HE Bioscience Teacher of the Year 2019 Application Form
Dr David Martin - University of Dundee

1. **Individual excellence in the development and implementation of teaching bioscience**
   In not more than 500 words please outline, with evidence (references are not included in the 500 word limit), how the candidate displays individual excellence in the development and implementation of approaches to teaching that have proven successful in promoting bioscience student learning and achievement

As a module manager for several core general molecular biology and higher level specialist modules, I have faced the challenge of engaging, enthusing and inspiring both the students and the staff who participate in this teaching. My teaching philosophy is to examine this at all levels, from the activity (lecture, workshop), the assessment (for assessment drives the teaching and learning) and the management, to give a coherent and harmonious delivery. Does it work well? Can it work better? How can that be done?

I have developed interactive artefacts to engage and keep attention - a simulation of Next Generation DNA sequence assembly/analysis [1] that is used in labs worldwide for teaching and public outreach; A large 20 sided dice with amino acid symbols on each face which is used in large lectures to make a 'catalogue' lecture engaging and non-linear; A DNA transcription/translation game, built in collaboration with a team of students.

From a student perspective I have sought to give them control over their learning, identifying barriers to participation and giving opportunity for personal exploration. I have pioneered the use of video led instruction (with an instructor present) in IT workshops. This has dramatically improved engagement as students do not wait on their peers, can safely go 'off script' without being left behind and can revisit areas they are unsure of. In this case one size really does fit none, so every student can take control of their own learning. The impact of this was recognised with a departmental teaching award. A recent innovation I have made is to disallow students raising their hands for help - instead they place a 'duck' (plastic ones are available but any item will do) on top of their monitor and that signals to staff that they require assistance. Meanwhile, the student can continue to focus on solving the problem themselves, or press on with the knowledge that the simple duck is working for them. These efforts lead to excellent student feedback with requests to other staff for the same teaching approaches.

I work hard to engage my colleagues in curriculum design and coherence. I introduced module glossaries, where a list of terms which should be understood by all students are examined. This has also proved to be useful in diagnosing key misconceptions that are reviewed by the lecturers responsible and new emphasis fed into the following year's

lectures. I also introduced a comprehensive and detailed study guide that covers the learning objectives for each activity with links to the textbook. One of the most significant innovations was the introduction of a question setting meeting where the examination is set. This allows for discussion between staff, peer review of the questions and model answers resulting in a better and fairer assessment for the students with the benefit that all staff appreciate the breadth of topic. With a consistent framework and collaborative question setting, our marking and moderation becomes smoother with the ability to share the workload and ensure a consistency of standard.

[1] Gigsaw – Physical Simulation Of Next Generation Sequencing For Education And Outreach (2012) EMBnet Journal **18**, 28-32

2. Involvement in scholarly and professional development activities

In not more than 500 words please describe all scholarly or professional development activities that the candidate has undertaken, which have influenced and enhanced the learning of bioscience students

As a biologist, when an organism stops growing it begins to die. And for an organism to evolve it needs diversity and to avoid monoculture. I received my PgCertHE in 2011 specialising in the teaching of computational methods to biologists. Since then I have regularly attended HEA conferences for STEM and for surveys, benefiting from the interchange with colleagues in both closely related and distant fields. I have supported my practice through development of teaching guides for key software in the field - I wrote the first edition of the EMBOSS Administrators Guide and the Jalview User Guide. These captured the expertise of the software authors in a way which could be readily taken on by the user community. The current generation make heavy use of video and my scholarly efforts now produce training videos that are well viewed.

Locally I participate in our institute wide scholarship group and presented some of the developments we have made in Life Sciences to the broader community within our institute. I also attend and have presented at our educational practice monthly meetings which cross departmental boundaries. A recent initiative is a cross-sector forum which brings together educators from secondary, primary and higher education. I regularly attend and discuss with colleagues, identifying opportunities to learn and transfer practice from one sector to my own, and providing advice on how we have approached problems locally.

I have been keen to enhance our local practice and initiated a staff 'book club' where we work through evidence led literature on effective teaching practices with a critical eye.

I am a STEM ambassador and have worked with a local secondary school and their feeder primaries, designing a scientific experiment around camera traps and bird feed. The impact of this on the class of 10 year olds has been dramatic as they have an incentive to develop and improve numeracy and data literacy skills, as well as identifying the local avian wildlife.

I have participated in our Enhancement Led Institutional Review with a particular focus on how this impacts the student experience. Do we develop appropriately skilled graduates in biosciences? This process allows another avenue for reflection at an institute level.

One key area of personal development has been to better understand the cognitive psychology that underpins effective education - putting a rational scientific basis to a 'gut feeling' or experience. To this end I have brought cognitive psychology into both our staff seminars and into the lecture room through collaboration with colleagues from the Department of Psychology.

The cognitive psychology approaches provide a sound theoretical framework for structure and delivery of teaching activities. Much of this is 'invisible' to the students but they reap the benefits of evidence-informed approaches. A challenge remains in bringing these practices to some of my less teaching focussed colleagues.

3. Supporting colleagues and influencing learning

In not more than 500 words please provide evidence of how the candidate supports colleagues and influences bioscience student learning beyond their department and institution

A key strategy in my department over the last half decade or so has been the aggressive development of quantitative skills. As a computational biologist I am familiar with the challenges of statistical software and of teaching it to those who may be less enthused. In partnership with key colleagues and with the support of our management team we have delivered a curriculum that engages the students and provides them with a very good level of analytical skills based around the R software. Now several student cohorts have proceeded through this curriculum the positive feedback is enhancing student engagement. Part of the challenge in engaging students has led to innovative teaching methods described earlier, with a strong emphasis on self-paced, guided learning. These are being refined year on year.

The second aspect has been to bring my colleagues along. I have organised training sessions, encouraged and supported with learning both the statistical software R and python programming, and also demonstrated and trained them in the creation and use of video guides, and of the mathematical software NUMBAS. It is a pleasure to see these skills now being applied by others and enhancing their teaching and student experience too.

I lead the bioinformatics stream in our degree. Bioinformatics is an inherently applied topic so the approach I have taken is to relate it to real world experiments and data wherever possible. The pre-honours practical modules use real data and projects as the basis for student exploration where students themselves manage and run the project under guidance. The modules have high student satisfaction and equip students well for their final year projects.

I have produced a number of teaching tools that are in use across the globe. The Gigsaw sequence simulation is used at every level from postgraduate bioinformatics courses, through secondary level masterclasses, down to pre-primary children in science engagement activities. The software guides are in daily use and videos are viewed regularly.

I have encouraged colleagues to think outside the box with regard to assessment, moving away from the 'standard multiple choice' question and using more creative approaches.
I am a Software Carpentry instructor and have led courses in effective computational practice for

biologists both locally and at Exeter and Bath universities. I have incorporated some of their practices, where appropriate, into my local teaching.

Some of my workshops are adopted and used by colleagues in other contexts. Colleagues from the medical school have taken on a mutations workshop I developed and repurposed it for medical students.

I am a big fan of open science and am keen to share resources and expertise where possible. As an External Examiner for a Genomic Medicine MSc, it has been a privilege to share teaching approaches such as the video led workshops. These enable equitable participation in technical courses for those with very different competence and confidence on entry. Reports mirror our local experience that this is an extremely effective approach.

4. Exhibit innovation that has proven to improve their teaching practice to enhance student learning

In not more than 500 words please provide evidence of how the candidate exhibits nnovation in their teaching practices to enhance student learning

Innovation is my lifeblood. I struggle with routine, pedestrian and boring. There are some lectures that can be like reading a catalogue. I improved engagement in the amino acid properties lecture by creating a large polyurethane die in collaboration with the Art School sculpture workshop. This can get rolled or thrown, around a large lecture theatre and, with suitable supporting materials, leads to a non-linear lecture. This is the only lecture specifically mentioned in student feedback (and the feedback is positive). and is supplemented with a rapid response quiz on the amino acids, with prizes for the students able to complete it successfully within a very tight time limit.

I have developed novel software to assist with teaching and try to use real life examples when teaching bioinformatics. The students have to engage as part of a team to analyse and report on the data given.

I have previously mentioned the video-led workshops, the assistance ducks and the introduction of cognitive psychology into bioscience teaching. These have transformed IT based workshops from a time of torture for the students, and high stress for the staff, to a pleasant experience where students are engaged and effective learners, and staff have the time to discuss science instead of holding up the whole class to fix trivial errors.

The student response has been to request more of this - they enjoy the self-paced nature of the video workshops and the control it gives them over their learning.

Innovation isn't always about doing a new thing, but doing a thing in a new way, or translating from one environment to another. Together all these innovations accumulate and see an increase in student satisfaction from year to year.

The best engagement comes from a sense of fun. I am a member of the local bat group and to improve understanding of how bats echolocate I built a pair of 'see like a bat' goggles. These are a blindfold fitted with an ultrasonic distance monitor, that, through a microcontroller, provides

audible indication of distance to the wearer. A low tone is a long space ahead, and a high tone is a close object. It is quite entertaining seeing children explore echolocation with one child being the moth and the other being the bat trying to find the moth. The success of these goggles led to the creation of 'see like a snake' goggles (using thermosensing) and 'home like a pigeon hat' gadgets, the latter of which provides a direction to the students' union from anywhere in the world. All of these are very popular for science engagement.

Most innovations come from an itch that needs to be scratched. In response to a lack of readily accessible common biochemical information, I produced the Life Scientists' Crib Sheet, a poster which contains the information I was most likely to look up. This has not only been very popular with the undergraduates but many copies appear to have made their way into the research laboratories as well.