How online gamers are solving science's biggest problems

A new generation of online games don't just provide entertainment – they help scientists solve puzzles involving genes, conservation and the universe

 Zoran Popovic, director of the Centre for Game Science at the University of Washington, is the co-creator of Foldit. PR

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For all their virtual accomplishments, gamers aren't feted for their real-world usefulness. But that perception might be about to change, thanks to a new wave of games that let players with little or no scientific knowledge tackle some of science's biggest problems. And gamers are already proving their worth.

In 2011, people playing *[Foldit](http://fold.it/portal/" \o ")*, an online puzzle game about protein folding,[resolved the structure of an enzyme that causes an Aids-like disease in monkeys](http://www.scientificamerican.com/article/foldit-gamers-solve-riddle/" \o "). Researchers had been working on the problem for 13 years. The gamers solved it in three weeks.

A year later, people playing an astronomy game called [*Planet Hunters*](http://www.planethunters.org/) found a curious planet with four stars in its system, and to date, they've discovered 40 planets that could potentially support life, all of which had been previously missed by professional astronomers.

On paper, gamers and scientists make a bizarre union. But in reality, their two worlds aren't leagues apart: both involve solving problems within a given set of rules. Genetic analysis, for instance, is about finding sequences and patterns among seemingly random clusters of data. Frame the analysis as a pattern-spotting game that looks like [*Candy Crush*](http://en.wikipedia.org/wiki/Candy_Crush_Saga), and, while aligning patterns and scoring points, players can also be hunting for mutations that cause cancer, Alzheimer's disease or diabetes.

"Our brains are geared up to recognise patterns," says Erinma Ochu, a neuroscientist and Wellcome Trust Engagement Fellow at the University of Manchester, explaining why scientists are turning to gamers for help, "and we do it better than computers. This is a new way of working for scientists, but as long as they learn how to trust games developers to do what they do best – make great games – then they can have thousands of people from all around the world working on their data."

The potential is huge. As a planet we spend 3bn hours a week playing online games, and if even a fraction of that time can be harnessed for science, laboratories around the world would have access to some rather impressive cognitive machinery. The trick, though, is to make the games as playable and addictive as possible – the more plays a game gets, the larger the dataset generated and the more robust the findings.

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[Zoran Popovic](http://homes.cs.washington.edu/~zoran/) is the director of the Centre for Game Science at the University of Washington and is the co-creator of *Foldit*. He explains that while successfully entertaining the masses, these games are meeting a very pressing need: science needs more people.

"No matter what academic process we go through," he says, "we end up whittling down a huge population of middle schoolers interested in science to some small percentage that actually survive the PhD process and end up doing science. Considering how many open scientific problems there are, and how few scientists there are, it's clear that we're stymied in the progress of science simply by the number of able and interested people out there."

Through *Foldit* alone he estimates that the number of people working on protein folding around the world has increased by four times in the past two and a half years. [Zooniverse](https://www.zooniverse.org/" \o "), a website that offers a wide range of online citizen-science projects including *Planet Hunters*, estimates that, together, their volunteers give them a virtual office block of 600 people working around the clock on scientific questions.

If you want to join in and become a fully fledged citizen scientist, or if you just want to contribute to science on your way to work, here are 10 of the best games around. But be careful, because they're all pretty addictive. But that shouldn't be a surprise… they've been designed, by scientists, to be so.

[**Phylo**](http://phylo.cs.mcgill.ca/)

 Phylo: 'colourul puzzles and jazzy music'. PR

**Make patterns and research diseases**

It's tough to know what to like more about *Phylo*, the colourful puzzles or the jazzy music. Either way, their combination makes the complicated world of bioinformatics, or more specifically multiple sequence alignment optimisation, incredibly accessible. By pushing around coloured blocks into patterns, you're actually aligning DNA from different animal species, helping research into genetic diseases by identifying disease-associated or mutated genes. Beat algorithms and other players by aligning the patterns and minimising gaps as much as possible.

[**Foldit**](http://fold.it/portal/)

**Make a shape and understand proteins**

A bewitchingly addictive puzzle game. Use shakes, tweaks, wiggles and rubber bands to twist and contort your protein into its most stable and thus highest-scoring shape. Each puzzle is a bit like a Rubik's cube in that there is only one perfect solution to each structure, but there are various intermediate or less stable ones in between. Work your way up the high scores tables by joining groups and sharing puzzle solutions with other players. En route, you'll help researchers discover more about the rules that govern the shape, and therefore function, of proteins, helping the fight against cancer, Alzheimer's disease and HIV/Aids.

[**Forgotten Island**](http://ictmagic.sharedby.co/share/G0hoLT)

 Forgotten Island: 'visually beautiful'. PR

**Study organisms to assess man's impact**

If you loved *Monkey Island*, this game, a visually beautiful point-and-click adventure game with a compelling narrative, is for you. You're a scientist with a secret past, trapped on a mysterious island where an explosion has destroyed the biology lab. Photographs of organisms are strewn across the island. Collect and answer questions about the photos to earn game money, which you spend on tools to help you progress and hopefully get off the island. Your classification of these real-life photos from around the world will help biologists to study the effects of urban sprawl on local ecosystems or to detect evidence of regional or global climactic shifts.

[**Fraxinus**](https://www.facebook.com/fraxinusgame)

**Align patterns to save ash trees**

Think *Candy Crush* but with coloured leaves. To play this Facebook game, align different patterns with a reference pattern: the better the alignment, the higher the score. Tussle for ownership of a given pattern by beating other players' scores. In sorting the patterns to increasingly higher accuracy, you'll actually be helping to detect genetic variants that can protect Europe's ash trees (*Fraxinus excelsior*) from a deadly fungal disease. Each pattern represents actual DNA lengths from the trees and the fungus, from which scientists hope to identify genetic variants that either confer resistance or increase susceptibility.

[**EteRNA**](http://eterna.cmu.edu/web/)

**Make shapes to understand genes**

A similar concept to *Foldit* (it was made by some of the same people), but this time you're trying to get RNA into a target shape. RNAs, which have an important role in building proteins and regulating genes, are made up of four different types of nucleotide bases. Switch these to alter the RNA's configuration, increase its stability, and up your score. Target shapes get increasingly more complicated as you progress to becoming a puzzle architect or, in the lab mode, compete for the chance to have your own RNA designs synthesised and assessed by scientists at Stanford University.

[**Ora**](http://www.playora.net/get-involved/)

**Protect a forest… to help protect forests**

Not released until later this year, but well worth keeping an eye out for. You'll be charged with taking care of a plot of New Zealand forest and protecting it from ravenous Australian bushtail possums. Set traps, create sanctuaries or fly aerial operations to sow toxic bait to save your pixelated forest. Researchers will then take the best strategies and apply them in real New Zealand forests, where native plants and animals are under threat from these invading possums. To help raise money for the game, Ora's developers have released [*Possum Stomp*](http://www.playora.net/possumstomp/), a mini game app available on iOS or Android.

[**Galaxy Zoo**](http://www.galaxyzoo.org/)

 Galaxy Zoo: 'an authentic experience of science'. PR

**Classify galaxies to understand universe**

Zooniverse's flagship project. Sift through pictures of millions of galaxies and help classify their shapes to unravel their history. A galaxy's shape tells you whether it's collided with another galaxy, if it's formed stars, and how it's interacted with its environment. Like all Zooniverse projects, [*Galaxy Zoo*](http://www.theguardian.com/science/2012/mar/18/galaxy-zoo-crowdsourcing-citizen-scientists) offers an authentic experience of science, so you'll not get points. However, if seeing far-flung corners of the universe before any other human eye isn't enough for you, keep a look out for weird and wonderful objects and they might be named after you, such as [Hanny's Voorwerp](http://en.wikipedia.org/wiki/Hanny's_Voorwerp" \o "), a galaxy-sized gas cloud named after one player.

[**Eyewire**](https://eyewire.org/signup)

**Untangle puzzle and unearth new neurons**

Help scientists figure out how the brain is wired, starting with nerves in the back of the eye. You're given a cube of tangled nerves from which you have to tease out the shape of individual nerves and, slice by slice, build up their three-dimensional structure. It's little wonder this game is so pleasing: it taps into two things you probably forgot that you love – colouring in and treasure hunts. Score points by tracing well and unearthing new neurons. The timed events really ramp up the heat, and might have you sitting at your computer all night. Be warned.

[**Whale FM**](https://www.zooniverse.org/project/whalefm)

 Whale FM: help marine biologists find out more about whales. PR

**Listen to whales, help marine biologists**

Another authentic experience from Zooniverse. This time be a marine biologist (no scuba diving, sadly) and study whale song. Listen to recordings of killer whales and pilot whales from around the world and link them with a list of potential matches. Find a match and it'll be stored for further analysis. Your work will help biologists determine the size of these animals' repertoire and whether they have accents, indicators of intelligence or a culture. If you've noticed neither animal is a whale but instead a type of dolphin, this game is probably for you.

[**Cropland Capture**](http://www.geo-wiki.org/games/croplandcapture/)

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**Identify arable land to feed the world**

By 2050 there will be 10 billion of us on the planet. That's a lot of hungry mouths that we'll struggle to feed with the current agricultural setup. Trawl through satellite images of the Earth and look for arable land to help develop the first-ever global crop map, which will help plan for global food security, identify yield gaps and monitor crops affected by droughts. The more land you identify, the higher your score and the better your chances of winning great weekly prizes, such as an Amazon Kindle, a smartphone, or a tablet. But hurry: the competitions stop in April.

• This article was amended on 27 January 2014. An earlier version referred to Zoran Popovic as director of the Centre for Game Science at Washington University. That should have been the University of Washington at Seattle, Washington state. Washington University is in St. Louis, Missouri.