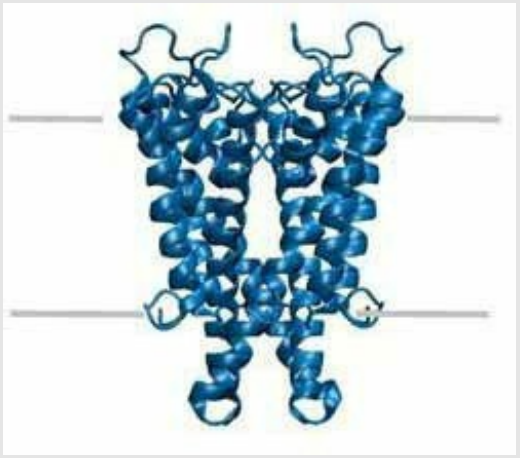
iSGTW Feature - Ion channel simulations

Philip Fowler had a problem.

He wanted to find out how selective a certain ion channel is for potassium over sodium—vital for its function—via a process known as "computational chemistry."

Unfortunately, while the techniques used to get such results are well-known and well-established, they are extremely time-consuming. Sometimes, he needed to do as many as 34 parallel simulations, and with each one taking one to two days, that could take over two months.



Visualization of the KcsA ion channel. *Image courtesy of National Grid Service*

But by accessing the grid via the UK's National Grid Service, Fowler -- previously at University College London and now at the University of Oxford -- found he could complete the entire job in less than two weeks.

Fowler uses classical molecular dynamics to study membrane proteins, in particular the proteins that allow ions such as potassium to diffuse in and out of cells, otherwise known as ion channels. Ion channel research is extremely important, not only for its scientific interest, but also because ion channels are intimately involved in, for example, the functioning of the brain and heart.

Well-established molecular dynamics packages such as NAMD and GROMACS can be used to produce simulations that can be used in either a quantitative or qualitative way. Qualitative simulations are run by taking the structure of a protein and putting it in a more realistic environment, such as in a membrane surrounded by water and with ions added to simulate a salt solution. The results are then visualized so the structure can be viewed at and sampled, providing understanding of how particular parts of the function work.

Enter the grid

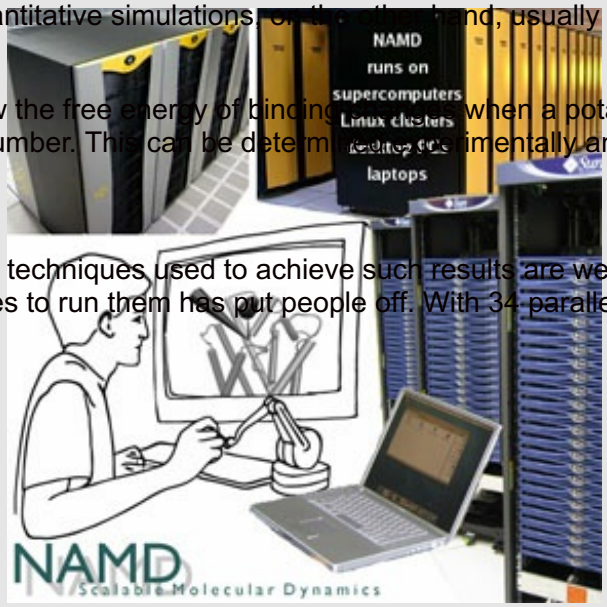


Image courtesy of NAMD

Quantitative simulations, on the other hand, usually produce a number that can then be compared to experimental results.

How the free energy of binding changes when a potassium ion is changed to a sodium ion is one example of such a number. This can be determined experimentally and compared to the value yielded by the simulation. This free energy tells us how selective a certain ion channel is for potassium over sodium.

The techniques used to achieve such results are well-known and have been around for a long time, but the time it takes to run them has put people off. With 34 parallel simulations, it's not surprising. Using the NGS, they can now be run in under two weeks. With such a drastic reduction in time, researchers can run more complicated simulation scenarios such as running two mutations, checking the results by repeating simulations and running simulations backwards.

Fowler was a user of the National Grid Service before it even went into production. He is now a veteran of the service, having used it for over three years, but would he recommend it to others?

"No way," he laughs. "I want it all to myself!"

—Gillian Sinclair, for iSGTW