INVERNESS RESEARCH

REPORTS FROM THE FIELD

SCIENCE FOR MONKS

Science for Nuns:

Observations of and Reflections on a Nuns Workshop

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Reports from the Field:

Inverness Research supports the Science For Monks program through a process of "groundtruthing" where we help the program articulate its theory and intentions, and then make site visits to the field to check the congruence of theory and field realities. This report is part of a series of Reports from the Field where we ask senior researchers to write about their site visits sharing what they learn from their in-depth interviews, observations and discussions with monks, nun and faculty. The reports are intended to maintain an informal tone and reflect the researcher's impressions as well as the data they have gathered.

Background on this report

This report shares the observations and reflections of Laurie Lopez, a senior researcher at Inverness Research. Laurie attended a Science For Monks workshop held in Dharamsala in October 2017. This workshop was the first to be devoted entirely to nuns, taught by an all-woman Western faculty. In her observations, Ms. Lopez describes the key characteristics of the workshop and identifies a number of ways in which the workshop contributes to the nuns, and to a future group on "nun leaders" who can promote science with their peers. More deeply, it suggests benefits to the Science For Monks initiative, and the monastic education systems for nuns and monks.

Background on the Science for Nuns program

The first ever Science for Nuns program took place in August–September 2017 at the Dolma Ling Nunnery in Dharamsala, India. Twenty-six nuns from six different nunneries took part in the 4-week workshop led by an all women faculty and then participated as panel-speakers during a 3-day public dialogue. The Science for Nuns Program is an effort to include Buddhist nuns in learning science and is a natural offshoot of the Science for Monks (SFM) initiative. http://scienceformonks.org/

The new program is designed to provide Buddhist nuns with an opportunity to learn science and broaden the connections between science and Buddhist philosophy. While small numbers of nuns have been part of previous Science for Monks workshops, this initial four-week institute was the first SFM effort to include only nuns. The monastic education system hasn't always been equitable to nuns and this workshop was an important step in providing an opportunity to women to learn science concepts in a rigorous way supported by an all-women faculty and skilled staff.

Science for Nuns:
Observations of and Reflections on a Nuns Workshop

How this report was written

I am Laurie Lopez, a senior researcher with Inverness Research. Our group has been working with and studying the Science For Monks (SFM) program for over a decade. I traveled to India for the purpose of documenting the workings of the workshop, and to explore its potential benefits to nuns, faculty and future efforts to bridge science and Buddhism.

I have worked with Inverness Research for 15 years and I've had the privilege of observing hundreds of classrooms and professional development sessions over the years. My visit to the workshop was not significantly different than what I'm usually looking for and in this case I was focused on learning about if and how the nuns engaged with the science, the faculty and each other and what supports are in place that allow for this to happen or not.

I attended the workshop for two weeks in the middle of the 4-week Science for Nuns program and observed eight full days of classes. With the help of translators I interviewed the teaching faculty in attendance during my visit and all of the nuns. I had in-depth conversations with the program director on several different occasions. The translators and I also talked informally and frequently about many different aspects of the program. In addition, the faculty and I held an informal evening focus group with the nuns to learn what they thought we should know about them. I observed an evening astronomy event. Through all of these activities and my constant immersion I was able to gather data and more informal impressions about the program and its potential benefits to multiple audiences. I also had an experience that changed my perspective about worms.

Upon return from my visit I worked with Dr. Mark St John, the founder and president of Inverness Research who has extensive experience with Science For Monks, to debrief our findings and formulate this report.

We have structured this report around several different "evaluation questions" which are really prompts related to the goals and potential benefits outlined at the beginning of this report. These questions thus provide a structure for me to report what I saw and heard during my visit to the workshop.

The purpose of this reporting out is thus to provide the reader with a better understanding of the design and implementation of the Science for Nuns program, to

share my impressions and findings about its unique qualities, and put forward some conjectures, based on evidence, about how this program can promote the attainment of multiple goals.

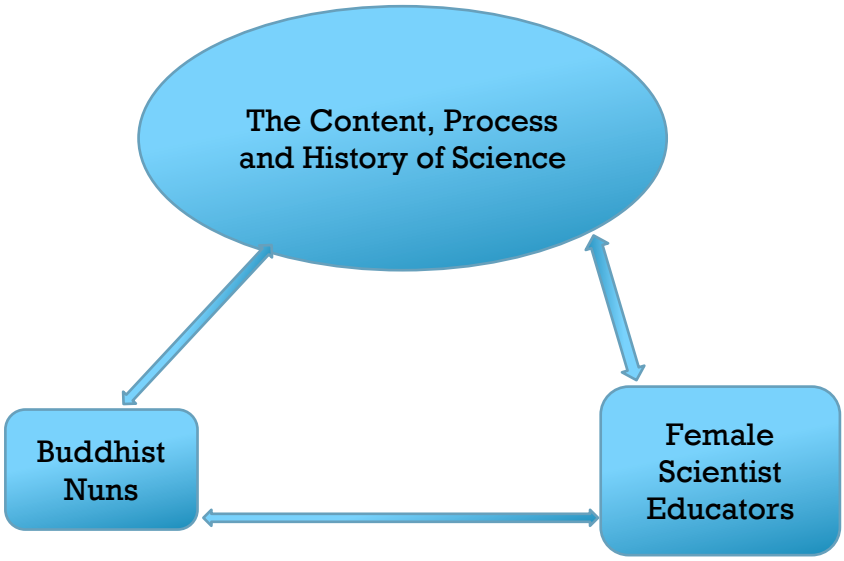
The Design, Structure and Supports for the Workshop

What were the key elements in the design of this workshop?

The design of the Science For Monks program has been iterated and refined for many years to continually incorporate the constructive feedback that has been provided by Inverness Research and others over the course of its 17-year run. The Science for Nuns program builds closely on this foundation and uses the same design principles but with an all-women faculty, the SFM pedagogical strategies – hands-on activities, exploration of important science ideas, learning how science studies the world and progresses, participant journaling and more informal "office hours" – were all included here. The workshop immersed the participants in a very *packed* and intensive 4 weeks of learning science and building relationships.

> *Worms…*
>
> *One late night following a long day that ended with a night sky viewing session with the nuns and the astronomy teacher, I was walking back from the nunnery to the guest house with Jampa, a young translator who was smuggled out of Tibet as a small child.*
>
> *She noticed a bunch of worms trying to make their way from one side of the dirt road to the other. She was genuinely concerned for their safety and did not want harm to come to them. I could see her deeply held Buddhist beliefs – and compassion for all living creatures. Because there was ample evidence of worms losing the battle with two- and four-wheeled traffic, Jampa asked me to hold the flashlight so she could see clearly as she picked up each worm gently with a stick (this is harder to do than you might think).*
>
> *One by one she moved each worm carefully to the other side of the street. This took over an hour (it seemed much longer at the time) – and it taught me a concrete lesson in compassion that will last a lifetime.*

The Science for Nuns program is designed to do more than teach science to nuns. Its hope is to build a triangular relationship between the Buddhist nuns, female educators, and science itself.



This relationship triangle is based on the work of Martin Buber and David Hawkins. Both describe the power of the *I–Thou–It* relationship. Each relationship is strengthened by the existence of the others: the relationship between nuns and educators helps nuns strengthen their own relationship with science; the relationship between scientist educators and science is motivational to nuns in terms of building their relationship with the educators as well as their relationship with science itself. The workshop can thus be seen as an effort to simultaneously develop all three legs of this relationship triangle.

In this way the workshop goes beyond simply teaching science to a group of nuns. Rather it becomes a long-term effort to create a cohort of nun science learners and leaders that will continue to grow and develop in the future. The long-term goal is to unlock the potential that the nuns can have in shaping their own world and also in contributing to the broader world.

How was the workshop structured?

The workshop was held at the Dolma Ling Nunnery, a non-sectarian nunnery funded by the Tibetan Nuns Project. It is nestled against the lower Himalayan Mountains in Dharamsala, India.

The nuns attended class in a big, airy room above the Buddhist temple which provided ample space for the nuns to be seated in table groups with room to move about, work on the floor, reconfigure in numerous ways, as well as providing room for all of the necessary supplies and the support team of translators and staff. The power was interrupted at times, and although the faculty was made aware this could happen, most of the time it happens without warning. The faculty was adaptable, prepared, and quick to respond to challenging situations that emerge – such as teaching without power.

The nuns learned about biology, astronomy, physics, neuroscience (brain basics), and the Science of Happiness over the course of the month. The daily and weekly structure of the workshop was constant throughout the 4 weeks and provided a routine that created a sense of continuity during the workshop. For two weeks the nuns would delve into two areas of science while spending part of day learning about each. Then for the next two weeks they studied two other areas of science in the same way.

The faculty taught lessons and activities that they've used multiple times with their own students and audiences back home.

The structure of this workshop looks different than either a high school classroom or a college classroom. It's a blend of both – introductory material, hands on, challenging lectures, discussion groups, and projects to engage with.

Evenings provide flexibility to offer more *office hours* that were scheduled twice a week throughout the workshop. Office hours were a chance for the nuns to ask the faculty anything – whether it was something they didn't fully understand or perhaps weren't comfortable asking during class. These meetings also provided additional opportunities for Nuns to share with the faculty and increase their learning.

Time was built into the schedule for the nuns to reflect and write during a journal writing time at the end of most of the sessions. The nuns participated in many inquiry activities throughout the workshop and they would write in their journals as a way to process and make sense of their inquiries and investigations. (We note that such reflective writing is not common in traditional Buddhist studies).

On the weekends the group would take an outing together. During my visit the entire group took a trip to McLeod Ganj and walked the Kora, a sacred path around the home of the Dalai Lama and visited the Buddhist Temple.

What were key supports for this workshop?

The supports in place for the Science for Nuns program enabled the nuns and faculty the best possible arrangement for a robust learning experience.

A key reason that the program can create what it does is by having a program director that holds the vision of the project and eliminates anything that deviates from the core design principals.

Selecting excellent faculty, building a cohesive staff including gifted translators who have been together for years, and locating a beautiful setting with a big, bright classroom provided this workshop with all of the elements necessary for creating an optimal learning atmosphere for the nuns and teachers.

The Tibetan Library and Nunneries all contributed by arranging the logistics, the participation of the 26 nuns, the translators, support staff and equipment.

Given the amount of time and resources required to successfully plan and run the 4-week workshop (including the whole group weekend outings) it's remarkable that it could all take place for less than $100,000.

Summary Reflections on the Multiple Contributions of the Nuns Program

Based on my experience in this workshop, and on our previous experience in studying Science for Monks events, and on the stated goals of the program, we suggest that the Science for Nuns program is contributing to the following short-term and long-term goals.

1) Nuns understanding and appreciation of science: The workshop clearly was effective in helping nuns learn (for the first time) science – and appreciate both its content and its process.

2) Nuns experience of new ways of learning and a new interest in teaching and learning: The workshop exposed the nuns to many novel ways of learning beyond the monastic traditions. They became aware of and interested in different pedagogies and instructional approaches.

3) Development of leadership for future education efforts targeted toward nuns: As with Science for Monks, individuals emerge who have the interest, motivation and skill to continue their own learning and become positioned as leaders for future Science for Nun efforts.

4) Creating opportunity for participation of nuns in future Science for Monks programs and centers: With this foundational training nuns will have more confidence and knowledge allowing them to participate in future SFM And Emory efforts.

5) Allowing nuns to contribute their unique perspectives to western faculty (scientists and educators) vis-à-vis natural philosophy, ethics, logic and Buddhist teachings.

6) Benefiting the educators who serve as faculty for the nuns: They learn from teaching these model students as well as gain access to a Buddhist perspective on the world.

7) Furthering the development of the Science for Monks Initiative: This effort clearly was educative for the SFM program in terms of learning how best to reach and engage the

nuns in science education – a challenge to date for the program. The design lessons learned here can be applied not only in India but also across Asia.

8) Strengthening the monastic education system for nuns (and monks): This is a first effort to broaden and "modernize" the curriculum within the Monastic education system.

These contributions are all explored in the following dialogue, which is structured around questions we asked ourselves about the workshop.

QUESTION 1

1) To what extent and in what ways does the workshop help the nuns engage with and learn about science?

- Nuns understanding and appreciation of science: The workshop clearly was effective in helping Nuns learn (for the first time) science – and appreciate both its content and its process.

The nuns are keenly aware of the Dalai Lama's desire for them to learn science and rather than being resistant to new ideas they eagerly embraced the opportunity to challenge their previous understanding of the world through the investigation of science.

The nuns were engaged in learning about human health, biology and physics in the 2 weeks before I arrived. During my visit they learned about astronomy, biology, the philosophy of science and the science of happiness. I saw a wide range of fun and engaging lessons where the nuns were able to engage with important ideas about topics such as matter and energy, the carbon cycle, photosynthesis, exploration of the solar system and the timeline of the earth.

Almost everything the nuns learned was new to them. Everything. For example, the faculty who arrived before I did and taught human health told me later that they were shocked at how little the nuns knew about their own bodies. The nuns were hungry for information about common female maladies such as menstrual cramps and bloating. The nuns were able to jot down questions and pop them into the question box and the faculty would address them either before the next class or during office hours.

Sample of the range of questions added to the box during the workshop

- Although the plant grows, does it have life or not?
- Will a seed grow into a plant without water and sun?

- If we intake large amount of lemon, will the color of our blood change? What chemical is needed to change sound?
- What is the cause of fire? What comes first among the four elements? Do the scientists believe that the world will be completely destroyed by disasters and start again?
- Are stones living beings? If so, living beings are born and they die but stones don't.
- Wheat flour becomes fluffy upon adding baking soda but not when sugar is added. Why? We also see bubbles when baking soda is added. Why is it so? Will the human body swell if they consume yeast or sugar?
- How does the improvement in science affect our mother earth?
- What is the main function of our brain?
- What are the functional differences between our mind and brain?
- Why does February sometimes have 29 days?
- According to Buddhism, early men had natural light emitting from their bodies. Do the scientists believe that?

The nuns told me that they want to learn science because His Holiness wants them to receive a modern education, and they believe there is a connection between science and Buddhism. I also was told by a handful of nuns that while they say they are confident in their study of Buddhist Philosophy, they feel they lag behind in reasoning around other topics, especially science. Nuns shared that at times they see similarities between Buddhism and science and gave me the example of the concept of interdependence among all the organisms. At other times they noticed real differences in the world views of science and Buddhism – for example, science claims that most functions are carried out by the brain and nervous system, but in Buddhism it's mind and consciousness.

The nuns took the journal writing seriously and would often be seen going back through their journals to add to their thoughts or to ask questions during class or later during the office hours. Occasionally I even saw nuns find photos of the PowerPoint slides from the faculty presentation on their phones (for those who had them) to ask questions and dig further into topics they were curious about. During office hours the nuns would gather in closely around the faculty to pursue questions that frequently led to rich and engaging discussions.

The desire to learn science has only increased through the experience of participating in the workshop and all of the nuns I interviewed expressed interest to continue learning about science. There are many topics they're interested in, but the main areas in which they'd like to learn more about are: the brain, biology, physics, astronomy, and human physiology. Not surprisingly, these are the topics the nuns learned about during the workshop, but some topics are more personal. For example, a nun tells me that she wants to learn more about the conditions in which plants can grow better because they

don't grow as well near her home. She says that learning about plants is important because "we get everything from plants: shelter and food."

A vignette from an astronomy lesson with Vivian White

The nuns are in their table groups and take the ball of dough that they've been given and break it into 2 pieces: 1 to represent the earth and the other to represent the moon. A nun from each table is asked bring their "earth" over to the wall. Another nun from each group is asked to put the "moon" at the distance it should be – given the scale size of the models. The nuns place the "moons" in various distances from the "earths."

Vivian explains to the nuns that they're going to make the actual scientific measurement. She hands each of the five groups a ball of dough the size of the "earth" and asks them to make 10 balls so that altogether the whole group has made 50 very small balls. Vivian takes out one ball (of the 50) and asks the nuns to gather the remainder of the dough into one ball.

"So if we measure the difference in volume it's 49:1 earth to moon." Vivian lets this sink it. She then shows the nuns that the earth is 4X the diameter of the moon. And says, "let's talk distance. You could fit 30 earths in between the earth and moon. How would you figure out a way to decide how far apart to put them?

The nuns excitedly talk among themselves and then share out their approaches. One group confidently claims, "measure the diameter of the earth and multiply that number by 30." After figuring out that the diameter is 11 cm Vivian asks the nuns to think about how far away they should put the moon. They measure and it turns out that 330 cm is much closer than their original guesses.

The workshop takes place right after the solar eclipse on August 21 and the nuns are curious about what causes lunar and solar eclipses so Vivian now addresses this by saying, "it's actually much harder for the earth sun and moon to line up" and next each table group makes a much smaller earth and moon model to the correct scale size using what they just learned.

After creating their scale models of the earth and the moon the nuns are asked to figure out how far apart they should be at this scale.

The nuns are measuring and discussing and arguing and very actively engaged in trying to figure this out. Vivian and the translator, Karma, are check in with each group until everyone has been successful and has accurately calculated the distance of 30 to 1 and been able to place the scale models of the earth and sun on their yard sticks.

Next everybody goes outside to create a model of size, distance and motion altogether. The nuns try to line up their model with the sun, known as *Nyima* in Tibetan, to make an eclipse. They move about the courtyard of the nunnery trying to create a solar eclipse and a lunar eclipse.

The nuns ask a variety of questions during this activity, for example…

Is the moon alive?

How come eclipses don't happen more often?

If the moon is solid how can craters be made?

If the sun is made of atoms where does the light come from?

Back inside the nuns draw the two types of eclipses that they created outside. Vivian makes a diagram and explains that the earth rotates around the sun on a flat plane and the moon travels in a slightly tilted plane so most of the times that moon with be above or below the sun when it passes and that an eclipse happens when their orbits line up. Vivian then turns on a light bulb and shows the nuns one more time what they just did outside to reinforce their learning.

The nuns have been fully immersed in the activity and before class ends they write and draw what they have learned in their journals. It's quiet except for the sound of writing.

Thoughts from the nuns

In past times nuns only did rituals and didn't have the opportunity to learn science or philosophy. His Holiness says the monastics should learn science and the now the nuns have the opportunity to become Geshema. Then they will go outside to teach and we will have to teach foreigners who don't follow Buddhism and they will be able to relate to them better.

The Dalai Lama has been asking us to be a 21st century Buddhist and you need to learn science in order to do that.

In Buddhism love and compassion are important but even more important is improving your mind.

You've taught us about biology, physics and astronomy. We have these things in Buddhism but learning them through science is helpful to understanding Buddhism.

In Buddhism we use reasoning and logic but in science we get to learn by experimenting. In Buddhism we use inference and observation so they are similar.

Since we're learning Buddhism and Buddhist philosophy we have to know what the similarities and differences are between them.

There's a connection between science and Buddhism and the relationship to the environment.

In science there are subjects such as evolution that are also in Buddhism and so it's related.

Since His Holiness implemented the Geshema program science is very important and we need it to be able to cope with the modern world.

QUESTION 2

2) What did the nuns learn about teaching and learning?

- Nuns experience new ways of learning and develop a new interest in the design of teaching and learning: The workshop exposed the nuns to many novel ways of learning beyond the monastic traditions. They became aware of and interested in different pedagogies and instructional approaches.

It is important to understand that monastic Buddhist education is very traditional and hierarchical. Students learn from the sutras and from their "teachers" – older monks who have decades of experience studying Buddhism. While they do engage in dramatic forms of debate and discussion, they do little that would be called inquiry, or hands-on or self-expressive

The nuns overwhelmingly told me that they found the doing of activities and experiments to help them learn in new ways that are easier and better. For the few who have attend the Emory program they say that it helped reinforced what they have learned there. They report understanding the concepts more deeply by being able to do the modeling. By contrast, the nuns tell me, when they study scripture it requires a high level of concentrative effort – but in science doing activities in the workshop helps capture their attention; they tell me they learn more this way.

Some nuns said they had heard science was difficult, but they feel that if students were taught in the way that they're learning during the workshop that it wouldn't be so difficult. The nuns repeatedly tell me that doing the experiments on their own makes the learning more meaningful and as one nun said, "helps me to keep it in mind more." Several nuns said that workshop makes science more visual and practical so when then go out to teach others, as Geshema, they can use these techniques.

As part of the workshop the nuns engage in group and collaborative learning – also a relatively new experience. There is affection among the nuns and also with the faculty and staff, and this joyful affinity infects the classroom environment and everybody in it. The rapport with the interpreters is special and adds a layer of warmth to the classroom culture. The program director and the translators have a gentle way of joking with the nuns that gets them to relax and open up and be more comfortable. The nuns work together, share ideas, ask questions of one another and appear to delve deeply into the ideas. The workshop gives the nuns the rare chance to interact with nuns from different nunneries and get to know each other, learn from each other and enjoy each other's company. (The relationship triangle is strongly in place here.)

More thoughts from the nuns

You made us draw things and do things and it helps us to remember better.

Before I didn't have the idea about the sun being at the center of the universe... but now I have learned that the earth is moving around the sun and also I now understand about the lunar and solar eclipse… people had the belief that something ate the moon but it's actually the shadow between earth coming between the moon and the sun.

I used to believe that the world is flat but now I learned that it's spherical. I always wondered why we didn't fall off and now I understand about gravity.

We have knowledge and wisdom but we don't have the confidence to share. How can we gain confidence?

If you have a workshop with the monks it has its own benefit because they are Geshe and you learn Buddhism from them. But the bad thing is that you can't speak up… but you can speak up here.

I am more comfortable and don't feel shy when I have a question to ask and I don't have to consider the question before asking.

You taught us about biology, physics and astronomy and we have these things in Buddhism, but by learning them through science it is helpful to understanding Buddhism.

QUESTION 3

How did this workshop position the nuns for future science learning and leadership efforts?

- Development of leadership for future education efforts targeted toward nuns: As with Science for Monks, individuals emerge who have the interest, motivation and skill to continue their own learning and become positioned as leaders for future Science for Nun efforts.

It's clear that the nuns are interested in learning science and that they will likely share their enthusiasm with others in their nunneries. It also becomes apparent which of the nuns are more comfortable leading their peers, sharing findings with the larger group and taking on more responsibility within the group. During the course of the workshop these nuns emerged as potential future leaders for upcoming workshops and some of them also presented at the 3-day conference held immediately following the conclusion of the SFN workshop.

One nun said that participating in the workshop enriches her education and that not only is she learning for herself but, "*if I tell this information to my nun friends I might be able to get them interested to take part in science programs."* And perhaps more importantly many nuns tell me that being exposed to science helps them understand the world around them better. For example, one nun said she never understood what caused day and night and now she does.

QUESTION 4

How do the Faculty benefit?

- Benefits to the educators who serve as faculty for the nuns: They learn from teaching these model students as well as gain access to a Buddhist perspective on the world.

The educators have traveled thousands of miles to be in India and have left families and work responsibilities at home. It's not an easy thing to carve out 2-3 weeks away and yet the faculty chooses to do this work because they too find great benefit in doing it. The educators say that it's an honor to work with such joyous, willing students and to learn from them about how Buddhist Philosophy influences the way they perceive the world.

Teaching nuns in a nunnery in India is a special opportunity for these educators. Not only is it exotic and unusual to be in such a different world, the faculty also point out how different it is to teach a group of women who are ready and willing to try anything. This can be quite different from the teaching situations that some of the faculty face at home. Here in India there is tangible interest and support coming from the nuns to the teacher as the lesson is happening. There is almost infinite patience and willingness on the part of the students to do what they are asked to do. There is wholehearted engagement without concern for "grades."

The nuns, as with their counterparts the monks, are in many way ideal students. The faculty will tell you that teaching the nuns is a best-case scenario. The nuns are curious, attentive, engaged, generous, and kind. They eagerly participate in all of the activities, stay focused and on the task while being alternatively playful and serious. They transition from activity to activity smoothly. Their attention span and focus are truly extraordinary.

For example, in one activity the nuns gathered outside to use their traditional Buddhist debating skills to debate two views of the universe: the geocentric (earth at center) or heliocentric (sun at center) view. During the debate the nuns were loud, rambunctious challengers and defenders employing the ritualistic clapping and stamping and yet as soon as they stepped into the classroom they were totally focused and ready to go.

When a nun asks a question of the faculty the others remain silent while she asks her question and listen attentively for the response. This is a revelation to teachers used to a much more distracted audience of students.

Some faculty have said that the monastics make ideal learners so *if your lesson bombs here, there's no one to blame but yourself.*

One evening the faculty and I hosted a voluntary focus group with the nuns to find out from them what they felt we could learn from their unique perspective. Not surprisingly all of the nuns showed up even though we didn't begin until 8pm. What transpired was an interesting discussion about consciousness and what science believes about consciousness in the context of doing an experiment that involved using snails in the sealed bio jars that the nuns made during a lesson on the cycle of matter. In a mason jar groups placed water, soil, plants, and snails and then had sealed the top. Some of the nuns were afraid that the snails would die and they believed the snails had consciousness and were therefore living creatures because when they touched the snails they shrink back into their shells. "That shows that they yearn for happiness," explained a nun. Vishnaya, the philosophy of science professor said that we don't know if that's an automatic reaction like moving your hand when you touch fire. The nun responded that it's a message from the consciousness. This led to a conversation about the nuns holding two dissonant ideas i.e., that science says plants are living, but that in Buddhism plants aren't sentient beings and are therefore can't be alive. The nuns told us that we should know that in Buddhism love and compassion are the foundation but most important is improving one's mind.

The faculty enjoys the rare opportunity to work intensively with other faculty. (In the case of human health and biology there were two teachers handling the topic and working intensively together on the activities and design of the lessons.) Teaching can be an isolating experience at times but the Western teachers found this experience to be invigorating and rejuvenating. Here the teaching is more communal.

The support and connection with the translators is another interesting experience. Faculty finds that they must be very precise and limited in their language, as everything must be translated. This is often seen as a useful exercise and good discipline as educators must not be excessive or sloppy in their presentations, explanations or answers to questions. t is also a powerful experience to realize that the learning issues and benefits are the much the same – no matter the language or difference in culture.

Overall there is a real sense of camaraderie among the faculty, staff and the nuns. There's a sense of working toward a larger purpose and doing it together.

As an aside, if a program such as this one can keep folks in the teaching profession for longer that is a tremendous benefit.

Thoughts from the Faculty

Being in the classroom (with the nuns) and having the chance to teach – and then reflect – really changes how I teach.

It's really cool for me to get to collaborate with another teacher and that's a huge learning experience…

I'm interested in the intersection of science and spirituality. The astronomy I'm studying and teaching is relevant to very ancient ideas and traditions. I am interested to see how this science is intersecting with the nuns' spiritual beliefs and practices.

The nuns' prior knowledge is so different and the way they conceptualize things is fascinating. It reinforces in me the importance of accessing and connecting to your students' prior knowledge.

QUESTION 5

How did this workshop further the goals of the overarching Science For Monks initiative?

- Furthering the development of the Science for Monks Initiative: This effort clearly was educative for the SFM program in terms of learning how best to reach and engage the nuns in science education – a challenge to date for the program. The design lessons learned here can be applied not only in India but also across Asia.

This workshop was an experiment for SFM. Following up on their research and talking with many nunneries, the program decided to try a single-sex design focused on creating a safe and empowering learning environment for nuns.

According to two of the faculty that have previously attended the Science for Monks program, the monks are much more confident in sharing their ideas and opinions in class. In the past when there have been nuns participating with the monks the nuns have been much over-shadowed by the monks. The nuns are meeker and less prone to asking questions or sharing their thoughts in the presence of monks who they see as more knowledgeable in science. In my discussions with the faculty, they do confirm the benefits of the single sex educational environment, which allows for the development of relationships, and space for nuns to express themselves.

The all-female faculty was a benefit to the nuns in many ways. The nuns reported to me that they feel more confident being in class with only nuns (no monks) and female faculty. For example, one nun said, when learning about human health they were able to ask the teacher questions that they wouldn't feel comfortable asking a male teacher. Many nuns are extremely shy, and we heard that with female teachers the nuns feel more empowered to ask questions without considering the question before asking. They feel more comfortable and are therefore able to share and speak more liberally than if men were present and would have found it especially difficult to open up on some topics in particular about women's health. When they are with monks (who they think have more knowledge), they are afraid they might say something wrong and they often feel intimidated. Here they can speak freely; I can see them grow more confident day by day.

The women educators brought to India for this program were experts from many backgrounds. The faculty ran the spectrum from a philosophical college professor to science museum educators; the pedagogy ranged from college lecture to the hands-on approach of the very best high school teachers. The faculty understands their content areas deeply, but what they are teaching is much more than a typical biology, astronomy or physics class. True to the relationship triangle they are developing an affinity for the subject area, an interest in learning how we learn, and in building relationships along the way. The rapport that was developed in the classroom among the nuns and between the nuns, educators and staff was key to lessening the inhibition of many of the nuns who initially were hesitant to speak but over the course of the workshop became increasingly more confident and at ease.

Another benefit to an all-women faculty is that they serve as role models and help the nuns to broaden their ideas of what women can do. You can't be what you can't see.

I think that the mix of experiential science learning and the access to talented women is a very novel and powerful motivator for many of these nuns. And in the case of one faculty member, the experience can create meaningful relationships that can transcend the enormous distance through an iPhone. The teacher has developed a deep connection with several nuns who she grew close with during the workshop and most especially during the group outings. She was then invited to meet one of the nun's families high up in the mountains. The nuns continue to email their beloved teacher daily. The value of this Eastern/Western relationship is one more example of the relationship triangle.

The Science for Nuns program has carefully identified talented and highly skilled teachers. The success of the workshop hinges in large part on the deep content knowledge and savvy pedagogical skills of the educators and they go to great lengths to create meaningful activities that will develop and cement foundational conceptual ideas in the nuns. The activities are ones they've usually used many times with their own students so it's interesting and insightful for the Western faculty to compare the

differences between the pre-conceptual understandings of the nuns compared to their students back home.

The Science for Nuns Program design and the structure for running a fully realized workshop are now part of the skillset that the program director and the staff have going forward. And certainly everything that has been learned by the experience with Science for Monks has also been incorporated into the Science for Nuns and so capacity is already built. Now that the first workshop has been tried with the nuns the capacity is further strengthened.

QUESTION 6

What might be the long-term contributions to the monastic education system?

- Strengthening the monastic education system for nuns (and monks): This is a first effort to broaden and "modernize" the curriculum within the monastic education system.

Benefit to the Tibetan language and monastic traditions

One important idea (that was shared with me by one of the Tibetan translators) was that "there is more to this program than science," that in fact it's the science combined with the Tibetan language that makes the workshop so meaningful. In order for the Tibetan language to continue to exist it must incorporate modern scientific language.

Monastics could potentially make new discoveries from bringing their unique perspective and training in Buddhism to concepts like quantum mechanics.

The nuns are eager for more educational opportunities and this program was something they are immensely grateful for.

In order for the nunneries and monasteries to remain relevant in the future they will need to continue to attract people to the monastic tradition. Offering rich educational opportunities is an important way to continue to do that.

The women monastics bring values and perspectives that could be very influential to science, but most of the nuns participating in the program have never been exposed to science and hold many misconceptions about the world. In order to address the deeper question about how the philosophical ideas of science and Buddhism might combine to impact the world in a positive way it's necessary to access the potential and power of the other pillar of the monastic community, the nuns. And to do that they need to have the opportunities granted to monks. The historical underpinnings of their traditions have the potential to provide powerful insight into our world by including science to the

unique way in which the nuns, trained in Buddhist philosophy, approach the understanding of the world and our place in it.

A Few Summary Thoughts

- The Science for Nuns workshop was run well and has clearly benefited from the years of experience of the running the well-designed Science for Monks program.

- There is a lot of potential for future programs and the program director and staff is well positioned to continue to develop this strand of work.

- The educators were not only knowledgeable in their fields of study but were empathetic and deeply interested in the nuns as people and this helped build relationships among the faculty and nuns and staff. The fact that they were all women greatly enhanced the experience of the workshop for the nuns.

- The size of the group seemed to be ideal, and the fact that it's not too large creates intimacy and relationships that might not occur in a larger or more formal setting.

- There is a special learning environment created when you bring together the nuns, the faculty, and interpreters into a close community with the focus and purpose of learning science together in a hands-on, experiential way. The culture created in that setting allowed for optimal learning because the nuns became increasingly more confident and comfortable as time passed; many became less shy over time and were able to open themselves up to the experience wholeheartedly, taking risks by sharing and asking questions.

- The importance of doing activities and talking about them and sharing understandings together increased the learning for everyone and this workshop exemplified what can happen when all of these things come together.

- Overall, it is clear to me that this first-ever science workshop for nuns was a rousing success.