BRITISH PHARMACOLOGICAL SOCIETY

WHEN SHOULD YOU DRINK LIZARD SPIT?

HOW DO PILLS KNOW WHERE TO GO?

HOW DO DRUGS WORK?

PHARMACOLOGY: LIFE CHANGING ‹··· ···› CHANGING LIFE

WHAT IS PHARMACOLOGY?

WHAT IS PHARMACOLOGY?

Pharmacology inspired the Beatles, killed Michael Jackson and made Alice in Wonderland grow.

Pharmacology can make you better (antibiotics, painkillers, beta blockers). Even make a better you (cognitive enhancing drugs, coffee, steroids)...?

Pharmacology is the science of drugs and their effect on living systems.

Pharmacology is everywhere. Every bathroom cabinet. Every dentist's chair. If you're put under, using an inhaler, having a drink or taking an aspirin, pharmacology is the science of what is happening to that drug and to your body.

Every time we take a pill our body's chemistry changes. Pharmacology's job is to understand why. And to use this knowledge to build better drugs.

A label on the side of a bottle can list ingredients. It can give dosage advice. And warn you of side effects. But a label on the side of a bottle can't begin to tell you what will happen when you take that pill; the fantastical, chemical chain of events that will be unleashed when a complex compound (the drug) is introduced to a complicated living system (that's you). This is the science of pharmacology. A vital, exciting, life-changing science masquerading as a little white pill.

PHARMACOLOGY?

Not to be mistaken with pharmacies, pharmacists or farmers.

Who are we?
The British Pharmacological Society (BPS) is a charity whose aim is to educate and expand the frontiers of pharmacology and support those who are training and working in the field.

WHAT IS A DRUG?

A drug is any chemical substance that changes normal body functions. A drug can be a medicine, a drug of abuse or a poison.

VITAMINS

HEADACHE

PAINKILLERS

ALCOHOL

MARIJUANA

POISON

TEA & COFFEE

CHOCOLATE

THE PILL

INSULIN

PARACETAMOL

ASPIRIN

CAPSICUM

A DRUG HISTORY

Or why you should be very, very glad you live in the 21st Century...

1600s Medicine is guesswork. Fashionable 'fixes' of the day include blood letting and purgatives – ejecting disease from your body.

1700s Doctors get better at diagnosing. Treatment is still violent. Leeches and laxatives remain popular. Botanical cures gain favour.

1800s Creation of pharmacology – a biomedical science based on experimentation. Things begin to look up.

1805 *Friedrich Sertürner purifies morphine from opium. Modern medicine begins.*

1810+ *Identification of crude, plant-based drugs (quinine, digitalis, ephedrine and strychnine) still in use today.*

1900s Pharmacologists understand more and more about the building blocks of drugs and the body.

1900+ *Creation of synthetic (lab-created) chemistry. Arrival of amphetamines and barbiturates. Local anaesthetics allow for painless operations!*

1905 *Langley identifies 'receptors' – giving us a language to describe the behaviour of cells and drugs.*

1931 *British Pharmacological Society formed to promote the science of drug discovery.*

1960s *Vaccines mainstreamed. Widescale reduction in measles, mumps, hepatitis and meningitis.*

1980s *Scientists begin genetically modifying bacteria in huge quantities to create synthetic human insulin. This replaces insulin manufactured from pigs, and improves the quality of life for diabetics who had suffered side effects and allergic reactions to this medication over many years.*

1928

Fleming accidentally discovers penicillin

You probably knew the discovery of penicillin was a mistake. Alexander Fleming was a brilliant pharmacologist who went on holiday, left his lab in disarray, and returned to find penicillin – or 'mould juice' – or the most life-saving drug in the history of the world.

200,000,000

lives saved by penicillin since its discovery in 1928

1940

The field of Chemotherapy emerges

Pre 1800: cancer is incurable, medically untreatable. **1800s:** development of anesthesia made surgical solutions more mainstream. **1900s:** the field of chemotherapy is born following an accident where mustard gas, a chemical weapon used throughout WW1 & WW2 is discovered to lower white blood cell counts. **Today:** cervical cancer vaccine. **Tomorrow:** the creation of personalised medicines using nanotechnology.

1960s

The Pill

This drug didn't just revolutionize contraception; it accelerated social change for women. Pharmacologists in some American states faced prosecution if they conducted clinical trials. Today, over 100 million women worldwide use the Pill as their primary form of contraception.

2000s

AIDS becomes manageable

AIDS: Initially a death sentence, HIV/AIDS becomes a manageable condition with the invention of antiretrovirals – one of pharmacology's finest hours.

2000s Artificial gene-based therapies developed.

2000s *Asthma advances – leukotrienes become the first new, improved medicine for asthma sufferers since the 1960s. Asthma still causes 2,000 deaths a year in the UK.*

AND BEYOND?

Cure for cancer? Alzheimer's? Malaria? The science of drug discovery is changing. With the patents of the early 'block-buster' drugs now expiring, pharmacologists are trying to develop an even greater understanding of our bodies to create personalised medicines, tailored just for you.

PHARMACOLOGY – VOICES FROM THE FIELD

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

NASA employs pharmacologists to advise on medications, as microgravity affects the behaviour of drugs.

"I think I'm living proof that a qualification in pharmacology needn't just lead to a career in the lab."

Sarah Teather, Minister of State for Children and Families 2011

"We work with rats that are trained to do very sophisticated behavioural tests, to study ADHD, depression and addiction. By working with our rats we can profoundly change how we understand an illness and develop better medicines."

Dr Emma Robinson, Behavioural Pharmacologist

"In the Welsh National Poisons Unit we see around 1,700 patients a year – over five a day – who have self harmed or been poisoned. Through the National Poisons Information Service I advise other hospitals how to manage poisoned patients. Often it's about children under 5 who have got into medicine bottles accidentally, teenagers who may have deliberately self harmed, elderly patients with therapeutic (prescribing) errors or accidental poisonings - things like carbon monoxide when somebody's decided to have a BBQ inside!"

Dr John Thompson, Senior Lecturer in Clinical Pharmacology, Wales College of Medicine, Cardiff University

BRITISH PHARMACOLOGICAL SOCIETY

The British Pharmacological Society is the professional association for pharmacologists in the UK. Our aim is to develop, support and promote pharmacologists in universities, labs, and in clinical settings.

WANT TO FIND OUT MORE?

www.bps.ac.uk
britpharmsoc
Search 'Pharmacological'
education@bps.ac.uk

WHAT DOES A DRUG DO?

LET'S LOOK AT ASPIRIN

Drugs change the behaviour of our cells.

When we swallow, inhale, apply or inject a drug it locates its target (usually a protein molecule), binds to it and sets about changing it for as long or as little as its chemistry permits.

These changes can be physical or psychological. Temporary or permanent. They can cure, slow or prevent disease. Numb, intensify or alter senses.

They can shut off pain receptors. Enhance neural pathways. And reveal what once was 'magic' to be a complex chemical choreography between body and drug.

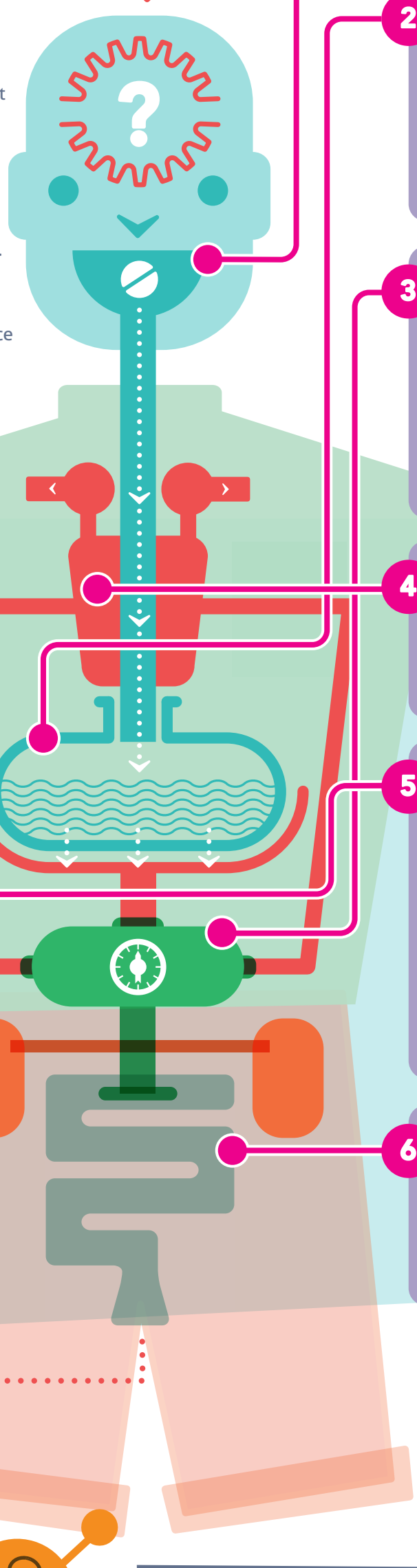
To find its target, a drug can either go direct – by applying a cream or being intravenously injected – or it can be taken internally, swallowed, inhaled, (or even inserted through the back door). Then, it jumps on the body's superhighways (bloodstream, lymphatics and cerebrospinal fluids) to get where it needs to go.

ORAL

INHALATION

INTRAVENOUS

RECTAL ADMINISTRATION



1 *Swallow tablet*

You can swallow your aspirin, or you can chew it (much better if you're having a heart attack...)

2 *Dissolved into stomach*

All drugs need to be dissolved before they can be absorbed, and aspirin is particularly clever as it can be broken down in both water and oil.

This means it can be absorbed into the oily membranes that line the stomach and small intestine. Once it has crossed these membranes it enters your bloodstream.

3 *Through the liver*

The blood drains from your stomach through the liver. The liver is the body's bouncer, preventing everything that could harm us from entering the bloodstream.

Cunningly the aspirin manages to bind itself tightly to the proteins in our blood so that the liver can't dispose of it all immediately. Told you it was clever.

4 *To the heart of the matter*

The heart pumps the aspirin-infused blood around your body, using blood vessels – the body's superhighways. The blood returns to your heart in a matter of minutes.

5 *Get to work*

When we are in pain, injured cells release prostaglandins which cause an inflammatory response. Ultimately, inflammation is a good thing – it leads to healing and repair – but the first stage of this process can amplify the injury, making it more painful. Aspirin gets to work by looking for the specific enzymes that are generating the prostaglandins, then binding irreversibly to them, and preventing them from making any more. This process reduces inflammation and kills pain.

6 *Disposal*

After 1 hour the aspirin is working at its peak. But with each subsequent cycle the liver clears more and more until, 5 or 6 hours post-dose, it will have disposed of it entirely into your bile to be excreted unceremoniously out.

A DRUG ACTS ON RECEPTORS, BUT WHAT IS A RECEPTOR?

A receptor is the part of the cell which the drug recognises and can bind to. These receptors are usually proteins and are a bit like a lock for which only the right key will fit. Because nature is fiendishly clever not all cells express the same 'lock' (i.e. receptor). Therefore the drug has to be the right 'key' for the cell to be affected and the drug to work.

'Keys' come in a variety of shapes. Some drugs work by stealth – mimicking a naturally occurring hormone or transmitter in the body so that cells recognise and welcome them in (agonists). Other keys are fashioned to jam the lock (antagonists) – inhibiting the receptor so that it can't do any of its normal things.

ALWAYS READ THE LABEL

When doctors talk about the 'pharmacology' of a drug they are essentially talking about its behaviour; how it reacts, how long it reacts for, and at what dosage it will be a) ineffective, b) efficient or c) dangerous. *You would be surprised at how little sometimes separates these three.*

WARNING: MAY CAUSE NAUSEA. *Why is it that some drugs make you ill? Surely that's missing the point?* Some drugs have serious side effects. Pharmacologists work hard to mitigate these when creating a compound but sometimes it is impossible. Chemotherapy will kill cancer cells, yes, but also healthy, functioning cells. Part of pharmacology's job is to work out if the end (cancer cure) is worth the means (hair loss).

THE NATURE OF DRUGS

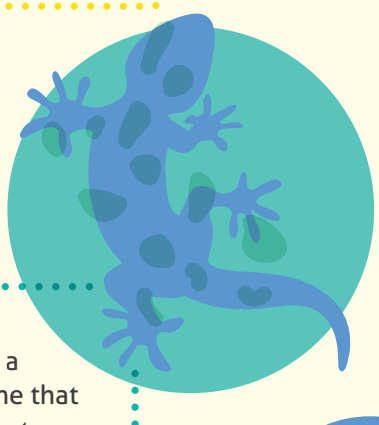
Pharmacology has always looked to nature for ideas. From diabetes treatment and pain relief to cancer cures and aspirin, many of our medical breakthroughs originated under a rock or skulking along the ocean floor.

CONE SNAIL

The tiny cone snail can release venomous conotoxins that render its predators very dead. Conotoxins have powerful effects on nerves: properties that scientists can now recreate for chronic pain relief.

CURRY

Capsaicin, from chillies, is used in the treatment of certain types of cancers, in pain relief creams and is also the main component of pepper sprays.



GILA MONSTER

The spit of the Gila monster - a giant, poisonous lizard - contains a chemical which mimics the hormone that helps us regulate blood sugar. Diabetes sufferers could soon use the chemical to help prevent heart disease, kidney failure and blindness.

FOXGLOVE

The toxin "digoxin" in foxgloves is a powerful "cardiac glycoside" used for people with heart problems.

CLOSTRIDIUM BOTULINUM

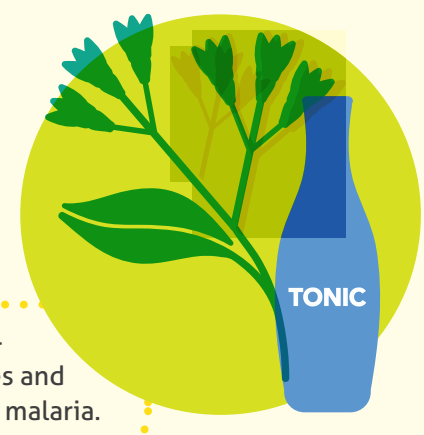
A bacteria that causes a flaccid muscular paralysis in the body and a fixed, startled expression in Hollywood starlets (botox).

WILLOW

Hippocrates used willow, a major ingredient in aspirin, for pain relief in 400 BC and its bark extract became recognized for its specific effects on fever, pain and inflammation in the mid-eighteenth century.

THE MADAGASCAN PERIWINKLE

The young leaves of this pink flower are the only known source of two potent anti-cancer drugs – vinblastine and vincristine. Pharmacologists are working to try and create them in the lab but to date have failed.



QUININE

Quinine (found in tonic) has fever-reducing and painkilling properties and has been revolutionary in treating malaria.

ANY QUESTIONS?

A pharmacologist's job doesn't end with the creation of a drug. It is just the beginning.

Once a new drug is discovered there will be big issues around implementation, access, experimentation and ethics. Want to know more about pharmacology and where drugs come from?

Visit www.bps.ac.uk

ONE DAY WILL I TAKE ONE PILL FOR EVERYTHING?

SHOULD WE BE DEVELOPING AN ANTI-OBESITY DRUG?

'Both my parents are cancer sufferers and both have had their lives extended and their quality of life enhanced by therapies and treatments that were brought into being by animal research.'

'CAN DRUGS REALLY MAKE ME SMARTER?'

A new generation of cognitive enhancers or 'cogs' are said to help people think, plan and remember more efficiently. They are already being used by some students and business people. Should we be discouraging or promoting this?

'Surely society would function better if IQ levels were higher?'

'If you haven't learned it you haven't earned it. There are no short cuts in education.'

'DO WE REALLY STILL NEED TO BE ANIMAL TESTING?'

Pharmacologists will always try to use alternative testing methods, as long as they produce equally valid results. Animal are still essential for drug development and testing. Scientists work tightly within the law and with the NC3Rs, an agency that seeks to reduce, refine and replace the use of animals in pharmacology.

Want to know more?
www.understandinganimalresearch.org.uk

'No. Testing on animals is always morally wrong. I don't eat them and I don't want my drugs tested on them.'

This leaflet is produced by the British Pharmacological Society. *www.bps.ac.uk*