AraCyc and the OMICS Viewer: Making sense of metabolism in your favorite biological process

Kate Dreher

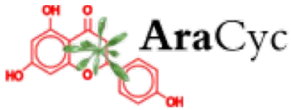
AraCyc, TAIR, PMN
Carnegie Institution for Science

Everyone is studying metabolism

- Many biological processes connect to metabolism
  - Drought tolerance – changes in osmolyte concentrations
  - Hormone signaling – biosynthesis and degradation of hormones
  - Photosynthesis – chlorophyll production and ROS scavenging
  - Translation – amino acid biosynthesis and riboswitching
  - Plant defense – phytoalexin synthesis

  - Your favorite process . . .

  - AraCyc can help you find these connections!
    - **Ara**bidopsis Metabolic En**Cyc**lopedia
    - Database of metabolic pathways found in Arabidopsis
      - **www.arabidopsis.org/biocyc/ (TAIR)**
      - **www.plantcyc.org/ARA (Plant Metabolic Network)**



AraCyc 4.5 (released June 2008)

Pathways	288
Compounds	1956
Reactions	1723
Genes (in pathways)	1914
Citations	2279

- How can you connect these to your research efforts?

OMICS Viewer to the rescue . . .

- Overlay experimental data on a metabolic map
  - **Transcript data (for enzymes)**
  - **Proteomic data (for enzymes)**
  - **Metabolomic data**
- Use multiple data sources
  - Your data
  - Publicly available data
    - Gene Expression Omnibus
    - NASC Proteomics Database
    - NSF2010 Metabolomics
    - Many more . . .
- Generate new testable hypotheses about your favorite
  - gene
  - metabolite
  - biological process
  - etc.

Addressing common research conundrums . . .

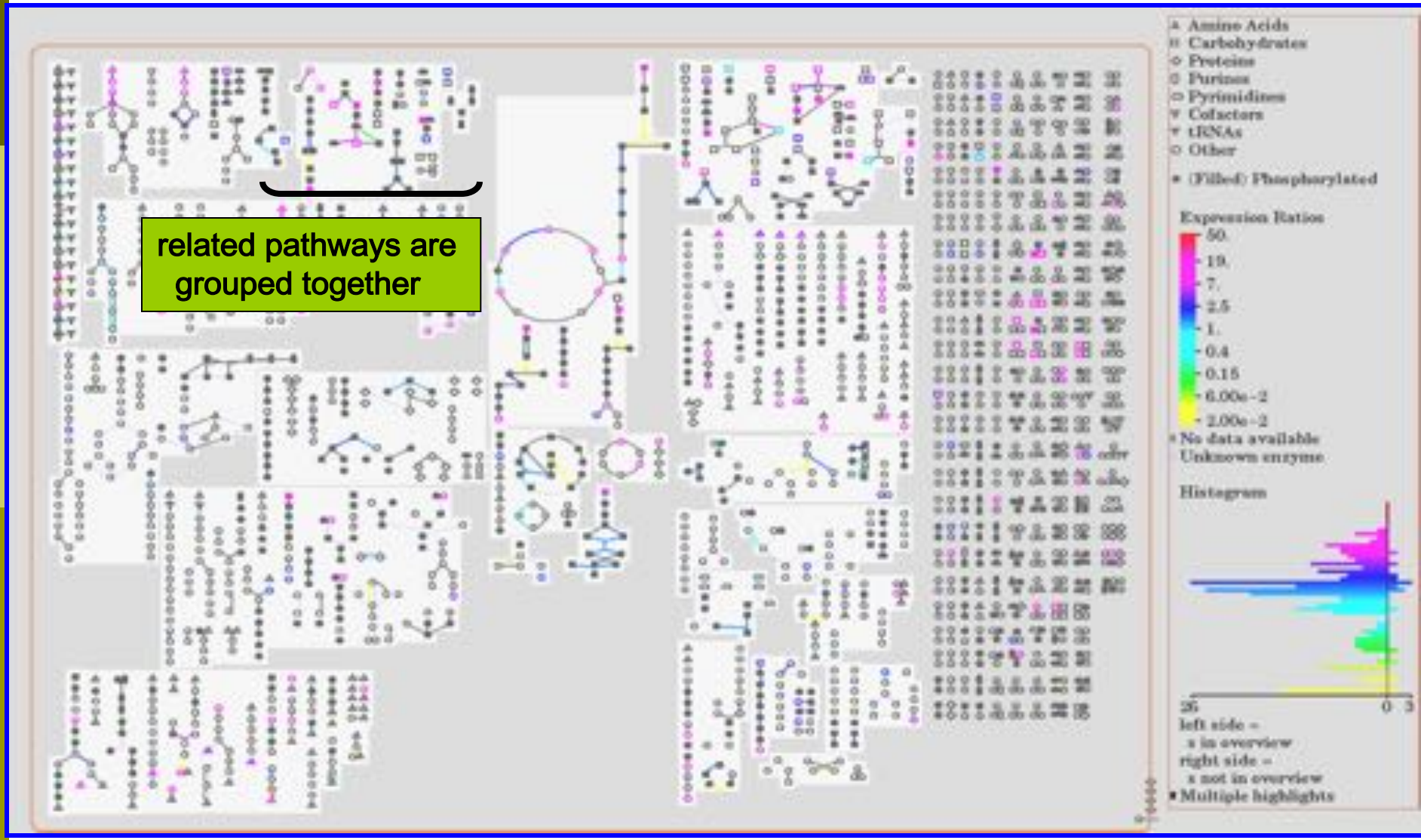
- My (single/double/triple/quadruple) mutant has "no phenotype"!!!!
  - **Compare transcript levels / protein levels / metabolite levels in wild-type and mutant plants using the OMICS viewer**
  - **Look for "hidden" perturbations in metabolism**

- I have a mutant with a defect in (biological process)
  . . . but I don't know the mechanism
  - **Use the OMICS viewer to compare data from WT and mutant plants**
  - **Download publicly available data sets related to the biological process**
  - **Scan for affected areas of metabolism**

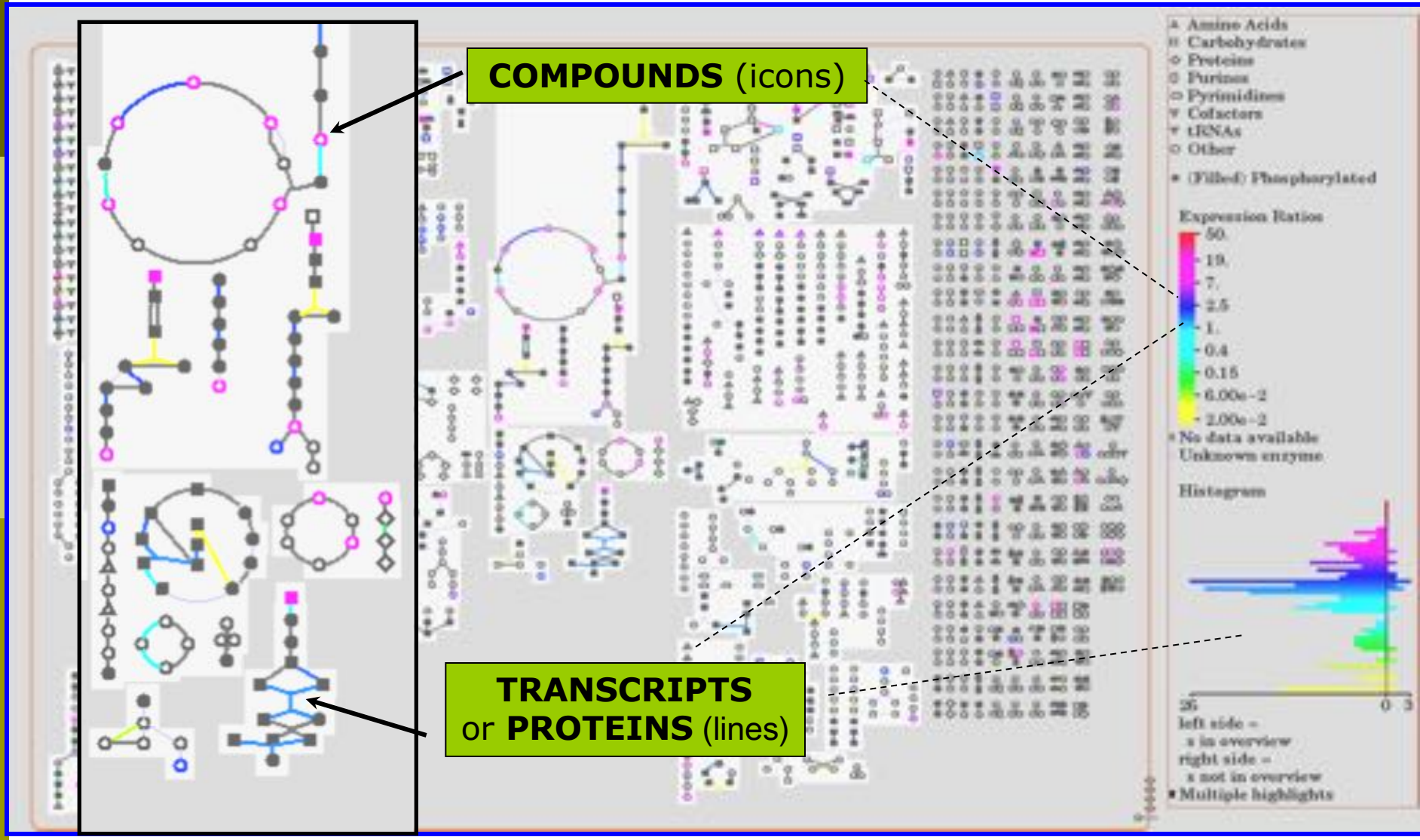
- I just did a microarray experiment and a bunch of metabolic enzymes popped up . . .
  - **Use the OMICS Viewer to quickly identify metabolic pathways that are up- or down-regulated**

- And many more . . .

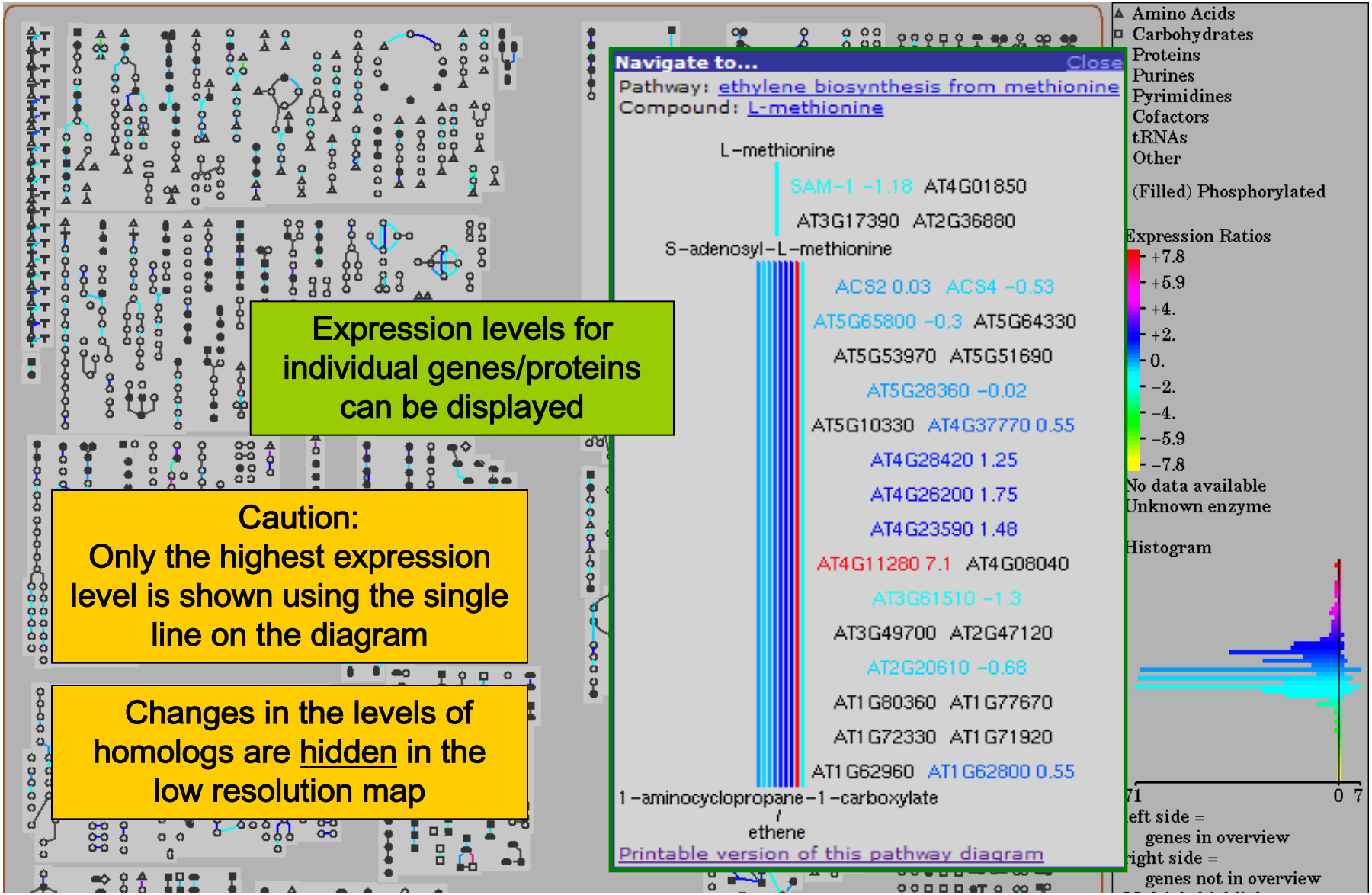
OMICS Viewer Overview



OMICS Viewer Overview



Viewing gene/protein families

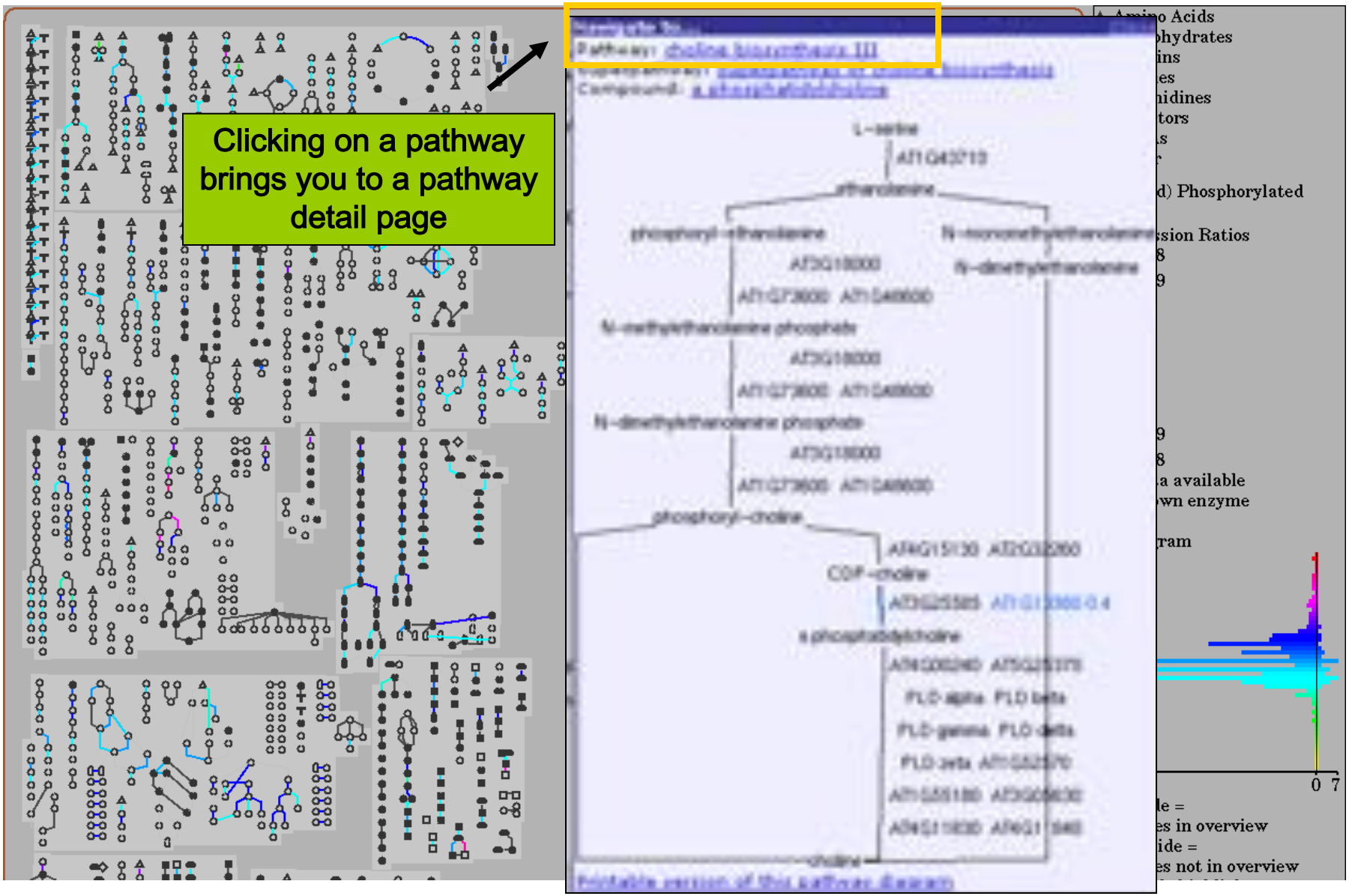


Expression levels for individual genes/proteins can be displayed

Caution:
Only the highest expression level is shown using the single line on the diagram

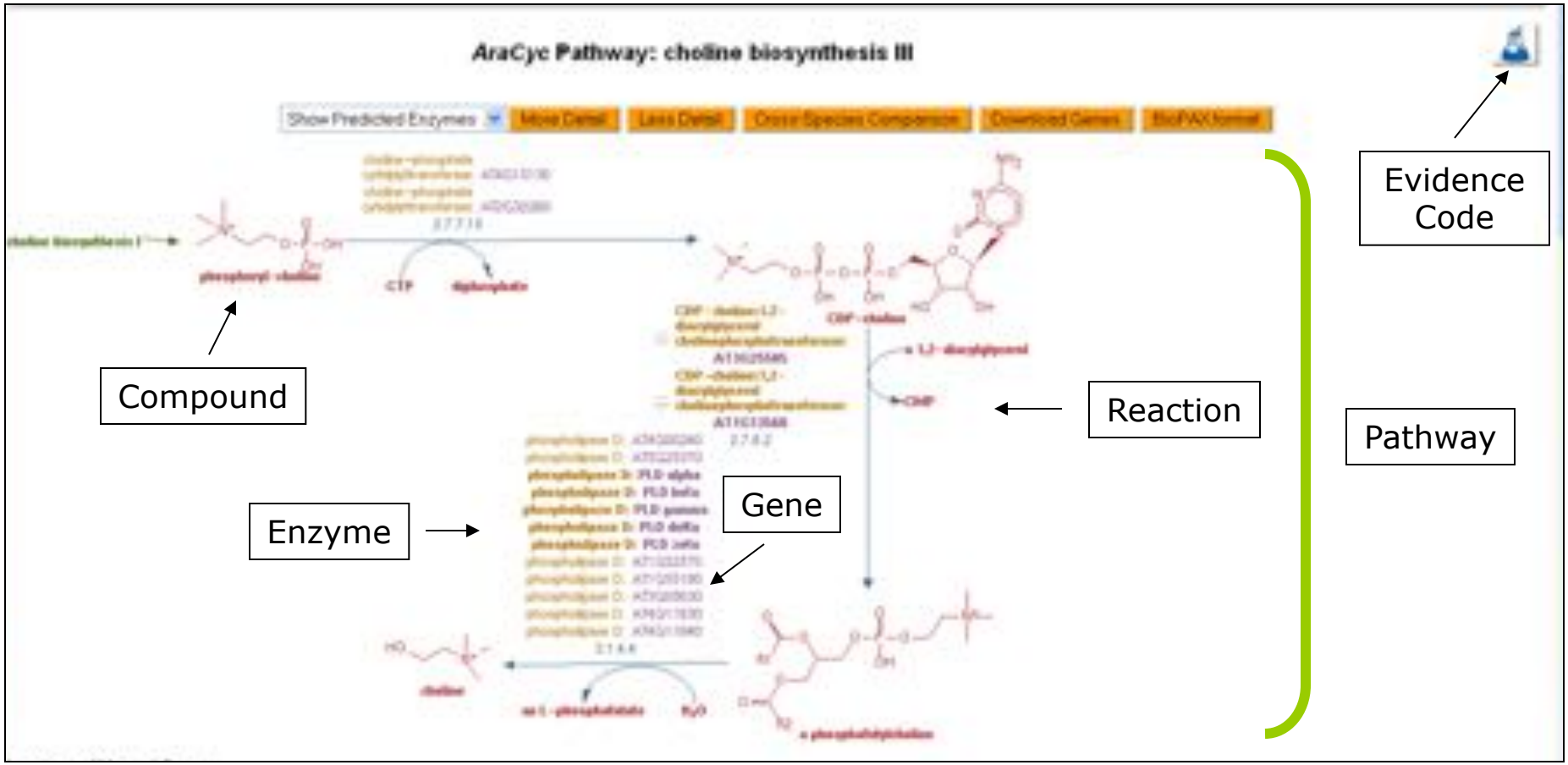
Changes in the levels of homologs are hidden in the low resolution map

Getting more information



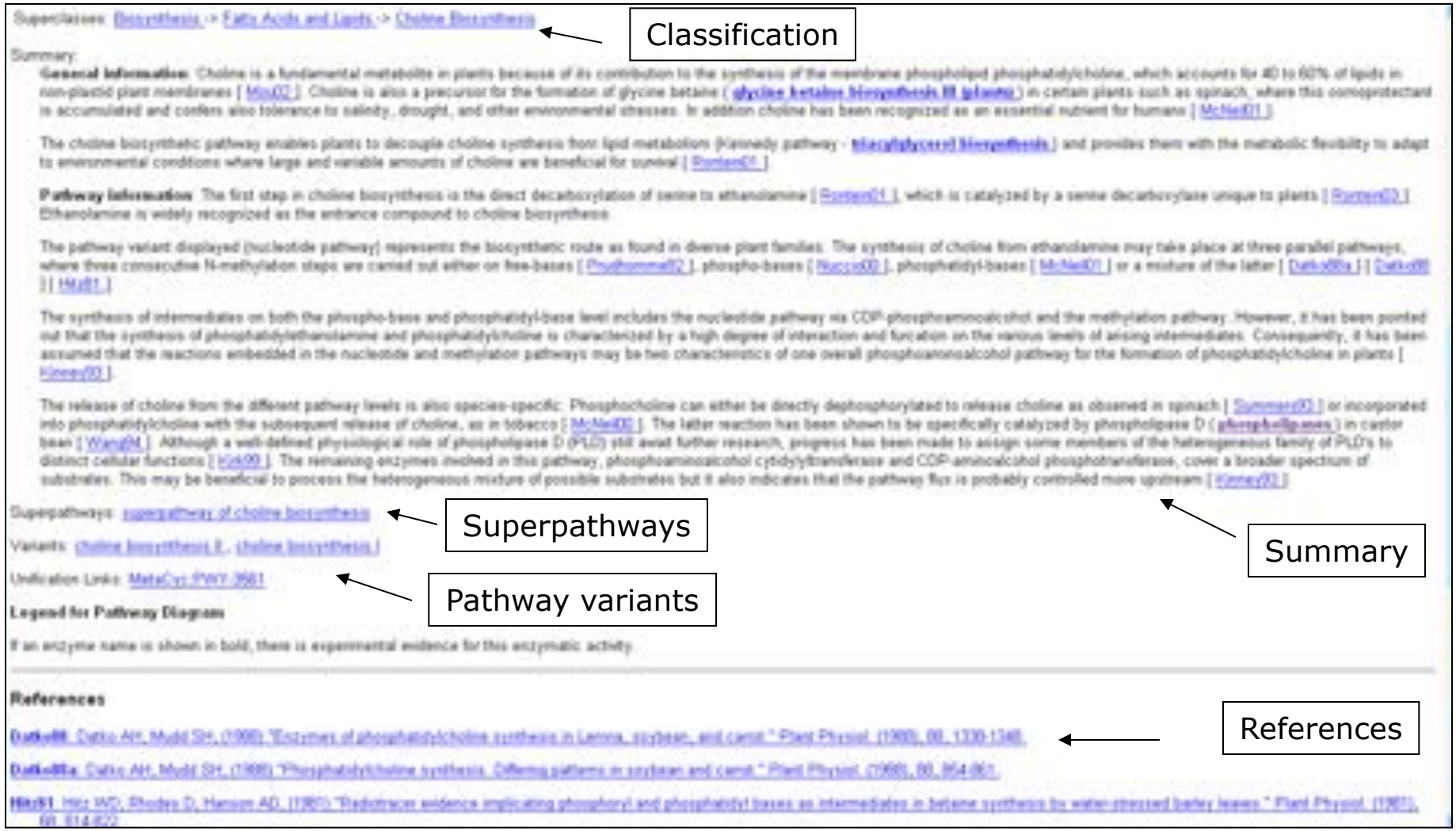
AraCyc Pathway pages

All items can be clicked on to obtain more information

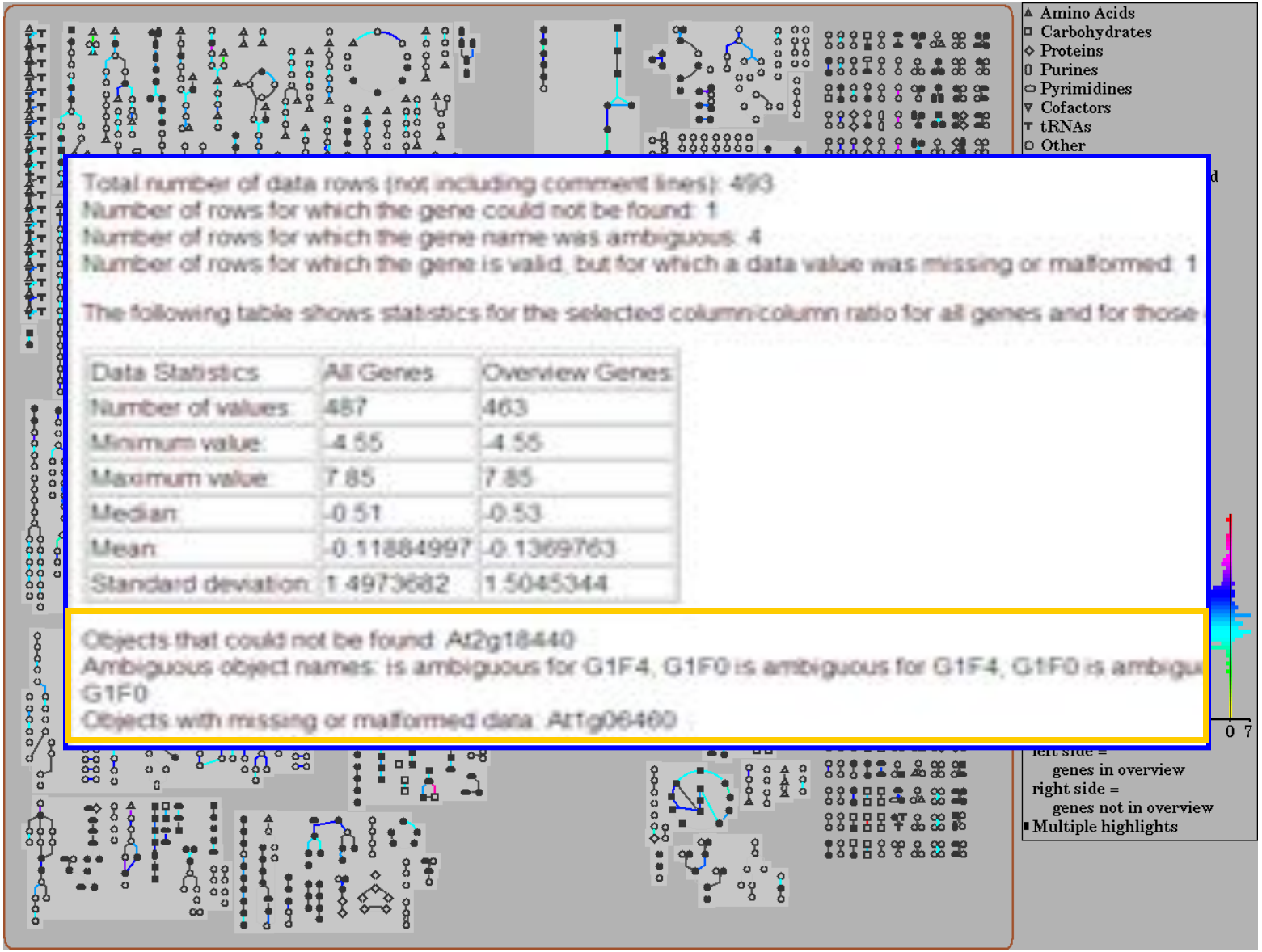


+ Additional curated information

AraCyc Pathway pages



OMICS Viewer Statistics



OMICS Viewer in action

- Multiple data sets can be entered using the same input file

- An animation can show changes in data sets:
  - wild type /mutant a / mutant b / mutant c / . . .
  - time points 0, 1, 2, 3, . . .
  - compound concentration x, y, z, . . .

Suberin Biosynthesis

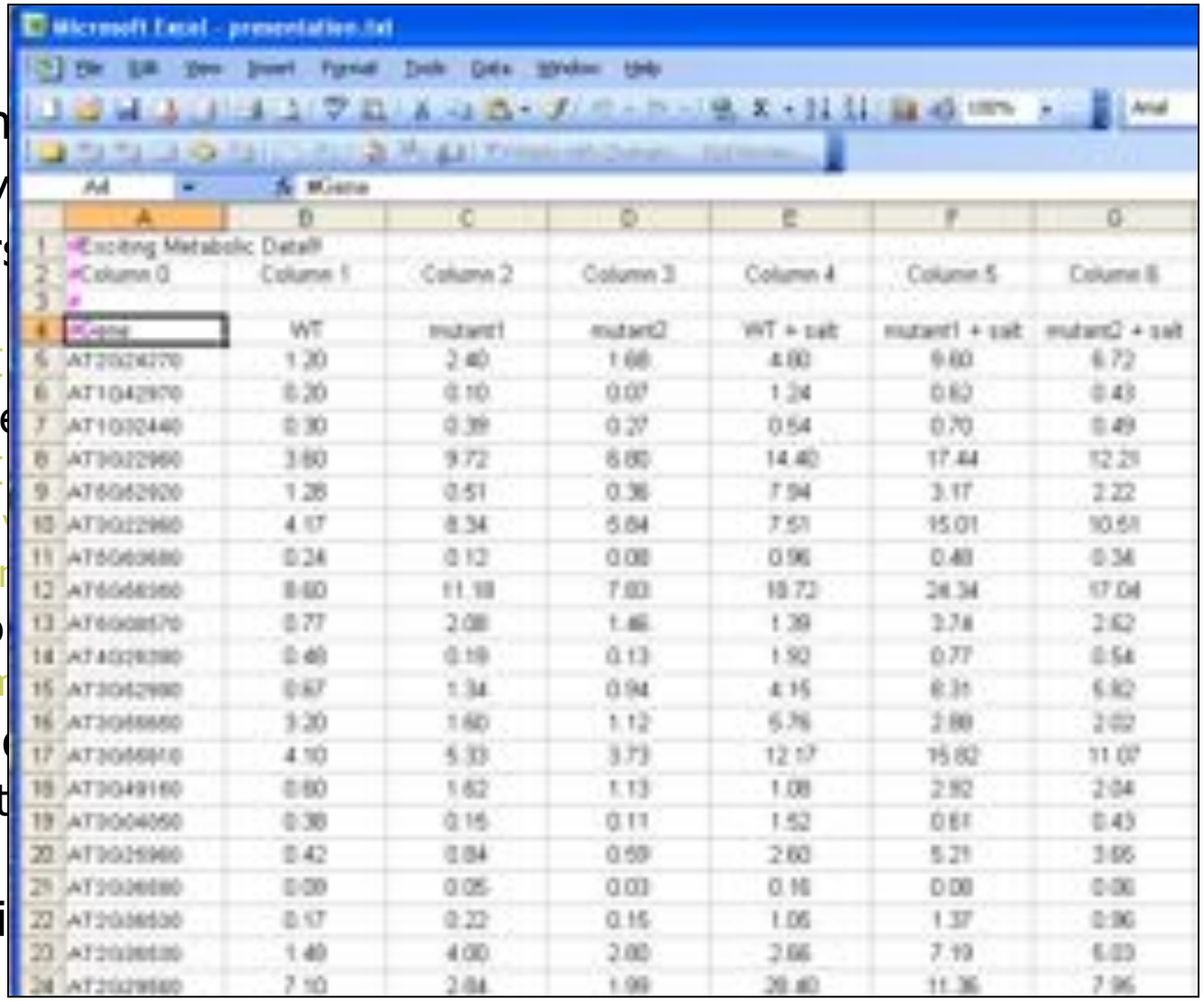
Wild type

mutant A

mutant B

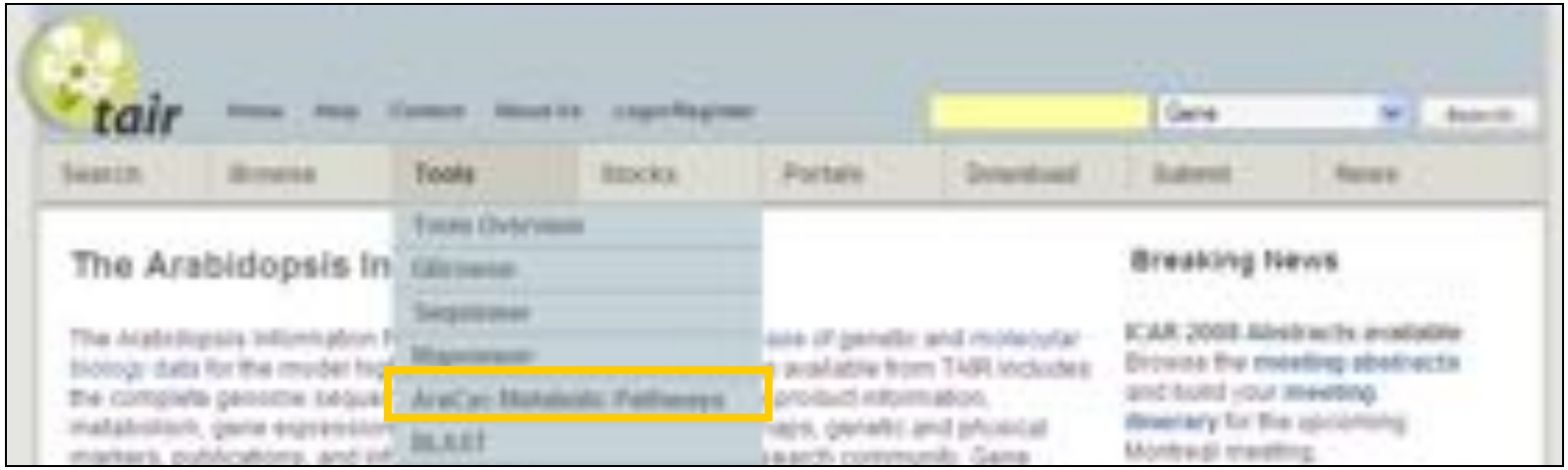
OMICS Viewer data inputs

- Input file
  - tab-delim
  - pre-analy
  - Identifiers
    - Genes
      - AGI
    - Enzyme
      - AGI
      - Enz
      - EC
    - Compo
      - Com
  - Data in a
    - absolut
  - Sample fi



OMICS Viewer data upload

TAIR - www.arabidopsis.org

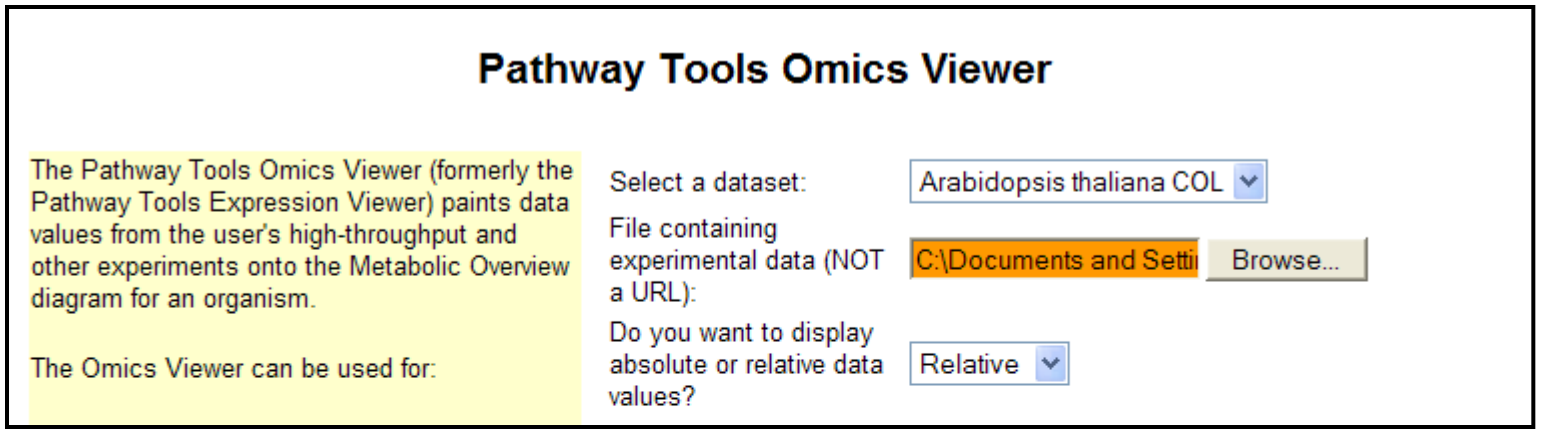


AraCyc - www.arabidopsis.org/biocyc

OMICS Viewer data upload

PMN – www.plantcyc.org

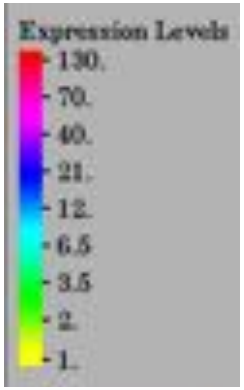
OMICS Viewer data upload



- Select species
- Upload data file
- Enter appropriate parameters
- GO!

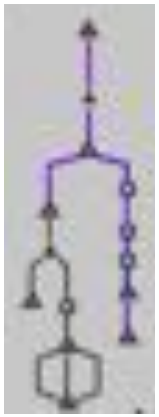
New ideas to pursue . . .

Wild type



Mutant with
"no phenotype"

Mutant with
a metabolic
phenotype



The transcript levels
of several enzymes in the
lysine biosynthesis pathway
are reduced ~4-fold!

New hypotheses and experiments

Acknowledgements

AraCyc, the PMN, and TAIR

Sue Rhee *(PI and Co-PI)*
Eva Huala *(Director and Co-PI)*

Current Curators:
- Peifen Zhang *(Director and lead curator- metabolism)*
- Tanya Berardini (*lead curator – functional annotation*)
- David Swarbreck (*lead curator – structural annotation*)

- Debbie Alexander (*curator*)
- A. S. Karthikeyan (*curator*)
- Donghui Li (*curator*)

Recent Past Contributors:
- Christophe Tissier (*curator*)
- Hartmut Foerster *(curator)*

Tech Team Members:
- Bob Muller (*Manager*)
- Larry Ploetz (*Sys. Administrator*)
- Raymond Chetty
- Anjo Chi
- Vanessa Kirkup
- Cynthia Lee
- Tom Meyer
- Shanker Singh
- Chris Wilks

Metabolic Pathway Software:
- Peter Karp and SRI group (**NIH**)

CARNEGIE INSTITUTION FOR SCIENCE

NSF National Science Foundation WHERE DISCOVERIES BEGIN

Need more help?

If you have any questions or want a live demo . . .

Come to the Curation Booth – Booth #1
Open throughout the conference!

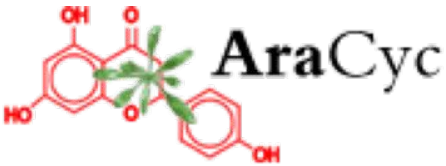
banner by Philippe Lamesch

Please stop by during a poster session

Thank you . . .

www.arabidopsis.org

curator@arabidopsis.org



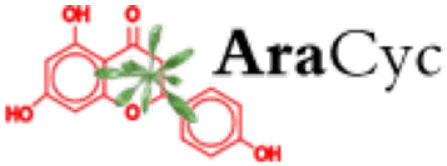
www.arabidopsis.org/biocyc

curator@arabidopsis.org

www.plantcyc.org

curator@plantcyc.org

More Help and Tutorials



http://www.arabidopsis.org/help/tutorials/aracyc_intro.jsp

curator@arabidopsis.org

PMN
Plant Metabolic Network

http://www.plantcyc.org/tutorials/tutorials_index.faces

curator@plantcyc.org