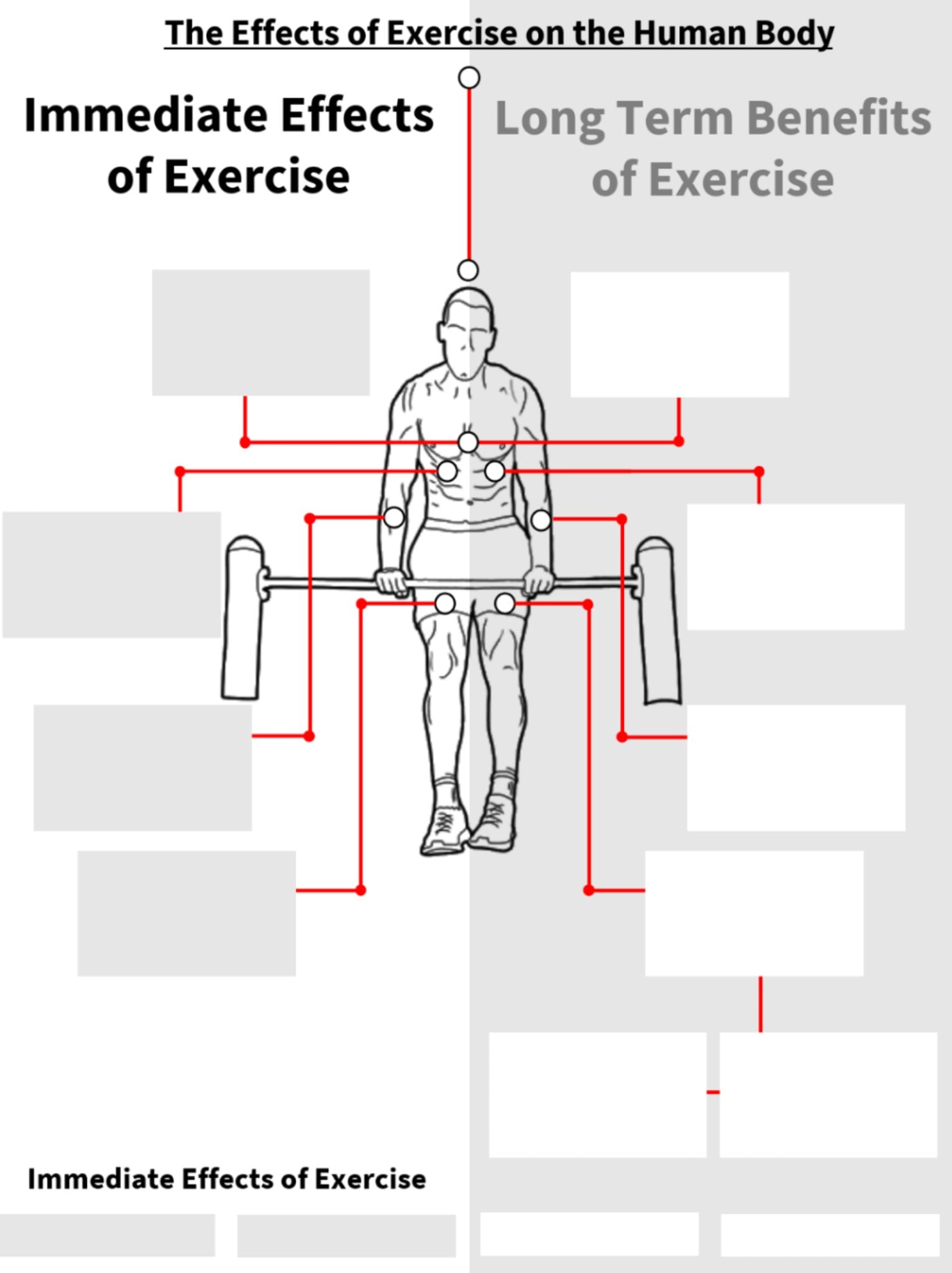
**Exercise Physiology Workbook 2**

Teacher:

Student:



**Learning Intentions:**

* Understanding the immediate physiological responses to Physical Activity (PA)
* Identifying the long-term adaptations caused by PA

**Success Criteria:**

* Explain the immediate responses to PA
  + Heart rate Stroke Volume Blood Pressure
  + Cardiac Output Respiratory rate Perspiration
  + Maximum oxygen uptake Blood redistribution Gas exchange
  + Arteriovenous oxygen difference
* Explain the long-term adaptations to PA
  + Cardiac hypertrophy Heart rate Stroke Volume
  + Blood pressure Blood volume Vo2 Max
  + Capillarisation Ventilation Oxygen exchange

Exercise Physiology

Oxygen consumption

Draw a diagram that displays oxygen consumption during and after exercise.   
Be sure to label: *oxygen deficit, EPOC and steady state*

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**Question 1**

Explain why an oxygen deficit accrues at the beginning of any exercise bout.

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**Question 2**

List the factors that could determine the size of the oxygen deficit.

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**Question 3**

Explain steady state exercise and describe when it would occur on the graph above.

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**Question 4**

Explain factors that could be responsible for elevated levels of EPOC.

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Exercise Physiology

Immediate adaptations to exercise

**Question 1**

Describe the difference between acute and chronic responses to exercise.

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**Question 2**

List all the immediate responses of the circulatory system during physical activity.

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**Question 3**

List 3 of the immediate responses of the respiratory system during physical activity.

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**Question 4**

Explain the relationship between cardiac output, stroke volume and heart rate?

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**Question 5**

Why does your heart rate and breathing rate increase whilst you are exercising aerobically?

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**Question 6**

Outline how and why blood is redistributed away from major organs to working muscles as exercise intensity increases.

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**Question 7**

Explain what is meant by the arteriovenous oxygen difference. Explain why this increases during exercise and it’s importance.

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**Question 8**

Explain why AVO2 difference is greater when someone is jogging than when they are walking.

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**Question 9**

Explain why stroke volume plateaus at exercise intensities approaching 40–60 per cent of maximum exertion levels. Discuss why this might not be the case with highly trained athletes.

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**Question 10**

De­fine the terms respiratory rate, tidal volume, gas exchange, maximum oxygen uptake.

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***Exam Questions***

**Question 1**

Explain the relationship between training intensity and heart rate. (3 marks)

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**Question 2**

Describe how heart rate, stroke volume and cardiac output respond during exercise of increasing intensity. Ensure that you explain how these three variables are interrelated. (8 marks)

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**Question 3**

Using practical examples, describe the redistribution of blood during exercise. (5 marks)

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**Question 4**

Analyse some of the immediate physiology responses to training not discuss above. (8 marks)

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Exercise Physiology

Chronic adaptations to exercise

**Question 1**

Resting HR is one variable that decreases as a result of training. Often people say this is because the heart becomes more efficient. What does this mean?

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**Question 2**

Why does your heart rate and breathing rate increase whilst you are exercising aerobically?

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**Question 3**

How does the formation of more capillaries as a response to endurance training improve an athletes VO2 max?

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**Question 4**

Explain why trained athletes have higher stroke volumes than untrained individuals.

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**Question 5**

1. Explain how long-term exercise may improve performance of a marathon runner.

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1. Differentiate the physiology differences of a sprinter.

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**Question 6**

De­fine the terms lung volume, vital capacity and tidal volume. Explain the changes that occur over time to each of them.

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**Question 7**

Explain 3 changes that occur to the muscular system as a result of long-term exercise.

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**Question 8**

Explain 3 changes that occur to each of the energy systems as a response to long-term exercise.

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**Section Three: Extended answers 30% (40 marks)**

This section contains **four (4)** questions. You must answer **two (2)** questions. Write your answer in the spaces provided.

Supplementary pages for the use of planning/continuing your answer to a question have been provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 50 minutes.

**Question 1 (20 marks)**

A friend invites you to play touch rugby in their summer social league team. You play the entire 40 minute game and enjoy it so much that you sign up for the more competitive A grade competition. Your new team trains three times a week and plays once a week.

1. Identify and explain **two (2)** immediate responses to physical activity that you would experience during a touch rugby game, and **three (3)** long-term adaptations you would experience after six months of the A grade competition.

(10 marks)

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1. Using your prior knowledge of the respiratory system, explain the mechanics of inspiration (inhalation) and expiration (exhalation), and how gases diffuse into and out of the lungs and blood vessels.

(10 marks)

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**Question 2 (20 marks)**

A female PE student completes a 3-km cross-country course in 12 minutes on a 20°C day. She wears a heart rate monitor and holds a steady pace until the fin­al minute where she increases her pace until she crosses the finish line. She notices that her heart rate reaches a plateau after about three minutes from the start. She also notices that her heart rate returns to pre-race levels about four minutes after her race is completed.

1. Draw and label a graph that illustrates oxygen uptake for the female student for the 12 minutes of the race and 4 minutes of recovery. On your graph, label and include:

* any periods of rest
* any periods of oxygen de­ficit
* any periods of steady state
* any periods of EPOC

1. Explain the terms oxygen deficit, steady state and EPOC

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1 mark for identifying the response / adaptation and 1 mark for explanation.

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| **Marks** | **Elaboration** |
| **Max 4 marks** | ***Immediate Responses – choose from***   * Increased Heart Rate- Heart will beat more times per minute to increase blood flow to working muscles * Increased Stroke Volume- Heart will eject more blood per beat to increase blood flow to working muscles * Increased Blood Pressure- More blood flow throughout the body creates increased pressure on the walls of the arteries * Increased Cardiac Output- Increased HR and SV creates an increase in total blood circulation per minute * Increased Tidal Volume- The amount of air inhaled and exhaled with each breath will increase due to increased oxygen requirements and CO2 production * Increased Respiratory Rate- The number of breaths taken per minute will increase due to increased oxygen requirements and CO2 production * Increased Gas Exchange- The rate of diffusion will increase due to increased oxygen requirements and CO2 production * Increased Arteriovenous Oxygen Difference- More oxygen is being utilised by the working muscles therefore minimal amounts of oxygen are remaining in the veins * Blood Redistribution- More blood is sent to working muscles rather than other parts of the body |
| **Max 6 marks** | ***Long-Term Adaptations***   * Increased Cardiac Output – Amount of total blood circulation per minute will increase to higher levels during exercise so higher intensity activity can be sustained for longer * Lower Resting Heart Rate –Heart will beat less times per minute due to more efficient heart (higher stroke volume) * Decreased Blood Pressure – Less pressure on the walls of arteries due to more elastic artery walls * Increased Blood Volume/Haemoglobin – Training leads to an increase in plasma volume and haemoglobin concentration leading to better temperature regulation and oxygen transport * Stroke Volume – Training creates a stronger cardiac contraction therefore more blood ejected per beat * Maximum Oxygen Uptake (VO2 max) – Training leads to an improved ability to process and utilise oxygen during aerobic exercise * Increased Capillarisation – More capillaries around the muscles and lungs to increase speed and efficiency of diffusion of O2 and CO2 * Ventilation – Increased tidal volume and lung capacity during exercise to allow more air to be inspired and expired with each breath * Oxygen Exchange – training increases the utilisation of all alveoli to increase the surface area for gaseous exchange * Increased Flexibility – regular training/stretching/explosive movements increase the range of motion at particular joints * Increased Aerobic & Anaerobic Capacity –Training improves the capacity of both aerobic and anaerobic energy systems to resynthesise ATP |

|  |  |
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|  | 1. Each label worth ½ mark (4 marks total)  * Label O2 axis * Label time axis * Resting steady state * Commencement of activity/exercise * O2 deficit * Exercise steady state * Completion of activity/exercise * EPOC/O2 debt |

**Steady State Exercise**

* Oxygen consumption rises sharply during first minutes of exercise.
* This consumption begins to plateau between 3-4 mins and will remain stable for the duration of exercise.
* This means there is a balance between energy required by working muscles and ATP produced by the aerobic pathway.

**Oxygen Deficit**

* When exercise commences, O₂ consumption does not reach “steady state” plateau immediately.
* Oxygen deficit is the state in which there is a discrepancy (shortfall) between oxygen supply and demand and the oxygen required to meet the energy requirements of the activity.
* Energy used during O₂ deficit period is supplied ***through Anaerobic pathways***
* The oxygen deficit occurs because the respiratory and circulatory systems take some time to adjust to the new oxygen demand and, consequently, the amount supplied lags behind the amount needed.

The bodies systems will adjustments to increase oxygen supply. This includes:

* increased respiratory frequency
* increased tidal volume
* increased heart rate
* increased stroke volume

**EPOC – Excess post exercise oxygen consumption**

* Excess post-exercise oxygen consumption (EPOC) is the amount of oxygen consumed during the recovery period (after the end of activity). It is an increased rate of oxygen consumption above that required during rest.

The purpose of EPOC is to:

* replenish ATP-CP stores
* remove lactic acid
* Replacing depleted oxygen stores in body
* Supply oxygen to heart and respiratory muscles-still active
* Supply oxygen to body tissues to be used-because of increased body temperature resulting from exercise.