A multidisciplinary approach

- does it encourage engagement with all the sciences?

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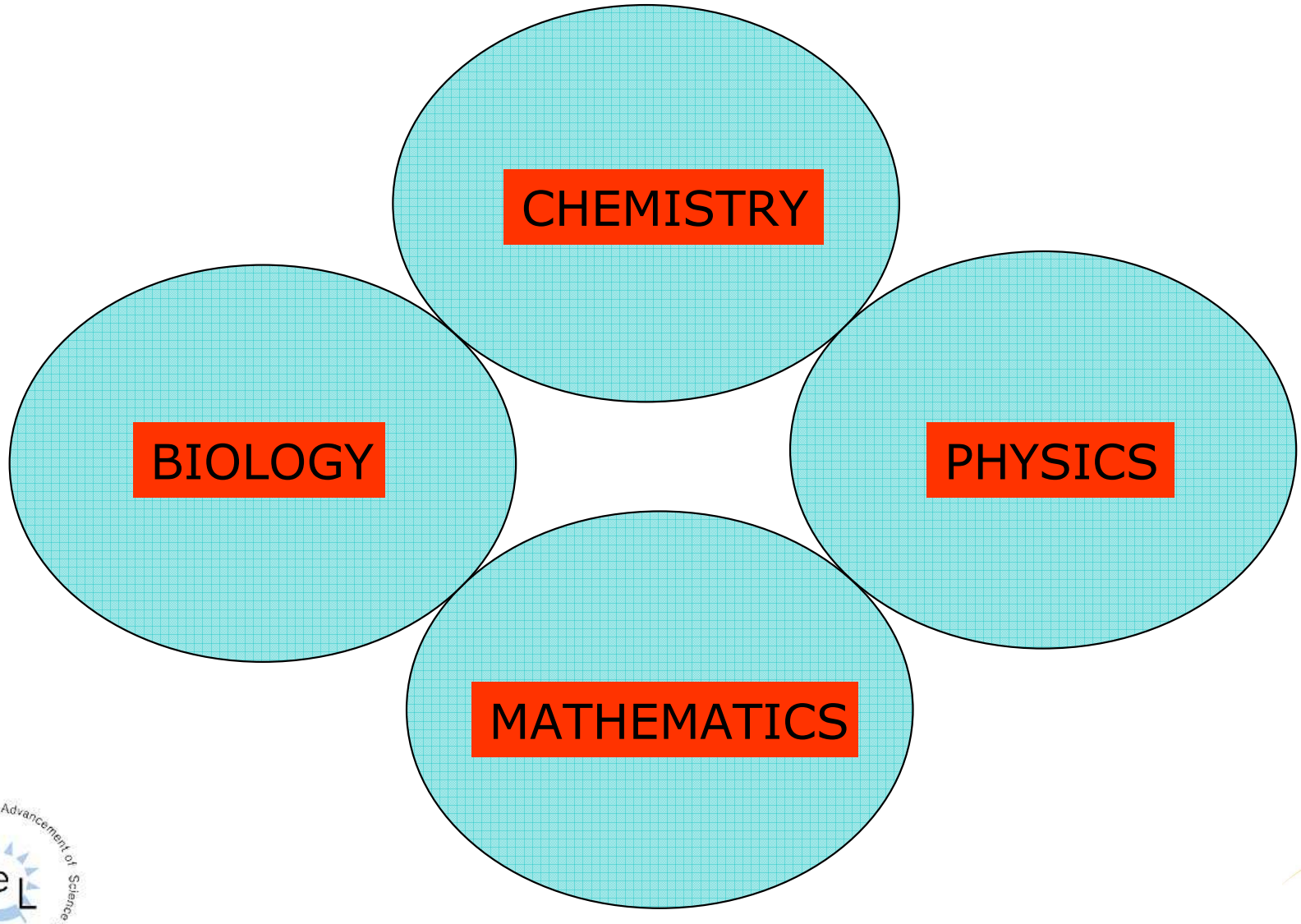
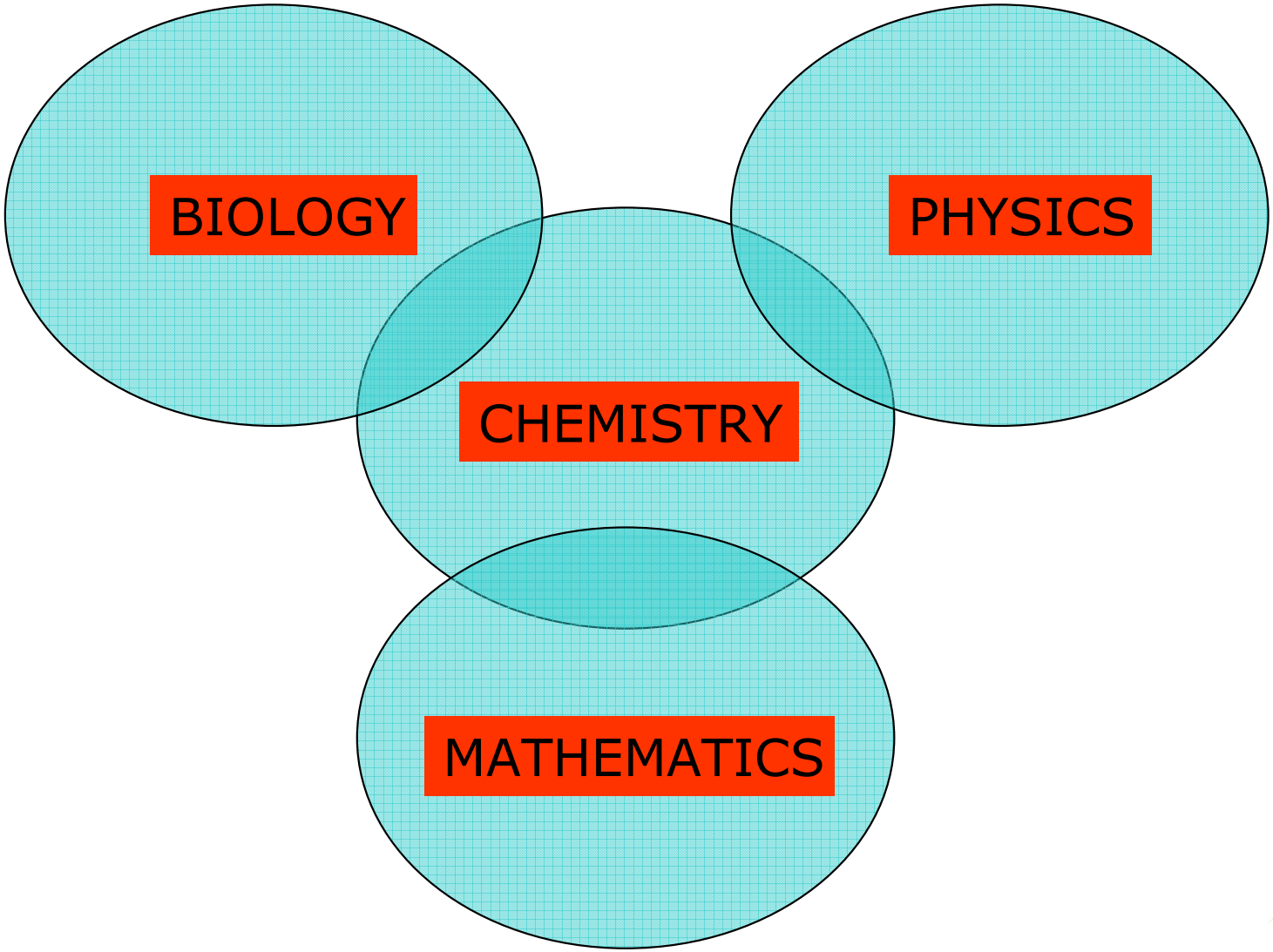
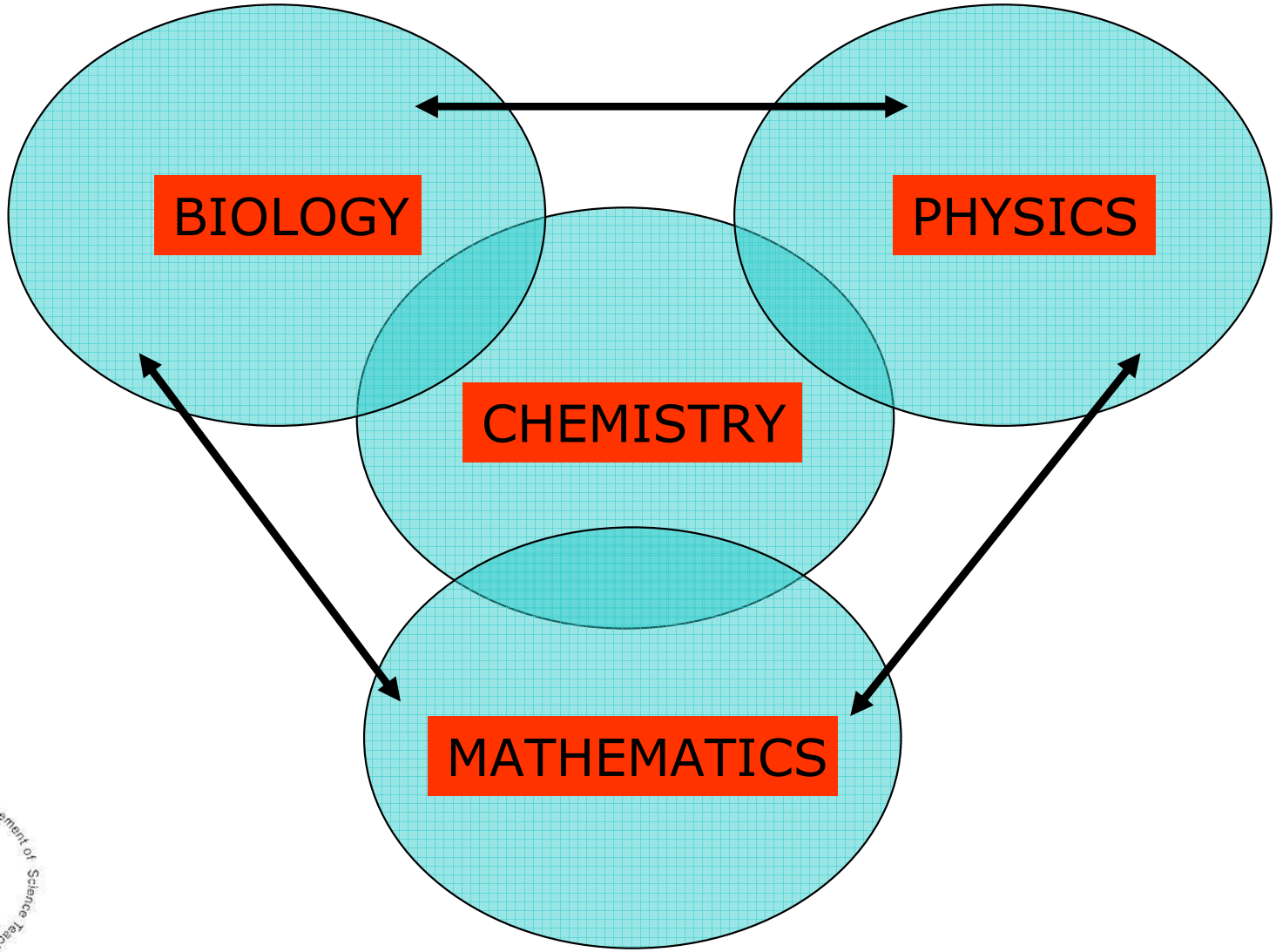
Typical 1st year undergraduate programme in science



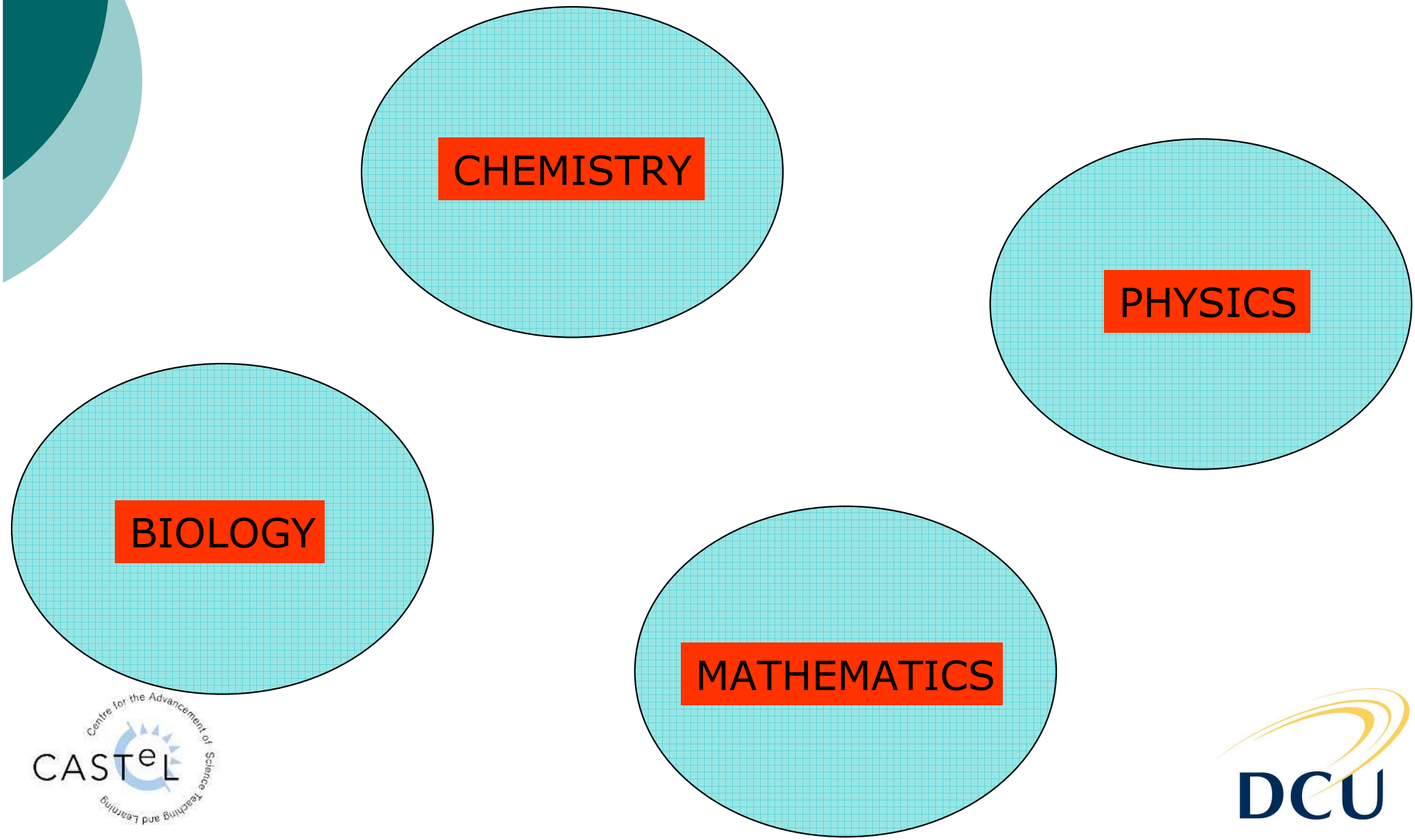
1st year undergraduate programme in science



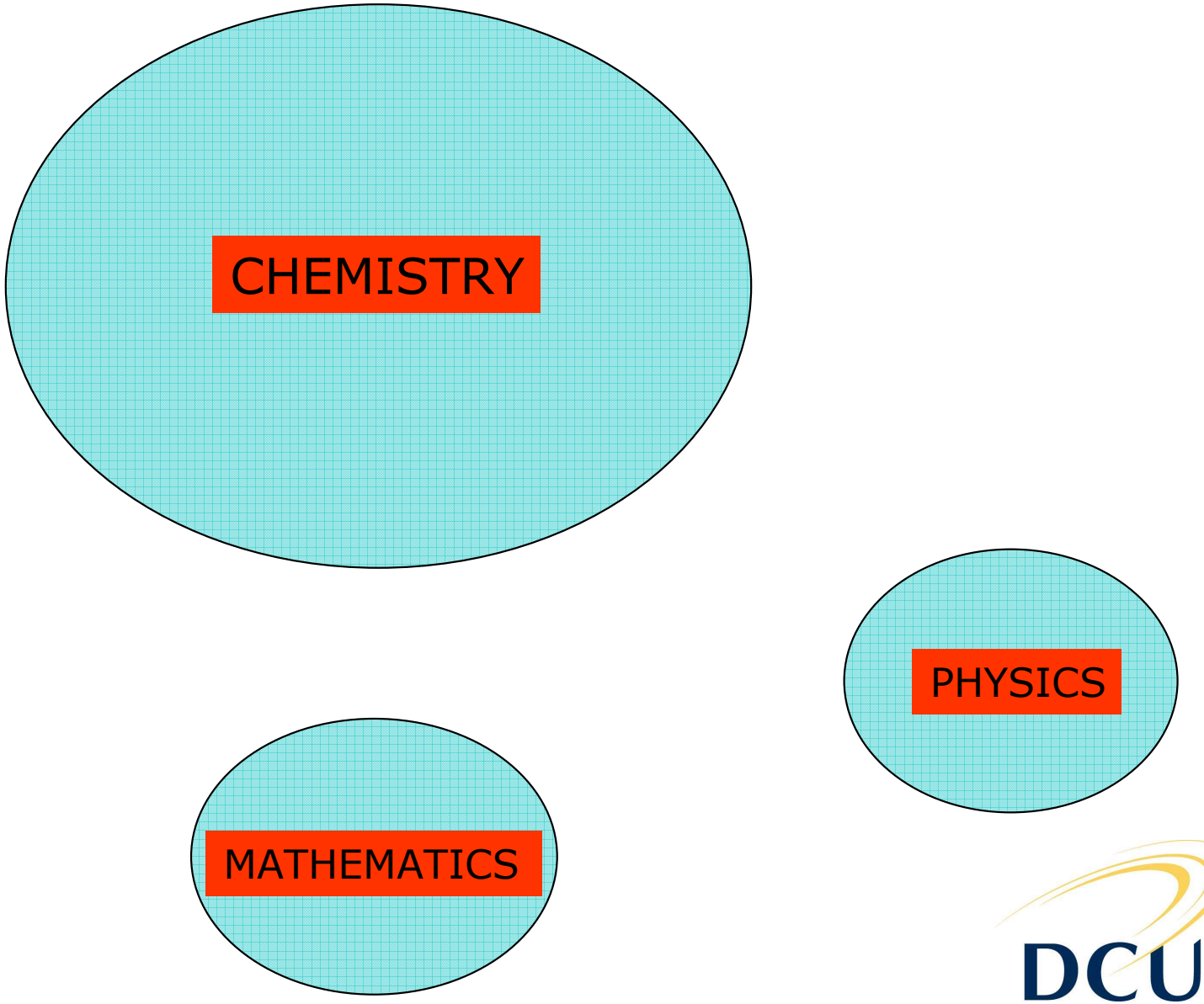
1st year undergraduate programme in science



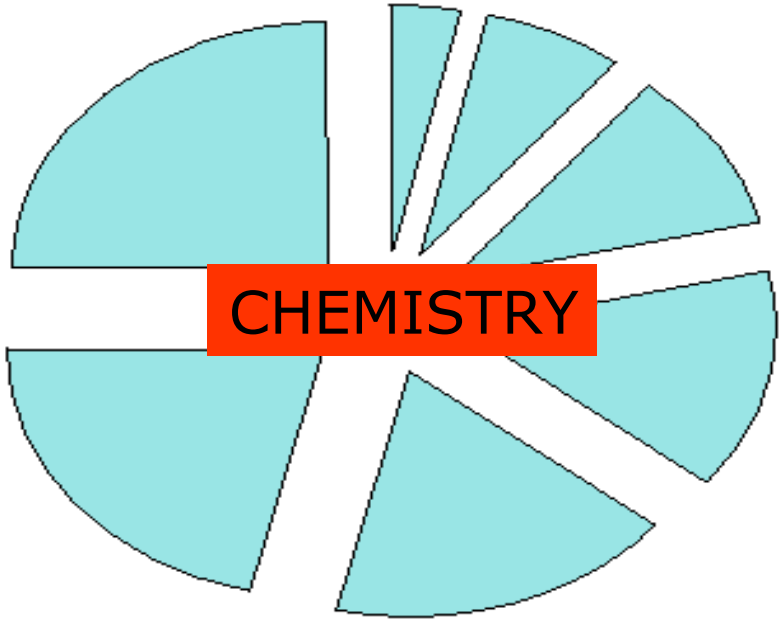
But …from the students perspective…



From the students perspective… this is even…..



Or from the students perspective… even…..



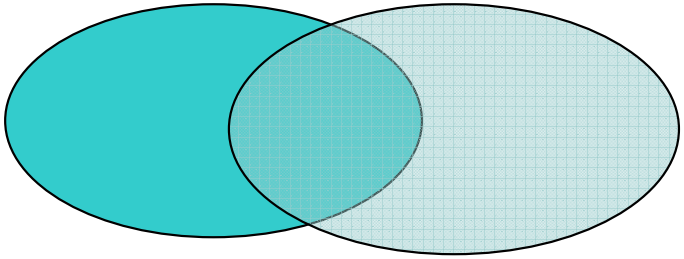
BIOLOGY

PHYSICS

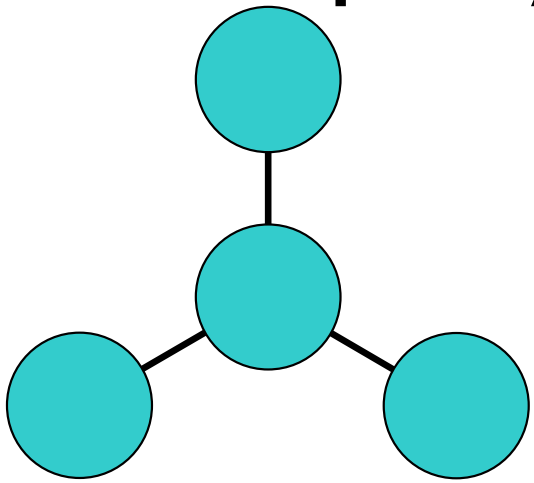
MATHEMATICS

But much of science is…..

- **Interdisciplinary**



- **Multidisciplinary**



So how can we get students to engage in 'science'?

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What we have tried….

- Developed a series of problems
  - based on their first year science modules;
  - included aspects of physics, chemistry and biology;
  - ‘open’ and ‘closed’;
  - relevant / interesting to students.
- Broad scope for assessment.
- Opportunity to introduce other topics.

Problems – all group work

Problem Title	Scope	Content	Output
Morning in the life	Explanation of everyday applications of chemistry, physics, biology.	open	Poster / Critique
Nuclear Energy	Process; reading of scientific articles; extracting arguments	Given number of reference papers	Letter to Minister
Shrinking Man	Cell structure and function, Immune response system, DNA, Electronic configuration, Reduction /enlargement.	Series of questions to solve	Scientific report
Genetic Screening	Genetic screening. Ethics arguments.	Representative of particular lobby group	Debate
Home Brewing	Thermodynamics, Energy calculations, Organic synthesis of ethanol. Sterilization techniques.	Process and data re-scale	Report - profit

Requirements of problems – e.g. Home brewing

- The chemical synthesis of alcohol
- Workflow of the brewing process
- Asepsis /sterilization techniques
- Energy and Thermodynamic Calculations:
  - Energy of heating and cooling
  - (involved volume, surface area, weight)
  - Energy Costs
- Profit Determination
  - Cost of Equipment
  - Cost of all ingredients
  - Optimise profit

Implementation (180 students)

- Semester Two of First Year
- 3 sessions
- Group size 4/5 students
- Biology, chemistry and physics tutors
- 3 academics
- Week 1 – introduction to group work
- Group mark – based on submitted work

Cohort 1 3hr session

- Student prior knowledge:
  - Biology: 81%, Chemistry: 63%, Physics: 25%
- 'Closed' → 'more open'
- Issues:
  - Time for group to meet
  - Possibility for ambiguity in the more open-ended questions
  - Feedback – more detailed
  - Mechanism to show involvement by every member of the group

Cohort 2 1hr +2hr session

- Student prior knowledge:
  - Biology: 83%, Chemistry: 52%, Physics: 19%

- 1hr → feedback and introduce next problem
- All 180 students spread over 3 rooms
- General feedback within 24 hrs
- Individual 'paragraph' – noting their own involvement in the problem solving
- Introduced new problems
- 'Open' → 'Closed'

Student Feedback - Focus Groups

- Group Organisation/Functioning
  - Groups of 4/5 randomly formed. No fixed roles.
  - Some groups had individual problems
- Problem approach
  - more challenging than a traditional lecture format , self-directed learning, increased attendance
- Individual Contribution
  - group approach was preferable to individual assignments
- Types of Problems
  - closed questions versus open-ended
- Learning
  - agreement that they learned more than they would in a traditional lecture format.

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Evaluation – I

Statement **(agree strongly = 1, disagree strongly = 5)**	**Year 1 (mean)**	**Year 2 (mean)**
I learn a lot of science working in my group	2.2	2.7
I make a large input into the work of my group	1.8	1.8
My group functions very well - everyone contributes and the work is shared evenly. Everyone makes a valuable input.	1.8	2.2
I like working in my group	1.6	2.1
The number of people in my group is just right for tackling the problems set	1.6	2.2
I would prefer to work on my own to solve the problems	3.9	3.6

Evaluation - II

Statement **(agree strongly 1, disagree strongly 5)**	**Year 1 (mean)**	**Year 2 (mean)**
I find the problems interesting and challenging	2.3	2.8
I like the mix of physics, chemistry and biology in the problems	2.1	2.6
I have the necessary Physics background required to solve the problems	3.2	3.5
I have the necessary Biology background required to solve the problems	2.1	2.2
I have the necessary Chemistry background required to solve the problems	2.5	2.9
I feel that I am learning a lot by doing the problems	2.2	2.7
Overall I found the problems challenging but doable	2.1	2.5

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Opinions on Individual Problems

Problem Title	Type	I liked the problem (% Agree)		I learned from this problem (% Agree)	
		Year 1	Year 2	Year 1	Year 2
Introductory Problem	-	79	63	57	44
Science in the News	Open		40		57
Morning in the life	Open		69		66
Nuclear Energy	Open	72 (1)	70	87	80
Water Contamination	Open	82 (4)	61	89	74
Shrinking Man	Closed	66 (3)	49	75	60
Genetic Screening	Open		73		78
Moon Hoax	Open		84		83
Home Brewing	Closed		50		65
Industrial Oil Spill	Closed	74 (2)	43	84	54

Conclusions

Constraints

- Balance and order of open versus closed problems
- Designing good problems
- Time issues
- Room availability

Outcomes

- Assessment Performance > than in other subjects
- Science knowledge? - difficult to determine
- Social skills - group work
- Communication skills
- Attendance and individual participation
- Breadth of topics

Acknowledgements

Group of problem developers –
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