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Case Study for School Biology Teacher of the Year 2018

In this Case Study I will share my experiences of teaching Biology and reflections on what I feel makes for excellent teaching and learning in Biology.

I call them my "Magnificent Seven".

1. Enthusiasm is essential.
 2. Teaching is a social contract.
 3. Variety is the spice of life science.
 4. Share and share alike.
 5. Great teachers are great learners.
 6. Enrichment has far-reaching benefits.
 7. Act locally. Act nationally. Act globally.
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1. Enthusiasm is essential.

27 years ago, I was working as a post-doctoral researcher on *Salmonella* genetics when I was given the opportunity to lecture on HND and BSc Applied Biology courses. I became interested in teaching pre-university, particularly what enthused students to study Biology beyond A level. The answer was clear: inspiring Biology teachers. I completed a secondary science PGCE at Durham University and landed my first job at a local sixth form college. I approached an A level Biology teacher I knew to see if he had any advice about teaching post-16 students and will never forget his words. He said "Well, it'll stick in your teeth after a while". I was determined that this would not be the case! This would assume that whatever teaching and learning resources you develop as a new teacher are the same ones you churn out year after year.

I was determined to grow and develop as a teacher and to remember that, no matter how many times I have taught a particular topic, the students in front of me are experiencing those lessons for the very first time. It really does make a difference, because, in your mind, you are teaching a topic with that same excitement as when you taught it last week, last year or last decade. To achieve this, you have to continuously revise your resources, update your knowledge and never forget to share your excitement for the topics you are teaching. Where possible, this involves connecting learning to current news items, interesting historical facts or thinking starters such as "What do you think are the five most common types of cancer in the UK?"; "Why do you think these cancers the most common?" and "Suggest why obesity increases a person's risk of developing cancer".

2. Teaching is a social contract.

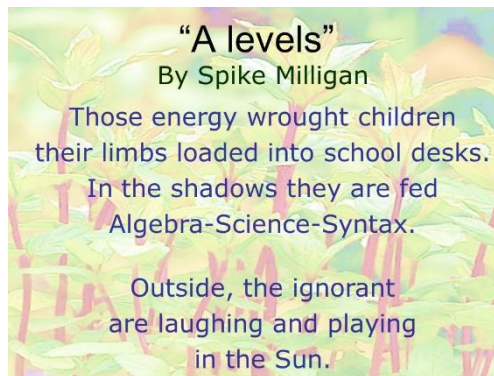
As a teacher of Biology in Further Education, I don't know my students before they walk in the door for their first lesson. I get to know my students quickly and vice versa, making sure that I learn every student's name by the end of their first lesson. I create an A4 badge about myself, share it, and then ask the students to make a badge about themselves, using

coloured cards and other bits and bobs, summarising their interests and ambitions. Students share what they have created. This is so important: it establishes a sense of community and enables me to learn about my students, their interests, goals and aspirations. Just as importantly, it helps them get to know each other as, typically, a class will have twenty students drawn from at least ten different schools.

The more you know about the students and the more interest you in take them, the better the learning experience. You can connect individuals' self-perception into all aspects of your teaching, including focus on topics of individual interest and enrichment opportunities and verbal/written feedback on assessments. As an example, last September I discovered that one of my students had an interest in writing and an ambition to study medicine. Later in the year, I knew she would be interested in creating a drama about DNA paternity tests and I knew who would be interested in acting out the drama. The outcomes of this are described under "Enrichment".

3. Variety is the spice of life science.

Some years ago, my students bought me an anthology of poems by Spike Milligan. In the front they had written the following message: "Thanx (sic) for making Biology lessons so much fun! Turn to page 121". I read the poem "A levels":

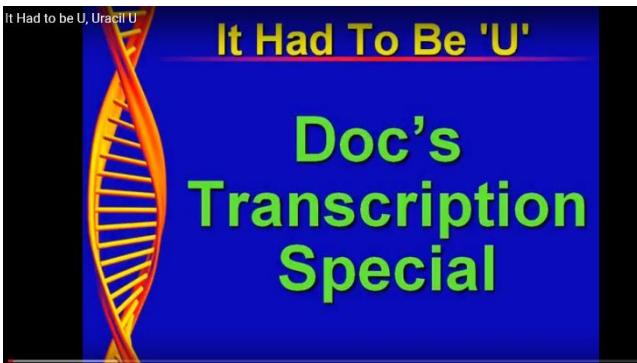


Reading this poem really did change my approach to learning. It's not just about having fun though! Having fun in lessons is wonderful for the endorphins but there must always be a learning at the heart of it. When I surveyed my students to find out what they thought makes a good lesson and categorised their comments, fun came second from the bottom (teacher knowledge came bottom – maybe that's a given). Top of the list was variety (structure of lessons came second). A good lesson is carefully crafted – I believe a teacher must walk in the shoes of their students and think about the whole learning experience. However, a good lesson is not a straitjacket and you must be perceptive throughout, changing tack if needs be.

I believe firmly that students are best engaged by a diverse menu of learning activities and changes of state. Biology teaching lends itself to a wide variety of approaches: practicals, investigations, residential field trips, demonstrations, peer teaching, discussions, role play, e-learning, biology tours, card activities, simulations of complex processing and videos are all part of the variety of methods used by myself and no doubt by many other teachers.

More novel is the use of song and dance in Biology lessons, but I'm quick to point out that this is now and again. It's the aspect of my teaching which has drawn the most attention but I hope it does not define my teaching; it is just part of the variety. Songs and dances do two things: they help students to verbalise specialist terminology and they help students

understand complicated processes. I wouldn't do them otherwise. The Heart Song helps students learn the structure of the heart and the direction of blood flow through it. "It Had to be U, Uracil U" helps students to learn about transcription and the different base composition of DNA and mRNA. Aerobics Respiration helps to explain the stages of aerobic respiration and why Krebs cycle and oxidative phosphorylation stop in the absence of oxygen. Mitosis Mamba uses simple hand actions to demonstrate the stages of mitosis and behaviour of chromosomes during cell division and the Meiosis Square Dance, based on a ceilidh dance, is a memorable way of teaching meiosis and non-disjunction. The DNA Boogie is a great way to teach DNA structure and when students become part of the DNA double helix, they realise why the two strands have to be antiparallel and how the sugar-phosphate backbone protects the genetic code comprised of nitrogenous bases. Creating songs and dances has helped to invigorate my love of teaching. I know they are not for everybody and they are a bit edgy, but believe me, they work! Here are two examples for you to explore in more depth:



Click on this link to watch:

https://www.youtube.com/watch?v=k7fziJB_AdM&t=98s



Click on this link to watch:

<https://vimeo.com/100695547>

I also acknowledge that A level Biology is very challenging (even more so since A level reforms) and that development of higher order thinking skills is essential to student success. This is best achieved through active learning and emphasis on thinking skills through stretch and challenge activities. As an A level Biology teacher, I walk the tightrope of keeping students engaged and interested on the one hand and developing skills for examination success on the other. Veer too much to one side or the other at your students' peril – it's about getting the balance right!

4. Share and share alike.

I started teaching in the days of the locked filing cabinet. I don't remember being given much at all – it was a case of sink or swim. Years down the line, I share everything with other teachers. They are, of course, free to adapt the teaching and learning resources I have created; after all, every teacher and every class is different. Also, I'm not precious about the resources – if another teacher has a better idea, then great. I welcome feedback from other teachers and of course from students themselves. If something doesn't work, or doesn't work so well, I want to know how it can be done better. Application of a shared Scheme of Work pays dividends, though, because I often teach year 2 Biology students that I didn't teach in year 1. It makes working with me as their new teacher seamless – they know the approach,

they know the structure and they know that the expectations are high (for both teacher and learner).

5. Great teachers are great learners.

Last October I prepared for a panel discussion on active learning at the QUDWA (Role Model) conference in Abu Dhabi. I aim to instil a love of learning in my students. In his closing speech for the conference, Andreas Schleicher, Director for Education and Skills at the OECD, picked up on something I said during the discussion:

I was also impressed by teachers' commitment to their profession beyond the role they play in the classroom. These teachers saw themselves as learners with a growth mind-set, and as contributing collaboratively to system leadership. As Richard Spencer, a teacher from the United Kingdom, noted: 'Great teachers are great learners and students need to see their teachers learning.'

Reimagining the teaching profession. Andreas Schleicher, 2017.

Perhaps the most important aspect of this quote is my view that the best teachers take charge of their own learning and make it visible to their students. How can you instil a love of learning in your students if you don't demonstrate love of learning yourself? As a result, I value CPD opportunities immensely and take as many opportunities as possible to enhance my own learning. Again, it is about achieving a balance – time out of the classroom versus improvements to teaching and learning in Biology. It takes careful planning and you have to be quite selective. In the past sixteen months I have visited seven different countries, giving presentations, judging a science festival or to taking part in projects (see Act locally, nationally, globally). I've also attended two ASE Annual Meetings and a SAPS Summer School in the UK.

I have learnt so much from other teachers and experts as a result –and this learning has informed my own teaching. When you present at a science meeting, you also have the opportunity to learn from others' presentations. To give a few examples, I didn't know obesity is associated with increased risk of cancer until I attended a presentation at the Irish Science Teachers Association Conference. I came to realise the importance of epigenetics in regulation of flowering times and at last found how to use potometers that work at the SAPS Summer School. I understand the use the value of diagnostic questioning and how to improve students' performance on the AQA Biology essay thanks to attending workshops at ASE meetings. These are just a few examples –there are many more.

Most of these CPD opportunities took place out of student term time and, where I had to miss lessons, I put them on at different times or ensured that the lessons missed were tests or other assessments which did not require my presence. Clearly this did not disadvantage my students, as from Learning Plus value added analysis, A level Biology in 2016-2017 was highly significant and the highest of all A level subjects in the sixth form. It's about being flexible and creative with your planning. It's about how you can, not why you can't. It's also about having a line manager who gives you the autonomy to make decisions about what to CPD to participate in and where – a manager who trusts your judgment and knows that you will make up the time elsewhere, if needed.

6. Enrichment has far-reaching benefits.

Recently, I have involved groups of students in the following enrichment projects:

- (A) Investigating the effect of light wavelength on recovery of grass on football pitches.
This project has been reported in iStage 3: Football in Science Teaching (Science on Stage Europe) and has been translated into eight languages.



<https://www.science-on-stage.eu/page/display/5/28/1645/pitch-perfect-the-rate-of-photosynthesis-of-football-turf-istage-3>

The following benefits to students were identified as a result of their participation:

- Impact on knowledge & understanding: light dependent & light independent reactions (Calvin Cycle) of photosynthesis.
- Impact on planning for valid experimental design: controlling variables.
- Practice in evaluating evidence & drawing conclusions: red is best!
- Generating further enquiry: unexpected results - why isn't blue the best?
- Help with personal statements: University applications.
- Appreciating the value of research: industrial links.

Following presentation of this project at the ASE Schools Exhibition, Liverpool 2018, the project has been submitted for report in the ASE's School Science Review later this year. As a result of contacts established during the project, students will visit the STRI in Bingley, a research facility involved in production of grass sports surfaces for national and international events, including Wimbledon, The Open and the football World Cup in Qatar.

- (B) Investigating the effect of herbal essential oils on memory.

This project was completed as part of a SAPS/Enthuse Award, following participation in a SAPS Summer School in June 2017. The following benefits to students were identified as a result of their participation:

- (1) Access to AQA A Level Biology CPAC 5a and 5b by researching and referencing the uses of medical plants, including their reported effects on memory.
- (2) Access to AQA A Level Biology CPAC skills by researching, planning an investigation, risk-assessing procedures and reporting experimental data.
- (3) Increased student interest in plant biology (all year 1 and year 2 students were involved as test participants). This included organisation of a lecture on pharmacognosy (medicinal plants) given by Dr Nicolette Perry of Dilston Physic Garden, Northumberland (all students).
- (4) Creation of a resource which can be used to develop students' ability to evaluate experimental data (all students).



Herbal oils and their application

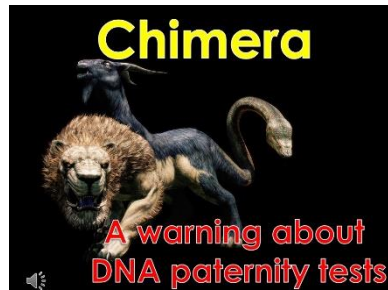
(C) Production of a drama about the problems of chimerism and DNA paternity testing.

This fascinating project involved students in scripting, acting and filming a drama based on a scientific paper about a failed paternity test. The story is truly fascinating! The project is currently entered for the Finish StarT Luma international science festival 2018 and Chimera – The Movie is entered for UKCineFest 2018 as a student drama-documentary. The movie is already being used in other areas of my college, for example for Access to Health Care, to stimulate debate about DNA paternity tests.



A video about the project

https://youtu.be/j4qj_ep7YdY



Chimera – The Movie

https://youtu.be/hR_p2zXu5Sc



A video about best practices.

<https://youtu.be/HVleBM9go8M>

7. Act locally. Act nationally. Act globally.

Coming back to what interested me in Biology teaching in the first place, I realise how important it is to enthuse pupils pre-A level. I organised a DNA lab for Year 6 pupils from a local primary school, during which they made DNA models, extracted DNA and carried out gel electrophoresis. We've had 200 year 5 and year 6 pupils from other local primary schools into college to carry out heart dissections. The pupils enthusiasms is phenomenal and the feedback from teachers has been excellent and makes it all the extra work more than worthwhile. Apart from the usual liaison events, I have also visited several local secondary schools (year 10 and year 11 pupils) to involve students in an activity about meiosis and genetic variation ("Boro Bugs") and helped organise two Medical Days for students of the same age from nine different secondary schools in Teesside.

Nationally, I've presented iStage 3 projects at ASE Reading (2017) and Pitch Perfect at ASE Liverpool (2018). I'm a member of the national advisory group for Science on Stage UK and helped judge projects for the international festival in Hungary and mentored the teachers selected. It's a great privilege to be involved and you learn so much from the work of others – including new ideas for enrichment projects and tips for your own teaching.

Internationally, I'm involved in an Erasmus Plus Project "DesignSTEM", working with design, science and maths teachers to create teaching and learning objects. We visit each other's countries and in November 2017, I hosted a visit by twenty teachers from the other eight countries involved in the project, learning on so many levels! In 2017, I presented "All Singing, All Dancing Biology" at the Irish Science Teachers Association Conference in Maynooth, joined in a panel discussion at Qudwa Conference in Abu Dhabi and was part of a team of six international teachers who won the international pisa4U school improvement competition hosted by the OECD. My contribution was to add resources for teaching Biology to the portfolio of lesson plans and activities. You can find them at <https://sway.com/f45LkJnZcl9sUFQa?ref=Link>.

When I moved from test tubes to teaching all those years ago, I couldn't have imagined how exciting, rewarding and varied Biology teaching would be. It is wonderful to see students go on to study degrees in a huge range of Biology-related subjects and for those that don't, it is satisfying to know they are well-grounded in Biology and will find the knowledge, understanding and skills developed useful in a huge range of careers. And there is one final point: the future of science education depends on enthusiastic teachers; perhaps my greatest achievement has been to inspire many students to want to become Biology teachers themselves!