7. Statement of Curriculum Proposal

1. Why *Darwin's Drama*?

Fifty years ago, the structure of DNA had just been discovered, the human genome was only being sequenced in pulp sci-fi novels, and the full extent of our modern ecological crisis was barely perceived. In those distant days, it was possible to imagine that the average person could make it through her or his lifetime without needing much of a background in the life sciences. The world today is a very different place. From pandemics to global warming, biological issues are central to many of the major public policy concerns of the early 21st century, while the rapid accumulation of our knowledge of genomics has forced new ethical and existential dilemmas. Biological literacy has more uses today than it has probably ever had before.

Unfortunately, during the past decade the teaching of evolution in American public schools has once again become controversial, and organized groups in several states have attempted to alter science curricula to cast doubts on evolutionary theory. By turning evolution into a topic of controversy, these attacks on Darwinian ideas have polarized debate, turning participants in the discussion into either "enemies" or "defenders" of evolution. This has had several pernicious consequences. Many of the "enemies" of Darwinism have distorted the theory of natural selection in their writings, intentionally ignoring the scientific evidence that has accumulated in the past 150 years; this has made it more difficult for students to identify reliable sources and to even understand what evolutionary theory is about. In the face of these misrepresentations, "defenders" of evolution have closed ranks and mounted a well-coordinated counter-attack. While this defense has in many ways improved public education, it has also made it more difficult to create an atmosphere in which students can think critically about the application of biological ideas. There is a very substantial difference between questioning evolutionary theory, which has great explanatory value, and questioning the uses to which Darwinism is put, which have often been dark and bloody; in our current combative milieu, though, many defenders of Darwinism smuggle an uncritical acceptance of scientific expertise along with their defense of Charles Darwin. With so many of the genomic issues we face involving complex ethical choices, this too can be dangerous.

Darwin's Drama attempts to work around this tricky situation. During Part One of the course, students will learn the fundamentals of modern evolutionary biology. While examining how the theory has gradually developed, they'll see how valuable it has been for answering a wide range of questions in the life sciences. By the conclusion of Part One, students will understand why virtually all practicing biologists today accept evolution. In Part Two, students will be introduced to the historical and cultural context in which evolutionary biology developed. Here they will see both ways in which biological thought has been applied constructively outside of the laboratory and ways in which scientific ideas have been abused to promote unsound policy. While students will spend the first part of the course learning to think like a biologist, they'll spend the second part of the course thinking critically about the philosophical, ethical, and moral quandaries that have developed alongside modern evolutionary thought.

2. Content Objectives

During Part One of *Darwin's Drama*, students will be introduced to the fundamentals of modern evolutionary biology. They will encounter the following content:

I. Classical Genetics
- Mendel's Laws of Inheritance: Segregation, Independent Assortment.
- Punnett Squares: Monohybrid and Dihybrid Crosses.
- Mutations.
- Genes in Populations: Allele Frequencies, The Hardy-Weinberg Equation.

II. Concepts in Evolutionary Theory
- Natural Selection and Adaptations.
- "Non-Adaptive" Traits: Sexual Selection, Kin Selection.
- Mathematical Models of Evolutionary Processes.
- Genetic Drift, Law of Large Numbers, Founder's Effect, Population Bottleneck.
- Mechanisms of Speciation.
- Convergent vs. Divergent Evolution.
- Elementary Cladistics.
- Macroevolution: Biodiversity, Adaptive Radiations, Mass Extinctions, Gradualism, Punctuated Equilibrium.
- The Evolution of Behavior.

III. The History of Life
- The Origin of Life.
- The First Eukaryotes.
- The Development of Multicellularity.
- The History of Kingdoms Protista, Fungi, and Plantae.
- The History of Invertebrates.
- The Evolution of Vertebrates in the Paleozoic and Mesozoic Eras.
- The Diversification of Mammals in the Cenozoic Era.
- Hominid Evolution.

During Part Two of *Darwin's Drama*, students will explore the impact that evolutionary biology has had on society. They will encounter the following content:

IV. The Internal and External History of Evolutionary Thought, 1800 to 1950
- Jean-Baptiste Lamarck and Pre-Darwinian Theories of Evolution.
- Charles Darwin and the *Origin of Species*.
- The Reception of Darwinian Thought in the Mid-19th Century.
- The Decline of Darwinian Natural Selection in the Late 19th Century.
- Social Darwinism in the Late 19th Century.
- The Eugenics Movement of the Early 20th Century.
- The Origins of Population Genetics in the 1920s.
- The Modern Synthesis of the 1930s and 1940s.

V. The Relationship of Darwinian Thought to Religious and Philosophical Thought
- The Challenge Natural Selection Posed to Natural Theology.
- The Reception of Darwinian Thought by Several Different Religious Traditions.
- Teleology in the Darwinian World.
- Progress in the Darwinian World.
- Darwin and the Pragmatists: William James, Chauncey Wright, John Dewey.

VI. The Abuse of Darwinian Thought
- Social Darwinism, Eugenics, and Scientific Racism: How Darwinian Thought was Employed to Bolster Each of These Social Projects.
- Social Darwinism, Eugenics, and Scientific Racism: When and Why Modern Biology Rejected Each of These Social Projects.

VII. Darwinian Thought in Literature and the Visual Arts
- Literary Darwinism: *The Time Machine*, H.G. Wells, 1895.
- Darwin among the Artists.

VIII. Current Public Issues Involving Darwinism
- The Controversy over Teaching Evolution in American Public Schools in Historical Context.
- Contemporary Attempts to Apply Darwinian Thought to Human Nature: *Sociobiology* by E.O. Wilson and *The Selfish Gene* by Richard Dawkins.
- Conservation and Biodiversity.

3. Skill Objectives

The student will learn how to ...
- convert textual descriptions into mathematical equations.
- use mathematical models to predict outcomes, evaluate empirical results, and approach novel situations.
- apply abstract theoretical concepts to detailed, specific situations.
- use empirical evidence available in the present to reconstruct events that occurred in the past.
- infer the function of morphological traits.
- plan and write a short essay that answers an open-ended question.
- use scientific knowledge to evaluate public policy.
- compare and contrast historical developments to contemporary developments.
- write critically about a philosophical passage and a literary text.
- organize and undertake a research project.

4. Understanding Objectives

The student will understand ...
- why a theory of evolution requires both a theory of heredity and a causal mechanism.
- why Darwin's theory of evolution was considered superior to theories that preceded it.
- why it matters that Mendel's Laws assume that genes are discrete, heritable units.
- how theoretical population geneticists synthesized Mendelian genetics and Darwinian selection.
- why different extant taxa evolved when they did.
- that Darwinian evolution has been received in different ways by different religious groups, in different national contexts, and during different time periods.

- how the theory of natural selection has been used by a range of different philosophers.
- that scientific ideas can provide inspiration in literature and the arts.
- that Darwinian thinking has been applied in ways that we would judge today as destructive.
- that evolutionary ideas are relevant to many non-scientific issues today.
- that the modern theory of evolution is integral to the modern life sciences
- that the modern theory of evolution has developed over the past 150 years through the combined efforts of the entire scientific community

5. Concepts and Themes

- Theory
- Progress

6. Essential Questions

- How integral is the modern theory of evolution the modern life sciences?
- What are the consequences of scientific ideas for society at large? Which are foreseeable and why?
- How has Darwinian thought been used and abused over the past 150 years?
- How do scientific approaches and humanities approaches complement one another?

6. Sample Lesson: Social Darwinism and Eugenics

The Sample Lesson, which is attached to this proposal, utilizes the following objectives:

Content:
VI. The Abuse of Darwinian Thought
- Social Darwinism, Eugenics, and Scientific Racism: How Darwinian Thought was Employed to Bolster Each of These Social Projects.
- Social Darwinism, Eugenics, and Scientific Racism: When and Why Modern Biology Rejected Each of These Social Projects.

Skill:
- plan and write a short essay that answers an open-ended question.
- use scientific knowledge to evaluate public policy.
- compare and contrast historical developments to contemporary developments.

Understanding:
- why it matters that Mendel's Laws assume that genes are discrete, heritable units.
- that Darwinian evolution has been received in different ways by different religious groups, in different national contexts, and during different time periods.
- that Darwinian thinking has been applied in ways that we would judge today as destructive.

7. Suggested Flexible Pacing and Extension Activities

Along with the activities listed in the syllabus, *Darwin's Drama* will include extension activities. Some examples are the following:
- Detailed suggestions for field trips to observe plants or animals in zoos, botanical gardens, or parks.
- An annotated list of novels, short stories, and poetry that involve evolutionary themes.

- Side boxes on evolutionary topics that are not directly addressed in the twenty lessons of the course. One example would be the Endosymbiont Hypothesis of Lynn Margulis.