## What are the 3Rs?

The 3Rs – Replacement, Reduction and Refinement – are the scientific and ethical principles that guide the use of animals in research and testing. Scientists should **replace** the use of animals with alternatives wherever possible, **reduce** the number of animals involved to the minimum required, and **refine** procedures and animal care to minimise pain, distress and suffering. Using 3Rs approaches, scientists can maximise animal welfare and improve the quality and reliability of their research. The National Centre for the 3Rs (NC3Rs) was established in 2004 to support the scientific community develop and implement 3Rs approaches, advance the 3Rs in policy and practice around the world, and pioneer better science.

## Replacement

Replacement means using alternative methods instead of animals. Some examples are using cells to investigate how a disease develops, or a computer programme to see if a new drug would have toxic side effects. If scientists use cells, tissues or data from humans, these alternative approaches may also more closely mimic human biology than the animal models they replace. Replacement models can be faster and cheaper than using animals, for example when pharmaceutical companies need to test large numbers of molecules to identify potential new drugs.

**For more information, please visit:**

nc3rs.org.uk/3rs-public

lms.mrc.ac.uk/about/animals-in-research

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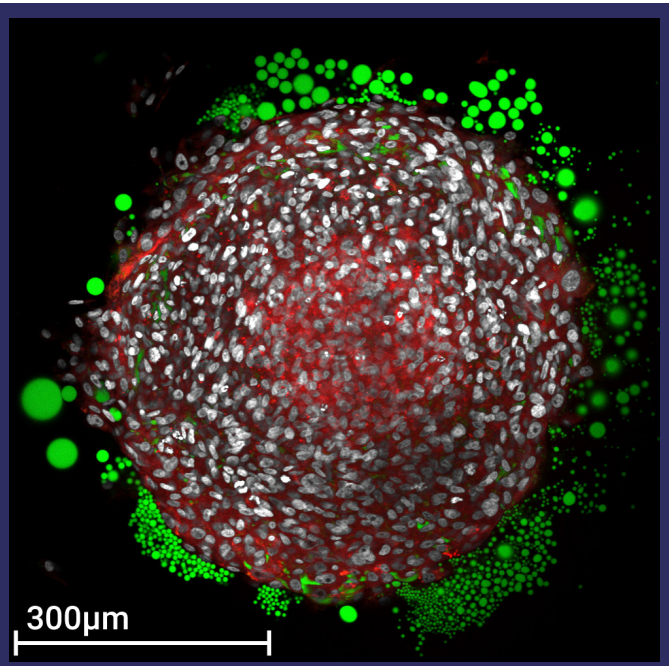
NC 3Rs National Centre for the Replacement Refinement & Reduction of Animals in Research

UKRI MRC Laboratory of Medical Sciences

# 3Rs Replacement Reduction Refinement

## Organoids

Organoids are small clumps of cells, often containing multiple types of cells grown together in 3D to model how cells interact and work together in the body. Different organoids have been made to replace animals in studies into cancer, the immune system, gut health, neurological disease and many more areas of research.




*A human adipose tissue stem cell-derived organoid imaged through a microscope by Dr Alice Pollard at Imperial College London.*

This is an organoid made from stem cells taken from human fat tissue and has been used instead of mice in research into type 2 diabetes. The stem cells can make both new fat cells (in green) and supporting cells found in in fatty tissue (in red) that create a 'glue' and support a 3D structure.

*A wax moth caterpillar in a laboratory dish.*

## Insects and invertebrates

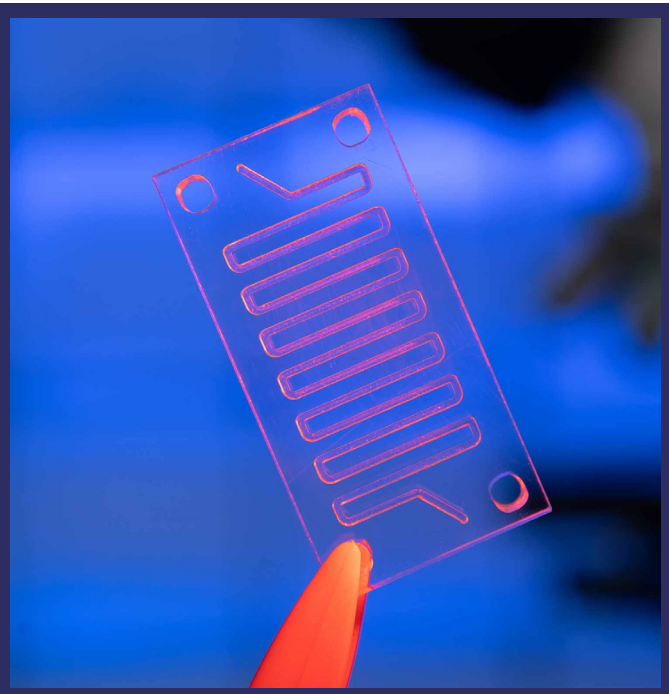
Fruit flies, wax moth caterpillars, microscopic nematode worms and other insects can be used instead of vertebrates and mammals such as mice. This is called partial replacement. While these species may respond to pain, parts of the nervous system and brain that are important for memory, cognition and emotion are less complex than in vertebrate animals. This means that, according to scientific thinking, species used as partial replacements are unable to experience suffering.

Wax moth caterpillars are particularly useful to study infection because they can be kept at human body temperature (37°C). This is important for scientists to properly understand how bacteria grow in the human body and cause infections. Mice prefer it a little chillier, at around 30°C, which may slow down bacterial growth.

## Organ-on-chip

Cells can be grown in microscopic channels in a plastic device called an 'organ-on-chip'. This technology allows scientists to make their cell-based model more complex and more similar to how organs are structured and function in the human body.

One of the first organ-on-chip devices was a lung-on-chip, with epithelial cells (which create a barrier around tissues) and capillary cells (which line the inside of blood vessels) grown in different channels to mimic how these cells are arranged and interact in the lung. The lung-on-chip has been used to replace mice in studies into lung function and disease. Scientists can even stretch the chip to mimic the mechanical forces on cells in the lung during breathing.



*An organ-on-chip device.*