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**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
TWENTY FIRST CENTURY SCIENCE  
BIOLOGY A**

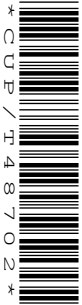
**A223/02**

Unit 3 Ideas in Context plus B7 (Higher Tier)

**INSERT**

**WEDNESDAY 21 MAY 2008**

Afternoon  
Time: 60 minutes



**INSTRUCTIONS TO CANDIDATES**

- This insert contains the article required to answer question 1.

This document consists of **3** printed pages and **1** blank page.

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Read the article about pathogens and use it to answer question 1.

## Deadly pathogens survive the longest

Researchers have discovered that the most deadly pathogens are those that can survive for the longest time outside the human body (host).

Scientists used to think that pathogens such as viruses and bacteria always evolve to be less deadly. After all, what good is it to a pathogen to kill its host? By keeping the host alive, far more pathogens can be passed on to other hosts. A dead host is not going to pass on the pathogen to anybody.

A new theory, however, suggests that the length of time a pathogen survives outside the host determines how deadly it is. Some pathogens such as the chickenpox virus can only survive outside the host for a short time. These pathogens must keep the host alive so that they can be passed on to other hosts. This means the pathogens need to be less deadly.

Pathogens, such as tuberculosis bacteria, that can survive outside the human body for a long time simply wait for a new host to come along. This means they can be very deadly and kill their host.

Scientists who agree with this theory use the example of cholera arriving in South America. The disease quickly spread throughout Chile and Ecuador. In Chile there was good sanitation and clean drinking water. This made it harder for the pathogen to survive outside the human body, and the pathogen became less deadly. In Ecuador, there was poor sanitation and contaminated drinking water. The pathogen could easily survive outside the human body. It evolved to become more deadly.

However, some scientists disagree with this theory. They think that pure chance or competition between pathogens inside the host will decide how deadly a pathogen becomes.

Although not all scientists agree how deadly pathogens have evolved, they all agree that the damage done to the human body by pathogens can be prevented by vaccination.

The most deadly pathogens tend to be those that can survive longest outside the human body		
pathogen	deaths per 100 000 people infected	survival time outside human body (days)
smallpox virus	10 000	885
tuberculosis bacterium	5000	244
diphtheria bacterium	200	370
whooping cough bacterium	100	12
pneumonia bacterium	36	29
influenza virus	10	14
measles virus	7	4
mumps virus	5	1
parainfluenza virus	4	5
chickenpox virus	3	1
rubella virus	3	1

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*Copyright Acknowledgements:*

Table Data                      Source: B.A. Walther & P.W. Ewald, *Pathogen survival in the external environment and the evolution of virulence*, Biological Reviews, 2004, vol. 79 (04), pp. 849-869

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