BBC BITESIZE

I'm Dr Alex Lathbridge, and this is Bitesize Biology.

This is the fourth episode in a six-part series about Infection and Response. In this episode we're going to talk about drug discovery: how new drugs are discovered and how they are tested before they can be used by you and me.

And just a heads up, in this episode we're going to be talking about testing on animals.

Lots of our current medicines were discovered by studying plants. And that sounds weird, right?

Well, not when you think about history and biology. Because plants are organisms that can get diseases, just like us. So they've evolved to have chemicals that protect them against infection.

And before modern medicine made pills and injections commonplace, people would find ways to treat themselves, so they looked to different plants.

For thousands of years, plants have been used to treat illnesses and their symptoms. Because they contain hundreds of different chemicals, with some of them being useful for drugs.

Today, there are over a hundred active compounds derived from plants for use as drugs and medicines. For instance, quinine found in tree bark is the basis for the first anti-malarial drugs. And chemicals taken from pacific yew trees have been used as the basis for chemotherapy drugs.

It's not that you can just eat the plant or brew it into a tea, as they did in the past. Nowadays, scientists have been able to extract the active compounds, the chemicals that protect them against infection, and work out how they can be turned into medicine.

You're going to need to remember these examples for your exam:

The Ancient Greeks used willow bark to help cure fevers and pain. It was later discovered that it had an active ingredient, salicylic acid, and this same ingredient is now used in the modern painkiller Aspirin.

The drug Digitalis is used to treat heart conditions. This was originally developed from the flowering plants known as Foxglove, (which is the Latin name for the genus Digitalis). But they also have other names such as Dead Man's Bells and Witches Glove. Why? Because, depending on the species of Foxglove plant, the chemicals inside can be toxic. This is a good example of why it's important to understand how the chemicals inside plants work, because it allowed scientists to work out the correct compound and dosage required to be used as medicine.

Some drugs have been extracted from microorganisms, a famous one is penicillin. Penicillin was the first antibiotic discovered back in 1928 by Alexander Fleming.

He discovered it almost by chance. He was a bit of a sloppy scientist and went away on holiday leaving a sandwich out in his lab. When he came back, he noticed some petri dishes that had developed bacteria and mould from the sandwich. The area around the mould was completely free of bacteria. He found that the mould was a naturally occurring substance, that killed the bacteria, this became known as penicillin.

Today drugs are created by scientists in laboratories, but they may still start with a chemical extracted from a plant.

So let's look at drug discovery.

It's really important that when new potential drugs are found that they are tested thoroughly to make sure that they're safe. An example of when this didn't happen is the story of a drug called Thalidomide

Thalidomide is a drug that was originally developed in the 1950s as a sleeping pill but was also thought to be useful for pregnant women to reduce morning sickness. Unfortunately, it had not been tested thoroughly for use in this way and caused unexpected side effects and serious damage to unborn babies.

By 1960 Thalidomide was found to damage the development of unborn babies, leading to arms or legs of the affected babies being very short or incompletely formed. More than ten thousand babies were affected around the world and it was banned for use. It caused major changes in pharmaceutical policies worldwide, including a rule that, if a drug was to be taken when pregnant, they had to be tested to see if they were safe for use in pregnancy.

Let's take a look at how testing a new drug works.

Imagine that you and I are in the lab, and we've got to test new potential compounds before they can become drugs to be prescribed.

Grab a pen and write this down:

There are three things that we need to test potential compounds for:

1. Their safety. Some drugs might be toxic of have harmful side effects

2. Their effectiveness, also known as efficacy. Basically, how well a drug cures a disease or helps with symptoms

3. The dosage, what the optimum dose for humans is. This one is basically a balance of the last two. You want to make sure that the dosage is high enough to be effective but not so high that it causes dangerous side effects.

There's a really good saying from the 1500s that sums this up and is worth remembering: the dose makes the poison.

So the important factors are: safety, effectiveness, and dosage.

So we're in the lab right now, how do we get that data?

This can also be broken down into three stages. There are three stages of testing new potential drug compounds :

1. Testing on Cells and Tissues. Compounds are initially tested using human cells and tissues grown in a lab. This allows for efficacy and possible side effects to be tested. You can tell which new compounds fail this first step because they damage cells (which are side effects) or do not work (which is efficacy, or effectiveness). Once we have a compound that's successful from there, we move on to the next step.

2. Testing on animals. This involves giving a known amount of the compound to an animal, and then checking for any side effects. We can check the efficacy and how safe it is this way.

The law in the UK is very strict that any new drug must be tested on two different species of live animal.

There are real ethical considerations with testing new drugs on animals.
Not all scientists have the same opinion and this is something that opens up lots of debate

So once animal testing is completed, successful compounds move onto the third and final stage.

3. Testing on human volunteers. Compounds are tested in two ways: first in healthy volunteers to check they are safe and give no worrying side effects. Then the same drug is then tested on those who already have the illness, to check that it is safe and actually works. At the start, doses of the drug are very low, and then gradually they get increased to find the optimum dose.

I don't know about you, but when I was in primary school and someone scraped their knee playing, the school nurse would treat it with some blue tissue and water. We were told though, that it was magic tissue and magic water and we immediately felt better.

This was my first discovery of something known as the placebo effect: essentially the belief that something will have a positive effect on you.

A placebo is a tablet or medicine or treatment that has no active drug in it. These are used in drug testing with humans, where patients are split into two groups. One group is given the placebo (which has no drug in it) and the other group is given the new drug being tested.

Double-blind trials are often used to test drugs where neither the patient neither the doctor doing the tests, knows whether the patient in the study is getting the drug or the placebo. This is so the patients and the doctors aren't subconsciously influenced, and the drug test is as unbiased as possible.

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