

NYU  
G12.3200 & G65.1103

SUMMER SESSION I, 1993

**GAIA: THE EARTH AS A SYSTEM**

PROF. RAMPINO

Prof. Michael R. Rampino (Office: Rm. 502, Barney Bldg., 26 Stuyvesant St. (near the corner of 9th St. and 3rd Ave.); Phone: Office: 998-8995; Fax: 995-3820—Home: 242-0929; Home Fax: 255-2739). Class meets Tuesday/Thursday, 6:00 to 8:30 PM in Room 402 Main.

**READING:**

Gaia: A New Look at Life on Earth, J. Lovelock (Oxford, paper, 1979).

Healing Gaia, J. Lovelock (Harmony, 1991)

Gaia: The Growth of an Idea, L. Joseph (St. Martins, paper, 1990).

The Next 100 Years, J. Weiner (Bantam, paper, 1990).

Xeroxed Notes for the Course, Rampino (available at Unique Copy Shop)

*Check the Strand Bookstore (12th St. & B'way), Natural Science Section, before you buy these books new. Xeroxed material will be available after the first class at Unique Copy Shop on Greene St. between 8th St. and Waverly Place under my name. The Course Notes will help you study and keep up in the course.*

**GAIA: The Earth as a System** is a basic course that is designed to provide an appreciation of the new view of the Earth as an integrated system involving dynamic interactions and feedback loops among astrophysical factors, the atmosphere, oceans, solid earth, and life. The central idea of **Gaia** is that the planet is alive and functions as a superorganism in which living things interact with geophysical and chemical processes to maintain conditions suitable for life. This is a debatable idea.

Emphasis is placed on how the components of the environment work together at present, how they co-evolved in the past, and predictions for the future. The subject matter includes discussion and critique of the Gaia Hypothesis; basic geology; extraterrestrial factors; the circulation of the oceans and atmosphere; cycles of chemical elements essential for life; the co-evolution of climate and life on earth; and current environmental problems, such as the population explosion, global warming, deforestation, and depletion of the ozone layer.

**COURSE OBJECTIVES.** The aim of the course is to give non-science oriented students an understanding of one of the exciting current scientific debates—the concept of **Gaia** as a way of looking at the interactions of life with other aspects of the planetary (and extra-planetary) environment. This requires some astronomical background and a survey of the dynamics and interactions of the major Earth systems. Students should gain an understanding of the debate surrounding Gaia theory and a working knowledge of our present conceptual models of "how the earth works".

**COURSE REQUIREMENTS.** The grading in the course will be based on performance in TWO exams, each cover 1/2 of the course. The Class Notes contain Study Guides for the exams. A great deal of factual information, and a number of new concepts will be introduced in this course; it is essential to keep up in the readings. Students are expected to attend the class, as some class material will **not** be covered

completely in the readings. Make-up exams must be scheduled **in advance** for students with a valid excuse (illness with doctor's note, or family emergencies).

**Note exam dates now: 6/15 AND 7/1.**

## SYLLABUS

---

**5/25**

**Origins.** The Gaia Hypothesis. Life in the Universe. Galaxies in space. Stellar evolution and the creation of elements in stars. Supernovae explosions—stardust memories. The Solar System.

**Reading:** Class Notes. Start reading Gaia: A New Look at Life on Earth.

---

**5/27**

**Home: Planet Earth.** The origin and early history of the Earth and its atmosphere. Planetary habitability. The Goldilocks Problem. A comparison of Earth, Mars & Venus.

**Reading:** Class Notes; Healing Gaia, p. 9-34.

---

**6/1**

**The Unsolid Earth.** The composition and structure of the Earth. Continental drift. Driving forces for earth motions. Origin of oceans, continents, and the Earth's magnetic field.

**Reading:** Class Notes; Healing Gaia, p. 47-49

**Guest Lecture: Dr. Lonnie Thompson, Institute of Polar Studies, Ohio State Univ.**

**"The Record of Climatic Change from Ice Core Drilling"**

---

**6/3**

**Air.** The composition and dynamics of the atmosphere. The heat budget of the Earth. The hydrologic cycle.

**Reading:** Class Notes; Healing Gaia, p. 35-46. Weiner, Chap. 1.2.

---

**6/8**

**Water.** The composition of the oceans. The basic wind-driven and thermohaline circulation of the oceans. El Nino events.

**Reading:** Class Notes; Healing Gaia p. 35-46.

**Guest Lecture: Dr. Lee Kump, Earth System Science Center, The Pennsylvania State Univ.**

**"Ocean Plankton and Cycles of Elements Important for Life"**

---

**6/10**

**Life.** What is life? Life's origins. Basic life processes. Biogeochemical Cycles: The carbon and oxygen cycles. The nitrogen and phosphorus cycles.

**Reading:** Class Notes; Healing Gaia, p. 89-132. Joseph, Intro., Chap. 1

---

### 6/15: MIDTERM EXAM (1 hour)

6/15

**How Climate and Life Co-Evolved.** Causes of long-term atmospheric and climatic changes, connections between climate change and life, and some highlights in the history of life and climate.

**Reading:** Class Notes; Healing Gaia, p. 133-152; Joseph, Chap. 2; Weiner, Chap. 3,4,5.

---

6/17

**Gaia: Does Life Regulate Conditions on Earth?** The Gaia Hypothesis of Lovelock & Margulis. Control theory and the principle of feedback. Daisy World models. Computer simulations of the Earth's climate and biogeochemical cycles. The Gaia Debate.

**Reading:** Healing Gaia, p. 50-88; Joseph, Chap. 3, 4; Weiner, Chap. 6,7,8.

---

6/22

**Gaia vs. Shiva: Challenges to Gaia.** Mass extinctions of life. Collisions of comets and asteroids with the earth—the Shiva theory. Energetics of impacts. The Galactic Carrousel Theory of terrestrial catastrophism.

**Reading:** Class Notes; Joseph, Chap. 5, 6.

---

6/24

**Gaia and Us.** Human-induced environmental changes: Energy use and the CO<sub>2</sub> greenhouse effect. Is the Greenhouse Effect here? Predicting climate change for the next 100 years. The effects of other trace gases (methane, fluorocarbons) on climate and the ozone layer. Destruction of the tropical rainforests.

**Reading:** Healing Gaia, Chap. 7,8; Joseph, Chap. 7-10 Weiner, Chap. 9, 10

---

6/29

**Wishful Thinking?** What can we do (if anything) to mitigate natural and human-induced change? The Gaia Debate: Where do we go from here? The Anthropogenic Principle. Terraforming other planets.

**Reading:** Healing Gaia Chap. 9; Joseph, Chap. 11, Epilogue; Weiner, Chap. 11.

---

### 7/1 Final Exam (two hours)

---