Astronomy 301G
Revolutionary Ideas in Science
Section 1 **Fall 2008**

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Texts

What's the Matter? Readings in Physics
and The Nature of Life: Readings in Biology

Web Page: http://astronomy.nmsu.edu/kurt/Astronomy301G/

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Prerequisites: Any 100-level general education science course

Location & Time

Class meets in Biology Annex Room 102 (BX 102)
Mondays, Wednesdays, and Fridays from 9:30 PM to 10:20 PM

Calendar

22 August:	First Class Meets
1 September:	Labor Day Holiday (no class)
3 September:	Course addition deadline
26 September:	Examination #1
15 October:	Drop date
31 October:	Examination #2
24-28 November:	Thanksgiving Holiday (no classes)
5 December:	Examination #3
8 December:	Final Class Meeting (Official final exam date.)

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Class Format

Lectures and Presentations
Discussion (and occasional quizzes, exams, etc.)

Grades and Grading

30% Exams (3)
10% Quizzes
15% Class Projects
25% Homework
20% Attendance & Class Participation

...and what does "grading on a curve" really mean?

Evaluations

Now and then, and near the end of the semester...

Other Matters Arising

Resources
Disabilities & Discrimination
Misconduct

General Advice

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Plan of Attack

What is Science?

- ..... Scientific Ideas
- ..... The Scientific Method
- ..... Science in Theory and Practice

Our Place in the Universe

- ..... Classical Astronomy
- ..... The Copernican Revolution
- ..... Science & Observation: Kepler's Laws

Beginnings of Modern Physics

- ..... Experimental Science: Galileo
- ..... Mathematical Physics: Newton's Mechanics
- ..... Forces of Nature: Newtonian Gravitation

The Nature of Matter

- ..... Atoms & Elements
- ..... Atoms & Molecules: Chemistry
- ..... Nuclear Physics & Radioactivity
- ..... Mass Conservation

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The Nature of Energy
- ..... Heat & Light
- ..... Thermodynamics
- ..... Energy Conservation

Electricity & Magnetism
- ..... Charges & Currents
- ..... Maxwell's Electromagnetism
- ..... Electromagnetic Waves & Light

The Nature of Life
- ..... Mendelian Genetics
- ..... Darwinian Evolution
- ..... The Origins of Life on Earth

Special Relativity
- ..... The Nature of Space and Time
- ..... Foundations of Special Relativity
- ..... Matter & Energy Revisited

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General Relativity

..... Space, Time, and Gravity
..... General Relativity and Cosmology

The Quantum World

..... Waves and Particles
..... Heisenberg's Uncertainty Principle

Reprise: The Next Scientific Revolutions?

..... Cosmology: Dark Matter & Dark Energy
..... Particle Physics: Finding the Higgs?
..... Biology: The Mechanisms of Life
..... Astrobiology: Extraterrestrial Life
..... Physics: Quantum Gravity and Grand Unification

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Getting Started

What is Science?

Reading Assignment: <u>What's the Matter? Readings in Physics</u>

- **Foreword & Introduction**
- **Richard Feynman (1918-1988 CE)**
  "The Uncertainty of Science"
- **Aristotle (384-322 BCE)**
  "The Science of Nature"

..... and also take a first look at Aristotle's
"Moving Things"

Make an effort to formulate answers to the "Discussion Questions" at the end of each selection. (Suggestion: Look at these questions before you first read the selections.)

What is Science?

Science is the systematic study of the physical world.

(Qualification: "Science" = "Natural Science")

Science is based upon observations of that world.

Science is empirical and progressive.

It involves the formulation and testing of hypotheses.

Science attempts to explain phenomena.

Goals and Objectives

To gather information through observation and experiment

To organize and systematize that knowledge

To infer the the "laws of nature" which govern natural events

The Working Assumptions of Science

The Universe is Causal: Natural phenomena have natural causes which precede them.

(No magic!)

The Universe is Rational: Identical causes produce identical effects under identical conditions.

(The game rules don't change!)

The Universe is Understandable: The laws of nature can, in principle, be deduced from observations of nature.

(Nature is not unreasonably complex!)

Note that these assumptions are themselves testable!