Lecture 15

Introduction to Next Generation Sequencing

MCB 416A/516A
Statistical Bioinformatics and Genomic Analysis

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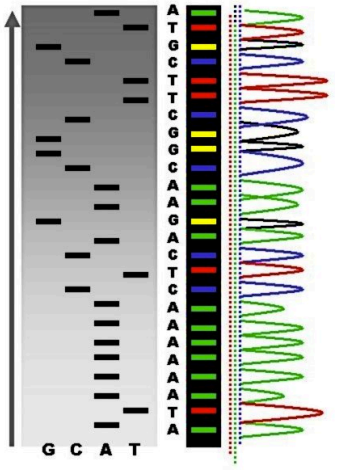
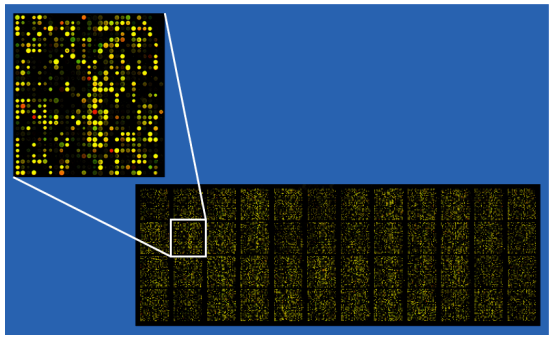
Breakthroughts in Technology

- An essential tool in the molecular biology toolkit is the ability to read the base sequence of DNA molecules

- Rapid DNA sequencing in the 1970s
  - Sanger



- Microarrays in late 1990s and 2000s
  - cDNA arrays
  - oligonucleotide arrays



Microarray

- Extremely successful
- Popular applications: gene expression profiling, DNA copy number, SNPs, microRNAs, ChIP-chip, splicing

Disadvantages:

- One must know the sequences to design the array
- High noise level due to cross-hybridization etc.

Why is called next generation sequencing

First Generation Sequencing

1. Sanger sequencing 1970

Second (or Next-) Generation Sequencing

1. 454 pyrosequencing 2004 (read length = 200-nt)
2. Solexa sequencing 2006 (36-nt)
3. ABI SOLiD sequencing 2006 (50-nt)
4. Illumina GA II 2007 (70-nt)
5. HeliScope 2009
6. ION torrent sequencing 2010
7. Illumina HiSeq2000 2010 (100-nt)

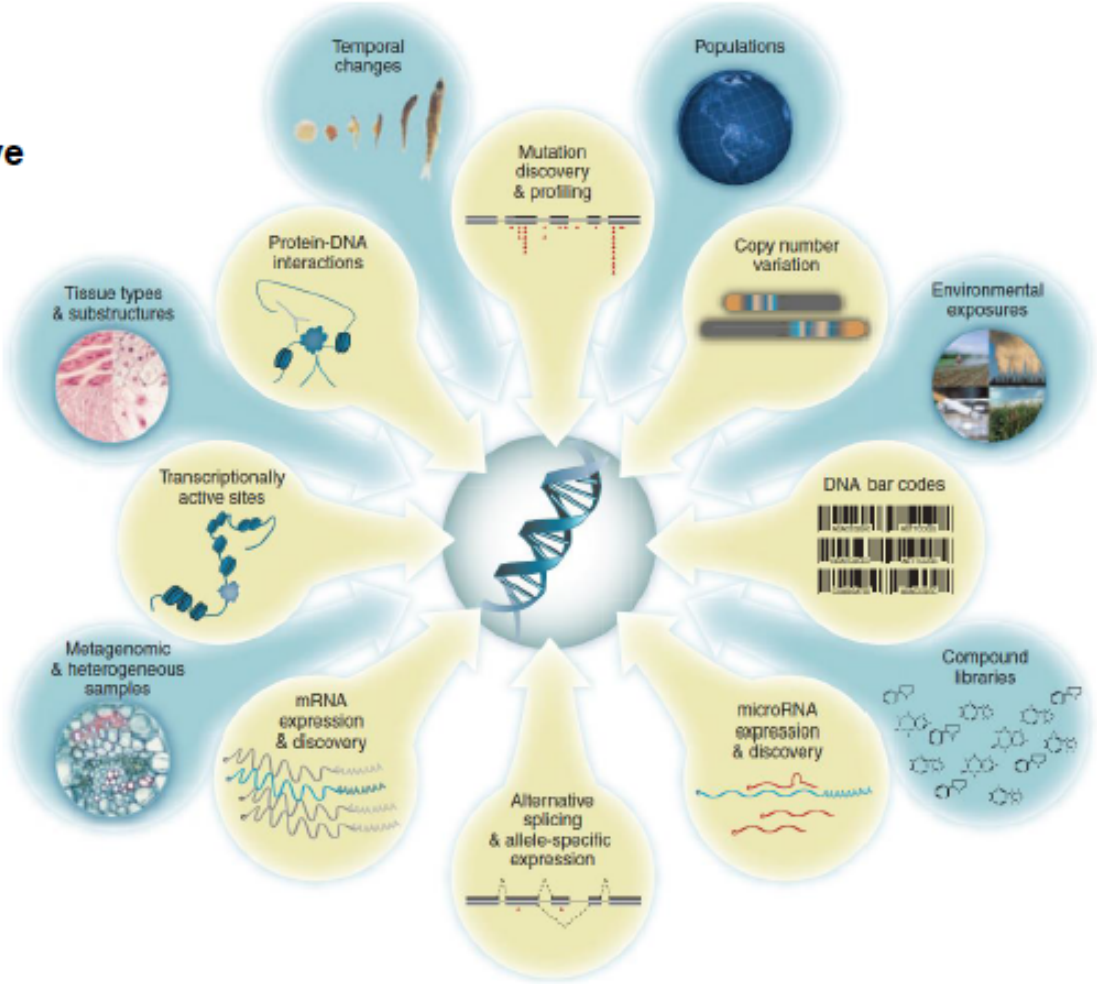
Third Generation Sequencing

1. Pacific Biosciences SMRT (single-molecule real-time) sequencing 2012 generating 30 Kb long read
2. Oxford Nanopore exonuclease and strand sequencing 2013

The list is growing..

- omics studies promoted by NSG tech

- **Genomics and comparative genomics**
- **Transcriptomics**
- **Non-coding RNAs**
- **RNA degradomics**
- **Epigenomics**
- **Metagenomics**
- **Systematics and Evolutionary genomics**
- **Genotyping and GWAS**
- **Protein-DNA interaction**
- **Protein-RNA interaction**
- **Long distance DNA-DNA interaction**



Kahvejian 2008

Short videos

1. Intro to NSG

https://www.youtube.com/watch?v=jFCD8Q6qSTM

https://www.youtube.com/watch?v=6TfYnsyo77o

2. Sample reparation

https://www.youtube.com/watch?v=-kTcFZxP6kM

3. Coverage & quality control

https://www.youtube.com/watch?v=PGAfwSRYv1g

4. Alignment

https://www.youtube.com/watch?v=W6UL3UVdZDw

5. Data analysis

https://www.youtube.com/watch?v=l4BAfRekohk