

## Interdisciplinary Physics Example Cognate Plans

The Interdisciplinary Physics concentration allows students substantial flexibility to define the thematic focus of their study. This flexibility comes with a responsibility; each student must work with a physics concentration counselor to select the right 400 level physics courses and to define a cognate course plan when declaring the IP concentration. The plans defined at this early stage need not be final. In fact it is quite likely they will evolve as you learn more and understand better where you want to go with your degree.

To help with this process, and to illustrate the range of options available within this concentration, we provide here a set of example cognate plans. Each is meant to illustrate how a student focusing in a particular area might best prepare themselves for the future. These are only examples, and even within the areas we describe here, we expect most students will define their own, quite possibly different, cognate plans.

### **The parameters**

Each IP concentrator must complete a set of Physics and Mathematics prerequisites, Physics 390, a choice of three 400 level physics courses, and 15 credits of cognate courses.

### **The examples:**

#### 1: IP with a focus on Statistical Physics and Methods

- 400 Level Physics Courses:
  - 401: Intermediate Mechanics
  - 406: Statistical and Thermal Physics
  - 453: Intermediate Quantum Mechanics
- Cognate Courses:
  - Statistics 412: Introduction to Probability and Statistics
  - Statistics 425: Introduction to Probability or Mathematics 525
  - Statistics 406 or Physics 411: Computational Methods
  - Statistics 426: Introduction to Theoretical Statistics
  - Complex Systems 501 Intro to Complex Systems or Mathematics 523: Risk Theory

#### 2: IP with a focus on Astrophysics

- 400 Level Physics Courses
  - 405: Electricity and Magnetism
  - 406: Statistical and Thermal Physics
  - 453: Intermediate Quantum Mechanics
- Cognate Courses:
  - Physics 401: Intermediate Mechanics
  - Astronomy 160: Introduction to Astrophysics
  - Astronomy 361: Astronomical Techniques

- Astronomy 404: Galaxies and the Universe
- Astronomy 405: High Energy Astrophysics

### 3: IP with a focus on organismal biology

- 400 Level Physics Courses:
  - 402: Optics
  - 406: Statistical and Thermal Physics
  - 417: Dynamical Processes in Biophysics
- Cognate Courses:
  - Biology 162 or 163: Introduction to Biology
  - Biology 225 & 226: Animal Physiology and the accompanying lab
  - Biology 305: Genetics
  - Biology 390: Evolution

### 4: IP with a focus on biological systems modeling

- 400 Level Physics Courses:
  - Physics 406: Statistical and Thermal Physics
  - Physics 401: Intermediate Mechanics
  - Physics 411: Computational Physics
- Cognate Courses:
  - BiomedE 211. Circuits and Systems for Biomedical Engineering
  - Physics 417: Dynamical Processes in Biology
  - EECS 280. Programming and Introductory Data Structures
  - Mathematics 463: Mathematical Modeling for Biology
  - Biology 162 or 163

### 5: IP with a focus on Economics

- 400 Level Physics Courses
  - Physics 401: Intermediate Mechanics
  - Physics 406: Statistical and Thermal Physics
  - Physics 453: Intermediate Quantum Mechanics
- Cognate courses
  - Physics 411: Computational Physics
  - Economics 401: Microeconomics
  - Economics 402: Macroeconomics
  - Mathematics 423: Mathematics of Finance
  - Economics 409: Game Theory

### 6: IP with a focus on Global Change and the Environment

- 400 Level Physics Courses
  - Physics 401: Intermediate Mechanics
  - Physics 405: Intermediate Electricity and Magnetism
  - Physics 406: Statistical and Thermal Physics
- Cognate courses
  - Physics 411: Computational Physics
  - Physics 453: Intermediate Quantum Mechanics

- Physics 438: Electromagnetic Radiation
- Climate modeling
- Planetary science?
- Environmental economics?
- Intro global change courses

7: IP with a focus on Mathematical Physics

- 400 Level Physics Courses
  - Physics 401: Intermediate Mechanics
  - Physics 405: Electricity and Magnetism
  - Physics 406: Statistical and Thermal Physics
- Cognate Courses
  - Physics 451: Methods of Theoretical Physics I
  - Physics 452: Methods of Theoretical Physics II
  - Physics 453: Intermediate Quantum Mechanics
  - Physics 435: Gravitational Physics
  - Mathematics 555: Introduction to Complex Variables

8: IP with a focus on Philosophy

- 400 Level Physics Courses
  - Physics 405: Electricity and Magnetism
  - Physics 406: Statistical and Thermal Physics
  - Physics 453: Quantum Mechanics
- Cognate Courses
  - Physics 435: Gravitational Physics
  - Philosophy 201 or 296: Introduction to Logic (or Honors)
  - Philosophy 420: Philosophy of Science
  - Philosophy 423: Problems of Space and Time
  - Philosophy 482: Philosophy of the Mind

9: IP with a focus on Science and Society

- 400 Level Physics Courses
  - Physics 405: Electricity and Magnetism
  - Physics 406: Statistical and Thermal Physics
  - Physics 481: Physics and National Science Policy
- Cognate Courses
  - Course listings for the Science, Technology and Society minor offer a good array of appropriate choices here

10: IP with a focus on Nanotechnology

- 400 Level Physics Courses
  - Physics 405: Electricity and Magnetism
  - Physics 406: Statistical and Thermal Physics
  - Physics 453: Quantum Mechanics
- Cognate Courses
  - Physics 401: Intermediate Mechanics

- Physics 451: Methods of Theoretical Physics
- Physics 463: Condensed Matter Physics
- EECS 414. Introduction to MEMS
- EECS 425. Integrated Microsystems Laboratory

11: IP with a focus on Computational Physics

- 400 Level Physics Courses:
  - Physics 401: Intermediate Mechanics
  - Physics 405: Electricity and Magnetism
  - Physics 451: Methods of Theoretical Physics
- Cognate Courses
  - Physics 411: Computational Physics
  - Physics 453: Quantum Mechanics
  - EECS 183 or EECS 280. Programming and Introductory Data Structures
  - Mathematics 471: Introduction to Numerical Methods
  - Statistics 426: Introduction to Theoretical Statistics

12: IP with a focus on Quantum Computing

- 400 Level Physics Courses
  - Physics 451: Methods of Theoretical Physics
  - Physics 453: Quantum Mechanics
  - Physics 460: Quantum Mechanics II
- Cognate Courses:
  - Physics 405: Electricity and Magnetism
  - Physics 406: Thermal and Statistical Physics
  - Physics 402: Optics
  - Physics 441: Advanced Lab I
  - Physics 442: Advanced Lab II

13: IP with a focus on Cosmology

- 400 Level Physics Courses
  - Physics 405: Electricity and Magnetism
  - Physics 406: Statistical and Thermal Physics
  - Physics 435: Gravitational Physics
- Cognate Courses:
  - Physics 411: Computational Physics
  - Physics 451: Methods of Theoretical Physics
  - Physics 453: Quantum Mechanics
  - Astronomy 404: Galaxies and the Universe
  - Physics 525: Introduction to Topics in Astrophysics

14: IP with a focus on Applied Physics

- 400 Level Physics Courses:
  - Physics 405: Electricity and Magnetism
  - Physics 406: Statistical and Thermal Physics
  - Physics 453: Quantum Mechanics

- Cognate Courses:
  - Physics 463: Condensed Matter Physics
  - Physics 411: Computational Physics
  - Physics 441: Advanced Laboratory I
  - EECS 320: Introduction to Semiconductor Devices
  - EECS 311 or 314: Electrical Circuits Introductions

#### 15: IP with a focus on Medical Physics for Medical School

Students thinking about continuing on to medical school may distinguish themselves from typical applicants by designing an Interdisciplinary Physics concentration with a focus on Medical Physics. If you expect to apply for medical school, you should be sure to cover the usual pre-medical course requirements as well.

Pre-medical requirements (see [this link](#) for official LSA information):

- Two years of Chemistry
- One year of Biology
- One year of Physics
- A course in Biochemistry
- A course in Mathematics

Prerequisites for Interdisciplinary Physics cover the Physics and Mathematics requirements, leaving Chemistry, Biology, and Biochemistry requirements.

- 400 Level Physics Courses
  - Physics 405: Electricity and Magnetism
  - Physics 406: Statistical and Thermal Physics
  - Physics 417: Dynamical Processes in Biophysics
- Cognate Courses
  - Chemistry 210 & 211: Structure and Reactivity and its Lab
  - Chemistry 215 & 216: Structure and Reactivity II and its Lab
  - Chemistry 260: Chemical Principles
  - Biochemistry 310 or 415: Introduction to Biochemistry
  - Biomedical Engineering 484: Radiological Health Engineering Fundamentals

#### 16: IP as preparation for a Health Physics graduate program

- 400 Level Physics Courses
  - Physics 405: Electricity and Magnetism
  - Physics 406: Thermal and Statistical Physics
  - Physics 453: Quantum Mechanics
- Cognate Courses:
  - Chemistry, biology, human physiology, statistics, electronics

Cognate requirements: In addition to the courses outlined above, students are expected to define a series of cognate courses including a total of at least 15 credits, at least 9 at the 200 level or above.