

Name: \_\_\_\_\_

**Homework 7 – Ast 281 – Spring 2009**  
**Due Thursday 3/12/09 – 12:00pm, Watanabe 420**

The Gaia hypothesis was the result, in part, of J. Lovelock's quest for an answer to the question "how will life on another planet be recognized?" in relation to the Mars Viking program. It is particularly relevant to this class for several reasons:

- Class themes involve looking at the suitability of other worlds for life in our solar system (either in the past, the present or in the future – via terraforming)
- We discuss the possibility of life elsewhere, so it is relevant to discuss the conditions under which it might evolve and survive
- The hypothesis involves an understanding of complex feedback systems – skills necessary for survival in space
- The hypothesis has evolved in ways that were not predicted, launching into a huge area of pseudo science. We discuss many topics in this course which have found their way into this realm. Part of a science class should be to learn sound scientific principles and reasoning skills. By examining and discussing what happened in the case of Gaia, hopefully you will be better able to draw reasonable conclusions in other areas.

## 1 Introduction – The Gaia Hypothesis

In the 1970s Dr. James Lovelock formulated what he called the "Gaia Hypothesis" which asserts that the planet Earth is not simply an "environment" for "life," but in fact a living organism, a self sustaining system which modifies its surroundings so as to ensure its survival.

Lovelock states that the Gaia Hypothesis "postulates that the physical and chemical condition of the surface of the Earth, of the atmosphere, and of the oceans has been and is actively made fit and comfortable by the presence of life itself." Lovelock continues, "this is in contrast to the conventional wisdom which held that life adapted to the planetary conditions as it and they evolved their separate ways." Lovelock is careful to note that the planet's self-regulation is automatic, requiring no conscious guidance.

Though largely discredited in its initial form, this systems perspective was an intuitive framework as a representation of the larger scale ecological processes occurring on the planet. Emphasis upon the Earth's processes necessitates that conservation place great importance upon the maintenance of various ecological sub-systems involved in nutrient and energy exchanges; *i.e.* the world's forests, oceans and atmosphere. Forests hold a particular significance, with numerous ecological interactions and cycling of materials. Examples are plants' obvious roles in photosynthesis, carbon sequestering and numerous other energy flows and nutrient conversions which occur in a forest ecosystem. Continued large tracts of intact forest landscapes are crucial to Gaia's well-being through their cycling of energy and nutrients.

### 1.1 Geological / Physical view of the Earth

- as a ball of rock
- moistened by oceans
- covered by a thin layer of air to exclude the vacuum of space
- life is just an accidental passenger



then the only clear conclusion is that the plants / animals communicate with each other to coordinate their actions – which is clearly ridiculous! [15]

4. How can the presence of life possibly influence the geophysics of a planet? [15]

5. If the hypothesis says that systems can withstand large perturbations, won't the Earth take care of its own pollution? [15]

6. How might this apply to geoengineering, or terraforming – making a planet which is not now habitable, habitable? [15]