‘Analyses in Biology’: an analytical alternative to traditional laboratory or field research projects

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Traditional style projects

- laboratory or field
- 8 weeks
- 10-15 hours / week
- usually Spring semester
- assessed by conduct, report and talk

"The aim is to provide an introduction to biological research, the formulation of hypotheses, and appreciation of the processes involved in designing and carrying out experiments and determining outcomes"

Pressures

- Students' perspectives
  - do not want a practical based project
  - know that hands-on research is not for them
- Supervisors' perspectives
  - growing numbers of students
  - limited space, time, day to day supervision
  - cost

Analyses in Biology

- An analytical alternative
- 8 weeks
- 10-15 hours / week
- usually Spring semester
- assessed by conduct, report and talk

"The aim is to provide an introduction to biological analysis; the formulation of hypotheses, and appreciation of the processes involved in undertaking rigorous analysis of existing data and determining outcomes"

- By the end of the Analyses in Biology project students should have:
  - developed an understanding of the nature of scientific research and analysis
  - developed key skills, including an appreciation of experimental design and hypothesis testing, written and oral communication and the use of specialised analytical methods
  - developed the ability to acquire, analyse and assess data and to critically test theories and concepts

Analyses in Biology

- is not an easy alternative
- nor is it an opt out from research
- is not just a literature review

- it is a rigorous analysis of existing data
- students still own the research and produce novel findings

- both styles of project must be regarded as equally robust and scientifically equivalent
- assessments must be similar
- must be transparent about objectives of both types of projects

Example 1:

"Characterisation of cysteine proteases at the tomato *Rcr3* locus and investigation of structural differences between the $Rcr3^{pim}$ and $Rcr3^{esc}$ proteins"

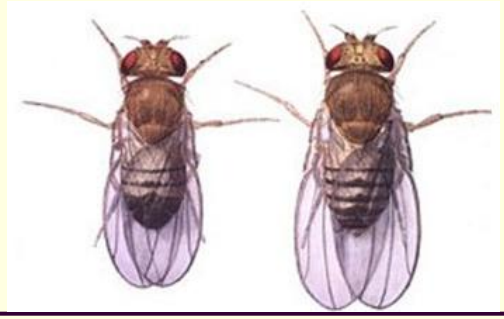
BLAST analysis to find proteins with homology to Rcr3

Expressed sequence tag alignments

CLUSTALW analysis - to compare proteins

Modelling analysis of the identified proteins (Swiss, CPH, Jigsaw, Geno3D modelling)

Example 2:



"Novel odorant receptors and odorant binding proteins, their arrangement and phylogeny in the reproductive tissues of *Drosophila melanogaster*"

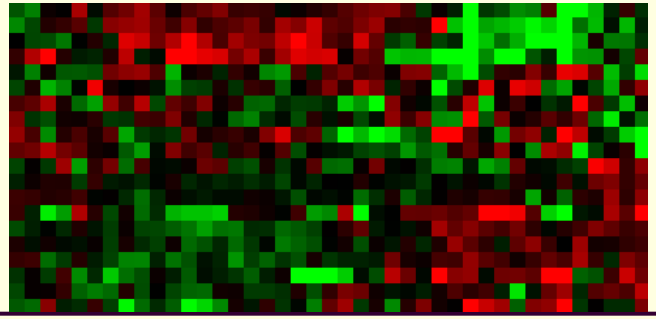
FlyAtlas and FlyBase databases to identify proteins in various tissues

BioGRID database used to identify associated genes

BLAST and cluster analysis

Phylogeny analysis

Example 3:



"Smoking and alcohol do not up or down regulate protease expression in head and neck squamous cell carcinoma"

Real time PCR data was provided by PhD student

(alternative - microarray data)

Statistical analysis of the data sets

Hierarchical clustering

Comparison to data within Oncomine database

In our experience:

- both weak and strong students opt to take this module
- strong students can really excel – demonstrate independence, initiative and critical thinking
- weak students may try to use this style of project to ‘hide’ – put in little effort

Advantages and disadvantages

- relatively cheap (no consumables – although there may be software costs)
- less time consuming
- less disruptive for research group
- no experimental errors or technical difficulties
- long waited for analysis can be achieved

- colleagues and students can be sceptical as to the appropriateness and nature of the projects
- seen to be less important?
- an (apparent) lack of ideas or data to be analysed

Does it work?

- 4 years experience of the two styles
- 6.2% (~30) students have opted for this module
- achieves same ‘score’ in evaluation as the traditional project module
- student feedback:
  - “I really did enjoy my project, it was brilliant. I got to delve in to the subject”
  - “I enjoyed the project and liked the nature of the analysis”
  - “felt as if you were up and running right from the start rather than the slower learning curve of a lab-based project”

Ongoing issues

- still a reluctance by colleagues to offer these sorts of projects and by students to take up these offers
  - due to a lack of understanding of this style of project?
- still a pressure on lab space, time etc
  - student numbers
  - low uptake of these projects

And now…

- Traditional laboratory and field based projects
- Analyses in Biology projects
- Scientific Research Skills

  adapted from a 2nd year module

  http://www.bioscience.heacademy.ac.uk/ftp/TeachingGuides/studentresearch/yeoman.pdf