

**Year 10 – Student Booklet B (Triple)**

Key Stage 4 Science:

**Infection & Response**











**This booklet is for use in your Science lessons. Please look after it in the same way you would your exercise book and ensure that your presentation is always PROUD.**

**Ensure that your booklet is returned to your class book box at the end of the lesson.**

**Lesson Breakdown**

Lesson 1: 4.3.1.1 Communicable diseases

Lesson 2: 4.3.1.2 – 4.3.1.4 Viral diseases, bacterial diseases, fungal diseases

Lesson 3: 4.3.1.2 – 4.3.1.4 Viral diseases, bacterial diseases, fungal diseases

Lesson 4: 4.3.1.5 Protist diseases (including malaria)

**Lesson 5 (HT only): 4.3.3.1** **Detecting and identification of plant diseases**

**Lesson 6: 4.3.3.1 Plant defence responses**

Lesson 7: 4.3.1.6 Human defence systems (barriers and symptoms)

Lesson 8: 4.3.1.6 Human defence systems (white blood cells)

Lesson 9: 4.3.1.7 Vaccination

Lesson 10: 4.3.1.8 Antibiotics and painkillers

Lesson 11: 4.3.1.9 Discovery and development of drugs

Lesson 12: 4.3.1.9 Discovery and development of drugs (placebo effects,

 double blind trials etc).

**Lesson 13 (HT only): 4.3.2.1 Producing monoclonal antibodies**

**Lesson 14 (HT only): 4.3.2.1 Uses of monoclonal antibodies**

**Keystone words**

Microorganism

Communicable

Pathogen

Vector

Response

Infection

Resistance

Immune

**Knowledge Test Tracker**

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| **Lesson** | **Marks achieved** | **Percentage** |
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**Lesson 7: Human defence symptoms**

**Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Objective: By the end of this lesson, you will be able to explain how the human body uses three non-specific defences to combat pathogens.**

**Skills Drill / Retrieval**

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| Answer | PA / SA |
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**Connect**

List the different ways that pathogens can enter the body



**I DO**

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**In an area where there is a lot of air pollution or somewhere very dusty and dirty, the mucus produced is black in colour when the nose is blown. Explain why.**

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**WE DO / YOU DO -** The figure below shows some of the ways that the body defends itself against infectious diseases.



(d)  Describe how the skin, airways and stomach defend against diseases.

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**Lesson 8: Specific human defence symptoms**

**Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Objective: By the end of this lesson, you will be able to explain how the human body uses three specific defences to combat pathogens.**

**Skills Drill / Retrieval**

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| Answer | PA / SA |
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**Connect**

State the different components of blood & describe the function of each

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4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Describe the roles of white blood cells when a pathogen enters the body.

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White blood cells make and release antitoxins and antibodies when you have a bacterial infection.

Explain why they release both antitoxins and antibodies.

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Explain how different **types of organism** defend themselves against microorganisms.

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Describe the role of memory cells in protecting our bodies from future infections.

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**Lesson 9: Vaccinations**

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**Objective: By the end of this lesson, you will be able to explain how vaccinations and herd immunity are used to fight disease.**

**Skills Drill / Retrieval**

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| Answer | PA / SA |
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**Connect**

State and describe five different ways of preventing spread of disease

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Describe the concept of herd immunity.

Explain how herd immunity can prevent unvaccinated people from contracting a communicable disease.

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Explain how vaccination makes a person immune to a disease.

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Gonorrhoea is a bacterial disease.

A new vaccine is being developed against gonorrhoea.

Describe how a vaccine would work to prevent gonorrhoea.

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The graph below shows the concentration of measles antibodies in the blood of a boy.



Explain the differences between antibody production after the vaccine injection and after exposure to the measles virus.

You should include data from the graph above.

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**Edward Jenner – the first vaccination**

1. Edward Jenner tested the hypothesis that infection with cowpox could protect a
2. person from smallpox infection.
3. Cowpox is an uncommon illness in cattle, usually mild, that can be spread from a cow to
4. humans via sores on the cow. During an infection, dairy workers may have pustules on
5. their hands. Sufferers can spread the infection to other parts of the body.
6. We know now that the cowpox virus belongs to the Orthopox family of viruses.
7. Orthopox viruses also include horsepox virus, monkeypox virus, and variola virus, which
8. causes smallpox.
9. On May 14, 1796, Jenner inoculated eight-year-old James Phipps with matter from a
10. cowpox sore on the hand of milkmaid Sarah Nelmes.Phipps suffered a local reaction and
11. felt poorly for several days but made a full recovery. In July 1796, Jenner inoculated Phipps
12. with matter taken from a fresh human smallpox sore, as if he were variolating the boy, in an
13. attempt to challenge the protection from cowpox. Phipps remained healthy. Jenner next
14. demonstrated that cowpox matter transferred in a human chain, from one person to the
15. next, provided protection from smallpox.
16. Jenner was not precisely sure about the nature of the cowpox material he used. He
17. suspected that cowpox actually came from horsepox; in other words, he speculated that
18. cows became infected with the same agent that caused a similar disease in horses. Recent
19. genetic analysis ofold samples of smallpox vaccine have revealed that the samples were
20. more closely related to horsepox virus than cowpox virus.

**Edward Jenner did not understand why his procedure protected people from smallpox.**

**Use your knowledge of vaccinations and white blood cells to explain why his procedure worked.**

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**Lesson 10: Antibiotics and painkillers**

**Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Objective: By the end of this lesson, you will be able to explain how drugs are used to treat people with communicable diseases.**

**Skills Drill / Retrieval**

|  |  |
| --- | --- |
| Answer | PA / SA |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |

**Connect**

Categorise the following medicines

Penicillin Advil Paracetamol Asprin Caffeine Streptomycin Digitalis Statins Ibuprofen Amoxicillin Doxycycli**ne**

|  |  |  |
| --- | --- | --- |
|  |  |  |
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A patient has a viral infection.

Explain why the doctor:

1. Might prescribe painkillers

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1. Is unlikely to prescribe antiviral drugs

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1. Won’t prescribe antibiotics

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Explain why antibiotics cannot be used to treat viral infections.

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**WE DO / YOU DO – Natural Selection**

Head lice live on people’s heads and feed on their blood.
Head lice cause itching and people may develop open wounds from scratching.

A poisonous chemical has been used to kill head lice for many years.
Recently, the chemical has not been as successful at killing head lice. Many head lice now survive treatment with the chemical.

Explain in terms of **natural selection** why most head lice are no longer killed by the chemical.

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**I DO – Natural Selection**

A particular species of snail has a shell which may be pink, yellow or brown. It may also be plain or have bands running round it.

The snails are eaten by song thrushes.

Explain why snails with plain brown shells are the most common in hedgerows.

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**WE DO / YOU DO – Natural Selection**

Penicillin is an antibiotic which stops bacteria from reproducing. It was used a lot in

the past to treat bacterial infections in humans and other animals. In many hospitals

there are now strains of penicillin resistant bacteria.

Explain how natural selection could have produced these strains of penicillin resistant bacteria.

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Much of the rain forests are unexplored; we do not know which species live there and how they might benefit us.

Using your knowledge of drugs and where they originate from, to explain why destroying the rain forests could harm the human population.

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**Lesson 11: Discovery and development of new drugs** 

**Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Objective: By the end of this lesson, you will be able to describe how new drugs are developed and assessed using pre-clinical trials.**

**Skills Drill / Retrieval**

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| Answer | PA / SA |
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**Connect**

Scientists need to understand the life cycle of pathogens and their vectors (if they have one) so that they can development control measures and treatments.

Mosquitoes are the vector for the protist that causes malaria.

1. Outline the life cycle of a mosquito.
2. Suggest control measures to prevent the spread of malaria.

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1. **Medicinal chemists play a vital role in the process of drug discovery, helping**
2. **to create new and more effective medicines**
3. As a medicinal chemist, you'll use a range of chemistry techniques, primarily synthetic organic chemistry and
4. data analysis tools, to design and create new pharmaceutically active molecules to combat a particular disease
5. or condition. You'll also work on improving existing pharmaceuticals.
6. Working closely with other scientists within a project team, you'll carry out biological testing of the compounds
7. that you've created to see if they're effective. You'll then analyse the results of these tests to identify how the
8. molecule could be improved until there's sufficient evidence that it works and is safe for testing in people.
9. Alternative job titles include synthetic organic chemist, (graduate) scientist and research chemist. It's important
10. to look beyond titles to the job description, to ensure you're finding roles in medicinal chemistry.

Responsibilities

1. As a medicinal chemist, you'll need to:
2. plan and conduct scientific experiments in the lab to create and refine target molecules
3. follow health and safety guidelines and safe working practices
4. undertake data analysis to assess the results of experiments and the characteristics of the molecules produced
5. ensure the structure and purity of compounds are correct
6. write up experiments accurately
7. work closely with other scientific colleagues across different disciplines
8. use computational techniques to model the properties of new molecules
9. explore how it may be possible to 'scale up' production of useful compounds that are created
10. generate reports and deliver presentations about your work for colleagues, partners and clients
11. attend and contribute to internal and external project meetings
12. liaise with partners and clients and respond to queries about the progress of your research
13. keep up to date with scientific literature
14. undertake ongoing professional development by attending training and conferences.

 Salary

1. Starting salaries for medicinal chemists are between £22,750 and £33,000.
2. With experience, the salary range for medicinal chemists is between £38,300 and £83,000, with the median being £56,200.
3. General managers can earn a median salary of £82,000.
4. Salaries vary depending on a range of factors including location, the size of the company, the sector you work in
5. and the nature of the job.
6. Some employers will also offer additional benefits such as pension schemes, healthcare plans, share ownership
7. schemes and other employee lifestyle benefits.

**Questions (answer on the next page)**

1. **What do medicinal chemists do?**
2. **Which of the skills shown below would be useful if you were a medicinal chemist?**
3. **Explain your answer to question 2.**
4. **Which of the skills would be most important?**
5. **Explain your answer to question 4.**









Would you abort or continue trials of a new drug if preclinical trials showed that:

1. **I DO -** Efficacy was high and toxicity was high?

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1. **WE DO / YOU DO** Efficacy was high and toxicity was low?

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1. **WE DO / YOU DO** Efficacy was low and toxicity was low?

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Microorganisms cause infections.

The human body has many ways of defending itself against microorganisms.

(a)     Describe **two** ways the body prevents the entry of microorganisms.

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(b)     In 2014 the Ebola virus killed almost 8000 people in Africa.

Drug companies have developed a new drug to treat Ebola.

Explain what testing must be done before the drug can be tested on humans.

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**Lesson 12: Discovery and development of new drugs**

**Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Objective: By the end of this lesson, you will be able to describe how new drugs are developed and assessed.**

**Skills Drill / Retrieval**

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| Answer | PA / SA |
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**Connect**

Describe the steps that might be used in preclinical trials of a new drug.

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Explain why placebos are used in clinical trials.

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Explain why double-blind trials are used during clinical trials.

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**I DO -**  In 2014 the Ebola virus killed almost 8000 people in Africa.

Drug companies have developed a new drug to treat Ebola.

Explain what testing must be done before this new drug can be used to treat people.

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**Key terms:** Dose toxicity efficacy placebo double blind control

**PARTIAL RESPONSE WE DO / YOU DO**

Monoclonal antibodies (mAbs) have many uses in medicine. For example, they are

being developed for treatment of *Candida albicans*.

It has been shown that this mAbs treatment is effective in the laboratory using both:

•   infected tissue culture cells

•   infected live animals.

The mAbs treatment for *Candida albicans* is now ready for clinical trials on people.

Describe how the clinical trials should be carried out.

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**WE DO / YOU DO -**

Dravet syndrome is caused by a genetic mutation.

Dravet syndrome causes epileptic seizures. An epileptic seizure is caused by unusual brain activity.

Scientists have transferred the mutated gene for Dravet syndrome into zebrafish using genetic engineering.

This means the scientists could test a new drug to treat Dravet syndrome on the zebrafish.

Describe the processes that then need to happen to test the new drug before it can be used to treat all children with Dravet syndrome.

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 **Lesson 12: Teacher notes**

**AQA Content**

**Students should be able to** describe the process of discovery and development of potential new medicines, including preclinical and clinical testing.

Clinical trials use healthy volunteers and patients. • Very low doses of the drug are given at the start of the clinical trial. • If the drug is found to be safe, further clinical trials are carried out to find the optimum dose for the drug. • In double blind trials, some patients are given a placebo.

WS 1.6 Understand that the results of testing and trials are published only after scrutiny by peer review.

**Chunking**

1. What is a clinical trial?
2. Placebos.
3. Double blind trials.

**Lesson 13: Producing monoclonal antibodies**

**Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Objective: By the end of this lesson, you will be able to describe how to make monoclonal antibodies.**

**Skills Drill / Retrieval**

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| Answer | PA / SA |
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**Connect**

Monoclonal antibodies can be used to identify plant diseases.

1. List two other ways of identifying a plant disease.

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1. Give one advantage and one disadvantage for one of the methods that you listed.

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**We Do / You Do**

 A farmer thinks a potato crop is infected with potato virus Y (PVY).

The farmer obtains a monoclonal antibody test kit for PVY.

To make the monoclonal antibodies a scientist first isolates the PVY protein from the virus.

Describe how the scientist would use the protein to produce the PVY monoclonal antibody.

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**I Do**

  One treatment for RSV uses monoclonal antibodies which can be injected into the patient.

Scientists can produce monoclonal antibodies using mice.

The first step is to inject the virus into a mouse.

Describe the remaining steps in the procedure to produce monoclonal antibodies.

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**Lesson 14: Uses of monoclonal antibodies**

**Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Objective: By the end of this lesson, you will be able to explain how antibodies are used in different applications.**

**Skills Drill / Retrieval**

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| Answer | PA / SA |
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**Connect**

Monoclonal antibodies are produced using lymphocytes and tumour cells.

1. Explain why a lymphocyte is used. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Explain why a cancer cell is fused with the lymphocyte. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**We Do / You Do**

  A monoclonal antibody has been produced to treat pancreatic cancer.

Explain how the monoclonal antibody works to treat pancreatic cancer.

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 Describe how injecting a monoclonal antibody containing an antiviral drug for RSV helps to treat a patient suffering with the disease.

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**I Do**

  Monoclonal antibodies (mAbs) are usually made using mouse lymphocytes.

*Candida albicans* infection produces serious symptoms in patients with a poor immune system.

Recently scientists have produced mAbs to *Candida albicans* using human lymphocytes produced naturally after an infection.

 *Candida albicans* lives in the throat of infected patients.

A sample is taken from the throat of a patient with a suspected *Candida albicans* infection.

The sample is transferred onto a microscope slide.

Describe how the mAbs and a fluorescent dye could be used to see any *Candida albicans* pathogens on the slide.

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**We Do / You Do**

Monoclonal antibodies are used to measure the levels of hormones in the blood.

Pregnant women produce the hormone HCG.

HCG is excreted in urine.

**Figure 1** shows four pregnancy test strips.

**Figure 1**



(a)     Which test strip shows a negative test result?

Tick **one** box.

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| **A** |  |  | **B** |  |  | **C** |  |  | **D** |  |

**(1)**

(b)     Monoclonal antibodies are used for pregnancy testing.

Give **one other** use of monoclonal antibodies.

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(c)     **Figure 2** shows the parts of a pregnancy test strip.

**Figure 2**



The pregnancy test strip will show a positive test result when a woman is pregnant.

Explain how the pregnancy test strip works to show a positive result.

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