Bioinformatics projects

Carol Wagstaff

University of Reading

Informatics projects involve three elements

- a biological problem
- molecular genetics
- database interrogation

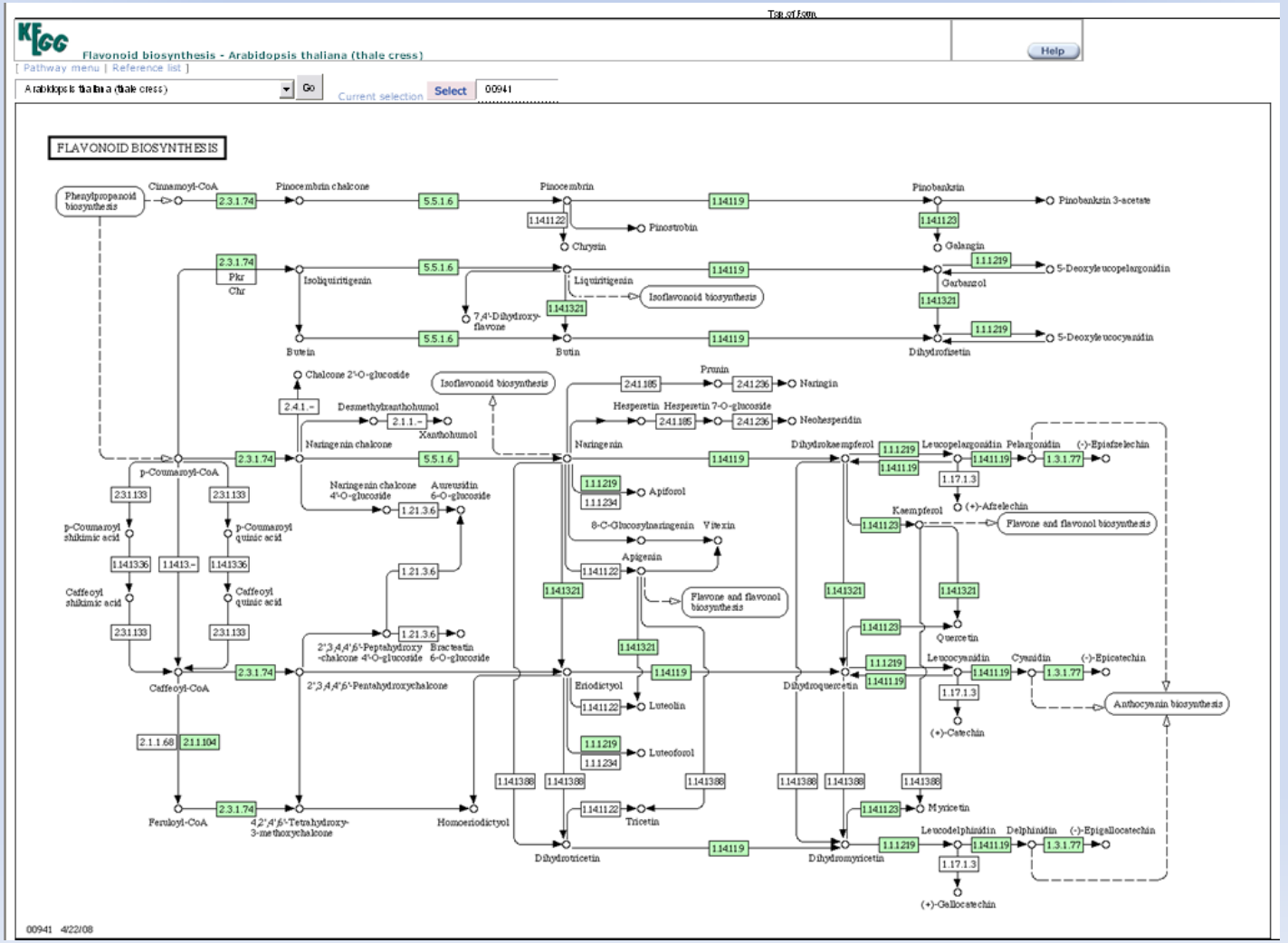
Case Study: Using *Arabidopsis* to identify targets for future research to manipulate the flavonoid content of lettuce

1) The importance of flavonoids in human health
2) Sources of flavonoids in the diet - identify which important ones are in leafy vegetables
3) Structure and biosynthesis pathways of the flavonoids identified in (2)
4) Genetic regulation of biosynthesis of flavonoids identified in (2)
5) Response of your chosen flavonoids to different types of stress relevant to postharvest quality e.g. cold, drought, pathogen
6) Using Arabidopsis (a model plant) to inform studies on economically significant leafy vegetables such as lettuce and *Brassica*

- Background to *Arabidopsis*
- Overview of available resources for *Arabidopsis* (full genome sequence, predicted proteins, microarray data for gene expression profiling)
- Overview of available resources for lettuce and *Brassica* (partial

Pathway analysis

- www.genome.jp/kegg/pathway/



Resources for crops

- http://cgpdb.ucdavis.edu/sitemap.html
- http://www.brassica.info/

Are there homologous genes known in the crop plant?

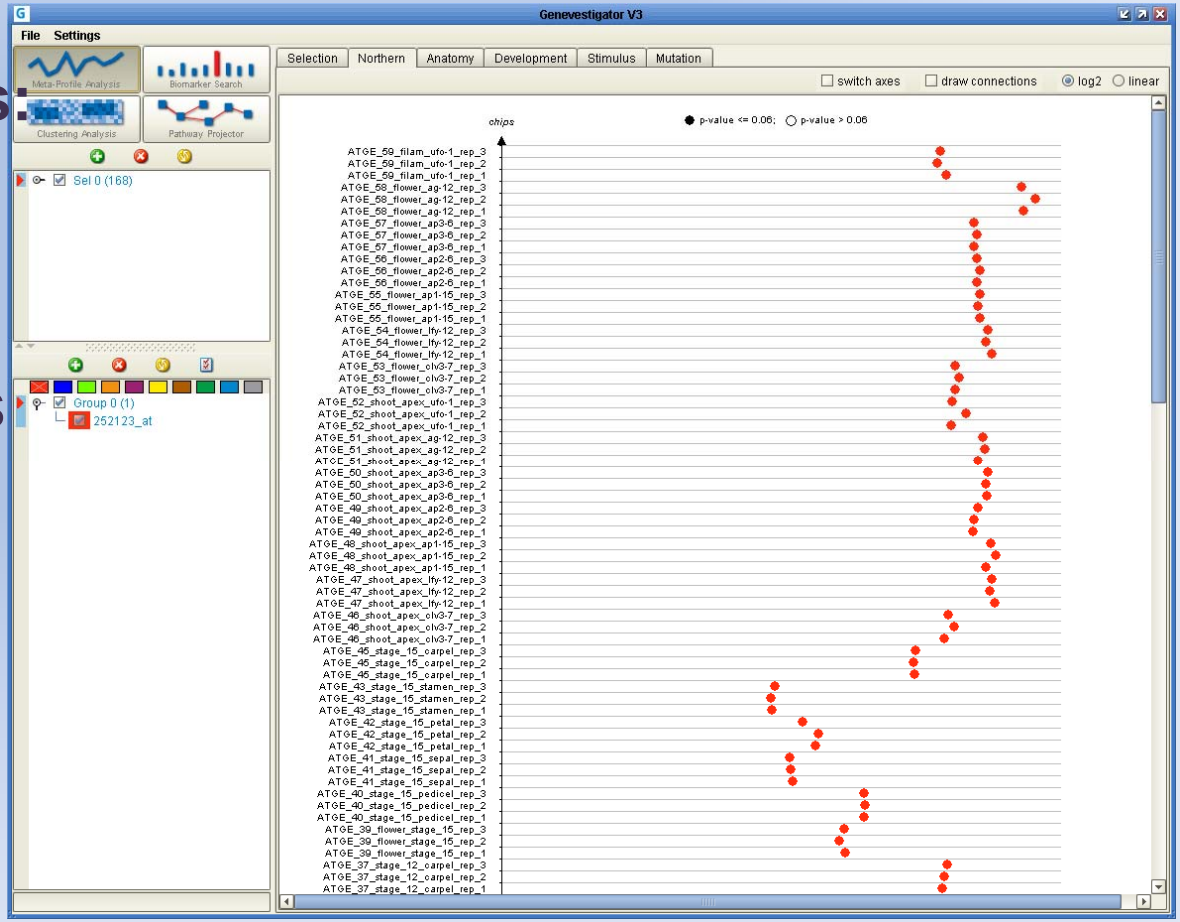
Are they part of a gene family?

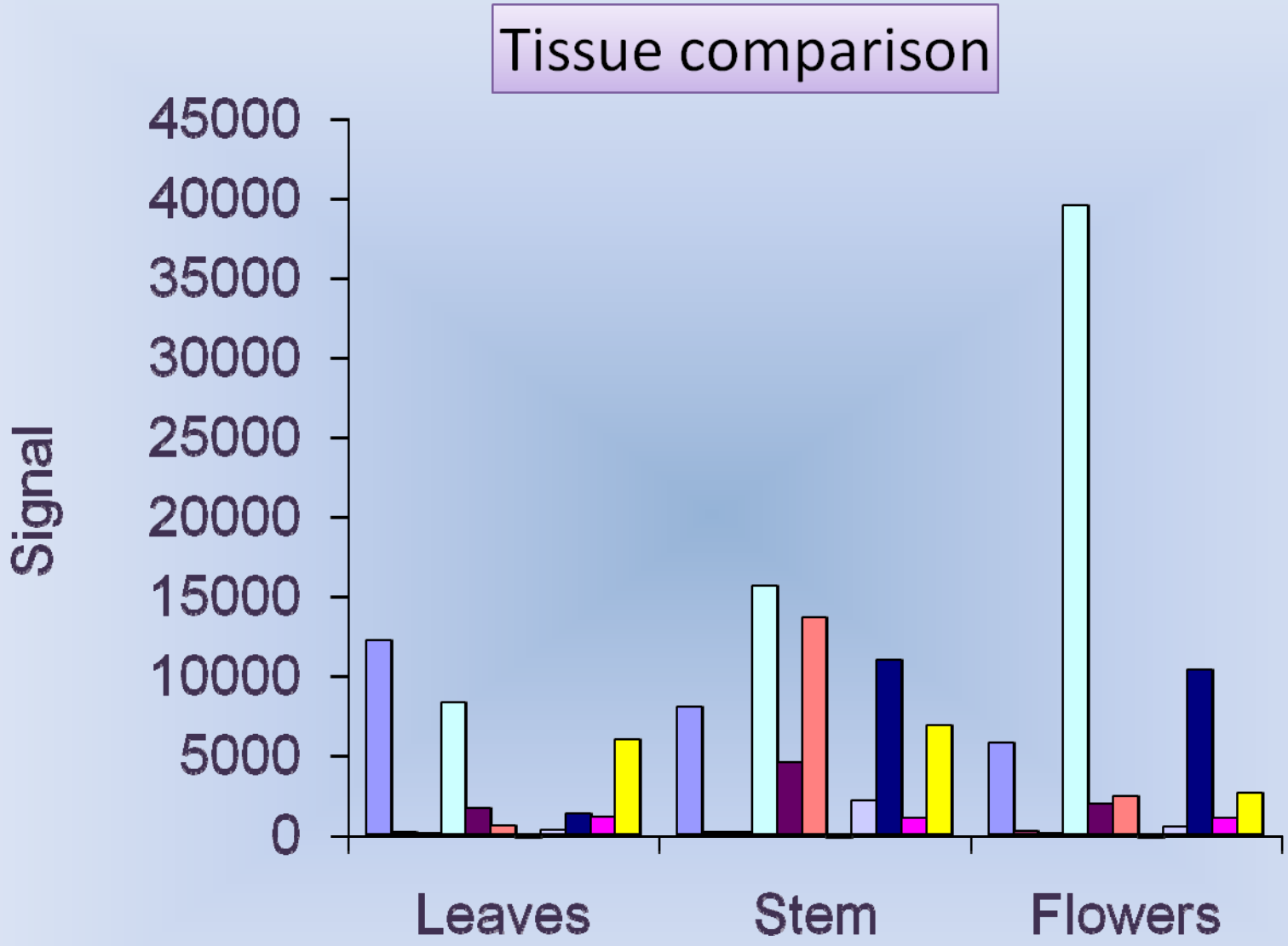
Finding the important members of a gene family

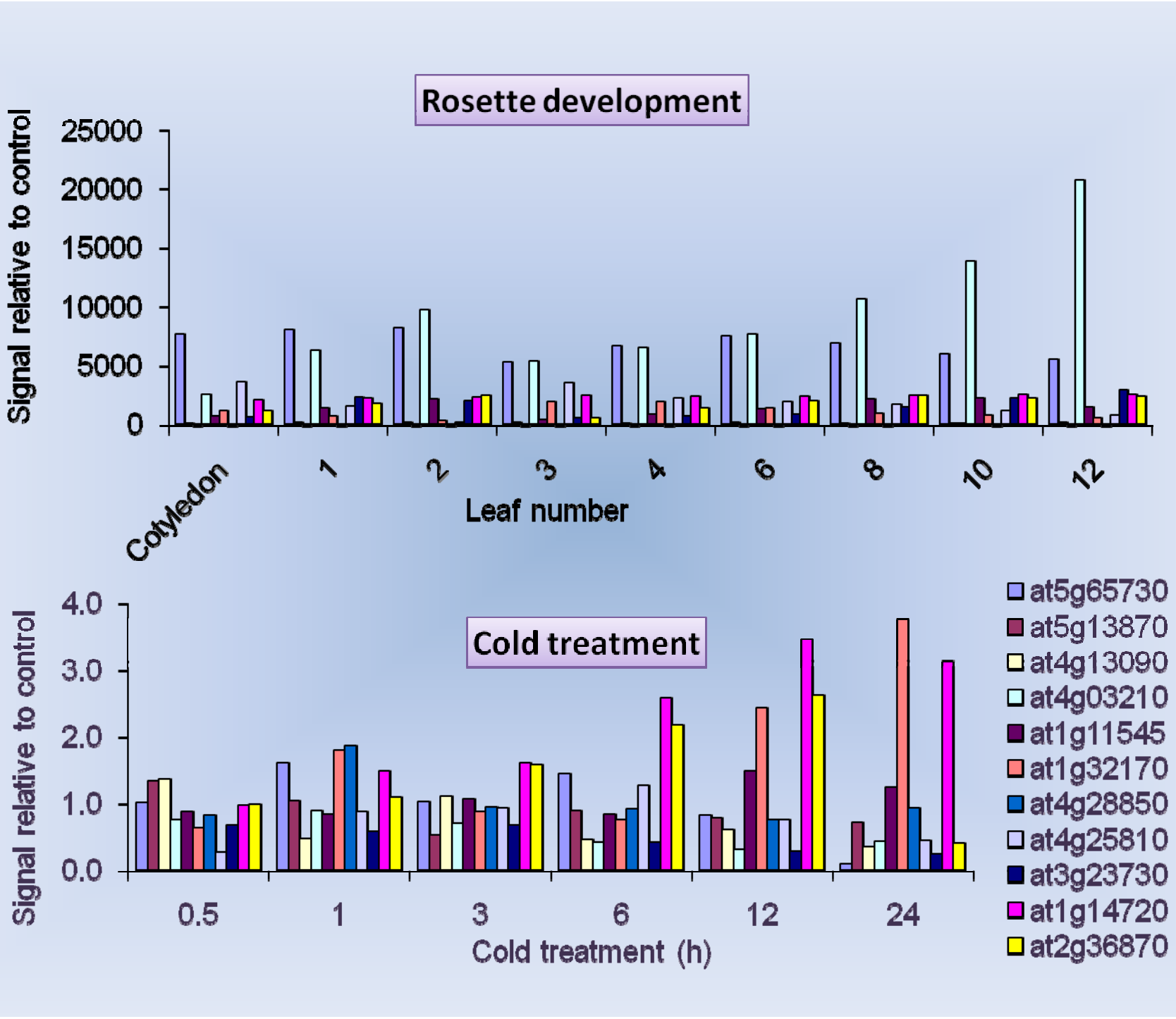
- https://www.genevestigator.ethz.ch/gv/index.jsp

Expression changes

- Through time
- In different tissues
- In response to stress



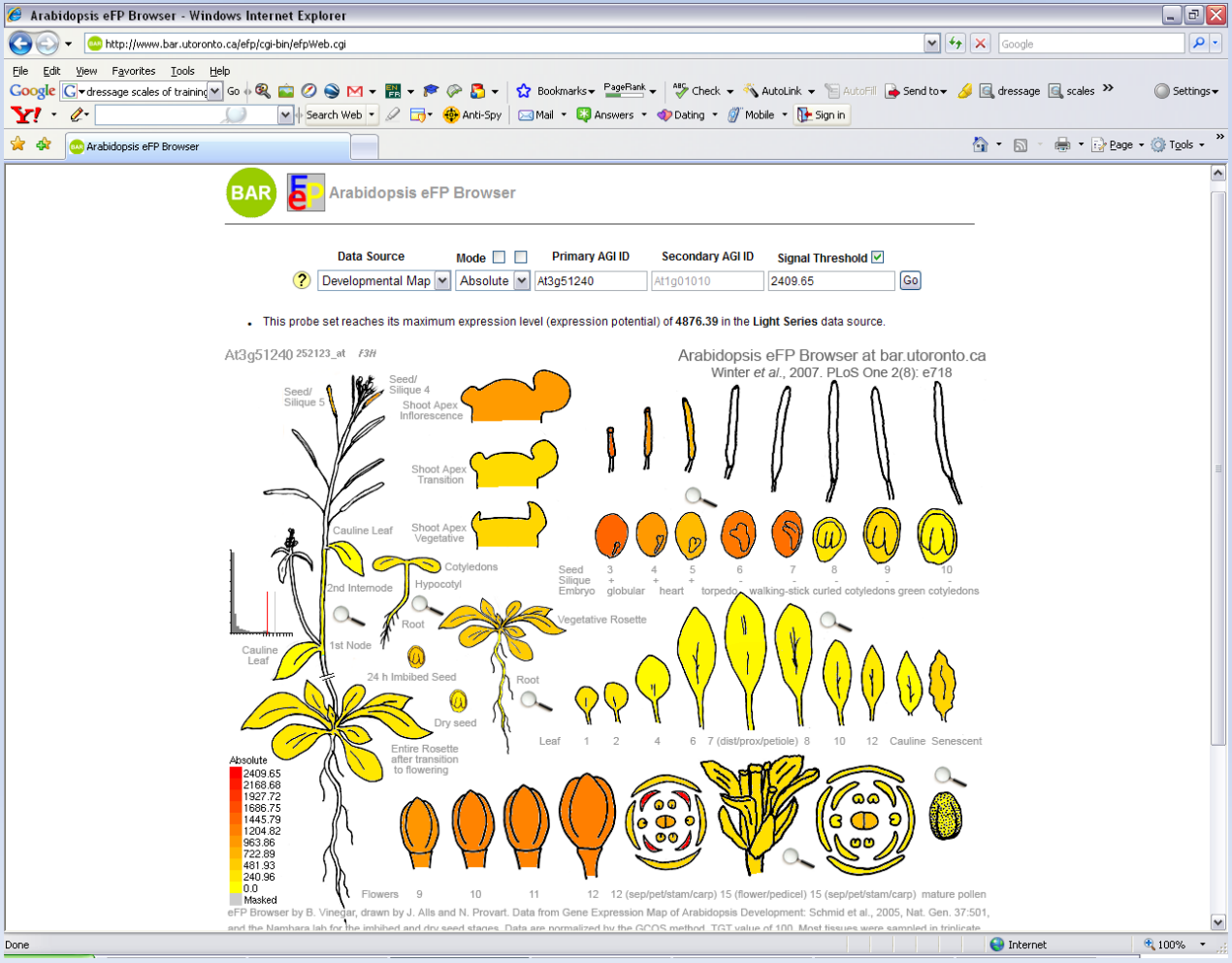

Tissue comparison
Signal
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Leaves
Stem
Flowers


Rosette development
Signal relative to control
25000
20000
15000
10000
5000
0
Cotyledon
1
2
3
4
6
8
10
12
Leaf number
Cold treatment
Signal relative to control
4.0
3.0
2.0
1.0
0.0
0.5
1
3
6
12
24
Cold treatment (h)
at5g65730
at5g13870
at4g13090
at4g03210
at1g11545
at1g32170
at4g28850
at4g25810
at3g23730
at1g14720
at2g36870

Visualising expression patterns

- www.bar.utoronto.ca

At3g51240



Tips and hints

- Be careful that the student doesn't lose sight of the aim of the project and collects data without thinking what it means.
- Insist that the student is organised and writes as good a lab book for this project as they would for a 'wet' project. Otherwise ……. pages of unidentified sequence and very little clarity.
- If databases or servers go down this can be frustrating. It certainly helps if the student has their own laptop and a fast internet connection rather than being reliant on the average university resource.
- Some weak students can give into the temptation to stay at home and 'play' with databases without actually achieving anything.

Does it give scope for good students to shine?

- Students can rapidly develop a sense of independence and ownership of their project.
- Many like the flexibility of working practice it offers and bioinformatics projects can be helpful for students trying to juggle work and family pressures with study.
- Some students can feel as though they are drowning in data.
- Some students discover an ability to synthesis large amounts of information and use the data to understand what is happening at the biological level in detail.
- One student was able to produce a theory of leaf development and shape determination that challenged the boundaries of what was already known.