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E-bioscience: a new way of life (science)

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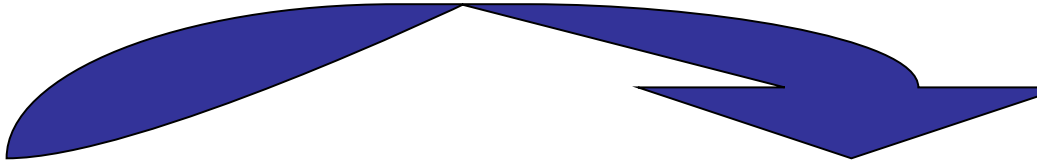
ICTDELTA
het ICT Innovatiecongres

What is Bioinformatics?

The development and application of informatics, mathematical, and statistical methods in life sciences.

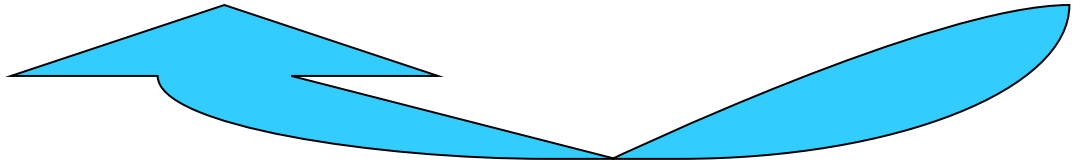
Enabling science for genomics

*convert data to knowledge
*generate new hypotheses



DATA

Knowledge



*Design new experiments

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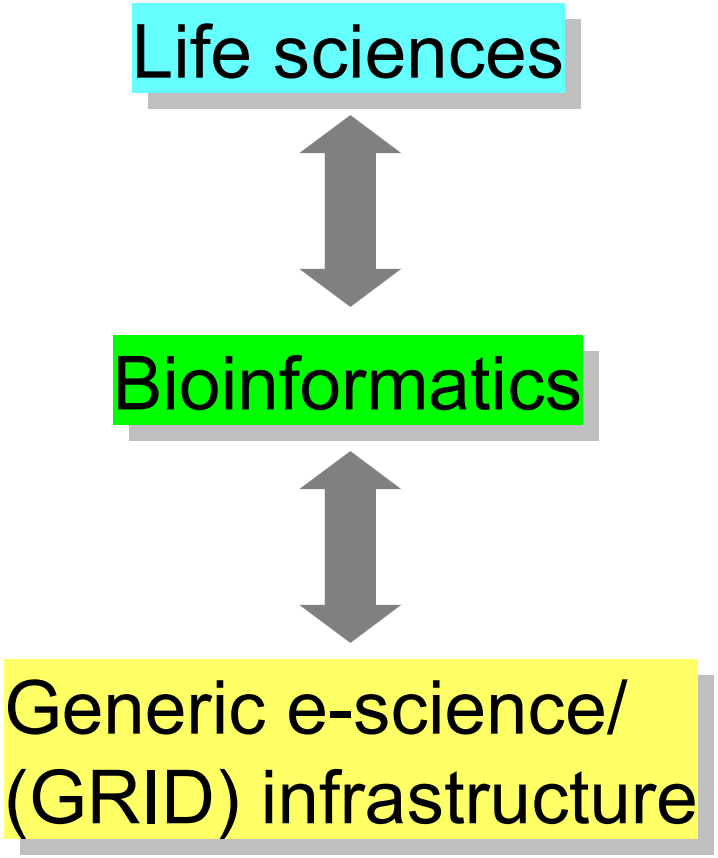
Bioinformatics as interface

- e-Bioscience
- How can we make generic e-science methodologies and (GRID) ICT infrastructure of benefit to life sciences?



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Netherlands Bioinformatics Centre (NBIC)

Programmes

Life science researchers (end-users)

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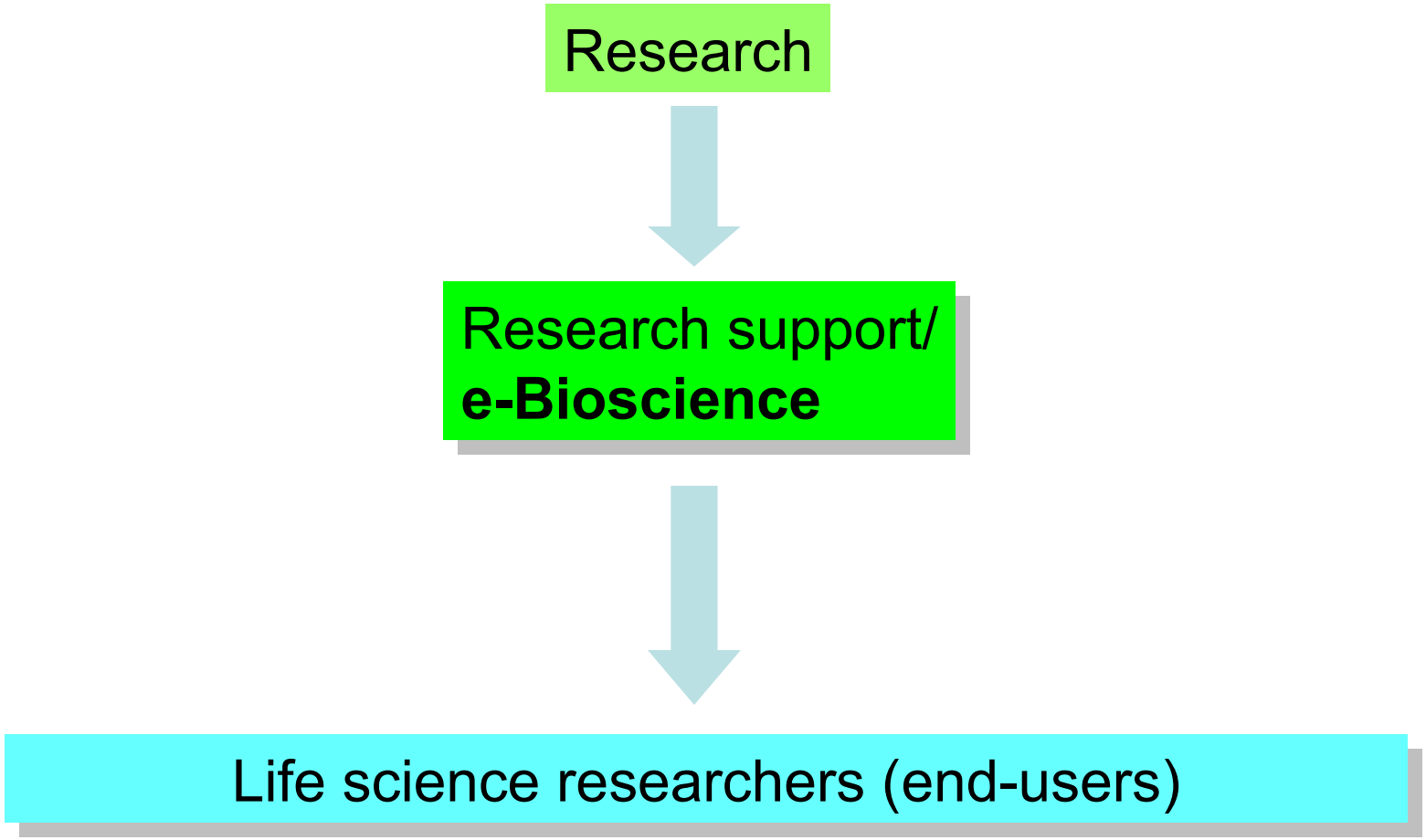
Deliver tools and databases to end-users



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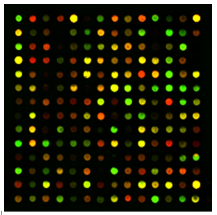
High-throughput experimental technologies in life sciences

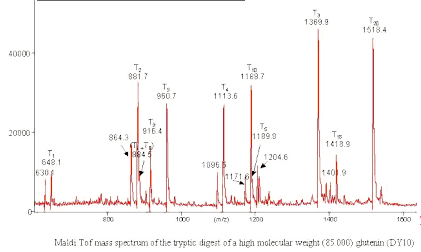
Cell/Tissue

Determine complete DNA sequence of organism (e.g., mutations)

Measure expression of all genes.

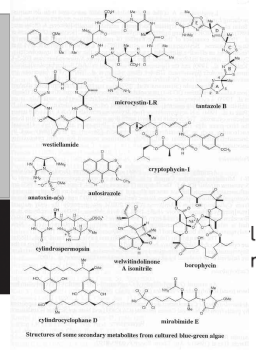


Identify many proteins or their expression level.



Maldi Tof mass spectrum of the tryptic digest of a high molecular weight (85 000) glutenin (DY10)

Identify many metabolites or their concentration.



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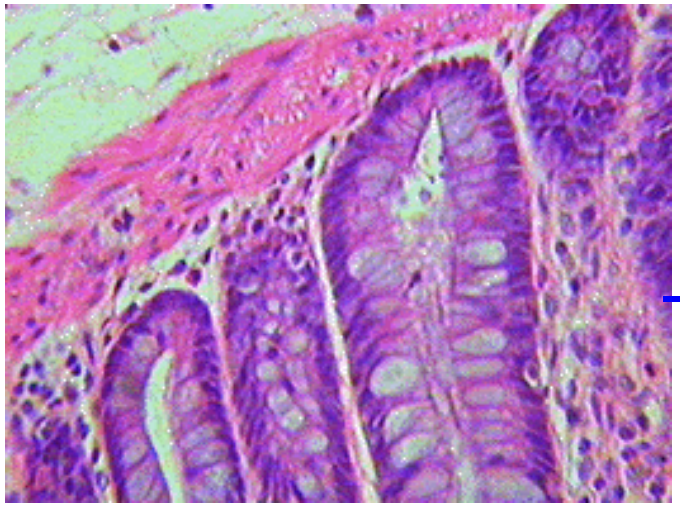
Compare normal versus cancer

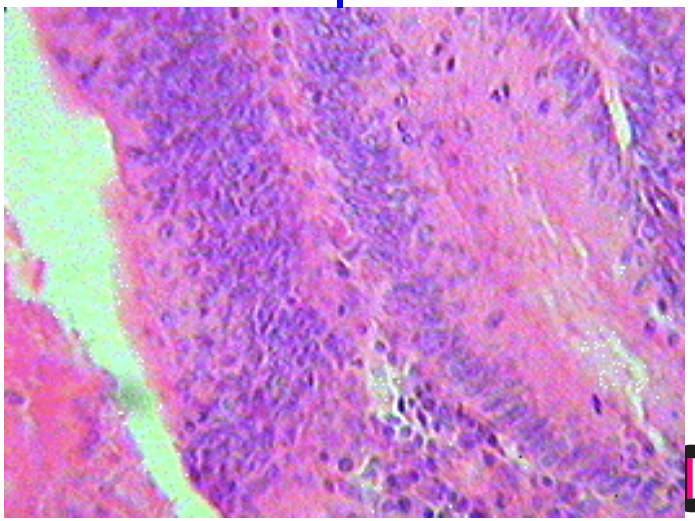


High magnification of a
normal human colon cell

Data

Data

High magnification of a
human colon cell with carcinoma



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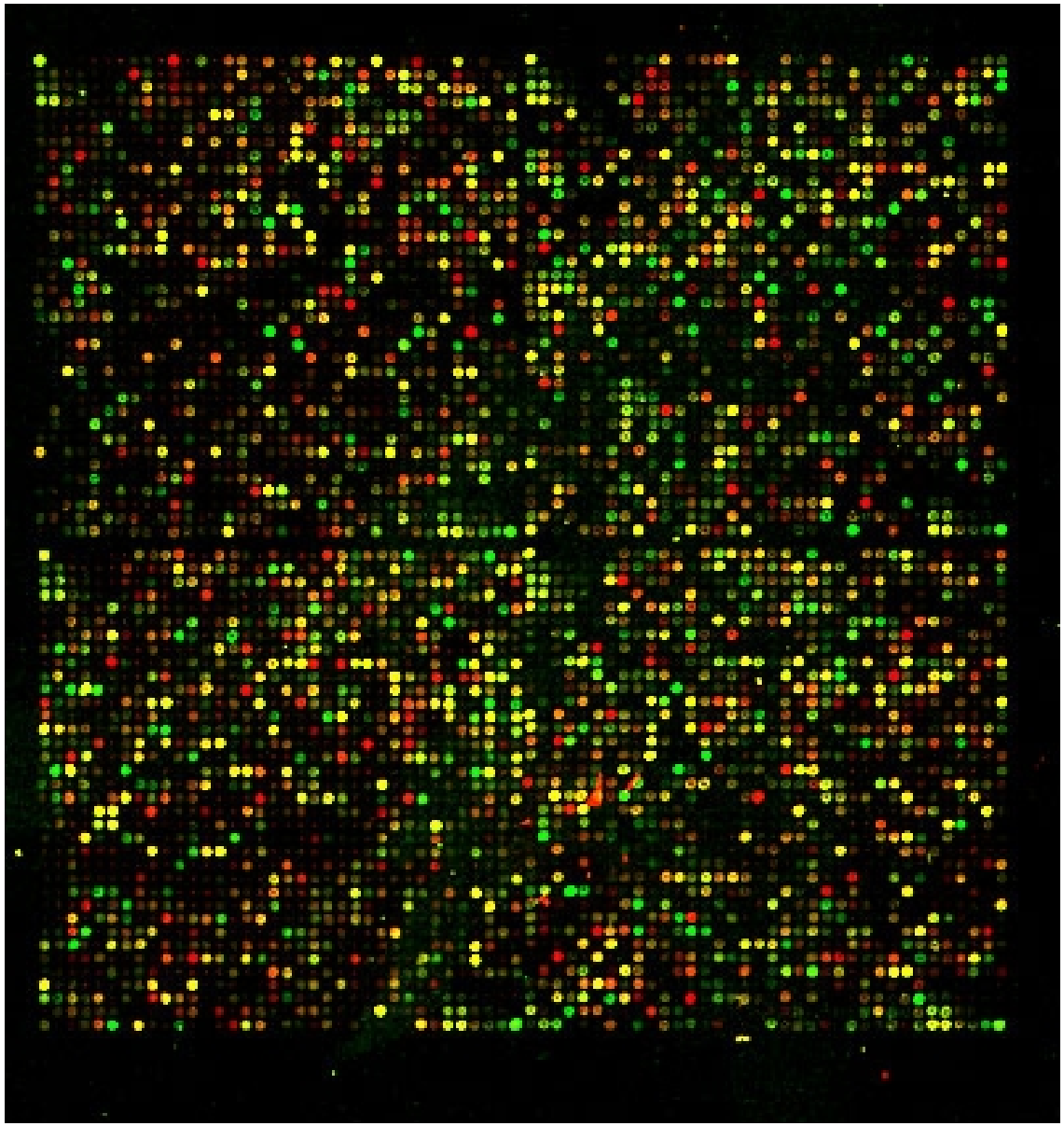
DNA microarrays



Single experiment:
30.000 – 40.000 genes

Requires dedicated approaches for analysis

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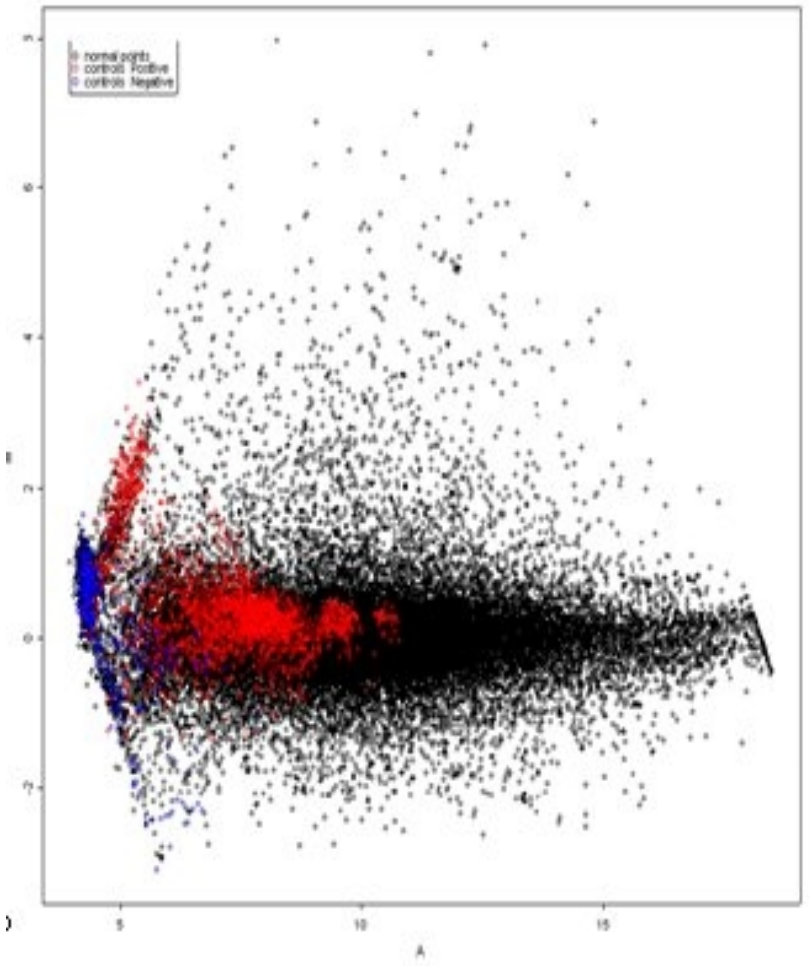
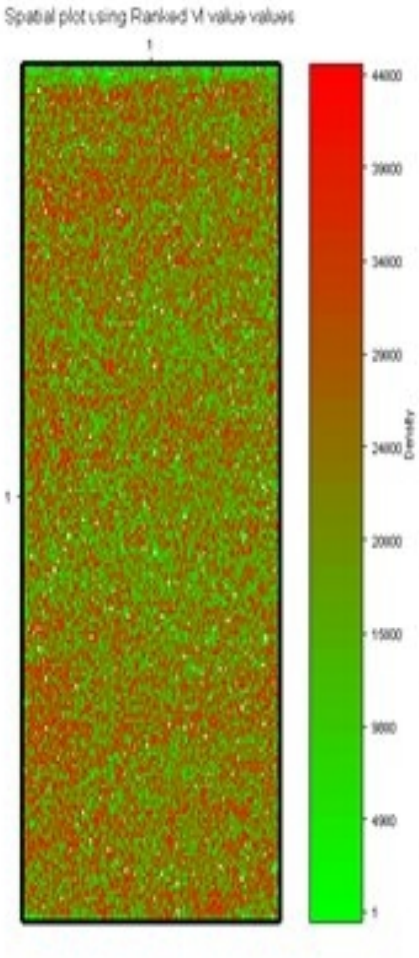
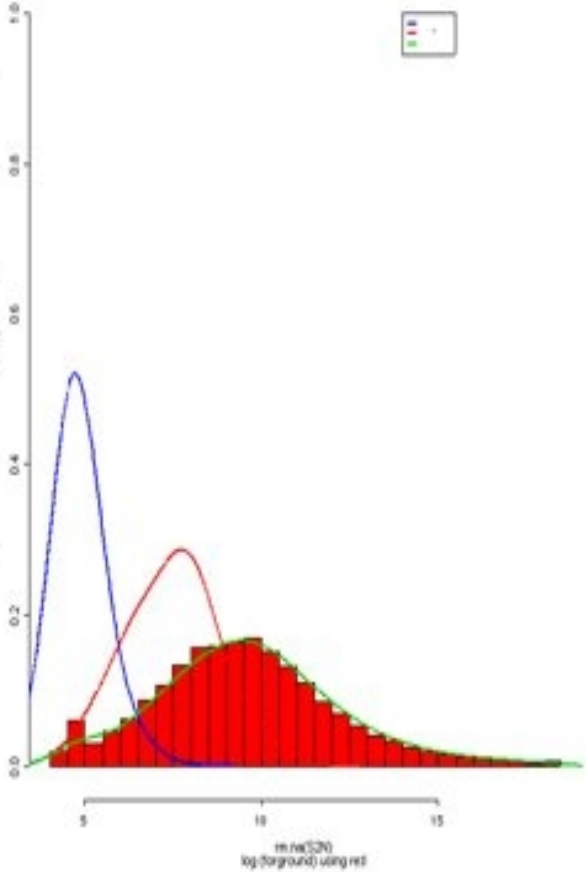
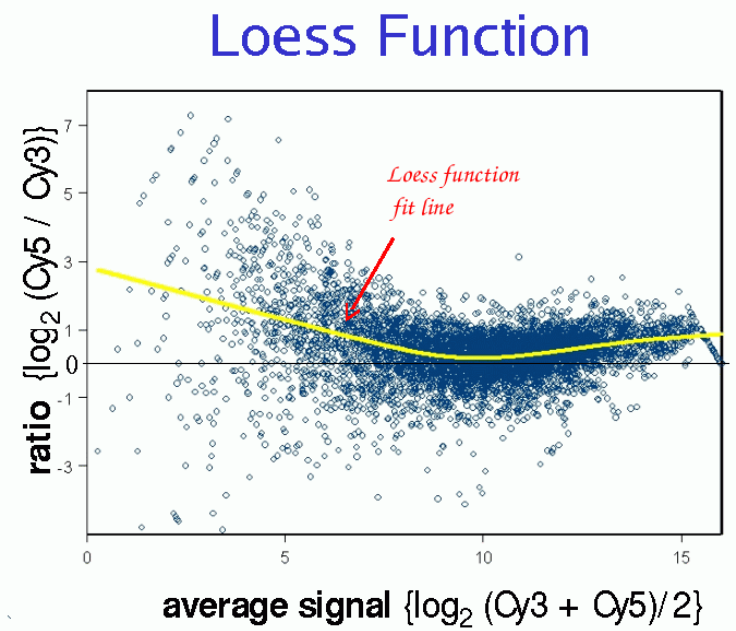
Quality control

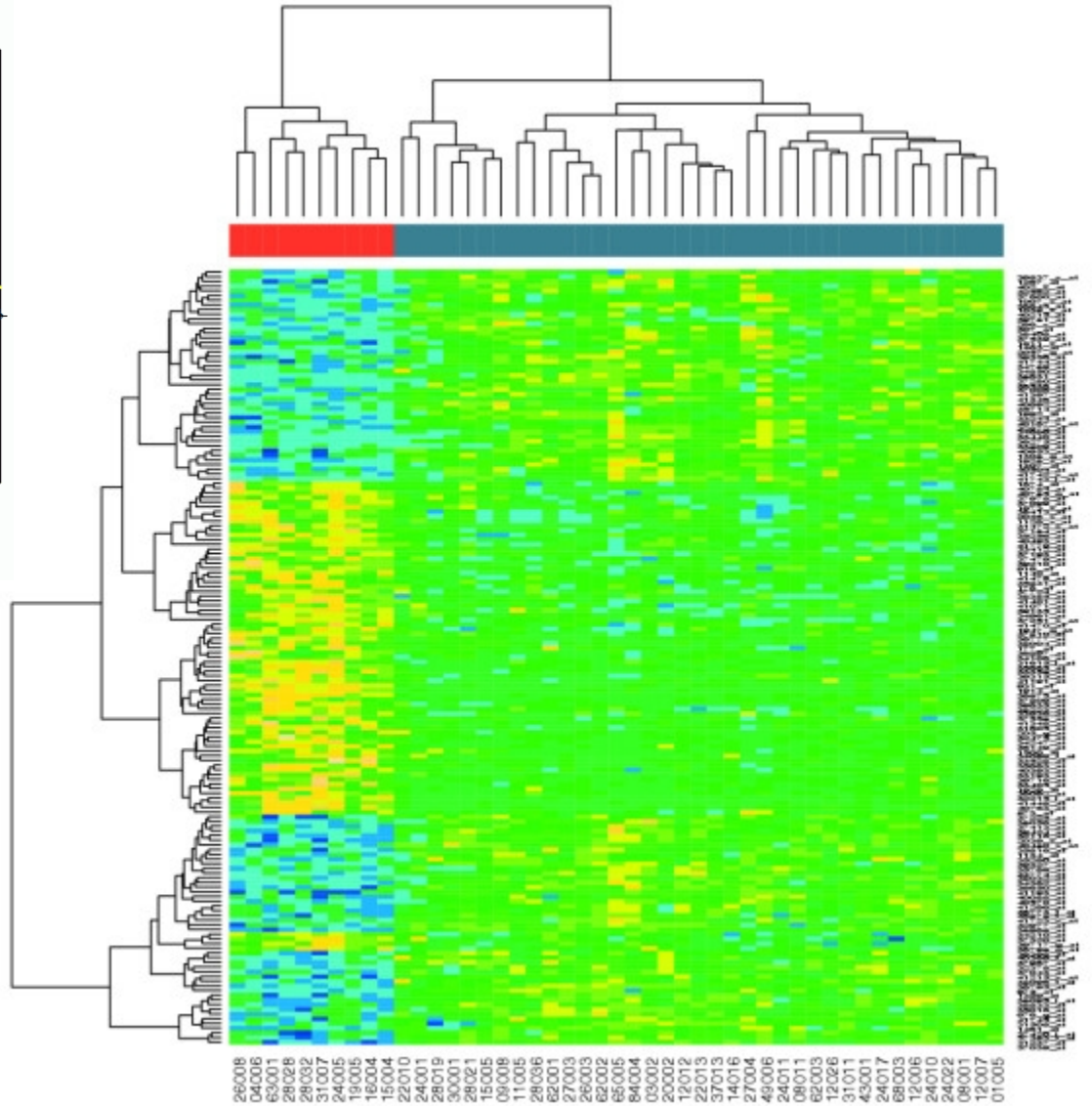




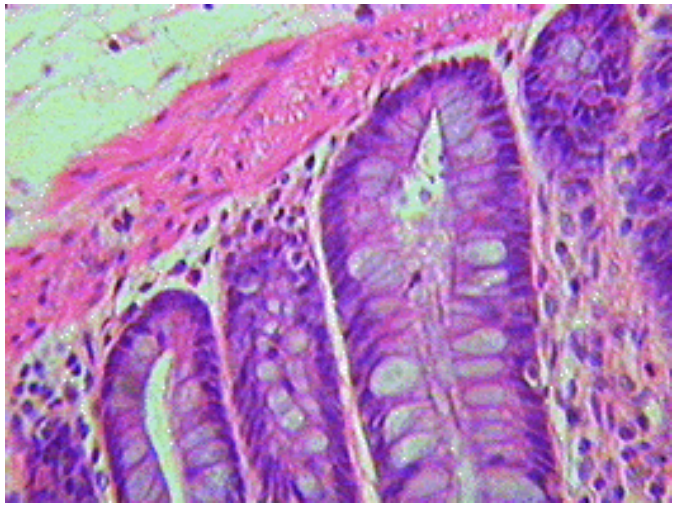


Normalization and statistical analysis

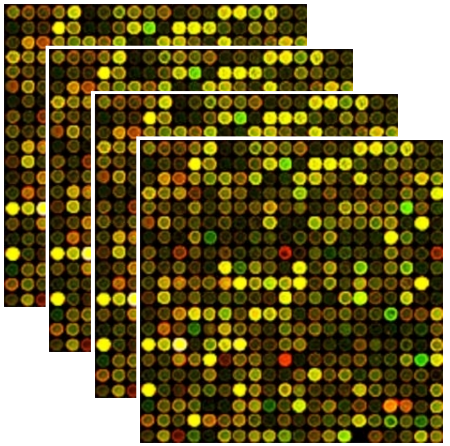




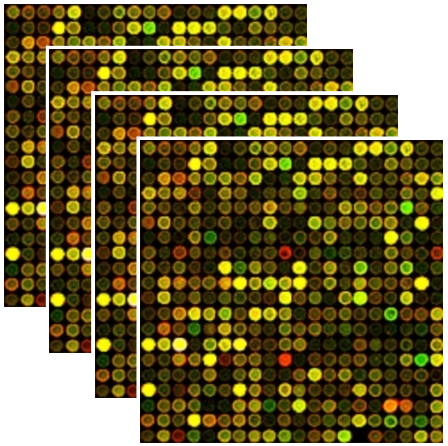
Molecular diagnostics

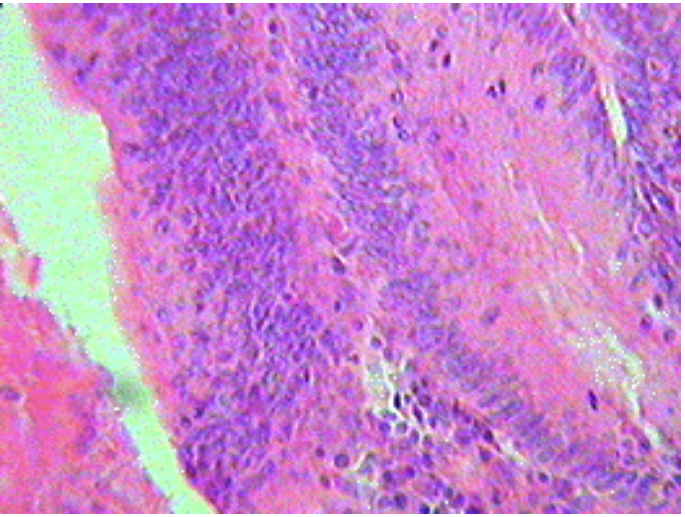


High magnification of a normal human colon cell



Which genes discriminate between normal & patient





High magnification of a human colon cell with carcinoma

This requires statistical analysis of the data. Complex!

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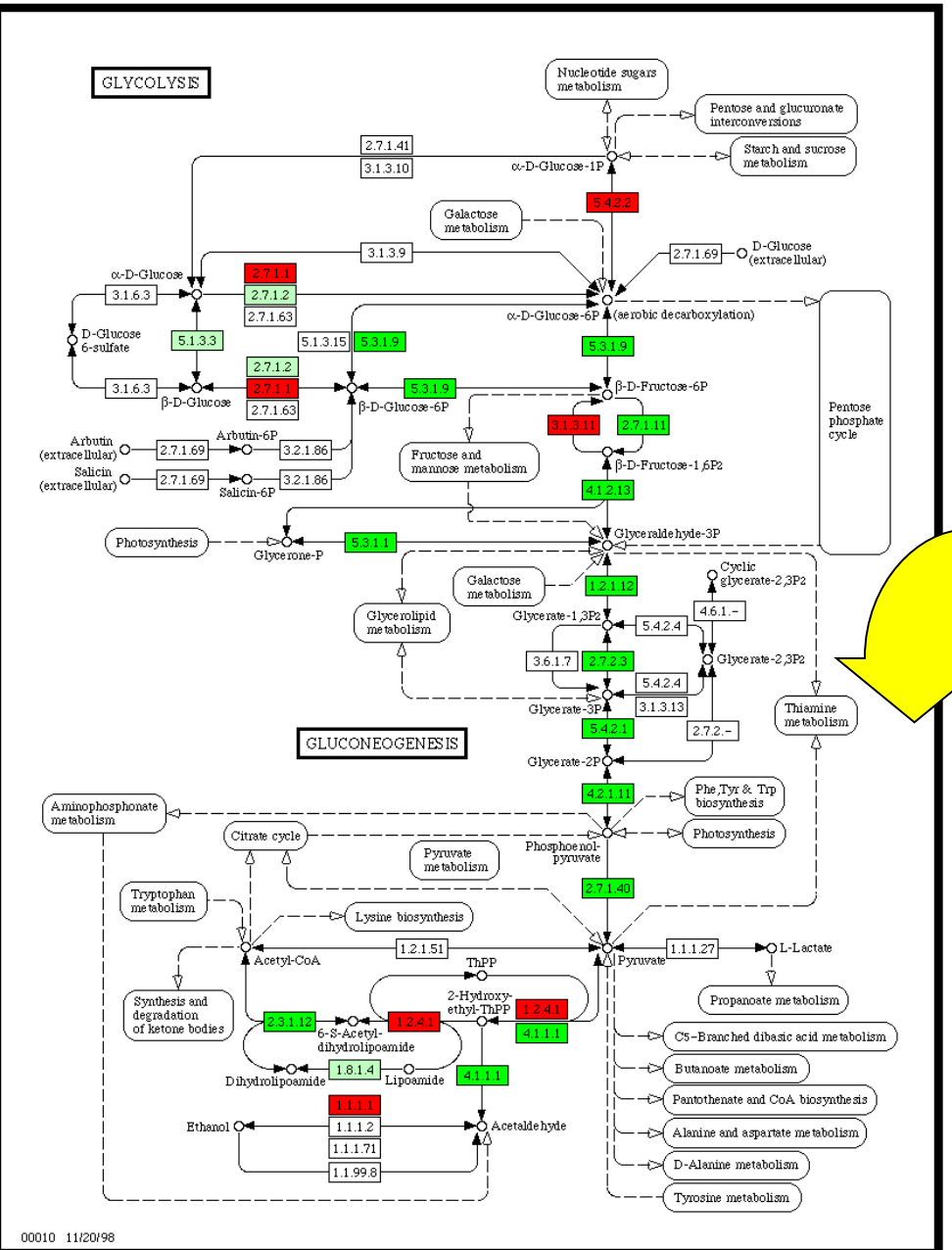
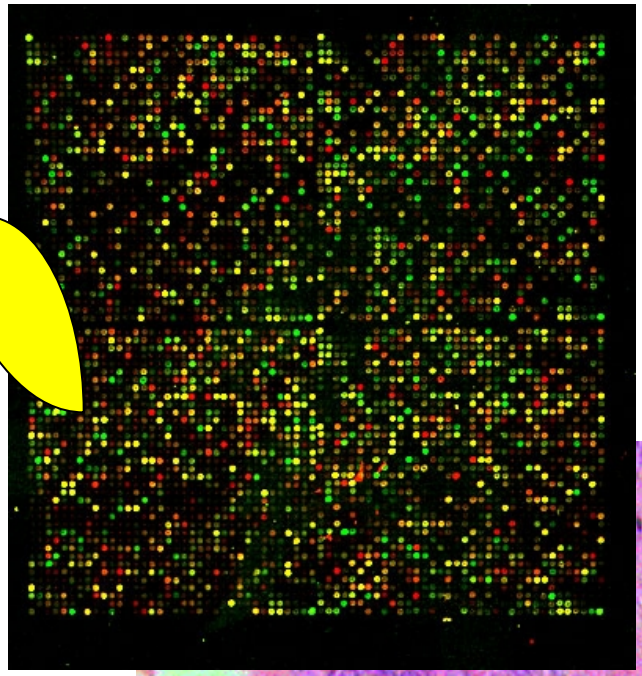
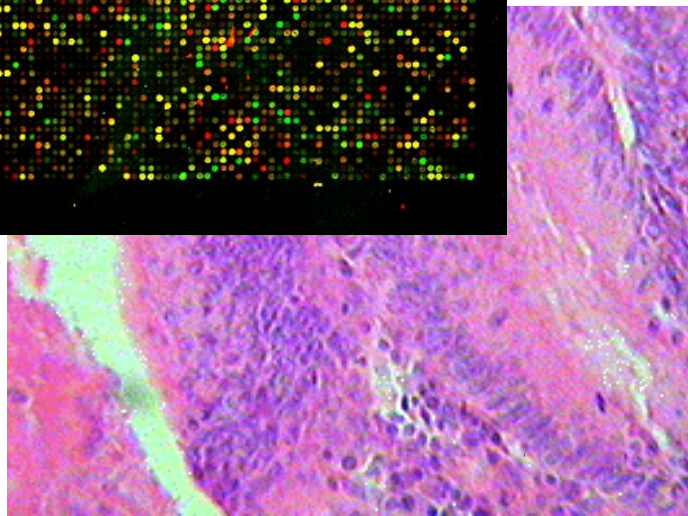
Understanding molecular processes

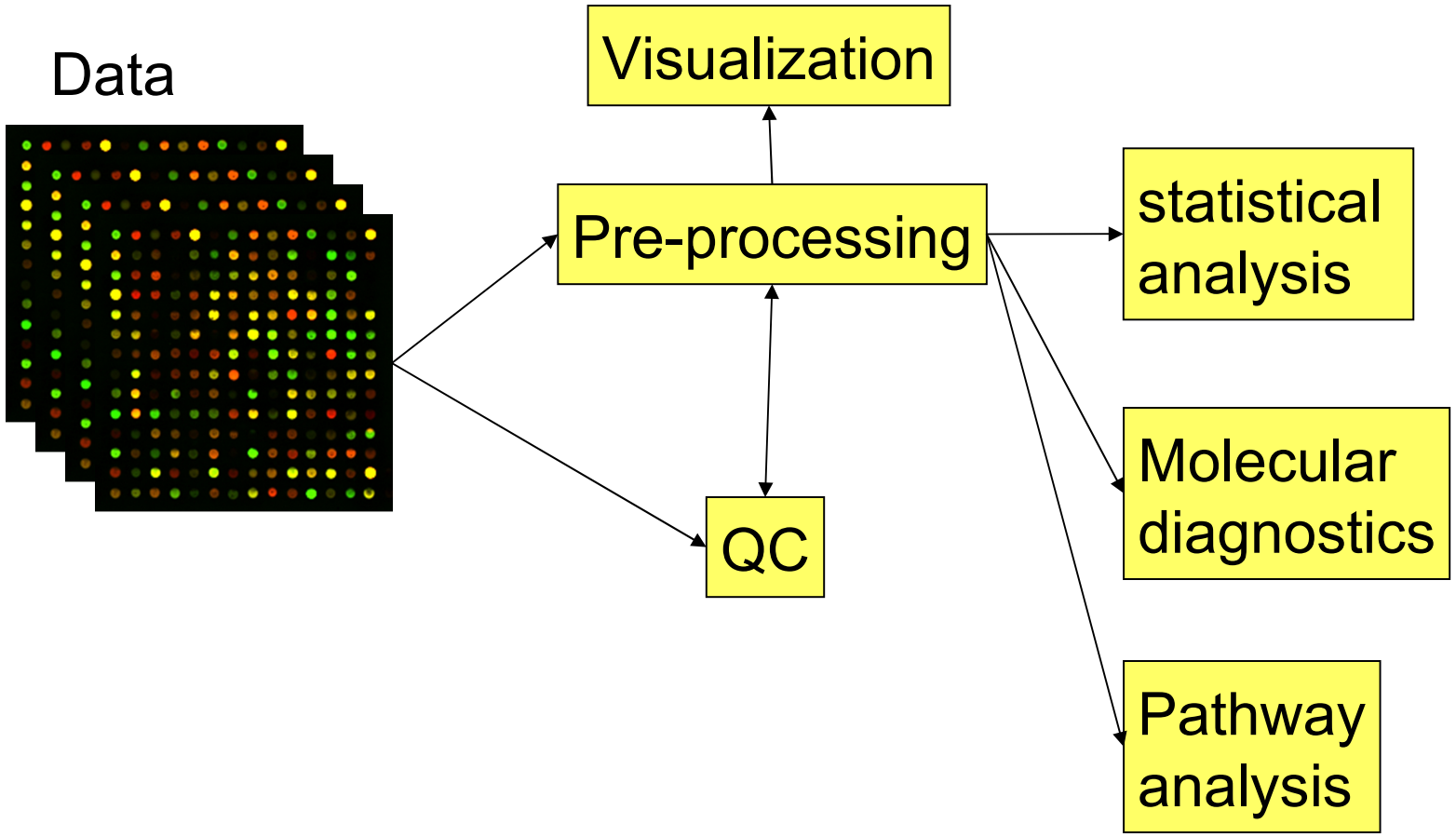


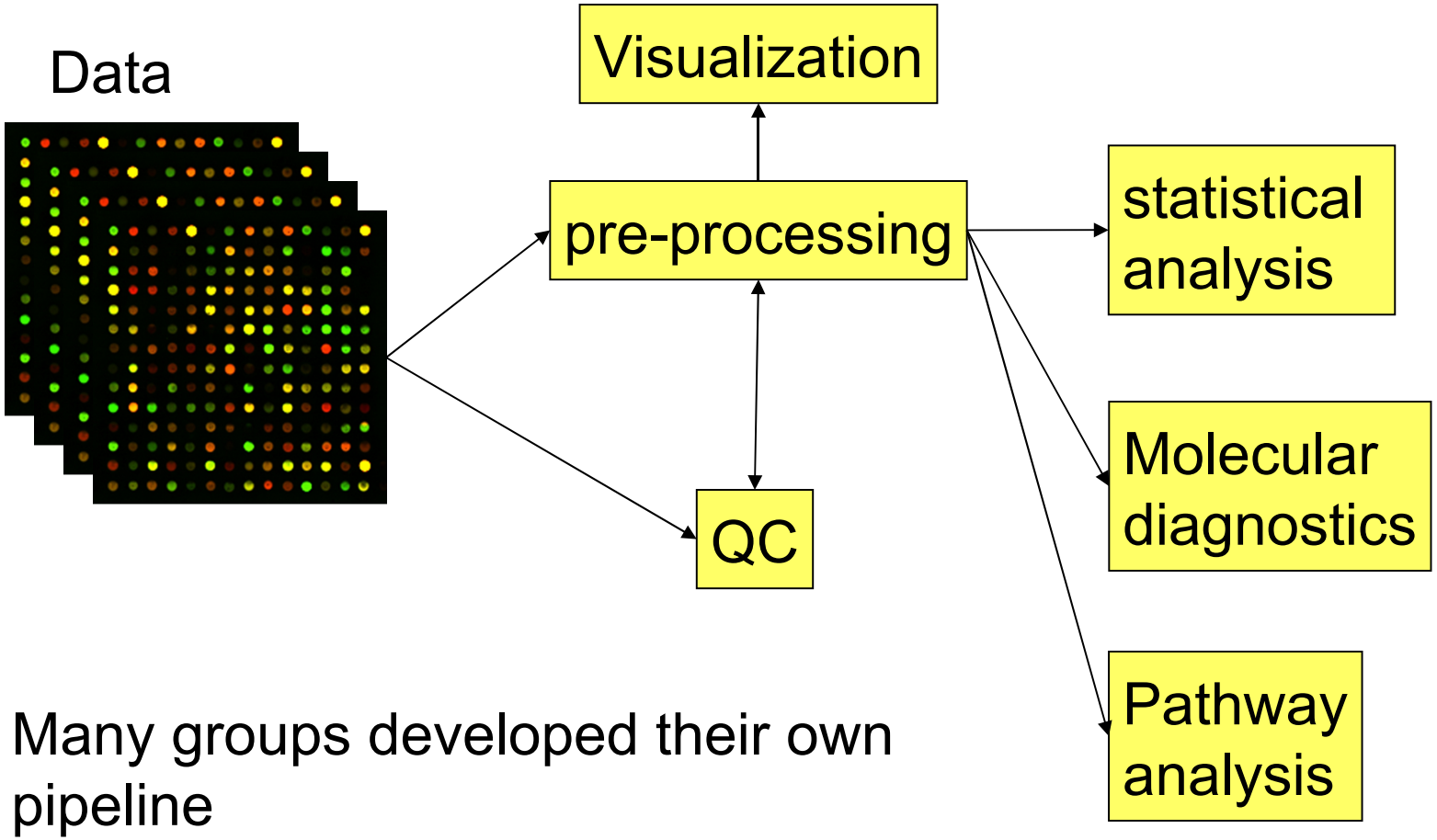
Integration with pathway databases (eg KEGG)





Microarray in-silico experimentation pipeline





- Many groups developed their own pipeline
- Large effort
- Development of modules may require specific expertise
- Difficult to use (state-of-the-art) methods of other groups

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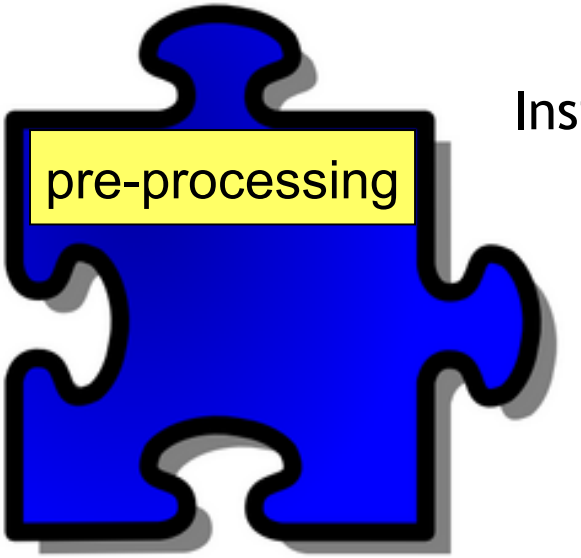
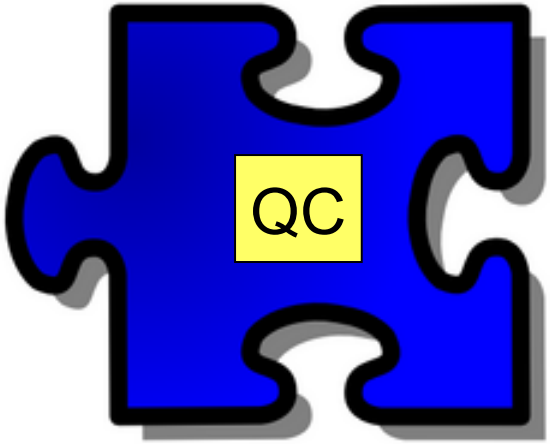
….but how to share tools, data, expertise?
….how to jointly solve problems?



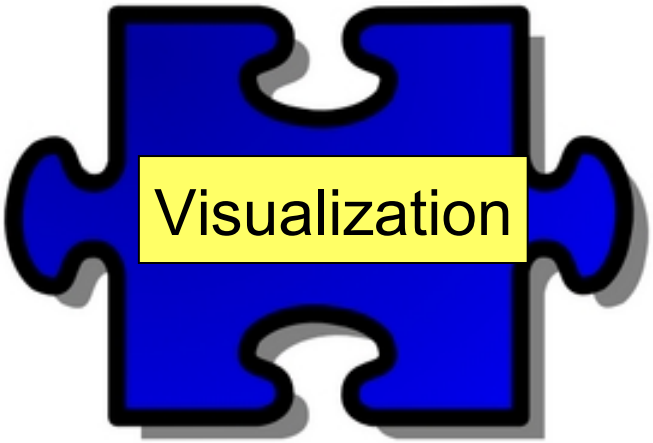
Institute 2



Institute 1

?

Institute 3



….e-Bioscience

Collaborate to develop experimentation pipeline

Service oriented architecture

Share environment with *de facto* standards; use common approaches

Generic e-Science infrastructure (VLe)

Life sciences GRID (NCF pilot, BIG GRID)

Basic infrastructure (SURFnet, Gigaport)

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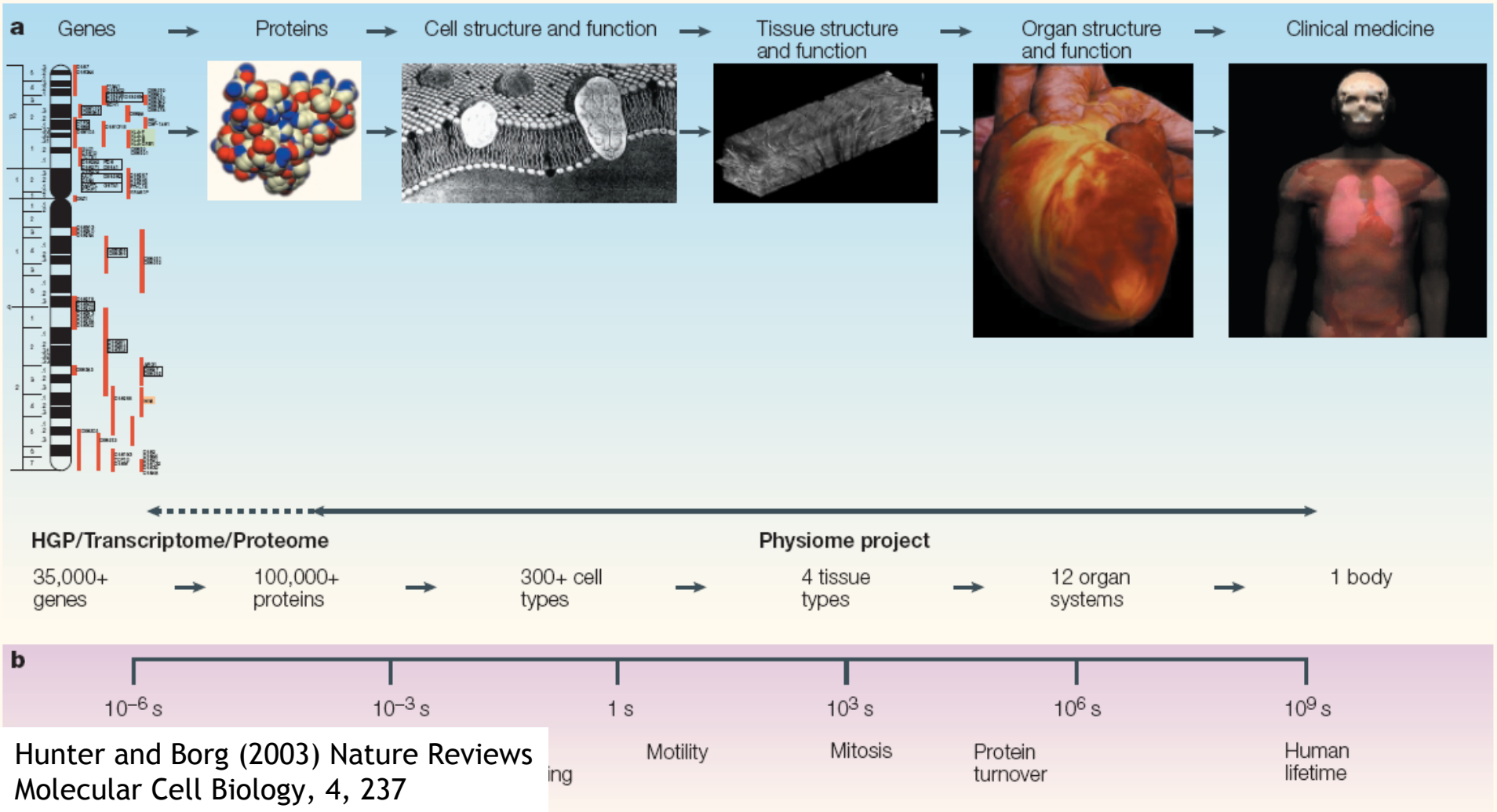
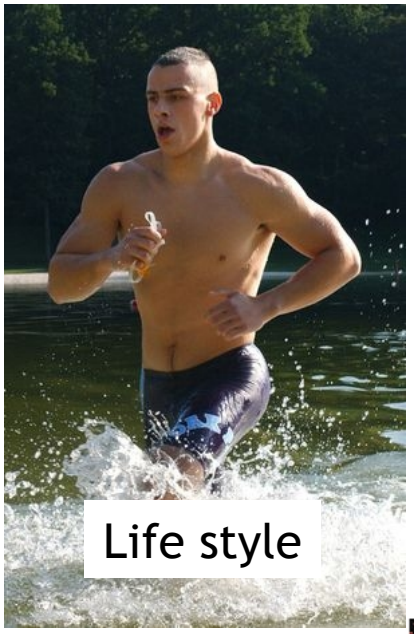
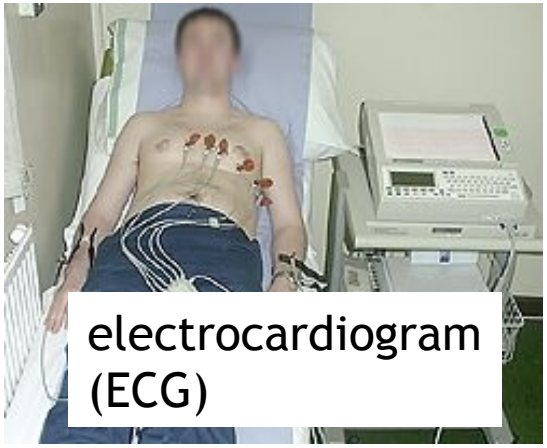
Moreover, science is becoming increasingly complex and multi-disciplinary

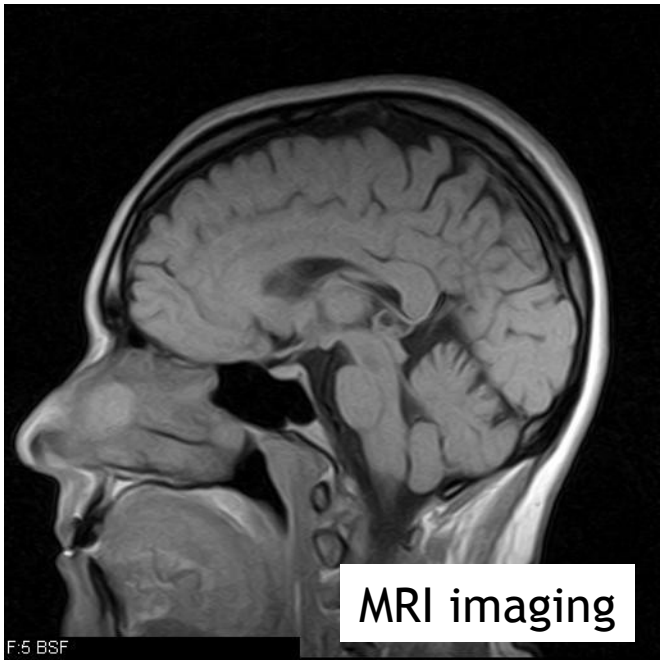


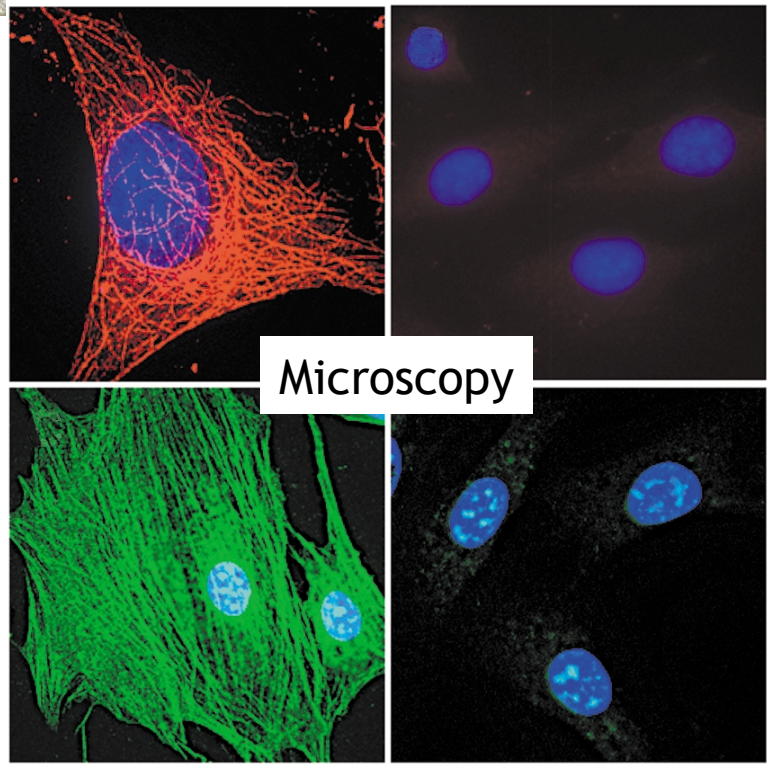
Hunter and Borg (2003) Nature Reviews Molecular Cell Biology, 4, 237


Clinical chemistry

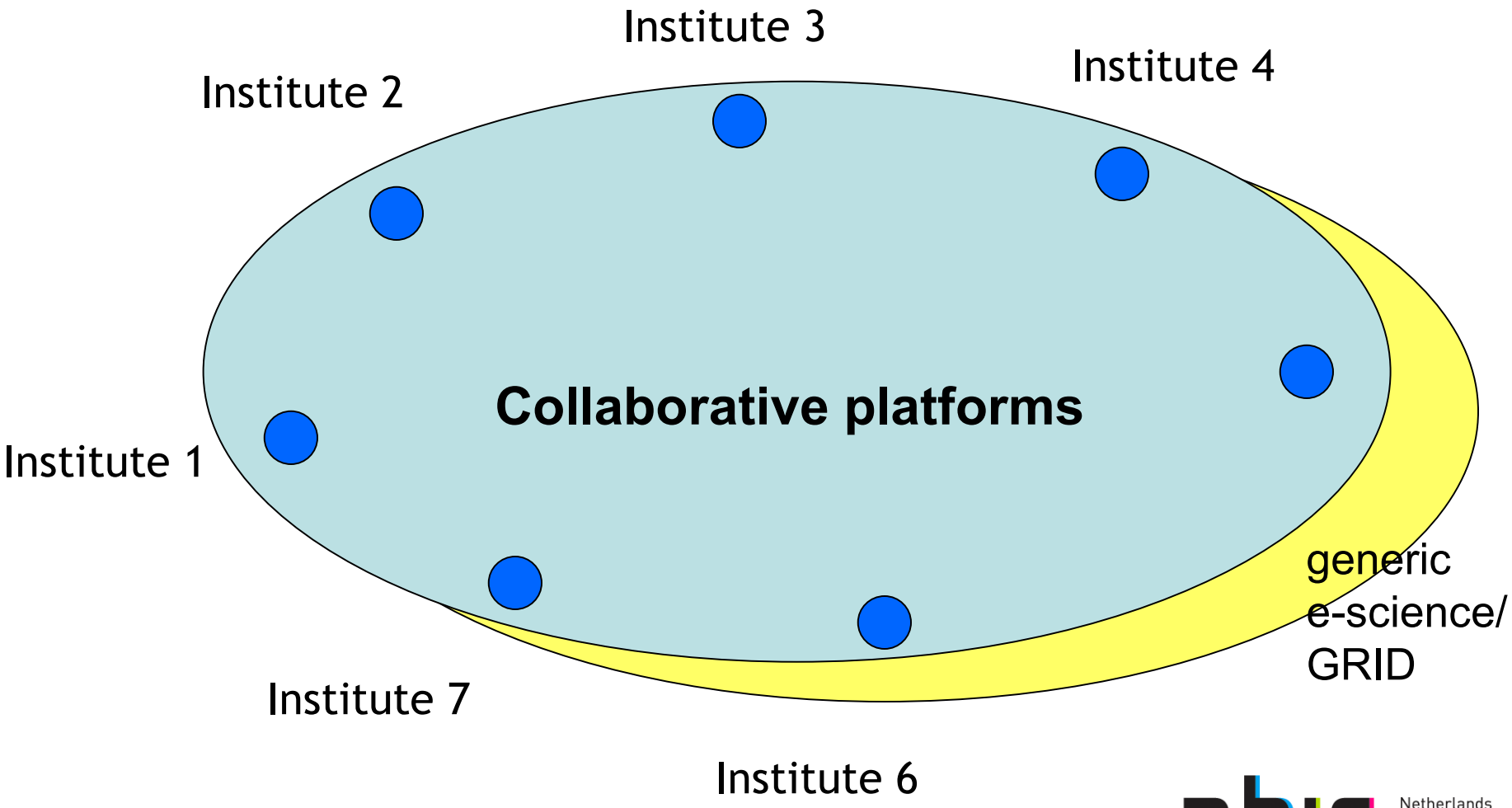

Life style


electrocardiogram
(ECG)


MRI imaging
F:5 BSF


Microscopy

Collaborative platform to address research questions



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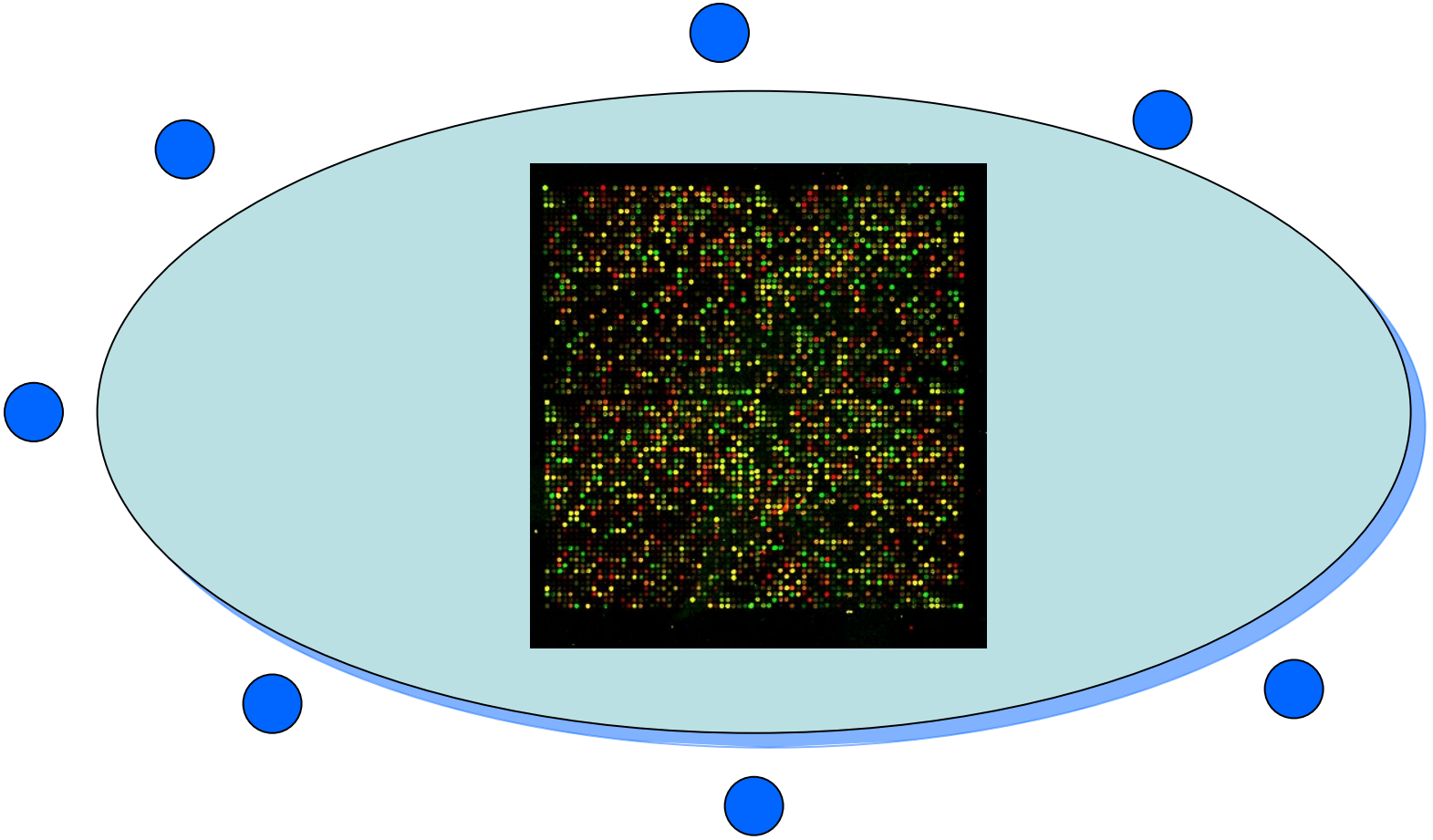
Collaborative platform for microarray research



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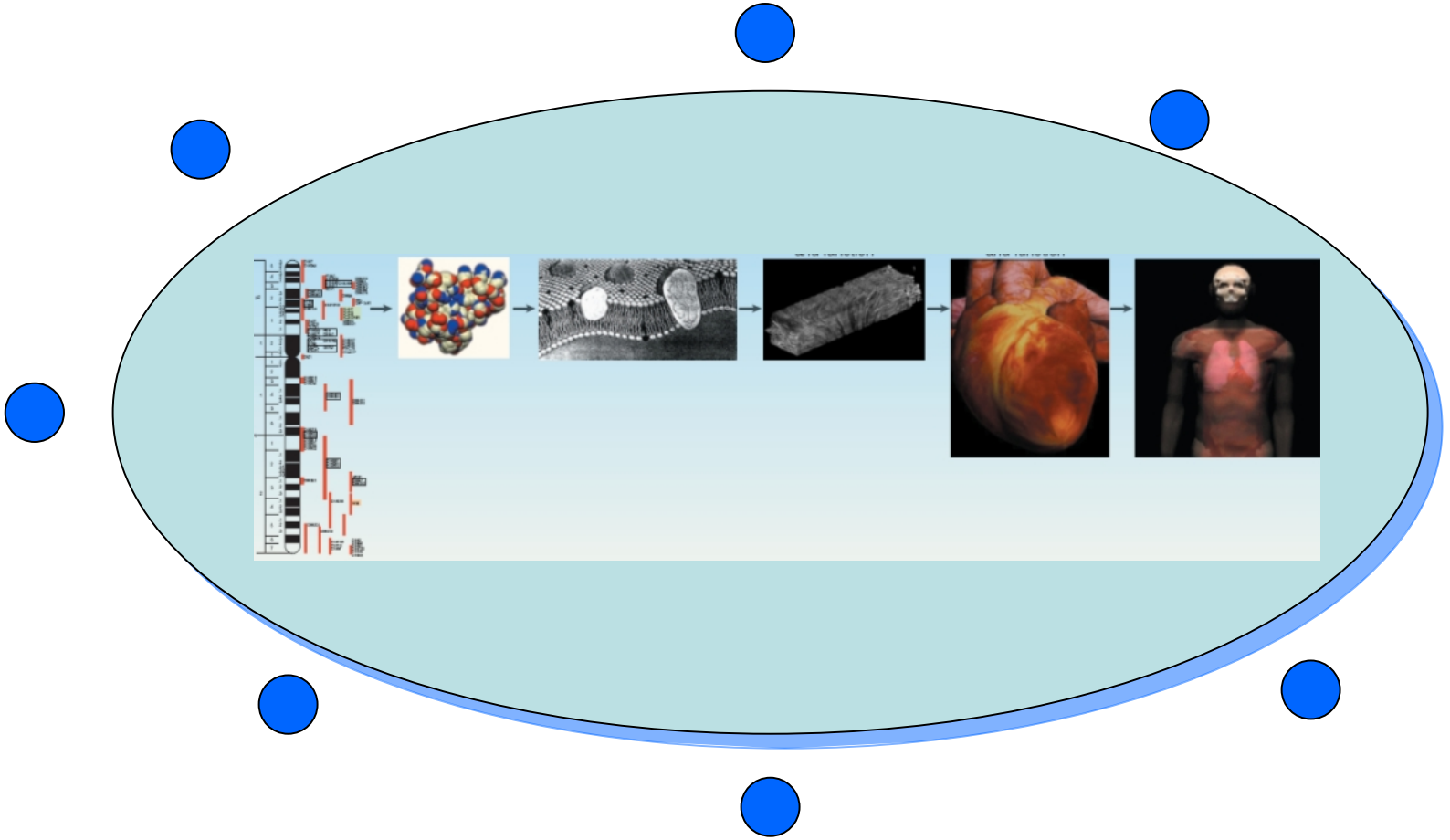
Collaborative platform for systems biology

Truly multi-disciplinary!



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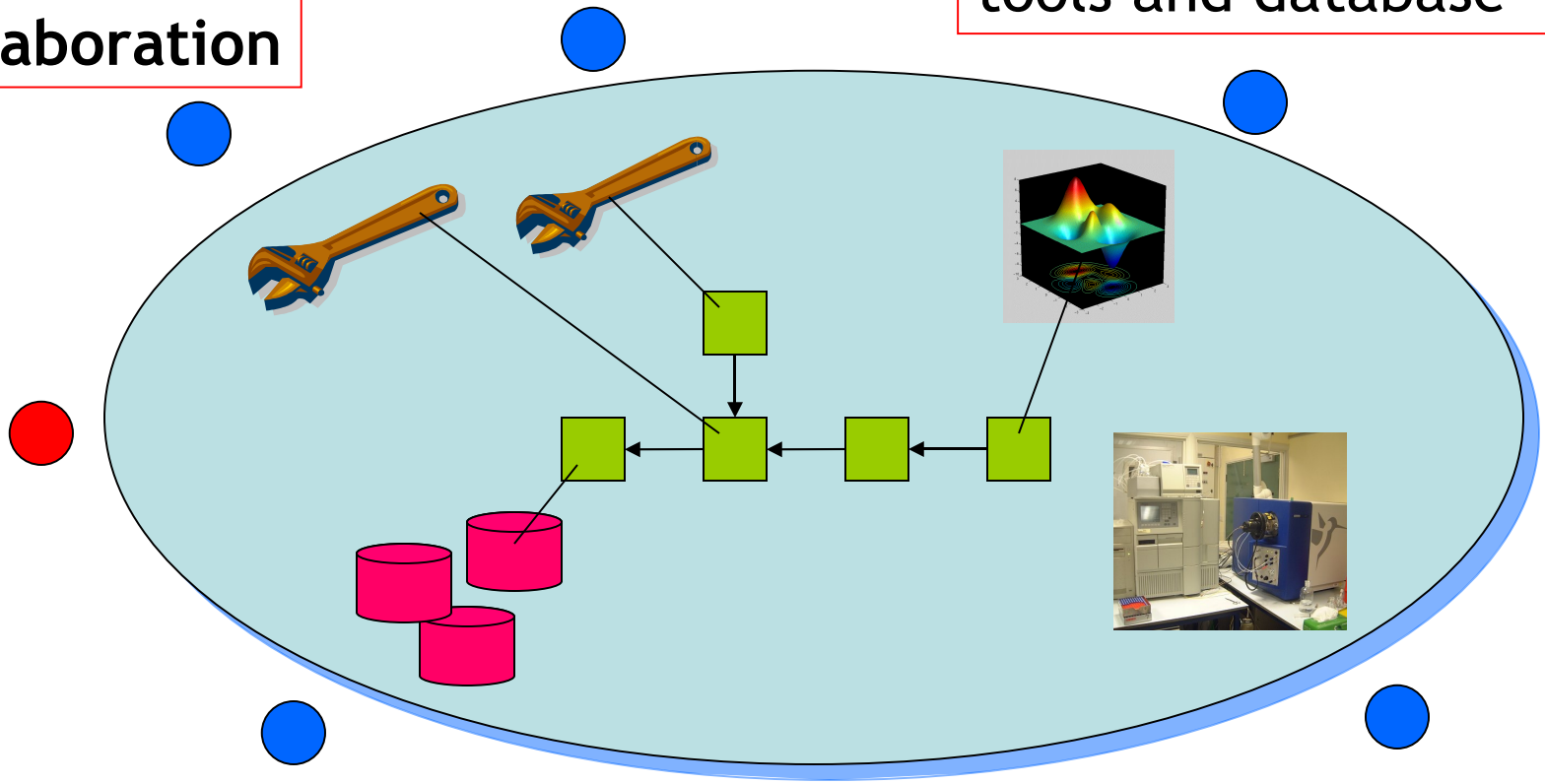
e-Bioscience

Exchange of data & tools & expertise

Define standardized workflows that connects tools and database

Collaboration



Accelerate research, avoid redundancy, reduce costs

Users

Solve the big scientific questions

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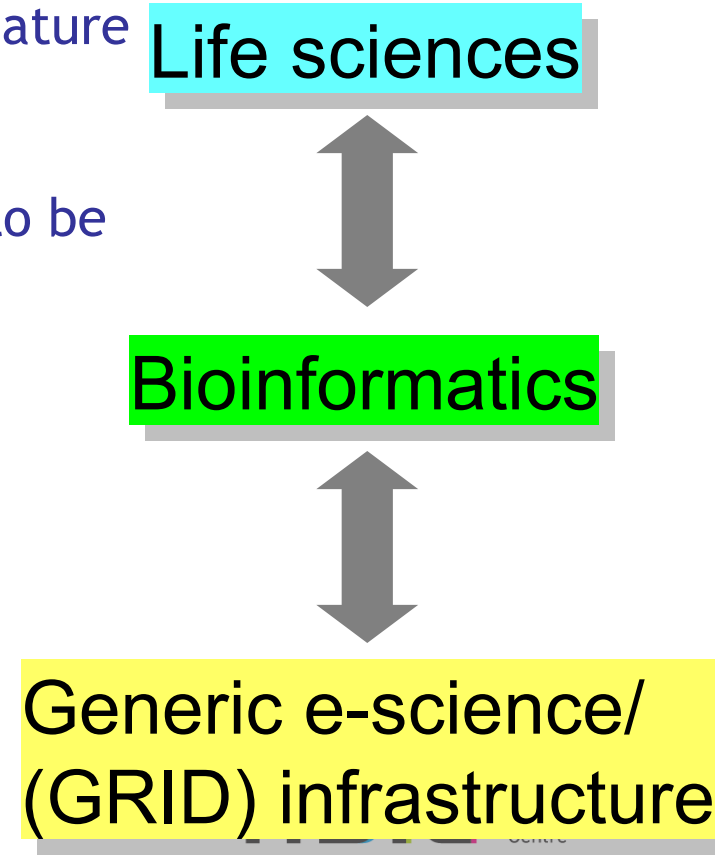
The e-Bioscience challenge

E-(bio)science/GRID are not production systems, instead

- developments/research on e-(bio)science and GRID is ongoing.
- Experience from current and future cases will mature this approach
- Collaborative platforms require sufficient time to be designed and implemented
- Requires specific expertise
- Investments (hardware, software, personnel)
- **Willingness to collaborate**



Acknowledgements

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- Prof. dr. L.O. Hertzberger
- Dr. T. Breit

SARA Computing and Network Services

- Dr. M. Bouwhuis

Virtual Laboratory for e-Science (VLe; www.vl-e.nl)

BIG GRID (www.nikhef.nl/grid/BIG)

NBIC (www.nbic.nl)

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