

Master Module
Proteinbiochemistry and Bioinformatics
December 2023

Session: Protein interaction networks

5. Visualizing and analyzing networks using Cytoscape

Introduction into Cytoscape

Software to:

- explore a set of genes with protein interaction data
- analyze and visualize network data

The screenshot displays the Cytoscape software interface. The main window shows a network diagram with nodes representing genes/proteins and edges representing interactions. The nodes are color-coded and connected by lines. The interface includes a top toolbar with various icons for navigation and editing. On the left side, there are panels for 'Network', 'Style', 'Filter', and 'Annotation'. The 'Network' panel shows a list of loaded files, with 'BAF_DDR_interactionfile.txt_2' selected. The 'Node Table' panel at the bottom right displays a table of node information.

shared name	name	gene_symbol	function	type	description
6595	6595	SMARCA2	BAF	cBAF	
6119	6119	RPA3	FCA EXC DSB O...	DDR	As part of the hete...
5440	5440	POLR2K	EXC	DDR	encodes one of th...
10973	10973	ASCC3	OTH	DDR	3'-5' DNA helicase...
6599	6599	SMARCC1	BAF	GEN	
2177	2177	FANCD2	FCA	DDR	Required for maint...
5982	5982	RFC2	FXC DSB IOTH	DDR	The elongation of ...

Introduction into Cytoscape

Example data:

Evidence for 28 genetic disorders discovered by combining healthcare and research data

De novo mutations in protein-coding genes are a well-established cause of developmental disorders¹. However, genes known to be associated with developmental disorders account for only a minority of the observed excess of such de novo mutations^{1,2}. Here, to identify previously undescribed genes associated with developmental disorders, we integrate healthcare and research exome-sequence data from 31,058 parent-offspring trios of individuals with developmental disorders, and develop a simulation-based statistical test to identify gene-specific enrichment of de novo mutations. We identified 285 genes that were significantly associated with developmental disorders, including 28 that had not previously been robustly associated with developmental disorders. Although we detected more genes associated with developmental disorders, much of the excess of de novo mutations in protein-coding genes remains unaccounted for. Modelling suggests that more than 1,000 genes associated with developmental disorders have not yet been described, many of which are likely to be less penetrant than the currently known genes. Research access to clinical diagnostic datasets will be critical for completing the map of genes associated with developmental disorders.

Kaplanis et al *Nature* 2020

What is the relationship between these genes?

In which processes are they involved?

Which genes to focus on for downstream studies?

Introduction into Cytoscape

What you need on your computer:

- Cytoscape
- Cytoscape_tasks.txt
- STRING_interactions_Kaplanis_285.tsv
- Kaplanis_28_genes_annotated.txt
- GTEx_tissue_expression_Kaplanis_genes_285.tsv

What's the plan?

- Quick Cytoscape tour by lecturer (~10 minutes)
- Network visualization and exploration on your own following some guidance provided in file Cytoscape_tasks.txt (60 minutes)