

Difference Between Microarray and Next Generation Sequencing

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Key Difference – Microarray vs Next Generation Sequencing

[DNA sequencing](#) processes are used widely in the fields of [biotechnology](#), virology, medical diagnosis and forensic sciences. It is a process which determines the exact order of the [nucleotides](#); [adenine](#), [guanine](#), [thymine](#) and [cytosine](#) present within a DNA molecule. DNA sequencing procedures have become an accelerant for miraculous discoveries in medical and biological research. These sequencing methods have evolved up to sequencing a complete genome of individual organisms including humans and other living species. Microarrays and Next Generation Sequencing are modern DNA sequencing procedures. **Microarray technique is specifically based on [hybridization](#) which contains a set of known targets. Next generation sequencing is based on synthesis (which utilizes DNA polymerase to incorporate nucleotides) and has the ability to sequence the entire genome independent of previously selected targets.** This is the key difference between Microarray and Next Generation Sequencing.

What is Microarray?

DNA microarray is utilized as a laboratory tool in order to identify thousands of different gene expressions at the same time. It is a solid surface, i.e., microscope slide, which contains a collection of microscopic DNA spots printed on it. Each printed spot contains a known gene sequence or a gene. These known [probes](#) printed on the slide serve as probes in order to detect gene expression. This is known as a [transcriptome](#). Hybridization between two DNA strands is the primary principle microarrays are based on. It is the complementary base pairing of nucleic acid sequences with the formation of hydrogen bonds.

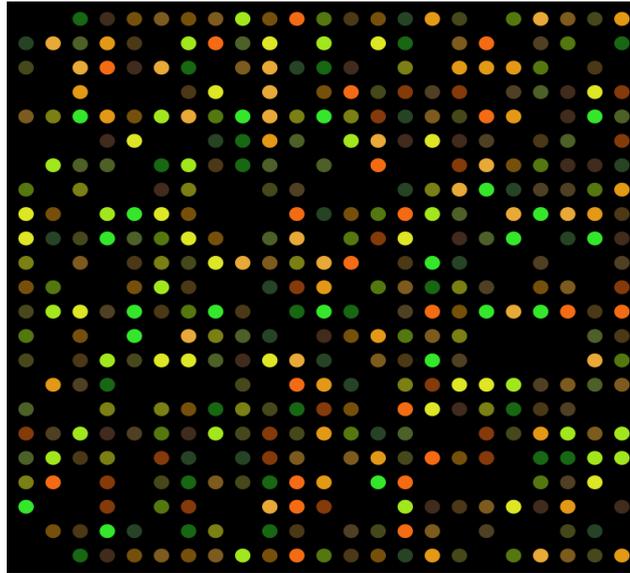


Figure 01: Microarray

Initially, [mRNA](#) molecules are collected from the experimental sample and reference sample obtained from a healthy individual. Experimental samples are obtained from diseased individuals; for example, an individual suffering from cancer. Once obtained, both mRNA samples are converted to [cDNA](#) (complementary DNA). Next, each sample is labeled using a fluorescent probe. The fluorescent probes are of different colors to distinguish the sample cDNA from the reference cDNA. In order to initiate the binding of the cDNA molecules to the microarray slide, the two samples are mixed together. Hybridization is the process by which the cDNA molecules get attached to the DNA probes on the microarray slide. Once hybridization is completed, a series of reactions take place in order to identify and measure the expression of each gene with the appearance of different colors according to the amount of the gene expressed. The results from microarray are utilized in the creation of a gene expression profile which can be used to identify different disease conditions.

What is Next Generation Sequencing?

Next Generation Sequencing (NGS) is an advanced method of genetic sequencing. Its principle is similar to that of [Sanger Sequencing](#), which depends on capillary electrophoresis. In NGS, the genomic strand is fragmented and ligated to a template strand. The bases of each strand are identified by the emitted signals during its ligation process. In Sanger sequencing method, three separate steps, sequencing, separation, and detection are involved. Due to these separate steps, automation of the sample preparation is limited in throughput. In NGS, the technique is developed using array based sequencing with the combination of the steps of Sanger sequencing procedure which can cause millions of reaction series to be carried out parallel at the same time; this results

in high speed and throughput at a low cost. NGS is composed of three steps; library preparation (creation of libraries with the use of random fragmentation of DNA), amplification (amplification of the library using clonal amplification and [PCR](#)) and sequencing. The genome sequencing processes that are carried out for extremely long durations using Sanger sequencing procedure could be completed in a matter of few hours using NGS.

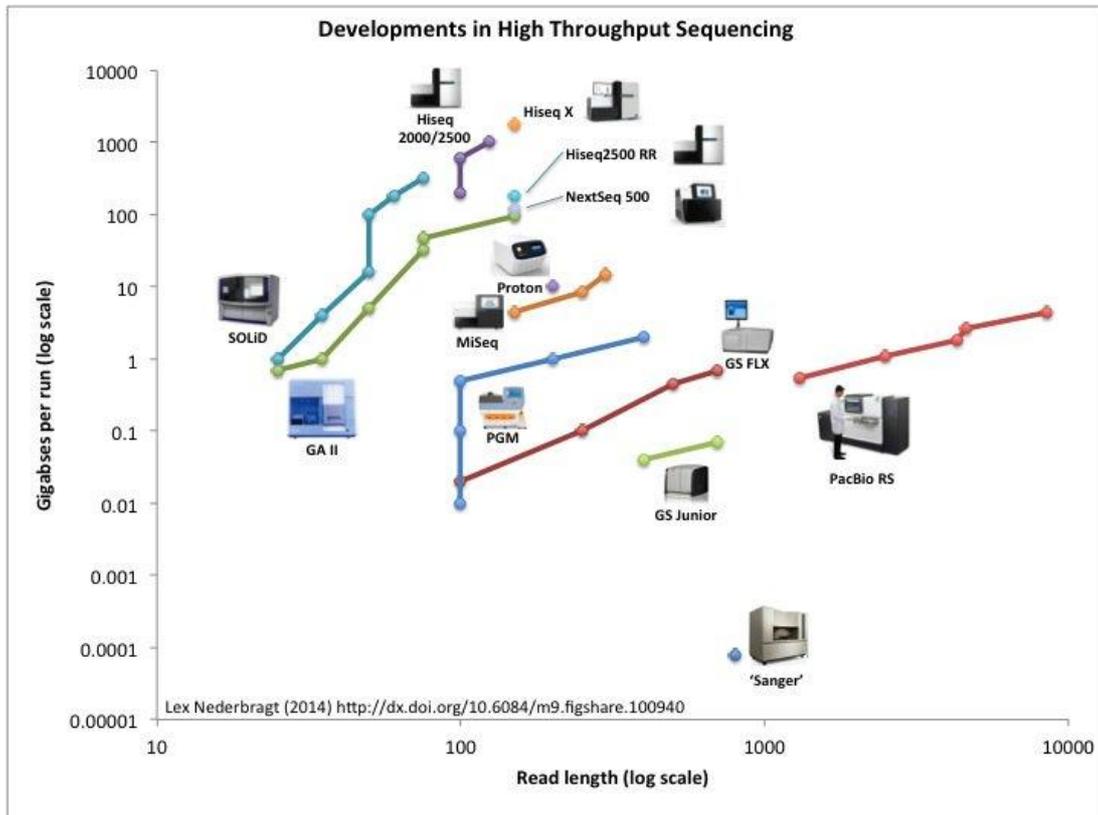


Figure 02: Developments in NGS

What is the similarity between Microarray and Next Generation Sequencing?

- Both Microarray and Next Generation Sequencing are developed using array based sequencing.

What is the difference between Microarray and Next Generation Sequencing?

Microarray vs Next Generation Sequencing

Microarray is a collection of microscopic DNA spots attached to a solid surface,

NGS (Next-generation sequencing) is a non-Sanger-based high-throughput DNA

which is used to measure the expression levels of large numbers of genes simultaneously.

sequencing technology which facilitates millions or billions of DNA strands to be sequenced in parallel.

Interactions with Antigen

Microarray is based on hybridization that is composed of a set of known targets.

NGS is based on synthesis which utilizes DNA polymerase to incorporate nucleotides and is independent of previously selected targets.

Summary – Microarray vs Next Generation Sequencing

In the context of research, DNA sequencing has become an important accelerant. It is widely used in biotechnology, medical diagnosis, and forensic studies. It has evolved and developed into more efficient and rapid sequencing procedures. Microarrays and NGS are two advanced DNA sequencing techniques present. Both are developed using array based sequencing. Microarray technique relies on hybridization whilst NGS is based on synthesis, which utilizes DNA polymerase to incorporate nucleotides. This is the main difference between Microarray and Next Generation Sequencing.

References:

1. Behjati, Sam, and Patrick S Tarpey. "What is next generation sequencing?" Archives of Disease in Childhood. Education and Practice Edition, BMJ Publishing Group, Dec. 2013, [Available here](#). Accessed 23 Aug. 2017
2. Bumgarner, Roger. "Overview of dna microarrays." Current Protocols in Molecular Biology, John Wiley and Sons Inc., 9 Feb. 2016, [Available here](#). Accessed 23 Aug. 2017.
3. "DNA Microarray Technology." National Human Genome Research Institute (NHGRI), [Available here](#). Accessed 23 Aug. 2017.

Image Courtesy:

1. "DNA microarray" By Guillaume Paumier (user:guillom) – Own work ([CC BY-SA 3.0](#)) via [Commons Wikimedia](#)
2. "[Developments in next generation sequencing](#)" By Nederbragt, Lex (2012) – ([CC BY 3.0](#)) via [Commons Wikimedia](#)

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