

# An Introduction to Microarrays

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# Microarrays

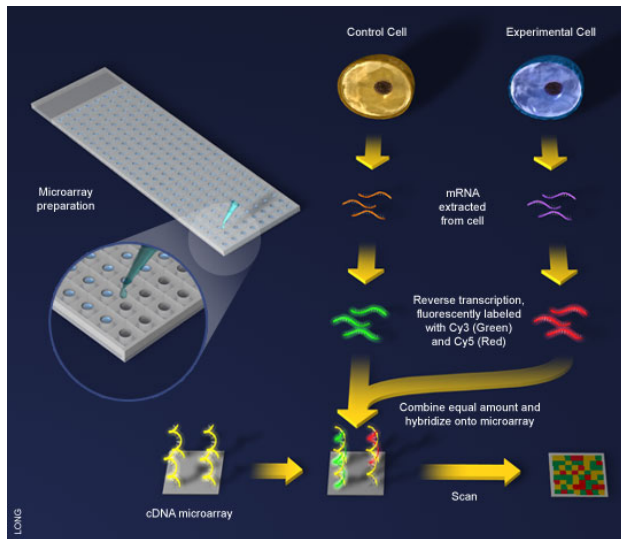
Microarrays are physical platforms that have nucleotide sequences bound to their surface.

Since nucleotide sequences hybridize to their complements we can use these bound sequences to fish out their complements from a mixture of nucleotide sequences.

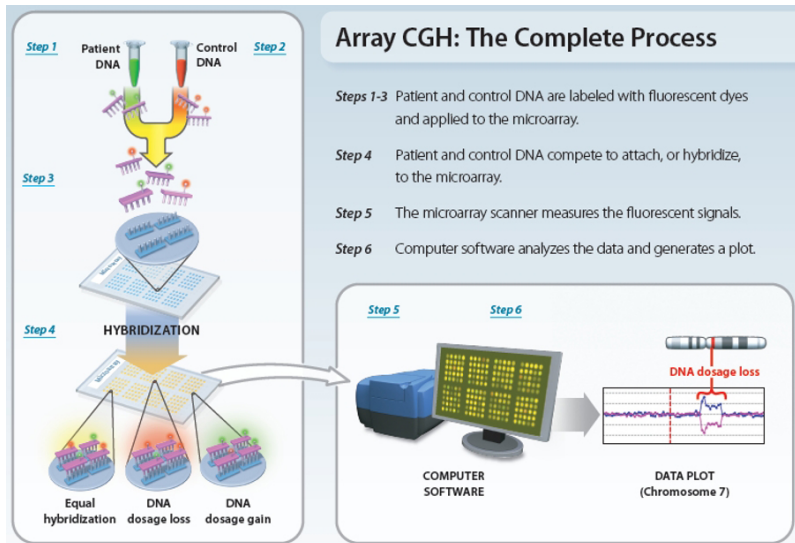
Microarrays can be used for many purposes including

- ▶ genotyping
- ▶ measuring gene expression
- ▶ determining DNA copy number
- ▶ determining transcription factor binding sites

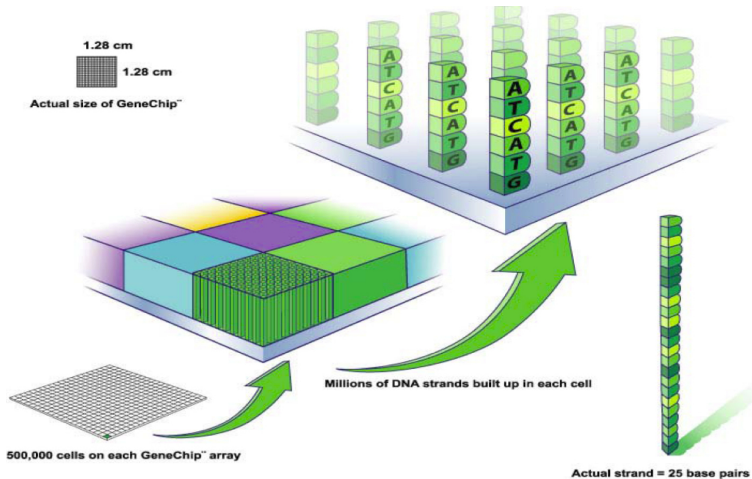
# One Type of Microarray Experimental Procedure



# Array-comparative genomic hybridization (aCGH)



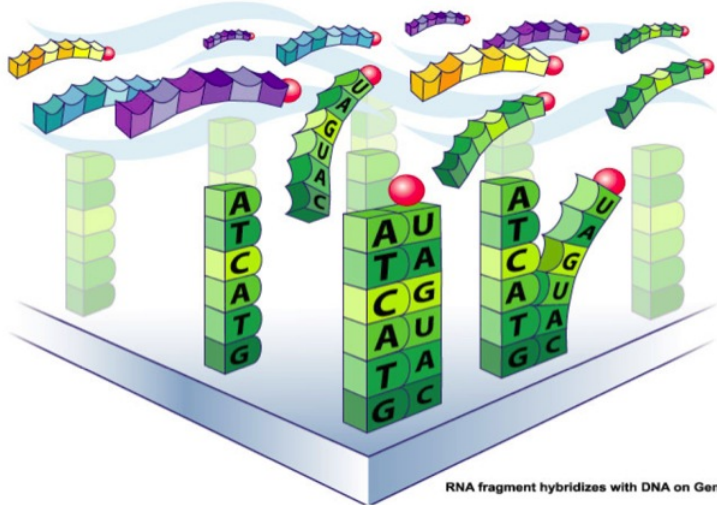
# Affymetrix GeneChip®



source: Affymetrix

# Affymetrix GeneChip®

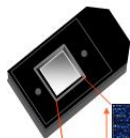
RNA fragments with fluorescent tags from sample to be tested



source: Affymetrix

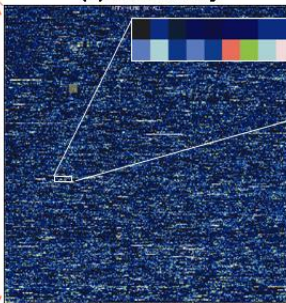
# Affymetrix GeneChip®

## Human Genome U133A GeneChip® Array



1.28cm

### (1) Probe Array



### (2) Probe Set

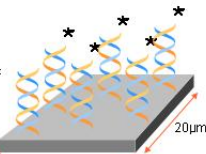
Each Probe Set contains  
11 Probe Pairs (PM:MM)  
of different probes

### (3) Probe Pair

Each Perfect Match  
(PM) and Mismatch  
(MM) Probe Cells are  
associated by pairs

### (4) Probe Cell

Each Probe Cell contains  
 $\sim 40 \times 10^7$  copies of a specific  
probe  
complementary to genetic  
information of interest  
probe: single stranded,  
sense, fluorescently labeled  
oligonucleotide (25 mers)

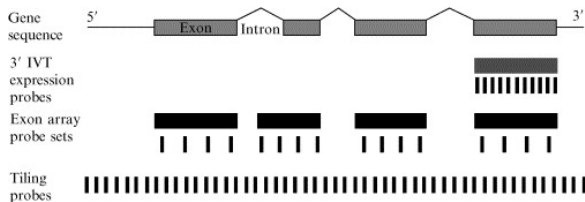


The Human Genome U133 A  
GeneChip® array represents  
more than 22,000 full-length  
genes and EST clusters.



# Probe Set

A probe set is a collection of probes designed to interrogate a given sequence.



# PM versus MM

## GeneChip® Expression Array Design

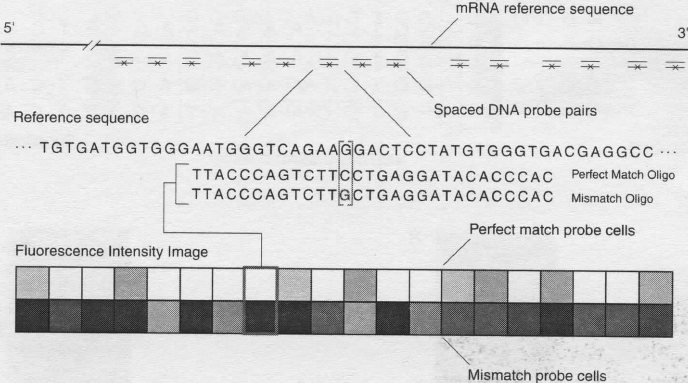
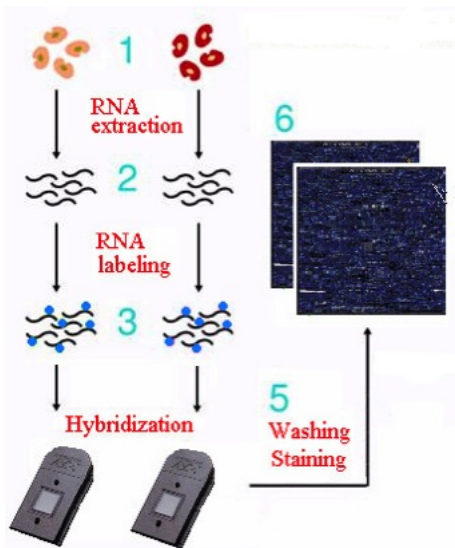
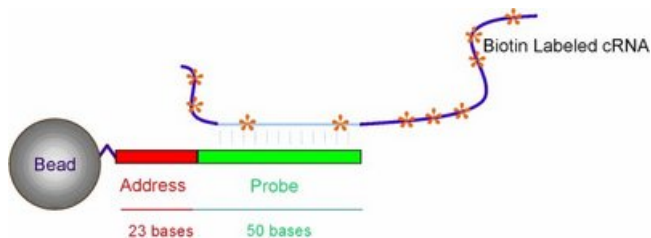


Figure 1-3 Expression tiling strategy

# Affymetrix GeneChip<sup>®</sup> Experiment Protocol



# Illumina BeadArrays



- Each silica bead is 3  $\mu$  in diameter
- 700,000 copies of the same probe sequence attached to each bead
- May have more than one bead for a particular gene

# Illumina BeadArrays

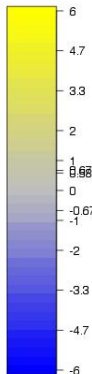
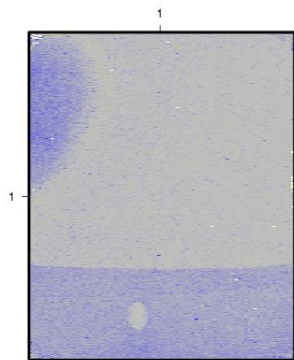
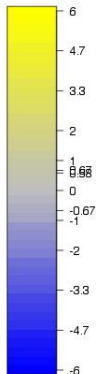
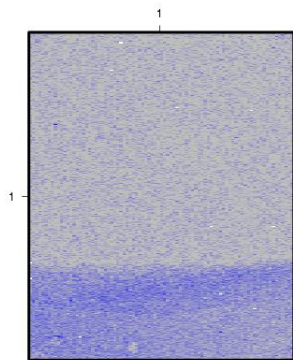


- RefSeq BeadChip (left) 8 arrays per chip, 1 strip= 1 array
- Whole Genome (right) 6 arrays per chip, 2 strip= 1 array

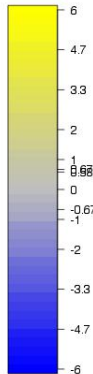
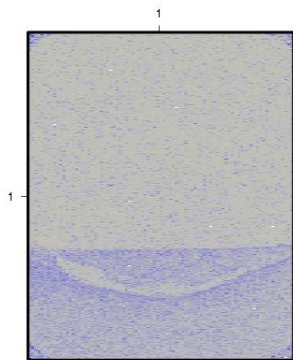
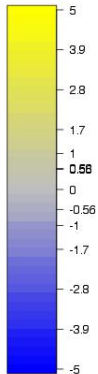
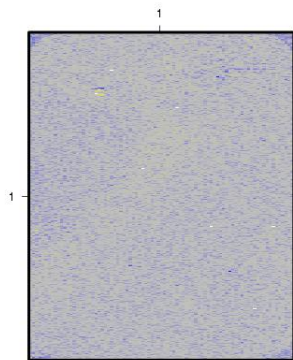
# Commons Issues

- ▶ Background: print-tip, plate, print-order, spatial effects
- ▶ Between arrays: batches, plates, cross platform comparison, experiment protocols
- ▶ Within arrays: background noise, intensity dependent effects

# Spatial Effect

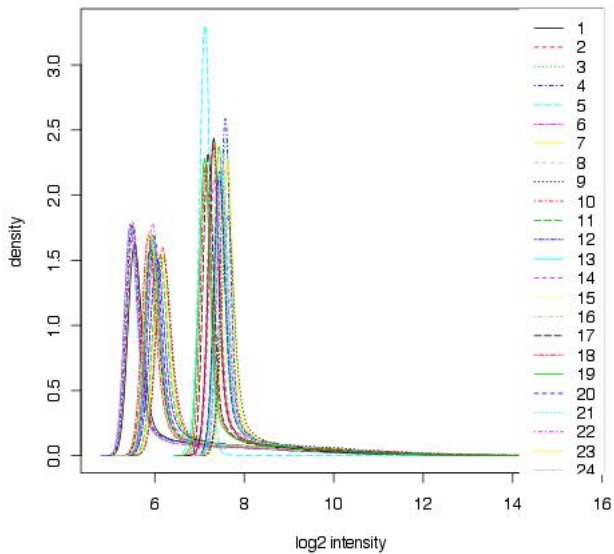


# Spatial Effect

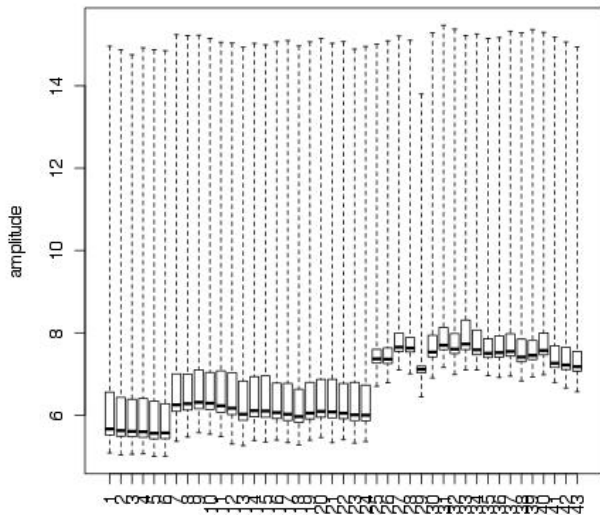




## Batch Effect



## Batch Effect



# ChIP-chip

Chromatin immunoprecipitation ("ChIP") with microarray technology ("chip")

