

## Creativity Skills

Prospective employers, government agencies and academic PhD supervisors have indicated repeatedly they want graduates who can solve problems creatively in laboratory, field and other settings. Bioscience undergraduates and postgraduates are expected to absorb an enormous amount of information from a rapidly expanding knowledge base. Further, when asked to solve problems, science students are usually expected to find the single correct answer to a precisely defined question. As a result there is often very little time left for the development of creative approaches to open-ended problem solving that may involve the generation of a range of alternative solutions. This short guide focuses on techniques and strategies designed to promote creative problem solving skills in bioscientists.

### Top tips to promote creativity:

- encourage *curiosity* – emphasise that major advances in the biosciences often occur because researchers are curious about unusual and unexpected results
- encourage *interdisciplinary collaboration*, both formally (in scheduled sessions) and informally (encouraging students to discuss their ideas with friends in other disciplines)
- ensure students realise the information you impart is not necessarily written on tablets of stone and it can be a good thing to *challenge assumptions*
- set *open-ended questions* that may have a diverse range of possible solutions
- introduce new topics e.g. exploration of the biosciences from an ethical standpoint should encourage *new perspectives*
- use ‘*real life*’ problems and scenarios
- give students the opportunity to produce work in *novel formats and settings*, ask them to submit something other than an essay or report e.g. a leaflet or poster, or encourage some form of role play
- identify *unexpected connections* between the apparently unrelated
- ask students to ‘*incubate*’ problems – give them the time to mull over ideas



## Creating the right environment

When promoting creative approaches and activities avoid at all costs the traditional tiered lecture room setting or other conventional teaching spaces. Instead find or create a more positive, welcoming environment with plenty of opportunity for exchange of views and group work (see examples throughout this guide and note the grand piano outside the labs in the new Biochemistry Department, University of Oxford!).



Devise working environments and situations that enable students from differing disciplines and perspectives to come together to exchange ideas and identify unexpected connections. This is likely to be achieved most readily with postgraduates but why not encourage 'speed dating' sessions where final year project students meet their counterparts from e.g. physical sciences, engineering or medical science faculties?

## Confidence and creativity

We can build the confidence of bioscience students to be creative by encouraging both their natural curiosity and their capacity to challenge assumptions.

### Curiosity

Individuals who are open-minded and confident enough to ask lots of searching questions will be much more inclined to welcome and pursue unusual observations, in research laboratories and elsewhere, that may lead to creative solutions to problems and major, unexpected developments. An excellent example is Viagra, initially developed as a drug to treat hypertension and angina, its subsequent, spectacular success in the treatment of male impotence resulted from the curiosity of medical scientists regarding an unusual side effect and high levels of patient compliance noted during clinical trials!



## Challenging assumptions

Scientists are expected to challenge assumptions and this practice has been associated with major advances in biology. For example, during the development of the polymerase chain reaction (PCR) Kary Mullis and collaborators challenged the assumption

that significant quantities of a specific fragment of DNA could only be produced *in vivo* following cloning and over-expression of the fragment in a suitable host organism: the PCR reaction generates a very large number of copies of a DNA fragment in a reaction vessel. We should encourage students to have the confidence to ask the questions 'Why?' and 'What if?' more often. In particular we need to persuade them we are often only one step ahead and that, especially with cutting edge developments, a great deal of what we say is not necessarily written on tablets of stone!



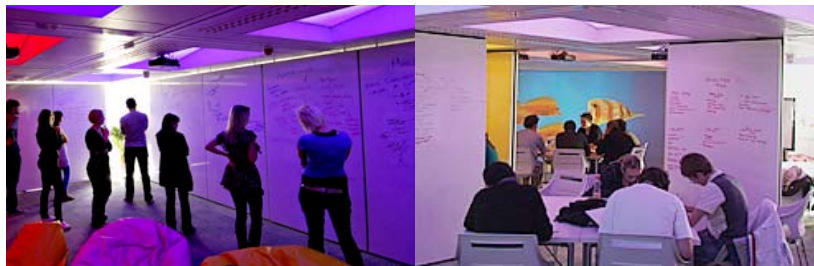
*"Another lecturer, in a session on the genome, went to great lengths to highlight what remains unknown. The class went quiet. All our academic career, we are taught about things that are known, so it was refreshing to be reminded that there is still some mystery left. As it turns out, there is a great deal left to discover, but this is hardly ever mentioned in class."* Sue Dixon, 2<sup>nd</sup> year undergraduate student

## Techniques/Tools for creativity

This section of the guide contains a small selection of techniques and tools that can be used to encourage creativity in students working alone or in groups.

### Analogies and bio-inspiration

In an analogy two things that are essentially different, but nonetheless have some similarities, are compared. An example of this approach, that should be attractive to bioscientists, is the identification of an analogy between a problem and a natural phenomenon (for examples, see [www.fbs.leeds.ac.uk/creativity](http://www.fbs.leeds.ac.uk/creativity)). Once students have identified a problem they wish to address, encourage them to identify an analogy between the problem and a natural phenomenon. Alternatively they may find a useful analogy stems from an entirely different source such as an inanimate object or an obscure activity. Once an analogy has been identified, knowledge or technology from the source should be applied to the problem and this may bring new insights and perspectives.



## SCAMPER

SCAMPER is an acronym and procedure that can help you find a creative solution to a specific problem by asking a series of 'What happens if we Substitute, Combine etc. ...' questions to encourage new perspectives.

**Substitute** - What else could we do/use instead?

**Combine** - Blend methods, materials, ideas.

**Adapt/Adjust** - Copy an existing approach in the new context.

**Modify** - Change meaning, size, frequency etc.

**Put to other use** - Re-purpose materials.

**Eliminate** - Divide, separate, subtract, delete.

**Rearrange or Reverse** - Do the opposite, work backwards, arrange in different order.

With hindsight it's easy to identify how SCAMPER might have been used, in biology and elsewhere, to solve problems. For example, artificial blood (Substitute), clockwork radio (Combine radio and dynamo), microwave oven (Adapt technology originally developed for radar), keyhole surgery (Modify), put to other uses (300+ uses have been identified for a peanut!), iPod revolution (Eliminate), Copernicus (Reverse; the earth orbits the sun). Try using this checklist of idea-stimulating questions with a problem of your choice. You will find a great deal of useful information about the SCAMPER approach at the website: <http://litemind.com/scamper/> or in Michalko (2006).



### Brainstorming

Traditional brainstorming sessions, involving the recording of ideas on a flipchart, are generally not effective in generating robust, innovative ideas. More carefully structured approaches, that encourage simultaneous collective thinking, are much more effective.

These include 'Post-it', in which participants record ideas on Post-it notes that are collected, reviewed and analysed, and 'Grid', where participants record some solutions to a problem on a grid which is then completed by other members of the group. Electronic approaches to brainstorming can also prove useful (see e.g. the 'Fridge Magnet' approach at [www.fbs.leeds.ac.uk/creativity/](http://www.fbs.leeds.ac.uk/creativity/)).

### Organised random search/'Googlestorming'

This technique helps promote creativity through the creation of a forced relationship between your problem and a random word or piece



of information. A traditional approach is to choose a page of a dictionary at random and use words from the page to help generate ideas. Alternatively identify, at random, an item in the office, laboratory or elsewhere and do a Google, Yahoo or other form of Internet search on the item. Use the words or images generated to stimulate novel perspectives on the problem you are trying to solve.

For a wide range of further creativity techniques and tools see the list of resources at the end of this Short Guide.

### Incubation

Encourage students to 'incubate' their problems, perhaps over a period of days. Inspiration may occur at any time, day or night, so they should have some way of recording their thoughts and ideas, perhaps an electronic method? During this time they may find it useful to discuss problems with friends studying other disciplines. This will allow them to obtain novel perspectives and may identify unexpected connections leading to novel solutions.



### Promoting Creativity in Groups

Well managed, interactive group sessions frequently lead to the generation of novel ideas and the development of innovative approaches to problem solving. For example, Edward de Bono's 'Six Thinking Hats' method is an excellent 'parallel thinking' process that minimises conflict by ensuring everyone is focused in the same direction and they consider a problem from a wide range of perspectives; it also encourages the participation of all members of the group. For more information about creative group sessions see [www.fbs.leeds.ac.uk/creativity/groupsessions](http://www.fbs.leeds.ac.uk/creativity/groupsessions).



## Resources from the Centre

The report from the event “**Creativity in the Sciences**” brings together presentations on aspects of creativity in the STEM sciences, resources from the day and links to further information, including an extended resource list. [www.bioscience.heacademy.ac.uk/events/glasgow290409](http://www.bioscience.heacademy.ac.uk/events/glasgow290409)

**Developing Problem-solving Skills in Bioscientists.** This report brings together information and resources on creative and other approaches to problem solving, including a number of case studies. [www.bioscience.heacademy.ac.uk/resources/problemsolving/index.aspx](http://www.bioscience.heacademy.ac.uk/resources/problemsolving/index.aspx)



**Student Research Projects: Guidance on Practice in the Biosciences.** Written by Martin Luck this guide has advice and information on student research projects. It contains 10 case

studies from a range of practitioners that illustrate a wide variety of research projects in the biosciences. [www.bioscience.heacademy.ac.uk/resources/guides/studentres.aspx](http://www.bioscience.heacademy.ac.uk/resources/guides/studentres.aspx)

## Resources from the sector

**Creativity in the Biosciences** - a website designed to promote creativity in individuals, with creative approaches, resources and information for students and tutors.

The site can also be used to encourage teams of students to work together creatively on an agreed problem. [www.fbs.leeds.ac.uk/creativity/](http://www.fbs.leeds.ac.uk/creativity/) (N.B. if you are not based at the University of Leeds you will have to register to use the Creativity website, registration is free of charge.)

Michalko, M. (2006) **Thinkertoys: A Handbook of Creative-Thinking Techniques** (2<sup>nd</sup> Edition). Ten Speed Press.

**Creativity Techniques** – an extensive repository of tools and techniques for enhancement of creativity and innovation. [www.mycoted.com/Category:Creativity\\_Techniques](http://www.mycoted.com/Category:Creativity_Techniques)

Adams, D.J., Beniston L.J. and Childs, P.R.N. (2009) **Promoting creativity and innovation in biotechnology.** Trends in Biotechnology 27(8), 445-447.

The Palatine Subject Centre’s **Creativity in Higher Education** resource page provides a good introduction to creativity. [www.palatine.ac.uk/resources/creativity/](http://www.palatine.ac.uk/resources/creativity/)

Also available from Palatine’s website is the **Imaginative Curriculum Project** resources archive. [www.palatine.ac.uk/resources/imagincurric/](http://www.palatine.ac.uk/resources/imagincurric/)



The **Centre for Excellence in Enquiry-Based Learning (CEEBL CETL)** brings together a wide range of resources and information on EBL, including guidance on introducing EBL, and case studies of practice. [www.campus.manchester.ac.uk/ceebl/](http://www.campus.manchester.ac.uk/ceebl/)

Verran, J. (2008) **Developing creativity amongst first year science undergraduates: art assignments in science curricula.** A range of innovative assignments used in a microbiology course. [www.celt.mmu.ac.uk/ltia/issue16/verran.php](http://www.celt.mmu.ac.uk/ltia/issue16/verran.php)

The **InQubate CETL**, at the Universities of Brighton and Sussex, explores how a technology-rich environment can support the creative process in both science and arts subjects. [www.inqbate.co.uk/](http://www.inqbate.co.uk/)

The images of working spaces in this guide are of: Biochemistry Building, University of Oxford; Creativity Centre, InQubate CETL; and the ALPS CETL Group Study Area, University of Leeds.

*“A fantastic lecturer teaches students the art of independent creative thinking. To become the next generation of scientists students must be taught the art of looking for flaws in arguments, examining weaknesses in data and taught never to accept that an experiment is finally completed. A scientist’s work is never done!”* Kar-Wei Leung, 2<sup>nd</sup> year undergraduate student

