

A Subjective Cultural History of Physics

Dr Dorothy Sebestyén

Óbuda University, Budapest, Hungary
sebestyen.dora@kvk.uni-obuda.hu

***Abstract:** Designed for engineering students we introduced an optional course at our university: *The Cultural History of Physics*.*

The history of physics can help a lot in studying the main laws of physics: it is easier to understand them knowing the life of the physicist, and the historic and cultural background of the discovery. It helps to raise interest in getting further knowledge in physics and in the cultural surroundings of the discoveries.

The first part of this paper intends to introduce this subject briefly. In the second part, examples of testing the students' knowledge will be presented. It will be highlighted how distance learners can be inspired to use the coursebook, or the Internet at home.

***Keywords:** history of physics; art; culture; testing*

1 Introduction

It is a great adventure to investigate the history of the discoveries in physics and the great physicists' lives. Peculiar sequences of thought can be called into action by discovering the fact that Kepler and Shakespeare or Newton and Moliere were contemporaries. Although these personalities were far from one another in space and activity, they can get on well together side by side in the course of history of physics which is embedded in the general history of culture. I consider it especially important assignment that nowadays, when an incredible amount of information hits our students, we should show them orientation points of general culture. So we could arouse their intellectual interests in addition to their knowledge of profession.

The history of physics is always subjective. The special subjectivity in this course means that we can confirm that there is only one integrated culture, showing the important parallels between science and art.

Seeing that the character of this subject is essentially different from Physics, it seems to be an important question, how the students' knowledge, especially the knowledge of the distance learners can be evaluated.

2 The Structure of the Subject of “The Cultural History of Physics”

In this one semester long course we try to *complement* a compulsory introductory physics course. So in case of the topics which were discussed before in physics, we do not touch upon the physical laws in detail, instead of this, description of the characters of the physicists, of their connections, and of their contemporaries is given, their interests are mentioned or their thoughts are quoted.

2.1 The Program of “The Cultural History of Physics” Course

The main flow of the course is divided into thirteen chapters. We focus our attention on the stories of the physicists' lives, and the cultural surroundings or the parallels with other physicists or artists, emphasising the cultural history. The titles of the chapters are the next ones:

1. Ancient physical and technical results
2. Interests in mathematics and physics in the Middle Ages
3. Relationship between art and optics in the 15th-17th Centuries
4. Geniuses of the classical and „the celestial” mechanics in the 16th-17th Centuries
5. Discoveries in the field of electromagnetic phenomena in the 17th-19th Centuries
6. From the nature of heat to the heat engines of the 19th Century
7. The “classical” models of atomic structure
8. Leading characters of special relativity and quantum mechanics
9. History and fundamental phenomena of acoustics using a computer program
10. Interests in the history of condensed matters from the discoveries to the applications
11. History of nucleus from radioactivity to the use of nuclear energy
12. Historical overview of the fundamental particles and interactions
13. Hungarians in the history of physics

2.2 Tables of Chronological Order

To characterize the course I would like to highlight the role of the chronological tables extended to some famous contemporaries from the other areas of culture.

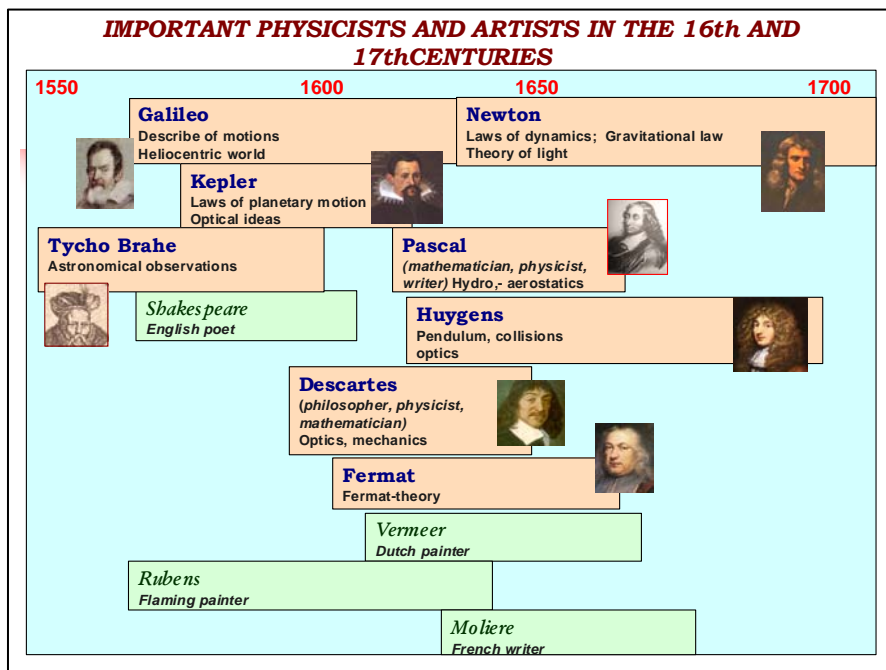


Figure 1
Chronological table of the the 16th and 17th centuries

At the beginning of each chapter a chronological table is presented about the physicists of the investigated period. These tables show the physicists’ portraits, the time of their births, length of their lives, the main points of their activity and their contemporaries (painters, writers, poets, composers, etc. besides other physicists). Of course the possibility of the selection is very limited and subjective. Here can be seen an example of these tables. (Figure 1)

2.3 Details from the Presentation of “The Period of Geniuses”

Let me present here some special details from the chapter of the geniuses of the 16th and 17th Centuries as examples in order to illustrate the character of the course.

I would like to put more emphasis on Tycho Brahe’s interesting life, because I can use my remarkable experiences and informational materials acquired at a previous international conference held in Sweden about the physics teaching. Moreover I can show the very interesting illustration from Brache’s book and my photo of his tomb in Prague.

The next examples emphasize the wider cultural aspects mentioned above.

To make colorful the history of Galileo's life and the results he achieved I can use the following, among others. To highlight the fact that 400 years after Galileo, we sometimes happen to follow Aristotle's way of thinking, I ask my students the following question:

A cyclist moving with uniform velocity on a horizontal -section of road, throws a golf-ball up in the air. Find the right answer from among the next ones:

- a) The ball falls back in front of the cyclist.
- b) The ball falls back into the hand of cyclist.
- c) The ball falls back behind the cyclist.

One of Galileo's pupils, the mathematician Viviani found that the genius of Galileo was the scientific equivalent to Michelangelo's art. So he did his best to arrange that the tombs of Galileo and Michelangelo are in the same church in Florence.

To characterize this chapter, let me mention an interesting thing about Blaise Pascal. Giving a lecture on him, his activity as writer and philosopher is also mentioned beside his scientific results in mathematics and physics. According to the Hungarian poet, D. Kosztolanyi, the most beautiful sentence of the world literature is the next one, written by Pascal: "The eternal silence of these infinite spaces frightens me."

Last year one of my students, B. Kompp gave a "multimedia like" presentation on Newton's life-work, which complemented my lecture. His presentation was full of original ideas: it started by a route from our university to Newton's birthplace by Google Earth, then followed some details from the French "Once upon a time" cartoon series about Newton's life. A scene from the feature film, The Da Vinci Code called the audience's attention to the tomb of Newton, and the presentation was closed by a picture sequence about the scientist accompanied by details from the Carmina Burana.

3 Testing the Students' Knowledge

As this is an optional subject with a rather special character, at the end of the course we cannot use the usual testing. So the written examinations determine the mark, which is a midyear mark, but there is a possibility to hold a short lecture (like the previously mentioned Newton-presentation) to get a better mark. To the distance learners a possibility is suggested: they can receive a maximum "satisfactory" mark by solely work done at home. This work has two parts: an essay about a physicist (its length has a limit and the reference is compulsory) and an individually different question series. To answer these questions the students have to browse the course-book. Here I show some examples of the types of these tests.

3.1 The Examples of the Types of Tests

While the birth date and death date of the physicist are not important, I think that it is important to know the century, the given physicist lived in, to know about the length of his life. For example in which century was Galileo born (A. 16th, B. 17th, C. 18th), and how long did he live (A. 45, B. 78, C. 85)?

It is worth calling students' attention to physicists who worked in several fields of physics or also other areas. Have a look at the next example.

Who was the English physicist in the 19th Century, whose activity extended beyond physics; he was also a painter, doctor, musician, and linguist?

- A. Newton
- B. Huygens
- C. Young
- D. Fresnel

Physicists and concepts or laws which are connected to their names occur in several classifications. For example:

Connect the physicists with ideas!

- | | |
|---------------|---------------------------|
| 1. TELLER | A. TOTAL REFLECTION |
| 2. COPERNICUS | B. ENTROPY |
| 3. BLACK | C. PULLEY |
| 4. KEPLER | D. SUN-CENTERED THEORY |
| 5. CLAUSIUS | E. HYDROGEN BOMB |
| 6. ARCHIMEDES | F. SPECIFIC HEAT CAPACITY |

3.2 The Crossword Puzzle as a Possible Means of Playful Assessment

The level of knowledge can be also checked in a playful way, by a crossword puzzle. In the next example the questions remind us of the connection between physics and the other areas of the culture. (Figure 2) The main question is to find the missing word in Pythagoras' saying: „All things are *numbers*”.

	1.	L	E	O	N	A	R	D	O		
			2.	H	U	Y	G	E	N	S	
	3.	T	H	O	M	S	O	N			
		4.	G	A	B	O	R				
5.	K	E	P	L	E	R					
		6.	V	E	R	M	E	E	R		
	7.	F	R	E	S	N	E	L			

Figure 3
Crossword puzzle

1. Besides being the one of the greatest painters, he formulated the law of action-reaction at first.
2. Whose biography can be written under this title: „From the pendulum clock to the longitudinal light wave through the rings of Saturn”?
3. Two great physicists had this same name; one of them later became Lord Kelvin.
4. He created the theory of spatial imagery, which also gave inspiration to S. Dali.
5. He had written the laws of motion of the planets, and also created a camera obscure, and using it, later painted a landscape.
6. Who was the Dutch painter, who could know Huygens personally?
7. French physicist, the lenses which are used in the lighthouses bear his name.

Conclusions

As a conclusion, let me quote the motto of the course of The Cultural History of Physics:

„A student is not a vessel to be filled, but a lamp to be lit.”

This true saying is variously quoted as a Hebrew saying, or as an adaptation of a quotation by Plutarch. It can be the motto also of each physics course.

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