Core Curriculum  
CC105 Natural Sciences  
The Evolution of the Physical Universe and of the Earth  
Course Syllabus  

OVERVIEW  

CC 105 is the first-semester natural science course of the Core Curriculum, concentrating on the physical sciences. (Note: You should also be enrolled in the concurrent Core humanities course CC 101.) The Core Curriculum is a general education program that provides an overview of human knowledge and achievements in the humanities, natural sciences, and social sciences. Through the study of these subjects, students develop academic skills that will be of great use in the remainder of their formal education as well as in their lives beyond academia. In CC 105, we will explore the physical sciences (astronomy, physics, chemistry, and geology) within the overall context of the story of physical matter within the universe. The "Dramatic Narrative" gives a nice overview of the course content. Perhaps the greatest contribution that CC 105 will make to your life, however, will be less practical but no less important: You will gain a sense of how you personally, and humanity in general, fit into the universe.  

Core Curriculum explores fundamental intellectual issues from the points of view of the humanities, natural sciences, and social sciences. To promote this integration among disciplines, throughout CC 105 we will discuss the historical, philosophical, and theological implications of the scientific description of the universe.  

There are three main components to the course: the lectures, the discussions, and the laboratory exercises. **You must attend all three components throughout the semester.** The lectures are held twice per week, Tuesdays and Thursdays 2:00-3:30 in the Tsai Performance Center, 685 Commonwealth Ave. The discussion sections meet for one hour each week in room CAS B6A. The regularly scheduled labs meet biweekly according to the attached laboratory information sheet. In addition, there is a specially scheduled evening planetarium show (choose either Sept 16. or Sept. 17; 6:00 pm, Museum of Science).  

On Fridays there will be optional problem solving sessions for those who need extra help with math and the homework assignments. These will meet on the hour in the Kenmore Classroom Building.
Room 102 from 9-12, and CAS 226 from 12-4. These tutorials are not required, but may be helpful for students who need to strengthen their problem solving skills.

The CC 105 course coordinator is Professor James Jackson. He, Professors Brainerd, De Paor, Marscher, Mendillo, and Whitaker, and Drs. Gutlerner and Hudon will lead the discussion sections. All the professors will give lectures (see attached lecture schedule). The lab instructors will be Drs. Gutlerner and Hudon.

In order to facilitate integration of the humanities with the natural sciences, the lecture series includes three "integrating forums" in which professors in philosophy, theology, and natural science will participate. Each forum will leave ample time for discussion among both the faculty and the students.

The Lecture + Examination Schedule is on the last page; the Laboratory Schedule is on a separate sheet. These schedules are subject to change, in which case announcements will be made in class.

LOGISTICS

1. Professors (Lectures & Discussions)

James Jackson (Astronomy), CC 105 Course Coordinator; room CAS 605, 353-6499, e-mail (preferred): jackson@bu.edu; office hours: M 9-11 (To get to the 6th floor, go to the west side of the CAS building, take an elevator to the 5th floor, then take the stairs next to room 520 to the 6th floor)

Tereasa Brainerd (Astronomy), room CAS 515, 353-6646, brainerd@bu.edu; office hours: T 12:30-1:30, W 3-4.

Declan De Paor (Earth Sciences), room STO B47, 353-2532, e-mail: depaor@bu.edu; office hours: TBA

Alan Marscher (Astronomy, also Associate Dean), CC 105 Course Coordinator; room CAS 109 (sometimes in room CAS 418), 358-0570 (or 353-5029), e-mail: marscher@bu.edu (e-mail preferred, read often but not always on weekends or at night); office hours: M 11-12 W 10-11.

Michael Mendillo (Astronomy), room CAS 603, 353-2629, mendillo@bu.edu; office hours: T 10-11, 5-6.
Scott Whitaker (Physics, also Associate Dean), room CAS 115, 353-2690, e-mail (preferred): scott@bu.edu; office hours: W 12-1, Th 4-5.

2. Instructors (Labs and Discussions)

Johanna Gutlerner, Core Office (Room CAS 119), 353-5404, e-mail: TBA; office hours: TBA

Daniel Hudon, Core Office (Room CAS 119), 353-5404, e-mail: TBA; office hours: TBA

3. Core Curriculum Office: Prof. James Johnson, Assistant Dean (e-mail: jhj@bu.edu); Zachary Bos (e-mail: zakbos@bu.edu), Senior Secretary; room CAS 119, 353-5404

4. Where to get help: For help with the course material, see your discussion instructor or the professor who gave the lecture with which you need help. For administrative assistance, please see either Mr. Bos in the Core Office for routine matters or Professor Jackson or Johnson for stickier problems. If you need to see one of the professors or instructors at any time other than during their office hours, simply e-mail or call them to set up an appointment.

5. Books and Laboratory Manual: You need to purchase the CC 105 textbook *The Physical Universe* (by Krauskopf and Beiser) and the CC 105 *Laboratory Manual*. Both are available at the bookstore, Barnes & Noble @ Boston University (Kenmore Square). In addition, you might find helpful the optional book, *A Brief History of Time* by Stephen Hawking; this easy-to-read book will be especially helpful as a supplement to the course if you do not have a strong background in high-school physics. It is a popular book that is available at most bookstores and Internet companies that sell books.

6. Exams and Quizzes: There will be two in-class midterm exams (check the lecture schedule on the last page for the dates) plus a cumulative final exam, which will be given on Tuesday, December 16 from 9:00 to 11:00 A.M. in the lecture room (Tsai). This date is set by the University and cannot be changed for individual students. There will be quizzes in discussion sections (no quizzes on the first week, however), based on material that you were assigned to read (mostly from the textbook) as well as on material that was covered at your previous discussion meeting.

7. Grading: Your final numerical grade will give the following weight to each of these components of the course: midterm exams 30% (15% each), final exam 30%, discussion section 25% (1/2 for weekly quizzes, and 1/2 for homework assignments; outstanding class participation can raise your discussion grade, while absences or lack of class participation will lower it), laboratory exercises 15%. Since the course carries CAS laboratory science credit, missing (which includes handing in but
showing very little effort leading to a grade of less than 50% of full credit) two or more lab exercises will result in an "F" grade for the entire course! The course will be graded on a curve, with an average grade in the B- range. [In past years, this has caused the division between a B- and C+ to be at a final average grade of about 80 out of 100.] The lowest two quiz grades (including those missed because of absences) and the lowest homework grade will be dropped before computing your average grade.

8. Late Assignments: Homework assignments are due at the beginning of the discussion section. Lab assignments are due on the dates posted in the lab section of this syllabus. Since awarding credit to late work would be unfair to the students who hand their work in on time, we do not accept late work. This policy can be over-ridden if you arrange the delayed submission in advance with Prof. Jackson for lab exercises, and your discussion instructor for other work.

9. Absences: You are expected to attend two lecture sections per week, one discussion section per week, one lab section every two weeks, one planetarium show on either September 16 or 17, and the final exam. Attendance will be taken. Because we care about each of you, you will be missed if absent! Also, since some of your grade will depend on your performance on quizzes and (if it is outstanding or poor) class participation in your discussion section, unexcused absences will affect your grade! In addition, for CAS students the Dean's Office will be notified if you miss several classes without a valid excuse. Except in cases of personal illness or extraordinary personal problems (we require a note from Health Services or a doctor or other documentation if you miss coursework for these reasons), you are expected to attend all lectures, discussions, and labs. If you are or have been ill, etc., you should contact (in order of preference) your discussion leader or Prof. Jackson as soon as possible – preferably before – you miss a class. You must make up all work missed because of an excused absence.

10. The Lectures on Videotape: All lectures and integrating forums will be videotaped. Hence, in case of illness or if you wish to view a replay, you may review any of the lectures of the course. The tapes are available for viewing on-site at the Geddes Language Lab, on the 5th floor in the middle section of the CAS building (above the position of the Tsai Performance Center). Note that there are two sections to the 5th floor, which do not connect, so that you should take one of the elevators adjacent to Tsai. The Geddes Language Lab strongly suggests that you make reservations to use the tape players; these reservations must be made in person.

11. The CC 105 Web Page, URL http://www.bu.edu/core/cc105: On the web page, you will find a number of useful items, including the outlines and most of the graphics shown in the lectures, as well as some links to other informative sites of relevance to the course. The CAS PC Lab. in room CAS
330, has been reserved for CC 105 students at two time slots each week: T 3:30-5 and R 11-12. This should be useful if you do not have your own PC or if your Internet connection is slow.

12. Academic Conduct: You need to read the CAS Academic Conduct Code, which you can pick up in room CAS B3. Academic misconduct involves not only direct cheating on tests, but some more subtle acts as well. All work handed in for credit must be your own, with the exception that you may quote or paraphrase from other sources if you also cite the reference and page number. (It is not permissible, however, to use another student's work even if you cite that work.) For assigned homework and lab write-ups, take care not to work so closely with a classmate that some of your results or answers to questions are nearly identical. I.e., your consultations with classmates should be limited to general discussions, not specific items such as "Show me how you answered question 2." A good general rule is never to look at another student's written work and never to allow another student to look at yours. If you need help, consult with one of the professors or lab instructors; if they are unavailable, send your question via e-mail. If you do not receive a response in time to complete the assignment by the due date, state so in another e-mail to them (with a copy to Prof. Jacksonsk for more time. We are required to report cases of suspected academic misconduct to the Dean's Office. Penalties for violations of the Academic Conduct Code may include suspension or expulsion from the University.
THE DRAMATIC NARRATIVE OF CC 105

THE EVOLUTION OF THE PHYSICAL UNIVERSE AND OUR UNDERSTANDING OF IT

"The Story of Stuff"

Mathematics, logic, quantitative reasoning

Statistical inference

Modeling and computation

Flow

Observation
Scientific Method
Prediction
Interpretation

What

Philosophy

Astronomy

Physics

Chemistry

Geology

Biology

ancient knowledge of the natural world
observations of the stars and planets
empirical technologies, tools, and materials

REDUCTION

Natural Laws

SYNTHESIS

What

-500
1300
1470
1905
1927
1945
1956
1970
Now!

The Big Ideas

Experimentation
Universal gravitation
wave-particle duality
E=mc²
the Big Bang
We are stardust
Plate Tectonics

Who

Aristotle
Archimedes
Ptolemy
Copernicus
Brahe
Kepler
Galileo
Newton
Curie
Bohr
Schrödinger
Heisenberg
Einstein
Hubble
Wegener

Connections

Deism
Determinism
Truth
Theism
Ockham's Razor
Reality
Empiricism
Gap Theology
Creation
Beauty

Astrophysics
Biochemistry
Ecology
Medicine
CC105 LECTURE SCHEDULE: FALL 2003
Tsai Auditorium; 2:00 – 3:30 p.m.

METHODS OF SCIENCE: MOTIONS IN THE SKY

1. 9/4 Overview: why science matters (JJ)  
2. 9/9 The Practice of Science (AM)  
3. 9/11 The Copernican Revolution (MM)  
4. 9/16 Newtonian physics: Theory of Everyday Motions (AM)  
5. 9/18 Motions in the Sky (DdP)  
6. 9/23 Integrating Forum #1: Truth  

Chapter 1

STRUCTURE IN THE MICROWORLD: WAVES AND PARTICLES

7. 9/25 Waves (SW)  
8. 9/30 Light (AM)  
9. 10/2 MIDTERM #1  
10. 10/7 Radioactivity (SW)  
11. 10/9 Nuclei (SW)  
12. 10/16 Atoms (SW)  
13. 10/21 Quantum mechanics (AM)  
14. 10/23 The Periodic Table and Chemical Bonds (JJ)  
15. 10/28 Integrating Forum #2: The Nature of Reality

Chapter 6

THE EVOLUTION OF MATTER

16. 10/30 The Big Bang (TB)  
17. 11/4 The Evolution and Fate of the Universe (TB)  
18. 11/6 MIDTERM #2  
19. 11/11 Stars: Birth to Middle Age (JJ)  
20. 11/13 Stars: Death (JJ)  
21. 11/18 Formation of Solar System (MM)  
22. 11/20 Integrating Forum #3: Beauty

Chapter 7

THE EVOLUTION OF EARTH AND PLANETS

23. 11/25 Evolution of Planets and Moons (MM)  
24. 12/2 The formation of the earth (DdP)  
25. 12/4 Plate tectonics (DdP)  
26. 12/9 The Impact of Life and Humans on the Earth (DdP)  
27. 12/11 Science and Humanity in Perspective (JJ)

Chapter 8

The Chapters refer to the text The Physical Universe, the Readings will be handed out in lecture.  
JJ=Prof. Jackson; AM=Prof. Marscher; SW=Prof. Whitaker; MM=Prof. Mendillo; DdP=Prof. DePaor; TB=Prof. Brainerd
CC105 Fall Semester 2003
Lab Schedule

The normal meeting times for each lab section are given below.

<table>
<thead>
<tr>
<th>Lab Section</th>
<th>Day</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Monday</td>
<td>10 - 12</td>
</tr>
<tr>
<td>L2</td>
<td>Monday</td>
<td>10 - 12</td>
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<tr>
<td>L3</td>
<td>Monday</td>
<td>12 - 2</td>
</tr>
<tr>
<td>L4</td>
<td>Monday</td>
<td>12 - 2</td>
</tr>
<tr>
<td>L5</td>
<td>Monday</td>
<td>2 - 4</td>
</tr>
<tr>
<td>L6</td>
<td>Monday</td>
<td>2 - 4</td>
</tr>
<tr>
<td>L7</td>
<td>Monday</td>
<td>4 - 6</td>
</tr>
<tr>
<td>L8</td>
<td>Monday</td>
<td>4 - 6</td>
</tr>
<tr>
<td>L9</td>
<td>Monday</td>
<td>6 - 8</td>
</tr>
<tr>
<td>M1</td>
<td>Monday</td>
<td>6 - 8</td>
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<tr>
<td>M7</td>
<td>Wednesday</td>
<td>4 - 6</td>
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<tr>
<td>M8</td>
<td>Wednesday</td>
<td>6 - 8</td>
</tr>
<tr>
<td>M9</td>
<td>Wednesday</td>
<td>6 - 8</td>
</tr>
</tbody>
</table>

Your "Lab Groups" are given here. The schedule on the next page shows all of your lab meetings according to your Group. For example, if you signed up for section L6, you would be in Lab Group C.

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Group D</th>
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</thead>
<tbody>
<tr>
<td>Section #</td>
<td>L1</td>
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<td>M4</td>
<td>L6</td>
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<tr>
<td>Section #</td>
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<td>M6</td>
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<td>M7</td>
</tr>
<tr>
<td>Section #</td>
<td>L9</td>
<td>M8</td>
<td>M1</td>
<td>M9</td>
</tr>
</tbody>
</table>

Note: the sky motion "lab" does not count as a lab. It is an optional group project, but we will be discussing how to make the measurements for the project in the first lab meeting. The project will count as extra credit, or can be used to replace the lowest lab grade.
<table>
<thead>
<tr>
<th>LAB</th>
<th>Group</th>
<th>Date</th>
<th>Location</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sky Motions†</td>
<td>A</td>
<td>M 9/8</td>
<td>PSY B35</td>
<td>Th 12/11</td>
</tr>
<tr>
<td></td>
<td>B (M2)</td>
<td>W 9/10</td>
<td>KCB 101</td>
<td>Th 12/11</td>
</tr>
<tr>
<td></td>
<td>B (M4, M6, M8)</td>
<td>W 9/10</td>
<td>SAR 102</td>
<td>Th 12/11</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>M 9/8</td>
<td>PSY B35</td>
<td>Th 12/11</td>
</tr>
<tr>
<td></td>
<td>D (M3)</td>
<td>W 9/10</td>
<td>KCB 101</td>
<td>Th 12/11</td>
</tr>
<tr>
<td></td>
<td>D (M5, M7, M9)</td>
<td>W 9/10</td>
<td>SAR 102</td>
<td>Th 12/11</td>
</tr>
<tr>
<td>Planetarium*</td>
<td>A</td>
<td>T 9/16 OR*</td>
<td>Science Museum</td>
<td>Th 9/25</td>
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<tr>
<td></td>
<td></td>
<td>W 9/17</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>B</td>
<td>T 9/16 OR*</td>
<td>Science Museum</td>
<td>Th 9/25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W 9/17</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>T 9/16 OR*</td>
<td>Science Museum</td>
<td>Th 9/25</td>
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<tr>
<td></td>
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<td>W 9/17</td>
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</tr>
<tr>
<td></td>
<td>D</td>
<td>T 9/16 OR*</td>
<td>Science Museum</td>
<td>Th 9/25</td>
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<tr>
<td></td>
<td></td>
<td>W 9/17</td>
<td></td>
<td></td>
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<tr>
<td>Falling Bodies</td>
<td>A</td>
<td>M 9/22</td>
<td>SCI B03</td>
<td>M 10/6</td>
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<tr>
<td></td>
<td>B</td>
<td>W 9/24</td>
<td>SCI B03</td>
<td>W 10/8</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>M 9/29</td>
<td>SCI B03</td>
<td>T 10/14**</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>W 10/1</td>
<td>SCI B03</td>
<td>W 10/15</td>
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<tr>
<td>Pendulum</td>
<td>A</td>
<td>M 10/6</td>
<td>SCI B03</td>
<td>M 10/27</td>
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<td>B</td>
<td>W 10/8</td>
<td>SCI B03</td>
<td>W 10/29</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>T 10/14**</td>
<td>SCI B03</td>
<td>M 11/3</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>W 10/15</td>
<td>SCI B03</td>
<td>W 11/5</td>
</tr>
<tr>
<td>Electron Wave</td>
<td>A</td>
<td>M 10/27</td>
<td>SCI B03</td>
<td>M 11/10</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>W 10/29</td>
<td>SCI B03</td>
<td>W 11/12</td>
</tr>
<tr>
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<td>C</td>
<td>M 11/3</td>
<td>SCI B03</td>
<td>M 11/17</td>
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<td>D</td>
<td>W 11/5</td>
<td>SCI B03</td>
<td>W 11/19</td>
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<tr>
<td>Spectroscopy</td>
<td>A</td>
<td>M 11/10</td>
<td>SCI B03</td>
<td>Th 12/4</td>
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<tr>
<td></td>
<td>B</td>
<td>W 11/12</td>
<td>SCI B03</td>
<td>Th 12/4</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>M 11/17</td>
<td>SCI B03</td>
<td>T 12/9</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>W 11/19</td>
<td>SCI B03</td>
<td>T 12/9</td>
</tr>
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The building abbreviations are as follows:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Building Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAR</td>
<td>Sargent College</td>
<td>685 Comm. Ave.</td>
</tr>
<tr>
<td>KCB</td>
<td>Kenmore Classroom Bldg.</td>
<td>565 Comm. Ave.</td>
</tr>
<tr>
<td>PSY</td>
<td>Psychology</td>
<td>64 - 72 - 86 Cummington Street</td>
</tr>
<tr>
<td>SCI</td>
<td>Science Center</td>
<td>590 – 596 Comm. Ave.</td>
</tr>
</tbody>
</table>

†Optional group project: extra credit or replace lowest lab grade
*Students may attend the Hayden Planetarium at the Museum of Science on either Tuesday, September 16 or Wednesday, September 17 at 6:30 pm.
**Tuesday, October 14 follows the Monday class schedule due to a holiday.