

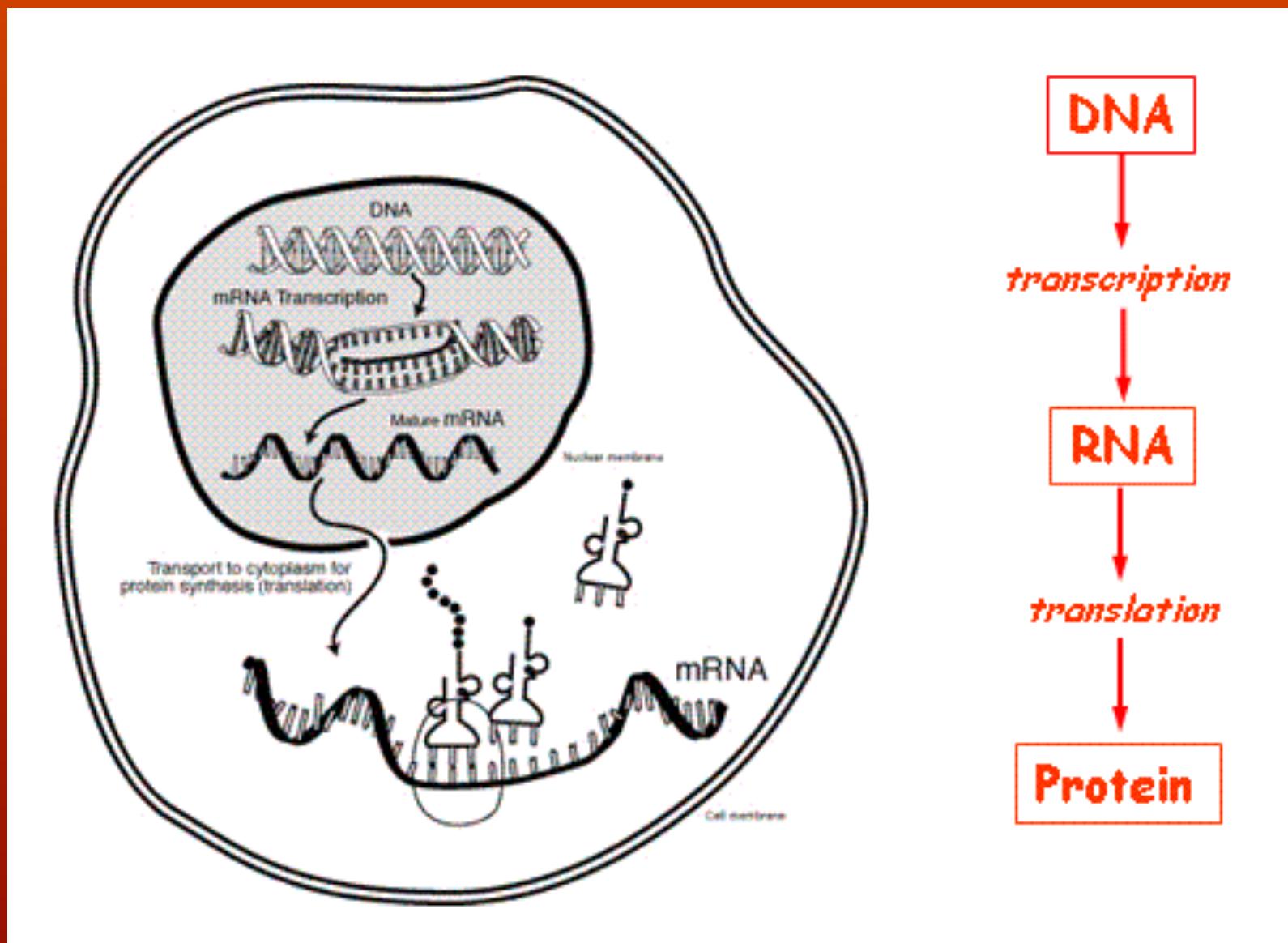
RNA-Seq

Jim Knowles, MD-PhD

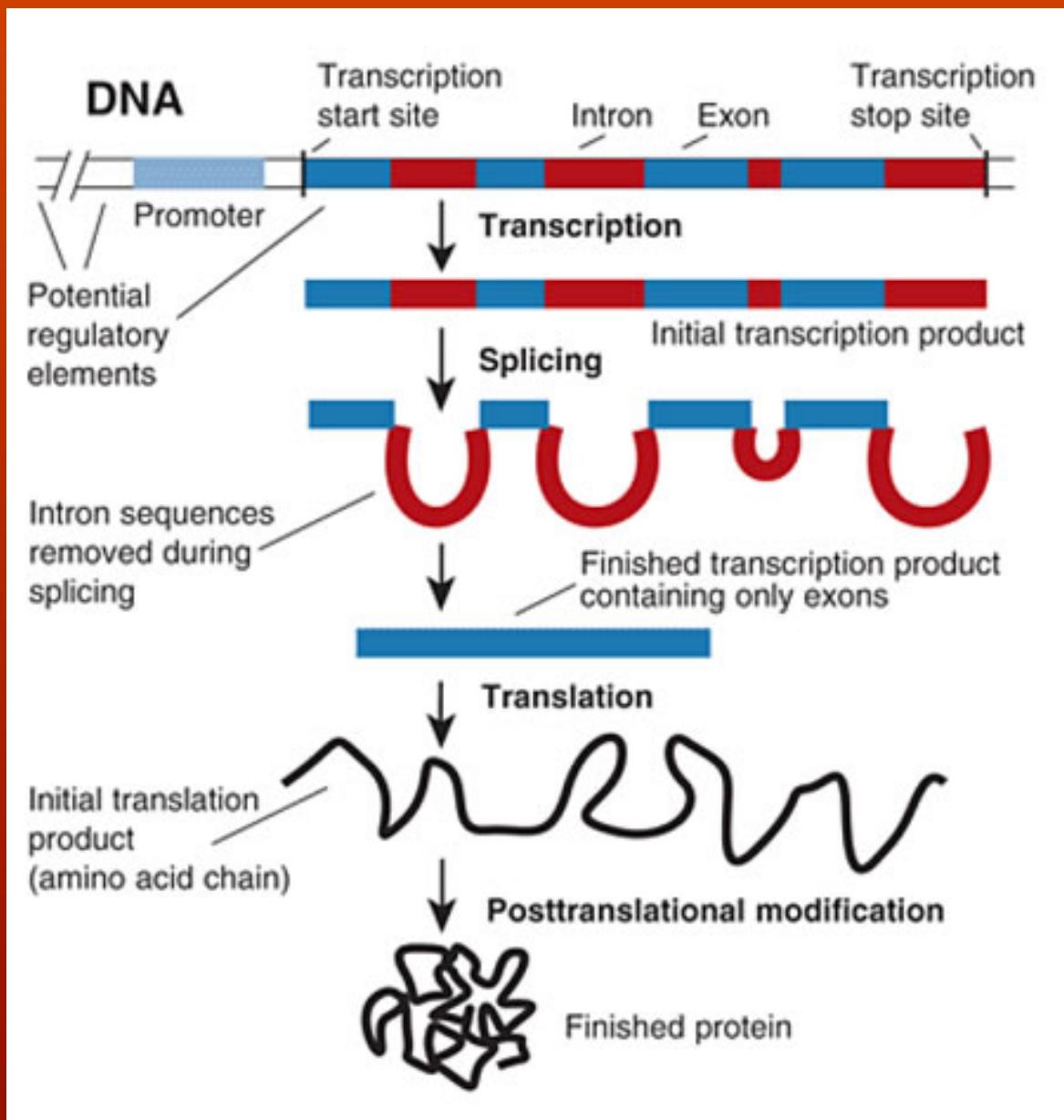
knowles@med.usc.edu

September 17, 2013

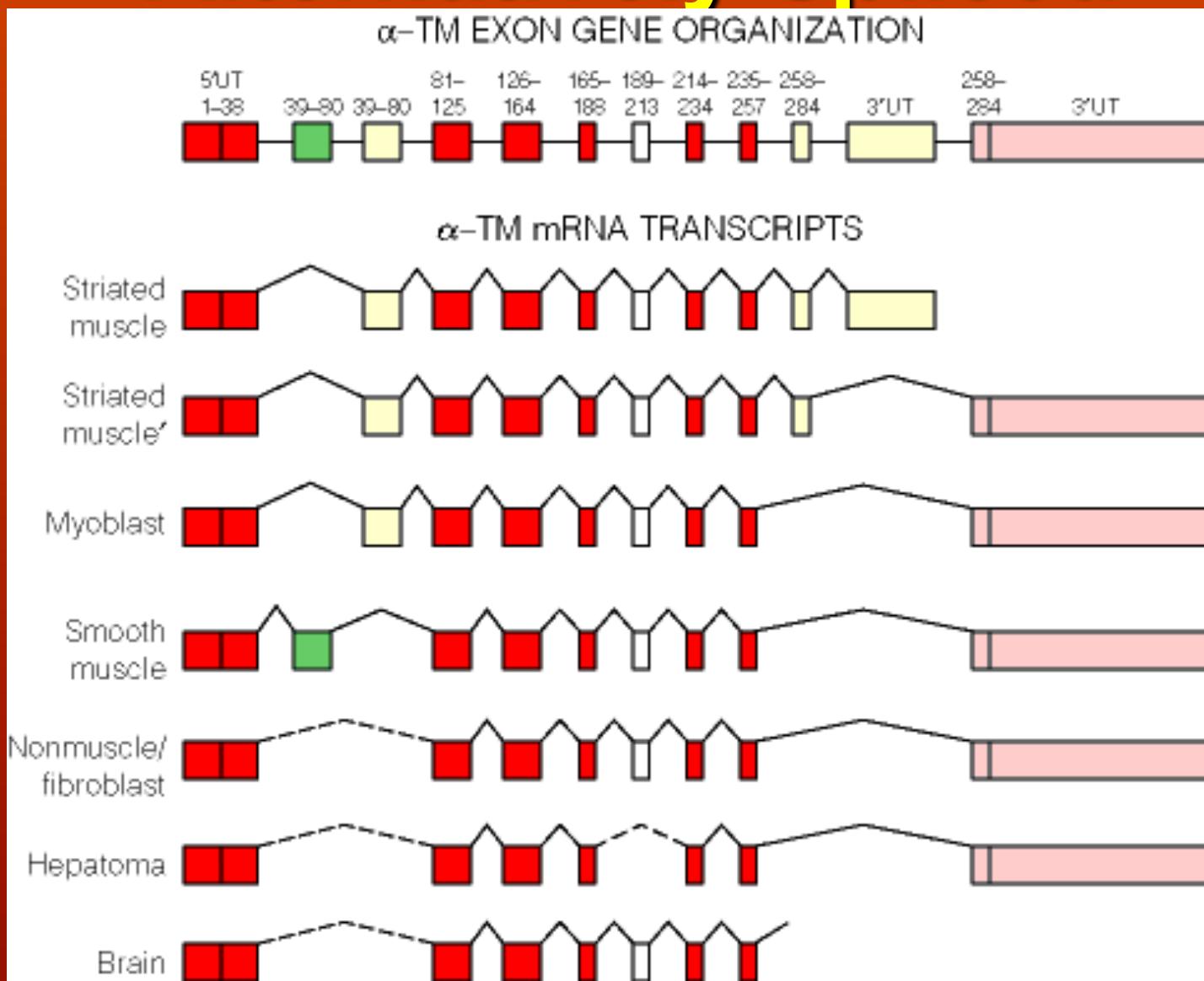
Central Dogma of Molecular Biology



Eukaryotic Genes are Spliced

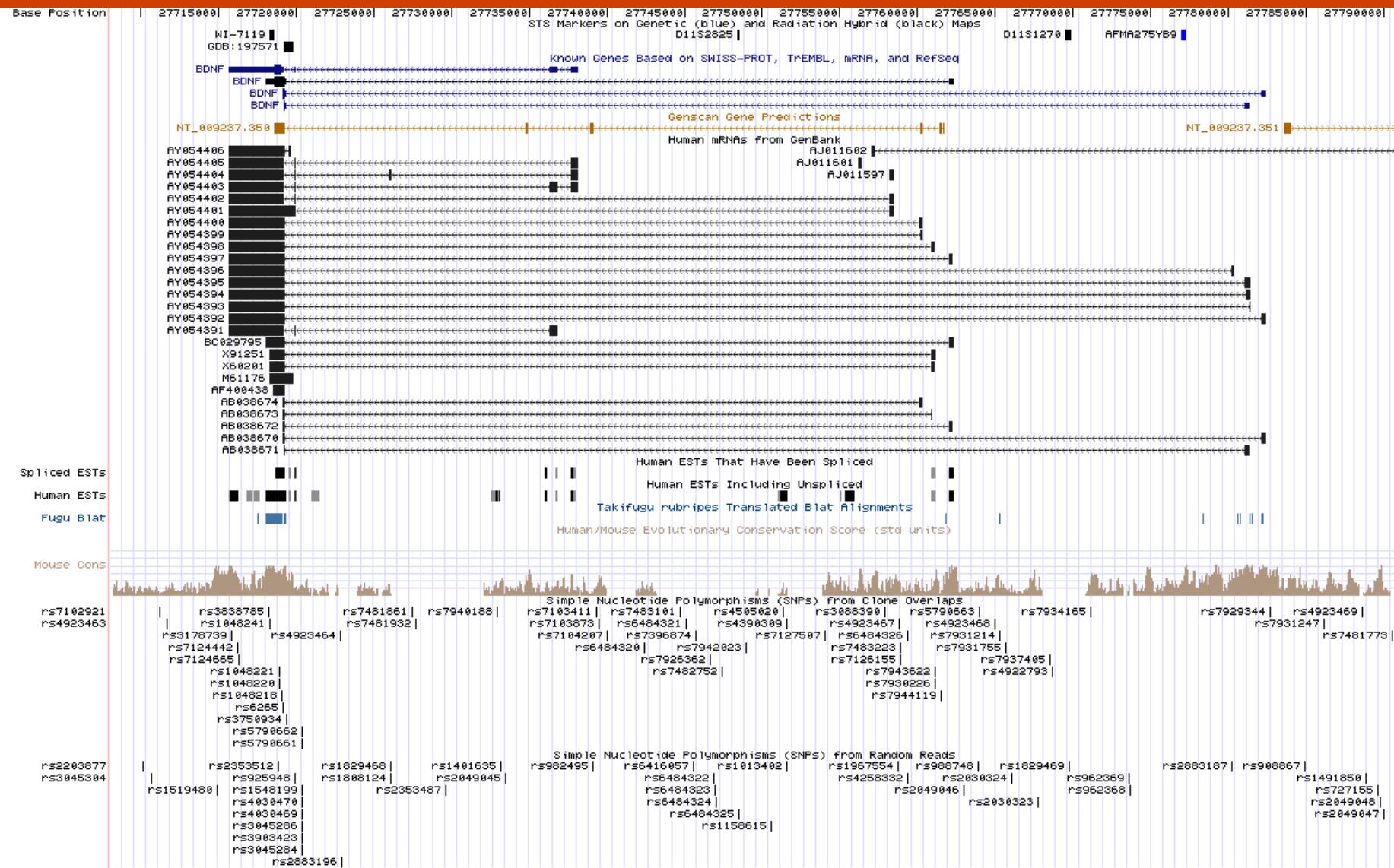


Eukaryotic Genes are Alternatively Spliced



UCSC Genome Browser

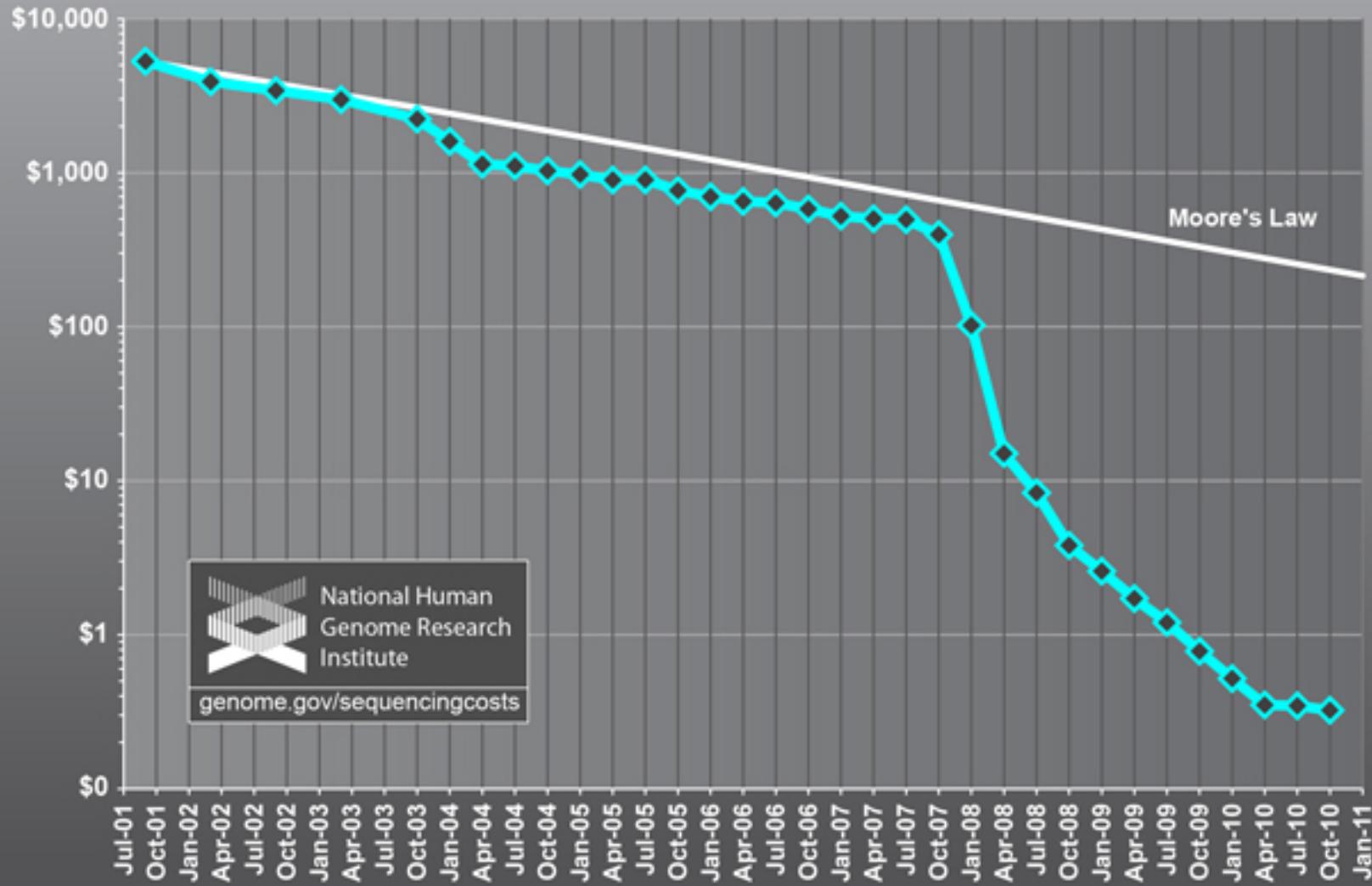
genome.ucsc.edu

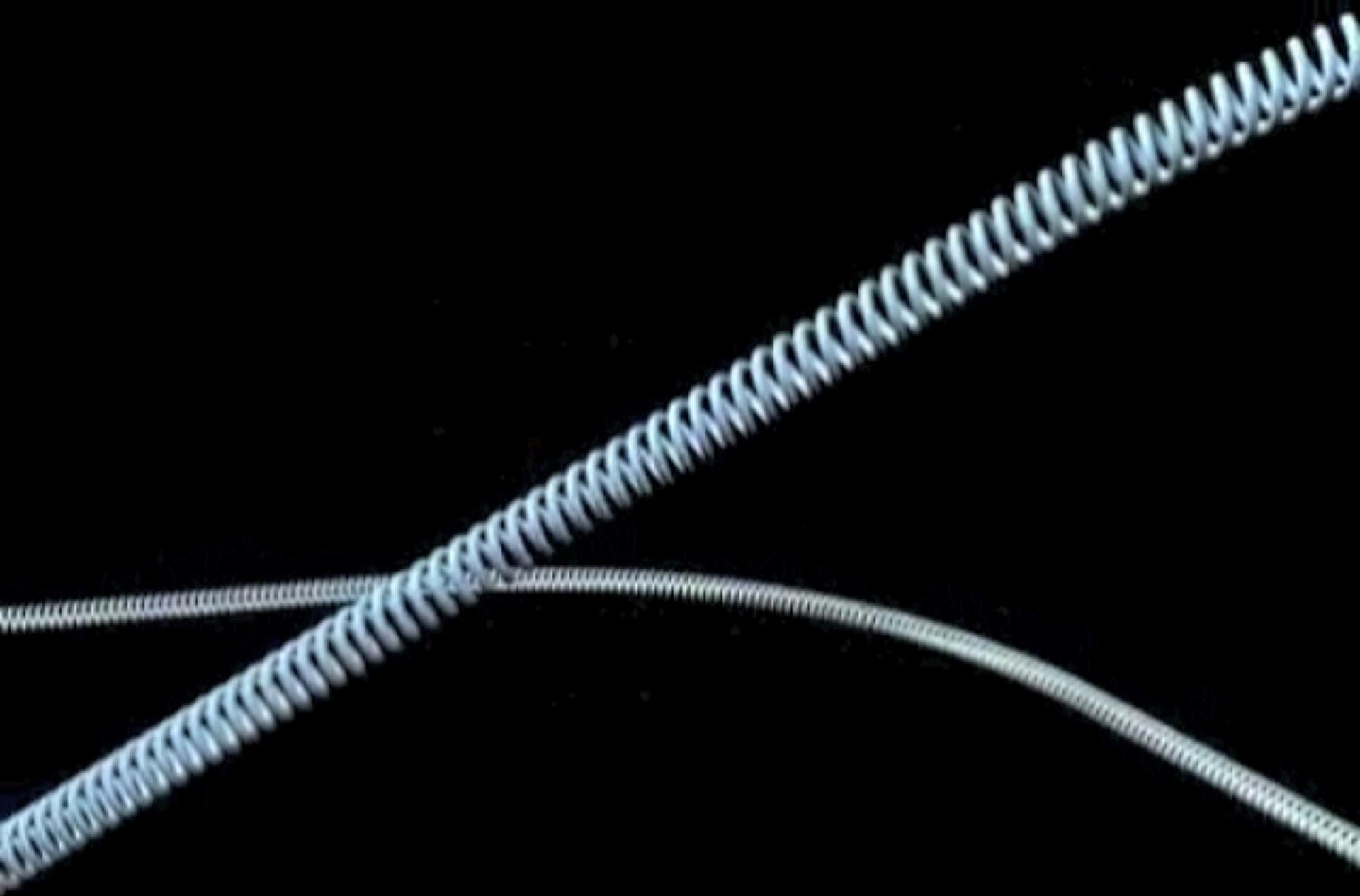


Next Generation Sequencing Applications

- Whole Genome Sequencing (WGS)
- Re-sequencing (Exons, other regions)
- Transcriptome Sequencing (RNA-Seq)
- Chromatin Immunoprecipitation Sequencing (ChIP-Seq)
- Meta-Genomics
- Other Methods
 - Footprinting
 - 3D mapping

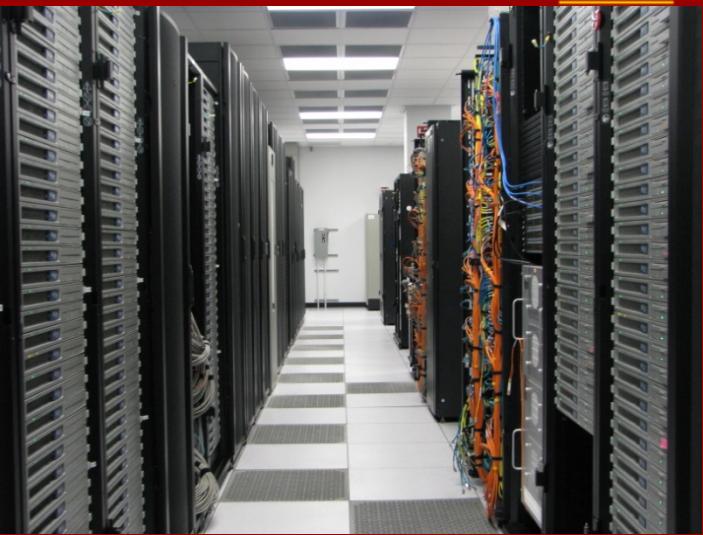
Cost per Megabase of DNA Sequence







ILMN HiSeq
@ ZNI



~1200 cores
@ HPCC

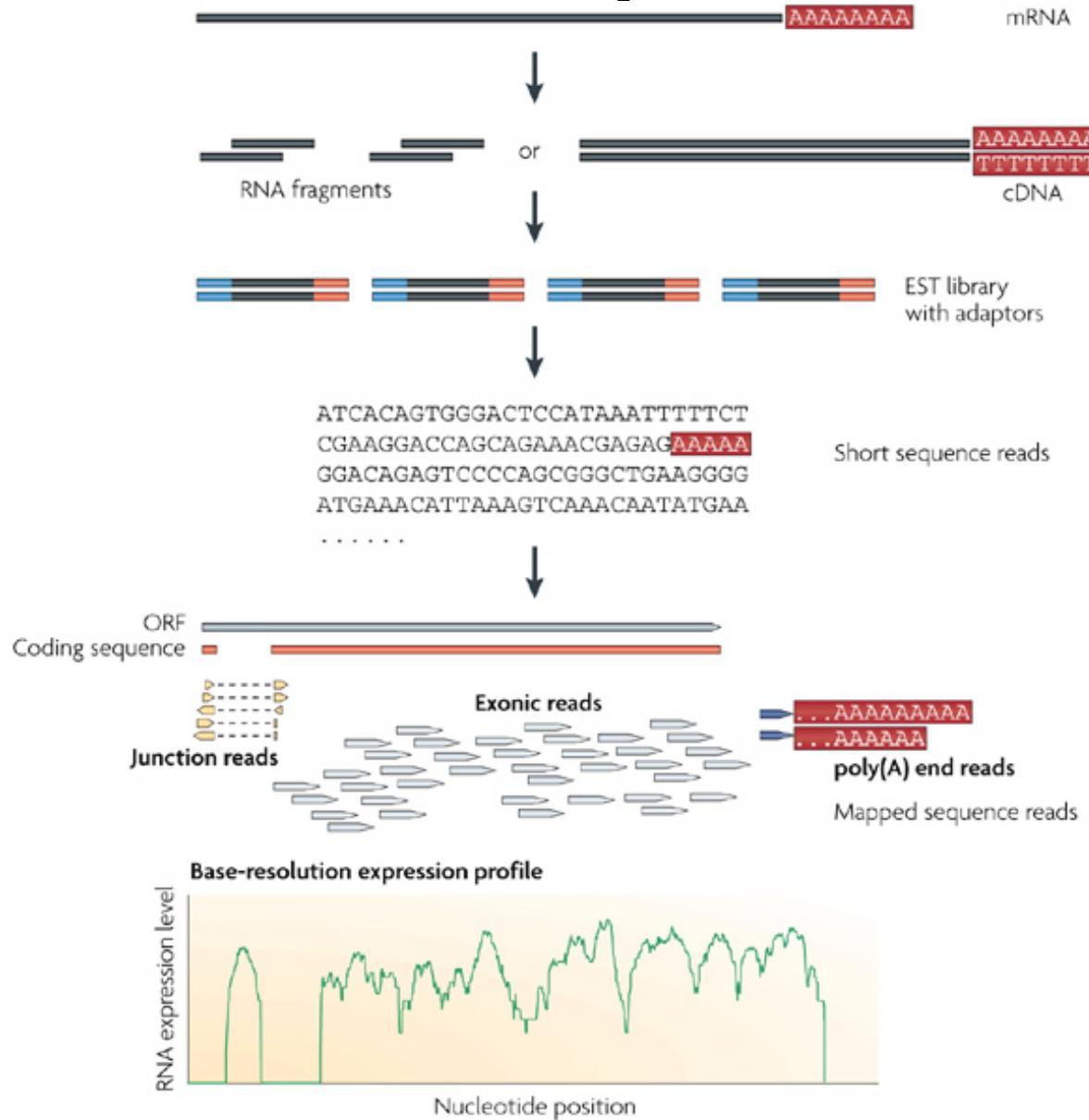


400 TB
@ ZNI

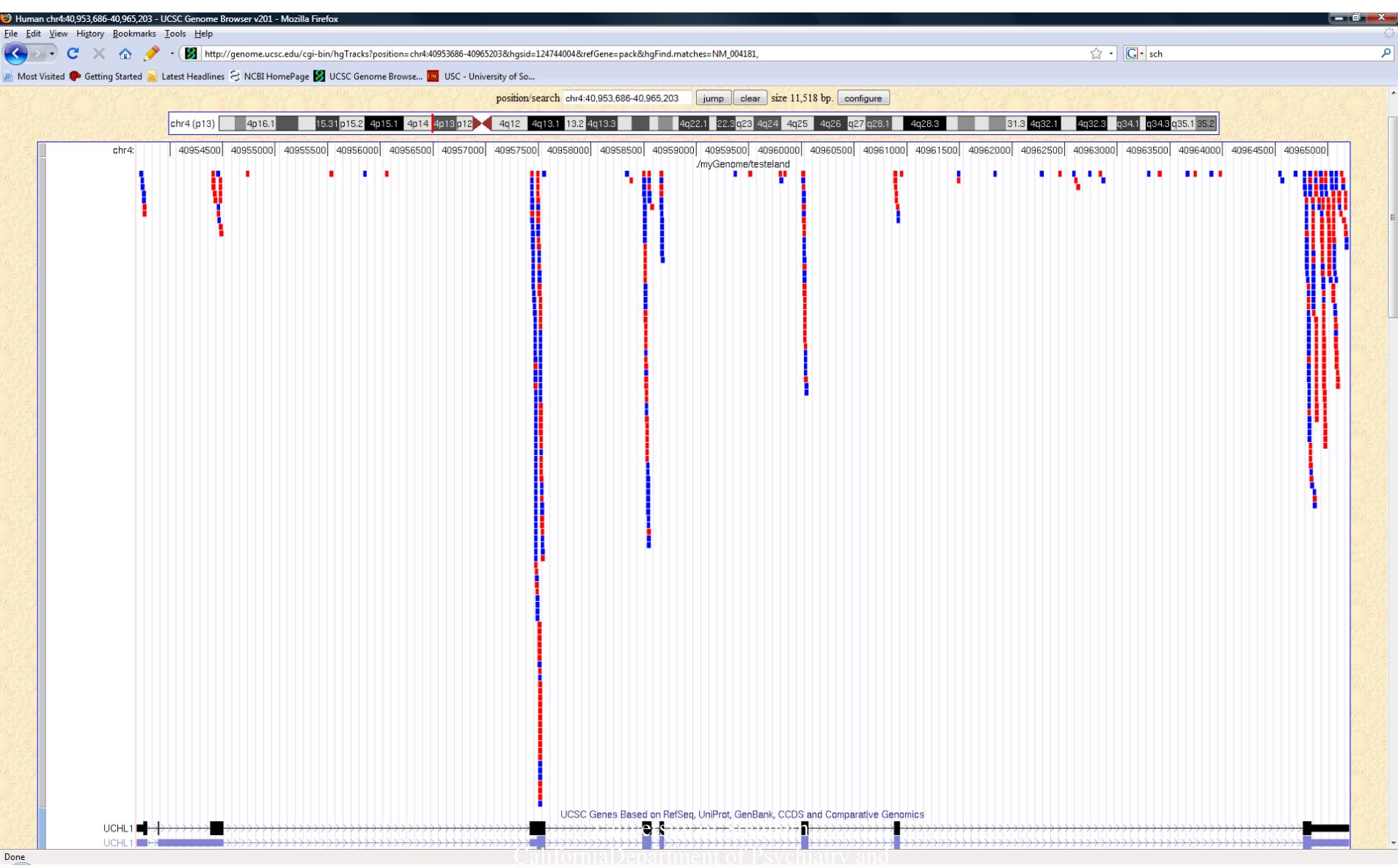


1.2 PB
@ HPCC

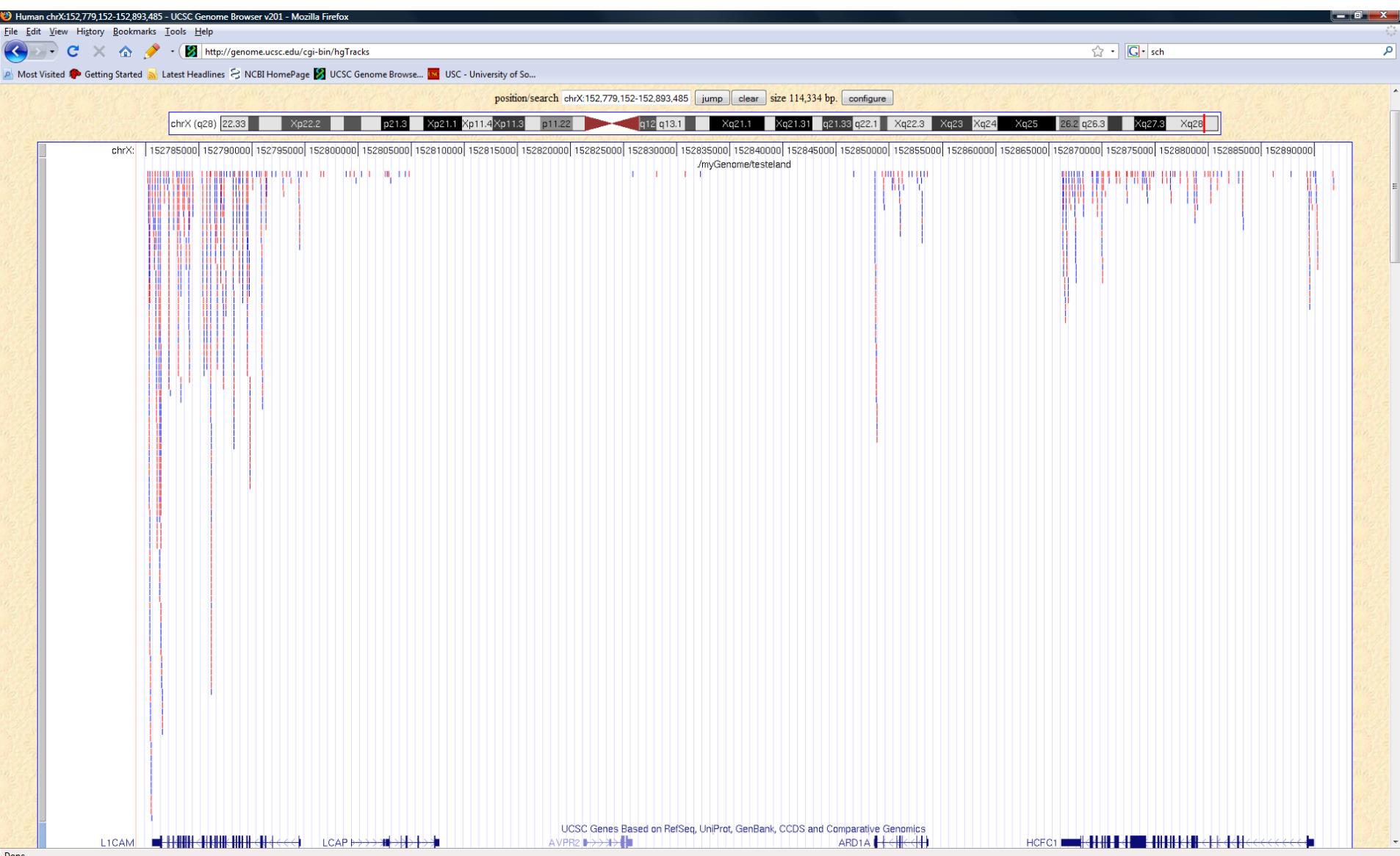
RNA-Seq Method



RNA-Seq: UCHL1 expression



RNA-Seq: Differential Expression



RseqFlow: Workflow for RNA-Seq Data Analysis

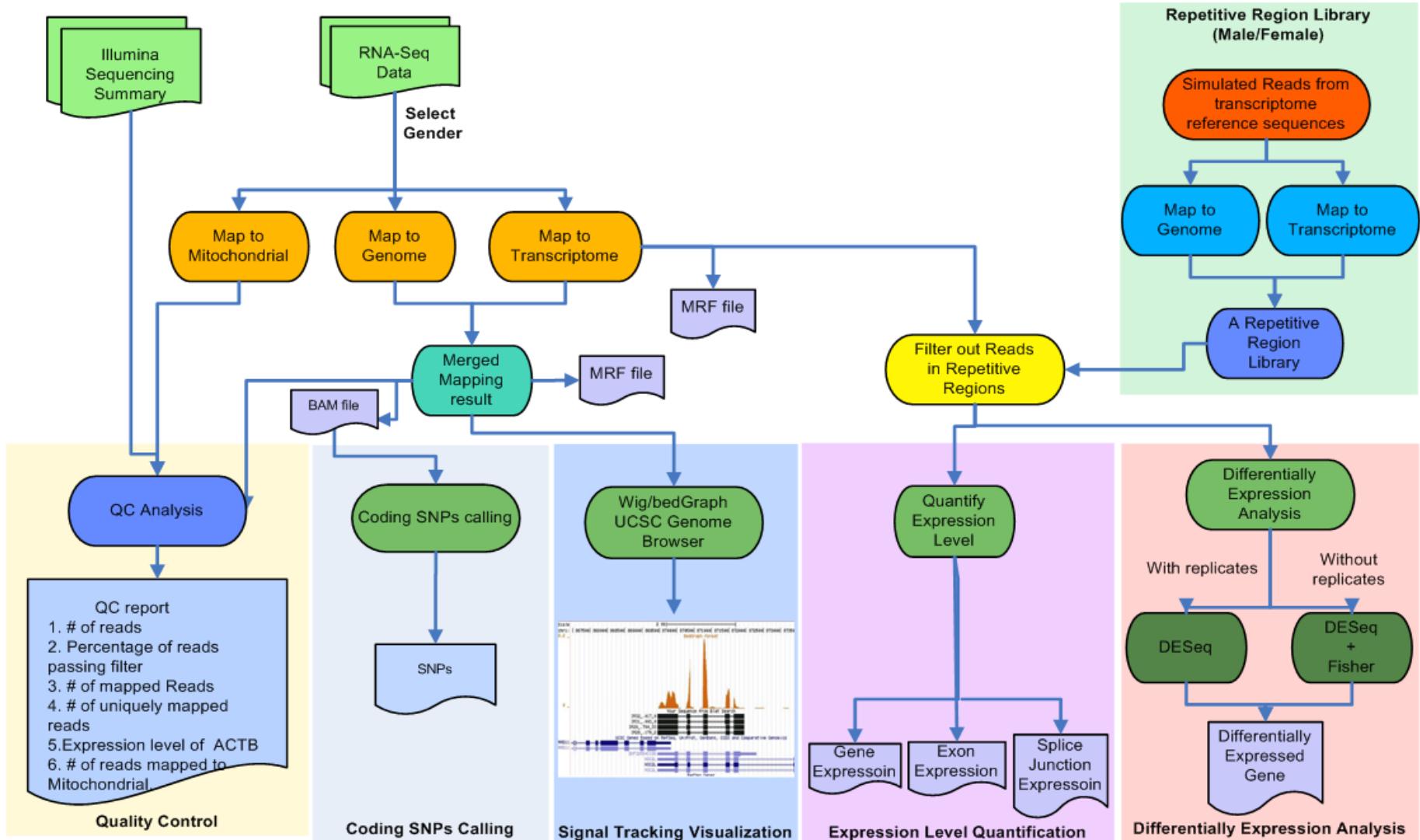
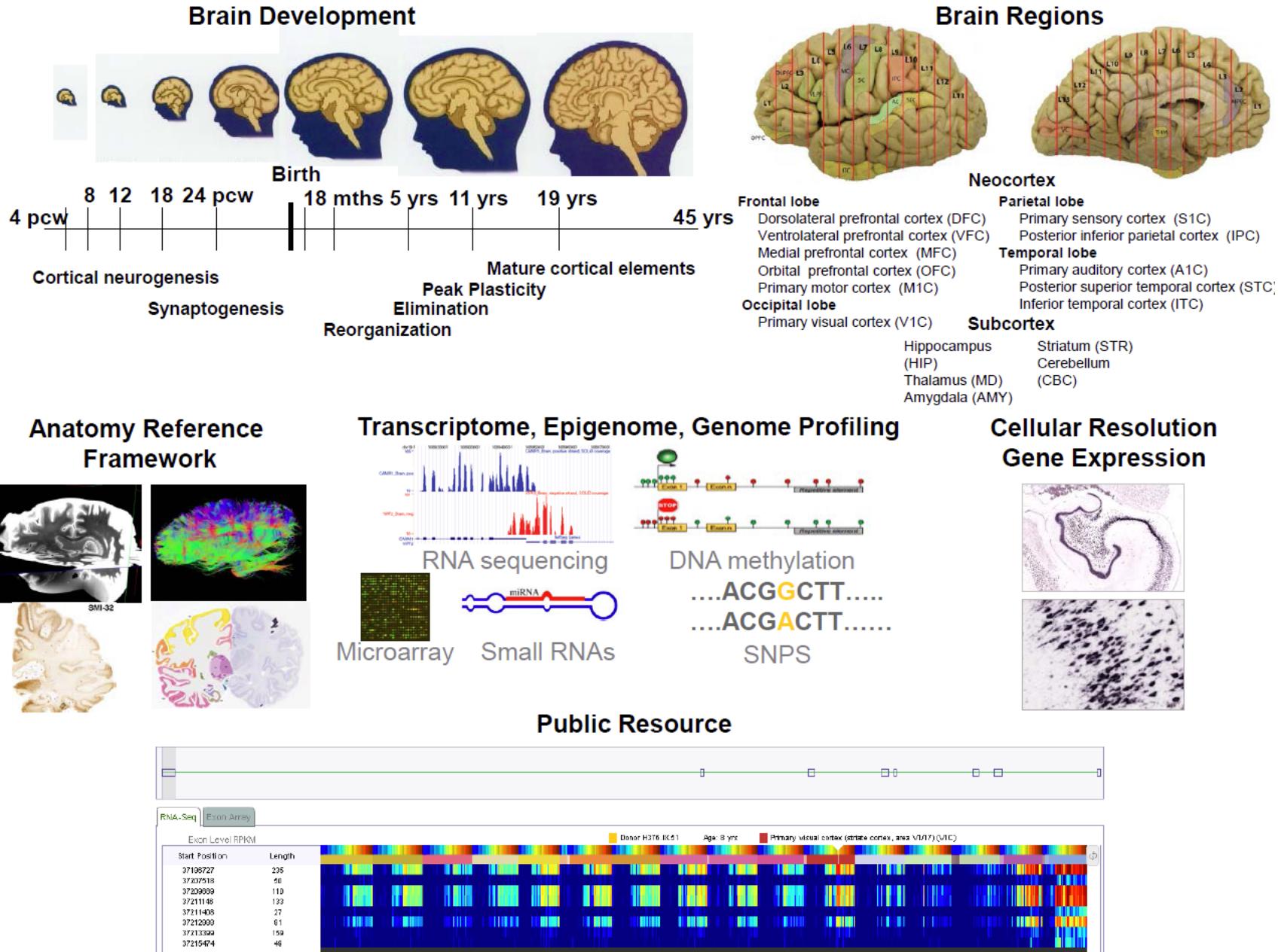


Figure 1. RNA-seq Workflow.

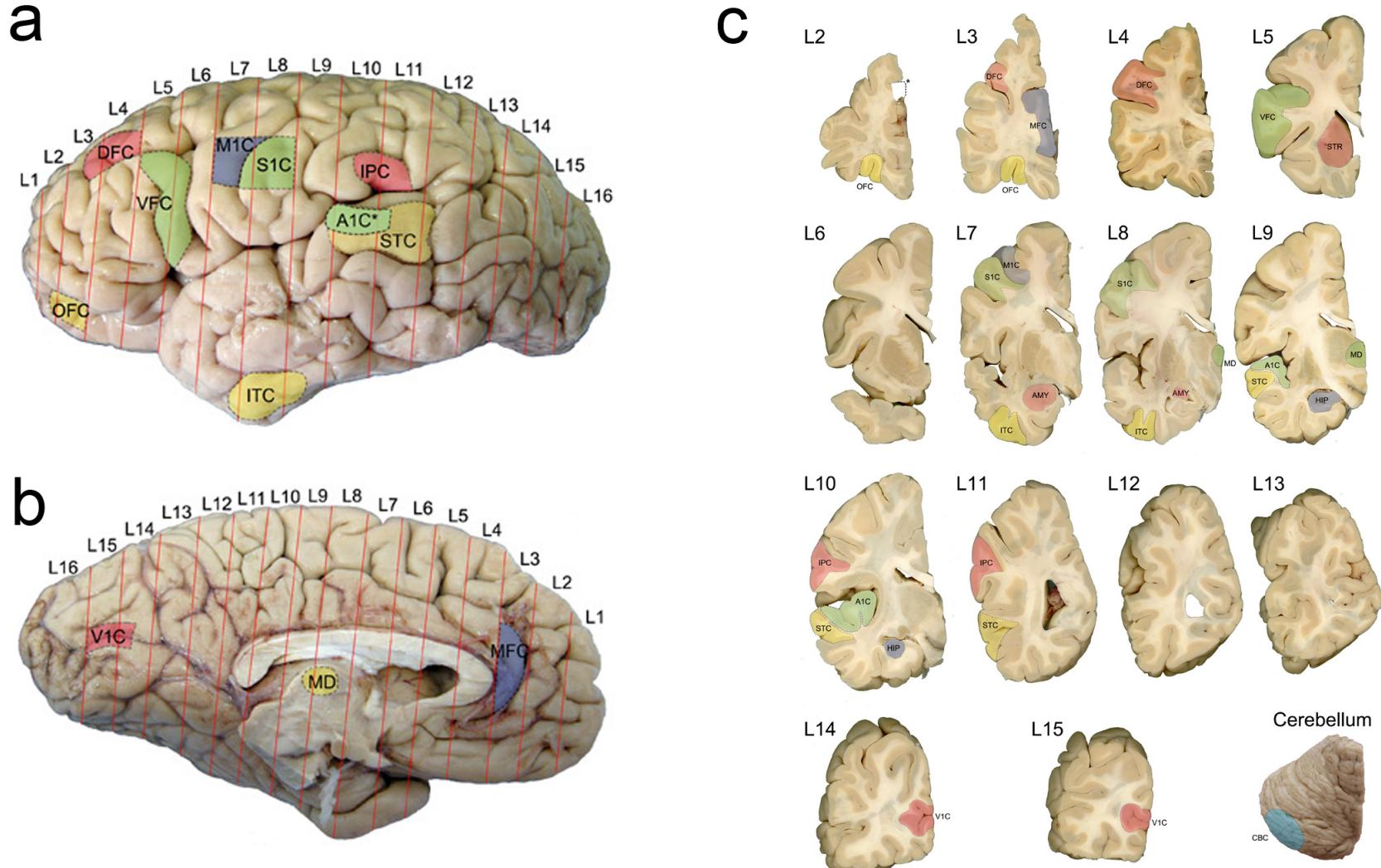
Wang Y, Mehta G, Mayani R, Lu J, Souaiaia T, Chen Y, Clark A, Yoon HJ, Wan L, Evgrafov OV, Knowles JA, Deelman E, Chen T. Bioinformatics (2011) 27 (18): 2598-2600. doi: 10.1093/bioinformatics/btr441



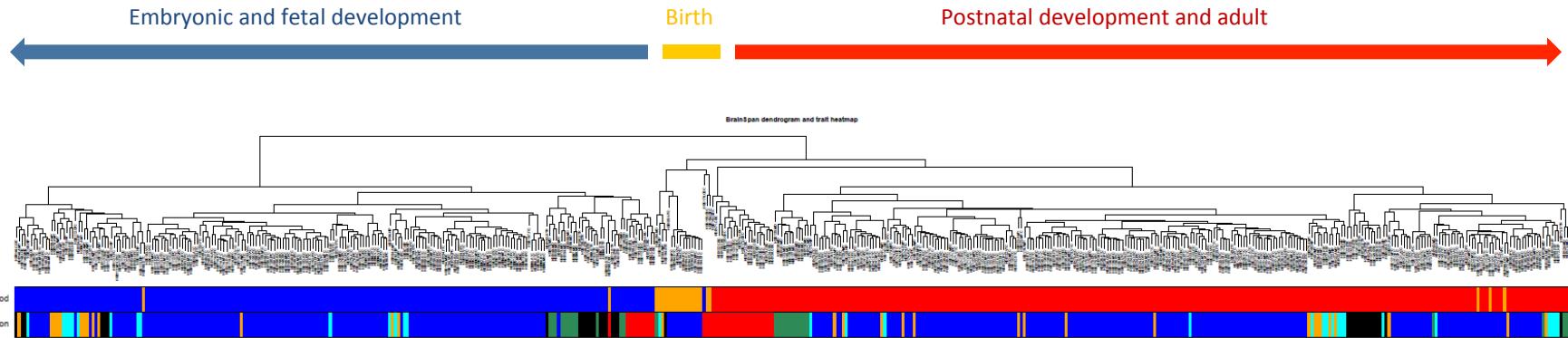
BRAINSPAN

ATLAS OF THE DEVELOPING HUMAN BRAIN

Adult Tissue Sampling



Hierarchical clustering and analyses of all RNA-seq samples



Top row color:

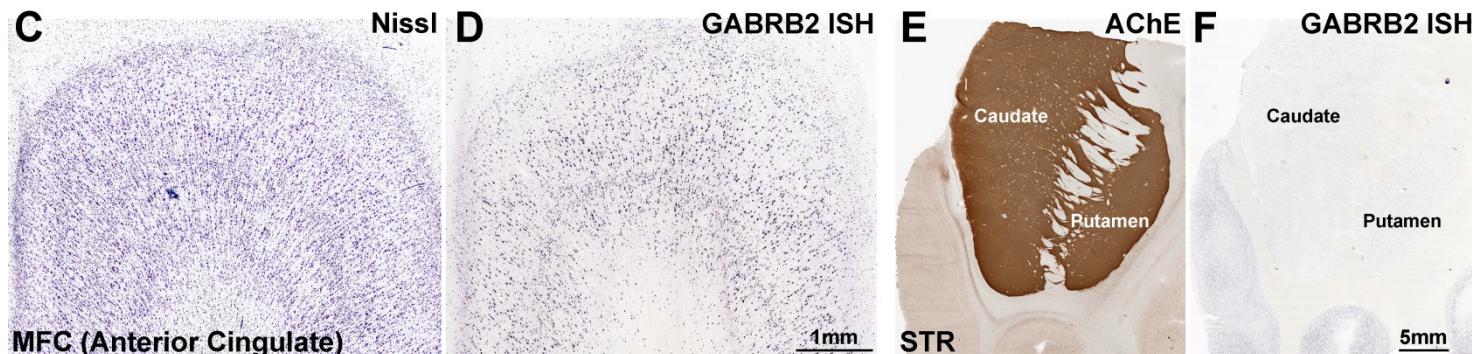
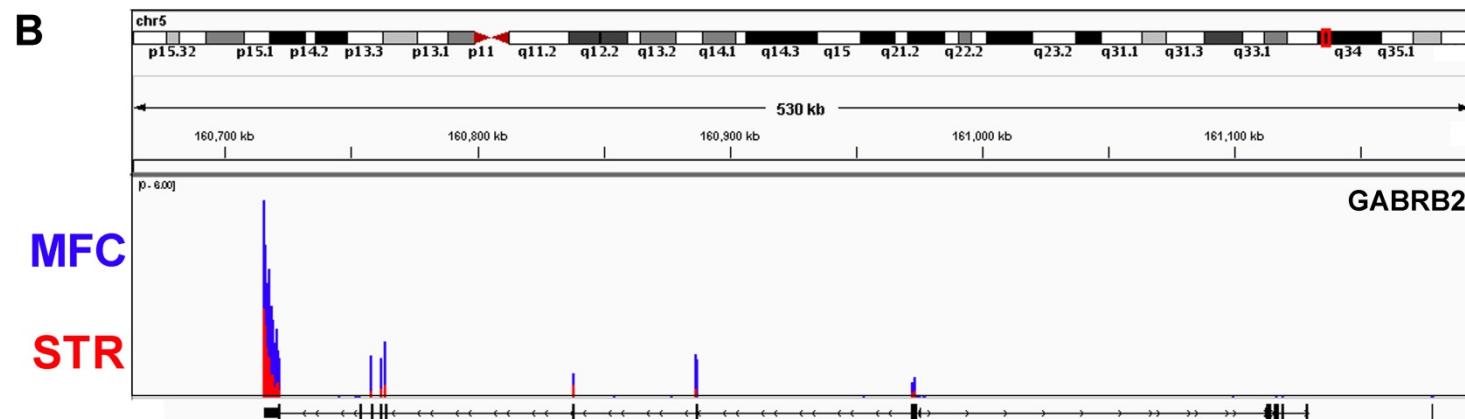
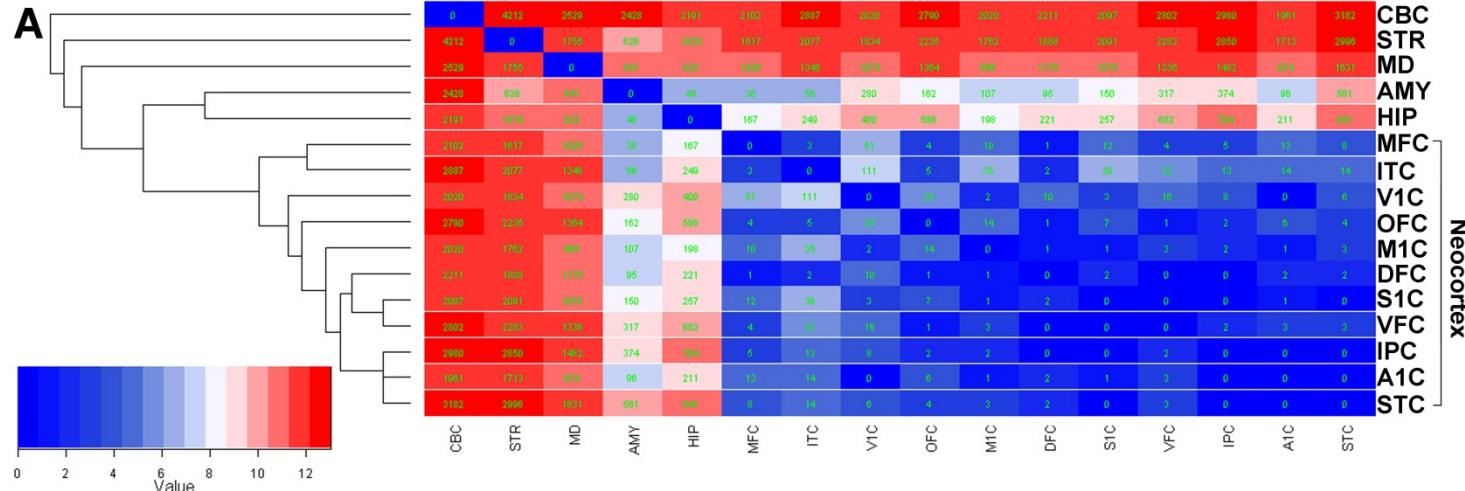
Blue is prenatal development
Orange is period 7 (late fetal to birth)
Red is postnatal development and adulthood

Bottom row color : Blue is NCX, Cyan is HIP, Orange is AMY,
Black is STR, Sea green is MD, Red is CBC

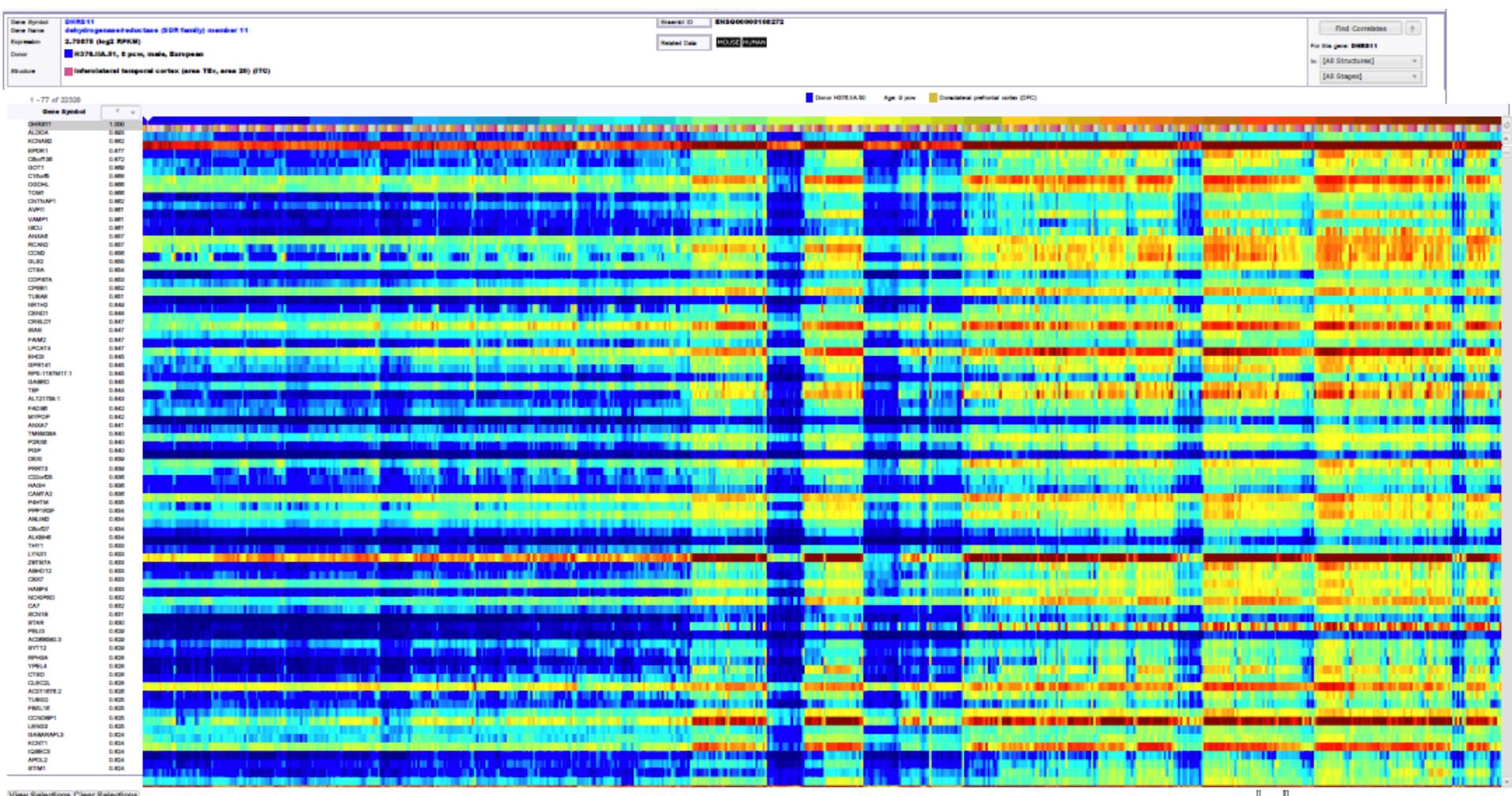
Bioinformatics Analyses:

Comprehensive QC analyses
mRNA transcript detection
Small non-coding RNA detection (microRNAs...)
Spatio-temporal differential expression (DEX)
Spatio-temporal differential splicing and exon usage (DEU)
Allele-specific expression
RNA-editing
Weighted correlation network analysis
eQTL

Differentially Expressed (DEX) genes



RNA-Seq of *DHRS11* and Correlated Genes Across Human Brain Development



BRAINSPAN

ATLAS OF THE DEVELOPING HUMAN BRAIN