Managing thousands of samples for answering ancestry questions

The Texas-based company Family Tree DNA provides genealogy testing for people who are researching their family trees and is currently heavily involved with the Genographic Project[1] mapping human migration patterns over time. The company uses PCR-based technologies to analyze DNA samples, relying on a REMP Small-Size Store™ and a Tecan Freedom EVO® liquid handling workstation to manage, process and store the hundreds of samples it receives every day.

Family Tree DNA was set up in Houston, Texas, USA, in 1999, specifically to provide DNA genealogy services on request for customers worldwide. The company analyzes DNA extracted from customers' cheek swab samples – currently around 200 samples each day – to compare the likeness of chromosomal markers in potentially related samples, helping people to establish whether they have a common ancestor. A number of different tests are available, based on either Y chromosome testing for identifying relatedness between males, or mitochondrial (mt)DNA comparisons for establishing relatedness between females.

Family Tree DNA is also now receiving samples from volunteers participating in the Genographic Project. This five-year, worldwide study was launched in April 2005 by National Geographic and IBM, with support from the Waitt Family Foundation. The project aims to map historical human migration patterns by collecting and analyzing DNA samples from over 100,000 people across five continents. Members of the general public are encouraged to take part and the samples are tested to determine what migratory routes the participants' deep ancestors followed (on either the maternal or paternal side), and to which branch of the human family tree each participant belongs.

The Genographic Project has unsurprisingly led to a large increase in sample numbers for the company and the decision was quickly made to update the laboratory's sample management system and automated processes. "I knew from previous experience that manually storing and picking hundreds of individual sample tubes can be extremely time consuming and very prone to error, so we looked for a more reliable method of cherry-picking and a more compact way to store DNA samples," said Dr Thomas Krahn, Chief Scientific Officer at Family Tree DNA. "After investigating several sample management systems, we chose the REMP technology because

Scientists at Family Tree DNA (l to r): Brent Manning, Astrid-Maria Krahn, Dr Connie Bormans and Dipl-Ing Thomas Krahn

it seemed to be the most efficient. Our REMP Small-Size Store (SSS) was installed in January 2007 and we are very happy with the system; it works very well and the REMP Sample Administration Software™ is a real advantage too. We currently have around 4,000 samples in the store; its total capacity is 82,560 so we are using under five per cent capacity at the moment, but our sample numbers are increasing so quickly that within a year we expect the store to be at least three quarters full, predominantly with scientifically interesting samples and samples from customers who have reordered more markers."

"We also chose the REMP 96 Tube Technology™ consumables," continued Dr Krahn, "using 300 µl volume tubes because they can be capped, and also because it is vital that the tubes hold sufficient DNA for the various tests. Each customer sample yields approximately 200 µl of 5 ng/µl DNA, which is the highest concentration that we can get in a 200 µl volume."

Family Tree DNA keeps part of every original sample in its REMP SSS in case the customer requests further tests, and also maintains a library of samples with rare alleles for control purposes. The company currently offers about 150 different DNA tests, including tests for 12, 25, 37 or 65 markers on the Y chromosome, and tests for parts of the hypervariable regions 1 and 2 of mtDNA, as well as full mtDNA sequencing. "Analyzing more markers provides higher resolution data and increases the chances of identifying small mutations that can be used to reconstruct a family tree or to separate different hereditary lines," Dr Krahn explained. "Some of our customers are involved in surname-based projects with hundreds of potential relatives, and they are keen to understand the different family lines."

About three quarters of the samples come from customers who order straightforward analyses and do not reorder tests, and these are sent on to colleagues at a testing laboratory at the University of Arizona for processing. "Here in Houston, we focus on the specialty tests that are ordered less frequently and those that have a high degree of diversity, such as the indigenous samples sent in for the Genographic Project. All the samples to be tested are subjected to PCR, followed by various genetic analysis procedures, such as sequencing, real-time PCR or fragment length capillary electrophoresis, depending on the test required."

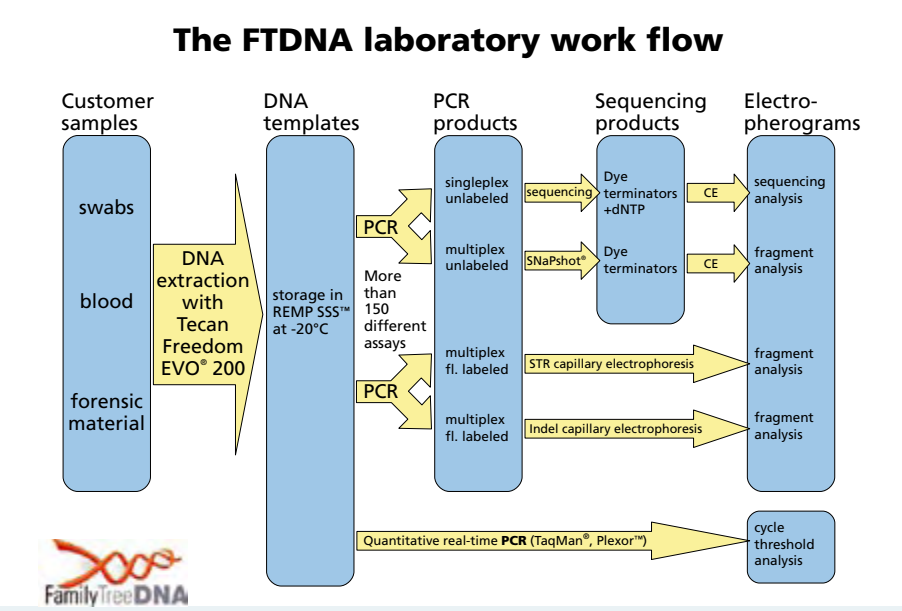
Each sample usually undergoes the same DNA extraction and storage preparation procedure, so Dr Krahn and his colleagues have set up an automated platform that includes a Tecan Freedom EVO liquid handling workstation, with an integrated REMP Reatrix™ DataMatrix scanner for identifying barcodes on tubes as well as tube racks, and a REMP Automated Capper Decapper™ (ACD96) device. The Freedom EVO performs all DNA extraction steps and purified samples are plated into REMP 96 Tube Technology tubes, placed into REMP 96 Storage Tube Racks and stored at -20 °C in the SSS. Any sample can then easily be accessed and grouped for testing as required.

"We are about to fully automate the entire procedure, from registering the sample tube that we receive from the customer to filling the REMP plates with purified DNA and storing them in the SSS," Dr Krahn added. "The software for this is currently being developed and it will mean we simply register the barcode of each tube on arrival and everything will be automatically stored in the REMP database, from which we will be able to handle the orders completely independently."

Reference

1. For more information on the Genographic Project, visit www.nationalgeographic.com/genographic

Some of the referenced instrumentation is not for use in clinical diagnostics.



The Family Tree DNA laboratory workflow