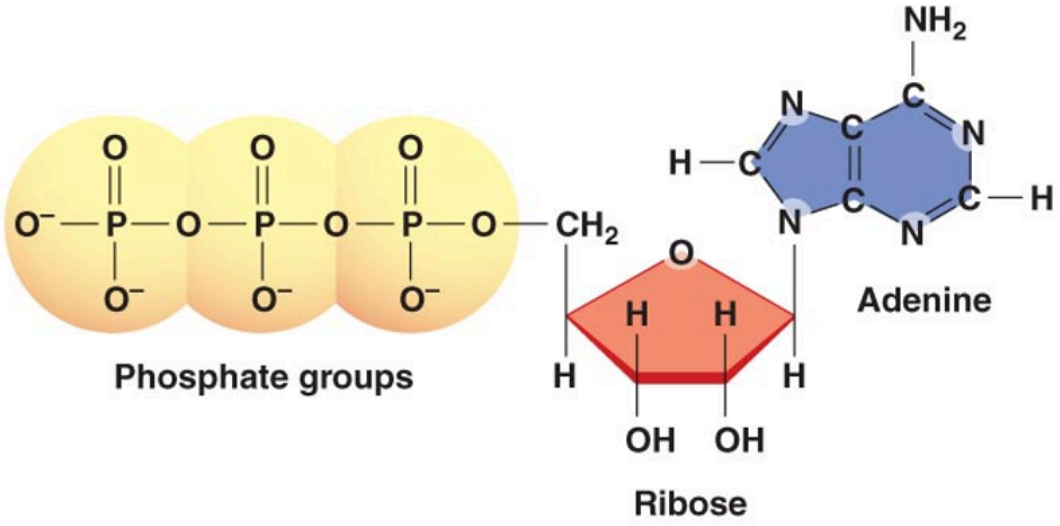
Energy and Training



Name:

Teacher: Mr Trent

Fast Facts

- Energy Sources: The body primarily uses three energy systems: ATP-CP (phosphagen), anaerobic glycolysis, and aerobic respiration.
- Immediate Energy: The ATP-CP system provides immediate energy for short bursts of high-intensity activity, lasting about 10 seconds.
- Lactic Acid Production: During anaerobic glycolysis, glucose is broken down without oxygen, producing lactic acid, which can cause muscle fatigue.
- Aerobic Powerhouse: The aerobic system uses oxygen to produce energy, making it ideal for endurance activities like marathons and long-distance cycling.
- ATP Stores: The body stores only a limited amount of ATP (around 80-100 grams), enough for about 2-3 seconds of intense activity.
- Energy Transition: During exercise, the body shifts between energy systems based on intensity and duration. For example, a sprint primarily uses the ATP-CP system, while a long run relies on aerobic respiration.
- Fuel Types: The body can use carbohydrates, fats, and, to a lesser extent, proteins as fuel sources, depending on the energy system in use.
- Recovery Time: After intense exercise, the ATP-CP system can recover in about 2-3 minutes, while the lactic acid produced during anaerobic glycolysis can take 30-60 minutes to clear.
- Heart Rate and Energy Use: As exercise intensity increases, the body gradually shifts from aerobic to anaerobic energy production, raising heart rate and breathing rate.
- Training Impact: Regular training can enhance the efficiency of all energy systems, allowing athletes to perform better at higher intensities for longer durations.
- Glycogen Storage: The body stores carbohydrates in the form of glycogen in the muscles and liver, which serves as a key energy source during exercise.
- Fat Utilisation: The aerobic system is highly efficient at utilizing fat for energy, particularly during low to moderate-intensity activities.
- Metabolic Rate: The rate at which the body converts food into energy is known as the metabolic rate, which can vary based on factors like age, gender, and muscle mass.
- Hydration's Role: Proper hydration is essential for optimal energy production and performance, as even mild dehydration can significantly impair physical performance.
- Energy Balance: Achieving an energy balance—consuming the same amount of energy as you expend—is crucial for maintaining weight and overall health.

A.2.2.1—Macronutrients (carbohydrates, proteins and lipids) provide sources of energy to maintain bodily functions during growth, rest and physical activity.

- € Relative contributions of macronutrients to bodily functions depend on an individual's body composition, age, sex differences and activity level.
- € The availability of macronutrients and their metabolisation within our body influences health and performance.
- € Nutritional strategies related to macronutrient consumption prior to and during exercise can affect gastrointestinal comfort and sporting performance.
- € These can be adjusted for the specific demands of the activity and the sportsperson's sex differences, age and activity level.
- € Low energy availability (LEA) is a state in which the body has insufficient energy to support physiological functions needed for optimal health.
- € Relative energy deficiency in sport (RED-S) is a consequence of prolonged LEA.

Individual Energy Intake Assessment Task Criteria

- € Accuracy and detail of the food diary.
- € Quality of the data analysis and ability to compare your macronutrient intake with recommended values.
- € Depth of understanding demonstrated in the comprehension questions.
- € Ability to apply nutritional strategies for optimising health and performance.
- € Reflection on the importance of energy availability and RED-S

Part 1: Keeping a Strict Food Diary

- For 3 days, record every meal and snack you consume, noting the specific types and quantities of food and drink.
- Use a reliable food tracking app or nutrition guide (e.g., **MyFitnessPa**l, Cronometer) to help you log your food and calculate the macronutrient content of each item (carbohydrates, proteins, fats).
- Daily Requirements: Ensure you record the following information for each day:
    - Total calories consumed
    - Carbohydrates (g)

- Proteins (g)
- Fats (g)
- Fibre (g)
- Water intake (litres)
- Physical activity levels (type and duration)
- Notes on any gastrointestinal discomfort (e.g., bloating, cramps, etc.) before, during, or after exercise.

Day	Meal	Food/Drink Consumed	Total Calories	Carbohydrates (g)	Proteins (g)	Fats (g)	Fibre (g)	Water Intake (litres)	Physical Activity (Type & Duration)	Notes
Day 1	Breakfast									
	Lunch									
	Dinner									
	Snacks									

Day	Meal	Food/Drink Consumed	Total Calories	Carbohydrates (g)	Proteins (g)	Fats (g)	Fibre (g)	Water Intake (litres)	Physical Activity (Type & Duration)	Notes
Day 2	Breakfast									
	Lunch									
	Dinner									

	Snacks									

Day	**Meal**	**Food/Drink Consumed**	**Total Calories**	**Carbohydrates (g)**	**Proteins (g)**	**Fats (g)**	**Fibre (g)**	**Water Intake (litres)**	**Physical Activity (Type & Duration)**	**Notes**
Day 3	**Breakfast**									
	Lunch									
	Dinner									

Snacks									

Part 2: Analyse Your Food Intake

- Step 1: Macronutrient Breakdown
    - For each day, calculate your total intake of macronutrients (carbohydrates, proteins, and fats).

    - Compare your intake to recommended daily macronutrient ratios:
        - Carbohydrates: 45-65% of total calories
        - Proteins: 10-35% of total calories
        - Fats: 20-35% of total calories

- Step 2: Compare to Averages
    - Compare your results to the average macronutrient distribution for your age, sex, and activity level (use online resources such as the Institute of Medicine's guidelines or a registered dietitian’s recommendations).

- Discuss any disparities in macronutrient intake, particularly if you consume more or less of one macronutrient relative to others.

- Step 3: Calculate Energy Availability
    - Based on your caloric intake and energy expenditure (consider your daily activity level and exercise routines), calculate your energy availability. Energy availability is the amount of energy left for physiological functions after accounting for energy expended in physical activity.

    - Discuss any potential signs of low energy availability (LEA), which occurs when the body does not have enough energy to support regular physiological functions, including growth, recovery, and hormonal health.

Part 3: Data Analysis

- **Risks of Relative Energy Deficiency in Sport (RED-S)**
    - Analyse your energy availability in relation to your physical activity levels. If your food intake appears insufficient to support your training, assess the potential risk of RED-S (Relative Energy Deficiency in Sport), which can have serious long-term impacts on health, including hormonal imbalances, impaired immune function, and reduced performance.

    - **Provide a self-assessment of how your eating habits might influence your physical health and performance in the short and long term.**

Part 4: Comprehension Questions

1. What are the primary roles of carbohydrates, proteins, and fats in the body, particularly during physical activity?
2. Explain how an imbalance in macronutrient intake (either too much or too little of a specific macronutrient) could impact an athlete's performance and health.
3. What is low energy availability (LEA), and how can it affect an athlete's overall health and performance?
4. Define LEA and explain the physiological consequences of this state. Discuss the long-term risks of prolonged LEA, including the potential onset of RED-S.
5. What are some strategies athletes can use to optimise their macronutrient intake for improved exercise performance and recovery?
6. Explore nutrition strategies such as carbohydrate loading, protein timing, and healthy fat consumption.
7. Discuss how these strategies can be adapted for different sports, considering the energy demands and individual needs of the athlete.
8. How do age, sex, and activity level influence macronutrient needs?
9. Compare the nutritional requirements of different demographic groups (e.g., children, adults, athletes, sedentary individuals) and explain how these factors affect the metabolism of macronutrients.
10. Describe the role of carbohydrates in sustaining energy levels during exercise and the potential effects of insufficient carbohydrate intake.

11. Provide examples of how carbohydrates are metabolised during different types of physical activity and the impact of depletion on endurance and performance.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

……

……

……

……

……

……

……

……

……

……

……

……

……

……

A.3.2 Benefits to health of being active

A.3.2.1—An active lifestyle supports physical well-being.

- € A healthy level of physical activity for an individual varies with factors such as age and sex differences.

1. Research the recommended physical activity levels for their assigned age group
2. Plan an exercise session which will meet the physical activity needs of your selected age group
3. Undertake the exercise session
4. Conduct a Self-Reflection

    - **Physical Experience**
    - **How did I feel during the warm-up and throughout the workout?**
    - Reflect on your energy levels and any physical sensations you experienced. Were you excited, nervous, or relaxed?

    - **Were there any exercises I found particularly challenging or easy? Why?**
    - Think about specific exercises that stood out. Did you struggle with certain movements, or did you feel confident and strong in others?

- **Did I feel energised or fatigued at any point?**
- Consider how your body responded during different parts of the session. Were there moments when you felt a burst of energy, or did you feel tired before the cool down?

- **Emotional Response**
- **What emotions did I experience during the session (e.g., joy, frustration, satisfaction)?**
- Identify your feelings throughout the workout. Did you find joy in completing an exercise, or did frustration arise when struggling with a particular station?

- **Did working out in a group affect my motivation? How?**
- Reflect on how the group dynamic influenced your workout. Did you feel more motivated because of your peers, or were there distractions that affected your focus?

- **Social Interaction**
- **How did I interact with my peers during the session?**

- Consider your engagement with others. Did you cheer someone on, or did you collaborate with a partner during certain exercises?

- **Did I feel supported or encouraged by others? Did I encourage anyone else?**
- Think about the sense of community in the group. Did you receive encouragement, and did you reciprocate that support to fellow participants?

- **Goal Assessment**
- **Did I achieve my personal goals for this session? If not, what can I change next time**
- Evaluate your performance against any personal targets you set. What specific changes can you implement to meet those goals in future sessions?

- **What did I learn about my physical abilities and limits?**
- Reflect on your experience regarding your physical capabilities. Did you discover any strengths or identify areas for improvement?

- **Future Planning**
- **Based on this experience, what type of physical activities do I want to include in my routine moving forward?**
- Consider the activities you enjoyed most during the session. Which exercises or formats would you like to explore more?

- **How can I improve my engagement in future exercise sessions?**

- Think about strategies to enhance your participation and enjoyment. Will you set specific goals, try new activities, or focus on building camaraderie with peers?

Discussion about how biological and societal factors might influence physical activity levels for different genders. Use prompts such as:

- How do societal expectations shape activity levels?
- Are there differences in sports or activities typically pursued by different genders?

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

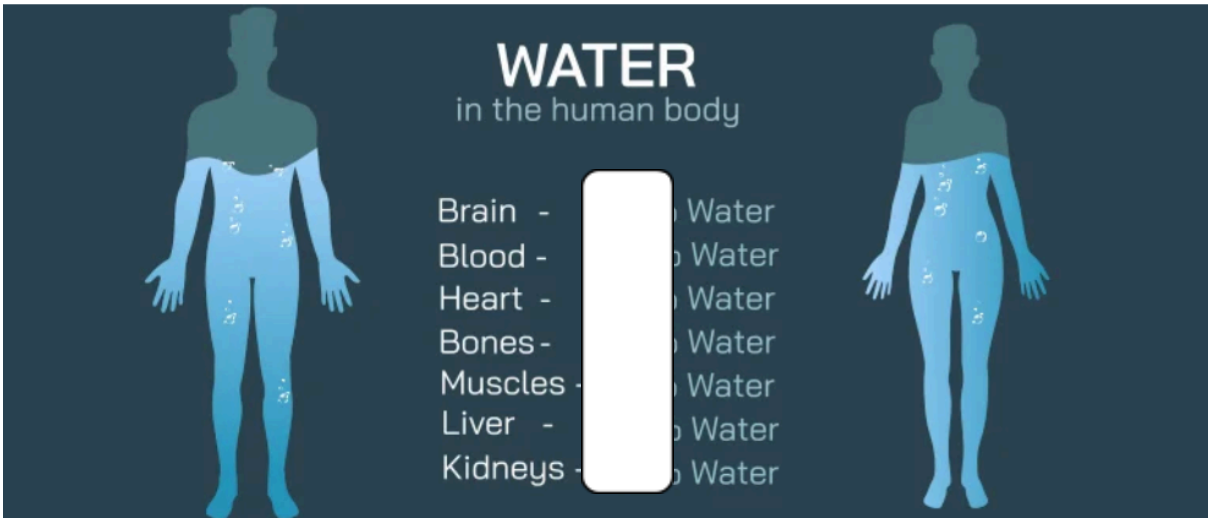
. . . . . .

. . . . . .

. . . . . .

A.2.1.1—Water and electrolyte balance is necessary for effective functioning of the body and is influenced by the environment

- € Water and electrolyte intake occurs via the large intestine.
- € Loss of fluids and electrolytes occurs via evaporation through the skin and the respiratory tract, and excretion via osmosis.
- € Dehydration, hypernatremia and hyponatremia are three states that can occur if water and electrolyte balance is not maintained.
- € This will affect health and performance.
- € Water and electrolyte balance can be measured in a variety of ways, including body weight, urine colour and osmolarity.
- € Electrolyte balance is regulated by the hypothalamus, pituitary gland and kidneys.

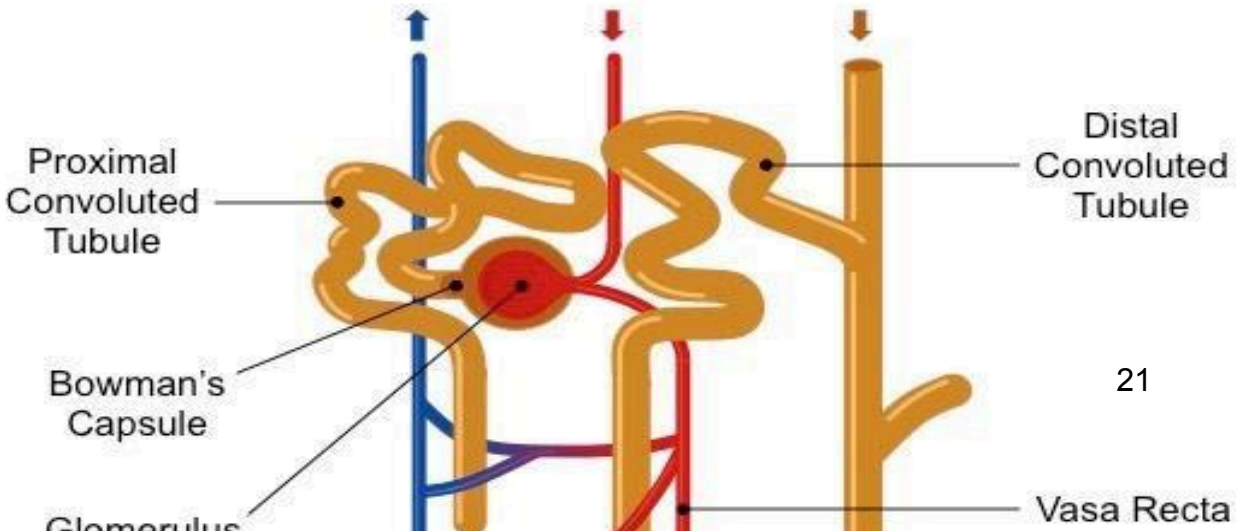


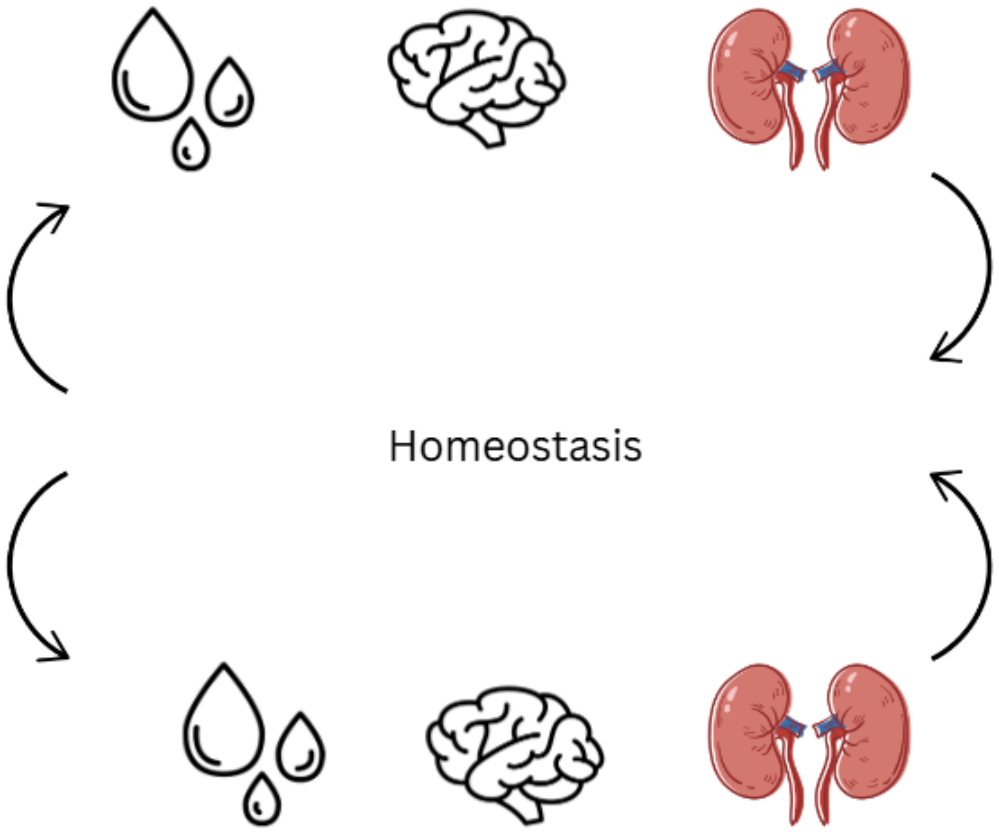
List 4 ways we lose water:

Term		Description
1. Dehydration		A. A condition that occurs when the sodium concentration in the blood becomes too low, often due to overhydration.
2. Hypernatremia		B. Occurs when the body loses more water than it takes in, leading to insufficient water for normal bodily functions.
3. Hyponatremia		C. A condition in which the sodium level in the blood increases due to excessive water loss or inadequate water intake.
4. Electrolyte Imbalance		D. The body's inability to maintain adequate hydration and electrolyte levels, leading to issues with muscle function, nerves, and cellular activity.
5. Water Intoxication		E. Symptoms include nausea, confusion, and fatigue, and can occur when large amounts of water are consumed without replacing electrolytes.

6. Sodium	F. An essential electrolyte in the body that helps regulate fluid balance, nerve function, and muscle contraction.
7. Thirst	G. A signal from the body indicating the need for water intake to prevent dehydration.
8. Cellular Dehydration	H. When cells lose water due to an imbalance in electrolytes, leading to possible organ dysfunction or damage.
9. Endurance Exercise	I. Prolonged physical activity that increases the risk of dehydration, electrolyte loss, and overhydration if not properly managed.
10. Electrolyte Replenishment	J. The process of restoring electrolytes, especially sodium and potassium, to the body, typically after exercise or sweating.

Define Osmosis:





1. Osmoreceptors
2. Antidiuretic hormone (ADH)
3. Hypothalamus
4. Pituitary gland
5. Aquaporins
6. Collecting Tube
7. Negative Feedback
8. Urine Volume
9. Urine Concentration

- **Steady state** is a condition

- **Cardiovascular drift** is a _____ that occurs due to _____ from the body or an increase in _____ body temperature. It typically takes place during a _____ steady-state of _____ (or _____) exercise, especially in _____ and hot _____.

- **Word Bank**: water loss, core, prolonged, submaximal, aerobic, thermoneutral, temperature, environments

Draw a graph to show the changes in HR, SV, CO, Blood Plasma and Blood Pressure over time.

Describe and explain the effects of hyponatremia and hypernatremia.

Measurement Method		Description
1. Body Weight		A. Measures the concentration of particles in the urine to determine hydration level, reflecting water and electrolyte balance.
2. Urine Colour		B. A simple visual indicator where darker colours suggest dehydration and lighter colours suggest proper hydration.
3. Urine Osmolarity		C. Monitoring changes in this factor over time can indicate fluid loss or retention, useful for assessing hydration status.

What does "steady state" refer to in exercise physiology?

A) The point at which exercise intensity exceeds aerobic capacity

B) When physiological systems stabilise and oxygen supply meets demand

C) The recovery period after intense exercise

D) The period of time after exhaustion

What is a primary cause of cardiovascular drift during prolonged exercise?

A) Decrease in blood volume and increase in oxygen demand

B) Water loss and increased core body temperature

C) Sudden increase in exercise intensity

D) Decrease in heart rate

Which of the following is NOT a common method for measuring water and electrolyte balance?

A) Body weight monitoring

B) Urine colour

C) Osmolarity

D) Blood pressure

Hyponatremia is a condition that can occur when:

A) Sodium levels in the blood increase beyond normal limits

B) Water intake far exceeds the body's needs, diluting blood sodium levels

C) Blood pressure drops excessively

D) The body experiences severe dehydration

Cardiovascular drift is most likely to occur during which type of exercise environment?

A) High-intensity anaerobic training

B) Prolonged, submaximal exercise in a hot or thermoneutral environment

C) Short bursts of maximal effort exercise

D) Exercise in cold environments

1. Explain how the cardiovascular system adapts during prolonged, submaximal exercise in a hot environment. (5 marks)
2. Describe the concept of cardiovascular drift and its effects on heart rate and cardiac output. (6 marks)

3. Compare and contrast dehydration, hypernatremia, and hyponatremia in terms of their causes, symptoms, and consequences on athletic performance. (7 marks)
4. Explain how the body regulates water and electrolyte balance during exercise. Discuss the role of hydration and electrolyte intake in maintaining performance and preventing heat stress. (6 marks)
5. Describe the effects of dehydration on exercise performance. Include the physiological mechanisms that are affected and how they influence endurance activities. (5 marks)
6. Discuss the different ways in which water and electrolyte balance can be measured and explain the advantages and limitations of each method. (6 marks)
7. Explain how cardiovascular drift can influence the performance of athletes during long-duration events. In your answer, include the effects on stroke volume, heart rate, and blood flow distribution. (7 marks)
8. Define steady state in the context of exercise physiology and discuss how it is affected by environmental factors such as temperature and humidity. (5 marks)
9. Describe the role of osmoreceptors, chemoreceptors, baroreceptors, and proprioceptors in regulating cardiovascular function during exercise. (6 marks)

€ The basic components of energy balance include energy intake, energy consumption and energy storage.

- € I will be able to **define and explain** what **energy intake, energy consumption, energy storage**, and **basal metabolic rate (BMR)** mean and how they relate to my health and physical activity.
- € I will track my daily food intake and physical activity levels, then **look at the relationship** between my energy intake and step count to understand how it affects my overall health.

Define:

Energy Intake

Energy Consumption:

Energy Storage:

Basal Metabolic Rate:

1. Track you daily food intake for a week. Calculate the total caloric intake and categorise foods based on their energy content (e.g., high, medium, low energy foods).
2. Track physical activity levels using step counter
3. Add your data to the class spreadsheet for analysis
4. **What is the correlation between daily energy intake and step count among adolescents, and how does this relationship impact overall physical activity levels and health outcomes?**
5. Evaluate this research question
6. Present your all of your information on 1 A4 canva.

- € Physical activity can positively or negatively affect muscular and immune system function.

Learning Objectives:

- € Encourage critical thinking about the multifaceted effects of physical activity on health.
- € Promote understanding of the balance needed in exercise routines.
- € Foster respectful discourse and the ability to present and defend an argument.

Debate Topic: **"The Impact of Physical Activity on Muscular and Immune System Function: Positive or Negative?"**

Debate Format

- **Teams: Two teams (Pro and Con)**

Pro - Supporting the Positive Effects	Con - Highlighting Potential Negative Effects

- **Structure:**
    - **Opening statements (3 minutes each)**
    - **Rebuttals (2 minutes each)**
    - **Cross-examination (2 minutes each)**
    - **Closing statements (2 minutes each)**

Background Information

Physical activity is widely recognized for its benefits to health, but the effects can vary depending on factors such as the type, intensity, and frequency of the activity. This debate will explore both sides of the argument regarding whether physical activity predominantly enhances or detracts from muscular and immune system function.

Conclusion

	Pro - Supporting the Positive Effects	Con - Highlighting Potential Negative Effects

Muscular		
Immune		

- The risk of developing osteoporosis, obesity, hypertension, cardiovascular diseases and type 2 diabetes can be reduced through an active lifestyle.

Learning Objectives

- Understand the connection between physical activity and health risk reduction.
- Develop research and design skills.

- € Present information clearly and effectively.

Create an informative leaflet that educates your peers about how an active lifestyle can reduce the risk of developing osteoporosis, obesity, hypertension, cardiovascular diseases, and type 2 diabetes. Your leaflet should be visually appealing, informative, and engaging.

Leaflet Requirements

1. **Content**
   Your leaflet should include:
   - **Title:** A catchy title that captures the essence of your leaflet.
   - **Introduction:** Briefly introduce the topic and why it's important to stay active.
   - **Health Risks:** Explain each of the following health risks:
     - Osteoporosis
     - Obesity
     - Hypertension
     - Cardiovascular Diseases
     - Type 2 Diabetes
   - **Benefits of an Active Lifestyle:** Describe how regular physical activity can help reduce the risk of these conditions.
   - **Recommended Physical Activity Levels:** Provide guidelines for different age groups.
   - **Tips for Staying Active:** Suggest practical ways to incorporate physical activity into daily life.
   - **Conclusion:** Encourage readers to take action and make physical activity a priority.
2. **Design**
   Your leaflet should be:
   - **Visually Appealing:** Use images, colors, and graphics to engage the reader.
   - **Well-Organized:** Information should be clear and easy to follow.
   - **Readable:** Use bullet points, headings, and subheadings for clarity.

3. **References**

   Include a list of sources for the information presented in your leaflet.

Criteria	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Content	Thorough and accurate information; covers all health risks and benefits.	Good information; covers most health risks and benefits.	Basic information: some health risks or benefits are missing.	Lacks important information; unclear or inaccurate content.
Organisation	Clear, logical flow; well-structured sections.	Mostly clear; some organisation issues.	Somewhat confusing; lacks clear structure.	Very disorganised; difficult to follow.
Design	Visually appealing; effective use of images and colours.	Good design; some effective visuals.	Basic design; minimal visual appeal.	Poor design; lacks visual elements and appeal.
Readability	Easy to read; excellent use of headings and bullet points.	Generally easy to read; some headings/bullet points used.	Some difficulty in reading; few headings/bullet points.	Hard to read; lacks organization and clarity.
References	Comprehensive list of credible sources included.	Good list of sources, mostly credible.	Limited sources; some may not be credible.	No references or sources provided.

Glue Leaflet Here

Checkpoint: Discuss the significance of an active lifestyle in supporting physical well-being. In your response, analyse its benefits to muscular health and immune system function, and evaluate how maintaining an active lifestyle can contribute to the prevention of chronic diseases such as obesity, cardiovascular conditions, and osteoporosis (15 marks)

A.2.3 Energy systems

A.2.3.1—The body relies on the phosphagen, glycolytic and oxidative systems for energy production to sustain life and physical activity.

- € The energy systems have different fuel sources for ATP production, recovery capabilities, benefits and limitations during physical activity.

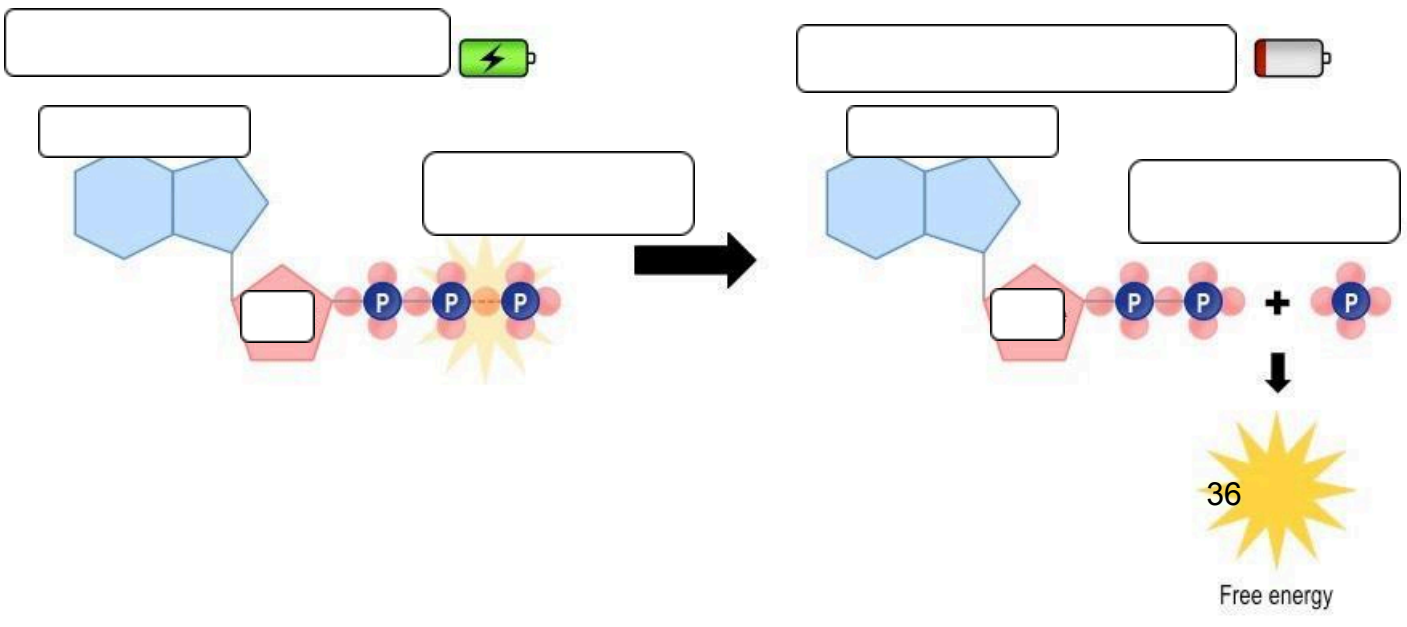
Draw and annotate a molecule of ATP to show how it stores and releases energy.

List six cellular process that use ATP as a source of energy.

- _____ contraction
- _____ synthesis
- _____ transport
- vesicle transport
- cell signalling
- _____ & _____ replication

- Anaerobic respiration involves the _____ breakdown of organic molecules for a small yield of ATP (_____ required)

- Aerobic respiration involves the _____breakdown of organic molecules for a larger yield of ATP (_____ required)

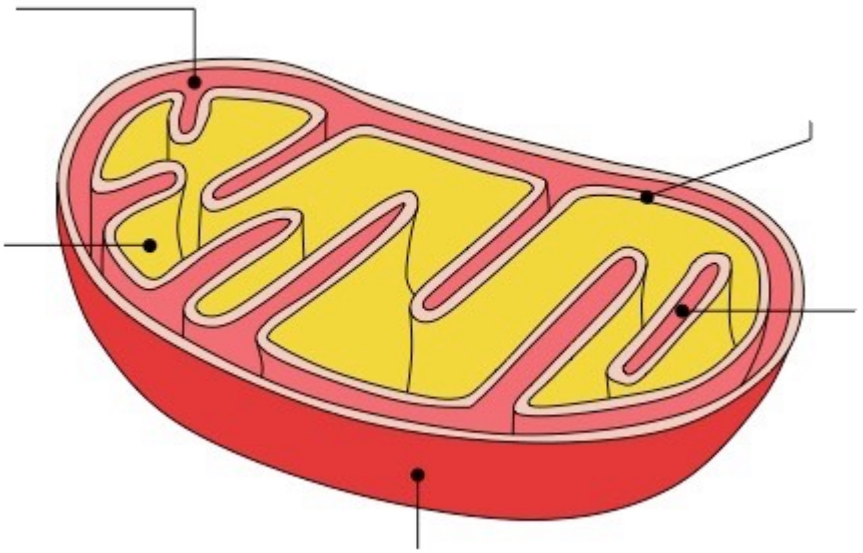


€ The energy continuum aids in describing the relative contribution of each energy system depending on the nature of the activity.

Duration

Draw a graph to illustrate the above energy systems

- While at rest, and during extended periods of submaximal intensity, the oxidative system is the dominant supplier of ATP to support the body's activities.



- During both short- and high-intensity periods, and sudden increases of intensity, anaerobic ATP production (phosphagen and anaerobic glycolysis) supports the body's functions.

- € Nutritional strategies related to macronutrient consumption prior to and during exercise can affect gastrointestinal comfort and sporting performance.

Gastrointestinal (GI) discomfort during exercise can arise due to physiological, mechanical, and nutritional factors:

Put these statements into the category of GI discomfort.

- € Blood flow redistribution
- € Hormonal changes
- € Dehydration
- € Impact from movement
- € Posture
- € Type and timing of food intake:
- € Hydration strategy:
- € Ingredients

Physical/Mechanical	Physiological	Nutritional

A.2.2.3—The gut microbiome influences the health and performance of an individual.

What is fibre and what is the role in the body?

What is inflammation and what causes it?

What are good sources of fibre?

Define Antioxidant

What are polyphenols and what foods do they come from?

What is the gut microbiome?

What is the role of gut microbiome?

Genetics, diet, medications and lifestyle influence microbiomes.

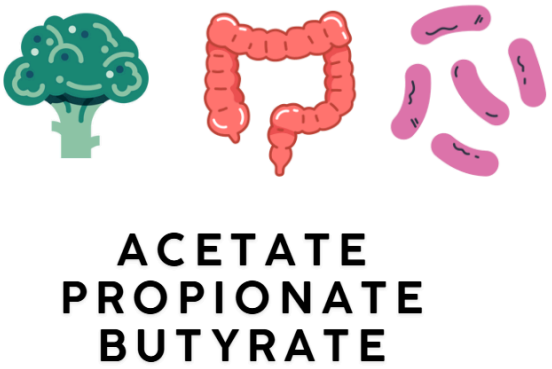
What is the role of each of these:

- Serotonin –
- Dopamine –

- Cortisol –

Describe the relationship between the digestive system and the nervous system

What are Short Chain Fatty Acids (SCFA's) and how are they produced?



How can processed food affect your gut microbiomes?

What are fermented foods and how can they help the gut microbiome?

How does medication affect the microbiome?

Which of the following is a major function of short-chain fatty acids (SCFAs) produced by gut bacteria?

Create an interview with a doctor to explain the gut microbes and gut microbiome to someone who has no idea. Max. 5 mins

A.2.3.2—Maximal oxygen consumption (VO2 max) is influenced by an individual's age, sex differences, body composition, lifestyle factors and level of fitness.

- € Endurance performance is affected by VO2 max and efficiency of movement, e.g. running economy.

VO2 max (also known as maximal oxygen uptake) is a measure of the maximum amount of oxygen your body can use during intense exercise. It is a key indicator of cardiovascular fitness and aerobic endurance. In simple terms, it tells you how well your body can take in and use oxygen when you're pushing yourself to the limit.

When you exercise, your muscles need oxygen to produce energy. The more oxygen your muscles can use, the longer and harder you can exercise without getting tired. So, the higher your VO2 max, the better your endurance!

VO2 max is a key factor in endurance sports, like running, cycling, and swimming. Athletes use it to gauge their fitness level and predict their performance. But even if you're not training for a competition, improving your VO2 max can help improve your overall health, stamina, and performance in day-to-day activities like walking or playing sports.

There are a few ways to measure VO2 max, ranging from simple tests to more complex scientific methods. Here are the main approaches:

1. **Direct Measurement (Lab Test)**
   The most accurate way to measure VO2 max is through a lab test, usually conducted on a treadmill or a stationary bike. During this test, you wear a mask that measures the amount of oxygen you inhale and the carbon dioxide you exhale. The intensity of the exercise increases gradually, and the test continues until you can no longer continue. The result is the highest amount of oxygen your body uses during the test, and that's your VO2 max.

2. **Submaximal Tests (Field Tests)**
   Not everyone has access to lab equipment, so you can also estimate your VO2 max using field tests. These tests usually involve running or cycling over a set distance or time, such as:

   - **The Cooper Test**: Run as far as possible in 12 minutes.
   - **The Rockport Walk Test**: Walk 1 mile as fast as you can, then check your heart rate.

In lab tests, VO2 max is usually expressed in milliliters of oxygen used per minute per kilogram of body weight (ml/min/kg). This allows for a comparison of fitness levels between people of different sizes. A higher number indicates better cardiovascular fitness.

For example:

A.2.3.3—The lactate inflection point is the maximum intensity at which the body can metabolize lactate at the same rate as its production

A.2.3.4—Excess post-exercise oxygen consumption (EPOC) is required for the body to return to homeostasis and is dependent on the oxygen deficit incurred during exercise. EPOC is typically divided into two subsections: fast and slow.

B) When physiological systems stabilize and oxygen supply meets demand

B) Water loss and increased core body temperature

D) Blood pressure

B) Water intake far exceeds the body’s needs, diluting blood sodium levels

B) Prolonged, submaximal exercise in a hot or thermoneutral environment

1. Explain how the cardiovascular system adapts during prolonged, submaximal exercise in a hot environment. (5 marks)

a. Increased heart rate: Due to cardiovascular drift, the heart rate rises to compensate for a decrease in stroke volume.

b. Reduced stroke volume: This occurs due to decreased blood volume from sweating and vasodilation.

c. Increased blood flow to skin: Blood is diverted to the skin for cooling, which reduces blood flow to muscles.

d. Elevated core temperature: Body temperature increases, affecting enzyme activity and performance.

e. Increased sweat rate: Sweating increases to regulate body temperature, leading to fluid loss.

2. Describe the concept of cardiovascular drift and its effects on heart rate and cardiac output. (6 marks)

a. Cardiovascular drift: A gradual increase in heart rate during prolonged submaximal exercise.

b. Decrease in stroke volume: Due to dehydration and reduced venous return to the heart.

c. Increase in heart rate: Compensates for the reduction in stroke volume to maintain cardiac output.

d. Effects on cardiac output: Initially, cardiac output is maintained but can decrease over time due to reduced stroke volume.

e. Blood redistribution: Blood is diverted from muscles to the skin for thermoregulation.

f. Core temperature rise: The body's temperature increases, contributing to drift.

3. Compare and contrast dehydration, hypernatremia, and hyponatremia in terms of their causes, symptoms, and consequences on athletic performance. (7 marks)

a. Dehydration:

Cause: Insufficient water intake during exercise.

Symptoms: Thirst, dry mouth, dizziness, fatigue.

Consequences: Reduced endurance, increased fatigue, impaired thermoregulation.

b. Hypernatremia:

Cause: Excessive sodium intake relative to water.

Symptoms: Confusion, nausea, swelling, high blood pressure.

Consequences: Impaired performance due to altered fluid balance, risk of stroke.

c. Hyponatremia:

Cause: Excessive water intake without sufficient sodium.

Symptoms: Nausea, headache, confusion, swelling of cells.

Consequences: Can impair muscle function, leading to cramps, reduced performance, or seizures.

4. Explain how the body regulates water and electrolyte balance during exercise. Discuss the role of hydration and electrolyte intake in maintaining performance and preventing heat stress. (6 marks)

a. Role of ADH (antidiuretic hormone): Increases water retention by the kidneys to maintain blood volume.

b. Role of aldosterone: Promotes sodium retention to maintain fluid balance.

c. Sweat production: Evaporation cools the body but leads to electrolyte loss (mainly sodium and chloride).

d. Electrolyte intake: Necessary to replenish lost sodium, potassium, and other electrolytes to maintain fluid balance.

e. Hydration strategies: Drinking water and electrolyte-rich fluids help maintain performance and prevent dehydration.

f. Heat stress prevention: Proper hydration helps regulate core temperature and prevent heat-related illnesses.

5. Describe the effects of dehydration on exercise performance. Include the physiological mechanisms that are affected and how they influence endurance activities. (5 marks)

a. Reduced blood volume: Dehydration decreases plasma volume, reducing venous return and stroke volume.

b. Elevated heart rate: To compensate for reduced stroke volume, heart rate increases.

c. Impaired thermoregulation: Reduced sweating and elevated body temperature impair heat dissipation.

d. Decreased endurance: Muscle function is compromised, leading to fatigue and reduced stamina.

e. Increased perceived effort: Athletes experience greater difficulty maintaining the same intensity.

6. Discuss the different ways in which water and electrolyte balance can be measured, and explain the advantages and limitations of each method. (6 marks)

a. Body weight:

Advantage: Simple, quick, and non-invasive.

Limitation: Does not differentiate between water loss and fat or muscle loss.

b. Urine colour:

Advantage: Easy to assess; darker urine indicates dehydration.

Limitation: Subjective and influenced by food or medication.

c. Osmolarity:

Advantage: Provides a direct measurement of electrolyte concentration in fluids.

Limitation: Requires specialized equipment and expertise.

7. Explain how cardiovascular drift can influence the performance of athletes during long-duration events. In your answer, include the effects on stroke volume, heart rate, and blood flow distribution. (7 marks)

a. Increased heart rate: To compensate for a decrease in stroke volume, heart rate rises gradually.

b. Decreased stroke volume: Due to reduced blood volume from sweating and reduced venous return.

c. Decreased blood flow to muscles: Blood is diverted to skin for cooling, reducing muscle oxygen supply.

d. Increased core temperature: Body temperature rises, leading to increased heart rate to maintain cardiac output.

e. Impaired endurance: As cardiovascular drift progresses, performance diminishes due to reduced oxygen delivery and increased perceived exertion.

f. Thermoregulatory challenges: Difficulty managing heat and hydration further impairs performance.

g. Fatigue: Athletes may experience greater fatigue as the body struggles to maintain homeostasis.

8. Define steady state in the context of exercise physiology and discuss how it is affected by environmental factors such as temperature and humidity. (5 marks)

a. Steady state: A condition where the body's energy demands and supply are balanced during submaximal exercise.

b. Environmental impact: High temperature and humidity increase cardiovascular strain, making it harder to reach steady state.

c. Impaired thermoregulation: Excessive heat makes it harder to dissipate body heat, reducing performance.

d. Dehydration: Environmental heat can cause fluid loss, affecting steady state maintenance.

9. Describe the role of chemoreceptors, baroreceptors, proprioceptors, and osmoreceptors in regulating cardiovascular function during exercise. (6 marks)

a. Chemoreceptors:

Detect changes in blood pH, CO2 levels, and oxygen concentration.

They help regulate ventilation and blood flow to ensure adequate oxygen delivery and waste removal.

b. Baroreceptors:

Located in the arteries, baroreceptors monitor blood pressure.

They trigger adjustments in heart rate and blood vessel diameter to maintain stable blood pressure during exercise.

c. Proprioceptors:

Found in muscles and joints, proprioceptors provide feedback on muscle activity and position.

They help regulate blood flow to active muscles by detecting movement and changes in muscle length.

d. Osmoreceptors:

Located in the hypothalamus, osmoreceptors detect changes in blood osmolarity, especially during dehydration.

They signal the release of antidiuretic hormone (ADH) to help conserve water and maintain fluid balance, which is crucial for sustaining cardiovascular function during exercise.