ETSI BIOLOGY SYLLABUS

Life Sciences Learning Plan
Emory Tibet Science Initiative
Arri Eisen

Overall approach

Life context

Our six-year curriculum strives to teach the basic concepts of biology and the life science in the context of the monastic life. People learn better if they engage in information relevant to their lives; additionally, given the unique nature of this project, we are searching for areas where biology and Buddhism complement and enhance our understanding of life and living.

The Life Sciences curriculum also sets the stage for the higher level, synthetic discipline of Neuroscience, which the monastics engage.

Thematic contexts

For all areas we teach in biology, we integrate them into two conceptual or thematic contexts: the 'living staircase' of biology and the central themes of biology.

The living staircase refers to the integrated steps moving from atoms and molecules, to cells, to organs and tissues, to organ systems, to organisms, to populations, to ecosystems. All biological information fits into this staircase and affects all the levels.

All biological information also resonates with one or more of these central themes: evolution and natural selection, similarity and diversity, communication, energy flow, structure and function, emergent properties, and homeostasis and regulation.

Experiential/experimental context

Throughout we teach biology as a series of historical, curiosity, and hypothesis-driven questions. How do scientists ask and address questions? How do we design experiments to test those questions? And how do we evaluate what we find? How is this process different and similar to monastic approaches to questions?

The monastics actually develop their own hypotheses, design experiments, carry them out, and analyze their results.

One area, for example, of profound differences and similarities between science and Buddhism comes in the discussion of the differences between correlation and cause and effect.

Pedagogical approaches

The life sciences curriculum—given our approach to teaching science as outlined above—is by its nature taught in a more informal, conversation style. We use the chalkboard to develop ideas, have the monastics working in small groups to test, design, and present ideas and models.

It's not just content and context we are learning from the monastics and they from us, but also pedagogy. We have adopted and adapted the monastic tradition of debate as a central tool in our teaching.

We are learning better approaches for teaching complex issues in science and religion (and science and belief and ethics) in the United States.

Year 1
Central Questions:
•What is biology?
•Why might monks want to study biology?
•Why might scientists want to learn Buddhism?
•What are the central themes of biology?
•Why do we study biology?
•What is the experimental approach? How does it work? What are its limitations?
•How are science and belief similar; how are they different?
•Review of what's to come in this curriculum:
--Evolution and natural selection
--Genes and cells
--Physiology and development
--Immunology and disease

Year 2: Evolution
Central questions:
•How did life originate?
--How could this be tested?
•How did Darwin come to his ideas?
*Using the rapid adaptation of Tibetans to the high altitudes of the Himalayas
•What is natural selection?
•How do organisms and the environment interact?
•What do we mean by 'the environment'?
•What is adaptation? Mutation?
•What is a population, and how can it change with time? Why might it?

Year 3: Genes and Cells
Central questions:
*Using the driving question of 'Are bacteria sentient beings?'
•Moving down the living staircase from populations to cells: what is the cell theory?
•What are cells and what are their parts?
•How do cells interact with their environment?
•What are genes and what roles do they play in cells' and, therefore, organisms' responses?
•What was monk Mendel's logic in figuring out what genes are?
•How are genes regulated? And how do they encode proteins?
•Design and carry out an experiment to isolate bacteria and test if they are sentient.
•What are the differences between single-celled and multi-celled organisms? How did the latter evolve from the former?

•What are the advantages and disadvantages of multicellularity?
•How and why do cells divide?
•How do genes operate as the 'substrates for evolution'?

Year 4: Physiology and Development
Central questions:
*Using the monks' own physiological responses as drivers:
•How can one set of genes result in a multicellular organism?
•How does a fertilized egg become an organism?
•What is differentiation and determination?
•How do different organs and organ systems develop in the same organism?
•What are the different physiological systems (digestive, immune, nervous, muscular, etc.) and how do they work and interact with each other?

Year 5: Immunology and Disease
*Using as a driver the question: How might meditation increase immune response (as an example of the mind/body connection)?
•How are Western and Buddhist definitions of complementary, similar different?
•What is disease?
•What is the immune system and how does it work?
•What was the logic involved in the experiments of those seven scientists awarded the Nobel Prize (so far) in figuring out the immune system?
•How does the immune system, during development, learn to differentiate self from non-self?
•How are the innate and adaptive immune systems different?
•How are mind and body interrelated in terms of healing? The immune and nervous systems?

Year 6: Synthesis, Review, and Higher level concepts
•At every level the living staircase is dynamic—how is this reflected in genes? Cells? Organs and organisms?
•What are the different environments (micro and macro) with which biology interacts?
•How does biology adapt to change in the short and long term—daily v. developmental v. generational v. evolutionary timeframes?
•What is epigenetics?