

The Privileged Planet *Teacher Guide*

Guillermo Gonzalez and Jay W. Richards



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Preview copy, not for resale

Guillermo Gonzalez

Jay W. Richards

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**DISCOVERY
INSTITUTE**

1511 Third Ave.

Suite 808

Seattle, WA 98101

206.292.0401

cscinfo@discovery.org

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Preface

This guide began its life as a set of notes developed by Michael N. Keas for use in his Unified Studies Natural Science survey course for non-science majors at Oklahoma Baptist University. At the time, Keas was an associate professor of natural science with expertise in the history, philosophy and rhetoric of science. With a particular interest in science education, he began incorporating *The Privileged Planet* into his lectures in 2002, when it was still in an incomplete manuscript. Today, Keas teaches at Biola University.

We are pleased that Dr. Keas has granted us permission to expand on and adapt his guide for a broader audience. It is appropriate for high school through advanced undergraduate students. It can be used as a supplement for an introductory astronomy or general science course, along with *The Privileged Planet* and accompanying documentary, an introductory astronomy textbook and perhaps a set of readings on the history of science (e.g., selected chapters from *The Book of the Cosmos* by Dennis Danielson).

The Privileged Planet and this guide can also be used as supplementary material for a college-level astrobiology course. In that case, the advanced questions would be particularly appropriate. It is not necessary to cover every chapter in the guide. Astrobiology courses, for example, can focus on the first eight chapters, and perhaps include some of the material on SETI. *The Privileged Planet*, along with *Rare Earth* by Peter Ward and Donald Brownlee, can serve to balance the more commonly available material with a strong pro-SETI slant. The astrobiology student would also benefit from the review paper published by one of us on habitable zones.¹ It expands on the astrobiology in *The Privileged Planet* with the latest research, including a more complete treatment of the Galactic Habitable Zone.

We welcome suggestions for improvement, reports of errors and particularly good answers to the advanced questions. We will acknowledge incorporated material in future versions of this guide. Please send correspondence to: csc@discovery.org.

Guillermo Gonzalez
Jay W. Richards
March 1, 2006

¹ Gonzalez G. (2005). Habitable Zones in the Universe. *Origins of Life and Evolution of Biospheres*, **35**, 555-606.

Introduction

Preview this study guide to know what to look for in your reading, then read the text of the Introduction of *The Privileged Planet*, then answer the questions below.

What event on Christmas Eve, 1968, attracted the largest single TV audience in history?

Probably a majority of scientists think that our Earthly existence is accidental and purposeless. *The Privileged Planet* challenges this view on scientific grounds. What matters most to the practice of science is not where scientists get their initial ideas (e.g., intuition, the Bible or a dream), but rather how well those ideas are tested against publicly accessible evidence. A scientist may begin assuming the importance or unimportance of our cosmic position, just so long as those initial assumptions are open to being accountable to the evidence of nature.

The Privileged Planet's main thesis: the conditions that allow for _____ on Earth also make it strangely well suited for _____ and _____ the universe.

Technical version of this thesis: _____ correlates with habitability.

Identify three views (among prominent scientists since the mid-20th century) of how common or uncommon life is in the cosmos (answer in the #1-#2-#3 outline below).

View #1: Drake-Sagan-SETI

Life, even intelligent life, is common / uncommon (circle one).

The late Carl Sagan (author of the novel *Contact*, upon which the motion picture by the same name was based) was fond of extolling the “billions” of stars in the cosmos; we will use this as a convenient device for remembering this most common twentieth century view. Frank Drake is the early SETI researcher who is especially remembered for his mathematical formula that attempts to calculate the number of advanced civilizations capable of communicating with radio signals in the Milky Way Galaxy.

What is the so-called Copernican Principle?

Define naturalism by completing Carl Sagan's secular liturgy: nature is “all that _____, or ever _____, or ever _____.” If naturalism is true, the Copernican Principle seems to naturally follow.

SETI = Search for _____ Intelligence. Drake & Sagan were leading SETI advocates.

View #2: Rare Earth Hypothesis

Simple life is common / uncommon, but complex life is common / uncommon (circle correct)

The name of this viewpoint comes from Peter Ward and Donald Brownlee in their book *Rare Earth* (2000). This view has taken its contemporary form within the new discipline of astrobiology, which is the study of the conditions necessary for life in the universe.

In what limited regard does the Rare Earth view (#2) *challenge* the Copernican Principle (CP)?

Answer: it challenges the CP in regard to simple / complex life (circle one)?

Does the “Rare Earth” view keep faith with the broader naturalistic philosophy that supports the Copernican Principle? Explain.

View #3: Privileged Planet Hypothesis (thesis of *The Privileged Planet*)

Part A, Habitability Thesis: Life, both complex *and* “simple,” is common / uncommon (circle one). This thesis, although not new, has taken on an unprecedented degree of scientific rigor in its latest form within the new discipline of astrobiology. Views #2 and #3 both recognize the precise fine-tuning (or “just right” arrangement of natural laws and events) that is required for the possibility of life’s existence.

Part B, Habitability-Measurability Correlation Thesis: The conditions that allow for intelligent life on earth also make it strangely well suited for measuring (analyzing) the universe.

Measurability [definition]: “refers to those features of the universe as a whole, and especially to our particular _____ in both in space and time which allow us to detect, observe, discover, and determine such features as the size, age, history, laws, and other properties of the physical universe.”

Does the Privileged Planet Hypothesis keep faith with the broader naturalistic philosophy that underwrites the Copernican Principle? Explain (compare with the Rare Earth Hypothesis).

“All design involves conflicting objectives and hence compromise, and the best designs will always be those that come up with the best compromise.” How does this insight, called constrained optimization, guide the Privileged Planet thesis? How does laptop computer design illustrate constrained optimization?

Advanced questions

1) Discuss the subtle differences among observability, discoverability, and measurability. Illustrate your answer with real-world examples.

Ch. 1: Wonderful Eclipses

Kinds of Solar Eclipses

- Total Eclipse (figure 1.1A): The fully shaded umbra of the Moon's shadow reaches Earth. This is called a total eclipse for those located on Earth where the umbra touches, because the Moon totally covers the Sun.
- Annular Eclipse (figure 1.1B): The semi-shaded penumbra of the Moon's shadow reaches Earth, while the dark umbra falls short. The Moon fails to totally cover the Sun for *any* observer on Earth.

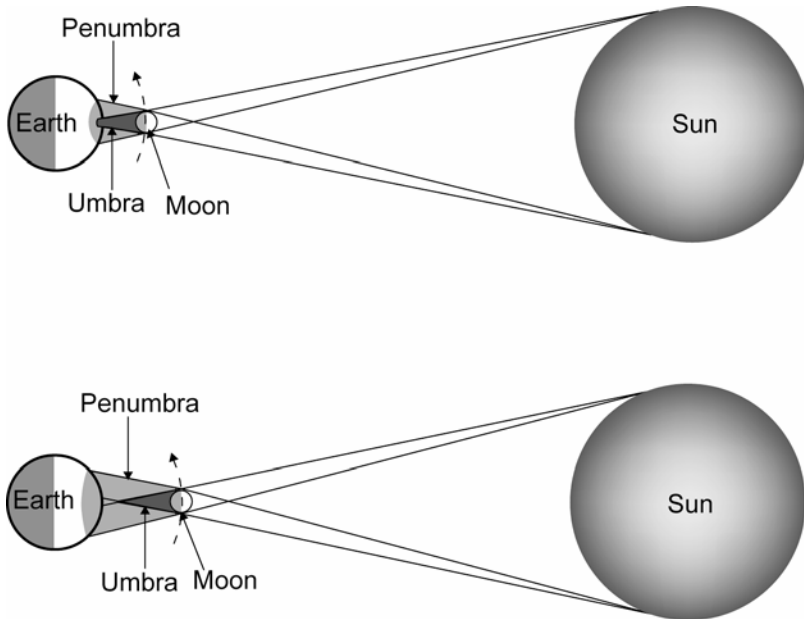


Figure 1.1A&B

More Detail on Total Solar Eclipses (figure 1.1A)

1. Moon's disk is large enough to cover the bright solar disk (Sun's photosphere)
2. Centers of the two disks at least approximately meet
3. Umbra touches Earth's surface
4. There are two kinds of total eclipses: super & perfect
 - a. **Super eclipse:** Moon's disk appears _____ than the solar disk and thus more than covers it.