

Physics

Scott N. Walck

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What is Physics?

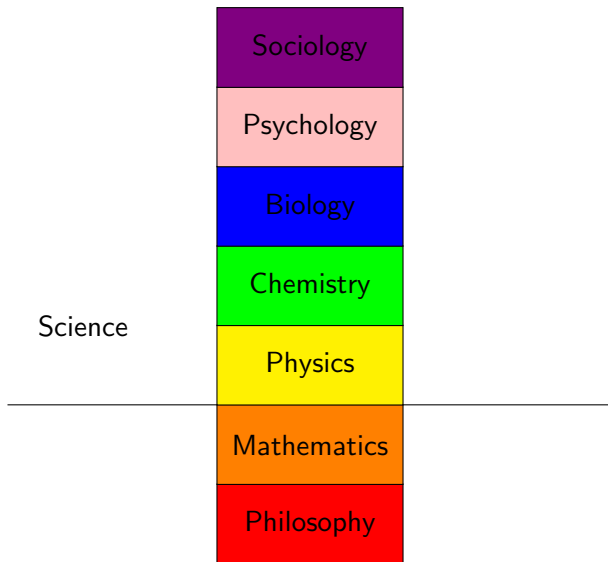
Physics claims these ideas:

- ▶ Motion
- ▶ Light
- ▶ Sound
- ▶ Gravity
- ▶ Electricity
- ▶ Magnetism
- ▶ Matter
- ▶ Energy
- ▶ Space
- ▶ Time

Physics is the science whose subject matter is furthest from people

- ▶ Sociology cares about people.
- ▶ Psychology goes beyond people to care about brains.
- ▶ Biology goes beyond brains to care about all life.
- ▶ Chemistry goes beyond life to care about all atoms and molecules.
- ▶ Physics goes beyond atoms and molecules to care about the fundamental building blocks of the universe.

Physics is the ground floor of science.



3 of 5 human senses are detectors of physics

Sense	Detector of	artificial extension
Sight	Light	microscope, telescope, glasses
Hearing	Sound	microphone, hearing aid
Feeling	Pressure	atomic force microscope
Taste	chemistry	
Smell	chemistry	

Physics is both:

1. a body of knowledge about the world, and
 2. a process of obtaining new knowledge about the world.
- ▶ Every science has these two aspects. Mathematics has these two aspects, except that it is not directly “about the world.”
 - ▶ In this introductory course, we focus primarily on the first aspect, but that creates a problem: how do we know the things we claim to know?
 - ▶ Pure sciences have these two aspects; applications of science, such as medicine, have a third aspect—an intent or purpose.

Some important physicists (terribly oversimplified)

Physicist	contribution	when?
?	Warren Field lunar calendar	8000 BCE
?	optics, lenses	2000 BCE
Newton	theory of motion	late 1600s
Young	wave optics	early 1800s
Faraday	electromagnetic induction	1830s
Stokes	fluid dynamics	1840s
Kelvin	thermodynamics	1854
Maxwell	electromagnetic theory	1865
Einstein	better theory of gravity	1915
Noether	symmetry in physics	1918
Heisenberg	quantum mechanics	1925
Feynman	quantum electrodynamics	1940s
Gell-Mann	quarks, standard model	1964, 1995, 2012
Thorne	gravitational waves	2015
Mayor	exoplanets	1992–2020

What we don't know

- ▶ Is there a theory that encompasses both general relativity and quantum mechanics?
- ▶ Is there a quantum theory of gravity?
- ▶ What is dark matter?
- ▶ How do galaxies form?
- ▶ Is the universe open or closed?
- ▶ How do high-temperature superconductors become resistanceless?
- ▶ Are quarks and leptons fundamental, or do they have structure?
- ▶ Are there fundamental forces beyond the four we know?

Learn a theory.

- ▶ A theory is a framework of thinking that has many applications. It can be used to understand many phenomena. A theory answers the question “Why does this happen?” by giving general principles for why and how many things happen.
- ▶ Physics has lots of theories.
- ▶ Theories in physics are more general, more abstract, and more mathematical than theories in other sciences.
- ▶ Learning a theory is good for your brain.

Theories in Physics

nonrelativistic quantum

wave
mechanics
Schrödinger
1926

electricity
Coulomb
1800

wave optics
Young
1803

mechanics
Newton
1687

gravity
Newton
1687

nonrelativistic classical

relativistic quantum

QED
Feynman
1949

Electroweak
Weinberg
1967

QCD
Wilczek
1973

quantum
gravity
?

EM Theory
Maxwell
1865

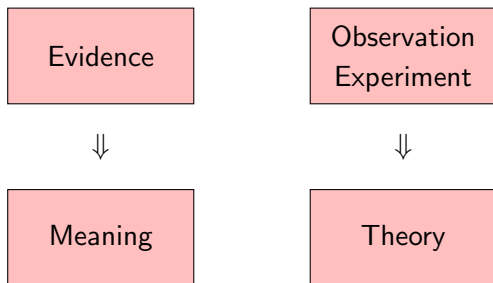
SR
Einstein
1905

GR
Einstein
1915

relativistic classical

Meaning from Evidence

In physics, making theories is our way of constructing meaning from evidence.

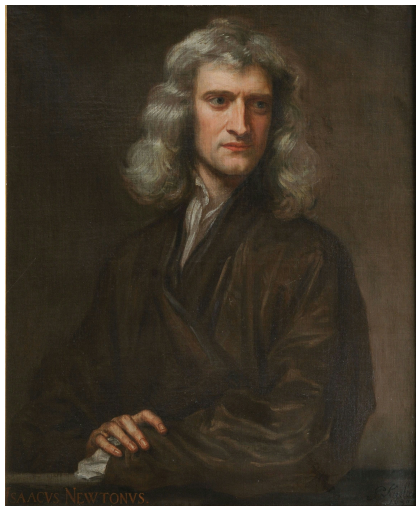


A natural way for people to process information is to construct meaning from evidence.

What is included in Physics 103?

- ▶ One theory in detail: Newtonian Mechanics
 - ▶ It's super-useful.
- ▶ We include the most useful stuff that doesn't require advanced mathematics.

Physics 103 is about Newton's theory of mechanics.



Isaac Newton (1642–1726)

The Pre-Newtonians

Aristotle	384–322 BCE
Nicolaus Copernicus	1473–1543
Tycho Brahe	1546–1601
Francis Bacon	1561–1626
Galileo Galilei	1564–1642
Johannes Kepler	1571–1630
René Descartes	1596–1650

Summary of Physics

- ▶ Physics is alive, because there are so many things we don't know.
- ▶ Physics is broad in its applications.
- ▶ Today's physics research doesn't look like this introductory course, but this course does contain the first part of the common background that today's researchers share.