**Evolutionary Race**

There is an evolutionary race between pathogens and medical science.

1. Define the following key terms:

* Resistance
* Antibiotics
* Mutation
* Adaptation

1. Complete the paragraph using the words from the box.

* Antibiotics
* Industry
* Mutated
* Medicines
* Reproductive
* Resistance

Certain bacteria, such as *Staphylococcus aureus*, have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and become resistant to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Due to their high \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and mutation rates, bacteria can develop \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ faster than the drug \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can discover and test new \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Draw a flow diagram on A4 paper to show how antibiotic resistance can arise in a population of bacteria.
2. Methicillin resistant *Staphylococcus aureus* (MRSA) has become a problem in hospitals as most antibiotics are ineffective in treating MRSA infection. Describe precautions taken to prevent new infections with MRSA in hospitals. (4 marks)
3. A new antibiotic, teixobactin, has recently been discovered that is effective against bacteria with high levels of resistance, including methicillin-resistant *S. aureus* (MRSA). Explain the steps that should be taken to ensure that resistance to this antibiotic does not develop. (3 marks)
4. Match up the problems with the possible solutions.

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| * Antibiotics are too widely prescribed and used by doctors. |  | * Reducing the use of antibiotics in farm animals. |
| * Wide-spectrum antibiotics are often used to make sure that they have an effect. |  | * Better education, so people understand why they need to complete courses of antibiotics. Supervise courses of treatment. |
| * People do not complete courses of antibiotics, which makes it easier for resistance to develop. |  | * Use of narrow-spectrum antibiotics once patient has been tested to determine which bacteria is involved. |
| * Antibiotics widely used in farming. |  | * Reduce the use of antibiotics. Not prescribed for viral or minor infections. |
| * Lack of basic hygiene in hospitals and care homes has encouraged the spread of antibiotic resistant bacteria such as MRSA. |  | * Increased hygiene in hospitals and care homes. For example: thorough cleaning of wards, regular hand washing, use of alcohol-based gels, isolation of infected patients, staff wear clean clothing, screening patients for infection on admittance, monitor levels of healthcare-acquired infections. |
| * It is a difficult and long process to develop and test new antibiotic drugs. As antibiotic drug use is declining, there is less financial incentive for pharmaceutic companies to develop new antibiotics. |  | * DNA sequencing will help identify bacteria and their new mutations quickly to find new ways of targeting them with newly developed antibiotic drugs. |
| * Bacteria reproduce rapidly. Populations evolve quickly to existing antibiotics. Mutations can be easily spread by transfer to offspring. Genes can even be transferred between different species on plasmids (horizontal transmission). |  | * Pharmaceutical companies are looking at natural chemicals that show antimicrobial properties and using computer modelling to design new drugs. Genetic engineering will enable large amounts of new drugs to be produced rapidly. |

**Evolutionary Race**

There is an evolutionary race between pathogens and medical science.

1. Define the following key terms:

* Resistance

A resistant bacterium is not affected by an antibiotic.

* Antibiotics

A drug that either destroys bacteria or prevents them from growing and reproducing.

* Mutation

A permanent change in the DNA of an organism.

* Adaptation

The adjustment or changes in behaviour, physiology and structure of an organism to become more suited to an environment.

1. Complete the paragraph using the words from the box.

* Antibiotics
* Industry
* Mutated
* Reproductive
* Resistance
* Test

Certain bacteria, such as *Staphylococcus aureus*, have \_\_\_\_\_\_mutated\_\_\_\_\_\_\_\_\_\_\_ and become resistant to \_\_\_\_\_\_\_\_\_\_\_antibiotics\_\_\_\_\_\_\_\_\_\_\_\_. Due to their high \_\_\_\_\_\_\_reproductive\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and mutation rates, bacteria can develop \_\_\_\_\_\_\_\_\_resistance\_\_\_\_\_\_\_\_ faster than the drug \_\_\_\_\_\_\_industry\_\_\_\_\_\_\_\_\_\_ can discover and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_test\_\_\_\_\_\_\_\_\_\_ new medicines.

1. Draw a flow diagram to show how antibiotic resistance can arise in a population of bacteria.

See PowerPoint.

1. Methicillin resistant *Staphylococcus aureus* (MRSA) has become a problem in hospitals as most antibiotics are ineffective in treating MRSA infection. Describe precautions taken to prevent new infections with MRSA in hospitals. (4 marks)

Hygiene measures such as use of hand gels between patients. Isolation of infected patients. Screening of new patients for infection before entry to hospital. Advising visitors to stay away if unwell.

1. A new antibiotic, teixobactin, has recently been discovered that is effective against bacteria with high levels of resistance, including methicillin-resistant *S. aureus* (MRSA). Explain the steps that should be taken to ensure that resistance to this antibiotic does not develop. (3 marks)

Avoid exposing bacteria to the antibiotic unnecessarily as this will reduce the chances of selecting resistance organisms.

Do not prescribe for infections unless it is known to be effective.

Supervise courses of treatment to ensure that they are always completed.

1. Match up the problems with the possible solutions.

|  |  |  |
| --- | --- | --- |
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| * Antibiotics widely used in farming. |  | * Reducing the use of antibiotics in farm animals. |
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