

# INTRODUCTION TO THE RULES OF THE UNIVERSE

## **More Rules or Fewer Rules? (Which would you prefer?)**

In your study of science, you may have learned many scientific laws. Throughout the broad scope of science, there are many laws--more than you'd ever want to know. Yet, it is often said that the **basic** laws of the universe are few in number and simple to state. The **many** "laws of nature" are simply restatements or special deductions of these **basic** laws. If the **basic** laws of the universe really *are* few in number and simple to state, you have the right to ask, "How many?" and "What are they?"

Not all physicists would answer these questions exactly the same way. This is partly because physics is an unfinished enterprise, and no one knows what the finished list will look like.

What all physicists will agree on is this remarkable fact: *The **more** we come to know about the laws of the universe, the **fewer** basic laws are needed to completely describe everything that has ever been observed by humans.*

**In other words, as we come to know more, the list of the rules of the universe becomes *shorter*, not longer.**

*"The more we know, the less we need to know!"*

## **"Same Difference"**

Sometimes there are two or more ways of saying the same thing. Two principles may be stated in different terms, but contain the same physical fact. For example, Newton's Laws of Motion are equivalent to the principles of conservation of momentum and energy. Each can be derived from the other. So there is a choice about which to list as the "basic rule." You can list one **or** the other, but you cannot list both as separate rules, since one is a result of the other. *You will notice that our list contains many **ors**—these indicate two or more principles that state the same Basic Rule.*

For an everyday example, consider this: *It is your first day at a new school and you ask someone what the tardiness rule is. [First hour begins at 8:00.] One person tells you the rule is that you have to be in class at 8:00. Another person tells you that the rule is that you cannot miss any part of first hour.* Although each person used different terms, they both stated the same rule with the same meaning.

## **Question Authority**

Another problem is that most physicists work in very specialized fields on complex problems far removed from the basic rules of the universe. "Authorities" often lose sight of the basic rules, and perhaps that is a good lesson in itself.

**Assembled on the other side of this sheet is a list of the basic Rules of the Universe by which it is possible to explain the millions of things that happen around us each day.**

Unlike the laws of society, there is no punishment for breaking a Rule of the Universe. Why? Because the Rules of the Universe cannot be broken by anyone or anything. If a Rule of the Universe *is* ever broken, it can no longer be considered a Rule!

The Rules are listed here by name only, without definitions or equations. In order to use them and the results that follow from them, you will need to know much more. In this introductory course you will learn enough to get a complete picture of as much of the universe as you are likely to encounter. Now, on to the other side of the page...

# THE RULES OF THE UNIVERSE

## **I. Laws of Motion** (relating force to motion)

1. Newton's Second and Third Laws of Motion  
[or the principles of conservation of momentum and energy]
2. Einstein's first principle of Relativity: that the laws of nature are the same everywhere, even on planets in galaxies that are speeding very rapidly through space  
[From this comes a relation between space and time to be used when applying Newton's Laws, and better definitions of momentum and energy.]

## **II. Fundamental Force Laws** (describing the four known forces)

1. Gravity: Newton's Law of Universal Gravitation  
[and Einstein's second principle, expressing the gravitational field as an acceleration that matter builds into the geometry of the space we live in]
2. Electromagnetism: Coulomb's Law of Electric Force and the corresponding Law of Magnetic Force  
[or Electric and Magnetic Force Laws in terms of electric and magnetic fields given either by Gauss' and Ampere's Laws or, better yet, in Maxwell's first two Laws]

...AND...

Maxwell's other two Laws describing electromagnetic field "interactions," which led to the discovery of electromagnetic waves such as radio, microwaves, light, and X-rays

3. The Weak Force: Laws describing the Weak Nuclear Force
4. The Strong Force: Laws describing the Strong Nuclear Force

## **III. Quantum Principles**

1. Quantization of energy states
2. Pauli exclusion principle
3. Heisenberg uncertainty principle
4. Conservation laws
  - a. Electric charge
  - b. Baryon number
  - c. Lepton number
  - d. "Strangeness"
  - e. "Charm"
5. Expression of the action of Forces as a series of "elementary interactions"

**IV. The Second Law of Thermodynamics**, or The Principle of Entropy, which predicts the statistical behavior of large assemblies of similar objects (such as water molecules). There is not agreement that this is a basic physical law, since it can be derived from statistical mechanics.