# The magic of science

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ABSTRACT. This is a general introduction to science, with some emphasis on the underlying mathematics and physics, and discussing both the main scientific findings, from the main branches of science, and their various philosophical aspects. We first provide a general introduction to mathematics and physics, followed by a general introduction to chemistry, and materials science. Then, we discuss life and biology, followed by a look into humans and social science, from ancient times, up to nowadays.

#### Preface

Is there anything interesting to be learned, there in college? Well, certainly some smart new ways of making money, by staying inside, and with having money being of course a good thing, but with working inside being not very good for your health.

Passed this, however, and getting now to more philosophical aspects, in relation with our brain and knowledge in general, and especially, with our well-being as individuals, things are less clear. Science is something quite complex, sort of a big fluffy thing, accumulated by mankind since ages, and while the more things you know, the better that certainly is, when it comes to draw conclusions, from all this science that you can learn in college, this is no easy task. In fact, navigating all this science, with the aim precisely of drawing conclusions, and improving your well-being, is a sort of science itself.

Fortunately, math and physics are there, for some guidance. It is sort of agreed that first came numbers, and basic mathematics, which by some sort of mysterious mechanism, called Bing Bang by the physicists, started to materialize, as elementary particles. But then, these elementary particles started to team up, and form atoms. Which atoms started to team up too, and form molecules. And then, the most advanced of these molecules, called organic, again went subject to some mysterious mechanism, and produced life and cells, and then plants and animals as we know them. Moreover, these plants and animals are subject to some precise evolution rules, with things coming and going, depending on their reliability and toughness, and with, quite interestingly, most of what happens here being again understandable, via basic methods from mathematics and physics.

Which is not that bad, because, as we can see, science eventually brings an answer to a question that you might certainly have, and which is not obvious to deal with, with bare hands, namely who we are, as humans, and what are we doing on this planet.

Of course this still does not answer the main question that you might have in mind, namely what exactly you will have to do today, or tomorrow, for being a better, and happier human being. But hey, science does not have answers to everything. Actually, for that sort of question, the best is perhaps not to attend at all college, and start doing instead some honest, manual work. Indeed, as science, as presented above, tends to

#### PREFACE

suggest, we humans are here on this planet for working, so you can somehow short-circuit all this science just by adopting its final conclusions, which means doing some work.

Getting now to the present book, this will be a general introduction to science, by insisting on what science has the most interesting to say, philosophically speaking, which is the above-mentioned story, with mathematics and numbers producing particles and physics, and then chemistry, and eventually cells and life, including me and you. Or at least, this will be for the general idea, because from time to time, depending on the context, we will go as well on discussing more concrete things, for instance in relation with engineering. Also, we will have as well a look into social science, at the end.

Many thanks to my cats, for precious help with the preparation of this book. In fact, I forgot to mention in the above, but besides learning serious science, or not learning any science at all, there is a third way too, namely listening to what your cat says.

Cergy, January 2025 Teo Banica

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Part I

Math and physics

Cherish the thought Of always having you here by my side Oh baby, I cherish the joy You keep bringing it into my life

## Numbers

#### 1a. Numbers

1b.

1c.

1d.

#### 1e. Exercises

Exercises:

Exercise 1.1.

EXERCISE 1.2.

Exercise 1.3.

EXERCISE 1.4.

EXERCISE 1.5.

EXERCISE 1.6.

## Mathematics

#### 2a. Mathematics

**2b**.

2c.

2d.

#### 2e. Exercises

Exercises:

EXERCISE 2.1.

EXERCISE 2.2.

Exercise 2.3.

EXERCISE 2.4.

Exercise 2.5.

EXERCISE 2.6.

## **Basic** physics

3a. Basic physics

3b.

3c.

3d.

#### 3e. Exercises

Exercises:

Exercise 3.1.

Exercise 3.2.

Exercise 3.3.

Exercise 3.4.

Exercise 3.5.

EXERCISE 3.6.

## Atomic theory

#### 4a. Atomic theory

4b.

4c.

4d.

#### 4e. Exercises

Exercises:

EXERCISE 4.1.

EXERCISE 4.2.

EXERCISE 4.3.

EXERCISE 4.4.

EXERCISE 4.5.

EXERCISE 4.6.

# Part II

Matter, chemistry

Sonically we're in control We're the diamond in your soul Images come thick and fast From the future, from the past

## **Chemical elements**

#### 5a. Chemical elements

5b.

5c.

5d.

#### 5e. Exercises

Exercises:

Exercise 5.1.

EXERCISE 5.2.

EXERCISE 5.3.

EXERCISE 5.4.

EXERCISE 5.5.

EXERCISE 5.6.

### Molecules

6a. Molecules

**6**b.

6c.

6d.

#### 6e. Exercises

Exercises:

EXERCISE 6.1.

EXERCISE 6.2.

Exercise 6.3.

EXERCISE 6.4.

Exercise 6.5.

EXERCISE 6.6.

### States of matter

7a. States of matter

7b.

7c.

7d.

#### 7e. Exercises

Exercises:

Exercise 7.1.

Exercise 7.2.

Exercise 7.3.

Exercise 7.4.

Exercise 7.5.

Exercise 7.6.

## Into chemistry

#### 8a. Into chemistry

**8**b.

8c.

8d.

#### 8e. Exercises

Exercises:

Exercise 8.1.

EXERCISE 8.2.

Exercise 8.3.

Exercise 8.4.

Exercise 8.5.

EXERCISE 8.6.

# Part III

# Life and biology

They say our love Won't pay the rent Before it's earned Our money's always spent

## Organic molecules

9a. Organic molecules

9b.

9c.

9d.

#### 9e. Exercises

Exercises:

Exercise 9.1.

Exercise 9.2.

Exercise 9.3.

EXERCISE 9.4.

Exercise 9.5.

Exercise 9.6.

## Cells, life

10a. Cells, life

10b.

10c.

10d.

10e. Exercises

Exercises:

Exercise 10.1.

Exercise 10.2.

Exercise 10.3.

Exercise 10.4.

EXERCISE 10.5.

Exercise 10.6.

## Plants, animals

11a. Plants, animals

11b.

11c.

11d.

#### 11e. Exercises

Exercises:

EXERCISE 11.1.

Exercise 11.2.

Exercise 11.3.

Exercise 11.4.

EXERCISE 11.5.

Exercise 11.6.

## Rules of nature

12a. Rules of nature

12b.

12c.

12d.

#### 12e. Exercises

Exercises:

EXERCISE 12.1.

Exercise 12.2.

EXERCISE 12.3.

EXERCISE 12.4.

Exercise 12.5.

EXERCISE 12.6.

Part IV

Social science

My life seems unreal, my crime an illusion A scene badly written in which I must play Yet I know as I gaze at my young love beside me The morning is just a few hours away

## Homo sapiens

13a. Homo sapiens

13b.

13c.

13d.

#### 13e. Exercises

Exercises:

Exercise 13.1.

EXERCISE 13.2.

Exercise 13.3.

EXERCISE 13.4.

EXERCISE 13.5.

EXERCISE 13.6.

## The Stone Age

14a. The Stone Age

14b.

14c.

14d.

#### 14e. Exercises

Exercises:

EXERCISE 14.1.

Exercise 14.2.

EXERCISE 14.3.

EXERCISE 14.4.

Exercise 14.5.

EXERCISE 14.6.

### Ancient societies

15a. Ancient societies

15b.

15c.

15d.

#### 15e. Exercises

Exercises:

Exercise 15.1.

Exercise 15.2.

Exercise 15.3.

EXERCISE 15.4.

EXERCISE 15.5.

EXERCISE 15.6.

## Modern times

16a. Modern times

16b.

16c.

16d.

16e. Exercises

Congratulations for having read this book, and no exercises for this final chapter.

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