15 DRUGS

YOUR NOTES

CONTENTS:

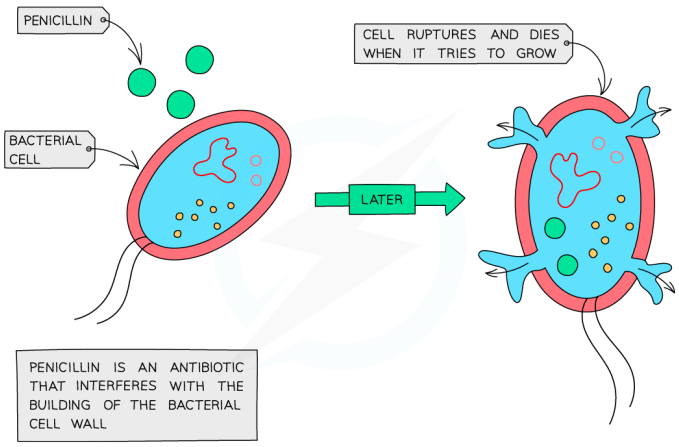
15.1 MEDICINAL DRUGS

What is a Drug?

- A drug is **any substance taken into the body that modifies or affects chemical reactions in the body**
- Some drugs are medicinal drugs that are used to treat the symptoms or causes of a disease – for example, **antibiotics**

Antibiotics

- Antibiotics are **chemical substances** made by certain **fungi or bacteria** that affect the working of bacterial cells, either by **disrupting their structure or function** or by **preventing them from reproducing**
- Antibiotics are **effective against bacteria but not against viruses**
- Antibiotics target processes and structures that are specific to bacterial (prokaryotic) cells; as such they do not generally harm animal cells



How antibiotics work

Why Don't Antibiotics Affect Viruses? The Basics

- Some bacteria that cause disease have **become** resistant to antibiotics and this **reduces the effectiveness of prescribed antibiotics** when someone has a bacterial infection, as it might be caused by a type of bacteria that is resistant to that particular antibiotic

15 DRUGS

15.1 MEDICINAL DRUGS cont...

YOUR NOTES

EXTENDED ONLY

Why Don't Antibiotics Affect Viruses?

- Viruses cannot be treated with antibiotics
- This is because antibiotics work by **disrupting cell functions such as respiration, or breaking down the structure of the cell in some way**
- However, viruses **do not carry out any cell functions** and **do not have cell walls, cell membranes or any cell organelles** as viruses infect and utilise the machinery of animal cells to reproduce, which are not affected by antibiotics
- Therefore the action of antibiotics **do not affect them**

Antibiotic Resistance

- Since the first antibiotic was discovered in 1928, many more have been discovered and developed
- Antibiotics were and are **widely overused**
- Commonly prescribed antibiotics are becoming **less effective** due to a number of reasons:
  - **overuse** and being prescribed when not really necessary
  - patients **failing to complete the fully prescribed cours**e by a doctor
  - large scale **use of antibiotics in farming** to prevent disease when livestock are kept in close quarters, even when animals are not actually sick
- This has lead to the effectiveness of antibiotics being reduced, and the incidence of antibiotic resistance increasing
- These bacteria are commonly known as superbugs and the most common is **MRSA**
- Ways individuals can help **prevent** the incidence of antibiotic resistance increasing include:
  - only taking antibiotics when **absolutely essential**
  - when prescribed a course of antibiotics, **ensure that the entire course is completed** even if you feel better after a few days

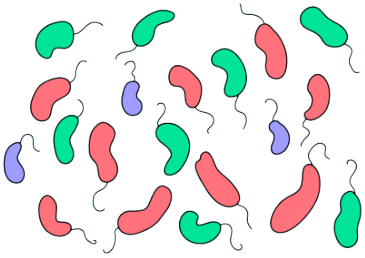
15 DRUGS

15.1 MEDICINAL DRUGS cont...

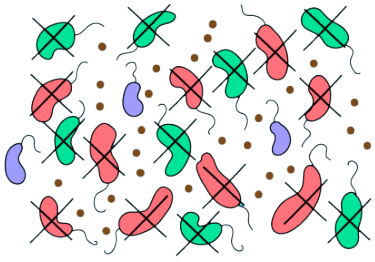
YOUR NOTES

EXTENDED ONLY cont...

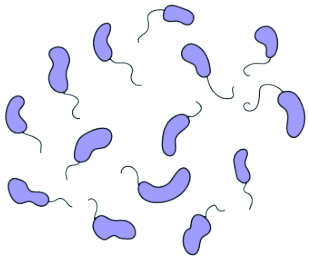
1 A POPULATION OF BACTERIA IN THE GUT. SOME HAVE ANTIBIOTIC RESISTANCE



2 WHEN EXPOSED TO AN ANTIBIOTIC, BACTERIA CAUSING ILLNESS, AS WELL AS HEALTHY GUT BACTERIA, ARE KILLED



3 WITH REDUCED COMPETITION FOR NUTRIENTS, ANTIBIOTIC–RESISTANT BACTERIA MULTIPLY, FORMING A LARGER POPULATION THAT IS DIFFICULT TO CONTROL



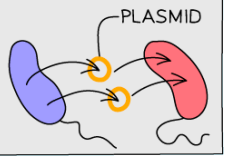
KEY:

= PATHOGENIC, ANTIBIOTIC RESISTANT, BACTERIUM

= HEALTHY GUT BACTERIUM

= PATHOGENIC BACTERIUM

PLASMIDS WITH ANTIBIOTIC–RESISTANT GENES CAN BE SHARED BETWEEN BACTERIA OF BOTH THE SAME AND DIFFERENT SPECIES.



Antibiotic resistance

15 DRUGS

15.2 MISUSED DRUGS

YOUR NOTES

Alcohol

- Wines, beers and spirits contain an alcohol called **ethanol**
- It is a **depressant drug** – it slows down signals in the nerves and brain
- Because alcohol **increases reaction times** (meaning it increases the time taken to react to situations because it slows down signalling in the brain), there are **legal limits for drinking and driving** in many countries

SHORT–TERM EFFECTS	LONG–TERM EFFECTS
VOMITING – ALCOHOL IS TOXIC TO THE BODY AND THIS IS THE QUICKEST WAY TO GET RID OF IT	DAMAGES THE BRAIN CAUSING MEMORY LOSS AND CONFUSION
IMPAIRED JUDGEMENT AND POTENTIALLY VIOLENT BEHAVIOUR – THE USER HAS REDUCED SELF–CONTROL	HEAVY ALCOHOL ABUSE OVER A LONG PERIOD OF TIME DAMAGES THE LIVER, CAUSING CIRRHOSIS
IMPAIRED BALANCE AND MUSCLE CONTROL	
SLEEPINESS AND, WHEN CONSUMED IN LARGE ENOUGH QUANTITIES, UNCONSCIOUSNESS	

- The **liver** removes alcohol from the bloodstream
- It has enzymes that break down alcohol but the products of the reactions involved are toxic and, over time, the liver can be **irreparably damaged**
- In many people, alcohol can be a very **addictive** drug

15 DRUGS

15.2 MISUSED DRUGS cont...

YOUR NOTES

Heroin

- Heroin is a powerful **depressant** drug
- It **reduces pain** and **slows down breathing**
- It is **highly addictive** and users quickly develop a **tolerance** for it, meaning they need larger and larger amounts in order to feel the same effects – this increases the risk of accidentally **overdosing**, which can cause **death**
- This means they need **more money** to pay for the **increased amounts of the drug** they are taking; as the drug makes them **less able to cope with everyday life and maintain a job**, they may **turn to crime** in order to get the money they need
- As it is so addictive, if a user stops taking heroin they suffer from significant **withdrawal symptoms**, such as **nausea, muscle cramps, sweating, anxiety** and **difficulty sleeping**
- Heroin can be taken into the body in different ways; one of the most common is **injecting with a syringe**
- As syringe needles cost money, heroin addicts may share needles which increases the risk of **transmission of blood-borne infections such as HIV**

EXTENDED ONLY

How does Heroin Affect the Nervous System?

- In the brain there are many different **chemical neurotransmitters** that transfer nerve impulses across synapses
- The neurotransmitters diffuse across the synapse and fit into **receptor molecules** on the postsynaptic membrane
- One group of neurotransmitters is called **endorphins** which help to **reduce sensations of pain, affect mood and reduce sensations of hunger and thirst**
- When it enters the brain, heroin is metabolised to **morphine**
- Morphine molecules **fit into some of the endorphin receptors** and this is why taking heroin makes users feel so good
- Taking heroin can **reduce the production of natural endorphins** and other neurotransmitters, which is why repeated use **leads to the need for greater and greater amounts** in order to get the same feelings

15 DRUGS

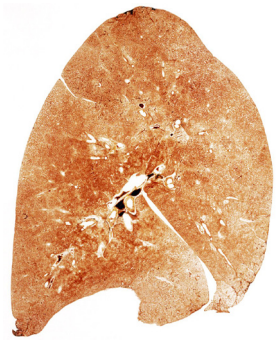
15.2 MISUSED DRUGS cont...

YOUR NOTES

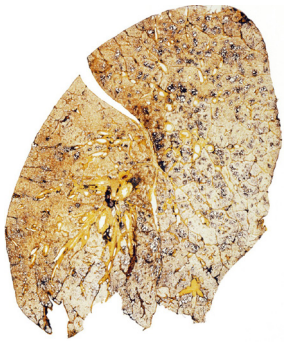
Tobacco & The Gas Exchange System

Tobacco & Disease

- Smoking causes **chronic obstructive lung disease, coronary heart disease** and increased risks of several different types of cancer, including **lung cancer**
- Chemicals in cigarettes include:
  - **Tar** – a carcinogen (a substance that causes cancer))
  - **Nicotine** – an addictive substance which also narrows blood vessels
  - **Carbon monoxide** – reduces the oxygen-carrying capacity of the blood



Section through a normal lung



Section through a smoker's lung

Effects on the Gas Exchange System

Tar

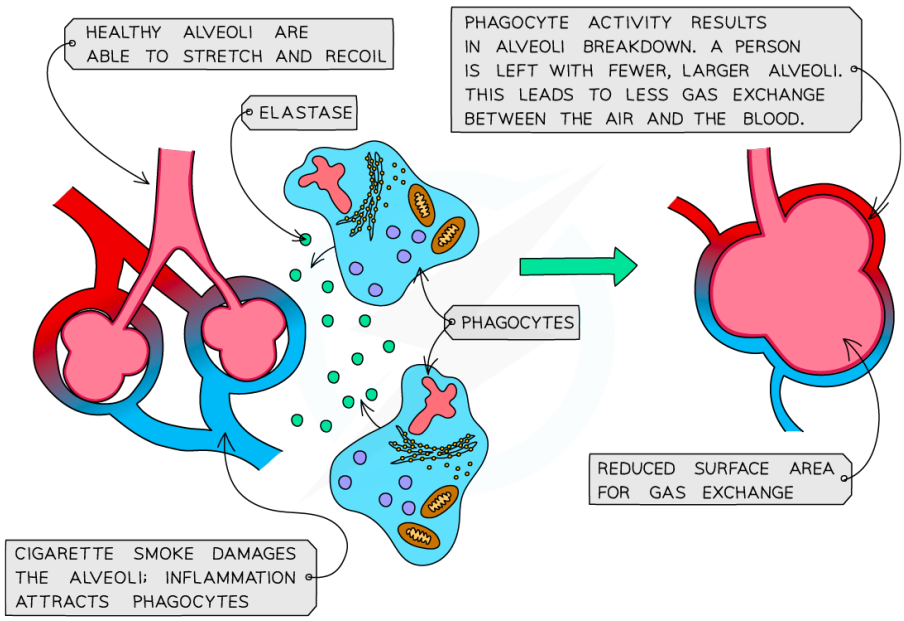
- Tar is a **carcinogen** and is linked to increased chances of cancerous cells developing in the lungs
- It also contributes to **COPD**, which occurs when **chronic bronchitis** and **emphysema**, two different diseases which are frequently linked to smoking, occur together
- Chronic bronchitis is caused by **tar** which stimulates goblet cells and mucus glands to enlarge, **producing more mucus**
- It destroys **cilia**, inhibiting the cleaning of the airways, and **mucus** (containing dirt, bacteria and viruses) **builds up**, blocking the smallest bronchioles
- A **smoker's cough** is the attempt to move the mucus but it **damages the epithelia** resulting in scar tissue, which **narrows the airways** and makes **breathing difficult**
- **Emphysema** develops as a result of **frequent infection**, meaning **phagocytes** are attracted to the lungs where they release **elastase** – an enzyme that **breaks down the elastin in the alveoli walls**, to enable them to reach the surface where the bacteria are
- Without adequate elastin, the **alveoli cannot stretch**, so they recoil and many burst
- The breakdown of alveoli results in the appearance of large air spaces, **reducing the surface area for gas exchange** and making sufferers breathe more rapidly

15 DRUGS

15.2 MISUSED DRUGS cont...

YOUR NOTES

- As it progresses, patients become **breathless and wheezy** – they may need a constant supply of oxygen to stay alive



The breakdown of alveoli in emphysema reduces the surface area for gas exchange

Carbon monoxide

- **Carbon monoxide binds irreversibly to haemoglobin**, reducing the capacity of blood to carry oxygen
- This puts more strain on the breathing system as **breathing frequency and depth need to increase** in order to get the same amount of oxygen into the blood
- It also puts more strain on the circulatory system to pump the blood faster around the body and **increases the risk of coronary heart disease and strokes**

Nicotine

- **Nicotine narrows blood vessels** so will put more strain on the circulatory system and **increase blood pressure**
- Narrow blood vessels are more likely to become clogged with fat, including cholesterol – if this happens in the coronary artery, this causes **coronary heart disease**
- This means the heart muscle cells do not get sufficient oxygen and so less aerobic respiration takes place
- To compensate the cells respire **anaerobically**, producing **lactic acid** which cannot be removed (due to lack of blood supply)
- This creates a **low pH** environment in the cells causing **enzymes to denature** and eventually **heart muscle cells will die**
- If enough die this can cause a **heart attack**

15 DRUGS

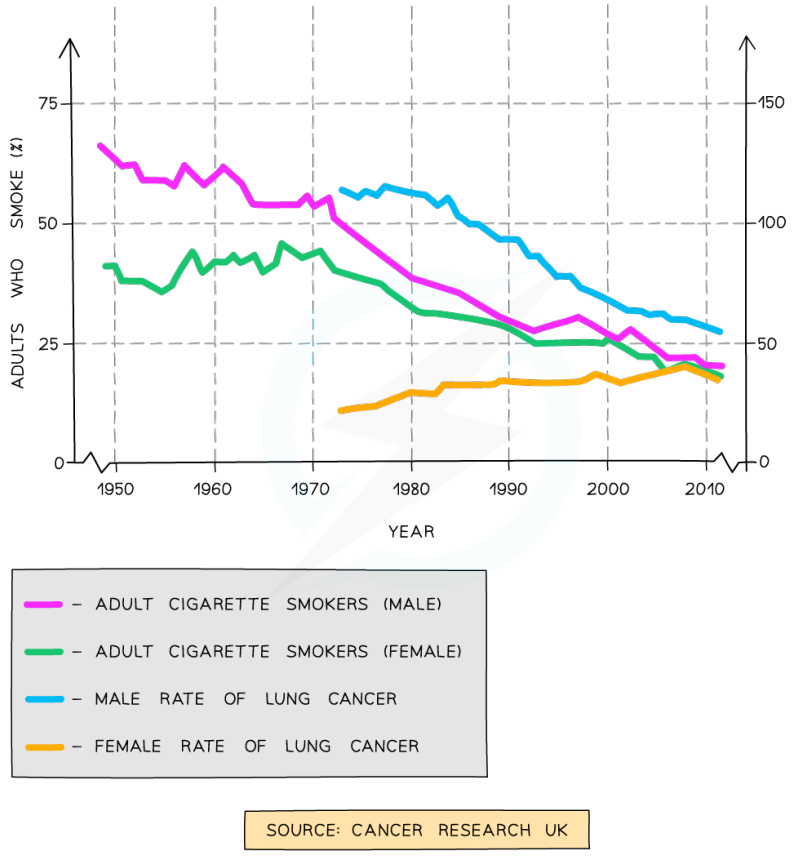
15.2 MISUSED DRUGS cont...

YOUR NOTES

EXTENDED ONLY

Smoking & Lung Cancer: Is There a Link?

- The majority of cases of lung cancer are caused by smoking



Graph showing correlation between numbers of adults who smoke and lung cancer rates over time

- Note that, as the general trend for the number of adult smokers decreases, so does the trend for lung cancer rates a few years later (as cancer takes some time to develop)
- The trend in the rate of developing lung cancer for women has been increasing, while in men it is decreasing
- This is because the numbers of female smokers – unlike men – continued to increase in the 1950s and 1960s before starting to fall
- As cancer takes some years to develop, a fall in female rates of lung cancer is likely to occur later

15 DRUGS

15.2 MISUSED DRUGS cont...

YOUR NOTES

EXTENDED ONLY cont...

Performance-Enhancing Drugs in Sport

- Hormones produced in the body help to control the way it develops and responds to changes
- Some people take additional hormones to **increase these effects**
- This is most commonly done to **improve sporting performance**
- **Testosterone** is the hormone produced in the testes that affects the development of male secondary sexual characteristics
- It is one of a group of hormones known as **steroids** which stimulate **anabolic reactions** to occur in the body (meaning the synthesis of large molecules from smaller ones), so it is known as an **anabolic steroid**
- One of the effects of testosterone is to cause **more proteins to be made in muscles** so that muscles become larger and stronger
- Taking anabolic steroids therefore **increases muscle mass, helps athletes train harder and for longer periods of time**, and can **increase aggression** which can give an edge when competing
- The use of anabolic steroids in sports is banned as it gives an **unfair advantage** and also has **serious side effects**, including:
    - increases risk of heart disease
    - increases risk of liver damage
    - increases risk of kidney damage
    - affect the menstrual cycle in women
    - decreases the ability of the immune system to destroy pathogens

EXAM TIP

Most questions about smoking and lung cancer expect you to analyse data in a table or graph and discuss it to show the evidence for a link, as shown in the notes above.

Keep your points concise and refer to the data as much as possible.

> NOW TRY SOME EXAM QUESTIONS

15 DRUGS

EXAM QUESTIONS

YOUR NOTES

QUESTION 1

Which organ is the most damaged by excessive alcohol drinking?

A liver

B heart

C pancreas

D stomach

QUESTION 2

Which of the following statements about antibiotics is not correct?

A some antibiotics are produced by fungi

B some bacteria are resistant to antibiotics

C antibiotics are used to treat diseases caused by viruses

D when taking antibiotics for an infection, the treatment should be completed.

QUESTION 3

A man has been smoking for many years.

Which of the following statements could not be correct?

A the cilia in the trachea have been destroyed

B he is addicted to nicotine

C his arteries are blocked with tar

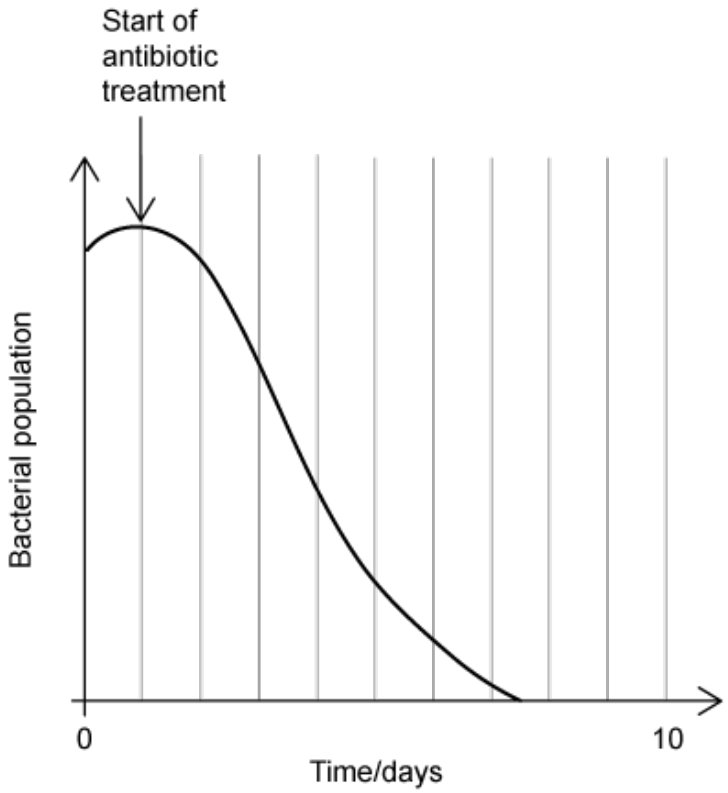
D the surface area of the lungs is reduced

YOUR NOTES

EXAM QUESTIONS cont...

QUESTION 4

The data in the graph shows the effect of an antibiotic on the population of bacteria in the blood.



What can be concluded from the data?

A antibiotics take 10 days to kill all bacteria

B antibiotics cause reduction of division in bacteria

C antibiotics are effective against viral and bacterial infections

D before the start of the antibiotic treatment the bacterial population was increasing

15 DRUGS

EXAM QUESTIONS cont...

YOUR NOTES

QUESTION 5

Which two of the following statements correctly describe the effect of smoking cigarettes?

1 Goblet cells produce more mucus

2 Goblet cells stop producing mucus

3 Cilia beat more slowly

4 Cilia beat more quickly

A 1 and 3 **B** 2 and 3 **C** 1 and 4 **D** 2 and 4

> CHECK YOUR ANSWERS AT SAVEMYEXAMS.CO.UK