maximum Heart Rate (MHR)</p> <p>Example, for a person of 25 years</p> <p>Target Heart Rate Zone (THRZ) = (50% of 195 – 85% of 195) = <b>(98 – 166) bpm</b></p>

Exercising regularly at Target Heart Rate Zone (THRZ) ensures that there is minimum undue stress on the heart and maximum benefit from the exercises. Knowing your Target Heart Rate Zone helps you to pace your workout and keep safe.

Calculate your Target Heart Rate Zone (THRZ)

### Activity 2: Heart Rate Activity

In this activity, learners will observe how physical activity affects the heart rate by measuring their pulse rate after doing different activities.

1. Complete the activities listed and enter the results in the table. Be sure to sit quietly for 3-5 minutes to have enough time between activities to regain your Resting Heart Rate (RHR) before beginning a new activity.
2. Before starting each activity listed in the table, predict how that activity will affect your pulse rate (increase? decrease? or remain the same as the resting heart rate?)
3. Carry out each activity for one minute. Stop and immediately take your pulse for 15 seconds. Multiply by 4 to obtain the number of beats per minute.
4. Calculate the difference between your resting heart rate and your heart rate after each activity,

Heart Rate Observations:

Type of Activity (Conducted for 1 min)	Prediction (Increase? decrease? Same?)	Pulse rate (heart rate) immediately after activity (bpm)	What happened (Increased?, decreased? or the same?)
Jog in place			
Sprint in place			
Listen to fast music			
Breathe deeply			
Stand relaxed			
Speed walk			
*			
*			
*			

\* Add activities of your own choice

<p><b>10 minutes</b></p>	<p>Learners will use their results to answer the following questions:</p> <ul style="list-style-type: none"> <li>● How do activities affect your heart rate?</li> <li>● Did any of the activities hit your maximum heart rate?</li> <li>● Could you tell when your heart rate was within your target heart rate zone?</li> <li>● What activities were you doing when you were within your target heart rate zone?</li> <li>● How did your predictions compare with your actual data?</li> </ul> <p>To discuss: When do you think a footballer gets close to his/her MHR? How do you think regular exercise helps in:</p> <ul style="list-style-type: none"> <li>- Getting the heart more efficient in pumping blood</li> <li>- Getting a footballer to sprint faster without crossing the MHR threshold</li> </ul>
<p><b>30 minutes</b></p>	<ul style="list-style-type: none"> <li>● How do our bodies convert food into energy?</li> <li>● <b>Respiration</b> is the process of releasing energy from the breakdown of glucose. Respiration takes place in every living cell; all of the time and all cells need to respire in order to produce the energy that they require. There are two main types of respiration, <b>aerobic</b> and <b>anaerobic</b>:</li> </ul> <ul style="list-style-type: none"> <li>- Aerobic means “with air”. This type of respiration needs oxygen for it to occur, so it is called aerobic respiration.</li> <li>- Oxygen and Glucose are carried to our muscles via the blood, enabling our bodies to move and perform activities like running and kicking the ball.</li> <li>- Anaerobic means without air (“an” means without). When we carry out vigorous exercise, our heart and lungs would not be able to get sufficient oxygen to our muscles in order for them to respire. In this case muscles carry out anaerobic respiration. Anaerobic respiration is not as efficient as aerobic and only a small amount of energy is released.</li> </ul> <p>Examples of anaerobic movements are sprinting and jumping.</p> <p>Source: <a href="http://passmyexams.co.uk/GCSE/biology/aerobic-and-anaerobic-respiration.html">http://passmyexams.co.uk/GCSE/biology/aerobic-and-anaerobic-respiration.html</a></p>
<p><b>25 minutes</b></p>	<ul style="list-style-type: none"> <li>● <b><u>Activity 3: Creating an Infographic for Aerobic and Anaerobic Respiration</u></b></li> <li>- Create an infographic showing the definitions of Aerobic and Anaerobic respiration, their corresponding word equations, and examples on each.</li> </ul>

- Criteria- the infographic must: be on one page, provide all information as briefly as possible, and look pleasant and appealing.
- In this table you will find data from 24 matches of the best teams in the 2014 FIFA world cup in Brazil. They recorded the total distance covered by 64 players in 24 matches.

**Table 1.** Mean values of the maximum running distances of the best four teams of the 2014 World Cup

No.	Team	Number of players	M distance (metres)	Min. (metres)	Max. (metres)
1.	Germany	14	12,418	6,607	15,338
2.	Netherlands	15	11,664	6,949	13,906
3.	Argentina	17	11,462	5,143	15,012
4.	Brazil	18	11,142	8,481	14,513
Mean for 64 players			11.628		

M – mean; Min. – minimum results; Max. – maximum results.

**Source:** Central European Journal of Sport Sciences and Medicine | Vol. 11, No. 3/2015: 145–151

- From the above table, what was the overall mean distance covered by all the teams?
- Let's verify the mean distance from the information provided:

We know that for Germany's 14 players, the mean distance was 12'418m. Similarly, for other teams. To calculate the overall Mean, for each team we multiply the number of players by the mean distance for the team, add all values and divide by the total number of players:


$$M = \frac{(14 \times 12418) + (15 \times 11664) + (17 \times 11462) + (18 \times 11142)}{(14 + 15 + 17 + 18)}$$

**Math Talk:**

- -Why is this expression true?
- -Can you explain in your own words what this expression means?
- -What assumptions are you making in this expression?

Calculate M without using a calculator and verify that your answer is correct from the answer provided in the table (bottom row).


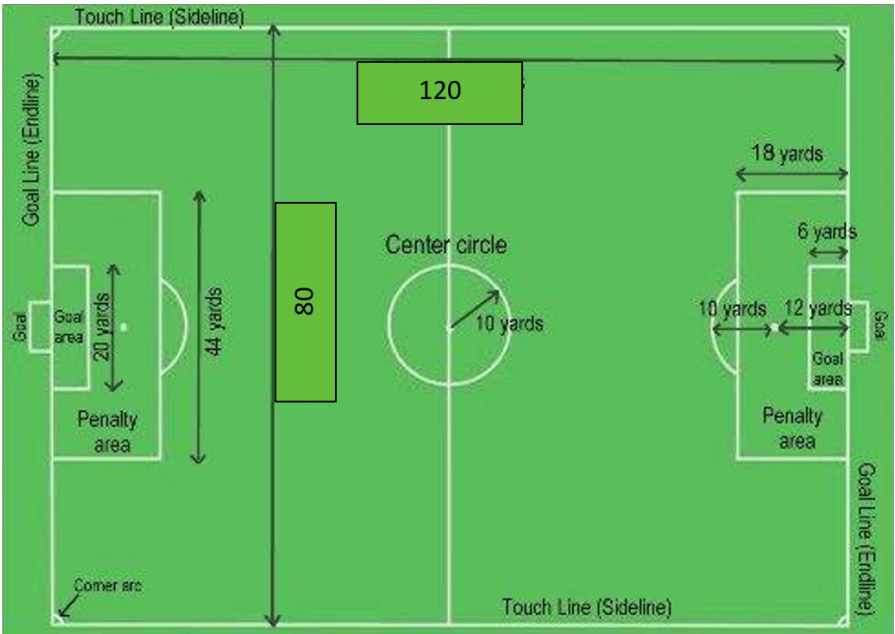
- Can you guess: Which playing position do you think runs the minimum distance in a match?
- Can you guess: Which playing position runs the highest distance? Which position runs the second highest?

	<ul style="list-style-type: none"> <li>- If you were to place players in playing positions in a football team according to their running abilities, where would you position and why?:             <ol style="list-style-type: none"> <li>a. The fastest sprinters</li> <li>b. Those who have the highest endurance (can run longer distances in a match)</li> </ol> </li> </ul>
<p><b>10 minutes</b></p>	<ul style="list-style-type: none"> <li>● Reflection questions:             <ul style="list-style-type: none"> <li>- Compared to your friends or classmates, are you a fast sprinter, someone who runs slower but for longer distances, or someone who does not run much?</li> <li>- According to your answer, where would you best be positioned?</li> </ul> </li> <li>● The below diagram shows the positions of Goal Keepers, Defense, Midfielders, and Forward. For the Red team, the formation shown below is 3-5-2.</li> <li>● While for the Blue team, the formation is 4-4-2.</li> </ul> 

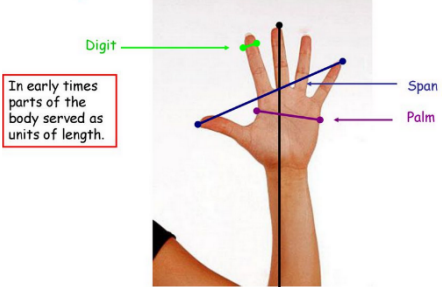

## DAY 2

Today you will create your own football team!

Suggested Duration	Activity and Description
<p><b>10 minutes</b></p>	<ul style="list-style-type: none"> <li>● Let's start the session by measuring your HR, then doing an exercise for 1 minute, then measuring the HR again, and walking for a few minutes to cool down and get your HR to its resting mode.</li> <li>- Measure and record your HR.</li> </ul>

	<ul style="list-style-type: none"> <li>- Perform the Mountain Climber exercise- as shown in the image below- for 1 minute (the version on the left-hand side is more challenging than that on the right).</li> </ul> <p style="text-align: center;"><b>Mountain Climbers</b></p>  <ul style="list-style-type: none"> <li>- Measure your HR after the exercise.</li> <li>- Walk for 5 minutes until you cool down and feel that your HR went back to its resting mode, or as it was before the exercise.</li> </ul>
<p><b>25 minutes</b></p>	<ul style="list-style-type: none"> <li>• Now create a model of a football pitch to scale on a A4 piece of paper.</li> </ul>  <ul style="list-style-type: none"> <li>• In order to draw a football pitch to scale, use the scale of 1 digit: 10 Yards.</li> <li>• A digit is the width of your finger.</li> </ul>



	 <ul style="list-style-type: none"> <li>• Yards distance on the diagram is divided by 10 to get the model distance in digits. For example, the length of the pitch on your model is 120 Yards; <math>120 \div 10 = 12</math>. So, count 12 digits using your finger as shown below to draw the length:</li> </ul>  <ul style="list-style-type: none"> <li>- Convert all Yards distances to the corresponding digit lengths for the model, then draw the scale model.</li> <li>• <b>Criteria:</b> The model must be drawn to scale, following the dimensions on the previous diagram, and showing all the white lines and arcs that are usually drawn on a football pitch.</li> </ul>
<p><b>25 minutes</b></p>	<ul style="list-style-type: none"> <li>• Team distribution</li> <li>• To visualize distributions, we need to represent the 11 players of a football team. Try to cut 11 similar rectangular pieces of paper that are around <math>1 \frac{1}{2}</math> digit by 1 digit. For example, they should measure around 3 cm by 2 cm on your ruler.</li> <li>• After that, you can use these to try different formations. The different positions are: <ul style="list-style-type: none"> <li>- Goalkeeper (G), who is always in a fixed position</li> <li>- Defenders (D)</li> <li>- Midfielder (M)</li> <li>- Forward (F)</li> </ul> </li> <li>• In Football, the formation is denoted with 3 numbers:</li> <li>• number of Defenders – number of Midfielders - number of Forward</li> </ul> <p><b>Numeracy Extension:</b> List all possible formations that a football team can have.</p>

	<ul style="list-style-type: none"> <li>Hint: you need to assign a number (not zero) for each of D, M &amp; F; such that <math>D+M+F=10</math>.</li> </ul>												
<b>15 minutes</b>	<ul style="list-style-type: none"> <li>The most popular formations in football are <b>4-4-2, 4-3-3, &amp; 4-5-1</b>.</li> <li>Try to visualize the 4-4-2 formation on your model using the player icons you created. <ul style="list-style-type: none"> <li>Then, think of the strengths and weaknesses of this formation given the below possibilities: <ul style="list-style-type: none"> <li>The opponent team is playing with 5 M.</li> <li>The opponent team is playing with 3 F.</li> <li>The opponent team is playing with 5 D.</li> </ul> </li> </ul> </li> <li>Repeat the above for the other formations: 4-3-3 and 4-5-1</li> </ul> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Formation</th> <th>Strengths</th> <th>Weaknesses</th> </tr> </thead> <tbody> <tr> <td>4-4-2</td> <td></td> <td></td> </tr> <tr> <td>4-3-3</td> <td></td> <td></td> </tr> <tr> <td>4-5-1</td> <td></td> <td></td> </tr> </tbody> </table>	Formation	Strengths	Weaknesses	4-4-2			4-3-3			4-5-1		
Formation	Strengths	Weaknesses											
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4-3-3													
4-5-1													

## DAY 3

Today you will continue exercising and present to your family what you've learned.

Suggested Duration	Activity and Description
<b>10 minutes</b>	<ul style="list-style-type: none"> <li>Let's start the session by measuring your HR, then doing an exercise for 1 minute, then measuring the HR again, and walking for a few minutes to cool down and get your HR to its resting mode.</li> <li>Measure and record your HR.</li> </ul>

- Perform Burpees for 1 minute. Do Full Burpees if you are feeling energetic, otherwise do the Half Burpees, as shown in the image below

**Full Burpee OR Half Burpee**



- Measure your HR after the exercise.
- Walk for 5 minutes until you cool down and feel that your HR went back to its resting mode, or as it was before the exercise.

**30 minutes**

- Make your dream team:
  - You will need 1 G, 4 D, 3 to 5 M, and 1 to 3 F.
    - Given the simple criteria below for each position, list down names of your friends or classmates – including yourself- for each of the positions:
  - G: quick reactions, jumps high, and good catching ability
  - D: High endurance, and good defense skills
  - M: Highest endurance (able to run for 90 minutes covering the longest distance), accurate long passes
  - F: Fastest sprinter, ball control, dribbling, and accurate & fast strikes

Position	Suggested players
G	
D	

	<table border="1"> <tr> <td>M</td> <td></td> </tr> <tr> <td>F</td> <td></td> </tr> </table> <ul style="list-style-type: none"> <li>Write the names of suggested players on the rectangular player icons that you created for the model</li> </ul>	M		F									
M													
F													
<b>20 minutes</b>	<ul style="list-style-type: none"> <li>Balanced diet for a footballer is:</li> </ul> <table border="1"> <thead> <tr> <th>Food type</th> <th>Average Diet</th> <th>Ideal Soccer Players Diet</th> </tr> </thead> <tbody> <tr> <td>Carbohydrate</td> <td>46%</td> <td>60%</td> </tr> <tr> <td>Fat</td> <td>38%</td> <td>25%</td> </tr> <tr> <td>Protein</td> <td>16%</td> <td>15%</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>Carbohydrate sources: Fruits, Rice, Pasta and Bread</li> <li>Fat sources: Red meat, eggs, dairy, vegetable oils, avocados, nuts (almonds, sunflower seeds...), and oily fish</li> <li>Protein sources: poultry, fish, lean red meat, eggs, nuts, beans and lentils and soy products.</li> </ul> <p>Source: <a href="https://www.sjeb.org/page/show/1225511-soccer-nutrition">https://www.sjeb.org/page/show/1225511-soccer-nutrition</a></p> <ul style="list-style-type: none"> <li>Questions to think about: <ul style="list-style-type: none"> <li>To what extent is your diet balanced as in the average diet mentioned above?</li> <li>The soccer player diet is for athletes who are practicing daily for long hours which may not be the case for you and your team. Knowing the food habits of your family and friends, what slight changes would you recommend for your team's diet?</li> </ul> </li> </ul>	Food type	Average Diet	Ideal Soccer Players Diet	Carbohydrate	46%	60%	Fat	38%	25%	Protein	16%	15%
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<b>20 minutes</b>	<ul style="list-style-type: none"> <li>Prepare a presentation showcasing the outcomes of your project: <ul style="list-style-type: none"> <li>Infographic about Aerobic and Anaerobic respiration</li> <li>Your dream team displayed on the Football pitch model with the names of players</li> <li>Justify your choice of players for the team using the required physical abilities for each position</li> </ul> </li> </ul>												
<b>10 minutes</b>	<p>Final reflections:</p> <p>Learner will complete the following statements:</p> <ul style="list-style-type: none"> <li>What I discovered .....</li> </ul>												

	<ul style="list-style-type: none"> <li>• What I appreciated most about the project .....</li> <li>• I never knew .....</li> <li>• What I would do differently .....</li> </ul>
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<b>Additional enrichment activities:</b>	<ul style="list-style-type: none"> <li>• Learners can explore what local foods is usually consumed by athletes or physically active individuals</li> <li>• What should be the values governing a football tea</li> </ul>
<b>Modifications for simplification</b>	<ul style="list-style-type: none"> <li>• A simple version of this project can be just to draw a model of a football pitch up to scale and come up with a team formation with players selected for each position according to their physical abilities.</li> </ul>

## ASSESSMENT CRITERIA

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A majority of my students were able to:

- Students can define and differentiate between aerobic and anaerobic respiration.
- Students accurately create a scale model of a football pitch with appropriate dimensions and markings
- Students reflect on what they discovered, appreciated, and learned during the project.
- Students demonstrate an understanding of terms like Maximum Heart Rate (MHR), Target Heart Rate Zone (THRZ), Resting Heart Rate (RHR), and Heart Recovery Time.
- Students can predict and observe how different physical activities affect their heart rate.

## APPENDIX

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### APPENDIX 1: KEY TERMS USED

- Heart Rate (HR):** Heart rate is the number of beats your heart makes per minute and measured in units of beats per minute (BPM). When the heart beats, it pumps

blood containing oxygen and nutrients around the body and brings back waste products.

As your heart pumps blood through your body, you can feel a pulsing in some of the blood vessels close to the skin's surface such as in your wrist, neck or upper arm. Counting your pulse rate is a simple way to find your heart rate.

2. **Maximum Heart Rate (MHR):** Maximum Heart Rate is the number of times your heart beats per minute when working at its hardest (maximum capacity) to meet your body's oxygen needs.

Maximum Heart Rate (MHR) is calculated using  $MHR = 220 - \text{Age}$

Example, for a person of 25 years.

Maximum Heart Rate (MHR) =  $220 - 25 = 195 \text{ bpm}$

3. **Target Heart Rate Zone (THRZ):** Target Heart Rate Zone is a healthy range that represents the number of times your heart should beat per minute during physical activity.

Target Heart Rate Zone (THRZ) is equal to 50% to 85% of the Maximum Heart Rate (MHR)

Example, for a person of 25 years

Target Heart Rate Zone (THRZ) = (50% of 195 – 85% of 195)  
= **(98 – 166) bpm**

Exercising regularly at Target Heart Rate Zone(THRZ) ensures that there is minimum undue stress on the heart and maximum benefit from the exercises. Knowing your Target Heart Rate Zone helps you to pace your workout and keeping safe.

4. **Resting Heart Rate (RHR):** Resting Heart Rate (RHR) is the number of times your heart beats per minute when you're at rest. When you are at rest, your heart is pumping the lowest amount of blood to supply oxygen for your body needs.

The normal resting heart rate for adults ranges from 60 to 100 bpm. Well trained athletes are known to have resting heart rates between 40 to 50 bpm. The lower your resting heart rate, the healthier your heart is.

5. **Heart Recovery Time:** Heart Recovery Time is the amount of time the heart takes to return to a normal resting heart rate after exercise. Heart recovery time is a measure of the body's general fitness. The shorter the recovery time, the higher the level of fitness.

## APPENDIX 2: TAKING YOUR PULSE (HEART RATE)

Your pulse is the rate at which your heart beats. As your heart pumps blood through your body, you can feel a pulsing in some of the blood vessels close to the skin's surface.

You can check your pulse by finding the radial artery or the carotid artery.

### Method 1: Radial pulse

To check your pulse using this method, you will find the radial artery. The radial artery is found on the inside of your wrist below your thumb. It supplies the arm and hand with oxygenated blood. Due to its size and its proximity to the surface of the arm, it is the most commonly used artery for taking the pulse.

1. Gently place your index and middle fingers of your hand on the inside of your opposite wrist just below the thumb. Don't use your thumb because it has its own pulse that may affect the accuracy of your results.



2. Once you feel your pulse, count how many beats you feel in 15 seconds.
3. Multiply this number by 4 to get your heart rate in beats per minute (bpm)

### Method 2: Carotid pulse

To check your pulse using this method you will find the carotid artery. The carotid arteries are located in your neck on either side of your windpipe. Carotid arteries supply oxygenated blood to the head region.

1. Gently place your index and middle fingers on the side of your windpipe below the jawbone. You may need to shift your fingers until you can easily feel your heart beating.



2. Count the pulses you feel in 15 seconds.
3. Multiply this number by 4 to obtain your heart rate in beats per minute (bpm)