Undergraduate Curriculum in Biology
Case Western Reserve University

Fall Courses

*114: Principles of Biology
*116: Introduction to Anatomy and Physiology I
*240: Personalized Medicine (tentative)

Spring Courses

*117: Introduction to Anatomy and Physiology II
225: Evolution (p/e)
307: Evolutionary Biology of the Invertebrates (p/e) (odd)

* Indicates courses that do not count towards any Biology degree or minor

@ Indicates courses for the B.S. in Systems Biology

214 / 214L
GENES, EVOLUTION, and ECOLOGY
(lecture / lab)
(Fall; Summer/Spring as available)

302: Human Learning and the Brain (o, DS)
310: Field Studies in Evolutionary Ecology (L) (on hiatus)
336: Aquatic Biology (p/e)
339: Aquatic Biology Lab (L)
351: Principles of Ecology (p/e)
351L: Principles of Ecology Laboratory (L)
364: Research Methods in Evolutionary Biology (p/e, DS)

223: Vertebrate Biology (L)
302: Human Learning and the Brain (o, DS)
352: Ecology and Evolution of Infectious Diseases (QL)
364: Research Methods in Evolutionary Biology (p/e, DS) (odd)
397: Molecular Phylogenetics (QL) (on hiatus)
398: Modern Human Biological Variation (p/e)

215 / 215L
CELLS and PROTEINS
(lecture / lab)
(Spring; Summer/Fall as available)

301: Biotechnology Lab: Genes and Genetic Engineering (L)
311: Survey of Bioinformatics:
311A: Technologies in Bioinformatics
311B: Data Integration in Bioinformatics
311C: Translational Bioinformatics
311D: Programming for Bioinformatics

303: From Black Box to Toolbox: How Molecular Biology Moves Forward (c/m)
308: Molecular Biology: Genes and Genetic Engineering (c/m)
311A/B/C/D: Survey of Bioinformatics (see Fall list for details)
316: Fundamental Immunology (c/m)
325: Cell Biology (c/m)
327: Functional Genomics (QL)
328: Plant Genomics and Proteomics (c/m)
334: Structural Biology (c/m)
343: Microbiology (c/m)
344: Laboratory for Microbiology (L)

216 / 216L
DEVELOPMENT and PHYSIOLOGY
(lecture / lab)
(Fall; Summer/Spring as available)

305: Herpetology (L) (even)
309: Biology Field Studies (L)
318: Introductory Entomology (o -OR- L)
321: Design and Analysis of Biological Experiments (QL)
333: The Human Microbiome (o, DS)
345: Mammalian Diversity and Evolution (L) (odd)
346: Human Anatomy (o)
353: Ecophysiology of Global Change (L)
362: Principles of Developmental Biology (o) (on hiatus)
373: Introduction to Neurobiology (o -OR- QL as of Fall 2014; o previous versions)
374: Neurobiology of Behavior (o, DS)

309: Biology Field Studies (L)
315: Quantitative Biology Laboratory (QL)
322: Sensory Biology (o)
324: Introduction to Stem Cell Biology (c/m)
338: Ichthyology (o -OR- L)
340: Human Physiology (o)
342: Parasitology (c/m)
346: Human Anatomy (o)
357: Backyard Behavior (CAP)
358: Animal Behavior (p/e -OR- L) (on hiatus)
365: Evo-Devo: Evolution of Body Plans (c/m, DS)
368: Topics in Evolutionary Biology (p/e)
379: Transformative Animal Models in Modern Biology (o) (DS)

326
GENETICS
(lecture)
(Spring and Fall)
Prerequisite: BIOL 214

Summer Courses

*114: Principles of Biology
302: Human Learning and the Brain (o, DS)
333: The Human Microbiome (o, DS)
336: Aquatic Biology (p/e)
346: Human Anatomy (o)
339: Aquatic Biology Lab (L)
343: Microbiology (c/m)

@306: Mathematical Analysis of Biological Models

@300: Dynamics of Biological Systems (QL)
@304: Fitting Models to Data: Maximum Likelihood Methods and Model Selection (QL)
@319: Biological Stochastic Processes
@378: Computational Neuroscience

Schedule and courses offered are subject to change without notice!

BREADTH, LABS, and SAGES

c/m	cell and molecular
o	organismal
p/e	population and ecology
L	laboratory
QL	quantitative laboratory
DS	SAGES Departmental Seminar
CAP	SAGES Senior Capstone

UNDERGRADUATE SEMINARS

369: Evolutionary Biology Capstone (CAP)
394: Seminar in Evolutionary Biology (p/e)

UNDERGRADUATE RESEARCH

388: Undergraduate Research in Biology
388S: Undergraduate Research (CAP)
389: Selected Topics in Biology
389S: Selected Topics in Biology (CAP)
390: Advanced Undergraduate Research
396: Research in Evolutionary Biology

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University Bulletin: **http://bulletin.case.edu/collegeofartsandsciences/biology/**

(Handout Rev. 11/08/2016)
(Course Map Rev. 11/08/2016)

SUMMARY OF BIOLOGY COURSE/DEGREE REQUIREMENTS

Biology Major (B.A.)

Core sequence lectures (214, 215, and 216) and labs (214L, 215L, and 216L) . . . . . 12 hr
*Courses in two of these three areas (see course lists on page 3): . . . . . typically 6 hr
- Cell and molecular biology
- Organismal biology
- Population biology/ecology

‡ Genetics (326) . . . . . 3 hr
* Two laboratory courses (see list on page 3) . . . . . 4–8 hr
* Electives (any BIOL at the 200 level or higher, except 240 or 390) . . . . . typically 3–6 hr
(Additional math, chemistry, and physics — 32 hr)

Total 30 hr

B.S. in Biology

Core sequence lectures (214, 215, 216) and labs (214L, 215L, 216L) . . . . . 12 hr
** Courses in two of these three areas (see lists on page 3): . . . . . typically 6 hr
- Cell and molecular biology
- Organismal biology
- Population biology/ecology

‡‡ Genetics (326) . . . . . 3 hr
One quantitative biology laboratory (300, 304, 315, 321, 327, 352, §373, or 397) . . . . . 3–4 hr
** One additional laboratory course (see list on page 3) . . . . . 2–4 hr
** Electives (any BIOL at the 200 level or higher, except 240) . . . . . typically 3–6 hr
Undergraduate research (388S and 390) . . . . . 6 hr
(Additional math, chemistry, physics, and computer programming — 41 hr)

Total 39 hr

B.S. in Systems Biology

Core sequence (✧214, ✧215, ✧216, 300, and 306) . . . . . 15 hr
Approved subspecialty track (two courses in any one of the following areas) . . . . . 6 hr
- Neuroscience (322, 373, 374, 378, NEUR 402)
- Bioinformatics and Genetics (301, 308, 311ABCD, 326, 327, 328, 397, EECS 358, EECS 459)
- Ecology and Evolutionary Biology (305, 310, 336, 338, 345, 352, 353, 358, 364, 365, 368)
- Cellular and Molecular Biology (308, 316, 324, 325, 333, 334, 342, 343, 344, 362, 363, 365)

Biology electives (any BIOL at the 200 level or higher, except 240 and 390) . . . . . 9 hr
Approved systems electives (two courses from a list of BIOL, EBME, EECS, MATH, and STAT) . . . . . 6 hr
(Undergraduate research strongly recommended — 388S and 390)
(Additional math, chemistry, physics, computer programming, computer science, and statistics — 43 hr)

Total 36 hr

Biology Minor

Core sequence: any two of BIOL 214/214L, 215/215L, or 216/216L . . . . . 8 hr
Any BIOL courses at the 200 level or higher, except 240 . . . . . 8 hr

Total 16 hr

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‡ Required for the Fall 2014 entering class and after; serves as a cell/molecular elective for earlier entering classes.
‡‡ Effective for the Fall 2014 entering class and after, BIOL 301 cannot substitute for the genetics requirement.
* Altogether, at least 12 hr of these courses must be at the 300 level or higher; minimum 15 hr required.
** Altogether, at least 11 hr of these courses must be at the 300 level or higher; minimum 17 hr required.
§ Only if taken Fall 2014 and after; earlier versions serve as an organismal elective.
✧ These courses replace BIOL 250 and BIOL 251 (both discontinued), effective for the Fall 2015 entering class and after. Legacy SYB-BS students who have not already completed both courses will be handled on a case-by-case basis. In general, the substitutions are BIOL 215 for BIOL 250, and either BIOL 214 or BIOL 216 for BIOL 251.

(Rev. 03/07/2016)

Breadth Requirement: Major Areas in Biology

Students in the B.A. and B.S. Biology degree programs must take at least one of the following 3-credit or 4-credit courses from two of the following three major areas. This insures broad exposure to different fields in Biology. The Breadth Requirement does not apply to the Systems Biology B.S. degree program.

Note: Only courses listed here may be used to satisfy the Breadth Requirement. Non-listed courses may count as Biology electives, depending upon degree program. No 100-level course may be used in any Biology degree program. BIOL 390 does not count towards the 30 hours of BIOL needed for the B.A. Biology degree.

Cell and Molecular Biology (c/m)	Organismal Biology (o)	Population Biology/Ecology (p/e)
303: From Black Box to Toolbox: How Molecular Biology Moves Forward (SAGES DS) (3)	302: Human Learning and the Brain (breadth and SAGES DS) (3)	225: Evolution (3)
308: Molecular Biology: Genes and Genetic Engineering (4)	318: Introductory Entomology (breadth or lab) (4)	307: Evolutionary Biology of the Invertebrates (odd years only) (3)
316: Fundamental Immunology (4)	322: Sensory Biology (3)	336: Aquatic Biology (3)
324: Introduction to Stem Cell Biology (3)	333: The Human Microbiome (breadth and SAGES DS) (3)	351: Principles of Ecology (3)
325: Cell Biology (3)	338: Ichthyology (effective Spring 2015, breadth or lab) (4) (Spring 2014 and earlier, breadth only) (3)	358: Animal Behavior (breadth or lab) (4) (on hiatus)
326: Genetics (only for entering classes before Fall 2014) (3)	340: Human Physiology (3)	364: Research Methods in Evolutionary Biology (breadth and SAGES DS)
328: Plant Genomics and Proteomics (3)	346: Human Anatomy (3)	368: Topics in Evolutionary Biology (3)
334: Structural Biology of Proteins, Enzymes and Nucleic Acids (3)	362: Principles of Developmental Biology (3) (on hiatus)	394: Seminar in Evolutionary Biology (3)
342: Parasitology (3)	373: Introduction to Neurobiology (effective Fall 2014, breadth or quantitative lab) (3) (Fall 2013 and earlier, breadth only)	398: Modern Human Biological Variation (3)
343: Microbiology (3)	374: Neurobiology of Behavior (breadth and SAGES DS) (3)	
365: Evo-Devo: Evolution of Body Plans (breadth and SAGES DS) (3)	379: Transformative Animal Models in Modern Biology (3) (SAGES DS)	

Laboratory Classes

Numbers in parentheses indicate the number of credit hours. Note: Some courses may count as either a breadth requirment or a laboratory (but not both). BIOL 346, 388, 388S, and 390 do not count as laboratories.

Fall	Spring	Summer
301: Biotechnology Laboratory (lab) (3)	223: Vertebrate Biology (lab) (3)	339: Aquatic Biology Laboratory (lab) (2)
305: Herpetology (lab) (even years only) (4)	300: Dynamics of Biological Systems (quant lab) (3)	
309: Biology Field Studies (lab) (3) Belize (effective Fall 2017)	304: Fitting Models to Data: Maximum Likelihood Methods and Model Selection (quant lab) (3)	
310: Field Studies in Evolutionary Ecology (lab) (3)	309: Biology Field Studies (lab) (3) — Belize (Spring 2017 only) and Namibia	
318: Introductory Entomology (lab or organismal breadth) (4)	315: Quantitative Biology Laboratory (quant lab) (3)	
321: Design and Analysis of Biological Experiments (quant lab) (3)	327: Functional Genomics (quant lab) (3)	
339: Aquatic Biology Laboratory (lab) (2)	338: Icthyology (lab or organismal breadth) (effective Spring 2015) (4)	
345: Mammalian Diversity and Evolution (lab) (odd years only) (4)	344: Microbiology Laboratory (lab) (3 effective Spring 2016, 2 previously)	
351L: Principles of Ecology Laboratory (lab) (2)	352: Ecology and Evolution of Infectious Diseases (quant lab) (3)	
353: Ecophysiology of Global Change (lab) (4)	358: Animal Behavior (lab or organismal breadth) (4) (on hiatus)	
373: Introduction to Neurobiology (quant lab or organismal breadth) (effective Fall 2014) (3)	397: Molecular Phylogenetics (quant lab) (4) (on hiatus)	

In both tables, numbers in parentheses indicate the number of credit hours.

BACHELOR OF ARTS DEGREE IN BIOLOGY
SUGGESTED SEQUENCE OF COURSES — FALL START (recommended)
(effective Fall 2014 entering class)

Freshman Year

FALL	SPRING
SAGES First Year Seminar (4)	SAGES University Seminar (3)
MATH 125 Mathematics I (4)	MATH 126 Mathematics II (4)
CHEM 105 Principles of Chemistry I (3)	CHEM 106 Principles of Chemistry II (3)
BIOL 214 + BIOL 214L Genes, Evolution, and Ecology (3 + 1)	CHEM 113 Principles of Chemistry Laboratory (2)
PHED ### Physical Education Activities (0)	BIOL 215 + BIOL 215L Cells and Proteins (3 + 1)
	PHED ### Physical Education Activities (0)

Sophomore Year

FALL	SPRING
BIOL 216 + BIOL 216L Development and Physiology (3 + 1)	BIOL Elective (3) OR BIOL 326 Genetics (3)
CHEM 223 Introductory Organic Chemistry I (3)	CHEM 224 Introductory Organic Chemistry II (3)
CHEM 233 Organic Chemistry Laboratory I (2)	SAGES Departmental Seminar (3)
SAGES University Seminar (3)	GER Course (3)
GER Course (3)	Open Elective (3)

Junior Year

FALL	SPRING
BIOL 326 Genetics (3) OR BIOL Elective (3)	BIOL Elective (3)
BIOL Laboratory (2–4)	BIOL Laboratory (2–4)
PHYS 115 Introductory Physics I (4)	PHYS 116 Introductory Physics II (4)
GER Course (3)	GER Course (3)
Open Elective (3)	Open Elective (3)

Senior Year

FALL	SPRING
BIOL Elective (3) OR SAGES Capstone (3)	SAGES Capstone (3) OR BIOL Elective (3)
Open Elective (3)	BIOL Elective (3) if needed OR Open Elective (3)
Open Elective (3)	Open Elective (3)
Open Elective (3)	Open Elective (3)
Open Elective (3)	Open Elective (3)

(Rev. 03/17/2014)

BACHELOR OF ARTS DEGREE IN BIOLOGY
SUGGESTED SEQUENCE OF COURSES — SPRING START (trailer)
(effective Fall 2014 entering class)

Freshman Year

FALL	SPRING
SAGES First Year Seminar (4)	SAGES University Seminar (3)
MATH 125 Mathematics I (4)	MATH 126 Mathematics II (4)
CHEM 105 Principles of Chemistry I (3)	CHEM 106 Principles of Chemistry II (3)
CHEM 113 Principles of Chemistry Laboratory (2)	BIOL 214 + BIOL 214L Genes, Evolution, and Ecology (3 + 1)
PHED ### Physical Education Activities (0)	PHED ### Physical Education Activities (0)
Open Elective (3)	

Sophomore Year

FALL	SPRING
BIOL 215 + BIOL 215L Cells and Proteins (3 + 1)	BIOL 216 + BIOL 216L Development and Physiology (3 + 1)
CHEM 223 Introductory Organic Chemistry I (3)	BIOL Elective (3)
CHEM 233 Organic Chemistry Laboratory I (2)	CHEM 224 Introductory Organic Chemistry II (3)
SAGES University Seminar (3)	SAGES Departmental Seminar (3)
GER Course (3)	GER Course (3)

Junior Year

FALL	SPRING
BIOL 326 Genetics (3) OR BIOL Elective (3)	BIOL Elective (3) OR BIOL 326 Genetics (3)
BIOL Laboratory (2–4)	BIOL Laboratory (2–4)
PHYS 115 Introductory Physics I (4)	PHYS 116 Introductory Physics II (4)
GER Course (3)	GER Course (3)
Open Elective (3)	Open Elective (3)

Senior Year

FALL	SPRING
BIOL Elective (3) OR SAGES Capstone (3)	SAGES Capstone (3) OR BIOL Elective (3)
Open Elective (3)	BIOL Elective (3) if needed OR Open Elective (3)
Open Elective (3)	Open Elective (3)
Open Elective (3)	Open Elective (3)
Open Elective (3)	Open Elective (3)

(Rev. 03/17/2014)

BACHELOR OF SCIENCE DEGREE IN BIOLOGY
SUGGESTED SEQUENCE OF COURSES — FALL START (recommended)
(effective Fall 2014 entering class)

Freshman Year

FALL	SPRING
SAGES First Year Seminar (4)	SAGES University Seminar (3)
MATH 125 Mathematics I (4)	MATH 126 Mathematics II (4)
CHEM 105 Principles of Chemistry I (3)	CHEM 106 Principles of Chemistry II (3)
BIOL 214 + BIOL 214L Genes, Evolution, and Ecology (3 + 1)	CHEM 113 Principles of Chemistry Laboratory (2)
PHED ### Physical Education Activities (0)	BIOL 215 + BIOL 215L Cells and Proteins (3 + 1)
	PHED ### Physical Education Activities (0)

Sophomore Year

FALL	SPRING
BIOL 216 + BIOL 216L Development and Physiology (3 + 1)	BIOL 326 Genetics (3)
CHEM 223 (or 323) Introductory Organic Chemistry I (3)	CHEM 224 (or 324) Introductory Organic Chemistry II (3)
CHEM 233 Organic Chemistry Laboratory I (2)	ENGR 131 Elementary Computer Programming (3)
SAGES University Seminar (3)	Open Elective (3)
GER Course (3)	GER Course (3)

Junior Year

FALL	SPRING
BIOL Elective (3) OR BIOL Laboratory (2–4)	Quantitative Biology Laboratory Course (3–4) – Select from BIOL 300, 304, 315, 321, 327, 352, §373, or 397
Advanced Mathematics or Statistics Course (3) — Select from MATH 201 or 304; or BIOL 431; or STAT 207, 312, or 313	SAGES Departmental Seminar (3)
PHYS 115 Introductory Physics I (4)	PHYS 116 Introductory Physics II (4)
BIOL Elective (3)	BIOL Elective (3)
GER Course (3)	GER Course (3)

§Only if taken Fall 2014 and after.

Senior Year

FALL	SPRING
BIOL 388S Undergraduate Research — SAGES Capstone (3)	BIOL 390 Advanced Undergraduate Research (3)
CHEM 301 Introductory Physical Chemistry (3)	BIOL Elective (3)
BIOL Elective (3)	BIOL Elective (3) if needed OR Open Elective (3)
BIOL Laboratory (2–4) if needed OR Open Elective (3)	Open Elective (3)
Open Elective (3)	Open Elective (3)

(Rev. 02/10/2015)

BACHELOR OF SCIENCE DEGREE IN BIOLOGY
SUGGESTED SEQUENCE OF COURSES — SPRING START (trailer)
(effective Fall 2014 entering class)

Freshman Year

FALL	SPRING
SAGES First Year Seminar (4)	SAGES University Seminar (3)
MATH 125 Mathematics I (4)	MATH 126 Mathematics II (4)
CHEM 105 Principles of Chemistry I (3)	CHEM 106 Principles of Chemistry II (3)
CHEM 113 Principles of Chemistry Laboratory (2)	BIOL 214 + BIOL 214L Genes, Evolution, and Ecology (3 + 1)
PHED ### Physical Education Activities (0)	PHED ### Physical Education Activities (0)
GER Course (3)	GER Course (3)

Sophomore Year

FALL	SPRING
BIOL 215 + BIOL 215L Cells and Proteins (3 + 1)	BIOL 216 + BIOL 216L Development and Physiology (3 + 1)
CHEM 223 (or 323) Introductory Organic Chemistry I (3)	CHEM 224 (or 324) Introductory Organic Chemistry II (3)
CHEM 233 Organic Chemistry Laboratory I (2)	ENGR 131 Elementary Computer Programming (3)
SAGES University Seminar (3)	Open Elective (3)
GER Course (3)	GER Course (3)

Junior Year

FALL	SPRING
BIOL 326 Genetics (3)	Quantitative Biology Laboratory Course (3–4) – Select from BIOL 300, 304, 315, 321, 327, 352, §373, or 397
Advanced Mathematics or Statistics Course (3) — Select from MATH 201 or 304; or BIOL 431; or STAT 207, 312, or 313	SAGES Departmental Seminar (3)
PHYS 115 Introductory Physics I (4)	PHYS 116 Introductory Physics II (4)
BIOL Elective (3)	BIOL Elective (3)
Open Elective (3)	Open Elective (3)

§Only if taken Fall 2014 and after.

Senior Year

FALL	SPRING
BIOL 388S Undergraduate Research — SAGES Capstone (3)	BIOL 390 Advanced Undergraduate Research (3)
CHEM 301 Introductory Physical Chemistry (3)	BIOL Elective (3–4)
BIOL Elective (3)	BIOL Elective (3) if needed OR Open Elective (3)
BIOL Laboratory (2–4) if needed OR Open Elective (3)	Open Elective (3)
Open Elective (3)	Open Elective (3)

(Rev. 02/10/2015)

BACHELOR OF SCIENCE IN SYSTEMS BIOLOGY
SUGGESTED SEQUENCE OF COURSES (non-prehealth students)
(all classes entering before Fall 2015)

Freshman Year

FALL	SPRING
SAGES First Year Seminar (4)	✧BIOL 250 Introduction to Cell and Molecular Biology Systems (3)
MATH 121 Calculus for Science and Engineering I (4)	MATH 122 Calculus for Science and Engineering II (4)
CHEM 105 Principles of Chemistry I (3)	CHEM 106 Principles of Chemistry II (3)
CHEM 113 Principles of Chemistry Laboratory (2)	Open Elective (3)
Open Elective (3)	SAGES University Seminar (3)
PHED ### Physical Education Activities (0)	PHED ### Physical Education Activities (0)

Sophomore Year

FALL	SPRING
✧BIOL 251 Introduction to Organismal and Population Biology Systems (3)	BIOL 300 Dynamics of Biological Systems I (3)
PHYS 121 General Physics I (4) OR §EECS 132 Introduction to Programming in Java (3)	PHYS 122 General Physics II (4) OR §PHYS 121 General Physics I (4)
MATH 223 Calculus for Science and Engineering III (3)	MATH 224 Elementary Differential Equations (3)
SAGES University Seminar (3)	Open Elective (3)
GER Course (3)	GER Course (3)

§Recommended order for computer science-oriented students.

Junior Year

FALL	SPRING
BIOL 306 Dynamics of Biological Systems II (3)	STAT 312 Basic Statistics for Engineering and Science (3)
EECS 302/MATH 304 Discrete Mathematics (3)	EECS 233 Introduction to Data Structures (3)
EECS 132 Introduction to Programming in Java (3) OR §PHYS 122 General Physics II (4)	BIOL Elective (3)
BIOL Elective (3)	SAGES Departmental Seminar (3)
GER Course (3)	GER Course (3)

§Recommended order for computer science-oriented students.

Senior Year

FALL	SPRING
SAGES Capstone (3) (recommended BIOL 388S Undergraduate Research — SAGES Capstone)	BIOL Elective (3) (recommended BIOL 390 Advanced Undergraduate Research)
BIOL Subspecialty Elective (3)	BIOL Subspecialty Elective (3)
Systems Elective (3)	Systems Elective (3)
Open Elective (3)	BIOL Elective (3) if needed OR Open Elective (3)
Open Elective (3)	Open Elective (3)

✧These courses were discontinued effective Spring 2015.
See note on page 2 for substitution information.
(Rev. 03/07/2016)

BACHELOR OF SCIENCE IN SYSTEMS BIOLOGY
SUGGESTED SEQUENCE OF COURSES (prehealth students)
(all classes entering before Fall 2015)

Freshman Year

FALL	SPRING
SAGES First Year Seminar (4)	✧BIOL 250 Introduction to Cell and Molecular Biology Systems (3)
MATH 121 Calculus for Science and Engineering I (4)	MATH 122 Calculus for Science and Engineering II (4)
CHEM 105 Principles of Chemistry I (3)	CHEM 106 Principles of Chemistry II (3)
CHEM 113 Principles of Chemistry Laboratory (2)	GER Course (3)
Open Elective (3)	SAGES University Seminar (3)
PHED ### Physical Education Activities (0)	PHED ### Physical Education Activities (0)

Sophomore Year

FALL	SPRING
✧BIOL 251 Introduction to Organismal and Population Biology Systems (3)	BIOL 300 Dynamics of Biological Systems I (3)
BIOL 216L Physiology and Development Laboratory (1)	BIOL 215L Cells and Proteins Laboratory (1)
CHEM 223 Introductory Organic Chemistry I (3)	CHEM 224 Introductory Organic Chemistry II (3)
CHEM 233 Introductory Organic Chemistry Laboratory I (2)	MATH 224 Elementary Differential Equations (3)
MATH 223 Calculus for Science and Engineering III (3)	EECS 132 Introductory Programming in Java (3)
SAGES University Seminar (3)	GER Course (3)

Junior Year

FALL	SPRING
BIOL 306 Dynamics of Biological Systems II (3)	STAT 312 Basic Statistics for Engineering and Science (3)
PHYS 121 General Physics I (4)	PHYS 122 General Physics II (4)
EECS 302/MATH 304 Discrete Mathematics (3)	EECS 233 Introduction to Data Structures (3)
BIOC 307 General Biochemistry (4)	SAGES Departmental Seminar (3)
GER Course (3)	GER Course (3)

Senior Year

FALL	SPRING
SAGES Capstone (3) (recommended BIOL 388S Undergraduate Research — SAGES Capstone)	BIOL Elective (3) (recommended BIOL 390 Advanced Undergraduate Research)
BIOL Subspecialty Elective (3)	BIOL Subspecialty Elective (3)
Systems Elective (3)	Systems Elective (3)
Open Elective (3)	BIOL Elective (3)
BIOL Elective (3)	BIOL Elective (3) if needed OR Open Elective (3)

✧These courses were discontinued effective Spring 2015.
See note on page 2 for substitution information.
(Rev. 03/07/2016)

BACHELOR OF SCIENCE IN SYSTEMS BIOLOGY
SUGGESTED SEQUENCE OF COURSES (non-prehealth students)
(effective Fall 2015 entering class)

Freshman Year

FALL	SPRING
BIOL 214 Genes, Evolution, and Ecology (3)	BIOL 215 Cells and Proteins (3)
MATH 121 Calculus for Science and Engineering I (4)	MATH 122 Calculus for Science and Engineering II (4)
CHEM 105 Principles of Chemistry I (3)	CHEM 106 Principles of Chemistry II (3)
CHEM 113 Principles of Chemistry Laboratory (2)	Open Elective (3)
SAGES First Year Seminar (4)	SAGES University Seminar (3)
PHED ### Physical Education Activities (0)	PHED ### Physical Education Activities (0)

Sophomore Year

FALL	SPRING
BIOL 216 Physiology and Development (3)	BIOL 300 Dynamics of Biological Systems (3)
PHYS 121 General Physics I (4) OR §EECS 132 Introduction to Programming in Java (3)	PHYS 122 General Physics II (4) OR §PHYS 121 General Physics I (4)
MATH 223 Calculus for Science and Engineering III (3)	MATH 224 Elementary Differential Equations (3)
SAGES University Seminar (3)	Open Elective (3)
GER Course (3)	GER Course (3)

§Recommended order for computer science-oriented students.

Junior Year

FALL	SPRING
BIOL 306 Mathematical Analysis of Biological Models (3)	STAT 312 Basic Statistics for Engineering and Science (3)
EECS 302/MATH 304 Discrete Mathematics (3)	EECS 233 Introduction to Data Structures (3)
EECS 132 Introduction to Programming in Java (3) OR §PHYS 122 General Physics II (4)	BIOL Elective (3)
BIOL Elective (3)	SAGES Departmental Seminar (3)
GER Course (3)	GER Course (3)

§Recommended order for computer science-oriented students.

Senior Year

FALL	SPRING
SAGES Capstone (3) (recommended BIOL 388S Undergraduate Research — SAGES Capstone)	BIOL Elective (3) (recommended BIOL 390 Advanced Undergraduate Research)
BIOL Subspecialty Elective (3)	BIOL Subspecialty Elective (3)
Systems Elective (3)	Systems Elective (3)
Open Elective (3)	Open Elective (3)
Open Elective (3)	Open Elective (3)

(Rev. 03/07/2016)

BACHELOR OF SCIENCE IN SYSTEMS BIOLOGY
SUGGESTED SEQUENCE OF COURSES (prehealth students)
(effective Fall 2015 entering class)

Freshman Year

FALL	SPRING
BIOL 214 Genes, Evolution, and Ecology (3)	BIOL 215 Cells and Proteins (3)
MATH 121 Calculus for Science and Engineering I (4)	MATH 122 Calculus for Science and Engineering II (4)
CHEM 105 Principles of Chemistry I (3)	CHEM 106 Principles of Chemistry II (3)
CHEM 113 Principles of Chemistry Laboratory (2)	GER Course (3)
SAGES First Year Seminar (4)	SAGES University Seminar (3)
PHED ### Physical Education Activities (0)	PHED ### Physical Education Activities (0)

Sophomore Year

FALL	SPRING
BIOL 216 Physiology and Development (3)	BIOL 300 Dynamics of Biological Systems (3)
BIOL 216L Physiology and Development Laboratory (1)	BIOL 215L Cells and Proteins Laboratory (1)
CHEM 223 Introductory Organic Chemistry I (3)	CHEM 224 Introductory Organic Chemistry II (3)
CHEM 233 Introductory Organic Chemistry Laboratory I (2)	MATH 224 Elementary Differential Equations (3)
MATH 223 Calculus for Science and Engineering III (3)	EECS 132 Introduction to Programming in Java (3)
SAGES University Seminar (3)	GER Course (3)

Junior Year

FALL	SPRING
BIOL 306 Mathematical Analysis of Biological Models (3)	STAT 312 Basic Statistics for Engineering and Science (3)
PHYS 121 General Physics I (4)	PHYS 122 General Physics II (4)
EECS 302/MATH 304 Discrete Mathematics (3)	EECS 233 Introduction to Data Structures (3)
BIOC 307 General Biochemistry (4)	SAGES Departmental Seminar (3)
GER Course (3)	GER Course (3)

Senior Year

FALL	SPRING
SAGES Capstone (3) (recommended BIOL 388S Undergraduate Research — SAGES Capstone)	BIOL Elective (3) (recommended BIOL 390 Advanced Undergraduate Research)
BIOL Subspecialty Elective (3)	BIOL Subspecialty Elective (3)
Systems Elective (3)	Systems Elective (3)
Open Elective (3)	BIOL Elective (3)
BIOL Elective (3)	Open Elective (3)

(Rev. 03/07/2016)

BIOLOGY COURSE UPDATES
SPRING/SUMMER/FALL 2017 and SPRING 2018

Subject to change! Check with your advisor and/or SIS for any updates.

SPRING 2017

- Courses not offered: BIOL 358/458, 346 (trailer), 377/467/EMAE 377/477 (probably permanently discontinued), 397/497.
- Odd-year-only courses returning: BIOL/EEPS 307, BIOL 364/464.
- Returning and moving to every-spring: BIOL 328/428.
- New courses: BIOL 303 (SAGES DS), 309/409 (lab, Belize and Namibia), 379/479 (SAGES DS), 398/498. See following pages for detailed descriptions.

SUMMER 2017

- May term (3-week, 15 May–2 June) courses offered: BIOL 114, 214, 214L, 215 (limit 22), 216 (regular format, limit 25), 216L, and BIOL 346.
- 5-week term (5 June–7 July) courses offered: BIOL 215, 215L, 216 (hybrid format), 302/COGS 322, 336/436, 339, and 343/443 (but <u>not</u> 344).
- 2nd 4-week term (10 July–4 August) courses offered: BIOL 333.

FALL 2017

- Courses not offered: BIOL 305 (even-year-only), 310/410, 340 (trailer, probably permanently discontinued as a trailer), 362/462/ ANAT 462.
- Returning from hiatus: BIOL 321/421.
- Odd-year-only courses returning: BIOL 345/445/ANAT 445.
- Moving to every-fall: BIOL 309/409 (Belize only; Namibia remains in spring)
- Tentative: BIOL 240.

SPRING 2018

- Returning from hiatus: BIOL 346 (trailer).

NEW COURSES FOR SPRING 2017

BIOL 303: From Black Box to Toolbox: How Molecular Biology Moves Forward
Instructor: Dr. Sarah Bagby
3 credits, SAGES Departmental Seminar
Tuesday/Thursday, 11:30 AM–12:45 PM

The pioneers of modern biology knew very little about the internal workings of the cell, and they had access to only a very limited set of very low-resolution tools. Yet clean experimental design and careful analysis let them ask and answer fundamental biological questions and enabled the development of better tools to use the next time around. In just seven decades, biologists have built a toolbox that offers astonishing precision and power, but the logic of biological experimentation hasn't changed. In this course, we will study that underlying logic, and what it lets us do. We will read key papers spanning the development of modern biology, from the most basic working-out of the Central Dogma to recent advances. We will pay particular attention to how well the authors used the tools available, and how successfully they accounted for their shortcomings — if indeed they did. The emphasis of the course will be on classroom discussion. In lieu of exams, students will (1) write brief responses to weekly in-class prompts for understanding, (2) write in-depth proposals for a molecular biology research project, and (3) present their proposals orally to the class. These assignments are designed to check that students are keeping up with weekly discussions and synthesizing what they have learned into a deeper understanding of how we develop questions and construct arguments in biological research. Prerequisite: completion of BIOL 215. This course is offered as a SAGES departmental seminar and fulfills the Cell and Molecular breadth requirement of the B.A. and B.S. in Biology.

BIOL 309/409: Biology Field Studies
3 credits, lab

Intensive investigation of living organisms in a natural environment. Location of the field site may vary with each course offering, and may be either domestic or international. Topics covered include logistics, biodiversity, and current ecological, environmental, and social issues surrounding the specific ecosystem being studied. Time at the field site will be spent listening to resident lecturers, receiving guided tours, observing and identifying wild organisms in their natural habitat, and conducting a research project. The undergraduate version requires students to plan and conduct a group research project and present results independently. The graduate version requires students to plan, conduct, and present an independent research project. Undergraduate prerequisite: BIOL 216. Graduate prerequisite: graduate standing. Instructor consent required to register. This course will fulfill a laboratory requirement of the B.A. in Biology. This course will fulfill an additional laboratory requirement of the B.S. in Biology. Course may be repeated for credit up to two times if traveling to a new destination.

Section 100/400: Belize
Instructor: Dr. Ron Oldfield
Tuesday, 10:00–11:15 AM

Section 101/404: Namibia
Instructor: Dr. Chris Cullis
Tuesday, 10:00–11:15 AM

NEW COURSES FOR SPRING 2017

BIOL 379/479: Transformative Animal Models in Modern Biology
Instructor: Dr. Brian McDermott
3 credits, SAGES Departmental Seminar
Monday/Wednesday, 12:45–2:00 PM

Animal models are extremely important in the study of biology and in modern medicine. They allow us to determine fundamental biological mechanisms and cellular and molecular causes of disease. There is logic to how each animal model has found its place in the menagerie of accepted animal models. Certain animal models allow us to test particular hypotheses that may not be possible to address in other animals. Moreover, some animal models are more relevant than others to studying a particular human disease. This seminar-based course will focus on animal models that either are effective at modeling human disease, approach relevant neurobiological questions, or play a role in translational medicine. The course will focus on mammalian and non-mammalian animal models that are important to biomedical research, including the primate, mouse, zebrafish, and roundworm. Comparisons between popular animal models will be made. Undergraduate prerequisite: BIOL 326 OR BIOL 373. Graduate prerequisite: graduate standing. This course fulfills the Organismal breadth requirement of the B.A. and B.S. in Biology.

BIOL 398/498: Modern Human Biological Variation
Instructor: Dr. Denise Su
3 credits
Monday/Wednesday, 8:00–9:15 AM, at the Cleveland Museum of Natural History

The objectives of this course are to provide students with an introduction to human biological variation and to understand the variation within an evolutionary framework through lecture, readings, discussion, and labs. We will examine the patterns of morphological and genetic variation in modern human populations and discuss the evolutionary explanations for the observed patterns. In order to do this, we will first build a solid foundation in the scientific method, population genetics, and evolutionary theory before exploring the adaptive significance of the observed variation. A major component of the class will be the discussion of the social and health implications of these patterns of biological variation, particularly in the construction and application of the concept of race and its use in medicine. There are three units to the course. Unit 1 focuses on the fundamentals to understanding biological variation, we will cover basic population genetics, evolution, and the human fossil record. Unit 2 concentrates on surveying modern human biological variation, examining both morphological and genetic traits, and why these variations exist. Unit 3 examines how race is constructed using population-based biological differences, its validity, and the implications for health and medicine. Prerequisite for undergraduates is completion of BIOL 214. Prerequisite for graduate students is graduate standing. This course fulfills the Population and Ecology breadth requirement of the B.A. and B.S. in Biology.
