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The Emory-Tibet Science Initiative: Rethinking Cross-Cultural Science and Teaching

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The Emory-Tibet Science Initiative was founded when the Dalai Lama invited Emory to develop and teach a comprehensive curriculum in modern science to Tibetan Buddhist monks and nuns. The project was built to grow and nurture a two-way exchange between complementary systems of knowledge. In the 10 years since the first days of the pilot, the interactions between people and places and the scientific and learning processes have served as a platform for exploring teaching across cultures and enriching approaches to teaching and science more generally. As a result of these interactions, we expand our definition of inclusivity in the classroom and the practice of science, emphasize connections and tensions between science and other systems of knowledge, and create space for student and instructor reflection and learning. The next phase of the project will engage students in research projects as tools for learning and as a means to contribute knowledge to the project and the larger science education community.

ཨེ་མོ་རི་དང་བོད་ཀྱི་ཚན་རིག་ལས་རིམ་ནི་༧རྒྱལ་བ་བསྟན་འཛིན་རྒྱ་མཚོ་མཆོག་གིས་ཨེ་མོ་རི་གཙུག་སློབ་གྲྭ་ཆེན་མོར་བོད་ཀྱི་གྲྭ་བཙུན་གྱི་ཆེད་དུ་ཚན་རིག་གི་བསླབ་གཞི་གསར་སྒྲིག་དང་སློབ་ཁྲིད་བྱ་རྒྱུའི་བཀོད་མངགས་གནང་བ་ལས་འགོ་བཙུགས་པའི་ལས་རིམ་ཞིག་ཆགས་ཡོད། ལས་རིམ་འདི་ནི་ཕན་ཚུན་ལ་ཁ་སྐོང་གི་ནུས་པ་འདོན་ཐུབ་པའི་ཤེས་བྱའི་གཞུང་ལུགས་མི་འདྲ་བའི་དབར་དུ་གྲོས་མོལ་གྱི་ས་བོན་འདེབས་འཛུགས་དང་ གོང་འཕེལ་གཏོང་བའི་སླད་བཙུགས་པ་ཞིག་ཡིན། ཐོག་མའི་ཚོད་ལྟའི་ལག་བསྟར་གྱི་ཉིན་དང་པོ་ནས་ལོ་བཅུ་འགྲོར་བའི་རིང་ལ་གང་ཟག་དང་། ས་ གནས། ཚན་རིག་དང་། ཤེས་སྦྱོང་གི་ཐབས་ལམ་བཅས་ཀྱི་གནས་ཚུལ་བརྗེ་རེས་བྱས་ཏེ། རིག་གཞུང་འདྲ་མིན་བར་སློབ་ཁྲིད་ཐབས་ལམ་ལ་དཔྱད་ ཞིབ་བྱེད་པ་དང་། ཚན་རིག་དང་སློབ་ཁྲིད་ཀྱི་ཐབས་ལམ་ཕྱུག་ཏུ་གཏོང་བའི་སྟེགས་བུ་ཞིག་ཏུ་གྱུར་ཡོད། དེ་འདྲའི་ཕན་ཚུན་མཉམ་གྲོགས་ཀྱི་མཇུག་འབྲས་སུ། ཚན་རིག་གི་སློབ་ཁྲིད་དང་ལག་ལེན་ནང་སྒྲི་ལ་ཁྱབ་ཀྱི་ཚན་རིག་ཅེས་པའི་གོ་དོན་དེ་རྒྱ་སྐྱེད་གཏོང་བ་དང་། ཚན་རིག་དང་ཤེས་ རིག་འདྲ་མིན་བར་གྱི་མཐུན་ཕྱོགས་དང་མི་མཐུན་ཕྱོགས་ཀྱི་གནད་དོན་རྣམས་གསལ་འདོན་གྱིས། སློབ་མ་དང་དགེ་རྒན་ཚོར་ཤེས་སྦྱོང་དང་བསམ་ གཞིགས་ཀྱི་ཁོར་ཡུག་ཅིག་བསྐྲུན་ཡོད། ལས་རིམ་དེའི་གོམ་སྟབས་རྗེས་མའི་ནང་དུ། ལས་རིམ་འདི་དང་ཚན་རིག་ཤེས་ཡོན་གྱི་ཚོགས་སྡེ་ཆེ་སར་ ཤེས་བྱ་མགོ་སྐྱོང་བྱེད་པའི་ཐབས་ལམ་ལྟ་བུ་དང་ཚན་རིག་སློབ་སྦྱོང་གཏིང་ཟབ་བྱེད་པའི་ལག་ཆ་ལྟ་བུར་སློབ་མ་རྣམས་ལ་ཉམས་ཞིབ་བྱེད་པའི་གོ་ སྐབས་བསྐྲུན་རྒྱུ་རེད།

INTRODUCTION

What is science? Why does the scientific method work? How do the pieces of scientific puzzles fit together? How do the answers to these questions differ across cultures? What can we learn from understanding the significance of these differences?

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The Emory-Tibet Science Initiative, a science education collaboration between Emory University and the Library of Tibetan Works and Archives, provides an opportunity to explore multiple perceptions related to these questions and to situate them in the context of teaching and learning science (1, 2). Since 2008, dozens of science professors from around the world have traveled to Tibetan Buddhist monasteries in India to teach during intensive summer sessions (Fig. 1).

Twenty-four of these monastic students have also taken two years of science classes at Emory. These monks and nuns then return to their institutions as science teachers, curriculum developers, and leaders of research projects. They connect their learning experiences at Emory, their continued relationships with fellow scientists, and science texts written by Emory scientists and translated into Tibetan with the needs and interests they identify at their respective monasteries and nunneries.

THE INITIATIVE

History and driving principles

The Dalai Lama invited Emory to develop and teach a comprehensive, rigorous science curriculum for Tibetan Buddhist monks and nuns. In the preparatory stage of this project, we investigated the cultural and educational background of Tibetan Buddhist monastics as well as their methods for studying and learning (3, 4). After two years, teams of faculty traveled to Dharamsala in the summer of 2008 to initiate the six-year pilot phase of the newly developed curriculum.

While monks and nuns in these classes were highly educated in logic and Buddhist philosophy, most did not have experience with contemporary science. The incorporation of these disciplines into monastic training is the most significant change to the Tibetan Buddhist curriculum in 600 years (2). The next five years of the project were dedicated to teaching the pilot versions of each year of the curriculum to two cohorts of monks and nuns who traveled to Dharmasala each summer from their monasteries located throughout India.

In 2014, we moved the revised program into three monastic universities in south India. As of summer 2018, the first five of six years of the curriculum were active, with over 1,000

FIGURE 1. Tibetan Buddhist monks at Sera Monastic University.

monastics engaged. During the summer science intensive, students are in class four and a half hours per day, six days a week. Seven instructional days and one day for the final exam and review are allotted for each of the topic areas: physics, biology, and neuroscience for all students (Table 1). First-year students have an additional class discussing the philosophy of science to bridge their training in philosophy with their science education. Learning is formatively assessed through group activities, class discussion, debate, and student presentations. Each class is led by a teaching team consisting of two visiting faculty, two translators, and a monastic teaching assistant.

As the monastic science curriculum has been iteratively refined and taught over the past decade, the following driving principles have emerged as priorities for teaching and learning in Tibetan monasteries. We propose these as a model for effective cross-cultural teaching writ large.

1. **Establish connections between complementary systems of knowledge**
   The Dalai Lama's interest in neuroscience and its commonalities and complementarities with the centuries-old traditions of meditation and mind science among Tibetan monastics first suggested the potential power of engaging Tibetan Buddhism with the process of science. This partnership can provide a deeper understanding of how the mind works and perhaps new insights and interventions to relieve suffering.
2. **Determine the value of specific knowledge in the context of the community**
   The Dalai Lama realized that in order for Tibetan culture to survive, it was vital to incorporate modern science into the education systems of monastics and lay Tibetans. Thus, it became crucial to evaluate the types of knowledge that are most important for our students to emphasize science as a new and complementary tool for understanding the world.
3. **Foster sustainable education practices that allow for a dynamic curriculum**
   Ultimately, science topics will be fully integrated into the monastic curriculum and knowledge will be assessed as part of earning a monastic Geshe degree (equivalent to a PhD). To accomplish this, we strive for monks and nuns to obtain full ownership of the project.

Here we focus on elaborating how putting these principles into action in Tibetan monasteries and nunneries halfway around the world transformed our approaches to the teaching we do in the United States.

How has teaching monastics in India changed the way we think about teaching?

Inclusivity. Traditionally, diversity and inclusion efforts in science education have focused on bringing underrepresented

TABLE 1.
Curriculum map for all subjects and years taught.

	Philosophy of Science	Physics	Biology	Neuroscience
Year 1	Introduction	Introduction	Introduction	Introduction
Year 2	—	Mechanics	Evolution	Perception and Vision
Year 3	—	Properties of Matter, Heat, and Sound	Genes and Cells	Neurons
Year 4	—	Electricity and Magnetism	Physiology and Development	Emotion and Memory
Year 5	—	Atomic and Nuclear Physics, Relativity	Immunology and Disease	Mind/Body and Internal Regulation
Year 6	—	Cosmology	Epigenetics	Cognitive Neuroscience

students into pre-existing frameworks for learning science. Another way to think about inclusivity is to allow for and encourage students to draw from their diverse backgrounds and integrate that knowledge and experience into the ways we make, build, and use knowledge both within and beyond the classroom. Scientific research is shaped by who is doing it, when it is conducted, and the cultural context in which it takes place. The experiments conducted and the approaches used are constantly evolving. We should encourage student participation in this complex process. The more different our students, the greater the variety of ideas—and the richer our science (5–7).

How should we best engage all cultural backgrounds in the room? Horowitz *et al.* note that culturally responsive teaching arises from the intersection of instructor knowledge of content, pedagogy, and students themselves (8). When each of these is considered in relation to one another, instructors may more effectively guide their students in forming personal, meaningful connections to the science. Such connections increase motivation in learning (9). In the United States, a diversity of methods for engaging students from a variety of backgrounds have been implemented and assessed. Examples include writing to learn (10) and innovative approaches to teaching evolution (11, 12). These teaching techniques have been used in science courses at the monasteries and have been shown to be effective in class through formative and summative assessments.

In describing the distinction between correlation and causation, the monks and nuns have many questions (2). According to Buddhist philosophy, everything at some level causes everything else; so, in a sense, there is no difference between causation and correlation. Backing up and exploring this difference and its implications and possibilities for *which* questions we ask in science and *how* we ask them was essential and changed the direction of our teaching and the way we ourselves thought about the science. We now include discussion of different types of causes and causes at different levels of analysis. For example, in Buddhism there are substantial causes and contributing causes. A substantial cause refers to the actual material substance that composes an object while contributing causes provide the action (13). While we may not typically think of nucleotides as the *cause* of DNA in Western science, in this case, we may describe the nucleotides as a substantial cause and DNA polymerase as a contributing cause. Considering the levels of cause ultimately provides a framework for deepening mechanistic understanding of science for all students (14). Loss of a tumor suppressor gene may cause cancer. Knowing this level of cause does not provide information about how loss of the tumor suppresser gene actually leads to the development of cancer. We may also want our students to consider the cause that resulted in loss of the tumor suppressor gene in the first place. By encouraging our students to look at events both upstream and downstream of the event of interest, we will cultivate a more holistic view of scientific phenomena (15).

Rather than employing linear descriptions, Buddhism more often refers to the cyclical, interdependent nature of events. This cycle-based framework provides a new metaphor for teaching aspects of biology; for example, the actions of the immune system. Monastic scholars, who promote nonviolence, do not optimally connect with the traditional description of immune cells attacking and killing invading cells. Thinking about the immune system as a cycle of life, death, and sacrifice, where some cells die to improve the overall wellbeing of an organism, is another way to consider the same scientific information in a different light. One can see here how rethinking tumor suppression or immune cell action, as just two examples, is not just a matter of semantics or only relevant to monastic students, but in fact could change both the way science educators teach these topics and how scientists ask questions and design experiments in these areas.

Content in context. Science is not an isolated practice. It is situated in the context of culture as noted above, and in the context of funding opportunities, political climate, the politics of peer-review publication, ethics, and law, to name a few. Removing science from its context limits the potential impact of our teaching. As scientists, we are aware of these factors, yet we often exclude them from our classrooms. We need to identify tensions embedded in scientific content and use them as entry points into teaching moments, rather than ignoring or avoiding them.

The Emory-Tibet Science Initiative presents a unique opportunity to teach the basics of science to individuals who are highly educated, with a solid knowledge base to connect with but little experience with modern science. This inspires the use of teaching strategies that connect fundamental scientific concepts with the pre-existing knowledge and experiences of the monastics. Are bacteria sentient? This question is particularly important in the context of Tibetan Buddhism because any sentient being may be reincarnated as any other sentient being, and if bacteria are sentient, it presents a problem. We have the monastics explore this question using experiments they design as well as the Tibetan pedagogical technique of debate, while teaching the fundamentals of cell biology and cell communication (2). In this way, we have incorporated culturally responsive teaching in our courses by connecting content knowledge with knowledge of our students and the types of questions that are most important to them. Furthermore, once the scientific content has been framed in terms of culturally relevant questions, we incorporate debate as a learning method, as this is commonly used by monastics to deepen their understanding of Buddhist texts.

Reflection space. Consciously or unconsciously, as science educators, we typically try to make our students like us, to 'convert' them to science. This keeps us from an opportunity to meet students halfway and develop their learning skills. The pressure to pack new science into every moment of class can be problematic because it leaves little room for students to consider the material in their own way.

Tibetan translators are key to teaching at the monasteries. Instructors pause after every few sentences while the translator relays the message (2). At first, it seemed as though this process would impede the ability of instructors to teach; having to stop so often would prevent us covering enough material and would interrupt the flow of the class. Exactly the opposite happens—translation creates an opportunity for instructors to reflect on their teaching as it happens and provides a natural space for questions, dialogue, and interaction. Teaching and learning are *enriched* through this process.

As a result of these reflections, we have become more responsive to the dynamic classroom environment. This may mean catching a few more student expressions and providing additional explanation when they are puzzled or more discussion time when they are excited. We have also improved focus on the overarching objectives and goals of the course. Rather than launching into increasingly complex details to fill a quiet moment, we might realize that the students' needs lie in making connections between what has already been learned.

NEXT STEPS

Here we have discussed the impact of the Emory-Tibet Science Initiative on the teaching practices of those involved. Lessons learned from teaching science to Tibetan Buddhist monks and nuns have implications for science education worldwide. We can all contribute to fostering more inclusive classrooms by taking the time to learn what is most important to our students and connecting this with course material. How do you know what is important? Ask them. In doing so, scientific topics will often be placed in a context that is valued by the student. While clearly not all science educators have translators in the classroom, we can become comfortable with the sometimes-uncomfortable moments of silence.

In the future, we plan to expand our analysis to specifically address the impact of the curriculum on Tibetan Buddhist monks and nuns. In the ten-year history of the program, science has now been added as a subject in the general educational mission in the monasteries and has begun to be a part of the year-round courses taken during advanced studies. In 2018, science was included on the Geshe exam—the monastic equivalent of a PhD qualifying exam—for the first time.

As science becomes an integral part of monastic culture, we are moving forward with the next steps of the project. Involving students in authentic research projects is an excellent method for engaging them in the process of science and encouraging questions that do not have straightforward answers (16, 17). Eight research projects in biology and neuroscience have been initiated in the monasteries based on questions developed by the monastics themselves. Topics include the effects of meal-timing on weight, characterizing factors that lead to feelings of anger, and the effects of meditation on blood pressure and heart rate.

There is also the potential to establish research projects related to innovation in education. Some in our project, for example, are looking at how monastics learn evolution and relate it to their previous knowledge, then comparing these results to those from studies of other cultures' evolution education. Given the contemplative, questioning, and reflective nature of Buddhism, one project involves characterization of the metacognitive abilities of monastic students, comparing these with metacognition of students at U.S. institutions, and developing interventions to improve the metacognitive abilities of students based on findings in the initial phases of the project (18–20). The knowledge gained in learning about learning from a Buddhist perspective will not only feed back into the continual changes being made within the Emory-Tibet Science Initiative but will inform the larger goal of teaching science across cultures in all classrooms.

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