Comets, Origins, and Life:
Interdisciplinary Science in the Secondary Classroom

Supported by The National Science Foundation

Teachers: Learn How to Integrate the Sciences in the Secondary Classroom
And Strengthen Your Background in a Particular Sub-Discipline

Summer 2010:
June 30 and July 1, 7, 8, 12 (9:30 a.m. – 4 p.m., 6 periods, including lunch break)
July 6, 9, 13 (9:30 a.m. – 3 p.m., 5 periods, including lunch break)
The Catholic University of America, Room 134, Hannan Hall

Teachers who attended the course in 2009 wrote in their anonymous evaluations:
“This course exemplifies what is good about science education”

“I learned to teach a process, rather than facts. This course has equipped me with the tools I need, including the content to do this.”

➢ This course meets the curriculum expectations of:
  o District of Columbia Science Standards
  o Maryland State Department of Education Voluntary State Curriculum in Science
  o Virginia Department of Education Revised Science Standards.

➢ The instructor will demonstrate the interdisciplinary nature of science by showing how concepts of physics, astronomy, chemistry and biology can be used together in the secondary classroom.

➢ High school teachers will discuss topics ranging from the birth of stars and the solar system to comets and their potential impact on the origin of life on our own planet.

➢ Biology and chemistry teachers will be given the opportunity to include physics and astronomy concepts in their classes.

➢ Physics and astronomy teachers will be offered tools to incorporate topics from biology and chemistry in their required curriculum.

Course credits:
45 contact hours (3 graduate-level credits) for teacher certification/recertification, continuing education or professional development.

Lowest tuition fees in the D.C. area: $510
• THIS IS THE TOTAL TUITION FOR THREE CREDITS, NOT PER CREDIT COST.

For further information or to register for the course, please contact Dr. Boncho Bonev, primary instructor and curriculum development team leader (301-286-1804, bonev@cua.edu) or Dr. Sue Edwards (program coordinator) by e-mail at edwardss@cua.edu.
Within 45 contact hours the instructors will describe the hypothesis for the “cometary” origin of the Earth's biosphere. The main SCIENCE GOAL is to describe HOW THIS HYPOTHESIS IS BEING TESTED by integrating astronomy, physics, chemistry, and biology.

The main PEDAGOGICAL GOAL is to present teachers with examples of how knowledge from physics, chemistry, biology, and astronomy can be used together in the secondary classroom.

Outline of topics:

1. Discussion about science education and promoting interdisciplinary science within national and state educational standards.
2. Developing collaborative learning strategies to be implemented by teachers.

A. Building the hypothesis for the cometary origin of the biosphere:
   3. Astronomy and evolution. The concept of time in astronomy.
   4. Comets in the present day sky: visual appearance, orbits, activity.
   5. Comets as “chemical fossils” of the early solar system.
   6. Stages of planetary (solar) system formation – from the interstellar medium, through star and planet formation, to early Earth.
   7. Comet bombardment on the young Earth and the hypothesis for the cometary origin of the biosphere.

B. Testing the hypothesis 1:
   8. The young Earth. Formation of the Earth/Moon system.
   9. Cometary bombardment: how it might have happened?
   10. Evidence today? The Moon, the solar system “architecture” and the orbits of the giant planets?

C. Testing the hypothesis 2:
   11. How do we compare the properties Earth’s water and cometary water?
   12. Spectroscopy as a “probe” of cometary ices (wavelengths, frequencies, spectra; isotopes).
   13. What do we learn from the “Stardust” space mission?
D. Testing the hypothesis 3 (the prospect of a biologist):

14. Why molecules in comet ices might be of interest to biologists?
15. The periodic table of elements: how a chemist, an astronomer, and a biologist would read it?
16. The chemistry of life (as we know it): from simple pre-biotic molecules to DNA. The role of water.
17. Can life develop in a comet?
18. Could life develop on Earth without the presence of oceans?
19. How could have pre-biotic matter organized itself if delivered by comets?

E. Testing the hypothesis 4:

20. Alternative hypotheses for the origin of Earth water against the “cometary origin” hypothesis.
21. Life on Mars? Could Mars methane come from comets?

F. Conclusion:

23. Discussion: Did life emerge by pure chance?
24. Discussion: The need for interdisciplinary science in testing complex hypotheses.
25. Discussion: The challenge of teaching science as a process of inquiry rather than facts.