Fate might not be so unpredictable after all, study suggests

Why does it take so long for soul mates to find each other? How does disease spread through a person's body? When will the next computer virus attack your hard-drive?

A new theory published last month in *Nature* on the statistical concept of "First Passage Time," or FPT, may provide the key to answering at least a few of these questions, says theory co-author Prof. Joseph Klafter from Tel Aviv University's School of Chemistry. And the answers may lead to breakthroughs in medicine, mathematics, the environment, and elsewhere.

Prof. Klafter and his colleagues from the University of Pierre & Marie Curie in Paris (where he has been visiting professor) are the first to have developed an analytical model that calculates the average arrival time – the mean FPT – of a randomly-moving object in a complex environment.

Understanding how randomly-moving objects arrive at a certain destination is no secret to scientists today. But no theory, until now, could predict the time it would take for an object to move between given addresses in a complex environment, like through the human body or the World Wide Web. Previous models only explained the passage of time when the event occurred in a homogenous environment, like in a vacuum or in a glass of water.

And in some instances, such as the movement of cancer cells in the human body, time is of the essence. The concept can best be understood by the question: How long will it take for a random walker to reach a certain destination"

Scientists from different backgrounds have studied and researched the predictability of FPT for decades. "Our new theory is exciting because it can be applied to a wide range of concepts in nature and mathematics," explains Prof. Klafter, the Heinemann Chair of Physical Chemistry at Tel Aviv University. "It can be used by biologists, by ecologists, and even help computer scientists predict when the next big virus will hit their computer."

When Prof. Klafter and his colleagues published their theory in *Nature* on November 1, they sparked interest from around the world – especially among biophysicists, who are looking for models to understand how long it takes for molecules to arrive at certain points in biological cells.

And although it will take months, maybe even years, for real-life experiments to prove the validity of this new theory, Prof. Klafter is looking forward to the results.

"I've received responses from researchers who are interested in using this model to analyze enzymes in cells," says Prof. Klafter. "Enzymes are important for controlling functions in the body. If a biologist can estimate the FPT of a certain enzyme (at the place where this molecule reacts), then perhaps one could interfere with or manipulate the system to help prevent a disease or make a bodily function more efficient."

He adds, "This theory can be applied to anything that moves randomly. It can be used for predicting when an enzyme will reach a target cell, how long a hungry animal will forage for food when food when is scarce – or even how viruses spread through the Internet."

Source: American Friends of Tel Aviv University