



BRITISH  
PHARMACOLOGICAL  
SOCIETY

# **How do Medicines Work?**



## What are medicines?

Medicines are compounds that are used to treat illness and help us stay healthy. Within these medicines, there is something called the active ingredient. This is the molecule which acts on your body to make you feel better. They can be molecules extracted from plants or they can be made in a laboratory.

Many medicines work by acting on particular targets within the cells in the body. In this way, they can stop pain or lower blood pressure. Other medicines work by killing bacteria or viruses to stop infections. Over history, medicines have been discovered by scientists trying to cure disease, but some of them happened by chance! For example, penicillin.

You may have heard about the famous scientist Alexander Fleming, or his most famous discovery, an antibiotic called penicillin. It all began in 1928 when he made

an important observation. While growing bacteria in the lab in petri dishes, he noticed that one of his petri dishes had mould on it. But in the area surrounding the mould, the bacteria had been killed.

Fascinated by this, Fleming grew the mould in his lab. He found that the liquid it grew in was deadly to many types of bacteria. The mould turned out to be a species called *Penicillium* and Fleming named the drug penicillin after it.

Without the discovery of penicillin, most of the surgical operations we take for granted today could not take place because of the risk of deadly infections. Successful treatment of diseases like cancer would not be possible.

Discoveries like these happen because scientists conduct experiments. Every experiment gives an answer, and often leads to many more questions.

All medicines are drugs, but not all drugs are medicines!

## **What is pharmacology?**

Pharmacologists are scientists who are fascinated by medicines. They work in the area of science called pharmacology and study how medicines affect the body. This is different to a pharmacist, who prepares, gives out, and advises people about medicines that are already available.

Pharmacologists make a difference to the lives of people all around the world every day. You can find pharmacology everywhere, from when you visit the dentist and have an injection to numb your mouth, to when you take medicine for a headache. Pharmacology is responsible for creating hay fever tablets, antibiotics, and even cups of tea and coffee!

Today's science, tomorrow's medicine.



## **Without pharmacologists we would not be able to:**

Discover new medicines to help fight diseases

Improve their effectiveness and reduce unwanted side effects

Understand why some medicines work better for some people than others

Understand why some drugs cause addiction

If you love science and want to make a difference in the world, you could become a pharmacologist and make the medicines of the future!

# The drug discovery process

## Build your own medicine in 6 (not so) easy steps

### 1. Target discovery

Understand which molecule in the body you need to target with a drug to treat a particular condition, like cancer. It is also important to understand how that molecule usually works when we are healthy and when we are ill, so you can see how targeting it might have other effects!

### 2. Drug discovery

Identify what existing or potential new medicines have an effect on that target. Test and refine them to look for strong candidates.

### 3. Safety

Test the medicine in the lab and in animal models of the disease to see whether it causes any unwanted side effects, and to make sure it can be broken down safely in our bodies.

## **4. Clinical trials**

The first tests of the medicine in humans. This helps to understand more about the medicine's safety and efficacy.

## **5. More clinical trials**

Test the medicines in larger and more diverse populations. This makes sure the medicine is safe and works as expected. It also helps doctors to know how to prescribe it safely for everyone.

## **6. Registering and monitoring**

Register your new medicine! Checking the medicine is safe and effective does not stop at the end of the clinical trial! Medicines are monitored in a process called pharmacovigilance. This helps to ensure that each medicine is used as safely and as effectively as possible to help treat people around the world.

**Developing medicines can be a long and expensive process. It can take an average of 9–12 years for a drug to be developed from the lab bench to be used to treat patients. Pharmacologists are involved at every stage of the process.**

## **Where could a career in pharmacology take me?**

Pharmacologists are interested in problems, and life changing solutions. If you have a passion for science and want to make a difference in medicine and health, a career in pharmacology could be for you.

Pharmacologists carry out essential research to understand how medicines work. Without them, we would not be able to develop new treatments, and we would not know about the safety of medicines that people take every day.

Pharmacology improves the lives of millions of people across the world. And we need it more than ever. As new diseases emerge and medicines like antibiotics stop working, the need for pharmacologists is becoming even more vital in the search for new, better and safer treatments.



Pharmacology is a great foundation for a wide range of careers, from treating patients to researching new medicines, working to share science around the world, or helping to inspire and support the next generation of scientists.

There is a wide range of roles you can do in pharmacology, with or without a university degree. Training as a pharmacologist also equips you with a wide range of transferable skills for many different career paths.

If you are a student considering your options, visit **[bps.ac.uk/careers](https://bps.ac.uk/careers)** to find out how rewarding a career as a pharmacologist can be, and the skills you will need to get there.

Daniel Marks is a doctor, a teacher and a researcher. He spends his time working in a laboratory carrying out research to understand diseases and how they progress. He also uses this knowledge to design and test new medicines for patients, treat patients in hospital, and teach new doctors about using medicines safely.

“Developing new medicines is exciting and very rewarding, and clinical pharmacologists are uniquely positioned to combine an understanding of patients with knowledge of chemistry and biology”

Manasi Nandi is a teacher and pharmacology researcher. Her research involves working with other scientists, as well as mathematicians, engineers, and medical doctors to find answers and clues in medical information like blood pressure measurements. She is also an expert in designing animal experiments and teaches pharmacology students at university.

“I really enjoy my job as an both a teacher and researcher... my recent research project has exposed me to lots of different disciplines and ways of thinking. I’ve learned a huge amount and met some really interesting people. We’re now translating our research findings using patient data which is very exciting.”

Oliver Bell is a student studying for a PhD in pharmacology, he is carrying out research into how the immune system in our eyes responds to damage or infection.

“As a PhD student, my primary job is to undertake research in a topic and ultimately write a large book called a thesis detailing my findings ... I really enjoy the ability to learn and discover new things, as well as develop new questions and test them. As our understanding is continually changing, it makes for very interesting work that will have a positive impact on society in the future.”

A pharmacologist can be anyone who deals with the discovery, development, or use of drugs.

Pharmacologists are interested in problems, and life changing solutions.

Since it's discovery in 1928, penicillin has saved over 200,000,000 lives.

Have you heard of drugs called beta-blockers?

They are one of the most important heart medicines of all time. They were developed by a famous pharmacologist called Sir James black and his team. Fascinated by an important hormone in the body called adrenaline, their research into its effects on the heart gave Sir James the idea to develop beta blockers. Today, millions of people across the world take beta-blockers to treat conditions affecting the heart and circulatory system and anxiety.

## **A pharmacologist's job does not end with the creation of a medicine - this is just the beginning.**

As a pharmacologist you can discover new medicines, improve our understanding of how they work, help ensure that medicines are safe, or advise on how they are used in hospitals.

Pharmacologists can work in a variety of places, such as hospitals and research labs, and in many different types of roles. Without them we would not be able to develop new treatments and we would not know about the safety of medicines that people around the world take every day.

Visit **[bps.ac.uk/careers](https://bps.ac.uk/careers)** to find out more about pharmacology and becoming a pharmacologist.