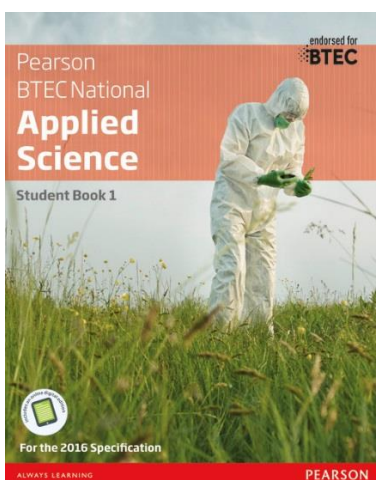


BTEC Level 3 Nationals in Applied Science: Unit 7

Your free sample of the student
book: preparation for
assessment

(BTEC National Applied Science: Student Book 1 (with
ActiveBook),
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Getting ready for assessment

This section has been written to help you do your best when you take your final assessment test. Read through it carefully and ask your tutor if there is anything you are not sure about.

About the test

Here is a brief summary of the Unit 7 assessment. It is divided into two parts.

Part A

You will be given your source booklet before your assessment. This will contain articles all relating to a contemporary scientific issue. You should complete the following tasks. Plan your time carefully!

- Read the articles several times. Analyse them in the context of how the scientific issue is being tackled, the intended audience of the article and the validity of the scientific content, including organisations and people who may be mentioned. You can highlight or annotate your articles. Here are some examples of how you might approach doing this.
- You must do further research. You need to find out about any organisations or scientists mentioned in the articles and decide how valid their opinions might be and how influential they are. You can also look for reliable evidence which confirms or refutes the ideas put across in the articles provided.

Part B

You complete your taskbook which contains copies of the articles. It must be completed independently and under supervised conditions. You write your answers directly into the taskbook, which is then submitted for assessment. The questions are all based on the articles provided. **Different questions are given different numbers of marks. Make sure you spend most of your time on the questions where you can gain most marks.**

The areas most likely to be highlighted in the questions include:

- **The implications of the scientific issue or issues in the articles**
- The organisations/individuals mentioned in the articles and their potential influence on the scientific issue
- **The validity of the judgements in one or more of the articles**
- Possible future areas for development or research linked to the main scientific issue
- **Your understanding of the scientific issues and ability to explain them to a given audience.**

Questions covering these issues will carry the most marks.

Annotating the Part A Articles

Here are some sections from three articles on treating malaria. Read them through and see how they have been highlighted and annotated. This gives you an idea of the task you will have to complete.

Article 1: What is Malaria?

Every 2 minutes a child dies from malaria - a disease spread by a single mosquito bite. **Nothing But Nets** works with supporters and partners around the world to raise funds and awareness about the disease and advocate for malaria prevention.



Malaria is a disease caused by the blood parasite *Plasmodium*, which is transmitted by mosquitoes. Each year, an estimated 219 million people are infected with malaria, causing approximately 600,000 deaths – mostly children under the age of five.

... Every 2 minutes, a child in Africa dies from a malaria infection and 90% of all malaria deaths occur in the region. When combined with HIV/AIDS, malaria is even more deadly, particularly for pregnant women and children.

Malaria is a big problem – and the disease has big consequences for families, communities, and countries. Fortunately, there are small things that can help make a huge impact in the fight against malaria. It's easy to help: *Nothing But Nets* works with our **UN partners** to prevent malaria in Sub-Saharan Africa by sending nets to save lives and raising voices to let policymakers know that the fight against malaria is important. Learn about the many ways you can take action now!

Did you know?

Four Nobel Prizes have been awarded for work associated with malaria to **Sir Ronald Ross (1902), Charles Louis Alphonse Laveran (1907), Julius Wagner-Jauregg (1927), and Paul Hermann Müller (1948)**

The two most effective and potent anti-malaria drugs come from plants with medicinal values recognized for centuries: artemisinin from the Qinghao plant and quinine from the cinchona tree.

How Is Malaria Prevented?

In the poorest parts of the world, window screens are lacking, anti-malaria drugs are expensive, and so far an effective malaria vaccine does not exist. ... Infections can be prevented by sleeping under long-lasting insecticide-

This student has used yellow highlighting to show the organisations they want to look up.

Here the student has underlined the main science issues explained in the text.

The student is using a different coloured highlighter to show up individuals involved in malaria research.

treated bed nets (LLINs). These nets, which are designed to last at least three years, work by creating a protective barrier against deadly malaria-carrying mosquitoes that typically bite at night.

The benefits of these bed nets extend even further than protecting those sleeping underneath them. The insecticide woven into each net makes entire communities safer – killing mosquitoes so that they can't go on to bite others who may not be protected by a net. Bed nets can reduce malaria transmissions by as much as 90 percent in areas with high coverage rates. It costs just \$10 to send a bed net to the families who need them. According to the **2012 World Malaria Report**, 90 percent of people with a bed net use it. Join us now. Send a net and save a life.

Other Prevention Measures and Treatment

In addition to bed nets, malaria can be prevented by applying insecticide to the inside walls of individual homes. Mosquitoes that land on treated walls are killed, preventing the transmission of malaria...

Source: Nothing but nets, charity involved in reducing and preventing the spread of malaria: <http://www.nothingbutnets.net/new/saving-lives/what-is-malaria.html>

Article 2: Drug-resistant malaria an 'enormous threat' — vigorous international effort needed to contain it



A drug-resistant form of malaria is spreading in southeast Asia and represents an "enormous threat" to the world.

The resilient form of the **mosquito-spread parasite** has been found in many parts of Myanmar (Burma) as well as Cambodia, Thailand, Laos and Vietnam.

The drug artemisinin is normally given as part of a combination therapy to battle the disease, but now a strain of the parasite is not responding to it.

The alarming discovery is a major blow to global health efforts to reduce the number of deaths from the mosquito-spread parasite.

Although initially other drugs given in the combination treatment could keep malaria at bay, the parasite is likely to develop resistance to the partner drugs as well - and there's evidence that this is happening already.

Health workers fear that the strain could soon spread to India, where thousands more lives would be at risk.

More underlining shows up a different aspect of the malaria story.

“It’s hugely worrying,” says Professor David Conway from the London School of Hygiene & Tropical Medicine, “both for people in southeast Asia and the rest of the world.”

“Should these [drugs] fail today, there’s nothing waiting in the wings that’s going to be affordable and adequately tested in time.”

Something similar happened in the 1950s, when malaria became resistant to a drug called chloroquine. It spread across the world and eventually reached Africa.

“The global spread of chloroquine resistance resulted in the loss of millions of lives in Africa and, clearly, Myanmar is an important part of the frontline in the battle to contain artemisinin resistance,” say the authors of the study, published in the *Lancet Infectious Diseases*.

“A vigorous international effort to contain this enormous threat is needed,” they say.

Conway adds: “It’s not too late, but action needs to be taken now to stop the spread.”

Healthcare workers should make sure that malaria isn’t being treated with artemisinin on its own (which is happening in some places “against all advice”), and efforts should be made to eliminate counterfeit medicines.

Continued molecular testing of the strain in real-time and monitoring patients in other territories, particularly Africa, for resistance is vital.

Source: <http://www.mirror.co.uk/news/technology-science/science/drug-resistant-malaria-enormous-threat--5197706>

Article 3: The ongoing battle against drug-resistant malaria

Artemisinin-based combination therapy

Artemisinin-based combination therapy (ACT) has been integral to the recent successes in global malaria control. The main idea behind ACT was to provide an inexpensive, short-course treatment that would also help protect against the development of drug resistance...

Is history repeating itself?

In 2009, researchers reported concerns that artemisinin was taking longer to clear parasites from patients infected with *Plasmodium falciparum* along the Thailand-Cambodia border — a worrying sign of emerging drug resistance. Since then, researchers have reported slow parasite clearance in four countries in the Greater Mekong Subregion...

What’s more, if artemisinin resistance were to arise in Africa or emerge independently elsewhere, as has happened with other antimalarial drugs, the public health consequences would be catastrophic...

In response to this threat, the World Health Organization (WHO) launched an emergency plan of action to tackle artemisinin resistance in the Greater Mekong Subregion covering 2013–2015. They proposed an immediate and coordinated increase in efforts to tackle malaria in Cambodia, Laos, Myanmar, Thailand and Vietnam. Currently the WHO’s goal is to initiate elimination activities by 2020 in order to remove malaria completely from Greater Mekong Subregion countries by 2030.

The London School of Hygiene and Tropical Medicine has an excellent reputation.

The student highlights a publication quoted in the article to look up later.

Here the student is using a different pattern of underlining to show up where one article reinforces another.

The World Health Organization needs looking up, then make notes about it.

But how are we going to stop the spread of drug resistance if we haven't been able to in the past? Well, now we have one more weapon in our arsenal that we didn't have before – genome sequencing!

Genomics vs. malaria – the fight is on

At the time that artemisinin resistance was first discovered in early 2009, no one knew which genetic changes were responsible, and pinpointing those changes proved more challenging than expected. However, faster and cheaper genome sequencing techniques have enabled us to learn a lot more about the underlying genetic changes responsible. ... By finding these genetic changes scientists are hoping that they may eventually be able to track and then prevent the spread of artemisinin resistance.

Clues on chromosome 13

In 2012, and then again in 2013, a couple of genome-wide association studies (GWAS) looking at the *P. falciparum* genome pointed towards two regions next to each other on chromosome 13 as potential sites of the mutations associated with artemisinin resistance. However, they needed to find out for sure if these mutations were directly involved in resistance. A year or so later, a collaboration led by scientists at the **Institut Pasteur in Paris** came up with an experiment that pointed them in the right direction.

Over a five year period, the scientists grew and nurtured a strain of *Plasmodium* parasite that they knew did not have any resistance to artemisinin. Every so often during this period they gave the colony of parasites a small amount of artemisinin. They hypothesised that sooner or later an artemisinin resistant parasite would emerge because of the selection pressure of the drug (the pressure to adapt in order to survive!). Sure enough, after four years of exposure to the drug, artemisinin resistant parasites were seen. With DNA sequencing they were then able to study the genome of the resistant parasites and compare them to the genome of the original, non-resistant strain of *Plasmodium*.

They found several genetic changes in the resistant parasite genome but the most significant one occurred bang in the middle of the previously-identified regions on chromosome 13, in a gene called *kelch13*.

Like spies in an enemy country, genomics can provide us with the intelligence to track drug resistance emerging in the malaria parasite. This gives us more time to plan our counterattack before drug resistance becomes more widespread.

Source: <http://www.yourgenome.org/stories/the-ongoing-battle-against-drug-resistant-malaria>

The Institut Pasteur needs looking up, then make notes about it.

Is this website reliable? More research is needed!

Revising for your test

In most exams the questions you have to answer depend on you learning about a particular aspect of science, and being able to answer questions on it. So before the exam, you have to revise the topic thoroughly. Unit 7 is rather different. The questions in the test are based on the skills which you have developed in researching and identifying key points of information from an extensive passage of text. They do not significantly test your knowledge of the subject material, so you will not be expected to recall information.

The best way to revise for the test is to work through the research and discussion sections in this unit, making sure that you understand the key differences in scientific reporting and issues involved in scientific development including:

- both sides of the issues involved – the positives and the negatives
- the overall quality and balance of reports including any coverage of data analysis, sampling and supporting evidence
- the reporting medium used and corresponding target audience
- the presentation of science reports.

Making notes

You may not have to learn all the science in Unit 7 by heart – but you *do* need to practise doing research and making notes. Always bear in mind the questions you are likely to be asked. You need to link all the information to the specific article it comes from. Here is a sample of some early notes made by a student....

Notes for Unit 7 assessment

- 1 The main science issue is the problem of malaria and the development of drug-resistant strains of the parasite which causes the disease e.g. In Article 1: an estimated 219 million people are infected with malaria, causing approximately 600,000 deaths – mostly children under the age of five.*
In Article 2: A drug-resistant form of malaria is spreading in southeast Asia and represents an “enormous threat” to the world.
In Article 3: Resistance to antimalarial drugs is one of the biggest problems currently facing malaria control.
The secondary issues include how do we treat or prevent malaria and how can we deal with the problem of the drug resistant parasites ...
- 2 Scientific organisations mentioned*
Article 1
 - World Health Organization (WHO): WHO is a specialised part of the United Nations and is very influential. – it collects data on diseases from all over the world and issues guidelines for treatments, flags up epidemics and pandemics etc. It put together the 2012 World Malaria Report based on data from 104 countries with endemic malaria. VERY influential globally (WHO publications website, Wikipedia).*

- Article 2
- *London School of Hygiene and Tropical Medicine: world-leading centre for research into tropical medicine and public health. Part of the University of London. Founded 1899. Research carried out here has big impact all over the world (2016 CWTS Leiden Ranking for research impact).*
- Article 3
- *World Health Organization (WHO): see Article 1*
 - *Institut Pasteur: in Paris, internationally renowned for research into microbiology and disease – based on the work on microbiology, vaccines etc of Louis Pasteur.*

Have a go and see if you can build up your own notes based on the articles.

Sample questions and answers

Remember: These examples are much shorter than you would write in your exam, because they are only based on single-page articles.

1 Discuss the implications of the scientific issue described in the article.

12 marks

Use your notes to remind yourself about the main issues in the three articles. Make sure you refer to all three of the articles and to other reading you may have done. This question carries a lot of marks so plan your timing and your answer carefully.

To score well you need to draw a wide range of links to and between the ethical, social, economic and/or environmental implications of the science. You are assessed on the structure of your answer which should be clear, coherent and logical so plan carefully.

- The main scientific issue identified in these three articles is the spread of drug-resistant malaria in many parts of the world. There are two aspects to this issue. One is the problem of malaria as a global disease. Every year around 219 million people are infected with malaria, causing approximately 600,000 deaths. Malaria is a disease caused by the blood parasite Plasmodium, which is transmitted by mosquitoes. Most of the deaths are in children under 5 years old. The level of disease in populations affects society because people are too ill to work effectively and look after their children. Economically this affects families and countries. Individuals can't make enough money to support their families, and countries cannot build secure economies.*
- The other problem is treating malaria successfully. It is common in poor countries for example on the continent of Africa and areas such as Cambodia and Myanmar. One line of defence is to try and stop the spread of mosquitoes as effectively and cheaply as possible – for example using insecticide impregnated mosquito nets. Other methods include general insecticides and anti-malarial drugs. Although these*

Student has read and summarised the article main points effectively.

Student has looked at the problem and identified issues, avoiding bias.

- can be expensive, combined anti-malarial therapies can be very effective. Unfortunately, forms of the malaria parasite are evolving which are resistant to our best anti-malarial drugs, and this is a big problem going forward. Solutions will depend on hi-tech genome analysis, which is expensive. This raises environmental issues because insecticides can have damaging effects on the environment.
- It also raises ethical issues because the countries which most need the solutions are also very poor.

Student recognises some of the environmental and ethical issues of potential solutions.

2 Identify two organisations and two scientists mentioned in the articles and suggest how they may have had an influence on the main scientific issues. 6 marks

Look back at your notes to remind yourself about the organisations and individuals mentioned in the three articles.

If you have made good notes, you will have these organisations and individuals already identified, which will make answering this type of question much easier. To score highly you need to make clear links between the institutions and people mentioned and the original articles.

- Two examples of influential organisations mentioned in the articles are:
- The World Health Organization, known as the WHO, is a specialised part of the United Nations and is very influential. It collects data on diseases from all over the world and issues guidelines for treatments, flags up epidemics and pandemics etc. It put together the 2012 World Malaria Report based on data from 104 countries with endemic malaria. VERY influential globally (WHO publications website, Wikipedia)
- The London School of Hygiene and Tropical Medicine is mentioned in Article 2. It is a world-leading centre for research into tropical medicine and public health. It is part of the University of London and it was founded in 1899. It specialises in tropical diseases such as malaria and specialist scientists come here from many different countries to study these diseases and how to treat them. Research carried out here has a big impact all over the world.
- Two examples of influential scientists mentioned in the articles are:
- Sir Ronald Ross (1902), the doctor who demonstrated that malaria is spread by mosquitos. His work allowed people to begin to work out how to prevent the spread of the disease. (Wikipedia, Nobel prize web site)
- Professor David Conway is very active in anti-malaria research. He is professor at the London School of Hygiene and Tropical Medicine, works in UK and African countries, has published over 170 research articles, and is well known in his field (LSHTM website).

3 Discuss whether the articles are expressing valid concerns about the problems linked to treating malaria. In your answer you should consider:

- How the articles have interpreted and analysed the scientific information to support the conclusions/judgements being made
- The validity and reliability of data
- References to other sources of information.

12 marks

Use your notes to remind yourself about the validity of the articles. What does validity mean? What will you be looking for? Make sure you refer to the points made in the bullet points given to guide your answer.

Look at your comparison of the three articles to help you highlight the main points you need to answer this question well. You will be assessed on the structure of your discussion as well as the content. It must be clear, coherent and logical. Make sure you take the time to plan carefully.

If results are valid they measure what they are supposed to measure. If results are reliable, the investigation produces stable, consistent results which other people can replicate. It is important to be sure that an article is valid and reliable before you take any notice of it. There is considerable agreement between the three articles, which in itself suggests that the conclusions are probably reliable.

Article 1 was published on a website by a charity which works with the UN. They are trying to raise money to supply insecticide impregnated mosquito nets in Africa to help prevent the spread of malaria. Charities should use reliable data but they are trying to persuade you to give money so it is important to double check their sources as they may be biased in their choice of evidence. When the data is published in reliable journals or on websites it suggests the content will be valid. Article 1 refers to the 2012 Malaria Report from the WHO – a very reliable source because it collects valid data from all over the world. However, much of the information it gives about malaria is supported by the other two articles, which increases its validity.

Article 2 is taken from the website of a popular newspaper. Not all science articles in newspapers are reliable so it is important to check the sources used and the way they are interpreted. This article focuses on the drug-resistant strains of the malaria parasite spreading from Myanmar. It quotes at least two reliable sources:

- *report based on work by Professor David Conway - very reputable, LSTM*
- *report from a study published in the Lancet Infectious Diseases, a very reputable scientific journal which only publishes peer-reviewed valid work.*

Student explains what valid data is and why it is important.

Student shows they are away of the possibility of bias in an charity.

Student highlights a number of reputable scientists and sources in all three articles.

Although the article is for a popular newspaper website, it uses the highly reliable sources it has chosen as evidence for its conclusions - that there is a global risk as a result of the emergence of artemisinin resistance in malarial parasites. These conclusions are also backed up in Article 3, suggesting that although they are part of the popular media aimed at a non-scientific readership, they are nevertheless valid and reliable. The article finishes by stating that the continued molecular testing of the malarial parasites, especially in Africa, is vital. This is not supported or explained in this article, but there is a lot more about it in Article 3 with good backing evidence.

Article 3 is published on the www.yourgenome.org website developed by the education team at the Wellcome Trust Genome Campus. This is the top institution globally for analysis of the genomes of different organisms, and it has many internationally renowned scientists working there on various projects. That alone suggests that the content will be both valid and reliable, and that any conclusions drawn will be supported by evidence. Reading through the article, evidence and data are presented from a variety of sources including the Worldwide Antimalarial Resistance Network of the WHO and Nature Genetics, a highly reputable peer reviewed journal.

The sources quoted in this article are very reliable. The content also confirms the impact of malaria, some of the problems in preventing malaria and the problems of drug-resistant malaria parasites described in Articles 1 and 2. For example, Article 3 quotes vector management as well as effective antimalarial drugs as an important reason why death rates from malaria have fallen by 47% since the year 2000. This reinforces the message in Article 1 about the importance of simple methods of vector control such as insecticide impregnated mosquito nets. Later in Article 3, it confirms the conclusion in Article 2 that malaria parasites have become resistant to various drugs and that the current drug resistance has emerged from South east Asia. Article 3 gives us a lot more information on the genetic basis for the development of drug resistance in malarial parasites. Considering where the article was developed, and the quoted sources, we can be fairly certain that the judgement made in the article that genome analysis of the malaria parasites is a vital tool in the ongoing battle against drug-resistant malaria is completely justified.

Student makes judgements on the sources quoted in the articles based on good evidence.

4 Suggest possible areas for further development or research related to the scientific issue covered by the articles. 5 marks

Look back at your notes – when you were reading the articles and making notes you will have thought about potential future development and research. In this answer you can suggest more than one direction for future R&D. You will need to justify your choices/explain why that research is needed. You are expected to link your ideas for further development/research to science from all three articles.

- The big problems highlighted in these articles are the issues of malaria – the toll it takes on human lives and the economies of affected countries – and the growing problem of drug resistance in the malarial parasite which causes the disease.

Here are some potential areas for further research and/or development:

- New drugs to cure malaria which work in a different way to the current medicines. This would mean that even the malarial parasites resistant to the current drugs would be wiped out as they would not have resistance to the new drug mechanism. A new drug like this could be used in combination with a current anti-malarial drug so it continues to be effective. This would be similar to the use of piperazine with artemisinin.

- Genome analysis to find out where the drug resistance genes are found.

- Genome analysis reveals the DNA sequences of the malarial parasites. We can use this information to show us when the malarial parasite begins to develop resistance to a drug and change the treatments used in this area. Then scientists can use this information to help develop potential medicines and vaccines.

- Development of new insecticides to be used on water or on mosquito nets. We need new insecticides which are safe in the environment and safe for people but effective at killing mosquitoes.

Student has highlighted the problem and suggested three interesting and different areas for further research and development, showing evidence of researching the subject and understanding the issues.

5 Write an article for a tabloid newspaper on the growing problems of malaria based on the information contained in these articles. You will need to identify:

- the target audience
- the level of language to be used
- amount of detail and accuracy
- what titles or captions may appeal to your target audience. **15 marks**

Think carefully about your target audience. Plan what you want them to know. You will need a good headline to catch your reader's attention.

Decide how you can include good, valid, reliable science but still make your article interesting – you want people to keep reading to the end. Use information from all three articles – show the examiners that you have read and taken in information from all your sources and understand where they agree and where they take different approaches. If you can, include some extra information from your reading around.

You MUST keep your tone, style and level of scientific terminology the same throughout the article – don't start off all chatty and then end up writing as if you are delivering a piece for a scientific journal!

You will get credit for a well-organised article, with a clear, logical, coherent structure – so make your planning time count.

A malarial time-bomb – and it could affect YOU!

Choose a big, bold headline if you are writing a newspaper article – this one uses emotive terms like ‘time-bomb’ and makes it feel personal to people with the use of the emphasised ‘YOU’.

- Every year about 600,000 people die of malaria. Most of them are children under 5 years old. The World Health Organization estimates that around 219 million people are infected with malaria. It is caused by a tiny parasite, spread by the bites of infected mosquitos. Malaria wrecks individual lives and destroys economies when many of the working population are infected with this dreadful disease.
- So what? Malaria doesn't affect us here in the UK – but only because it is too cold for the mosquitos which carry the malaria parasite to survive. But in Shakespeare's times malaria (the ague) was common. As global warming increases, our old enemy could return – with a vengeance.
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This is only the start of this answer. It is important to keep going in the same tabloid style!