**Exercise Physiology Workbook 1**

Teacher:

Student:

ADENOSINE

P

P

P

ADENOSINE

P

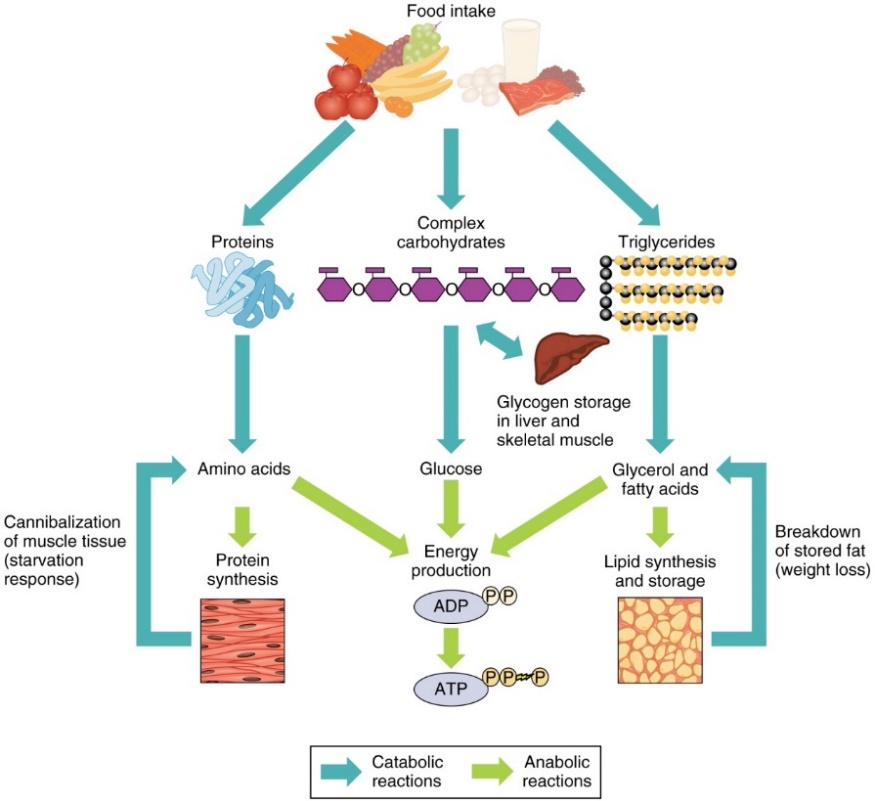
P

P

**ATP**

**ADP + Pi**

**The breaking of this phosphate bond releases energy for movement**



**Learning Intentions:**

* Understanding adenosine triphosphate (ATP)
* Identifying the energy systems and their response to physical activity
  + Anaerobic energy system
  + Aerobic energy system
  + Energy system continuum
* Understanding Carbohydrates, fats and protein as energy sources

**Success Criteria:**

* Define adenosine triphosphate (ATP)
* Describe how ATP is broken down by the body
* Explain each of the body’s energy systems response to physical activity
  + Anaerobic system
    - Anaerobic glycolysis
  + Lactic Acid system
  + Aerobic system
  + Energy system continuum

* Explain the role of carbohydrates, proteins and fats as an energy source for physical activity
  + Carbohydrates
    - Glycaemic Index
    - The role of low Low GI, High GI foods
    - Rebound Hypoglycaemia
    - Carb loading
* Explain how carbohydrates, proteins and fat can delay the onset of fatigue

Exercise Physiology

ATP

Carbohydrates, fats and proteins contain \_\_\_\_\_\_\_ which is converted into a chemical compound called \_\_\_\_\_\_\_\_\_\_. Electrical impulses sent to the \_\_\_\_\_\_\_\_\_ stimulate the breakdown of \_\_\_\_\_\_\_\_\_\_ into \_\_\_\_\_\_\_\_ plus P.   
Draw a simple diagram of this below

1. What does ATP stand for: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What does ADP stand for: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. There are two pathways for the production of energy:

6. Complete the table below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ENERGY SYSTEM | FUEL | OXYGEN REQUIRED? | SPEED OF ATP PRODUCTION | LIMITATION/CAUSE OF FATIGUE |
| ATP – PC |  |  |  |  |
| LACTIC ACID |  |  |  |  |
| AEROBIC |  |  |  |  |

Exercise Physiology

Energy Systems

1. What is the main difference between the aerobic and anaerobic energy pathways?

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1. List three things that determine which is the predominant energy system in any given physical activity:

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
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1. Give two examples of activities that each of the energy systems is used for:
2. ATP-CP system- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Lactic Acid system- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Aerobic system- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. What is the body’s preferred food fuel and why?  
   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. What are the by-products (waste products) of the aerobic energy system?  
   \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. Why is the aerobic energy system not used immediately?

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1. Why is the ATP-CP so quick in providing energy at the commencement of activity?  
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2. Draw a graph that explain the interplay of the 3 energy systems

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Exercise Physiology

Energy Systems

***ATP-PC System***

1. What does the term *anaerobic* mean?

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***Lactic Acid System***

1. What does the term ‘*glycogen’ refer to’*?

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***Aerobic System***

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

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1. What is the downside of using fat as the fuel for aerobic glycolysis?

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1. When athletes use the expression ‘*hitting the wall’*, what do they mean?

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Exercise Physiology

Recap

The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy system is the immediate source of energy for contraction of muscles at the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of activity. Small amounts of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ stores are already in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. When the chemical bonds of this \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are broken down into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, energy is released, which is used to contract the muscle.

There are also CP stores in the muscles. The breakdown of CP releases energy to rebuild the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds, creating A.T.P from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Beyond approximately 10 seconds the A.T.P stores are exhausted and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ levels are still not high enough so the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ system takes over. The conversion of glycogen into glucose releases energy which is used to rebuild the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Carbohydrates are the primary source of A.T.P in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ system pathway. They are broken down into glucose and stored as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and liver. With sufficient oxygen, the energy from this fuel is used to form a chemical compound called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. It is the breakdown of this \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ plus \_\_\_ that represents the immediate source of energy. This system also uses \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as fuel sources.

**Question 1.** Explain the energy systems a person will utilise when they set out for a 20 km cycle of moderate to high intensity.

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**Question 2.** An athlete skips at high intensity for 2 minutes. Identify the dominant energy system used by the athlete and outline three (3) characteristics of that energy system.

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**Question 3.** Explain how energy is provided, allowing the athlete to compete in shot put.

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**Question 4.** Summarise the ATP-PC energy pathway

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**Question 5.** Explain why the body utilises the lactic acid pathway for different track and field athletics events.

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**Answer the following questions based on the scenario below.**

The longest tennis match lasted for a total of 11 hours and 5 minutes between John Isner and Nicolas Mahut at 2010 Wimbledon. John Isner eventually won 6-4, 3-6, 6-7, 7-6, 70-68.

1. Tennis utilises the ATP-PC system for energy production. Outline the advantages and disadvantages of the ATP-PC system.

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1. Explain the possible causes of fatigue that both players would have faced during the match.

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Exercise Physiology

Food as Fuel

**Complete the tables below.**

|  |  |  |  |
| --- | --- | --- | --- |
| FOOD FUEL | CONVERTED TO | STORED AS | STORED IN |
| CARBOHYDRATES |  |  |  |
| FATS |  |  |  |
| PROTEINS |  |  |  |

|  |  |  |
| --- | --- | --- |
| Low GI Foods | Moderate GI Foods | High GI Foods |
|  |  |  |

Explain the difference between low GI and high GI foods and what occurs inside the body when they are consumed. Draw a graph to help explain your response \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Exercise Physiology

Role of Carbs, Proteins and Fats

**Question 1**

Explain how long before an event to carb load and the advantages and disadvantages. Give two appropriate examples of foods that could be used to carb load.

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**Question 2**

Explain the role of fats in the body during exercise.

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**Question 3**

Explain the role of protein in the body during exercise.

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**Question 4**

Explain the term Rebound Hypoglycaemia.

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Exercise Physiology

Nutrition - Exam questions

James is a rugby player who plays competitions on Saturday mornings. **Create** an appropriate **meal plan** for him to successful play out the entire 80-minute game. **Add** when these meals will be consumed and, in the space below **justify** why you have selected these foods.

|  |  |
| --- | --- |
| **Friday night** |  |
| **Breakfast** |  |
| **Before game** |  |
| **During game** |  |
| **Lunch** |  |

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Josie is a goal keeper for her soccer team in a competition on Saturday mornings.   
The table below details her diet in the lead up to her game, during and post-event.

|  |  |
| --- | --- |
| **Friday night** | Spaghetti Bolognese  Banana and custard |
| **Breakfast**  **(1 and a half hours before game)** | 1 piece of toast with peanut butter  1 x 250mL chocolate milk  1 x 250mL water |
| **Before game**  **(10 mins before)** | 1 x muesli bar  250mL water |
| **During game** | 500mL water  2 x lollies (snakes) |
| **Lunch**  **(30 minutes after game)** | 150mL water  1 banana  1 x large hot chips |

Suggest **improvements** that Josie could make to her diet, providing **reasons** for your choices.

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**Section Three: Extended answers 30% (30 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 29 (20 marks)**

In 2019 Kenyan marathoner Eliud Kipchoge became the first human to run a marathon in under two hours, covering the 42km distance in 1 hour, 59 minutes and 40 seconds. The run, organised specifically for Kipchoge to break the two-hour marathon barrier, and featured an electric pacer car that shot a laser beam to mark the best position on the road.

(a) A key component of the event was Kipchoge’s nutritional plan. Discuss what this nutritional plan would have involved before and during the event to ensure he had sufficient nutrients and energy to fuel the race.

(10 marks)

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(b) Discuss the term ‘energy system interplay’ as it relates to an athletics sprint event like the 400m (approximately 50 sec duration).

(6 marks)

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(c) Upon completing the 400m race, an athlete would continue to breathe quite heavily for a few moments after the race. Explain why the extra oxygen is required.

(4 marks)

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