

Linking Teaching and Research

Linking teaching and research can take many different forms within the biosciences. Students may learn about research findings, learn about research processes and learn as researchers. Finding ways to bring aspects of research and the processes of research into teaching can support students in developing a variety of skills, both specific to the biosciences and generic. It can also benefit departments and faculties, helping to support a research profile, generating ideas for future research and potentially encouraging links with other departments in the institution, or external research groups.

This short guide considers the skills linking teaching and research could encourage students to develop, how teaching and research could be linked at different levels and gives some practical examples of how they could be linked.

Top tips

- Introduce students to the processes of research from the first year, by both showing them how research is undertaken and having them undertake their own research;
- Incorporate examples of the latest bioscience research in your teaching;
- Demonstrate that research is open-ended and generates further questions as well as answers;
- Use PBL and EBL to introduce students to some of the processes of research;
- Give students the opportunity to use real research data or problems from your own or your colleagues' research;
- Encourage students to read and discuss primary papers and reviews;
- Demonstrate how research can be communicated by using different types of assessment (e.g. poster, presentation, report or using web2.0);
- Encourage students at all levels to attend research seminars and symposia and consider having research seminars for students;
- If appropriate, encourage your students to publish, for example in undergraduate research journals, both institutional and national, such as Bioscience Horizons;
- Raise students' awareness of research being undertaken in your department or faculty; and
- Encourage students to think about the skills research can enable them to develop and how this could relate to their employability.



“[My bioscience degree] has also taught me to critically analyse the work of others (as well as my own) and not just simply believe everything I see in print” Ruth Brown, University of Sheffield

What skills could linking teaching and research develop?

Depending on how you decide to bring research into teaching you could develop your students’:

- Understanding of how data can be analysed and interpreted;
- Critical analysis skills and ability to interpret primary literature;
- Skills in reinterpreting existing knowledge;
- Ability to communicate in a variety of formats and to a variety of audiences;
- Group working and collaboration skills;
- Self and peer-assessment and feedback skills;
- Ability to search for and analyse information;
- Understanding of how knowledge is generated through research;
- Lab skills, both specific (e.g. population sampling and PCR) and generic (e.g. pipetting);
- Enquiry and problem solving skills;
- Ability to undertake self-directed learning;
- Ethical thinking and professional behaviour;
- Hypothesis generation and experimental design skills;
- Project management skills; and / or
- Knowledge of current developments in the biosciences.

From the start:

- Use PBL or EBL in the lab, field and classroom to encourage students to develop a sense of enquiry;
- Use real data to generate questions / enquiry. This could be data from your research or freely available data, e.g. from the Food and Agriculture Organisation (<http://faostat.fao.org/>) or Gapminder (www.gapminder.org/);
- Encourage debate about the ethics of key research as such as GM crops or stem cells;

- Demonstrate the importance of basic practical techniques, such as pipetting, by showing students the implications of inaccuracies;
- Have students undertake a short research project early on in their course;
- Introduce students to scientific papers and reports. Perhaps have tutorials or sessions where you work through a paper with a group of students; and
- Develop skills such as questioning and formulating hypotheses.

Following on:

- Consider open-ended practical sessions, and have students design protocols and choose appropriate controls;
- You could have students write a short research or grant proposal, which is then evaluated by a panel of their peers.
- Develop students’ critical thinking skills, get them to evaluate the methods and results presented in scientific papers; and
- You could bring together students from different levels or disciplines to collaborate on a short research project.

By the final year:

- Students should be generating hypotheses for, and be involved in designing, their final year project. They could be writing short research proposals for a final year project they would like to undertake.
- Encourage students to aim for publication, perhaps in an undergraduate research journal or at a conference;
- Have students showcase their final year project in a capstone or department research day. This could give opportunities for talks, posters and networking. Could external evaluation of student work be arranged, e.g. by colleagues from another institution, learned society or employer contacts?



“So when it came to my first practical session at university I had high expectations. I was looking forward to seeing some *real* science”
Katherine Staines, University of Edinburgh

Research is competitive - working as ‘internationally renowned research scientists’

To engender a sense of fun, competition and hence greater interest in a 4 week practical investigating the quaternary structure of haemoglobin, I started introducing the practical by telling the students that they were to imagine they are a team of research scientists working in an internationally renowned lab on the quaternary structure of a novel protein. They suspect other groups have found a similar protein and want to publish their results at a forthcoming international conference and get recognised as the group that came up with the definite structure.

Taken from a case study by Jean Assender, available from www.bioscience.heacademy.ac.uk/resources/ltr/linkteachresearchcasestudies.aspx

Encourage:

- Your colleagues to highlight aspects of their own research in their lectures, you might consider capturing lectures as videos or podcasts and promoting them online;
- Student ownership of their work by getting them to be proactive in e.g. practicals and assessments through designing practicals and generating hypotheses;
- Creativity and problem solving. Review the Centre’s Creativity Skills Short Guide (www.bioscience.heacademy.ac.uk/resources/shortguides.aspx) for hints and tips on developing students’ creativity skills;
- Awareness of bioscience developments and issues in the media and primary literature;
- Discussion with students from other levels and disciplines. Highlight how other disciplines provide solutions e.g. engineers can design and build specialist incubators for maintaining animal tissue; and
- Joining a relevant learned society, undertaking industrial placements and taking part in a summer school or summer vacation research placement or scheme.

Is there potential to:

- Host summer vacation research projects in your department or faculty? Funding could come from the department or an organisation such as the Wellcome Trust or Nuffield Foundation (see www.bioscience.heacademy.ac.uk/ftp/resources/difflearn/studentships.pdf for some potential funders);
- Work with local businesses to offer research opportunities? e.g. researching a new bioscience related product, service or business opportunity;
- Employ undergraduate students as part-time lab technicians during term time or full time over the holidays? This could give them a taster of the research environment and benefit researchers and projects; and
- Have presentations / seminars from past students who are now in research careers? Or current research postgraduates about how they have used the research skills they developed as an undergraduate?

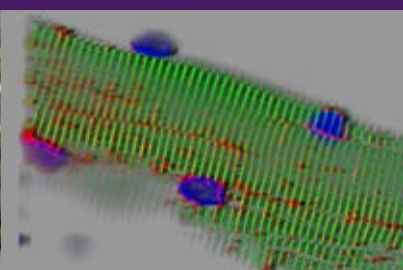
Introducing students to academic staff research

Level one students in Geography at UCL do an assignment in which they interview a member of academic staff about their research.

Each tutorial group is allocated a member of academic staff who is not their tutor. They are then given three representative pieces of writing by the member of staff along with a copy of their CV, and a date is arranged for the interview. Before the interview, students read these materials and develop an interview schedule.

On the basis of their reading and the interview, each student individually writes a 1,500 word report on: a) the objectives of the interviewee’s research; b) how that research relates to their earlier studies; and c) how the interviewee’s research relates to their teaching, other interests and geography as a whole.

From “Developing Undergraduate Research and Inquiry” by Mick Healey and Alan Jenkins.



Resources

The Centre has a range of **case studies and resources** focussed on linking teaching and research. www.bioscience.heacademy.ac.uk/resources/ltr/

Student Research Projects: Guidance on Practice in the Biosciences by Martin Luck considers the how and why of student research and contains a number of case studies illustrating a wide variety of student research. www.bioscience.heacademy.ac.uk/resources/guides/studentres.aspx

Linking Teaching and Research in the Biosciences. Review article with examples of how teaching staff have incorporated aspects of research into their teaching. www.bioscience.heacademy.ac.uk/journal/vol5/beej-5-4.aspx

Introducing undergraduate students to scientific reports. Describes a series of exercises undertaken with Level 1 students as training towards the reading and presentation of scientific papers at Level 3 and the writing up of student research projects. www.bioscience.heacademy.ac.uk/journal/vol1/beej-1-10.htm

Developing Undergraduate Research and Inquiry, by Mick Healey and Alan Jenkins. An extensive report, useful to dip into for ideas and short case studies on how others have implemented research-led or research informed teaching. www.heacademy.ac.uk/assets/York/documents/resources/publications/DevelopingUndergraduate_Final.pdf

Resources and publications from the Higher Education Academy on **Teaching and Research**. www.heacademy.ac.uk/ourwork/supportingresearch/teachingandresearch

One of the Scottish Enhancement Themes from 2006 - 2008 was **Research-Teaching Linkages**. www.enhancementthemes.ac.uk/themes/ResearchTeaching/

The **Teaching Research Nexus** website brings together resources and discipline specific examples of linking teaching and research. <http://trnexus.edu.au/>

CETL-AURS (Applied Undergraduate Research Skills) aimed to integrate research-based learning into the curriculum by developing undergraduate's research skills. Although the project has now finished, resources and outputs are available. www.reading.ac.uk/cetl-aurs/

The **Reinvention Centre for Undergraduate Research** (based at Oxford Brookes University and the University of Warwick) aimed to integrate research-based learning into the undergraduate curriculum. www2.warwick.ac.uk/fac/soc/sociology/rsw/undergrad/cetl/

For your students

National Undergraduate Research Journals

- Bioscience Horizons - <http://biohorizons.oxfordjournals.org/>
- Reinvention - www2.warwick.ac.uk/fac/cross_fac/iatl/ejournal

Institutional Undergraduate Research Journals and Repositories

- Biolog-e - www.biolog-e.leeds.ac.uk/
- BURN - www.nottingham.ac.uk/burn/
- Plymouth Student Scientist - www.theplymouthstudentscientist.org.uk

Undergraduate Research Conferences

- British Conference of Undergraduate Research - www.bcur.org/
- Student Conference on Conservation Science - www.sccs-cam.org/

Engage in research, information and guidance for students on undertaking research in the biosciences; from considering a research question to data analysis and producing a report. www.engageinresearch.ac.uk/

