CARING ABOUT *NATURE*

HOW CAN WE ENGAGE HIGH SCHOOL STUDENTS?

The future of conservation depends on the skills and tools of science teachers. High school teacher **Keith Martin-Smith** argues that field trips, real and virtual, are pivotal to engaging students.

Insect surveys on the Coral Sea Bush Blitz included light trapping. Sunscreen, hats and long-sleeve shirts were needed to avoid being burnt by the UV radiation from the high energy mercury vapour lamp. ***Photo: Gary Cranitch***

As a former marine biologist, I have a deep and passionate fascination with the organisms with which we share the planet. However, as a high school science teacher, I am concerned that my students don't share this interest or understand the importance of biodiversity. We know that students who are engaged with their subject material focus more on classroom tasks, work longer on problems and use higher level thinking skills. Yet, ironically, it seems that as our knowledge grows and becomes ever more available at the swipe of a screen, students seem to know and care less about the organisms around them.

Indeed, recent data from international studies shows Australia falling behind other countries in science skills. For example, in the 2015 Trends in International Mathematics and Science Study (TIMSS), only 7% of Australian Year 8 students achieved an advanced rating compared with 42% in Singapore, 17% in Slovenia and 15% in Kazakhstan. Across most measures in TIMSS, Australian students have remained static or gone backwards over the 20 years of measurement. It is difficult to establish baselines for the level of natural history knowledge, but informal discussions with colleagues indicate to me that students of all ages know less about the animals and plants around them than students of, say, 20 years ago. This view is supported by research showing a decline in the natural history knowledge of undergraduate and postgraduate students. One recent study in the United States showed that university students scored less than 20% in an 'ecoliteracy' questionnaire. The highest scores were achieved by those who spent the most time outdoors. One of conservation's big challenges is how to engage students with the natural world, so that they want to learn.

Field trips are probably the best way to interest students in species, habitats and ecosystems. By observing natural behaviours and getting close to wildlife, even the most disinterested students usually find something that is memorable or makes them think about the habitat.

I use a field-based curriculum to study ecosystems with my Year 9 students. We go to a local nature reserve and do activities like set up pitfall traps for invertebrates and quadrat surveys of vegetation. Most students are surprised by the variety of organisms we encounter. But even though legions of young children can recite a long list of dinosaurs by their scientific names, most of these older students can name only a few of the plants and animals we see in the field. This starkly illustrates our challenge to engage.

So, into the breach comes the virtual field trip.

The story of good field trips

For a successful field trip, the most important factors are interesting stories from a guide, and physical tasks. Teachers need to be able to weave stories into their teaching practice, either personally or by finding local experts, and students need to be able to do things, not just passively watch.

Despite my best intentions, it is not always possible to find appropriate destinations – if, say, we have been looking at food chains in the Antarctic or the speciation of finches in the Galapagos. Cost, access, and workplace health and safety are major constraints. Teachers, particularly those newly qualified, often find the logistics of field trips challenging, and choose to limit their activities.

So, into the breach comes the virtual field trip. There are a number of different models: video communication by scientists from field locations, students being provided with data from real field trips to analyse, and virtual reality simulations. Examples from Australia for students in both primary and high schools include Expedition Class (expeditionclass.com) and Bush Blitz TeachLive (bushblitz.teachlive.org.au).

Virtually in the field

Last year I was fortunate to participate in a Bush Blitz TeachLive expedition to the Coral Sea. Bush Blitz is a collaboration between government and non-government organisations to increase knowledge of Australian biodiversity. The TeachLive component selects teachers to accompany scientists during their expeditions and provides a virtual field trip experience for the teachers' students.

On my expedition we travelled from Hamilton Island, off the Queensland coast, about 500 kilometres out to the remote Diamond Islets, Coringa Islets and Herald Cays. These tiny specks of coral rubble and sand are part of the million square kilometre Coral Sea Marine Reserve, rarely visited due to their isolation. While well known for their thousands of nesting seabirds – terns, frigate birds, red-tailed tropic birds and three species of booby – little is known about these islands' terrestrial and marine invertebrates. Eight scientists, specialising in groups including moths, true bugs, spiders, crustaceans and soft corals, worked tirelessly to document, collect and preserve specimens. During the day they swept the vegetation with nets, set pitfall traps and snorkelled on the fringing reefs. At night a bright nimbus from the bushes showed where a light trap was operating.

My role as a teacher was to be the conduit between the scientists and my students back in Hobart: to establish the 'story', interpret the science and integrate the experience into the curriculum. Before the trip I developed lesson plans: plotting

No-one will protect what they don't care about; and no-one will care about what they have never experienced.
Sir David Attenborough

Skype discussions were held with the author's students allowing them to interact with scientists during the Coral Sea Bush Blitz. *Photo: Gary Cranitch*

One Bush Blitz focus is recording species. Zoologist Barbara Baehr collects spiders from a dead *Pisonia* branch on a Coral Sea island. *Photo: Gary Cranitch*

co-ordinates and bearings in maths, investigating the use of different sampling methods in science, and describing habitats and biodiversity in marine studies. During the trip I wrote a daily blog about our activities and took photos and videos that were uploaded to a website via satellite. The blog contained daily identification challenges and questions. We held Skype sessions with the students, during which I interviewed the scientists and the students asked questions. These ranged from the obvious – 'have you seen any sharks?' – to the deeply insightful – 'will spider dispersal by parachuting be affected by changing wind patterns due to climate change?'. I noticed that some students who are normally loath to ask questions in class were extremely enthusiastic and participated much more than I expected.

Back at school I conducted follow-up activities. My Year 9 students designed their own field study based on information from the Bush Blitz, and my marine studies class developed management plans for the marine reserve. I noted an overall increase in student engagement, particularly among some groups that I didn't expect. I shared some 'teachable moments' with students that I had previously failed to engage – one struggling student in a maths class told me he finally saw the use of some of the things that we'd studied!

Some students told me that they particularly enjoyed the Skype sessions where they could see me interacting with the scientists. One said he 'really wanted to do something like that' and another that it was 'cool to see one of my teachers finding new species'. Research suggests that students learn better when they accept their teachers as 'authentic' in their particular teaching field.

Discovering new species was the most popular expedition topic for the students, as it seems to be with the general public. The idea of undocumented species and the legacy of leaving something for the ages gripped their imagination, even if the reality is not quite as it appears. The work of identifying, describing and naming the species collected on the expedition goes on and it will be a couple of years before the final totals are known – an unfortunate, if unavoidable, aspect of the scientific process. Since 2009 more than 30 Bush Blitz expeditions have discovered more than 1100 putative new invertebrate species, so it seems likely there will be at least a couple of dozen from the Coral Sea islands.

Keeping it real

I think any teacher who participates in a Bush Blitz type expedition gains an enormous amount professionally. However, translating the experience into a local context and providing ongoing learning for students and colleagues is more complicated and requires commitment. In my case I work with colleagues to develop ecological methods that we can use with our students. Other initiatives include building up a reference collection of invertebrates, creating identification keys and establishing databases of all the organisms we find each year.

Teaching with virtual field trips is an emerging field, and studies of their contribution to scientific understanding and emotional connection with the environment are scarce. There is some evidence that students do show more interest in the subject, particularly when they are involved in data analysis, but the ultimate learning outcomes remain unmeasured. Given the rightful emphasis on measured outcomes in education, demonstrating the value of field trips, real and virtual, is a priority.

There are experiences that students do not have on a virtual field trip – the smell of the ocean, the feel of sand on bare feet, the glare of the tropical sun. They do not have to push themselves physically. These sensory inputs on a real field trip are likely to cement learning, particularly for kinaesthetic learners.

For me, it seems that we are at an important point, where technology is set to be the great disrupter of science teaching, with huge potential but also giant pitfalls. The same technology that allows students to experience a submarine voyage through the canyons off Western Australia also offers them a social gaming platform that may appeal much more than sitting in a science lesson. Field trips using augmented reality are already taking place, but can these compete with a Pokémon Go experience?

Ultimately, science teaching must embrace and adapt these new technologies while also fostering the personal connection of each student to the natural world. In the words of an ancient Chinese proverb:

Teach me and I will forget.
Show me and I may remember.
Involve me and I will understand. ■

READING: Alon NL, Tal T. 2015. Student self-reported learning outcomes of field trips: The pedagogical impact. *International Journal of Science Education* 37(8):1279–9 ■ Bergin DA, Anderson AH, Molnar T, et al. 2007. Providing remote accessible field trips (RAFT): an evaluation study. *Computers in Human Behavior* 23(1):192–219 ■ Tewkesbury JJ, Anderson JGT, Bakker JD, et al. 2014. Natural history's place in science and society. *BioScience* 64(4):300–10 ■ Whitesell ER. 2016. A day at the museum: The impact of field trips on middle school science achievement. *Journal of Research in Science Teaching* 53(7):1036–54

ACKNOWLEDGEMENTS: Thank you to Parks Australia, Earthwatch Australia and The Hutchins School for the opportunity to participate in the Bush Blitz as well as the scientists involved for generously sharing their knowledge.

DR KEITH MARTIN-SMITH is a Senior Classroom Teacher at The Hutchins School in Hobart. He participated in a Bush Blitz 12-day voyage of discovery to the Coral Sea in June 2016 (see bushblitz.org.au/keith-martin-smith/).