This tiny insect, which most of us brush aside from the fruit bowl, has been responsible for some of the greatest discoveries in modern science

By Tom Bonnett
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"Time flies like an arrow; fruit flies like a banana."

It's a phrase loved by linguists to show how a sentence can be read in multiple ways. It also holds truth about the common fruit fly, *Drosophila melanogaster*, which has been studied by scientists for more than 100 years.

Macro of common fruit flies (Drosophila melanogaster) on piece of rotting banana fruit (Credit: Sylvie Bouchard / Alamy Stock Photos)

Fruit flies do like bananas. They are the flies you find on your fruit bowl when things start to rot – a reminder that the "five-a-day" hasn't been going quite so well.

But they are also a great mechanism for studying time or, more specifically, the effects of time because fruit flies' life cycle is so fast, it allows scientists to study them over generations that would be near-impossible with humans.

Laboratory culture of Drosophila melanogaster at the Vienna Drosophila RNAi Center, Institute for Molecular Pathology, Austria (Credit: Nature Picture Library / Alamy Stock Photo)

They are cheap to breed and reproduce extremely quickly. At room

temperature a female can lay 30-50 eggs per day throughout her lifetime and they have a short reproductive cycle, usually about 8-14 days and can become grandparents in only 3-4 weeks.

At 3mm in size, populations in the millions can be kept in the lab at any one time and fed on a simple diet of carbohydrates and protein, usually cornmeal and yeast extract.

This creature, which most of us brush aside, has been responsible for some of the greatest discoveries in modern science.

Drosophila melanogaster eye colour variations - red (wild type) and white. The white eye gene is sex-linked (Credit: Martin Shields / Alamy Stock Photos)

In 1933, Thomas Hunt Morgan won a Nobel Prize for studying how *Drosophila* inherited a genetic mutation that meant they had white eyes rather than red. His research led to a theory that genes made by DNA were carried on chromosomes, which were passed down through generations. The finding laid the groundwork for the study of genetic inheritance and modern genetics.

Since then research carried out on Drosophila has led to five Nobel

laureates in 1946, 1995 and 2011. Current thinking on how we develop, our behaviour, ageing and evolution are all built on the foundation of fruit fly research. The more we study them the more similar we discover we are: 75% of human disease genes have a recognisable match in the common fruit fly.

Drosophila has four pairs of chromosomes and around 14,000 genes. Compare that with humans, which have an estimated 22,500, and yeast, which has about 5,800 genes, and we are much more similar than you might expect.

Research scientist Dr Anne von Philipsborn sorting a laboratory culture of common fruit flies (Credit: Nature Picture Library / Alamy Stock Photo)

This relative genetic closeness means experiments on *Drosophila* translate effectively to humans and scientists. We get them drunk to study alcohol addiction, we study sleep and how they are affected by coffee and we have learned that older flies sleep less. The first 'jet lag genes' were found in flies, and we now know we have them too.

Thousands of scientists use *Drosophila* as a model organism across all of the world, even outside it. Fruit flies were the first animals launched

into space and there is a permanent Fruit Fly Lab on the International Space Station. This is used to study questions such as why astronauts are more susceptible to disease when in space.

Why then, if we are genetically close are we different in so many ways to the fruit fly or even yeast? Dr Peter Lawrence, author of The Making of the Fly, describes this as the "third secret of life".

Fruit fly on a peach... because it can (Credit: blickwinkel / Alamy Stock Photo)

In an interview for the **BBC Radio 4 series Natural Histories** he said the first secret is Charles Darwin's theory of evolution, which "drives the genesis of all the plants and animals, everything, from scratch".

"The second is the discovery of DNA because without understanding that information is coded and stored in this molecule then we wouldn't have much of an understanding of a mechanism that lies behind life," he said.

The third secret is a question Dr Lawrence sees as the greatest problem that must be tackled by the biologists of the future.

"It is so every day that we don't think about it. What makes the difference between a rhino and hippo?" he said.

Drosophila melanogaster genetics research (Credit: Martin Shields / Alamy Stock Photos)

"When you look at the genes, it's not much. So, what makes the pattern and the size and so on? Where is the length of your nose specified and what information present when you are developing fixes it at a particular length? What makes children resemble their parents, what makes the shape of a face? We actually don't know.

"That for me is the biggest unsolved problem in biology and is what I call the 'third secret of life'. You see it every day but it is so big it's not obvious how to approach it."

"You can't build an animal without vectorial information so we need to know where a cell is, what it is and where it's pointing. Imagine an architect's plans without any orientation of north or south you wouldn't know which way to put the building."

A darkfield micrograph of fruit fly mutations, Drosophila sp. (Credit: Scenics & Science / Alamy Stock Photo)

It's a subject scientists have tried to break down. Flies with larger wings have been studied to try to isolate the genes responsible for the increase in size. Scientists have compared species that are evolutionarily closely related and tried to examine the differences that lead to differences in their morphology.

And **female fruit flies prefer males with "flashier" wings**.

But, according to Dr Lawrence, these studies are valuable in contributing pieces in a puzzle but there is long way to go before we answer the big question and we need to make it a greater focus of scientific study.

"If you look at the whole cosmos of science you see a big dark area, space, and if you look more closely you see that, here and there, there are many rooms full of light and in each there are people all beavering away and arguing and discussing with one another but they don't look out of the windows and see and wonder what there might be out there."

Whatever the answers are, Dr Lawrence says, the chances are that they will be found by studying *Drosophila*.