

FOOTBALL FOR THOUGHT (LEVEL 3)

Ages 11 to 14 (Level 3)

Description:	In this project, learners use examples of football to practice math skills and learn about physical education and nutrition.
Leading question:	What do I need to learn in order to form my dream football team?
Age group:	11-14
Subjects:	Physical Education/Biology (HR, Respiration, Nutrition), & Math (simple statistics, and Combinations)
Total time required:	~5 hours over 3 days
Self-guided / Supervised activity:	Low supervision (Learner is required to read text)
Resources required:	Paper and pencils

Learning outcomes:	<ul style="list-style-type: none"> ● Understand heart rate and how to measure it ● Identify the differences between aerobic and anaerobic respiration ● Describe the main characteristics of a football team ● Explain a balanced diet recommended for football players ● Use combinatorics to calculate possible formations in a football team.
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Topics/concepts covered and skills developed
<ul style="list-style-type: none"> ● Heart Rate (HR), Resting Heart Rate (RHR), Maximum Heart Rate (MHR), Target Heart Rate Zone (THRZ) ● Aerobic and anaerobic respiration ● Balanced diet for football players ● Football team formations

Day	Time	Activity and Description									
1	15 minutes	<p>Introduction: Parents inform learners that in this project they will conduct activities around Football to practice some Mathematics and learn some Biology & Physical education.</p> <p>We will start with learning about the Heart rate (HR) since an athlete needs to pay attention to it to keep his/her heart healthy and efficient.</p> <p>The Heart rate is the number of times the heart beats in one minute. Ask the learners: can you feel your heart beating right now.</p> <p>Discuss with the learner the claim: “HR when we are resting is different from HR when we are moving or exercising”. Ask them to provide reasons/examples to support their claim (i.e. When we run, for example, HR increases to supply the muscles with the necessary energy and oxygen).</p> <p>Introduce the learners to the following key terms:</p> <ul style="list-style-type: none"> (i) Maximum Heart Rate (MHR) (ii) Target Heart Rate Zone (THRZ) (iii) Resting Heart Rate (RHR) (iv) Heart Recovery Time <p>Ask the learner: Which one do you think is most important for a football player to monitor? Let’s see if we can find out.</p> <p>Where necessary, make use Appendix 1: Key terms used</p> <p>Numeracy Extension Learners will complete the Age-based Maximum Heart Rate (MHR) and Target Heart Rate Zone (THRZ)</p> <p>Learners will 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" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Age (years)</th> <th style="width: 33%;">Maximum Heart Rate (Beats per minute)</th> <th style="width: 33%;">Target Heart Rate Zone (Beats per minute)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">10</td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">15</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		
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10											
15											
	10 minutes										

5 minutes	20		
	25		
	30	190	(95-162)
	35		
	40		
5 minutes	<p>Activity 1: Measuring the Resting Heart Rate</p> <p>In this activity, learners will measure their resting heart rate. 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.</p>		
30 minutes	<p>Help the learners locate their pulse points either on their wrists or necks.</p> <p>If necessary, make use of Appendix 2: Taking your pulse (Heart rate).</p> <p>Let learners rest quietly before measuring their Resting Heart Rate (RHR)</p> <ol style="list-style-type: none"> 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.  <p>Source: Harvard Health Publishing</p> <ol style="list-style-type: none"> Once you feel your pulse, count how many beats you feel in 15 seconds. Practice taking your pulse rate several times for 15 second intervals and calculate the average pulse rate. Multiply this number by 4 to get your heart rate in beats per minute (bpm) and note it down, Measure the resting Heart rate of one or more other family members and note that down. 		

	<p>25 minutes</p>	<p>Learners discuss:</p> <ul style="list-style-type: none"> • Can the heart rate change or it is always the same? • Why would a slower resting heart rate indicate a healthier heart? • What kinds of situations might cause heart rate to change? <p>In order to keep your heart healthy, one needs to regularly exercise, but also learn not to over-exercise.</p> <p>Maximum Heart rate (MHR) is usually the limit that one must not exceed. Usually it is calculated as 220 minus your age, formula:</p> <p>MHR = 220 – Age</p> <p>Example, for a person of 25 years. Maximum Heart Rate (MHR) = 220 – 25 = 195 bpm</p> <p>Calculate your Maximum Heart Rate (MHR.)</p> <p>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</p> <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.</p> <p>Calculate your Target Heart Rate Zone (THRZ)</p> <p>Activity 2: Heart Rate Activity</p> <p>In this activity, learners will observe how physical activity affects the heart rate by measuring their pulse rate after doing different activities.</p> <ol style="list-style-type: none"> 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.
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10 minutes	<p>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?)</p> <p>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.</p> <p>4. Calculate the difference between your resting heart rate and your heart rate after each activity,</p> <p>Heart Rate Observations</p> <table border="1"> <thead> <tr> <th>Type of Activity (Conducted for 1 min)</th> <th>Prediction (Increase? decrease? Same?)</th> <th>Pulse rate (heart rate) immediately after activity (bpm)</th> <th>What happened (Increased?, decreased? or the same?)</th> </tr> </thead> <tbody> <tr> <td>Jog in place</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Sprint in place</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Listen to fast music</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Breathe deeply</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Stand relaxed</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Speed walk</td> <td></td> <td></td> <td></td> </tr> <tr> <td>*</td> <td></td> <td></td> <td></td> </tr> <tr> <td>*</td> <td></td> <td></td> <td></td> </tr> <tr> <td>*</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>* Add activities of your own choice</p> <p>Learners will use their results to answer the following questions:</p> <ul style="list-style-type: none"> ● How do activities affect your heart rate? ● Did any of the activities hit your maximum heart rate? ● Could you tell when your heart rate was within your target heart rate zone? ● What activities were you doing when you were within your target heart rate zone? ● How did your predictions compare with your actual data? <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"> - Getting the heart more efficient in pumping blood - Getting a footballer to sprint faster without crossing the MHR threshold <p>How do our bodies convert food into energy?</p>	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				*				*				*			
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	<p>Respiration 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, aerobic and anaerobic:</p> <ol style="list-style-type: none"> 1. Aerobic means “with air”. This type of respiration needs oxygen for it to occur, so it is called aerobic respiration. The word equation for aerobic respiration is: $\text{Glucose} + \text{Oxygen} \longrightarrow \text{Carbon dioxide} + \text{Water} + \text{Energy}$ 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. 2. 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. This is because glucose can only be partially broken down. Lactic acid is what makes us feel muscle ache after vigorous exercise. The word equation for anaerobic respiration is: $\text{Glucose} \longrightarrow \text{Lactic acid} + \text{Energy}$ Examples of anaerobic movements are sprinting and jumping. The only food type that the body uses for Anaerobic respiration is Carbohydrates. <p>Source: http://passmyexams.co.uk/GCSE/biology/aerobic-and-anaerobic-respiration.html</p> <p><u>Activity 3: Creating an infographic for Aerobic and Anaerobic respiration</u></p> <p>Create an infographic showing the definitions of Aerobic and Anaerobic respiration, their corresponding word equations, and examples on each.</p> <p>Criteria- the infographic must: be on one page, provide all information as briefly as possible, and look pleasant and appealing.</p> <p>In the below table you will find data collected from 24 matches of the best teams of the 2014 FIFA world cup in Brazil. They recorded the total distance covered by 64 players in 24 matches.</p>
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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

1. From the above table, what was the overall mean distance covered by all the teams?
2. 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: Ask the learner:

- 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).

3. Can you guess: Which playing position do you think runs the minimum distance in a match?
4. Can you guess: Which playing position runs the highest distance? Which position runs the second highest?
5. If you were to place players in playing positions in a football team according to their running abilities, where would you position and why?:
 - a. The fastest sprinters

		<p>b. Those who have the highest endurance (can run longer distances in a match)</p> <p>Answer key:</p> <ol style="list-style-type: none"> 11'628 m 11628 Goalkeeper Midfielders run the highest distance, followed by the Defenders! Strategies might vary for this question. Pay attention to the learner's reasoning. <p>Reflection questions:</p> <ul style="list-style-type: none"> - 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? According to your answer, where would you best be positioned? <p>The below diagram shows the positions of Goalkeepers, Defense, Midfielders, and Forward. For the Red team, the formation shown below is 3-5-2. While for the Blue team, the formation is 4-4-2.</p> 
2	10 minutes	<p>Let's start the session today 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.</p> <ul style="list-style-type: none"> ● Measure and record your HR. ● 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).

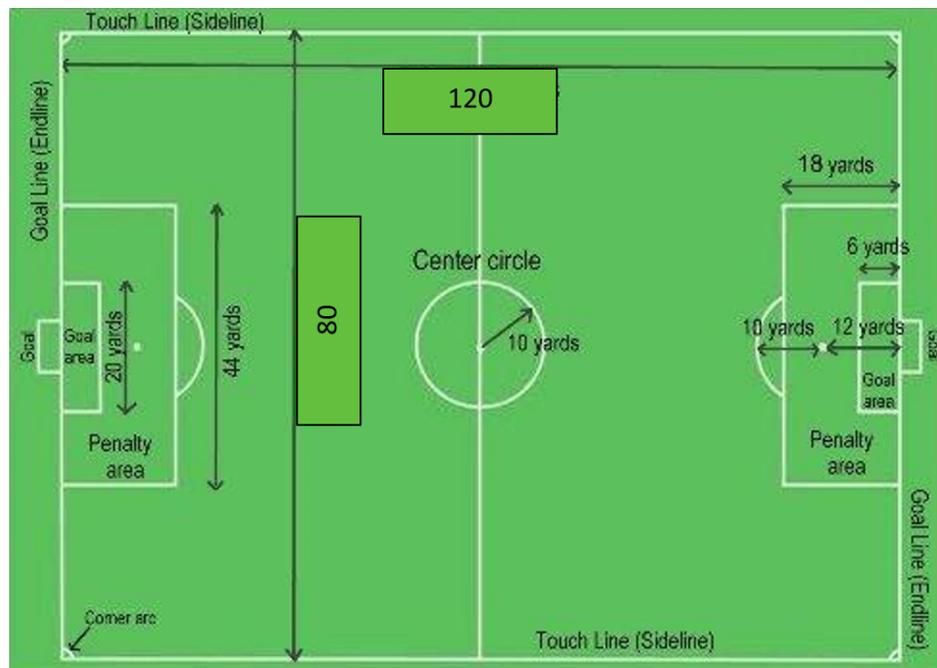
25
minutes

Mountain Climbers

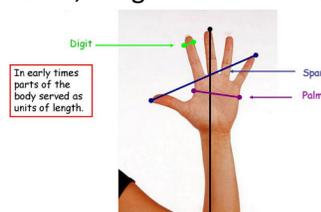


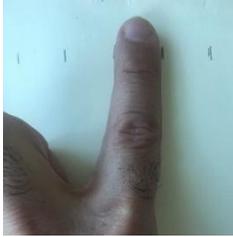
- Measure your HR after the exercise.
- Walk for 5 minutes until you cool down and feel that your HR went back to its resting mode, or as it was before the exercise.

Now you are required to Create a model of a football pitch to scale on one A4 paper. There is a range of dimensions for football pitches, so the one below is a suggestion acceptable by FIFA standards, where all dimensions are denoted in Yards.



In order to draw a football pitch to scale, use the scale of 1 digit: 10 Yards. As shown below, a digit is the width of your finger.



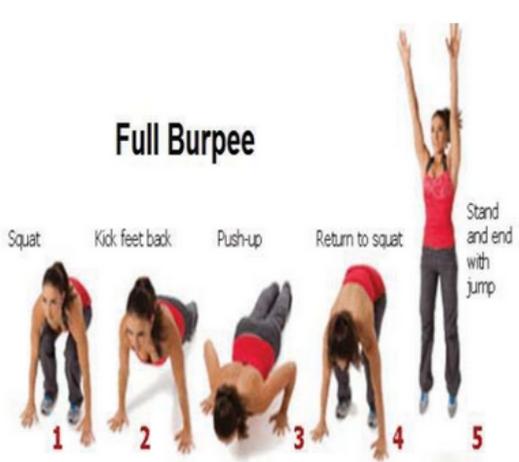
	<p>25 minutes</p>	<p>Divide the Yards distance on the diagram by 10 to get the model distance in digits. For example, if the length of the pitch on your model is 120 Yards, count 12 digits using your finger ($120 \div 10 = 12$). See the drawing for reference.</p>  <p>Convert all Yards distances to the corresponding digit lengths for the model, then draw the scale model.</p> <p>Criteria: 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.</p> <p>Team distribution</p> <p>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 $1 \frac{1}{2}$ digit by 1 digit. For example, they should measure around 3 cm by 2 cm on your ruler.</p> <p>After that, you can use these to try different formations. The different positions are:</p> <ul style="list-style-type: none"> - Goalkeeper (G), who is always in a fixed position - Defenders (D) - Midfielder (M) - Forward (F) <p>In the example to the right, the formation is:</p> <p style="text-align: right;">D-M-F 4-4-2</p>  <p>source</p> <p>In Football, the formation is denoted with 3 numbers: number of Defenders – number of Midfielders - number of Forward</p>
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	15 minutes	<p>Numeracy Extension List all possible formations that a football team can have. (Give some time for the learner to brainstorm some ideas as to how to do this.)</p> <p>Hint 2: assign a number (not zero) for each of D, M & F; such that $D+M+F=10$.</p> <p>Hint 2: place 1 D, and see in how many ways you can distribute the other 9 players into M and F. Then, place 2 D and see the possible distributions of the remaining 8 players into M and F. Keep going until you reach the maximum possible number of D. Then, add the number of all possible distributions.</p> <p>The most popular formations in football are 4-4-2, 4-3-3, & 4-5-1.</p> <ul style="list-style-type: none"> - Try to visualize the 4-4-2 formation on your model using the player icons you created. <ul style="list-style-type: none"> o Then, think of the strengths and weaknesses of this formation given the below possibilities: o The opponent team is playing with 5 M. o The opponent team is playing with 3 F. o The opponent team is playing with 5 D. - Repeat the above for the other formations: 4-3-3 and 4-5-1 <table border="1" data-bbox="394 1077 1370 1352"> <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		
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4-4-2														
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3	10 minutes	<p>Let's start the session today 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.</p> <ul style="list-style-type: none"> ● Measure and record your HR. ● Perform Burpees for 1 minute. Do Full Burpees if you are feeling energetic, otherwise do the Half Burpees, as shown in the image below. 												

30
minutes

Full Burpee OR Half Burpee

Full Burpee



Half Burpee



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

Make your dream team:

- You will need 1 G, 4 D, 3 to 5 M, and 1 to 3 F.
 - o 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	
M	
F	

Write the names of suggested players on the rectangular player icons that you created for the model

Balanced diet for a footballer is shown below in comparison to a western diet:

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EAA welcomes feedback on its projects in order to improve, please use this link:
<https://forms.gle/LGAP9k17fMyJrKJN7>

20 minutes	Food type	Average Diet	Ideal Soccer Players Diet
	Carbohydrate	46%	60%
	Fat	38%	25%
	Protein	16%	15%
	<ul style="list-style-type: none"> - Carbohydrate sources: Fruits, Rice, Pasta and Bread - Fat sources: Red meat, eggs, dairy, vegetable oils, avocados, nuts (almonds, sunflower seeds...), and oily fish - Protein sources: poultry, fish, lean red meat, eggs, nuts, beans and lentils and soy products. <p>Source: https://www.sjeb.org/page/show/1225511-soccer-nutrition</p> <p>*It is important to keep the body hydrated by drinking well before, during and after a match or exercise.</p> <p>Questions to think about:</p> <ul style="list-style-type: none"> - To what extent is your diet balanced as in the average diet mentioned above? - 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? <p>Prepare a presentation showcasing the outcomes of your project:</p> <ul style="list-style-type: none"> - Infographic about Aerobic and Anaerobic respiration - Your dream team displayed on the Football pitch model with the names of players - Justify your choice of players for the team using the required physical abilities for each position <p>Criteria:</p> <ul style="list-style-type: none"> - The outcomes are appealing and clear - Includes all necessary information - Justification show the acquired knowledge and thinking behind <p>The presenter shows confidence and enthusiasm</p> <p>Learners showcase their outcomes, and parents observe and assess. Parents give feedback:</p> <ul style="list-style-type: none"> - What they liked the most about the presentation - What they think could be improved with suggestions 		
20 minutes			
15 minutes			

	10 minutes	<p>Final reflection:</p> <p>Learner will complete the following statements:</p> <ul style="list-style-type: none"> ● What I discovered ● What I appreciated most about the project ● I never knew ● What I would do differently
Assessment Criteria:	- All observation and task criteria are mentioned respectively	
Additional enrichment activities:	<p>-Learners can explore what local foods is usually consumed by athletes or physically active individuals</p> <p>-What should be the values governing a football team</p>	
Modifications to simplify:	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.	

APPENDIX 1: KEY TERMS USED

1. **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.

6. 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.



7. Once you feel your pulse, count how many beats you feel in 15 seconds.
8. 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)