Undergraduate Curriculum in Biology

Case Western Reserve University

Fall Courses

*114: Principles of Biology
*116: Introduction to Anatomy and Physiology 1

(*Indicates non-major courses that DO NOT count toward the Biology major)

Spring Courses

*117 Introduction to Anatomy and Physiology II
225: Evolution (p/e)

214
Genes, Evolution, and Ecology
(BIOL 214L*)

223: Vertebrate Biology (L)
302: Human Learning and the Brain (o, DS)
352: Ecology and Evolution of Infections Diseases (QL)

302: Human Learning and the Brain (o, DS)
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)
398: Modern Human Biological Variations (p/e) *on hiatus*

215
Cells and Proteins
(BIOL 215L*)

303: From Black Box to Toolbox: How Molecular Biology Moves Forward (c/m, DS)
314: Taming the Tree of Life: Phylogenetic Comparative Methods-from Concept to Practical Application (L, CAP)
316: Fundamental Immunology (c/m)
325: Cell Biology (c/m)
327: Functional Genomics (QL)
328: Plant Genomics and Proteomics (c/m) *on hiatus*
343: Microbiology (c/m)
344: Laboratory for Microbiology (L)

301: Biotechnology Lab: Genes and Genetic Engineering (L)
311: Survey of Bioinformatics (A,B, and C)
329: Genome Dynamics (c/m, DS)
341: Basic Biology of Blood and Blood Diseases (c/m)

216
Development and Physiology
(BIOL 216L*)

309: Biology Field Studies (L) – Namibia
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: Anatomy (o)
357: Backyard Behavior (CAP)
358: Animal Behavior (p/e – OR – L)
365: Evo-Devo: Evolution of Body Plans (c/m, DS)
366: Genes, Embryos, and Fossils (DS)
368: Topics in Evolutionary Biology

305: Herpetology (even)
305L: Herpetology Lab (even)
309: Biology Field Studies (L) – Costa Rica
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)
373: Introduction to Neurobiology (on haitus)
374: Neurobiology of Behavior (on haitus)
379: Transformative Animal Models in Modern Biology (o, DS)

326*
Genetics
(lecture)
Prerequisite: BIOL 214

*requirement for the BA and BS degrees only

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

306: Mathematical Analysis of Biological Models

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

KEY

c/m:	Cell and Molecular Breadth
o:	Organismal Breadth
p/e:	Population Biology/Ecology Breadth
L:	Laboratory
QL:	Quantitative Laboratory
DS:	SAGES Department Seminar
CAP:	SAGES Senior Capstone

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Schedule and courses are subject to change without notice

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SUMMARY OF DEGREE REQUIREMENTS

B.A. in Biology

Core sequence lectures (214, 215, and 216) and labs (214L, 215L, 216L)……..…….12 hrs
Courses in the Biology Breadth Areas (see page 3 for course lists)…….....….typically 6 hrs
(choose 2 courses total from 2 separate categories)
Genetics (BIOL 326) ……..……..3 hrs
Two laboratory courses (see list on page 3) ……..……4-8 hrs
*Electives (any BIOL at the 200 level or higher, except 240 or 390…….....……..3-6 hrs
(Additional math, chemistry, and physics: 32hrs)

*A total of 30 credits in BIOL courses is required. 15 hrs must be at the 300 level or higher.

B.S. in Biology

Core sequence lectures (214, 215, and 216) and labs (214L, 215L, 216L)……..…….12 hrs
Courses in the Biology Breadth Areas (see page 3 for course lists)…….....….typically 6 hrs
(choose 2 courses total from 2 separate categories)
Genetics (BIOL 326) ……..……..3 hrs
One quantitative biology laboratory (see list on page 3)…….3-4 hrs
One additional laboratory (see list on page 3)…….3-4 hrs
**Electives (any BIOL at the 200 level or higher, except 240)…….....…….…....typically 6 hrs
Undergraduate Research (BIOL 388S and BIOL390)…….……...……6 hrs
(Additional math, chemistry, physics, and computer programming: 41 hrs)

**A total of 39 credits in BIOL courses is required. 17 hrs must be at the 300 level or higher.

B.S. in Systems Biology

Core sequence lectures (214, 215, 216, 300 and 306) …….……15 hrs
Approved subspecialty track electives (two courses in one of the following areas, see additional handouts for course lists)……....6 hrs
- Neuroscience
- Bioinformatics and Genetics
- Ecology and Evolutionary Biology
- Cellular and Molecular Biology

***Biology electives (Any BIOL at the 200 level or higher except 240 and 390)….……..…..9 hrs
Approved Systems Electives (see additional handouts for course lists) …….…….…….6 hrs
(Additional math, chemistry, physics, computer programming, computer science, and stats- 43 hrs)

*** A total of 30 credits in BIOL courses is required. 15 hrs must be at the 300 level or higher.

Biology Minor

Core sequence: any TWO of the biology core (214+214L, 215+215L, or 216+216L……..…8 hrs
Electives: Any BIOL courses at the 200 level or higher except 240…….…….……8 hrs
16 credits total

B.S. in Neuroscience

Core sequence lectures (214, 215, and 216) and labs (214L, 215L, 216L)
Programming (choose 1 – ENGR 131 **or** BIOL 321)
Mathematics: (MATH 125, MATH 126, STAT 312 (or 313)
Chemistry: (CHEM 105, 106, 113, 223, 224, 233)
Physics: (PHYS 115, 116)

Cell/Molecular Elective: (choose 1 : BIOL 326 **or** BIOL 325 **or** BIOC 307/CHEM 328)
Ecology/Evolution elective: (choose 1: BIOL 225 **or** BIOL 351)
Neuroscience: (required: NEUR 166, NEUR 201, NEUR 202)
Neurobiology core courses (choose 2: BIOL 373, 322, 358, 374, NEUR 301, PSCL 350)
Neuroscience electives (choose 2, at least 1 course from a non-biology dept: BIOL 302, 378, 385; PSCL 101, 352, 379; COGS 102, 201, 305; COSI 357; PHIL 311, 366; MATH 333

Neuroscience Research (6 hrs required: BIOL/NEUR 388, BIOL/NEUR 388S, BIOL/NEUR 390

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 or 4 credit courses from two of the following three breadth areas. This insures broad exposure to different fields in Biology. The breadth requirement does not apply to the B.S. in Systems Biology degree or the B.S. in Neuroscience Degree

Note: only courses listed here may be used to satisfy the breadth requirement. Non-listed courses may count as biology electives, depending on degree program. No 100-level courses may be used to count toward any of the biology degree programs.

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 (breadth and SAGES DS) (3)	302: Human Learning and the Brain (breadth and SAGES DS) (3)	225: Evolution (3)
316: Fundamental Immunology (4)	318: Introductory Entomology (breadth or lab) (4)	305: Herpetology
324: Introduction to Stem Cell Biology (3)	322: Sensory Biology (3)	307: Evolutionary Biology of the Invertebrates (odd years only) (3)
325: Cell Biology (3)	330: Human Genetics (3)	312: Introductory Plant Biology (3)
328: Plant Genomics and Proteomics (3)	333: The Human Microbiome (breadth and SAGES DS) (3)	336: Aquatic Biology (3)
329: Genome Dynamics (3) (breadth and SAGES DS)	338: Ichthyology (breadth or lab) (4)	351: Principles of Ecology (3)
341: Basic Biology of Blood and Blood Diseases (3)	340: Human Physiology (3)	358: Animal Behavior (breadth or lab) (4)
342: Parasitology (3)	346: Human Anatomy (3)	364: Research Methods in Evolutionary Biology (breadth and SAGES DS)
343: Microbiology (3)	362: Principles of Developmental Biology (3)	368: Topics in Evolutionary Biology (3) (on haitus)
365: Evo-Devo: Evolution of Body Plans (breadth and SAGES DS) (3)	373: Introduction to Neurobiology (breadth or quantitative lab) (3)	394: Seminar in Evolutionary Biology (3) (on haitus)
	374: Neurobiology of Behavior (breadth and SAGES DS) (3)	398: Modern Human Biological Variation (3)
	379: Transformative Animal Models in Modern Biology (3) (breadth and SAGES DS)	

Laboratory Classes

Note: Some courses count as either a breadth OR laboratory, but not both. BIOL 346, 388, 388S, 340, and 390 are not laboratories.

Fall	Spring	Summer
301: Biotechnology Laboratory (lab) (3)	223: Vertebrate Biology (lab) (3)	**subject to change**
305L: Herpetology Lab (even years only) (2)	300: Dynamics of Biological Systems (quant lab) (3)	
309: Biology Field Studies (lab) (3) — Costa Rica	304: Fitting Models to Data: Maximum Likelihood Methods and Model Selection (quant lab) (3)	
318: Introductory Entomology (lab or organismal breadth) (4)	309: Biology Field Studies (lab) (3) — Namibia	
321: Design and Analysis of Biological Experiments (quant lab) (3)	314: Taming the Tree of Life (lab and Capstone) (3)	
339: Aquatic Biology Laboratory (lab) (2)	315: Quantitative Biology Laboratory (quant lab) (3)	
345: Mammalian Diversity and Evolution (lab) (odd years only) (4)	327: Functional Genomics (quant lab) (3)	
351L: Principles of Ecology Laboratory (lab) (2)	338: Ichthyology (lab or organismal breadth) (effective Spring 2015) (4)	
353: Ecophysiology of Global Change (lab) (3)	344: Microbiology Laboratory (lab) (3 effective Spring 2016, 2 previously)	
373: Introduction to Neurobiology (quant lab or organismal breadth) (3)	352: Ecology and Evolution of Infectious Diseases (quant lab) (3)	
	358: Animal Behavior (lab or organismal breadth) (4)	

In both tables, numbers in parentheses indicate credit hours

BACHELOR OF ARTS DEGREE IN BIOLOGY
Suggested sequence of courses (Fall start)

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 215+BIOL 215L Cells and Proteins (3+1)
BIOL 214 + 214L Genes, Evolution, and Ecology (3+1)	PHED or other elective as necessary (GER course)
PHED or elective as necessary only (GER course)	

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 (2)	SAGES Departmental Seminar
SAGES University Seminar (3)	GER Course (3)
GER Course (3)	Open Elective (3)

Junior Year

FALL	SPRING
BIOL 326 Genetics (3) OR BIOL Elective	BIOL Elective (3) or BIOL 326 Genetics (3)
BIOL Laboratory (2-4)	BIOL Laboratory (2-4)
PHYS 115 Introductory Physics (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
Open Elective (3)	BIOL Elective (3) if needed OR Open Elective
Open Elective (3)	Open Elective (3)
Open Elective (3)	Open Elective (3)
Open Elective (3)	Open Elective (3)

BACHELOR OF SCIENCE DEGREE IN BIOLOGY
Suggested sequence of courses (Fall start)

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 215+BIOL 215L Cells and Proteins (3+1)
BIOL 214 + 214L Genes, Evolution, and Ecology (3+1)	PHED or other elective as necessary (GER course)
PHED or elective as necessary only (GER course)	

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 (2)	ENGR 131 Elementary Computer Programming
SAGES University Seminar (3)	Open Elective
GER Course (3)	GER Course (3)

Junior Year

FALL	SPRING
BIOL 326 Genetics (3) OR BIOL Laboratory (2-4)	Quantitative Biology Laboratory Course (2-4)
Advanced MATH or STAT course (MATH 201 or 304; OR STAT 312/312R (3)	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)

Senior Year

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

BACHELOR OF SCIENCE NEUROSCIENCE
Suggested sequence of courses (Fall start)

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)
NEUR 166 Explorations in Neuroscience (1)	CHEM 113 Principles of Chemistry Lab (2)
BIOL 214 + 214L Genes, Evolution, and Ecology (3+1)	BIOL 215+BIOL 215L Cells and Proteins (3+1)
PHED or elective as necessary only (GER course)	Elective as necessary

Sophomore Year

FALL	SPRING
BIOL 216+BIOL 216L Development and Physiology (3+1)	NEUR 202 Fundamentals of Neuroscience II (3)
CHEM 223 Introductory Organic Chemistry I (3)	CHEM 224 Introductory Organic Chemistry II (3)
CHEM 233 Organic Chemistry Laboratory (2)	GER or SAGES University Seminar as needed (3)
SAGES University Seminar (3)	Cell/Molecular or Ecology/Evolution elective (3)
NEUR 201 Fundamentals of Neuroscience (3)	Open Elective (3)

Junior Year

FALL	SPRING
Cell/Molecular or Ecology/Evolution elective (3)	Neurobiology Core Course OR Neuro Elective (3)
BIOL 321 OR ENGR 131 (3)	SAGES Departmental Seminar (3)
PHYS 115 Introductory Physics I (4)	PHYS 116 Introductory Physics II (4)
Neurobiology Core Coures OR Neuro Elective (3)	STAT 312 OR ENGR 131 if needed OR open elective (3)
Open Elective or GER elective (3)	Open Elective or GER elective as needed (3)

Senior Year

FALL	SPRING
BIOL/NEUR 388S Undergraduate Research – SAGES Capstone (3) or BIOL/NEUR 388 (Undergraduate Research)	BIOL/NEUR 390 OR BIOL/NEUR 388S (Advanced Undergraduate Research OR Capstone)
Neurobiology Core Course or Neuro Elective (3)	Neuro elective as needed OR Open Elective (3)
STAT 312 OR open elective (3)	BIOL Elective (3) if needed OR Open Elective
Open Elective (3)	Open Elective (3)
Open Elective (3)	Open Elective (3)

BACHELOR OF SCIENCE DEGREE IN SYSTEMS BIOLOGY

Suggested sequence of courses (Fall start)

*Pre-health students should include all core BIOL labs (214, 215, 216) and organic chemistry I and II with labs (CHEM 223, 233, 224, 234)

Freshman year

FALL	SPRING
SAGES First Year Seminar (4)	SAGES University Seminar (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)	BIOL 215 Cells and Proteins
BIOL 214 Genes, Evolution, and Ecology	SAGES University Seminar
PHED or elective as necessary only	PHED or elective as necessary

Sophomore Year

FALL	SPRING
BIOL 216 Development and Physiology (3)	BIOL 300 Dynamics of Biological Systems (3)
PHYS 121 General Physics I (4) OR EECS 132 Intro 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)

Junior Year

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

Senior Year

FALL	SPRING
SAGES Capstone (3) (recommended BIOL 388S – Undergraduate Research Capstone)	BIOL Elective (recommended BIOL 390 Advanced Undergraduate Research) (3)
BIOL Subspecialty Elective (3)	BIOL Subspecialty Elective (3)
Systems Biology Elective (3) (See list on check sheet)	Systems Elective (see list on check sheet) (3)
Open Elective (3)	Open Elective (3)
Open Elective (3)	Open Elective (3)