AAQ Medicinal Science Summer Workbook

Exploring the World of Medicine and Science

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Your Gateway to a Future in Medicine

Summer Term Edition

Designed for Aspiring Medical Students

Prepared By: The AAQ Medicinal Science Faculty

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Contents:

- Medicinal Chemistry Basics: Understand the fundamental chemical principles that underpin modern medicine.
- Human Anatomy and Physiology: Explore the intricacies of the human body and learn how its systems function together.
- Case Studies: Real-World Applications: Analyse scenarios to understand the application of medical science in solving real-world problems.

“Discover, Learn, and Build Your Path in the Medical Sciences!”

✅ Week 1: Biological Molecules & Enzymes

Theme: Understanding the building blocks of life and how enzymes support biological processes.

📘 Task 1: Identifying Biological Molecules and Their Monomers

Objective: To research and complete a table identifying the four main biological molecules, their monomers, and their roles in the human body.

📌 Biological Molecules and Their Monomers

Biological Molecule	Monomer (Building Block)
Carbohydrates	Monosaccharides (e.g. glucose)
Proteins	Amino acids
Lipids	Fatty acids and glycerol
Nucleic Acids	Nucleotides

📝 **Your Task:** Complete the following table by adding:

- The **function** of each molecule in the body (e.g. energy source, structural role, genetic storage)
- At least **two examples** of where each molecule is found (in food or in the body)

Biological Molecule	Monomer	Function in the Body	Example (Food or Body)
Carbohydrates	Monosaccharides		
Proteins	Amino acids		
Lipids	Fatty acids + glycerol		
Nucleic Acids	Nucleotides		

🔍 Research Tips:

- Use your GCSE notes or a reliable science website (e.g. BBC Bitesize, Seneca, or Khan Academy).
- Think about what these molecules do in digestion, energy release, growth, and inheritance.

📘 Task 2: Drawing Molecular Structures

Objective: To draw and label the basic structure of key biological molecules, showing how their components are arranged.

📝 Instructions:

Draw and label the following four biological molecules. For each one, include a short caption explaining its role in the body.

🔬 Molecules to Draw:

1. **A Simple Sugar (Monosaccharide)**
    - Show the basic ring structure.
    - Label the carbon atoms and functional groups (e.g. OH, H).
    - Caption: Describe its role in energy release.
2. **An Amino Acid**
    - Show the central carbon atom with four groups attached:
        - Amine group
        - Carboxyl group
        - Hydrogen atom
        - Variable R group
    - Caption: Explain how amino acids link to form proteins.
3. **A Triglyceride (Lipid)**
    - Show one glycerol molecule bonded to three fatty acid chains.
    - Label the ester bonds.
    - Caption: Describe its role in energy storage and insulation.
4. **A Nucleotide (Building Block of DNA)**
    - Include the three parts:
        - Phosphate group
        - Pentose sugar
        - Nitrogenous base
    - Caption: Explain how nucleotides form DNA strands.

🔍 You Should Include:

- Clear, labelled diagrams (use colour if possible).
- Accurate shapes and bond placements.
- A short explanation (1–2 sentences) for each molecule's biological role.

📘 Task 3: Types of Bonds in Biological Molecules

Objective: To describe the different types of bonds that hold biological molecules together and explain their importance.

📝 Instructions:

Write a short explanation (100–150 words) describing the **main types of bonds** found in biological molecules. You should include:

🔍 You Should Include:

- The **name** of each bond (at least four different types).
- The **biological molecule** where each bond is found (e.g. protein, carbohydrate, lipid, nucleic acid).
- What the bond **connects** (e.g. monomer to monomer, or parts of a molecule).
- Why the bond is **important** for the structure or function of the molecule.

🧠 Hints to Support Your Research:

- One bond joins **amino acids** together in proteins.
- Another bond links **sugars** in carbohydrates.
- A third bond connects **fatty acids to glycerol** in lipids.
- A fourth bond helps hold the **two strands of DNA** together.

🖍️ Extension (Optional):

Draw a small diagram to show one of the bonds forming between two monomers (e.g. two amino acids forming a dipeptide).

✅ Week 2: Cell Structure & Transport

📘 Task 1: Cell Structure

Objective: To identify and describe the structure and function of key organelles in animal and plant cells.

Instructions:
Draw and label diagrams of both an animal cell and a plant cell. For each organelle, write a short description of its function.

You should include:

- Clear diagrams of both cell types
- Labels for at least 6 organelles in each
- A brief function for each labelled part
- Highlight differences between plant and animal cells

Hints:

- Think about which organelles are involved in energy, protein production, and storage.
- Some structures are only found in plant cells.
- Use colour to distinguish parts and make your diagrams clearer.

📘 Task 2: The Plasma Membrane

Objective: To describe the structure and function of the plasma membrane using the fluid mosaic model.

Instructions:
Write a paragraph explaining how the plasma membrane is structured and how it controls what enters and leaves the cell. Include a labelled diagram.

You should include:

- A diagram showing the phospholipid bilayer
- Labels for proteins, cholesterol, and carbohydrate chains
- An explanation of selective permeability
- The role of membrane proteins in transport

Hints:

- Think of the membrane as a flexible barrier with moving parts.
- Use arrows to show movement of substances.
- Explain how the structure supports its function.

📘 Task 3: Types of Transport

Objective: To compare different types of transport across cell membranes.

Instructions:
Create a comparison table for diffusion, osmosis, facilitated diffusion, and active transport.

You should include:

- Definitions of each transport type
- Whether energy (ATP) is required
- Direction of movement (high to low or low to high concentration)
- Examples of substances moved by each method

Hints:

- Think about water movement in osmosis.
- Glucose often uses facilitated diffusion.
- Active transport moves substances against the gradient.

📘 Task 4: Visualising Transport

Objective: To illustrate how substances move across membranes using diagrams.

Instructions:
Draw four separate diagrams showing:

1. Diffusion
2. Osmosis
3. Facilitated diffusion
4. Active transport

You should include:

- Arrows showing direction of movement
- Labels for membrane, solute, solvent, and transport proteins
- A short caption for each diagram

Hints:

- Use different colours for solutes and solvents.
- Show concentration gradients clearly.
- Indicate where ATP is used.

✅ Week 3: Cardiovascular & Respiratory Systems

📘 Task 1: Structure of the Heart

Objective: To identify and describe the structure and function of the heart and the flow of blood through it.

Instructions:
Draw and label a diagram of the human heart. Use arrows to show the direction of blood flow. Write a short explanation of how blood moves through the heart and to the lungs and body.

You should include:

- Labels for atria, ventricles, valves, major blood vessels (aorta, vena cava, pulmonary artery and vein)
- Arrows showing the path of oxygenated and deoxygenated blood
- A brief explanation of the double circulatory system

Hints:

- Blood flows through the heart twice in one full circuit (to lungs and body).
- Use red and blue to show oxygenated and deoxygenated blood.
- Think about the role of valves in preventing backflow.

📘 Task 2: Components of Blood

Objective: To describe the structure and function of the main components of blood.

Instructions:
Create a fact sheet or poster explaining the four main components of blood and what each one does.

You should include:

- Red blood cells, white blood cells, platelets, and plasma
- A description of the function of each component
- A labelled diagram or illustration of blood components

Hints:

- Think about which component carries oxygen.
- Which part helps fight infection?
- Which part helps stop bleeding?

📘 Task 3: Structure of the Respiratory System

Objective: To identify and describe the structure and function of the respiratory system.

Instructions:
Draw and label the human respiratory system. Write a short explanation of how air travels from the nose to the alveoli.

You should include:

- Labels for trachea, bronchi, bronchioles, alveoli, diaphragm
- Arrows showing the path of air
- A brief explanation of the role of each part

Hints:

- Air enters through the nose/mouth and ends in the alveoli.
- The diaphragm helps with breathing in and out.
- Gas exchange happens in the alveoli.

📘 Task 4: Gas Exchange

Objective: To explain how oxygen and carbon dioxide are exchanged in the lungs.

Instructions:
Draw a diagram of an alveolus and a capillary. Write a short explanation of how gases move between the lungs and the blood.

You should include:

- Labels for alveolus, capillary, oxygen, carbon dioxide
- Arrows showing the direction of gas movement
- An explanation of diffusion and concentration gradients

Hints:

- Gases move from high to low concentration.
- Oxygen enters the blood; carbon dioxide leaves.
- Thin walls and large surface area help gas exchange.

📘 Task 5: Effects of Exercise

Objective: To describe how exercise affects the cardiovascular and respiratory systems.

Instructions:
Write a short report (150–200 words) explaining what happens to your heart and breathing during and after exercise.

You should include:

- Changes in heart rate and breathing rate
- Why these changes happen
- How this helps deliver oxygen to muscles
- A real-life example (e.g. during running or sports)

Hints:

- Muscles need more oxygen during exercise.
- The body removes more carbon dioxide.
- Think about how the systems work together.

✅ Week 4: Digestive, Renal & Musculoskeletal Systems

📘 Task 1: Digestive System Structure

Objective: To identify and describe the structure and function of the human digestive system.

Instructions:
Draw and label the human digestive system. Write a short explanation of what happens to food as it travels through the system.

You should include:

- Labels for mouth, oesophagus, stomach, small intestine, large intestine, liver, pancreas, rectum
- A brief function for each part
- Arrows showing the direction of food movement

Hints:

- Think about where digestion starts and ends.
- Some organs produce enzymes; others absorb nutrients.
- Use colour to highlight different sections.

📘 Task 2: Digestive Enzymes

Objective: To identify the main digestive enzymes and describe their roles.

Instructions:
Create a table listing the main digestive enzymes, what they break down, and what they produce.

You should include:

- Enzyme name
- Substrate (what it acts on)
- Product (what it breaks down into)
- Where in the body it works

Hints:

- One enzyme breaks down starch into sugars.
- Another breaks proteins into amino acids.
- A third breaks fats into fatty acids and glycerol.

📘 Task 3: Structure of the Kidney

Objective: To describe the structure and function of the kidney and nephron.

Instructions:
Draw and label a diagram of the nephron. Write a short explanation of how the kidney filters blood and produces urine.

You should include:

- Labels for Bowman's capsule, glomerulus, proximal tubule, loop of Henle, distal tubule, collecting duct
- A description of ultrafiltration and reabsorption
- The role of the kidney in removing waste

Hints:

- Blood is filtered under pressure.
- Useful substances are reabsorbed.
- Waste forms urine and travels to the bladder.

📘 Task 4: Muscles and Bones

Objective: To describe how the musculoskeletal system supports movement.

Instructions:
Draw and label a diagram showing how muscles and bones work together. Write a short explanation of how joints allow movement.

You should include:

- Bones, muscles, tendons, ligaments, joints
- An example of an antagonistic muscle pair
- A labelled diagram of a joint (e.g. elbow or knee)

Hints:

- Muscles pull on bones to create movement.
- Joints allow flexibility.
- Ligaments connect bone to bone; tendons connect muscle to bone.

📘 Task 5: Movement and Support

Objective: To explain the roles of the skeleton in movement, protection, and support.

Instructions:
Write a short paragraph (100–150 words) explaining how the skeleton helps the body move and stay protected.

You should include:

- The main functions of the skeleton
- Examples of bones that protect organs
- How bones and muscles work together

Hints:

- Think about the rib cage, skull, and spine.
- Bones act as levers.
- The skeleton gives the body shape and support.

✅ Week 6: Reporting on Human Health

Case Study-Based with Cross-Topic Links

📘 Case Study 1:

Patient: *David, Age 58*
Background: David works in an office and does very little physical activity. He eats a high-fat diet and smokes 15 cigarettes a day. He recently experienced chest discomfort while walking up stairs.

Health Check Results:

- **BMI:** 32.8
- **Blood Pressure:** 160/102 mmHg
- **Resting Heart Rate:** 108 bpm
- **Peak Flow:** 340 L/min
- **Cholesterol:** High
- **Lifestyle Notes:** Smoker, low physical activity, high saturated fat intake

📝 Questions:

1. Which of David's health indicators are outside the normal range?
2. What do these results suggest about his cardiovascular and respiratory health?
3. How might his lifestyle be contributing to these results?
4. What risks is David facing if no changes are made?
5. What advice or referrals might a healthcare professional recommend?

📘 Case Study 2:

Patient: *Layla, Age 47*
Background: Layla has been feeling tired, bloated, and has experienced unexplained weight loss. She has a family history of diabetes and coeliac disease.

Health Check Results:

- **BMI:** 19.4
- **Blood Pressure:** 110/70 mmHg
- **Blood Glucose (fasting):** 7.2 mmol/L
- **Iron Levels:** Low
- **Peak Flow:** 420 L/min
- **Lifestyle Notes:** Balanced diet, non-smoker, moderate exercise

📝 **Questions:**

1. Which of Layla's results are outside the normal range or raise concern?
2. What do these results suggest about her digestive or metabolic health?
3. How might her symptoms relate to conditions studied in previous weeks?
4. What further tests or referrals might be appropriate?
5. What advice might a healthcare professional give based on her profile?

📘 **Task: Writing a Health Report**

Objective: To summarise and communicate health data clearly and professionally.

Instructions:
Choose one of the case studies and write a short health report (150–200 words) as if you were a healthcare assistant reporting to a nurse or GP.

You should include:

- A summary of the patient's key health indicators
- An interpretation of what the results suggest
- Any concerns or risks that should be followed up
- Suggested lifestyle changes or referrals