Open and Subjective Curriculum 12

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Contents

1 Introduction

This document is a summary based on my experience as a Mentor at the Milestone Institute, as a former high school student at a Hungarian school in Slovakia, and University student at BME and ELTE in Budapest. (I graduated as a Theoretical Physicist and then worked at Wolfram Research.)

Hopefully, this document will be helpful not only for those who have similar interests to me, but it can bring us one step further towards a society where more experienced people share their knowledge with younger ones and where quality education is a shared value and a social enterprise.

1.1 Acknowledgement

I am deeply grateful to my friends and colleagues for their encouragement and relevant contributions: **Anita L. Verő, Dávid Komáromy, Ye In Oh, et al.** This work would be much more biased and partial without their different viewpoint and knowledge.

2 General

Online courses at high school level in English:

- Crash Course

- Khan Academy

- BBC bitesize (brief summaries of general subjects/concepts)

Online materials in Hungarian:

- zanza.tv (not all subjects)

- Videotanár private tutoring style high school material

- M5-Érettségi (High school final exams (érettségi) preparation)

(A general University level introductory series is the Very Short Introductions (not free to access))
Online University level courses:

- Coursera

- edX

- MIT OpenCourseWare

- Yale Online (their YouTube channel: YaleCourses)

- Stanford Online - Courses from Stanford University.

- OpenLearn - Free courses from The Open University.

Hungarian University level lectures:

- BME

- Academic lectures (in a non structured form)

Places to find Further general purpose online courses and resources may include:

- Udemy all sorts of typically non-free learning materials

- Skillshare mostly for craft-like skills, but a wide variety of topics is covered

- FutureLearn - Free and paid courses on a wide range of subjects.

3 Using the Internet

The Internet is an inevitable source of knowledge and information; therefore, it is essential to know how to use it effectively. First of all, I would highlight a short course: How to navigate digital media on Crash Course. It talks about the essential features of Online Media. Wikipedia is a surprisingly good starting point for gaining information. (A nice way to listen to the ongoing creation of Wikipedia can be found here.) Although Wikipedia is a good starting point and can give an overall picture, it is important to be able to follow the references provided at the end of the articles. These are usually books and scientific articles.[1]

It is often possible to access these materials; however, ethical and practical considerations must also be taken into account. These materials are accessible mainly by violating copyrights or paywalls. This is not only legally questionable, but one must consider the sustainability of quality knowledge and content making. Copyright can be debated (see also here, here, here and here), but it is part of the Human Rights (Article 27), and is implemented in USA, EU and various national legal systems. Copyright and Intellectual Property rights play an important role in financing content creators, meaning that if one accesses quality content without paying a contribution, the creator's financial support should be made in another way. Patreon is a possible way to support content creators, which can produce free and quality content however the distribution of financial support for authors is still a challenging problem (buy a coffee and Liberapay are further alternatives), which still needs creative problem solvers in the future.

After these legal, ethical and financial disclaimers, two sites might be mentioned regarding scientific books and articles: Sci-Hub in the context of scientific papers and Library Genesis related to books.

On the internet, the credibility of a source is key, which should be determined. In the case of scientific articles, the Journal where they appeared is an important indication of their credibility. In general, peer-reviewed articles are considered more reliable than non-peer-reviewed ones. Some most popular scientific journals are: Nature, Science, Plos One, Phys. Rew. (There are some sites where quality non-peer-reviewed content can be found. The main example is arXiv, other mentionable preprint servers are HAL and bioRxiv.) To check the background of an unknown scientific journal, SCImago is a good starting point.

Another obvious starting point to gain information is Google (there are many operators which can be used to search more effectively). An alternative to Google is DuckDuckGo, which lists different sites and gives more privacy than Google.[2] Additionally, there are specialized search engines like Google Scholar for academic papers and Google Books for all sorts of books.

To have a feeling about the structure of the "internet", one can browse an outdated but still more or less relevant map of the internet. A list of the biggest websites (globally and by country) can be found on SimilarWeb. (A little more recent poster can be seen here) To see how some sites evolved in time, one can use Wayback Machine to explore and make archived versions of sites. On the internet, sites can be different not only in time but by accessing them from different locations. (A site (or a server) knows about you this amount of information.) To access sites with possible Geo-blocking, one can use VPN.

On the internet, there are many, many things, and sometimes you are searching for alternative sites. In these cases AlternativeTo or SimilarSites can be helpful. To gain information about a website, use who is and possibly check it on SimilarWeb.

Give your privacy a thought, and control the content you want to see. Adblock Plus is a useful extension to filter ads on various platforms, and consider further tools to enhance your online privacy. (See further topics at the Electronic Frontier Foundation.)

3.1 Large Language Models

In 2022. November 30. chat GPT has been released, which was the first well-functioning and publicly available Large Language Model (LLM). These systems are built on machine learning algorithms, which

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[1] Other encyclopedia-like sites, which I would mention are: Encyclopædia Britannica, Scholarpedia, encyclpedia.com and for philosophy Stanford Encyclopedia of Philosophy.

[2] Google's Russian and Chinese alternatives are Yandex and Baidu respectively. Bing is search engine from Microsoft.

learn to predict the next words in a text, based on a huge amount of textual data collected from the internet. They are fine-tuned by human feedback to minimize unacceptable/harmful content[3].

These AI tools can be very useful, but they have their limits. They are trained on huge amounts of diverse data and can provide surface-level basic information about a wide variety of topics. (From home gardening to programming.)

However, in-depth topics and arguments requiring critical thinking and reasoning might be challenging for these models. Although their answers may appear confident and well-phrased, they might contain factual errors or internal contradictions. They tend to make assumptions or invent circumstances; in general, this is called "Hallucination". Another issue with these systems is that they were optimized to generate answers during their training, which pleased the human users. In technical terms, Reinforcement learning from human feedback has been used to fine-tune the system. In practice, this means that often you will get an answer which – based on your previous questions and attitude – you will like, even if it is not accurate or the opinion is not shared with the broader public.

In general, LLMs can be a very useful tool for acquiring basic knowledge and automating routine tasks. It can also help brainstorm for more complicated topics, but they are not 100% reliable even if they sound confident. These are not oracles but can be valuable if used properly.

For more effective or advanced use, the relatively new field of Prompt Engineering can give some guiding tips. (But the technology is changing so rapidly that some advice might be outdated in the next month.)

- chat GPT by OpenAI

- Claude by Anthropic

- Gemini by Google DeepMind

- Pi by Inflection AI

(For program code completion and programming aid GitHub Copilot can be helpful, which can be integrated, for instance, to Visual Studio Code.)

3.2   Current information

It is crucial to realize that, in general, news organizations aim to grab attention rather than to give readers a balanced worldview and information. It does not mean that news organizations always want to distort our view, but it does mean that if someone wants to have a realistic view, reading the headlines is not enough. Additional sources and statistics are crucial for a better understanding the world around us.

- Our World in Data

- Gapminder

- Pew Research Center

To understand the case, one can watch Stephen Pinker's presentation, or these articles on Our World in Data and BBC Future (based on the data from Gapminder).

On the other hand, positive change will not happen if individuals don't take action, and past statistics will not necessarily inform us about current trends, movements, and challenges. Therefore, we need reliable news sources (or a way to extract information from imperfect and biased sources).

To check a news source's Media bias one can use these sites:

- AllSides

- The Media Bias Chart

- Media Bias/Fact Check

- Ground News (payed subscription needed)

To fact-check some typically sensational news, one can use these sites

- Snopes in English

- Urban legends in Hungarian

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[3]Deciding what is acceptable or harmful is left to the companies training and hosting these models

An incomplete list of reliable International and English news sites:

- General news with little bias
  - AP The Associated Press
  - Reuters
  - NPR National Public Radio (USA)
  - BBC News
  - Deutsche Welle

- Thematic news
  - The Economist (Economics)
  - Financial Times (Economics, finance)
  - Wired (IT, Technology)
  - Politico (Politics)
  - EuroNews (Europe, EU)
  - Politico Europe (European Politics)
  - Foreign Affairs and Foreign Policy (Global Politics and Foreign Affairs from a USA perspective)

- Left-leaning, but still reliable sources
  - The Guardian
  - The Atlantic
  - New York Times

- Right-leaning (economically), but still reliable source[4]
  - Reason

An incomplete list of reliable and/or relevant Hungarian news sites:

- Eduline (Education, news about schools and Universities)

- Qubit (Science and Technology)

- Telex (General news, slightly liberal, critical to government)

- Válasz (General, slightly conservative, critical to government)

- Magyar Hang (General, independent, critical to government)

- Mérce (General, left-leaning, critical to government)

- Magyar Nemzet (General, pro-government)

- Mandiner (General, pro-government)

- 444 (General, liberal, critical to government)

- Atlatszó (Investigatory "watchdog" journalism, critical to government)

- Regional online media
  - szabadhirek.hu (Collection of Hungarian independent regional news portals)
  - Mediaworks owned media (Collection of Hungarian regional media outlets, with pro-government sentiment)

- Hungarian minorities media in neighbouring countries
  - Romania
    * Transtelex (General, Hungarian minority in Romania)
  - Slovakia

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[4]a more complete USA-based list of right-wing/conservative news sites is available here

* Körkép, ma7 (General, Hungarian minority in Slovakia (with pro-Hungarian government sentiment))
* Ujszo (General, Hungarian minority in Slovakia)
* Napunk (Hungarian language edition of the Slovakian media portal Denník N)
* Pozsonyi podcast (Podcasts about Hungarian politics, culture, education in Slovakia)
  · Napunk podcast

- Serbia
  * MagyarSzó (General, Hungarian minority in Serbia (with pro-Hungarian government sentiment))
  * SzabadMagyarSzó (General, Hungarian minority in Serbia)

- Ukraine
  * Kárpáti Igaz Szó
  * kárpátalja.ma

There is a list of centralized, pro-government media sources called KESMA, which has a conservative/populist bias. Together with the state media MTV, these news sources usually represent the government's narrative.

Index was a slightly liberal portal critical to the government; however, in 2020, after changes in top management, most of the journalists resigned and started Telex.hu. After this turn, Index became slightly pro-government but kept some elements of its original style.

For a more comprehensive list, see the collection of Hungarian newspapers on Wikipedia. I recommend reading and watching multiple sources on politically sensitive questions, mainly in and about Hungary. A list of unreliable, "news" sites (in 2020), which produce content purely to maximize their click numbers, is published by Urban Legends.

3.3 Blogs

Today, everyone with an internet connection can be a content creator. Blogging is neither professional journalism nor scientific publishing, but sometimes, professionals and enthusiasts can write about interesting ideas in an accessible way.

- Medium - A platform where diverse writers share articles on various topics

Examples of informative general and technical blogs:

- Wait But Why - Explores complex topics in science, technology, and society with humor and depth

- inFERENCe - Focuses on data science, machine learning, and statistical inference

- Towards Data Science - Features articles on data science, machine learning, and artificial intelligence (written by experts and enthusiasts in the field)

- mathbabe

- Galef siblings

- The Marginalian

3.4 Forums

Online forums can be good sources of information if one can critically investigate the opinions and suggestions that can be read there. In general, Stack Exchange is considered a useful international online forum. Reddit is one of the biggest general forum, with many "subreddits". The quality of the content fluctuates, but there are some interesting concepts, like the Ask Me Anything (AMA) sections, where professionals, interesting or popular people answer questions from the users. A general forum on the internet is Quora; this is very general, and further examination is needed to check the information gathered from it.

In Hungarian, one of the oldest IT forums is Prohardver. A much newer general online forum is Gyakori kerdesek, which unfortunately has low reliability. There is also a Hungarian subreddit on Reddit.

3.5 Communication tools

During the pandemic (COVID-19), there was a huge demand for online communication tools used in education, work, and keeping in touch with friends and relatives.

- For video and team calls
  - Zoom
  - Facebook messenger
  - Skype
  - Google Hangouts
  - Google Meet
  - Jitsi Meet
  - Microsoft Teams

- for chat
  - Facebook messenger
  - Slack
  - Discord
  - WhatsApp
  - Telegram
  - Signal

3.6 Social media

Social media – such as all technology – can have positive and negative impacts on individuals and societies alike[5]. It has the potential to connect people and aid in forming groups, organizing events, and starting projects. Still, it can also isolate people from "real-life" experiences, foster unrealistic expectations, polarize societies, reinforce addictive behaviour, etc. (See collected resources on the website of Humane Technology.)

My suggestion for users or potential users of these platforms is to:

- recognize addictive behaviour (and possibly set boundaries). This requires mindfulness and concrete steps from you. However, there are some tools and plugins which can help:
  - News Feed Eradicator for Google Chrome to escape the slot machine effect of several platforms,

- understand the business model of the given platform,

- be aware of algorithms choosing "relevant" content,

- and have a thought about privacy issues.

Maybe I should reiterate the main message: these days, a few global companies are capitalizing on their user's social connections, and – because of general ignorance toward privacy – they have access to a nearly unimaginable amount of data about individuals and their social circles. Because of this corporate model, the platforms are engineered to be addictive, usually by finetuned recommendation systems and other algorithms promoting engagement. (But the widespread criticism of these platforms might be partially attributed to Juvenoia as well. Meaning that what older generations think is harmful may just be different compared to their environment.)

A list of a few major platforms:

- Twitter or X

- Facebook

- YouTube

- photos, short videos:
  - Instagram

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[5]For a summary about the inconclusiveness of current research see this article, or this much more detailed google doc.

- TikTok (I can't wholeheartedly recommend it because of its addictivity and a tendency to shorten attention span. I suggest using it carefully.)

- job, work-related:

  - LinkedIn

- (regional) alternatives

  - V Kontakte Russia
  - We Chat China

3.7 Miscellaneous

- Less Wrong

- Center for Applied Rationality

- Aeon long-form magazine

- The Skeptic Encyclopedia of Pseudoscience

- MasterClass I found here some good classes but take into account the price.

- Brilliant Interactive learning platform

4 Study skills

Being able to learn new things, access the acquired information critically and then use this knowledge creatively are increasingly important skills and are in the focus of this guide. (Although finding – or creating – one's true interests, cultivating a sustainable and fulfilling life and finding the appropriate place and role in broader society are just as essential aspirations a good mentoring guide tries to enhance.)

A few approaches and techniques that I found useful:

- Build up a genuine interest in the topic. Motivation and interest can be created most of the time. Nearly for any topic, there is some connection to the things and causes you are already passionate about. Put time and energy into finding this connection. This can be done by reading broadly about the background, e.g., spending 15 minutes to an hour reading related (or loosely related) articles on Wikipedia. Build up your own motivation, and find out why the topic is – or which aspect(s) of it are – interesting and relevant to You. Studying becomes exciting and rewarding if the connection is found, making it more effortless and effective.

  - Have projects, ideally complex, "multidisciplinary" projects. These can channel your curiosity to structured learning and exploration.

- Teach it to somebody. This "method" is also known as the "Feynman technique" (see a more concise summary here). Finding someone to whom you can teach the learned material or, if you don't find anyone, imagining the situation and preparing seriously to communicate a topic or a concept automatically provides motivation and forces you to think deeply and critically about the material.

- Write an essay. This is a great tool with a long historical track record to collect and clear up thoughts. Essay writing is an essential part of the educational system in most English-speaking countries for a good reason. An essay can still help to learn and clarify a subject even if it is written for the shelf.

- If none of these work, you can still rely on more basic study skills

- In life, – at least in the way the society is currently organized –some tasks are very hard to make enjoyable: test preparation, memorization of some sort, etc. To make them more tolerable, these can be viewed as training tasks. An activity that is pointless on its own but can help you to improve some important skills, such as short- or long-term memory and stress tolerance, will help you achieve meaningful goals.

5 Subjects

5.1 Physics

First of all, physics has to be fun. I believe most children can be amused by the wonders of how inanimate objects can be transformed, manipulated, and predicted even with simple equipment. In my experience, it can take only a few simple experiments, demonstrations, or tricks to ignite interest. However, natural curiosity has to be kept alive. Don't let teachers or institutions extinguish the instinct of exploration with forced memorization of facts and explanations.

Don't get me wrong, facts and well-tested explanations (theories) are valuable, but mainly if they lead to somewhere, e.g. constructing things (leading to engineering), or further experimentation and deeper understanding (leading to physics and science)[6]. So, besides all the learning materials and resources listed below, don't forget to be curious and don't forget to have fun!

In general, I think it is remarkable and fascinating that in the world around us, we can spot patterns and formulate "physical laws" which can be correct on huge domains (sometimes the boundaries of validity are not even visible yet) and can be effectively used for predictions. Not all patterns have this robust nature, but exploring and investigating these "pockets of regularity" is a fascinating adventure and is the primary concern of Physics as a branch of science.

Physics – as an academic discipline – is one of the "hardest" branches in the Natural sciences and is the purest embodiment of the Scientific method. It briefly means that it builds testable mathematical models about the world, mainly in a reductionist way. (Reductionism brought us to the current impressive level of understanding and predictive power. However, it is less useful in understanding complex systems.) It has two to three branches: Theoretical physics, which is mostly about model making; Experimental physics, which is about collecting data and designing experiments; and Computational physics, which is sometimes viewed as a separate branch and tries to compute the consequences of theoretical models (typically with many constituents).

- The world around you. Be inquisitive; the world is full of mysteries. Observe Nature carefully, make Experiments, try to make predictions, and figure out how it might work.

- The Feynman Lectures on Physics One of the best theoretical physics introduction. It uses a little bit of calculus, but because of its didactic style, interested high school students can also read it. Additionally, see Feynman talking about magnets.

- University Physics with Modern Physics by Young and Freedman (accessible from here) is a nicely illustrated physics book, it does not use too much higher mathematics. It is also a nice book for interested high school students. (A similar resource is Physics for Scientists and Engineers with Modern Physics by Serway and Jewett (accessable from here).)

- Walter Lewin. Physics deals with phenomena in Nature. Walter Lewin is a physicist and an entertainer. His demonstrations are simply fun to watch.

- Härtlein Károly is a prominent figure of Hungarian physics demonstrations. Explore his demonstrations and physics shows online. His wiki page. (in Hungarian)

- Öveges József, an iconic Hungarian physics popularizer and teacher. See his performance and/or his book (on scribd)

- Négyjegyű is a Hungarian formula sheet and source of tabulated experimental data.

- Szalay Fizika is a comprehensive handbook about general Physics (written slightly from an engineering perspective) using high school mathematics. It is in Hungarian. A scanned version of its electromagnetism section can be found here (see on scribd).

- A cultural history of physics is a massive book which explores the historical development of Physics and puts the subject into a broader perspective.

- Physics competitions:

  - KöMaL is a perfect source of challenging problems for high school students in Mathematics, Physics and Computer Science.

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[6]Learning the standard curriculum might not be useless for those who will not pursue a path in science or engineering either if they are equipped with connecting the concepts with everyday life and experience. If the physics curriculum is thought and tuned in that way, it can help predict and make more sense of the world, making it a friendlier place.

- IPhO stands for the International Physics Olympiad. Past problems can be found here and here. The syllabus is available here. (Another collection of past problems in Hungarian can be found here.)
- Hungarian IPhO preparation Seminars, past problems in Hungarian.
- APhO stands for Asian Physics Olympiad and has an equal difficulty level to IPhO. Past problems (from 2019) are available here.
- Physics Cup "more difficult than the problems of EuPhO, IPhO, and APhO."
- List of other international Olympiads
- IOAA International Olympiad on Astronomy and Astrophysics
- Fykos Fyzikální korespondenční seminář
- IYPT International Young Physicist's Tournament. Team-oriented open-ended scientific competition for high school students. Hungarian section HYPT and a related competition is ICYS.
- BL4S Beamline for Schools is an international experiment designing competition for high school students
- Hatvani István Physics Competition
- List of Hungarian Physics competitions
- Rudolf Ortvay International Competition in Physics University level international physics competition.
- NyiFFF Hungarian University level outdoor (mainly experimental) Physics competition.
- IEPhO International Experimental Physics Olympiad (in Russian)
- IPT International Physicists' Tournament is similar to IYPT but for undergraduate University students.

- Laboratory sessions and Experimental physics:

  - Introduction to Error Analysis by John R. Taylor (accessible from here) is a useful basic book to interpret data, collected during experiments. (Student Laboratory Handbook gives a similar knowledge.)
  - Software for data analysis and visualization
    * QtiPlot is cross-platform (Linux, Mac OS, Windows) "free" (but proprietary) plotting and data analysis software. On Source Forge, and on FSF.
    * Origin is one of the most popular commercial plotting and data analysis software (works only on Windows)
    * Wolfram Mathematica much more general than data visualization and analysis. All the nonlinear fits and the appropriate statistical analysis can also be made in this framework. (Commercial, cross-platform.)

- Problems and problem solving:

  - A few steps during solving problems
  - 200 Puzzling Physics Problems creative (non conventional) physics problems. (Available online, but support the authors if the book is useful for you)
  - 200 More Puzzling Physics Problems more creative physics problems. (Available online, but support the authors if the book is useful for you)
  - 333+ furfangos feladat fizikából creative physics problems in Hungarian.
  - Collection of Solved Problems in Physics for high school students.

- Advanced books and resources:

  - Kísérleti fizika 1 University level, Hungarian introduction to Physics lecture notes (Mechanics)
  - Kísérleti fizika 2 University level, Hungarian introduction to Physics lecture notes (Electromagnetism and Special relativity)
  - Kísérleti fizika 3 University level, Hungarian introduction to Physics lecture notes (Thermodynamics and Quantum mechanics)
  - Kertész János - Zaránd Gergely - Deák András Statisztikus fizika

- – [Landau-Lifshitz](#) "Russian style" theoretical Physics book for University level
- – [Mathematical Methods of Classical Mechanics](#) classic graduate textbook by mathematician V. I. Arnold. Mathematically accurate and deductive at the same time. (Online available [here](#))
- – [David Tong: Lectures on Theoretical Physics](#) University level lecture notes in Theoretical Physics topics

- Relativity:
  - – [Spacetime Physics](#) by Taylor and Wheeler is a really nice introductory book to relativity (available [here](#))
  - – [Relativistic visualizations](#)
  - – [A Slower Speed of Light](#) a first-person game from MIT Game Lab, in a slower speed of light environment.

- [Physics FAQ](#)

- [The Review of Particle Physics](#) Most recent tabulated data about Particle physics and related parts of Cosmology.

- [Falstad Math/Physics simulations](#) Interactive simulations mainly about Electromagnetism and Wave mechanics.

- [The Biggest Ideas in the Universe!](#) by Sean Carroll

- [AtomCsill](#) "Az atomoktól a csillagokig". Presentations for high school students in Hungarian.

- [Nobel Prize experiments](#) for high school students on the BUTE (BME). (In Hungarian)

- S^3 and S^3++ Science summer schools in Croatia for high school students.

- [MIT Summer programs](#)

- [Hungarian-English dictionary](#) for scientific terms. (In Hungarian.)

- Astronomy:
  - – [Hayden Planetarium](#)'s homepage
  - – [Astronomy Today](#) a nice textbook about Astronomy (Another nice online resource can be found on the homepage of [NASA](#))

- Other reading list and books:
  - – [Simon Clark](#)'s list
  - – [Baez](#) list for fundamental/mathematical physics
  - – [Forces of Nature](#) by Brian Cox
  - – [Brief Answers to the Big Questions](#) by Stephen Hawkin

- Fun:
  - – Science kits:
    - ∗ [MEL Science](#)
    - ∗ [KiwiCo](#)
  - – [Interactive Simulations for Science and Math](#)
  - – [IBM Q-experience](#) Online quantum computer
  - – [What If?](#) by Randall Munroe (the crator of [xkcd](#))

- Engineering:
  - – [TeachEngineering](#) Free high school STEM curriculum and resources

- Possible projects:
  - – [TESS](#) Transiting Exoplanet Survey Satellite (official [page](#))

- Advice to Young Physicists
  - – [How to become a GOOD Theoretical Physicist](#) by Gerard 't Hooft
  - – [Advice to Young [Experimental] Physicists](#) by W. Bothe

5.2   Mathematics

Mathematics has many sides; one might say it is a language, others say it is a playful but rational way of thinking and problem-solving, and still others would emphasize its extraordinary usefulness in science and technology.

In my view, mathematics starts with observing that patterns in the real world can sometimes stripped from their realizations, and one can reason about these new abstract concepts. Remarkably, abstract statements can often be translated back to new patterns or predictions in the real world. Therefore, mathematics can be useful (even if it does not necessarily aim to be).

Another remarkable feature of these abstractions is that they can be the building blocks of a whole universe of formal statements and constructions, creating a playground where beauty, simplicity, and elegance can manifest. Some don't even bother to connect mathematics to the real world and simply find joy in manipulating abstract objects, formulas, and statements in the pursuit of "good mathematics".

- Find your entry point to Abstraction. There are a few traditional entry points:

  - Numbers, which can be viewed as the abstraction of counting "objects". Only by addition and multiplication a whole universe of abstract statements can be formulated;

  - Geometry, which is an idealization of points, lines, etc, leading to a rich abstract system;

  - Abstractions based on geometric (or other) transformations can naturally lead to group theory and abstract algebra;

  - Abstraction of computer programs can lead to algorithms;

  - Find the most natural entry point for you and start to explore the abstract universe, which unfolds with your own mixture of formalization and intuition.

- Obádovics's book is a detailed and didactic textbook which is – in my view –, perfect for high school students. However, it does not contain too many proofs, and its main aim is to give a solid ground for the usage of high school mathematics, mainly in engineering problems. (Which is only one side of mathematics.) It is in Hungarian, online available here and here.

  - Calculus for the Practical Man also seems to be a good introductory resource for self-study. (This was the book from which Richard Feynman learned calculus in high school.)

- How to Solve It? by George Pólya is about how to approach a problem systematically but creatively. "Teaching is an Art". See a summary here (or on Wikipedia), and a Pólya's performance here.

- Proofs from THE BOOK – an idea of Paul Erdős –, where all the beautiful proofs are listed ("The Book" is accessible only to "God"; we can construct only imperfect versions of it.) A lecture of Erdős in Hungarian.

- Letters to a Young Mathematician by Ian Stewart

- Handbooks:

  - Bronshtein and Semendyayev An extensive "handbook" of mathematical formulas

  - Handbook of Mathematical Functions by Abramowitz. An extensive handbook of (special) functions and formulas.

  - Online Handbook of functions and formulas.

  - A vintage book I might mention is A Synopsis of Elementary Results in Pure and Applied Mathematics by G. S. Carr, which was the entry point to Srinivasa Ramanujan to mathematics or rather mathematical formulas. (Also available on Google Books.)

- More on proofs:

  - Proofs Without Words visual "proofs" give an intuitive understanding of various theorems. Follow up books here and here.

  - How to Prove It "The transition from solving problems to proving theorems"

  - Elements by Euclid, an ancient classic.

- Competitions/Fun:

  - KöMaL is a perfect source of challenging problems for high school students in Mathematics, Physics and Computer Science.

- A gondolkodás öröme Exploratory experiencing of Mathematics (in Hungarian)
- Erdős Mathematics School
- Calendar for Hungarian Competitions (another calendar here and here.)
- List of mathematics competitions world wide
- Matematikai Diákolimpiák list of Olympiads (in Hungarian)
- IMO International Mathematical Olympiad
- European Girls' Mathematical Olympiad
- MEMO Middle European Mathematical Olympiad. (see their homepage)
- Arany Dániel Competition (Hungarian)
- Kürschák József Competition (Hungarian)
- Schweitzer Miklós Competition (Hungarian)
- Bolyai competition Group competition Hungarian, and International.
- MaTeGyE further math competitions in Hungary
- Náboj
- Квант magazine in Russian. (Archived Quantum issues in English)
- Wycombe Abbey Summer Mathematics Competition
- MATh.en.JEANS (French)
- University level:
  * Putnam Competition for USA and Canadian undergraduate students. (See the site's archived version, or see on Wikipedia)
  * International Mathematics Competition for University Students

- Resources for competitions:

  - Past problems
  - Books by Titu Andreescu
  - The Art of Problem Solving books by Paul Zeitz

- Concrete mathematics: a foundation for computer science

- Linear Algebra:

  - Obádovics (Vektoralgebra; mátrix determinánsok; többváltozós függvények.) A basic, application based introduction in Hungarian
  - Linear Algebra by 3Blue1Brown
  - Linear Algebra A nicely illustrated "second course" in Hungarian
  - Linear Algebra Done Right "Perfect second textbook" for linear algebra

- Calculus:

  - Obádovics: Felsőbb matematika is a high-quality didactic textbook, focusing on the usage and application of Calculus. (In Hungarian.) Online available here and here.
  - Essence of Calculus by 3Blue1Brown on YouTube
  - Two standard calculus books with problems from Stewart and Spivak
  - Principles of Mathematical Analysis from Walter Rudin is a classic Mathematical introductory to Calculus, also known as Mathematical Analysis. It focuses on the coherent mathematical foundation of calculus and not applications.
  - Analysis I, Analysis II by Terence Tao
  - Calculus by y R. Larson, B. Edwards is a richly illustrated approachable introductory textbook
  - Counterexamples
    * Counterexamples in Probability and Real Analysis
    * Counterexamples in Analysis
    * Counterexamples in Topology

- ∗ [Counterexamples in Probability](#)
- Mathematical software:
  - [Wolfram Mathematica](#) mainly for symbolic computations (commercial)
  - [Sage](#) an Open source but less powerful alternative for symbolic calculations
  - [GeoGebra](#) is a nice tool for geometry problems
    More software
    - ∗ [Matlab](#) is useful mainly for numerical computations
    - ∗ [GNU Octave](#) is a useful open source alternative to Matlab
    - ∗ [Maple](#) is good for symbolic and numerical computation
    - ∗ [gnuplot](#) a very basic open-source plotting and fitting tool.
    - ∗ [R](#) used typically for statistics
    - ∗ [Jupyter](#) is a nice exploring and presenting tool together with (among other possble choices) [Python](#).
    - ∗ See [Wikipedia](#) for much more.
    - ∗ [Desmos](#) is online graphing calculator for visualizing mathematical concepts.
- Comprehensive textbooks:
  - [What is Mathematics](#) "Mathematics as an expression of the human mind reflects the active will, the contemplative reason, and the desire for aesthetic perfection."
  - [Mathematics: Its Content, Methods and Meaning](#) close to the real-world but precise and high-quality comprehensive book in the "Russian spirit" familiar from the books of Arnold and Kolmogorov.
  - [The Princeton Companion to Mathematics](#) "General Map of Mathematical World"
- History of Mathematics:
  - [History of Mathematics](#)
  - [Nincs királyi út!](#) by Sain Márton. History of Mathematics in Hungarian
  - [A Very Brief History of Mathematics](#) podcast by Stephen Wolfram
  - [Math Geneology Project](#)
  - [History of Mathematics Project](#)
- [Paul's Online Math Notes](#) has a very hands-on approach to teaching from basic algebra to some higher level calculus. Lot of worked examples, some physics references at times.
- [Mateking](#) is a partially commercial but useful source of study materials (Hungarian).
- [Interactive Mathematics](#) high school/undergraduate level mathematics topics with real life and interactive examples
- [Mathematics Enhancement Programme](#) Study materials from The Centre for Innovation in Mathematics Teaching [CIMT](#).
- [Art of Problem Solving](#) commercial, but nice.
- [Solving Mathematical Problems](#) by Terence Tao
- [Terence Tao](#)'s personal homepage
- [Millenium problems](#) Unsolved problems in Mathematics
- [Open Problems With Monetary Rewards](#)
- [Michel Talagrand'](#) prizes
- [Hungarian final examination](#) (Érettségi feladatok) in Hungarian
- Other books and sources:
  - [Euclidean Geometry in Mathematical Olympiads](#) by Evan Chen

- – [An Infinitely Large Napkin](#)
  - – [Illustrated Elements of Euclid](#) by Oliver Byrne
  - – [mathematics books](#) blog

- Other reading lists:
  - – [Cambridge Mathematical reading list](#) (older version [archived here](#))
  - – [Oxford reading list](#) under "Recommended Mathematics Reading"
  - – [MIT reading list](#)
  - – [Baez](#) list for fundamental/mathematical physics
  - – [Toby's list](#)

- Fun:
  - – [99 Variations on a Proof](#) by Philip Ording
  - – [The Map of Mathematics](#)
  - – [The Book of Numbers](#) by Conway and Guy

5.3 Computer Science

Computer Science (CS) is a broad umbrella term that covers Algorithms, Programming, Theoretical computer science, Information theory, Computer networks, Cybersecurity, Artificial Intelligence (AI), Robotics, and a vast number of other areas. As a discipline, it can be divided into Theoretical Computer Science and Applied Computer Science.

Programming – or coding – consists of a solid applied branch of Computer Science. This branch is more industry and application-driven than Physics and Mathematics in general because of its profound and recent impact on society (see [Digital revolution](#), the [fourth industrial revolution](#) and [AI spring](#)). However, many other academic and even ethical questions arise that are deeply connected to Computer Science and its applications.

Computer Science is a field that is constantly evolving, with the cutting edge moving at a rapid pace. It's not something that can be fully grasped in a traditional school setting from a teacher. Instead, it's an ongoing discourse, a dynamic interplay between accumulated knowledge and emerging technologies.

Because of its [reflexive](#) impact on society, [AI ethics](#) can be considered as a relevant part of CS as well.

- <u>Write and run a "Hello World"</u> in virtually any programming language. Choose a language for which you have a good teacher, or you can find good learning materials. If you have no preference or guidance, then – at the time of writing – I might suggest starting with [Python](#). (See the Programming language list below for many good alternatives.)

- [Computational Thinking](#) is a short summary written for educators (see archived version [here](#))

- [Map of Computer Science](#) shows the current domain of CS ([image](#) format)

- [Cambridge A-level](#) gives a summary about various topics, covering basic skills and knowledge (see an archived previous syllabus (9608) [here](#))
  - – [CS A-level Course book](#). (Archived [here](#) and [here](#))
  - – [More recent Course book](#)

- Books about Problem-solving/Computational thinking/CS in general:
  - – [How to Solve it by Computer](#)
  - – [The New Turing Omnibus](#) is an exhaustive review of topics in CS (suggested for freshmen on CS at Cambridge)
  - – [How to think like a mathematician](#) helps to get familiar with analytic thinking required for CS (suggested for freshmen on CS at Cambridge)

- [Codecademy](#) is a useful place to learn programming

- [tutorialspoint](#) provides quick tutorials for many languages, together with an online compiler for the code.

- Programming languages. There is a plethora of programming languages, however here I will list a few from the "more relevant" ones. From an even shorter list I would mention a few (another measure of popularity can be seen here.)

    - Overview of languages from job market point of view
    - C basic Procedural language
    - C++ basic Object-Oriented language
    - Python a very popular, easy to learn language
    - other languages
        * HTML Hypertext Markup Language, the "language of websites"
        * SQL for standard database management
        * LaTeX markup language of most academic papers
        * Java is another very popular programming language, which, due to running on a Virtual Machine, is very suitable for developing cross-platform applications (such as different operating systems, e.g., notably Android).
        * bash scripting language
        * Haskell a popular functional programming language

- Hello World. Learning a new programming language starts with creating a tiny working code, usually printing or outputing "Hello World". The first working code is crucial because one can explore the functionalities of a language (or a package) in little, incremental steps through working codes. (Without a complete list of languages and editors or Integrated Development Environments (IDE-s).)

    - HW C, Linux (Ubuntu).
    - HW 01, 02, 03, 04 C, Windows. The tutorial in one HW list.
    - HW Python, Linux (Ubuntu)
    - HW Python cross platform
    - HW C++, Linux (Ubuntu)
    - HW C++, Windows
    - Hello World code on many-many other programming languages. (Another collection here)

- Standard books on programming:

    - C Primer Plus A huge, but popular introductory book into C
    - The C programming language by Kernighan and Ritchie. A classic from the creators of the language.
    - Programozás C nyelven by László Pere, a book in Hungarian (archived here)
    - C++ Primer A huge, but popular introductory book into C++
    - C++ by Bjarne Stroustrup. A classic from the creators of the language.
    - An Introduction to Python an introduction from the creator, Guido van Rossum.
    - Dive Into Python 3 introduction to Python, for those who already know some programming
    - Clean Code for an easy (not impossible) to read coding style
    - Best Practices for Scientific Computing

- List of Free Learning Resources In Many Languages on GitHub

- Graphics:

    - OpenGL 3D/2D graphics
    - SDL is a popular library
    - Unity a popular cross-platform Game engine
    - Allegro is simple to use library for 2D graphics

- Integrated Development Environment (IDE). In practice, it is good to have an environment which is essentially a text editor and a compiler, in which one can write, run, debug, and make a version control of its programs. Here are some good-to-know IDE-s

- – Code Lite C/C++ IDE
    - – Spyder Python IDE
    - – PyCharm Python IDE
    - – Visual Studio Code
    - – other notable IDE-s
        - ∗ Sublmie text
        - ∗ Code::Blocks
        - ∗ Visual Studio
        - ∗ Eclipse

- Online references:
    - – C++ reference
    - – Rosetta Code example programs in a huge variety of languages
    - – html
    - – w3schools for web development in general (HTML, PHP, SQL, CSS, JavaScript, Python, etc.)
    - – bash
        - ∗ Basic introduction to terminal, and other useful tricks.
        - ∗ How To
        - ∗ Beginner Guide
        - ∗ Advanced Guide
        - ∗ Cheatsheets
    - – ELTE Haskell interactive university course (in Hungarian).

- Libraries:
    - – GSL GNU Scientific Library (for C, C++) Wiki
    - – Boost a set of libraries for C++
    - – NumPy is the fundamental package for scientific computing with Python (a tutorial for those, who are already familiar with Matlab)
    - – SciPy Scientific computing library for Python
    - – Matplotlib plotting and visualization library for Python
    - – Anaconda a whole (mostly Python) environment for Data Science

- Operational Systems (OS) (Popularity of OS-s can be found here and here)
    - – Virtual Box is a very useful emulator to try out different OS-s in a virtualized environment
    - – Linux which ha many distributions.
        - ∗ Ubuntu is useful for general use. (A guide for installation)
        - ∗ Kali is a "hacking OS" with many built in Penetration Testing tools
    - – MacOS is a Unix based OS of apple computers
    - – Windows originally an MS-DOS based operating system
    - – Android is a Linux based mobile OS
    - – iOS is a Unix like OS for mobiles

- Some useful shell programs:
    - – ssh (see this how to for more detail)
    - – wget
    - – rsync
    - – scp
    - – htop
    - – mc Midnight Commander

- Word processors:
  - [Overleaf](#) online LaTeX document editor (this document was written on this platform). See their [learning page](#). LaTeXis a standard typesetting language to write scientific documents in many fields, including mathematics, computer science, engineering, physics, chemistry, economics, etc.
  - [LyX](#) a LaTeXeditor where the edited content is much closer to the compiled document than in most traditional script-based editors. It has a "what you see is what you mean" approach. (Easy and fast to use (with useful [keyboard shortcuts](#)) for taking notes or writing short documents, but might have compatibility issues in a collaboration.)
  - LaTeXresources in general
    * [TeXMaker](#) a popular offline LaTeX editor
    * [LaTeX Wikibook](#)
    * [The Not So Short Introduction](#)
    * [LaTeX Beginner's Guide](#)
    * [LaTeX Math Symbols](#) cheat sheet
    * [The Comprehensive LaTeXSymbol List](#)
    * [LaTeX Mathematical Symbols](#)
    * [Reference Sheet for a Thesis](#)
    * [LaTeX-Tutorial.com](#)
    * [Fun symbol detecting tool](#)
    * [LaTeX Tutorials](#) by Trefor Bazett
  - [Pandoc](#) "markup format" converter (for more details see its [Wiki](#))
  - [Google Docs](#) online word processor, presentation editor, etc. from Google.
  - [Microsoft Office](#) a word processor with the most users world wide. ([MS Office](#) also have an [online version](#))
  - [Libre Office](#) free and open-source office software suite (a successor to OpenOffice). It is a fully capable alternative to MS Office; the main issues are compatibility-related.
  - [Pages](#) a word processor developed by [Apple](#)
  - [Prezi](#)
  - [Sozi](#)
  - [Canva](#), commercial

- Other useful applications:
  - [Wireshark](#) network protocol analyzer
  - [qBittorent](#) which is a [BitTorrent](#) client
  - [MEGA](#) an encrypted file hosting service
  - [Proton Drive](#) encrypted cloud storage

- [git](#) and [GitHub](#): essential for version control and collaborative development
  - [Git & GitHub](#) for Windows
  - [git](#), [GitHub](#) for Linux (Ubuntu)
  - [Pro Git book](#)
  - [GitLab](#) an open source alternative to GitHub

- Books and resources on Theoretical Computer Science:
  - [Algorithms](#) (another classic book is [Introduction to Algorithms](#)). +1 book [The Algorithm Design Manual](#) (available [here](#))
  - Algorithms related courses on Coursera:
    * [Algorithms, Part I](#)
    * [Algorithms, Part II](#)
  - [Art of Computer Programming](#) by Donald E. Knuth

- Knuth's homepage containing further resources
- Computability and Logic
- Information theory
- AI:
  * Andrew Ng and his courses on Coursera (Such as Supervised Machine Learning.)
  * MLU-ExplAIn an education initiative from Amazon's Machine Learning University
  * Information Theory, Inference, and Learning Algorithms by David J.C. MacKay
  * Pattern Recognition and Machine Learning by Christopher M. Bishop
  * Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville
  * Reinforcement Learning by Richard S. Sutton, Andrew G. Barto
  * Bandit book by Tor Lattimore and Csaba Szepesvári
  * Introduction Reinforcement Learning lectures by David Silver in DeepMind and UCL (archived version available here)
  * Virtual Machine Learning Summer School 2020
  * Eastern European Machine Learning Summer School materials
    · EEML 2023
    · EEML 2022
    · EEML 2021
    · EEML 2020
    · Repository for tutorial sessions at EEML
  * Mediterranean Machine Learning Summer School
    · Playlist of Recordings
- Data Structures by GeeksforGeeks
- Introduction to Computation and Programming Using Python by John V. Guttag. A related course on EdX: MITx: Introduction to Computer Science and Programming Using Python

- Other reading lists:
  - Principles of Computing at CMU
    * Blown to Bits, available here
    * Explorations in Computing
  - MIRI reading list
  - AI Stackexchange
  - CS Stackexchange
  - How a begginer should start studies in ML? on AI Stackexchange
  - Oxford CS reading list
  - Carnegie Mellon list of books

- Competitions/hackathons:
  - KöMaL is a perfect source of challenging problems for high school Mathematics, Physics and Computer Science students.
  - IOI International Olympiad in Informatics
  - Central European Olympiad of Informatics
  - Google's coding competitions sadly, discontinued in 2023
  - Codeforces
  - AWS DeepRacer
  - Hungarian competitions
  - List of competitions
  - Devpost - Hackathons
  - University level
    * ICPC International Collegiate Programming Contest. See on Wikipedia. (A nice preparation book is Competitive Programming)

- * [Challenge 24](#)
- * [Kaggle](#) Data Science challenges
    - – Robotics:
        - * [World Robot Olympiad](#) see on [Wikipedia](#)
        - * [Robocup](#)
        - * [Robotverseny](#)
        - * [micro:bot](#)
    - – Challenges:
        - * [LeetCode](#)
        - * [HackerRank](#)

- Fun:
    - [Codingame](#)
    - [Lightbot](#)
    - [Shadertoy](#) (see on [Wikipedia](#))

- Quantum computing:
    - [Qiskit](#) IBM's Python-based library

- Robotics:
    - [Arduino](#)
    - [Maker Space](#) in Hungary

- 3D design and CAD:
    - [Auto CAD](#), for other CAD softwares see this [list](#)
    - [Blender](#)
    - [Rhino3D](#)
    - [3D Studio Max](#)
    - 3D printing
        - * [Tinkercad](#)

- Ethical hacking:
    - [HackerOne](#)
    - [Defcon](#)

- Possible projects:
    - [Techtábor](#) (in Hungary)
    - [Skawa](#) startup projects in Hungary

5.4 Chemistry

Disclaimer: I'm not a chemist and didn't do any serious chemistry during my University studies. My view on chemistry is highly subjective and probably naive. The contribution of a more experienced chemist would be valuable.
I think chemistry as a field is worthless without experiments. If I needed to introduce chemistry to a high school student, I would say that it is primarily magic and craft, and its view from an analytical and critical lens is secondary (however, that makes chemistry a science).

- <u>Do experiments.</u> Go to the kitchen and bathroom, find substances around the house and – by minding safety – make experiments and observations. Perform a crystallization experiment, produce some gases and bubbles, change the colour of the tea, and vary the temperature. Collect first-hand empirical experiences.

- Demonstrations by [Andrew Szydlo](#) and [Chris Bishop](#).

- [Fun and interesting videos](#) by NileRed
- [Map of Chemistry](#)
- Experiments
    - [Safety](#)
    - [Experiments at home](#)
- Laboratory experiments
    - [Safety](#) (less detailed [version](#))
    - [AP Chemistry](#)
- [Cambridge International AS and A Level Chemistry](#)
    - [Course book](#) online available [here](#)
- [Náray-Szabó](#) Chemistry book in Hungarian (online available [here](#))
- [Atkins](#) books are generally suggested for University chemistry courses
- [Resources for Learning Chemistry](#)
- [Professor Dave Explains](#) YT channel
- [Chemistry Library](#) on the LibreTexts project
- [American Chemical Society](#)'s YouTube channel, to find out what chemists do.
- [Magyar Kémikusok Egyesülete](#)
- [Royal Society of Chemistry](#) (UK)
- Competitions:
    - [Kökél](#) "Kömal" for chemistry
    - [Hungarian chemistry competitions](#)
    - [IChO](#) International Chemistry Olympiad
    - [IChTo](#) International Chemistry Tournament. Team-oriented open-ended scientific competition between secondary school students.
    - [International Mendeleev Chemistry Olympiad](#) (in Russian), [past problems](#) from 2015 in English
    - [Oláh György Országos Középiskolai Kémiaverseny](#)
    - [Curie Chemistry Competition](#)
- Textbooks:
    - [Organic Chemistry](#) by Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers
    - [Principles of Biochemistry](#) by Albert L. Lehninger, David L. Nelson, Michael M. Cox
    - [Organic Chemistry: Structure and Function](#) by K. Peter C. Vollhardt, Neil E. Schore
    - [DNA Nanoscience: From Prebiotic Origins to Emerging Nanotechnology](#) by Kenneth Douglas
- Handbooks/Data banks:
    - [CRC Handbook of Chemistry and Physics](#)
    - [Dortmund Data Bank](#) Thermodynamic data bank (mainly Commercial)
- Fun:
    - [Compound Interest](#) Infographics
    - [Chemistry World](#) magazine
    - [Periodic Videos](#) Clips about the Elements
    - [NileRed](#) YT channel
    - [FoldIt](#) gamification of protein folding problems

- – [PhET Interactive Simulations](#) virtual chemistry experiments
      - – [Chemistry in Your Kitchen](#) by Matthew Hartings
      - – [Theo Gray's Mad Science](#)
      - – [Books by Theodore Gray](#)

- Other reading lists:

    - – [Oxford](#) Chemistry
    - – [Oxford](#) Biochemistry
    - – [Cambridge](#)

- Blog:

    - – [In The Pipeline](#) Derek Lowe's commentary on drug discovery and the pharma industry. (Chemistry, medicinal chemistry, drug discovery, drug industry, microbiology, etc.)

- Twitter hashtags:

    - – [#chemtwitter](#) [#orgchem](#) [#fluorescencefriday](#)

- Internships, projects:

    - – Material science: [Bay Zoltán Nonprofit Ltd. for Applied Research](#)

5.5 Biology

Disclaimer: I'm not a physician or a biologist, and I didn't do any biology classes during my University studies. My view on biology is highly subjective and probably extremely naive. A contribution of a more experienced biologist/physician would be valuable.

Biology is of course a huge umbrella term. In my personal view, Biology as a field investigates replicators, which can evolve and interact. More specifically, Biology is about chemical life, in which DNA/RNA molecules evolve by mutations and complicated interactions. (It is interesting, that this life form is the dominant and most complex one that we know.)

Closely related fields are Physiology and Medicine, which are more anthropomorphic (in my view) and are interested in the functioning and "health" of a single individual.

- Observe the living world. Life is abundant on Earth. There are animals, plants, fungi, and microorganisms in water, soil, and air. You, yourself are full of life and biology. Marvel the diversity and complexity of life and the processes related to it.

- [Map of Biology](#) sketches the main topics in Biology ([poster](#) version)

- [Campbell Biology](#) is the main textbook for biology (mainly for undergraduate students). (Online available [here](#))

- [The selfish gene](#) by Richard Dawkins is a popular introductory to the genetic (or replicator-centered) view of life. (Online available [here](#))

- [Cambridge A-level](#)

    - – [Biology A-level Course book](#) online available [here](#)

- "Standard" online courses

    - – [Biology](#) on Khan academy
    - – [Crash Course Biology](#)
    - – [Crash Course Ecology](#)
    - – [Crash Course Anatomy & Physiology](#)
    - – [Biology](#) MIT OCW

- [Introduction to Biology](#) on study.com (commercial)

- [iBiology](#) a free online resource

- [Tree of life](#) explorer

- History
  - [A History of the Life Sciences](#)
  - [The great ideas of biology](#)

- Competitions:
  - [IBO](#) International Biology Olympiad
  - [Hungarian Biology Competitions](#) for high school students (archived version [here](#))
  - [iGEM Competition](#) world wide synthetic biology event. (Intense genetics focused team competition.)
  - [European DNA Day Video/Essay Contest](#) organized by [European Society of Human Genetics](#)
  - [DNA Day Essay Contest](#) organized by [American Society of Human Genetics](#)
  - [Neuroethics Essay Contest](#)

- Other reading lists:
  - [Introductory Biology texts](#) from Biology Stack Exchange
  - [List of lists](#) from Biology Stack Exchange
  - [Books for beginners](#) from Biology Stack Exchange
  - [Cambridge Natural Sciences](#) reading list
  - [Oxford](#) Biomedical Science
  - [Oxford](#) Medical school
  - [Medical school introductory advice](#) from Medical Sciences Stack Exchange
  - [The best books for medical school](#) Advice & Resources for the First and Second Years of Medical School
  - [Pleased to Meet Me](#) by Bill Sullivan

- Human Biology:
  - [Atlas of Human Anatomy](#)
  - [Zygote Body](#) a 3D anatomy atlas
  - [Visible Body](#) a 3D anatomy atlas (Commercial)
  - [Human Behavioral Biology](#) Lecture series by Robert Sapolsky, on Stanford.
  - [The Human Body](#) BBC educational series
  - Healthcare statistics
    * [Global Burden of Disease](#) (GBD)
    * [Causes of Death](#) on Our World in Data
    * [WHO](#) data and statistics

- Mathematical Biology:
  - [Society for Mathematical Biology](#)
  - [Proving Darwin: Making Biology Mathematical](#) by Gregory Chaitin (The framework and the book is not so great (admitted by Chaitin as well), but the idea might be interesting)

- Fun:
  - [Journey to the Microcosmos](#) YT channel
  - [Microscopic Life](#) YT channel of the American Museum of Natural History
  - [Animalogic](#) YT channel about animals
  - [Boxlapse](#) plant time-lapse videos
  - [Spore](#) evolutionary video Game
  - [Mini PCR](#) possible home genetic lab
  - [Cambridge University Museum of Zoology](#)
  - [Cells Alive!](#) Interactive Biology Animations

- – Immune by Philipp Dettmer
- Extended evolutionary synthesis is a modern way to look biological evolution wiki.
- Royal Society of Biology
- Projects, internships
  - – Sainsbury Laboratory in Cambridge
  - – Barabasi Lab

6 Subjects II

To save further disclaimers, I grouped the subjects I knew less together.

A **General Disclaimer** holds: **I'm not a Philosopher / Psychologist / Historian / Economist / Sociologist / Lawyer, etc., and I didn't do any serious formal classes during my University studies regarding these fields. My view on these subjects is highly subjective and probably extremely naive. The contribution of more experienced scholars/practitioners is much needed.**

Against my limited knowledge of the topics, I tried to collect together useful links and sources I learned from interested students and fill the gaps with resources I found reliable or useful for myself. The patchwork of resources, competitions, and books, all of varying depth and difficulty can not provide a coherent track for serious self-study. However, I hope it can help in initial explorations and enrich a standard curriculum.

6.1 Philosophy

General Disclaimer: I have limited knowledge in this field.

- BBC television series presented by Bryan Magee:
  - – Men of Ideas, see the playlist on YouTube
  - – The Great Philosophers, see the playlist on YouTube
- Stanford Encyclopedia of Philosophy
- International Philosophy Olympiad
- Dialexicon philosophy journal for high school students
- Trinity College Cambridge Essay Competition
- Baltic Sea Philosophy Essay Event
- "human rights competition" of Amnesty International
- Cambridge, Oxford & London Summer School Essay Competition
- Book and sources:
  - – Lecture on Ethics by Wittgenstein
  - – After Virtue by Alasdair MacIntyre
  - – Isaiah Berlin, "Two Concpets of Liberty"
- philosophy bites podcast

6.2   Psychology

General Disclaimer: I have limited knowledge in this field.

- The Brain by Gary L. Wenk

- Introduction to Psychology by Paul Bloom (Coursera course)

  - Psychology by Peter O. Gray is the suggested textbook for the course

- Introduction to Social Psychology on edX

- SimplyPsychology helpful study guides

- American Psychological Association (APA) great pool of resources

- Hidden Brain podcast

- Books:

  - Atkinson & Hilgard's Introduction to Psychology
  - The Man Who Mistook His Wife for a Hat by Oliver Sacks
  - The Social Animal by Elliot Aronson
  - Disorders of Childhood by Robin Hornik Parritz, Michael F. Troy

- Competition:

  - Neuroscience Competition for Teens
  - TOPSS Competition for High School Psychology Students Essay competition hosted by the APA

- Internships, projects

  - Central European University Baby Lab
  - Central European University Vision Lab

6.3   Medicine

General Disclaimer: I have limited knowledge in this field.

- Introductory Human Physiology by Duke University

- Books:

  - Do No Harm by Henry Marsh
  - The Emperor of All Maladies by Siddhartha Mukherjee

- Competitions:

  - Brain Bee Neuroscience Competition for Teens

- The Lancet peer-reviewed general medical journal

- Mayo Clinic

- NHS

- Magazines:

  - Healthline

- Possible projects:

  - e-NABLE makes 3D printed prosthetic upper limb devices
  - Institute of Experimental Medicine in Hungary
  - Bethesda children Hospital

6.4 History/Archeology

General Disclaimer: I have limited knowledge in this field.

- What Is History? by Ignác Romsics in Hungarian (see written version here and here)

- Philosophy of History

- Hungarian History and Literature online high school classes in Hungarian

- Magyarország Története documentary series on Hungarian history in Hungarian (see background here)

- GeaCron online Historical World map from 3000 BC

- Books:

  - The Oxford History of Ancient Egypt
  - Amarna Sunset and Amarna Sunrise by Aidan Dodson Wonderful Things by Jason Thompson Orientalism by Edward W. Said Middle Egyptian An Introduction to the Language and Culture of Hieroglyphs
  - Historical Dynamics or Cliodynamics by Peter Turchin
  - A History of the World in 100 Objects
  - China: A New History by John King Fairbank, Merle Goldman

- Competition:

  - Estöri creative history competition
  - Mary Renault Essay Competition on a topic relating to the reception of classical antiquity – including Greek and Roman literature, history, political thought, philosophy, and material remains – in any period to the present
  - UCL Classics Essay Competition

- Fun:

  - Fall of Civilizations Podcast and YouTube channel
  - UsefulCharts

6.5 Geography

General Disclaimer: I have limited knowledge in this field.

- NASA Earth Observatory

- World Factbook CIA's World Factbook

- National Geographic Society

- Books:

  - The Uninhabitable Earth: Life After Warming by David Wallace-Wells

- Competition:

  - International Geography Olympiad
  - Földgömb
  - "Itthon-Otthon Vagy" Földrajz Verseny

- Projects, internship:

  - Interreg-danube

- Maps on social media:

  - r/Maps and r/MapPorn on Reddit
  - Simon shows you maps, Simon Kuestenmacher' page

6.6 Economics/Politics/Law/Sociology

General Disclaimer: I have limited knowledge in this field.

- Capitalism: A Very Short Introduction

- The Economy Great free online textbook

- Sociology by Anthony Giddens

- An Introduction to Political Thought: Key Concepts and Thinkers by Peri Roberts, Peter Sutch

- Democracy and the rule of law in the European Union online course

- Security & Safety Challenges in a Globalized World online course

- Justice This introduction to moral and political philosophy is one of the most popular courses taught at Harvard College (published on YouTube as well)

- Is Eating People Wrong? by Allan C. Hutchinson

- Books:
  - Principles of Economics by N. Gregory Mankiw
  - Economics: The User's Guide by Ha-Joon Chang
  - Thinking, Fast and Slow by Daniel Kahneman (Behavioral economics)
  - Predictably Irrational: The Hidden Forces That Shape Our Decisions by Dan Ariely (Behavioral economics)
  - Capitalism Socialism and Democracy by Joseph A. Schumpeter
  - The Sharing Economy by Arun Sundararajan

- Game theory:
  - An Introduction to Game Theory by Martin J. Osborne (Online available here)

- Competitions:
  - Economics Olympiad
  - EcoSim

- Projects/Internships:
  - 21 Research Centre political think tank in Hungary
  - MFC Equity
  - Revas online business games
  - Pioneer Research Journal

6.7 Literature

General Disclaimer: I have limited knowledge in this field.

- Hungarian literature
  - Magyar Elektronikus Könyvtár MEK
  - Szerb Antal: Magyar irodalomtörténet available on MEK
  - Hogyan írjunk verset? by Lackfi János snippet
  - A vers ellenforradalma by Horváth Viktor (on Everand)
  - Szép Magyar Beszéd Hungarian Recitation Contest
  - Lyukasóra Hungarian poet guessing TV program
  - Arany János National Literature Competition

- International Literature
  - Szerb Antal: A világirodalom története available on MEK (in Hungarian)

- Babel Matrix
- "The Greatest Books of All Time"
- World Literature Categories on Five Books
- The Big Read popularity contest for the most loved novels in the UK in 2003 (see Similar contests for more popularity lists)
- A Poetry Workshop offered by California Institute of the Arts
- Poetry Out Loud English (USA) Recitation Contest
- Poetry In Voice English (Canada) poetry ricitation and writing contest
- Shakespeare's Globe productions
- Poetry Foundation

6.8 Art

General Disclaimer: I have limited knowledge in this field.

- Visual Arts:
  - Concepts and Problems in the Visual Arts by James Elkins
  - Great Art Explained YouTube channel
  - Csomópont Art School (in Hungary)

- Music:
  - The Art of Music Production
  - Pro Tools Basics
  - iReal Pro

- Architecture:
  - Arch Daily magazine

6.9 Language skills

General Disclaimer: I have limited knowledge in this field.

- English
  - IELTS
    * Fastrack IELTS a YouTube channel by Asiya
    * AcademicEnglishHelp another YT channel for Academic IELTS
  - TOEFL
  - British Council
  - Dictionaries, Synonyms
    * Google Translate
    * Thesaurus
    * Oxford English Dictionary
    * Merriam Webster
    * DeepL Translator
  - Style and Grammar
    * General post about the non-prescriptive nature of English grammar
    * English Grammar Reference from the British Council
    * The New York Times Manual of Style and Usage
    * AP Stylebook
    * Other Style guides
    * Grammarly online, AI aided grammar and style assistant.
- German

- – Goethe-Institut
  - – Österreich Institut

- French
  - – DELF DALF
  - – Institut français en Hongrie

- Spanish
  - – Instituto Cervantes
  - – DELE

- Chinese
  - – Hanyu Shuiping Kaoshi test

- Slovak
  - – e-slovak
  - – Cseregyerek exchange program for 8-15 years old Hungarian children living in Slovakia

- Peculiarities
  - – Interslavic see official page

- Learning apps:
  - – Duolingo popular app for learning various languages
  - – Babbel language learning with interactive lessons
  - – Memrise language learning with real-world context

7 Complementary materials

7.1 YouTube channels/Podcasts

- YouTube channels:
  - – The Royal Institution
  - – Kurzgesagt
  - – Sixty Symbols
  - – 3Blue1Brown
  - – Domain of Science
  - – Numberphile
  - – Mathologer
  - – Periodic Videos
  - – SmarterEveryDay
  - – Steve Mould
  - – Professor Dave Explains
  - – CGP Grey
  - – Veritasium
  - – Sabine Hossenfelder Science without the gobbledygook
  - – Vsauce
  - – minutephysics
  - – minuteearth
  - – Physics Girl
  - – Up and Atom

- The Action Lab
- Computerphile
- The School of Life
- Practical Engineering
- AppliedScience
- Geography Now
- Langfocus
- Crash course for Aliens from Zogg
- Cogito
- Let's Talk Religion
- Overthink Philosophy Podcast
- Carneades.org Philosophy
- Great Art Explained
- OverSimplified
- TierZoo
- Jubelee
- Medlife Crisis
- Oxford Union
- IntelligenceSquared Debates
- The Munk Debates
- The Nexus Institute
- Talks at Google

- Other podcasts:
  - Hidden Brain
  - The Naked Scientists
  - TED Ed
  - Sean Carroll's Mindscape Podcast
  - Freakonomics
  - Blogging heads (USA politics, news, etc.)

- Fun:
  - The Scale of the Universe other examples from Wikipedia

- Hungarian
  - Mindentudás Egyeteme further videos here.
  - Atomcsill, Az atomoktól a csillagokig
  - Szertár
  - Vírus Klub (on YouTube)
  - Mindenki Akadémiája

- Other lists
  - Top 100 Educational YouTube Channels
  - 60 YouTube channels
  - 100+ YT channels

7.2 Books, reading lists

- Sapiens by Yuval Noah Harari
- Brave New World by Aldous Huxley
- The Black Swan: The Impact of the Highly Improbable by by Nassim Nicholas Taleb
- Factfulness by Hans Rosling
- Life 3.0: Being Human in the Age of Artificial Intelligence by Max Tegmark
- The Language Instinct by Steven Pinker
- China in Ten Words by Yu Hua, Allan H. Barr
- What Is Life? by Erwin Schrödinger
- Reading lists
  - Bill Gates collected recommendations from 2012 to 2020
  - The Big Questions Series

7.3 Real life events

7.3.1 Science festivals

- Kutatók északája (in Hungary)
- Pint of Science
- CERN open days

7.3.2 Science museums

- Csodák Palotája
- Museum of Mathematics
- Science Museum London
- Museum of Science Boston
- Oxford University Museum of Natural History with digitalized online collection
- Semmelweis medical museum

7.4 Summer schools

- S^3/S^3++ in Croatia
- Wolfram High School Summer Camp in Boston
- MIT Summer programs
- MaMuT summer camp in Hungary
- FEB engineering programs organized by Budapest University of Technology and Economics
- Maths Beyond Limits in Poland
- INSEAD Institut Européen d'Administration des Affaires in France
- Immerse Education in England
- Engineering Summer School in Cambridge
- NYFA Teen & Kids camps in film, media, & performing arts organized by the New York Film Academy
- Varázslatos kémia tábor in Hungary
- Jesuit European Educational Project (JEEP) (2023)

7.4.1 Other competitions

- Oxford Schools debating competition
- Debating Society at Milestone Institute
- World Schools Debating Championship
- Jugend Debattiert
- John Locke Essay Competition
- National Conference of Researching Students (Kutdiák)
- International Natural Sciences Tournament
- IYNT International Young Naturalists' Tournament
- Cinemira International Children's Film Festival
- Ugrás a jövőbe! kreatív pályázat by Moholy-Nagy Művészeti Egyetem (MOME) (in Hungarian)
- Technovation innovation based team competition for girls
- 24h Innovation Marathon by Lauder Javne School
- National Scientific and Innovation Contest for Youth
- Social Impact Award
- International Economics Olympiad
- KEBA A Közép-európai Brókerképző Alapítvány diákoknak szóló pénzügyi vetélkedője
- International Olympiad of Metropolises
- Jugend Forscht
- High School Business Challenge
- First Lego League competition
- Model United Nations find a list of events here and see BIMUN and BME MUN for events in Budapest. Model European Parliament has a similar format
- NSS Space Settlement Contest
- Collection of national competitions in Hungary
- The New York Times Contest including the New York Times Summer Reading Contest
- Competitive Bridge card game
- International Trivia Competition of IBS
- World Skills

7.5 Teaching/Educational organizations

- Milestone Institute
- go2uni
- Romaversitas
- Kutdiak
- Crimson Global Academy
- Eton College
- Lyceum 239 in Saint Petersburg

- Pre-Collegiate Summer Course at Stanford University

- Yale Young Global Scholars program

- 1000 Girls 1000 Futures see here as well

- Smartiz multidisciplinary STEM program for girls

- Alternatív Közgazdasági Gimnázium

- Minds Underground

- Heterodox Academy

- Art of Problem Solving

- Advanced Placement (AP)

- Lumiere Education

- Scholarships

    - Study abroad program in the USA
        * ASSIST
        * FLEX

7.6 Volunteering/Activism

Being socially sensitive, reflecting critically on our social circumstances, and being an active member of society are virtues in our modern world. However, one needs knowledge and wisdom to see the relevant problems and determination to act effectively. While learning your civic roles, be critical, informed and active, but also be brave to revise your own goals and actions from time to time.

"To know how to criticize is good, to know how to create is better."

— Henri Poincaré

7.6.1 Real world challenges

Real-world challenges do not need to be global. However, there are some which are widely recognised:

- Global Risk Report 2020 by the World Economic Forum (see more reports here)

- Global Risk Report 2020 and 2024 by the Eurasia Group

- The Intergovernmental Panel on Climate Change (IPCC)

- Grand Challenges for Engineering in the 21st Century by the National Academy of Engineering (2008)

- A collection of Grand Challenges on Wikipedia

7.6.2 Organisations

There are many organisations where one can volunteer. Some are international, some national, and some focus on a small area. But keep in mind that you can be active even without joining an organisation (for instance, by simple things, such as picking up trash in nature, or helping your grandmother).

In some cases, you can form a group, and for some causes, the project can be aided financially, for instance, by the European Solidarity Corps.

- AFS

- Hungarian Helsinki Committee

- Hungarian Civil Liberties Union

- UNICEF Hungary

- United Nations

- Political Capital Hungarian Political think-tank

- ADOM mozgalom Hungarian high school youth movement

- European Solidarity Corps or in Hungarian

- Order of Malta (their Hungarian Charity Service). A more actual FB page

- 10 miilió FA

- Ökológiai Intézet

- Foncsorozó, NapSukár on Facebook

- Budapest Bike Maffia

- etanoda

- Fridays for Future

- Other collected volunteering opportunities:

  – Milestone Institute's collection

8 University choice

In the 21st century, any theoretical material can be learned if someone has a working internet connection. There is a huge variety of online courses, many books and papers are accessible. However, Universities are still useful for:

- Providing practical classes and access to laboratories

- Socializing with your classmates, which can provide a valuable professional network

- Changing and shaping your worldview

- Can give opportunities for research (mainly during MSc and PhD)

- Accommodates you to the academic workload

There are three main university ranking sites that provide a lot of additional useful information.

- Times Higher Education

- QS

- Shanghai Ranking

8.1 Interview tips

Some universities require an interview as part of the application process. Before preparing for this round, I think the most important thing is to realize what the interview process is for.

Here the interviewers are usually **not** interested in how flawlessly the candidate can answer all the questions, but in the following three main aspects:

- Interest

- Grasp of the discipline-appropriate way of thinking

- Teachability

These are mainly meta-learning skills, for which practising previous interview questions does not help. To figure out the mentioned aspects, the interviewers will ask hard questions, to the point when the candidate needs to figure something out, provide reasons, and take hints/help from the interviewers. If one can calmly form a coherent (but not necessarily perfect) argument and incorporate hints, then not knowing an answer here is not a bug but a feature.

Be prepared to discuss your interests and motivation for applying to the specific place, and be open to problem-solving and reasoning.

For more information, see:

- Oxford interview

- Cambridge interview

Past interview questions are available here and here. (There are some other sources, including a book, but I think it is not essential for preparation.) For online interviews, one can get familiar with online shareable drawing tools like Miro.

8.2   Test preparation

Many universities and various other admissions require tests. Preparation for these assessments can be time-consuming and stressful, but it can help students gain more structured knowledge and learn how to cope with stress.

In my view, tests do not require and enhance skills to solve real-world, complex problems. However, if one uses the preparation time and the motivation generated by the challenge wisely, the preparation can also be used to learn useful things.

A few general preparation tips:

- Know your test

  - University of Oxford admissions tests
  - Engineering Admissions Assessment
  - etc.

- Find past test papers if there are any

- Find out the precise actual conditions for your upcoming test (time constraints, scoring details, Syllabus, permitted devices (calculator, list of formulas, etc.))

- Familiarize yourself with the Syllabus but don't postpone solving past tests for the last few weeks

  - PAT Syllabus
  - ENGAA 2021
  - etc.

- Start with the oldest previous tests and try to solve them by simulating the conditions you will face on your own test.

- In case of not enough past problems, one can use similar tests/problems (for example, competition problems) for preparation. Try to find the most similar tests, and still try to solve them (maybe in a modified way) under your own test conditions.

- After you finish maximizing your points on a previous test, you can revisit the hardest questions. In a more relaxed way, you can learn something about the background of the problem or go through the solution.

- Many times, you don't need perfect scores for admission but aim for $10\% - 15\%$ more scores that you will probably need to compensate for unknown stress factors during the actual test. Find out past test results to see realistic requirements.

- Learn and channel your own Stress responses:

  - Surprising link between Stress and Memory
  - Find out your own optimal stress level and try to achieve it
  - Find a way to Relax (if needed)

* You put a lot of work into the preparation, so you don't need to worry (if applicable)
* The test is for finding out if you are suitable for admission (which can be an honest no, by which both parties can continue seeking an optimal fit)
* If it is hard for you, then it is probably hard for others as well
* Your existence does not depend on any test
* Breathe deeply; this can physiologically calm you down.

- Find ways to be Motivated
    * This can be a good time to show your abilities and step forward
    * The preparation itself can be good mental training
    * Getting familiar with your stress responses will be useful in many other fields of your life
    * If you find the test problems too dry, try to modify them in an interesting way after testing

- Some other useful tips

    - [Oxford PAT - how to prepare](#) by Simon Clark
    - [ENGAA Section 2 Guide and Tips](#)

9 Elements of Pastoral care

In this section, I want to share my highly subjective thoughts about psychological difficulties, existential crises, burnout, well-being, finding identity and finding meaning in life. Naturally, I will not provide solid answers to these questions, but I want to summarize the sources and directions I found useful for myself (or my close friends and relatives) and my former mentees.

In this section, I will use quotes and poetry, not because they are good at transmitting information precisely but because they can serve as mirrors, allowing one to explore and understand oneself. This section is mostly about the reader, yes, about you.

"Believe Those Who Are Seeking the Truth; Doubt Those Who Find It"

— Doesn't really matter who [said it first](#)

9.1 If you need help

9.1.1 Immediate help

There are situations that are harmful, and intervention is needed. If you face abuse, or you are in danger otherwise, don't hesitate to reach out for consultation and help:

- Hungarian

    - [Kék vonal](#) 116 111 (they do pick up the phone, and you can have an anonymous conversation) general crisis line for young people
    - [Országos Kríziskezelő és Információs Telefonszolgálat](#) +36 80 20 55 20 (they do pick up the phone and are nice)
    - [Magyar Lelki Elsősegély Telefonszolgálatok Szövetsége (LESZ)](#) 116 123
    - [NANE](#) +36 80 505 101 For victims of domestic and sexual violence and their supporters
    - [TASZ ingyenes jogsegély](#) +36 1 279 22 35 for legal help
    - [Hintalovon](#) children's rights organization

- International

    - [Child Helpline Networks](#)
    - [Find A Helpline](#)
    - [The Child Protection Hub](#) (Platform for professionals)

9.1.2 Help and Guidance

A summary of the WHO states, that "Globally, it is estimated that 1 in 7 (14%) 10-19 year-olds experience mental health conditions". (See the few most common problems under the link.)

The two main secular branches of medicine dealing with mental health are[7]:

- Psychology

- Psychiatry

The main difference in most countries between Psychology and Psychiatry is that Psychologists focus on thoughts, behavioural patterns and social relations and use primarily talk therapy[8], while Psychiatrists are trained to find biological and biochemical causes of certain mental disorders, and they can – and often do – prescribe psychiatric drugs.

Although psychiatric drugs can help in severe mental disorders, because of the over-medicalization and sometimes serious side effects of these medications, in most cases, it is better first to approach a Psychologist.

Even finding a good Psychologist is not simple. As a general advice, I recommend finding reviews by previous patients. Fortunately, there are some platforms where collective rating systems can give some information and background:

- Pszichológus Kereső (in Hungary)

However, many good therapists are not present on platforms like this. In general, it is good to seek recommendations. Keep in mind that there should be no obstacle to changing to another therapist if you don't feel comfortable or are stuck with your present one.

9.1.3 Substance abuse and Addiction

In the case of substance abuse, probably the first important step is to seek help. There are many places which can give assistance and help; a few I can recommend are:

- Narcotics Anonymous (NA). Official NA website, Hungarian NA

- Alcoholics Anonymous (AA). Official AA website, Hungarian AA

9.1.4 Coping strategies

"Adapting the right attitude can convert a negative stress into a positive one."

— Hans Selye

Difficulties and stress are a practically unavoidable part of life. A reasonable goal is not to eliminate all life stress but to learn how to manage it. This includes:

- Finding the optimal level of stress[9] (which can vary by individual to individual)

- Learn and use effective and sustainable coping strategies such as:
    - Get enough good quality sleep
    - Eat a well-balanced diet
    - Exercise on a regular basis
    - Take brief rest periods during the day to relax
    - Take vacations away from home and work
    - Engage in pleasurable or fun activities every day
    - Practice relaxation exercises such as yoga, prayer, meditation or progressive muscle relaxation
    - Avoid the use of caffeine and alcohol
    - some more useful suggestions can be found here

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[7]See a more complete list in the US context here.

[8]For connections between Cognitive-Behavioral Therapy (an often used psychotherapeutic technique) and Stoicism (an ancient philosophy) see this blog post.

[9]The mentioned Perceived Stress Scale is archived here

9.2 Changing your self and/or changing the World

"God, grant me the serenity to accept the things I cannot change,
courage to change the things I can,
and wisdom to know the difference."

In the following sections, I will assume that the reader is a teenager or a young adult. (I also assume that the reader is not in a miserable situation, where only by apathy or strong faith can they survive the days. I assume that they are not in luxury either from where injustice is barely visible.)

More often than not, people in their young ages observe injustice, unfairness, hypocrisy, etc., in the world around them, and they are – often rightfully – annoyed by it. Uneasy can come from the difference between how the world "should be" and how it actually is. This is perfectly normal and absolutely necessary in a modern society, where change is often seen as constructive and not a destructive force.

"What can I do where I am?"

To suggest some material about change and possible ways, I suggest watching Barack Obama's relatively sober advice on the matter.

9.3 Well being

Well-being is a highly subjective and not easy to define concept. However, to give some simple and hopefully useful advice, I would list a few relevant concepts popularized by Amit Sood:

- Gratitude

- Compassion

- Acceptance

- Meaning

- Forgiveness

A more detailed list containing elements, which – in my view – can be relevant when one faces difficulties or wants to be more resilient or balanced. (This is not a checklist, and there is no objective grading between the concepts. It can happen that for you, some elements are crucial, while others are irrelevant. These are only aspects that can often be considered relevant factors.):

- Meaning:
    - Meaning is both a deep concept and a meaningless cliché.
    - Meaning and Happiness
    - Viktor Frankl
    - Ikigai

- Food:
    - Food and diet can lead to heated debate even between experts. Because of that, I suggest not searching for the "best" diet but being a bit more conscious, making incremental changes, and figuring out which diet would fit best into your own life.
    - The link between mental health and diet is summarized here and on this BBC article
    - A very basic introduction on BBC Bitsize
    - Food has a big impact on health and quality of life
    - Diet comparing study

- Physical activity:
  - The link between mental health and physical exercise is summarized here.
  - Here are some more tips.

- Sleep:
  - Link between sleep and health
  - A few tips
  - A few mindfulness tips

- Compassion:
  - "Feeling for another"
  - A somewhat relevant quote, which has many variants : "Everyone you meet is fighting a battle you know nothing about. Be kind. Always."
  - Compassion and empathy are not only a deeply rooted instinct and possibly the foundation of many aspects of morality and ethics, but by cultivating them, one can expand even one's identity beyond the spatial and temporal boundaries we usually think our self is confined in.

- Social network:
  - Long-lasting, meaningful social relationships with friends and family were found as the most important factor in Harvard Study of Adult Development. Keep in mind that this is a precious resource, and put energy into developing and maintaining your connections, prioritizing quality over quantity.

- Romantic relationship:
  - Romantic relationships, seduction, long-term relationships, marriage and sexuality are widely debated topics on different levels and from various aspects. This note can not aim – and does not dare – to give a complete discussion of the subject; it tries only to provide some starting points and maybe two suggestions: Romantic relationships are changing because the world around us is changing. This is why creativity and flexibility are becoming increasingly important in long-term relationships and why old customs don't always work. There is no one single method for seduction, and genuine romantic relationships can not be measured in success rates. That is why I would warn you against the so-called Pickup artist movement, which targets mainly young heterosexual males and, besides teaching some basic psychology and manipulative techniques, totally misses the point by basically objectifying women.
  - There are 36 questions which can help to start meaningful conversations (archived)
  - Loving and being in Love
  - The psychology of seduction
  - BBC clip
  - Esther Perel an introductory TED talk and her book Mating in Captivity
  - A dry study
  - Sexuality
    * Human Sexuality Today by Bruce M. King
    * Sexplanations with Dr. Lindsey Doe
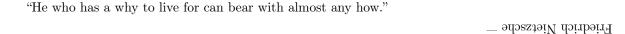
- Natural environment:
  - BBC article
  - Get Outside
  - NASA Clean Air Study

- Reasonable comfort:
  - Scholarships:
    * in some cases there are scholarship opportunities even for high school students (in Hungarian)
    * Bridge Scholarship by Milestone Institute
    * Mathias Corvinus Collegium scholarship
    * Collection of various scholarships in Hungary and the Carpathian basin
    * More scholarships in Hungary and the Carpathian basin

9.3.1 Meaning

"He who has a why to live for can bear with almost any how."

— Friedrich Nietzsche

Meaning is not something we can only find; it is something we create. It may not be objectively out there, but most people need to feel that they and/or their lives have meaning.

"For success, like happiness, cannot be pursued; it must ensue, and it only does so as the unintended side-effect of one's personal dedication to a cause greater than oneself or as the by-product of one's surrender to a person other than oneself."

— Viktor Frankl

"Drive overrides fear"

— Elon Musk

9.4 Coping and learning in difficult times

Experiencing challenging times is part of most humans' lives. However, with time and experience, one can learn how to navigate increasingly difficult situations, which are often opportunities for growth.

"In battle, in forest, at the precipice in the mountains,
On the dark great sea, in the midst of javelins and arrows,
In sleep, in confusion, in the depths of shame,
The good deeds a man has done before defend him."

— Subhaashita Trishate by Bhartrihari, translated by J. Robert Oppenheimer

9.5 Practices

- Meditation. (Do it carefully. See an introduction by Matthieu Ricard.):
  - A definition: Meditation is a practice in which an individual uses a technique to train attention and awareness and achieve a mentally clear, emotionally calm and stable state
  - Doing meditation is profoundly easy, and in its basic form, it is nothing else than getting familiar with your inner workings by being patient and accepting observation. For example, you sit down for 10-15 minutes and observe your mind and body without any specific aim.
  - Single meditation sessions will probably not make any difference, but daily cultivation can gradually affect your mind and even your body and brain. Similarly, how teeth brushing works.
  - For more detailed basic instructions see this guide
  - A word of caution: meditation (or getting more conscientious about your body and mind) is not a feelgood exercise only, and if you have unresolved conflicts, they can come up, and if you have rigid believes about reality and your self they can be altered. Go gradually, and ask for help if you feel too uneasy in a situation.
  - I found the course and presentation of Jon Kabat-Zinn teaching Mindfulness and Meditation worthy of mentioning (however it is tuned to a "Wester", or more precisely USA audience).
- Cold exposure:
  - Also known as the Wim Hof method these days. See a summary about the matter

- Another related book is Winter Swimming by Susanna Søberg

- Yoga/Pilates:
  - ZoeYoga Beginner - intermediate (Hungarian)
  - Leigha Butler all levels
  - Light on Yoga by B.K.S. Iyengar
  - 15 of the best free Pilates classes
  - Pilates for Men

9.5.1 Sports

- Karate:
  - Magyar Karate Szövetség
  - karate links

9.6 Getting Things Done

"Perfect is the enemy of good."

— Voltaire

This is an area where I personally struggle a lot. In my view, there are multiple styles of how different people get things done, and I can not claim that one is better than the other. A few simple techniques that worked (for me or someone I know personally):

- Make it interesting and enjoyable: there is an art to find the interesting aspects of any task. When I had to study a "boring" subject, I first read some background and tried to find something that was somehow connected to things I considered interesting. In this way, I was able to build up a narrative in which the given task becomes interesting and/or important, and I used this motivation to go through the material.

- Write a list: we often need to do multiple tasks a day/week/month. It can help to allocate a separate time to write down our tasks on paper (or into a dedicated app such as Notion, Trello or Google Calendar), acting as our own manager (prioritizing what is important in the long run, against what is rewarding in the short term), and then in a separate regime execute the tasks.

- Avoiding procrastination: the online environment is full of first-class procrastination materials. I advise cultivating time to time, days, and weeks when you don't stimulate your brain with specific content. This can be social media, YouTube, or any other activity which seems to consume an uncontrollable amount of time and attention. This is good only for developing a consciousness of addictive patterns. What is maybe more important is to invent some working norms and self-regulations, for example: limit some activities to certain periods of the day, set time limits, invent "rituals", for instance, to start working or when you go to sleep, etc.

- Brake down the problems: try to break down all big problems into smaller manageable pieces.

- Start it: as the quotation says, "Perfect is the enemy of good". If there is something important on your list or in your mind, but you are postponing because you don't think it will be good enough or want to do a "perfect" job, then my sincere advice is to start doing it instead of postponing. (Most often, you are learning while working on the given task, and you will nearly always find flaws in your previous work later (and if you think about it as a good thing, it means you are improving).)

- Don't be afraid of failing: "better to have tried and failed than to have never tried at all."

9.7 Success

"It is not often that a man can make opportunities for himself. But he can put himself in such shape that when or if the opportunities come he is ready."

— Theodore Roosevelt

Success is subjective, and there is no ready-made recipe to achieve "it".

"There is only one success – to be able to spend your life in your own way."

— Christopher Morley

- Grit seems to be important in multiple domains
  - Growth Mindset is a closely related concept. (However, it can depend strongly on institutional circumstances.)
- A father's letter to his kid: The 9 money and life lessons most people learn too late in life

9.8 Meaning of life

"Life is like music for its own sake. We are living in an eternal now, and when we listen to music we are not listening to the past, we are not listening to the future, we are listening to an expanded present."

— Alan Watts Life as Music

"Follow your bliss"

— Joseph Campbell

"We are the cosmos made conscious and life is the means by which the universe understands itself."

— Brian Cox (and many others including Alan Watts)

"I've told thee, man, strive and trust! "

— Imre Madách, The tragedy of man

The philosophy of Kurzgesagt: Optimistic Nihilism
Friedrich Nietzsche: The story of the camel, the lion, and the child

9.9 Rules, Paths, Advice

There is no ultimate rule book for life[10]. Every list will only grasp a small fraction of the complexity of existence. To show different flavours and the inconsistent nature of rules, I listed some popular/interesting ones together.

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[10]However, people wrote and read maxims and wisdom literature from about 2375 to 2350 BC. The oldest text known at the time of writing is The Maxims of Ptahhotep, which shows how important cultural context is in the case of giving appropriate advice.

9.9.1 The Noble Eightfold Path

1. Right understanding (Samma ditthi)

2. Right thought (Samma sankappa)

3. Right speech (Samma vaca)

4. Right action (Samma kammanta)

5. Right livelihood (Samma ajiva)

6. Right effort (Samma vayama)

7. Right mindfulness (Samma sati)

8. Right concentration (Samma samadhi)

The Buddhist tradition is 2500 years old and counting. Because of that, I believe it needs some context. I suggest Secular Buddhism lecture by Stephen Batchelor. (Right understanding traditionally refers to accepting reincarnation. However, the process seems to work "only" by accepting the rule of cause and effect and the non-absolute status of our own ego.) To have a broader historical view of the Buddha and Buddhism, I suggest this documentary.

9.9.2 Discipline

1. Stand up straight with your shoulders back

2. Treat yourself like you are someone you are responsible for helping

3. Make friends with people who want the best for you

4. Compare yourself with who you were yesterday, not with who someone else is today

5. Do not let your children do anything that makes you dislike them

6. Set your house in perfect order before you criticize the world

7. Pursue what is meaningful (not what is expedient)

8. Tell the truth — or, at least, don't lie

9. Assume that the person you are listening to might know something you don't

10. Be precise in your speech

11. Do not bother children when they are skate-boarding

12. Pet a cat when you encounter one on the street

Jordan B. Peterson 12 Rules for Life: An Antidote to Chaos

1. Make your bed

2. Find people to paddle with you

3. Measure the size of heart, not flippers

4. Get over being a sugar cookie and keep moving forward

5. Don't be afraid of the circuses

6. Sometimes you have to slide down obstacles head first

7. Don't back down from the sharks

8. You must be your very best in the darkest moments

9. Start singing when you're up to your neck in mud. Hope for everyone

10. Don't ever, ever ring the bell

Admiral William H. McRaven
See his Commencement Address which is a summary of his book.

Jordan Peterson is a polarising character. However, he and his message became very popular in a short amount of time, possibly reflecting a hunger for similar father figures. Personally, I think discipline and strength are not the single most important skills we need in life, but I mention this school because some people in some stages of their life might need some push in these areas, and they can probably

resonate with this kind of message.[11] My meta advice is to be able to maintain discipline, but don't stop there!

9.9.3   Life & work

1. Earn thy neighbor's love

2. Fight for your highest attainable aim
   But never put up resistance in vain

3. It seems to me that man's ultimate aim in life is to express himself as fully as possible, according to his own light, and to achieve a sense of security

4. Man must work. I think we have to begin by clearly realizing that work is a biological necessity

5. Whether we call our activity exhausting work or relaxing play depends largely upon our own attitude towards it

6. To remain healthy, man must have some goal, some purpose in life that he can respect and be proud to work for

7. Choose carefully between syntoxic [accommodating] and catoxic [confrontative] behaviour in daily life

8. There is no ready-made success formula which would suit everybody

Hans (János) Selye: Stress without Distress (personal selection[12]). In my view, this book and worldview are not for everybody, but there are some who can most easily find their purpose in work and achievements. This book (which I suggest reading in full to get the whole picture) can serve as guidance and confirmation for those who resonate with these few lines. However, keep in mind that the year of publication was 1974, and our scientific understanding changed (for instance, regarding "Adaptation Energy"). Therefore, the recommendations of this book are not unavoidable biological truths but the informed conclusions of the author.

9.9.4   More Rules

1. You don't have to dream

2. Don't seek happiness

3. Remember, it's all Luck

4. Exercise

5. Be Hard on Your Opinions

6. Be a teacher

7. Define yourself by what you love

8. Respect People With Less Power Than You

9. Don't Rush

Tim Minchin.
See his speech and/or read a blogpost about the details.

1. We are imperfect,

2. (True) Friendship,

3. Know your Insanity,

4. Accept your idiocy,

5. Good Enough,

6. Beyond Romanticism,

7. Cheerful despair,

8. Transcend yourself.

The Eight Rules of The School of Life. (See in an animated form.)

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[11]However, I would mention that a similar kind of Christianity-inspired self-help book is not entirely new. Here, I would mention M. Scott Peck and his book The Road Less Traveled.

[12]For another summary see this link.

1. Be adaptive

2. Learn how to deal with failure

3. Be a storyteller

4. Get to know yourself

5. Practice Vipassana meditation

6. Engage with spirituality

7. Study philosophy

8. Read lots of books

9. Develop your social skills

10. Find your mission

11. BONUS - Keep a broad perspective

Collected here from Yuval Noah Harari. Talking to/with young students about The Future of Education

1. Happiness

2. Achievement

3. Significance

4. Legacy

A snippet from Success That Lasts. Further advice can be found in the book: Uncommon Wisdom to Inspire Your Life's Work, which is summarized in the presentation: Building a Life by Howard H. Stevenson. (I want to add, that if one has a dream, and a will to work on it, then it should not be forgotten, even if it is being and actor.)

106 Rules by Richard Templar (or Richard Craze) from his book The Rules of Life. The rules are summarized, for example, here. (The book can be found here for instance, but consider buying it if you find useful.)

9.9.5 One "self help" book

I put this here because based on the the authors summary The Subtle Art of Not Giving a F*ck seems to be actual (in the current (2016) Western world for a middle-upper class reader), and it can embed some core concepts from long-existing philosophical traditions into this context. I don't recommend this for depth, but some concepts can be viewed as a fair first approximation for the complex art of living in our times.

9.9.6 Commencement speeches

- J.K. Rowling

- Steve Jobs

9.9.7 Planning and writing about yourself

"No battle was ever won according to plan, but no battle was ever won without one... Plans are useless, but planning is indispensable. "

— Dwight D. Eisenhower

- YearCompass

- Future Authoring Planner

9.9.8 Motivation

"Gurus ... make fortunes from motivational courses that are both amazing and sinister, but which boil down to an age-old and obvious adage: just get on with it. It's about do or don't do."

So, I think motivational speeches and speakers represent the fast-food version of the mentioned concepts. My advice – being coherent with the opening quote – is to be suspicious of speakers who claim that you can achieve (usually material) success without major failures, crises, and hard work. You will need to learn, and you will learn the most from failures. If you have never failed, then you were not ambitious enough. As you learn and grow (or simply by being in a new environment), your value system will at least partially change. This will most probably induce an existential crisis; it can be painful, but can cause a leap in your growth. If somebody says that you should not experience sadness and gloominess, and you should change yourself to achieve material success, run.

10 Replication manual

I am sure this document will seem partial and biased to many professionals, experts and readers. I am genuinely grateful for feedback, comments and constructive criticism; I will try to correct errors, include trusted materials, and I will consider incorporating feedback in general. However, I won't pretend (and I would not have the capacity to achieve) that this document could be an "authoritative" compilation of learning and mentoring materials at any point. Besides my own limitations, I don't even think that having a central curriculum would be desirable. I firmly believe that the best we can do is to seek knowledge, wisdom and ways to prosperity, but there is no ready-made recipe for any of these.

If, in your opinion, this curriculum is partial and biased, then I invite you to compile your own version. Not for the sake of competition but to enhance diversity and widen the menu for the younger generation to choose from. I hope that honest and accessible compilations of knowledge, experience and life lessons can make society more resilient and students' lives richer.

10.1 Used tools

This document was made by Overleaf, which uses LaTeX. One can find nice tutorials on Overleaf to learn how to use it. The source of the project can be found on:

- Overleaf

- GitHub (main.tex)

- Wayback Machine

10.2 Licensing

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- Share — copy and redistribute the material in any medium or format

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10.3 Instruction

If you write your own document, consider to include a **Replication manual.**

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