

# Fruit fly gene research may shed light on human disease processes

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Those small fruit flies buzzing around your bananas are more than pests—they may be allies in a fruitful search for clues to human diseases caused when genes malfunction.

"One common misconception is that individual humans may carry 'disease-causing' genes, such as a gene for cancer," explains James Erickson, a biology professor at Texas A&M University. "All humans have the same genes, but individual genes have different forms, called alleles, some of which may predispose an individual to a disease."

"Studying the common fruit fly – *Drosophila melanogaster* -- lets us conduct more sophisticated experiments than can be undertaken in humans. These simple organisms can be grown cheaply in test tubes, fed on yeast, corn meal and molasses, yet their embryos, which can be seen with the naked eye, undergo many of the same developmental processes as larger creatures. Thus, they can serve as models, allowing us to observe details we can't see in more complex animals."

To understand cellular differentiation, Erickson and his graduate students have been researching how fly embryos become male or female, a process that occurs over a 30-minute period early in their development and which is similar to the differentiation process for different types of cells, mirroring, for example, the way a liver cell becomes different from a blood cell.

Erickson cautions that there is no direct connection between sexual

development in flies and that of humans, but the logic driving their cellular and molecular processes is the same. A paper by Erickson and postdoctoral student Frank Avila detailing their work on such processes has been published in this month's issue of *Current Biology*, a leading biology journal.

Human females have two X chromosomes in every cell, while human males have an X and a Y chromosome. "Just as in mammals, flies have two 'sex' chromosomes, a X and a Y" he explains. "However, in the fly, unlike in humans, the Y chromosome does not influence sex. Instead, two X chromosomes signal the fly to be female, and one X chromosome means it will be male."

A chromosome is a single DNA molecule that may contain different units of inheritance called genes, along with proteins that help to activate these genes under certain conditions.

Even though it is the presence or absence of the human Y chromosome that directs sex development, human females still need to determine how many X chromosomes they have in each cell. They do this to ensure that similar amounts of the proteins encoded on the X chromosomes are produced in each sex. Failure to properly count X chromosomes is lethal to embryos of mammals and flies. That's why biologists want to understand the process of "chromosome counting."

Early in his career, Erickson was part of the research team that identified the genes involved in counting *Drosophila* sex chromosomes. Now, he and Avila have made another breakthrough, identifying a signaling pathway outside the cell that helps trigger a cascade of proteins to ensure embryos remain either male or female once their sex has been determined, as well as help in the chromosome-counting process and in regulating other crucial cell activities.

"This signaling process is not unique to embryonic sex differentiation, but occurs in hundreds of genes throughout the body, in flies and in higher animals, too," Avila says. "Our work sheds light on signal transmission in humans."

Erickson points out that flies have evolved along with humans and that the two species are "close."

Although he is quick to point out that the group's research has no short-term practical application, he believes down the road it has important implications for human health.

"Scientists have been trying to understand how the sex of mosquitoes is determined, with an eye to eradicating those which carry diseases," he says. "Our research on fruit flies may help in this quest."

"Additionally, many human diseases are linked to genes carried on the X chromosome. That's why women do not suffer in the same numbers as men from such ailments as color blindness or hemophilia, since their double dose of X genetic material helps compensate for 'defective' genes on one of their chromosomes. Men, with just one X chromosome, have less protection. Understanding the role of the X chromosome and the mechanism of chromosome counting in fruit flies may help shed light on these same features in humans."

Besides potentially shedding light on human genetic maladies, Erickson and Avila say their work is just plain interesting.

"After all," says Erickson, "fruit flies share the same life cycle as butterflies – they're just not as pretty."

Source: Texas A&M University

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