Description of the Molecular Biology Major

Students who enrolled before September 2014 may complete either the old Biology Major – MCB track, or the Molecular Biology major. **We recommend the Molecular Biology Major.** See page 6 for a direct comparison.

Requirements:

I. **BY 131** - *Introduction to Molecular and Cellular Biology*, or **BY 232** - *Cells and Genes* (which satisfies both the BY 131 and BY 231 requirements)
   - IB Higher Level score of 6 or 7 can substitute for this requirement. See page 4.

II. **BY 231** - *Genetics*, or **BY 232** - *Cells and Genes* (which satisfies both the BY 131 and BY 231 requirements)
   - No credit for BY232 if taken after BY 131 or BY 231

III. **Four** units in **Chemistry**
   - **CH 107** – *General Chemistry I* and **CH 108** – *General Chemistry II*, or AP/IB credit recognized as equivalent by the Department of Chemistry and the Registrar
   - **CH 250** - *Structures of Organic Molecules* and **CH 251** – *Reactions of Organic Molecules*

IV. **Two** units from the **Mathematics, Computer Science, or Physics**:
   - **Mathematics** courses MA 117, MA 125-6 (only counts as one unit toward the requirement), MA 126, MA 127, MA 129, MA 217, MA/BY 256
   - **Computer Science** courses CS 122, CS 222
   - **Physics** courses PC 241, PC 242 (calculus-based physics). Note that PC 141
and PC 142 are designed specifically for pre-health students but do not satisfy this requirement for the Molecular Biology major.

- AP or IB credit, recognized by the registrar, in calculus or statistics

V. **Seven elective units**

- **Four BY courses that have BY 231 - Genetics or BY 232 – Cells and Genes as a pre-requisite.**
  i. One of these units must be an approved Senior Capstone passed during the last two semesters before graduation; list of courses is available in the Molecular Biology office and on the departmental web site.
  ii. Students can petition the department to count up to two units of BY 309, BY 409, or BY 499 toward this requirement provided that they completed BY 231 or BY 232 prior to the independent study and the supervising professor agrees. See Appendix I, p. 8.

- **Three other elective units**
  i. Any BY course except BY 100 or BY 104 may count as an elective.
  ii. BY 101 counts as one unit of elective credit toward the Molecular Biology major.
  iii. AP Biology score of 5 or IB Higher Level Biology score of 5 may substitute for one of these electives.
  iv. One unit of elective credit may be drawn from the following list of Chemistry & Biochemistry courses: CH 382 - Biochemistry, CH 241, CH 351, CH 401, or CH 403. CH 382 is strongly recommended.
  v. Up to two units of elective credit may be drawn from the following list of Anthropology, Human Biology and Kinesiology, and Psychology (Neuroscience) courses: AN 201, AN 202, AN 301, HK 204, HK 206, HK 304, HK 321, PY 297, PY 298.
  vi. In rare circumstances, it is possible to petition the department to ask for other courses to count as electives.

- A maximum of 2 units of mentored research such as BY 309, BY 409, BY 499, CH 401, and CH 403 can be counted toward the Molecular Biology major.

VI. **Senior capstone experience**

- All seniors must participate in required seminars as announced at the Fall Majors’ Meeting and/or by emails in the fall.

- Earn a C- or higher in a Senior Capstone Molecular Biology course during the last two semesters before graduation. A list of courses is maintained in the Molecular Biology office and on the departmental web site. Courses taught by faculty outside Molecular Biology cannot satisfy this requirement. Capstone courses for 2014-15 are BY 309, 409, or 499 taught by Molecular Biology faculty Bertrand, Losroth, Huang or Killian, 349 Host Response to Disease, 350 Advanced Cell Biology, 359 Microbiology & Molecular Genetics (2014-15 only), 391 Molecular and Cellular Virology, 440 Developmental Neurobiology, 440 Cancer Biology, 466 Developmental Biology, 475 Molecular Techniques in Microbial Ecology, and CH 403 research in biochemistry with Prof. Grover or Daugherty.

- Participate in required departmental assessment, as announced at the Fall Majors’ Meeting.
Suggestions for completing the 15 units for the major in four years

For students who took calculus in high school:
First Year
- CH 107; and
- BY 232 (2 units) or BY 131 and BY 231; and
- CH 108.
- Note: students who did not take calculus in high school are advised to take calculus or statistics before taking any chemistry or molecular biology courses. See “Alternative suggestion for students who did not take calculus in high school, p. 4.”

Sophomore Year
- One elective
- CH250; and
- CH251; and
- One unit math/computer science/physics.
- Find a Molecular Biology advisor and declare the Molecular Biology major through the registrar's office.

Junior Year
- Two electives (CH382 strongly recommended); and
- One upper-level elective; and
- One unit math/computer science/physics.

Senior Year:
- One Senior Capstone elective; and
- Two upper-level electives; and
- Required seminar participation; and
- Required assessment activities.

Research: It is advisable to complete a research opportunity during at least one of your last two summers in college. Discuss this possibility with your Molecular Biology advisor and see www.nsf.gov/crssprgm/reu/. Positions are highly competitive, so apply broadly.

Study abroad: One semester in the sophomore or junior year recommended. Contact Heather Browne to find a study abroad program that is compatible with a major in Molecular Biology. Heather can also explain how financial aid applies to various study abroad opportunities.

Graduation With Distinction in Biology: In order to be eligible, you must have a high GPA, complete a research project, and write and defend a thesis; see p. 5 for details.

Phi Beta Kappa: In order to be eligible, you must have a high GPA and complete the intermediate college level in a second language (typically 202 or higher; may be an adjunct course) and satisfy certain distribution requirements; see http://www.coloradocollege.edu/other/pbk/membership-requirements.dot
For students who did not take calculus in high school:

First Year
- One unit math/computer science
- CH 107;
- CH 108; and
- BY 131

Sophomore Year
- One unit math/computer science/physics.
- BY 231;
- CH250; and
- CH251; and
- Find a Molecular Biology advisor and declare the Molecular Biology major through the registrar's office

Junior & Senior Years as on p. 3.

All-College Requirements
- FYE (2 units)
- West in Time (2 units)
- Scientific Inquiry (2 units, one with lab/field; satisfied by the MB major)
- Social Inequality (1 unit)
- Global Cultures (1 unit)
- Quantitative reasoning (1 unit)
- Foreign language (2 units)
  - Note that Phi Beta Kappa honor society requires completion of the intermediate college level in a second language (typically 202 or higher; may be an adjunct course)
- Writing requirement
  - Passed first year portfolio OR
  - Passed Writing Intensive class OR
  - Passed Writing in the Disciplines class with writing adjunct

Senior Capstone Experience
1. Seniors must participate in departmental seminars, as announced at the Fall Majors’ Meeting and/or by email. Stay tuned!
2. Seniors must participate in (attend or present at) Molecular Biology Day.
3. Seniors must pass a course designated as a Senior Molecular Biology Capstone during the last two semesters before graduation. Consult the Molecular Biology Office or the departmental web site to obtain the current list of Senior Capstone Courses. Capstone courses for 2014-15 are BY 309, 409, or 499 taught by Molecular Biology faculty Bertrand, Lostroh, Huang or Killian, 349 Host Response to Disease, 350 Advanced Cell Biology, 359 Microbiology & Molecular Genetics (2014-15 only), 391 Molecular and Cellular Virology, 440 Developmental Neurobiology, 440 Cancer Biology, 466 Developmental Biology, 475 Molecular Techniques in Microbial Ecology, and CH 403 research in biochemistry with Prof. Grover or Daugherty.
4. Seniors must participate in assessment activities, as announced at the Fall Majors’ meeting.
AP/IB Biology Credit in Biology

1. Students with a score of 5 on AP Biology or 5 on Higher Level IB Biology may count that as one lower-level elective unit.
2. Students with a score of 6 on IB Higher Level Biology may count that as one unit of elective or as one unit of BY131. Note that this policy may be different from the policy applied in other departments. We recommend using the unit as an elective and taking BY 131, however, to adjust to molecular biology courses on the block plan. These students may enroll in BY 232 – Cells and Genes to satisfy the BY 131 and BY 231 requirements for the major.
3. Students with a score of 7 on IB Higher Level Biology may count that as one unit of elective and as one unit of BY 131. These students may not enroll in BY 232 – Cells and Genes because BY 232 cannot be taken after BY 131 has been completed.
4. To formalize your AP or IB credit counting toward the Molecular Biology degree, you must send your answers to the AP/IB questionnaire in an email to the Molecular Biology Director, Staff assistant, Kelley.Mathers@ColoradoCollege.edu, and your molecular biology advisor. See Appendix II, p. 9.

Graduation with Distinction & Senior Thesis Information

To graduate with distinction, a student must:

1. Find a molecular biology research mentor to supervise independent research, or to supervise the writing of a thesis using off-campus research in molecular biology (such as that in an REU program); and
2. Enroll in one block of BY 499 with that research mentor during blocks 1-7 of the senior year; and
3. Register for the senior thesis with the department in blocks 1 or 2 of the senior year (see Appendix III, p. 10); and
4. Complete a Molecular Biology senior thesis BY 499 with a grade of A- or above; and
5. Present the thesis in a seminar at Molecular Biology Day; and
6. Provide a final digital copy of the thesis to Tutt Library; and
7. Achieve a GPA of at least 3.7 in 12 of the 15 courses taken to fulfill the major. The calculation must include 12 grade track courses.
8. If a student does not have twelve or more grade track courses because they are a transfer student, a faculty member may nominate the student for consideration for distinction by a departmental vote.

To enroll in BY 499 Senior Thesis, sign up for BY 499 with your molecular biology research mentor during pre-registration of your junior year. Your senior thesis block should be named beginning with the prefix “MB:.” For example, your block might be titled “BY 499 MB: RNA binding proteins and dendrite formation.”

To make sure that the Department knows that you will be presenting your senior thesis at Biology Day, register for the thesis by answering the “senior thesis questionnaire” in an email sent to your research mentor, the Molecular Biology Director, and the Molecular Biology staff assistant, Kelley.Mathers@ColoradoCollege.edu. See Appendix III, p. 10.

You must present your thesis in a 10-15 minute seminar at Molecular Biology Day, where other students and professors will ask you questions about the research. Students attempting to graduate with distinction in December (rather than May) must arrange an alternative way to fulfill this presentation requirement.
By the first Friday of Block 8, the final version of the thesis must be submitted to the library. The student should use their last name and tiger number to log in to the following website: http://discovery.coloradocollege.edu/etd/. After logging in, they will be prompted with instructions on how to complete the submission. For more information, see http://www.coloradocollege.edu/library/help/how-to-submit-a-thesis.dot.

It is also customary to obtain two bound copies of the thesis, one for the department and one for the thesis supervisor. For detailed directions on how to get these bound copies, see http://www.coloradocollege.edu/library/help/how-to-submit-a-thesis.dot.

**Significant differences between the Molecular Biology major and the Biology – MCB Track major**

1. The Molecular Biology major has a longer list of ways to satisfy mathematics/computer science/physics requirement.
2. The Molecular Biology major has a longer list of Anthropology, Human Biology & Kinesiology, and Psychology/Neuroscience courses that can count as electives.
3. Molecular Biology majors need *four* electives with BY 231/232 Genetics/Cells & Genes as a pre-requisite, whereas Biology MCB Track majors need *three*.
4. Biology MCB Track students *must* take BY101, BY105, BY106 or BY107, while Molecular Biology majors *may* take one or more of these courses as lower-level electives but are *not required to do so*.
5. Molecular Biology majors need a capstone course taught by Molecular Biology faculty, while Biology MCB Track students may take a capstone course offered by any Molecular Biology or Organismal Biology and Ecology professors.
The Old Biology - Molecular and Cellular Biology track

I. One of the following introductory organismic biology courses
   a. BY 105
   b. BY 106
   c. BY 107 or BY 101

II. Introduction to Molecular and Cellular Biology, BY131 or 2 units of BY 232

III. Genetics, BY 231 or 2 units of BY 232

IV. Four units in Chemistry
   a. CH 107
   b. CH 108
   c. CH 250
   d. CH 251

V. Two of the following mathematics courses:
   a. MA 117
   b. MA 125-6 (only counts as one unit toward the requirement)
   c. MA 126
   d. MA 127
   e. MA 129
   f. MA217
   g. BY 220
   h. BY 256/MA 256
   i. EV 228
   j. BY 220
   k. AP or IB credit, recognized by the registrar, in calculus or statistics

VI. Six approved biology electives
   a. Three must be Biology (BY) courses with BY 231 (or BY 232 or BY 361) as a pre-requisite. Students can petition the department to count up to two units of BY 309, BY 409, or BY 499 toward this requirement provided that they completed BY 231 prior to the independent study and the supervising professor agrees.
   b. One unit of elective credit may be CH 241 or CH 382
   c. One unit of elective credit may be GY 300, PY 299, SC 301, AN 201, AN 202, AN 301, HK 204, HK 206, HK 304, HK 321, PY 297, or PY 298.
   d. One unit must be an approved senior capstone course
   e. Any BY course except BY 100 and BY 104 may count as an elective
   f. BY 101 (FYE) counts as one unit of lower-level elective
   g. BY 220 counts as EITHER an elective or a unit of math. BY 256/MA 256 counts as EITHER an elective or a unit of math. Neither course can itself satisfy BOTH a unit of biology elective credit and a unit of math.
   h. Only two units of BY 309, BY 409, and BY 499 can count toward the major.
   i. It is possible to petition the department to ask for other courses to count as electives.

VII. Research Seminar Participation, as announced at the Fall Majors’ Meeting

VIII. Senior capstone experience, as announced at the Fall Majors’ Meeting

VI and VIII for 2014-15 will be the same as that for Molecular Biology majors; see p. 4.
Appendix 1 BY 309/409/499 as an elective with BY 231/232 as a pre-requisite

Type the following questions and your answers to them in the body of an e-mail sent simultaneously to your Molecular Biology advisor, the Molecular Biology Director Mario.Montano@ColoradoCollege.edu, the Molecular Biology staff assistant, Kelley.Mathers@ColoradoCollege.edu, and yourself. This e-mail will become part of your departmental file, maintained by the staff assistant.

Make sure the subject line of the email is “BY 309/409/499 as elective with BY 231/232 pre-requisite”

Note that if you plan to use two units of BY 309, BY 409, or BY 499 in this way, we need a separate form for each class.

1. In this e-mail, are you asking for BY 309, BY 409, or BY 499 to count as a course with BY 231/232 as a pre-requisite?
2. When do you plan to take BY 309, BY 409, or BY 499?
3. Who is your research supervisor for the BY 309, 409, or 499 block?
4. When did you take BY 231 or BY 232 and what letter grade did you earn?
5. What is your general research question and why is Genetics an important pre-requisite for the research you plan to do?
Appendix 2 Use of AP or IB credit in Biology, Mathematics, or Chemistry

Type the following questions and your answers to them in the body of an e-mail sent simultaneously to your Molecular Biology advisor, Molecular Biology Director Mario.Montano@ColoradoCollege.edu, the Molecular Biology staff assistant, Kelley.Mathers@ColoradoCollege.edu, and yourself. This e-mail will become part of your departmental file, maintained by the staff assistant.

Make sure the subject line of the email is “AP/IB credit”

1. Do you have AP or IB credit in Biology? Write out one of the following options in the email.
   a. I have a score of 5 on the AP Biology test and I plan to count this as one unit of lower-level elective credit. I understand that I still have to take BY 131 after I have completed its CH 107 pre-requisite. I can enroll in BY 232 instead of BY 131.
   b. I have a score of 5 on the IB Higher Level Biology and I plan to count this as one unit of lower-level elective credit. I understand that I still have to take BY 131 after I have completed its CH 107 pre-requisite.
   c. I have a score of 6 on IB Higher Level Biology and I plan to count this as one unit of lower-level elective. I understand that I still have to take BY 131 after I have completed its CH 107 pre-requisite. I can enroll in BY 232 instead of BY 131.
   d. I have a score of 6 on IB Higher Level Biology and I plan to count this as one unit of BY 131. I cannot enroll in BY 232.
   e. I have a score of 7 on IB Higher Level Biology and I plan to count this as one unit of lower-level elective and as one unit of BY131. I cannot enroll in BY 232.

2. Do you have AP or IB credit in mathematics or chemistry? Write out one of the following options in the email.
   a. The registrar has not awarded me any AP/IB credits in mathematics.
   b. The registrar has awarded me one unit of AP/IB credit in statistics.
   c. The registrar has awarded me one unit of AP/IB credit in calculus.
   d. The registrar has awarded me two or more other AP/IB units in mathematics (please describe….)
   e. The registrar and the Chemistry department have awarded me one or more units in Chemistry (please describe….)
Appendix 3 Senior Thesis Registration Questionnaire

Type the following questions and your answers to them in the body of an e-mail sent simultaneously to your research mentor/senior thesis supervisor, your senior thesis second reader, the Molecular Biology Director Mario.Montano@ColoradoCollege.edu, the Molecular Biology staff assistant, Kelley.Mathers@ColoradoCollege.edu, and yourself. This e-mail will become part of your departmental file, maintained by the staff assistant.

Make sure the subject line of the email is “Senior Thesis Registration Questionnaire”

1. Which twelve grade-track courses will you use to have the 3.7 GPA needed to graduate with distinction?
2. What is your current GPA in all of the courses you are using to fulfill the Molecular Biology major?
3. Who is your research mentor/senior thesis supervisor?
4. Who is your senior thesis second reader?
5. When have you enrolled in BY499 (block, or two semesters of ½ unit BY499 adjunct)?
7. What is the date for Molecular Biology Day?
8. Is there any reason that you cannot be there on Molecular Biology Day, such as graduating a semester early?