Humane research

Many people say that using animals in laboratory experiments for medical research and chemical toxicity testing is not only cruel but also produces results that are unreliable and misleading when applied to people. This factsheet looks at the range of modern, human-based research methods that could be used instead of animal studies.

Why humane research?

There are two benefits of using humane, scientific research methods. Firstly, they don't involve hurting or killing animals. Secondly, they produce results that can be reliably applied to people because they are based on relevant human studies, or human cells.

Cutting-edge research methods


Cultured human cells

Human tissues

Scientists can study the effects of chemicals and new medical drugs on human cells, or tissues, in the laboratory in what are called *in vitro*, or test tube, studies.

There are around 200 different types of cells in the human body.[1]

Cells can be obtained from almost any part of the human body – brain[2], heart, lung and other organs, skin, blood vessels and bone, and then grown in the laboratory. Tissue banks store both diseased[3] and healthy tissue.[4 5 6]

Human cell cultures are used in toxicity testing,[7] drug development[8] and the manufacture of vaccines.[9]

Organ-on-a-chip

Organ-on-a-chip is a small microfluidic cell culture chip, the size of a USB memory stick, which models the working of individual human organs or groups of organs (called organ systems). [10 11]

These chips have tiny chambers, each containing cells from different parts of the body. The compartments are linked by channels through which a blood substitute flows. The test chemical or drug is added to the blood substitute and circulates around the device, thus mimicking what goes on in the organ or organ system on a micro scale. Sensors in the chip send the results of how the different types of cells react to the test compounds to a computer for analysis.


Human lung on a chip
© Wyss Institute at Harvard University

Chips that model the workings of various human organs include skin-on-a-chip, lung-on-a-chip, heart-on-a-chip, kidney-on-a-chip and brain-on-a-chip. Researchers are working towards building a human-on-a-chip - a device that mimics several key organs in the body. [12] The Organ-on-a-Chip Technologies Network is a UK-based initiative working to develop research in this field.[13]

Computer modelling

Sophisticated computer models have been developed that simulate the workings of human organs such as the heart and the intestine.[14] Work is also ongoing in a European project to co-ordinate the development of a 'virtual physiological human' as a single complex system.[15] Virtual human organs can predict how a new medicine will affect different parts of the human body. These models are based on relevant human data and can be used to carry out simulated experiments, in place of experiments on animals.

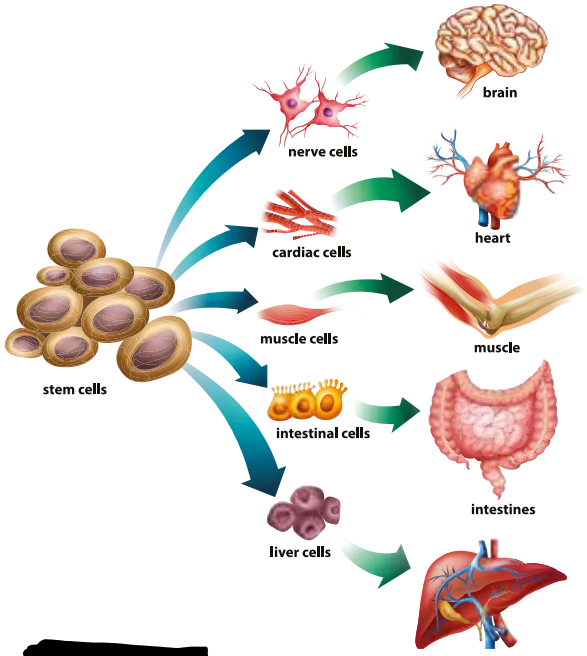
For example, in one study at the University of Oxford's Department of Computer Science, a computer model representing human heart cells predicted the risk of adverse drug effects, such as dangerous arrhythmias - where the heart beat becomes irregular and can stop, with greater accuracy than animal studies.[16]

Computer modelling is not just used to simulate human organs. This broader area of computer-based biomedical study and technology is also known as *in silico* research. It is becoming increasingly important in drug development [17] and new computer modelling techniques are being developed and refined.[18]

Human stem cells

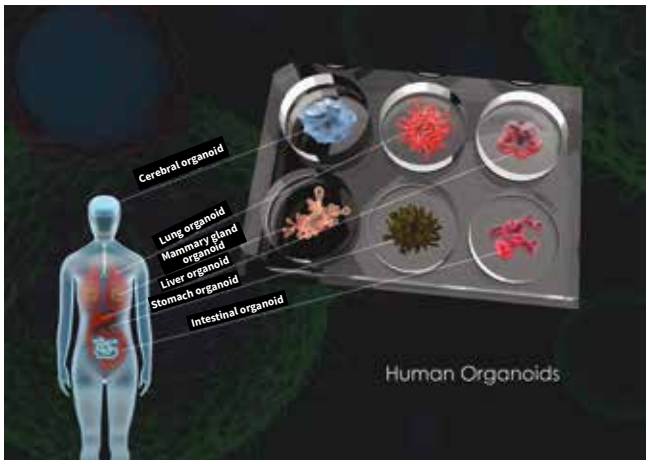
The generation of human induced pluripotent stem cells (iPSC) has been an important breakthrough. These are cells that can be grown into organoids (see below).

Potential Application of Human Stem Cells



Organoids

These are simplified *in vitro* versions of organs, capable of modelling some functions of that organ in the lab. Mini human brain organoids for example have been used in the study of microcephaly (a condition where a baby's brain does not develop properly during pregnancy). [19] [20] [21]



Microdosing[22]

This is a technique that enables potential new drugs to be tested, at an early stage, in humans. When used for this purpose, microdosing is sometimes described as a phase 0 or 'first-in-human' clinical trial and is increasingly seen as an alternative to some animal testing.[23] Volunteers are given a dose of a new medicine that is small enough to be safe, but large enough to study how it behaves in the body. This can be done non-invasively using advanced scanners which track the radioactively labelled drug in the human body. [24]

Imaging technologies

Diagnostic imaging techniques such as magnetic resonance imaging (MRI), functional MRI (fMRI), magnetic resonance spectroscopy (MRS), and positron emission tomography (PET), are able to show what is happening inside the human body and, particularly the brain.

Long-established research methods

Clinical Research

Clinical research, which involves the careful observation of people who are ill, has been responsible for much of the medical knowledge that we have today. Better use could and should be made of ethical, clinical research on patients to help find new treatments.

Autopsy studies

Autopsy studies involve the medical examination of people after they have died in order to establish the cause of death. Post mortem studies remain the best method of studying the effects of a disease on the whole body.

Epidemiology

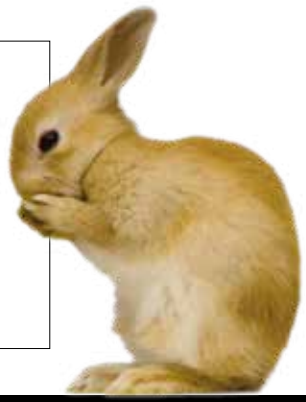
Epidemiology is one of the best ways to find out what causes disease. It involves studying different groups of people to find the links between disease and lifestyle or environmental factors. This is how, for example, it was discovered that smoking causes lung cancer.

For a table showing the current methods and the non-animal, humane alternatives for the different stages of drug development, please visit our website.

What you can do to make a difference:

- Order a free *End Animal experiments* action pack at **animalaid.org.uk/youth**
- Join Animal Aid and help to campaign against all animal experiments.
- Watch our *Investigating Animal Research* film on the Animal Aid website.
- Find out more about animal testing at **www.animalaid.org.uk**
- Ask your teacher if someone from Animal Aid can come to your school to give a talk on animal experiments or animal rights.

Glossary
Drug metabolism: How a drug is broken down and used in the body.
Efficacy: Whether a drug has a beneficial effect (whether it works).
Epidemiology: The study of the causes of health and illness in populations.
In vitro: 'In glass' in Latin – experiments that are done in test tubes and Petri dishes.
In vivo: 'within the living' in Latin - experimenting on a living organism.
In silico: Experiments or research conducted or produced by computer modelling or simulation
Organoid: Simple mini version of an organ grown in vitro (in the lab)
Stem cell: Cells that can, under certain circumstances, reproduce and that have the ability to develop into other cell types.
Tissue culture: The growth of tissues in vitro, separately from a living organism.



For more information on animal issues, please contact: Animal Aid, The Old Chapel, Bradford St, Tonbridge, TN9 1AW
Tel: 01732 364546 ext. 221 | www.animalaid.org.uk | education@animalaid.co.uk

For the references, see the *Humane research* factsheet on our website

January 2021