BIOLOGY 2

DISEASE, DEFENCE AND TREATMENT

My GCSE target grade is ..................
Microbes

Very small living things are called microbes.

Microbes such as bacteria and viruses can get into your body. Some of them cause disease. They can make you ill.

The cells of bacteria are even smaller than the cells of your body. The bacterium above is 2000 times larger than it is life.

The plant and the animal cell are also 2000 times larger than in life.

**Bacteria are everywhere**

Like you, bacteria need food and water to survive. Many of them need oxygen too. They grow best when it is warm. We find bacteria in places where there are all the things they need.

3. Write down three places where you would find bacteria.
   1. ___________________  2. ___________________  3. ___________________

Your body is full of places for bacteria to live.

4. Why is your body a good home for bacteria?

   ________________________

Millions of bacteria live between the cells of even the cleanest skin. Most of them do no harm, but some make you smell sweaty. Others can cause diseases such as sore throats and food poisoning.
What is the difference between bacteria and viruses?

Viruses are even smaller than bacteria. They are made of a few genes in a coat made of protein.

5. The picture below shows a bacterial cell infected by a virus. Which part of the virus goes into the cell?

Viruses cannot reproduce by themselves. They need to invade living cells and use the living cells to make more viruses. This damages the cells.

6. Why are viruses usually harmful?

A virus infecting a bacterium.

A virus. This is about 300,000 times bigger than real life.
What Happens When Microbes Get into Your Body?

Do microbes always make you ill?
Not all microbes make you ill. Many are easily destroyed by your white blood cells. Others are harder to destroy. When the numbers of microbes are small, you do not notice any effect. But microbes can breed very quickly. As their numbers get larger you begin to feel ill. This may take a few hours, days or even weeks.

1. What kind of cell destroys microbes?

2. Jan's sister Carol caught scarlet fever. As soon as her mother knew Carol was infected, she kept the two girls apart. It was too late. Jan became ill a week later.
   Why was it so long before Jan became ill?

3. What were the effects of the scarlet fever bacteria on the girls?

How do microbes cause these symptoms?
The pictures show how microbes can affect the body.

4. Your body temperature rises when you have an infection. Give one reason why.

5. You may also have a rash or a headache. Write down a possible cause for each of these symptoms.

Viruses damage cells as they escape.
How do disease organisms enter the body?

- Hand contact (rubbing), eg conjunctivitis.
- Through hair follicles and sweat pores, eg staphylococci causing boils.
- Contaminated food, drink, hands and utensils, eg salmonella, listeria, botulism.
- Insect bites, eg malaria, yellow fever.
- Sexual activity, eg AIDS virus, syphilis, gonorrhoea.
- Direct penetration of the skin, eg athlete's foot, bilharzia.
- Bruising or infected cuts and scratches, eg tetanus.
- Inhalation of infected droplets, eg 'flu.
- Injection of contaminated needles, eg transfusion, hepatitis.
Using sheet E8 - Transmission of Disease - answer the following questions.

**E8 Transmission of disease**

1. How it is possible to catch 'flu from someone sitting at the far end of a railway carriage?

2. In some parts of the world the standard of sanitation is low. Explain how the location of pit latrines on the bank of a river used for drinking water could aid the spread of typhoid fever.

3. Explain why being bitten by mosquitoes, fleas and tsetse flies can cause more harm than just a few irritating, itchy spots on the skin. Give details for one of them.

4. Name two ways by which the AIDS virus can enter the body. What precautions can be taken in each case to reduce the risk of infection?

5. Athlete's foot is a fungal infection which infects the feet. Can you suggest why it is often transmitted from person to person at swimming baths? Name one action which many swimming baths take to try to reduce the risk of transmission.

6. Rabies is a fatal disease. Can you say why dogs being brought into Great Britain from elsewhere have to be kept in quarantine for a number of months when they first arrive?

7. Complete the following paragraph using the words provided below. Each word or phrase may be used once, more than once or not at all.

   hair follicles skin fingernails sleep sexual activities life cycle dirty needles breathed in cuts insect bites water droplets other animal bites mouth nose eyes swallowed

   There are many ways in which diseases can be transmitted. Disease organisms carried in contaminated food or water enter the body through the _________ and are _________.

   Infected airborne _________ are _________, entering the body through the nose or mouth. Some diseases enter the body through the urinary, reproductive and anal passages, and are often transmitted during _________. Many diseases enter the body through the skin, by direct penetration, or through ________, ________, ________ and ________.
E9 Defence against disease

Eyes secrete tears containing an enzyme which destroys many bacteria.

Nose has hairs in the nasal cavity. These trap organisms and cells which secrete wax. This is mildly antiseptic, and can trap insects.

The outer ear is lined with cells which secrete wax.

The stomach secretes hydrochloric acid, which kills many bacteria in ingested food.

The vagina produces secretions which are mildly antiseptic.

White blood cells

Some of the white blood cells (phagocytes) engulf many of the disease organisms which invade through wounds or by other means.

Other white blood cells (lymphocytes) produce antibodies which make specific disease organisms and foreign proteins harmless.

The skin acts as a barrier to prevent disease organisms from entering the body.
Using sheet E9 - Defence against disease - answer the following questions.

1. Why do you think it is better to breathe through the nose rather than the mouth?

2. Acid in the stomach creates a low pH for the action of the enzyme pepsin. What other function does the acid have?

3. Give two reasons why the clotting of blood in a wound is important.

4. What is happening in the illustration below, and why is it important for our health?

5. After a child is vaccinated against measles, their body becomes able to produce antibodies very quickly when exposed to the measles virus. However, the measles vaccination does not give protection against chickenpox. Can you suggest why?

6. Although we do not usually notice tears unless we cry or get something irritating in our eyes, we produce small quantities of tears all the time. Suggest two ways in which this constant production of tears helps to prevent eye infections.

7. The skin is a very effective protective layer. Try to explain how it prevents germs entering, and under what circumstances they can get through it.
Humans against microbes

Skin - your first line of defence
Sharon has had whooping cough. Bacteria cause whooping cough. They spread through the air from one person to another.

1. Describe Sharon's illness. Use the chart to help you.

<table>
<thead>
<tr>
<th>Day</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>runny nose, sneezing, feeling ill</td>
<td>feeling better</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>fever</td>
<td>very bad coughing fits</td>
<td>still coughing</td>
<td></td>
</tr>
</tbody>
</table>

2. How could Sharon have caught the disease? Write down your idea in a few sentences.

Within a few weeks she was better. Her body had destroyed the bacteria.

How did Sharon's body destroy the bacteria?
The white cells in Sharon's blood destroyed the bacteria. The diagrams show how they can do this.

3. Look at the diagrams of the white blood cells. Write down the ways they can destroy bacteria and other microbes.

Some white cells make antibodies. These destroy the microbes. Each kind of antibody works against only one kind of microbe.

When a new kind of bacterium gets into your body, white cells have to start making a new kind of antibody. It takes time for the cells to make enough of the right kind of antibody. That is why it takes time to get better.

Bacteria makes poisons called toxins. White blood cells make antitoxins which destroy toxins. Each kind of antitoxin works against only one kind of toxin.

4. Where are antitoxins made?

5. Toxins have time to make you ill before they are all destroyed. Why do you think this is?
How is the spread of disease stopped?

The spread of disease can be prevented by making sure that good hygiene is used in key places such as bathrooms and kitchens.

Chemicals called antibiotics can be used to treat bacterial infections.

People can be immunized against some diseases by the injection of a vaccine.
VACCINATION or IMMUNISATION is a process in which the body is encouraged to make ANTIBODIES without having the disease.

The usual method is to inject dead or a mild form of the PATHOGEN. A pathogen is a disease-causing organism.

All microbes have special proteins on their surface called ANTIGENS. White blood cells recognise the foreign antigen and make ANTIBODIES. When the 'live' pathogen later invades the body, the antibodies already in your blood will destroy it quickly and you will not be ill. This is called being IMMUNE.

**ACTIVITY**

Who is Edward Jenner?

[www.bbc.co.uk/history](http://www.bbc.co.uk/history) or search Edward Jenner

**ACTIVITY**

Watch the film Microbeasts and Disease. (Section on Edward Jenner)
Microorganisms and disease

- There are an enormous variety of microorganisms. Most are harmless. Many are beneficial and perform vital functions, and some cause disease.

- Human skin forms an effective barrier to prevent microorganisms entering the body, as long as it is intact.

- If the skin is broken, the body has mechanisms to seal the wound, as blood clots to plug the gap.

- The body has an ‘immune system’ in which white blood cells play a key role. Some ingest any microorganisms that get into the blood, while others produce antibodies and antitoxins (see definitions, below).

- All cells have molecules on their surface called antigens. These antigens are different for each individual, and the white blood cells can therefore detect ‘foreign’ cells because their antigens are different from their own. This triggers an ‘immune response’ and the blood cells will then attack the foreign cell.

You need to know the following terms:

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pathogen</td>
<td>A microorganism which causes disease.</td>
</tr>
<tr>
<td>Antibody</td>
<td>A chemical produced by the body which can destroy microorganisms.</td>
</tr>
<tr>
<td>Antigen</td>
<td>A molecule on the cell surface that can be recognised by the immune system.</td>
</tr>
<tr>
<td>Antitoxin</td>
<td>A chemical which can break down poisonous substances.</td>
</tr>
<tr>
<td>Lymphocyte</td>
<td>The type of white blood cell which produces antibodies.</td>
</tr>
<tr>
<td>Immune system</td>
<td>The parts of the body which defend against disease.</td>
</tr>
<tr>
<td>Antibiotic</td>
<td>A drug which destroys microorganisms.</td>
</tr>
<tr>
<td>Vaccine</td>
<td>A medical preparation which is given to a patient to promote the development of immunity to a particular microorganism. It is usually given by injection.</td>
</tr>
<tr>
<td>Aseptic technique</td>
<td>A technique used when growing microorganisms, in which precautions are taken to ensure the culture is not contaminated by other microorganisms</td>
</tr>
</tbody>
</table>
Why do people need flu vaccines every year?

Example of vaccine pros and cons: Hepatitis B.

Hepatitis B is a serious disease which can cause liver damage and can be fatal. The advantage of being vaccinated is that you don't get hepatitis B.

What are the risks associated with having this vaccine?

Public debate about vaccination
Vaccines are only used to protect against diseases which can have serious consequences. Some of these vaccines have side effects. A judgement has to be made about the potential benefits of the vaccine against the risk of side effects.

In order to make an informed decision about having a vaccination (or getting your children vaccinated), the public need information, such as:

- The seriousness of the disease.
- The likelihood of catching it.
- The possible side effects.
- The chances of getting those side-effects.

This information needs to be based on sound scientific evidence.
The evolution of ‘super-bugs’

What do antibiotics do? Why can’t they be used against viruses?

For many years, doctors have given out antibiotics to treat infection. Common microbes can therefore be exposed to antibiotics very often.

This causes the natural selection of microorganisms which happen to have genetic immunity to the antibiotic. The MRSA bacterium is an antibiotic-resistant form which has evolved from the common *Staphylococcus* bacterium.

How to avoid super-bugs!

There are a large number of antibiotics than can be used to treat bacterial infections. Doctors are trying to avoid the evolution of too many super-bugs by:

- Not giving patients antibiotics unless it is essential (they cannot fight the infection on their own).

- Constantly varying the antibiotics they give to avoid constant exposure to the same antibiotic.
Antibiotic resistant strain

Staphylococcus bacteria naturally include some strains that are resistant to some antibiotics.

The bacteria are exposed to multiple doses of antibiotic over a period of time.

The non-resistant bacteria are killed by the antibiotic.

The resistant strain reproduces and becomes much more common than before.
MEDICINE

Vaccines cannot be made for every disease, but MEDICINES can help treat and cure many diseases.

Some chemicals can be used to relieve the SYMPTOMS of a disease but they don't kill the microbe.
E.g. aspirin or paracetomol are used as PAINKILLERS.

Other chemicals like ANTIBIOTICS relieve the symptoms by killing the microbe.

Complete Worksheet 1
Testing new drugs on animals

Read Worksheet 2-Trialling Drugs and then answer the following questions.

Q1 Write numbers in the boxes below to show the correct order in which drugs are tested:

☐ Drug is tested on live animals.  ☐ Human volunteers are used to test the drug.

☐ Drug is tested on human cells and tissues.

Q2 Before drugs are made freely available, clinical trials must be performed.

a) Give two reasons why clinical trials have to be done before drugs are made freely available.

b) Briefly explain why a drug is tested on healthy volunteers first?
Thalidomide is a drug that was developed in the 1950s.

a) What was this drug originally developed for?

b) Thalidomide was not fully tested. What effect did it have when given to pregnant women?

c) Name one disease that thalidomide is now used in the treatment of.

A pharmaceutical company is trialling a new drug. They are using a placebo in the trial and are conducting the trials ‘double blind’.

i) What is a placebo?

ii) Why are the scientists using a placebo?

iii) What is a double-blind trial?
Questions on Fighting Disease

Q1. Microbes must get into the body before they can cause disease. Our bodies have several natural defences that can stop microbes getting in. Match the natural defence to the correct part of the body:

- hydrochloric acid is produced to kill microbes
- acts as a barrier to microbes
- a sticky liquid is produced to trap microbes
- clots are produced to seal cuts.

Part of the body:

- skin
- stomach
- blood
- breathing organs

Q2. Cells in the blood can defend the body against microbes if they manage to get past the natural defences. The diagrams on the right show cells that are found in blood. Write down the name of each type of cell in the spaces. Choose from these labels:

- red cell
- white cell

Q3. White cells help to defend the body against microbes that cause disease. What do the red cells do?

Q4. Complete the sentences below using the words from the box:

<table>
<thead>
<tr>
<th>phagocytes</th>
<th>toxins</th>
<th>ingest</th>
<th>antibodies</th>
<th>antitoxins</th>
<th>microbes</th>
</tr>
</thead>
</table>

White cells can produce ______________________ which destroy particular ______________________. They also produce ______________________ which counteract poisons called ______________________. Special white cells called ______________________ can ______________________ microbes and so destroy them.
Questions on Fighting Disease

At each stage in getting a disease caused by a microbe, the body has defences. For each of the stages below, write down an example of the body’s defence against microbes:

Bacteria getting into a cut:

Bacteria producing toxins:

Bacteria being breathed in:

Look at the diagram on the right; then write down below how each of the parts A to D can protect the body against microbes.

A

B

C

D
Questions on Fighting Disease

Q7 In an experiment, somebody was injected with microbes. After 20 days they had produced 1 unit of antibody. After a few months, they were injected again with the same type of microbe. This time, they produced 2.5 units of antibody after 17 days.

a) Circle the correct words in the underlined pairs in the sentence below:

When you are exposed to a microbe for the second time, the production of antibodies is slower / faster than the first time, and more / less antibody is produced than the first time.

b) When you are vaccinated against a microbe that causes disease, you are usually injected with dead or damaged microbes, or parts of the microbe. Explain how vaccinations protect you from microbes that cause disease.

Q8 Use the list of infectious diseases in the box on the right to complete the table.

<table>
<thead>
<tr>
<th>diphtheria</th>
<th>measles</th>
<th>tetanus</th>
<th>rubella</th>
<th>mumps</th>
<th>whooping cough (pertussis)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MMR vaccine protects against</strong></td>
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</tr>
<tr>
<td><strong>DPT vaccine protects against</strong></td>
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Q9 Suggest reasons for the following precautions:

a) Putting a sticking plaster over a cut: .................................................................

.................................................................

b) Sneezing into a hankie when you have a cold: .........................................................

.................................................................

c) Washing your hands after going to the toilet: ..............................................................

.................................................................
A child had a sore throat so her mother took her to the doctor. The doctor said that the child had a bacterial infection.

(a) (i) What type of blood cell would help to fight the infection? [1]

(ii) Describe three methods that this type of blood cell would use to overcome the infection. [3]

I

II

III

(b) In the space below make a labelled drawing of a type of cell that would be useful in fighting the infection. [2]