The Theoretical Minimum

I love flipping through new textbooks at the university bookstore, and reading through several in parallel to get multiple perspectives when learning a new field. That's why I compiled a big list of physics resources to use after learning introductory physics. But if you're self-studying with limited time, you might prefer to get straight to the point. In that case, you can also get a deep understanding of physics with a more direct route, through a small set of canonical textbooks.

The Undergraduate Minimum

The following books are well-written and beloved by students. They are particularly useful for self-studying students because they are self-contained, anticipate possible misconceptions, and most importantly, contain lots of good problems. If you work through them, doing most of the problems on your own, then you'll know the core content of an undergraduate physics degree.

1. Any introductory calculus-based physics book, as listed here. They're all about equally good.
2. *Classical Mechanics* by Taylor.
3. *Thermal Physics* by Schroeder.
4. *Introduction to Electrodynamics* (4th edition) by Griffiths.
5. *Introduction to Quantum Mechanics* (3rd edition) by Griffiths and Schroeter.

Upper division students often loudly complain about these books to signal that they've used more "hardcore" books, such as Landau and Lifshitz for mechanics and Shankar for quantum mechanics. These are also great books, but not as suitable for self-study because they omit context a beginner needs, lack rich practice problems, and take mathematical background for granted. Like any book, reading them will certainly enrich your understanding, but I recommend mastering the five books above first. After you do, they'll be easily approachable if you want to read them.

Electives

Here are some excellent, gentle first books in several subfields of physics. None of them will get you all the way, but once you finish one, you'll have a clearer idea of what to do next. All of them should be readable after completing the undergraduate minimum.

- Astrophysics: *An Introduction to Modern Astrophysics* by Carroll and Ostlie.
- Cosmology: *Introduction to Cosmology* by Ryden.
- Condensed matter: *The Oxford Solid State Basics* by Simon.
- Continuum mechanics: *Physics of Continuous Matter* by Lautrup.
- Complexity theory: *Nonlinear Dynamics and Chaos* by Strogatz.
- Particle physics: *Introduction to Elementary Particles* by Griffiths.
- Plasma physics: *Introduction to Plasma Physics* by Chen.
- Quantum computers: *Quantum Computation and Quantum Information* by Nielsen and Chuang.
- String theory: *A First Course in String Theory* by Zwiebach.

The Graduate Minimum

A graduate degree in physics typically begins with seeing all the undergraduate material again, but at a higher level. In this context, there's a standard set of recommendations based on the books that boomers used when they went to graduate school. I think most of these "classics" have been improved upon by more modern sources, written in this century. Today's sources are simultaneously deeper, more relevant to current research, and easier to understand. My recommended list is:

6. *Modern Classical Mechanics* by Helliwell and Sahakian. (Improved version of Goldstein.)

7. *Modern Electrodynamics* by Zangwill. (Improved version of Jackson.)

8. *Statistical Physics* (two volumes) by Kardar. (Improved version of Pathria/Huang/Reif.)

9. Quantum Mechanics lecture notes by Littlejon. (Improved version of Sakurai.)

Further Specializations

Students often ask for a list of books to read to be totally "prepared" for research, but this is misguided: even within a subfield (such as particle physics), the answer depends entirely on the research problem you end up working on. There's too much in each subfield for any one person to learn. The right path is to master the fundamentals above, then get a research mentor who will direct you to an interesting problem, and help you figure out what you need to learn to attack it.

Alternatively, if you don't intend to do research in physics, and only want to study it for fun, then the right path forward is to figure out precisely why you're going to the trouble of doing so. Are you fascinated by the story of physics as a science? If so, you're well-prepared to read about the history of physics, either through the works of historians or directly from the primary sources. Do you enjoy the struggle of cracking tough problems? You can find many more such problems throughout the literature, or you might want to start formulating and solving your own. Do you just want to know what's going on at the research frontier? The next time you see a mindblowing but vague news article about the latest breakthrough, you'll be prepared to go right to the source and see for yourself. The "minimum" knowledge above will not be enough to understand *any* of those papers immediately, but it will be enough for you to figure out how to learn the parts you're missing in a reasonable amount of time. The foundation is set.