**4.6 Education, Training and Knowledge Transfer**

This section sketches a vision of sustainability in education at ETH and other institutions within the ETH domain or the IDEA league. Subsequently, it highlights measures that D-PHYS, or more broadly, ETH can adopt to this end. The overall aim here is to introduce sustainability into education and training in a way that helps individuals in taking sustainability into account when making decisions both in their professional as well as personal lives and as responsible members of society. In view of the particular relevance of this topic, this section has been conceived with strong involvement of student representatives.

**Sustainability in Education**

Sustainability in education has been recognised as a hot topic and is being discussed at the highest university levels. The ETH council is consulting with the student assembly on this matter with concurrent discussions being held at EPFL and other institutions of the ETH domain. Similarly, the homepages of elite institutions world-wide, such as Cambridge or Yale to name just two examples, are announcing ongoing changes to their curricula in this direction.

The reason for this global trend is clear: A central aim of university education is to turn students into responsible members of society, who can solve interdisciplinary local and global problems that define this generation, and simultaneously to prepare them for demanding work environments that require highly specialised knowledge and skills. ETH officially accepts this challenge as part of its mission statement.

Undoubtedly, the foundation is laid during primary and secondary education. And indeed, it could be argued that those are the stages during which environmental consciousness should be cultivated. When moving on to university, students will then specialise in their chosen subject. The traditional point of view at ETH is that you will learn about physics in D-PHYS while environmental topics belong in D-USYS. Yet in practice, this approach leaves many of our students only remotely aware of the necessity and approaches to resolve the dire climate situation for humankind. This, for instance, can be inferred from their inability to even state the central aims of the Paris Agreement or their ignorance of the Sustainable Development Goals “SDGs” (let alone knowing the contents). Universities like ETH Zürich are in an excellent position to fill this knowledge gap and, going further, make sure that students actively engage with the sustainability topic by strengthening the critical thinking approach which ETH Zürich takes pride in.

Importantly, viewing this particular task purely as a clash of priorities and time allocation is a false dichotomy. Much rather, D-PHYS alumni will inevitably be confronted with consequences of the climate crisis in their future careers – be it in technology, science, finance or services. A proper education in this regard will increase their chances of successful work, and incidentally, this will reflect positively on D-PHYS and ETH.

**Situation of D-PHYS**

In the case of D-PHYS we clearly need to rely on an interdisciplinary approach which is supported by ETH Zürich’s belief “that a network of knowledge and skills acquired in an interdisciplinary environment best respond to the natural and cultural interdependencies of life”. It is evident that the scope of D-PHYS is at a much more fundamental level than most scientific aspects with immediate connection to the climate crisis. Correspondingly, we lack concrete first-hand research expertise in this area and we on our own can only inadequately educate our students in this regard. Yet, physics provides the foundation for the earth’s climate, and there is clear demand and a great interest for climate sustainability topics among the present students and young academics. In fact, a curious observation is that among people who actively engage in fighting climate change, many have a solid foundation in physics, or even are physicists by training. This may indicate that physics education is indeed an ideal foundation for understanding nature along with its diverse orientations; perhaps this correlation is related to our deeply rooted understanding that violating the laws of nature is simply not an option.

Yet, it is also clear that education is a long-term investment while the challenges of the climate crisis are becoming imminent. If our efforts in education shall have an effect in tackling the latter, they need to be enacted as soon as possible. Hence we need to deal with the situation with the means presently available to us.

**Continued Training and Knowledge Transfer**

The university environment lives and thrives on academic exchange through an array of research seminars and colloquium talks. The academic community needs to be up to date with the latest developments in their field, but as scientists we are also very interested in interdisciplinary talks in order to understand better the bigger picture and to update our perspective on it. And also the non-scientific members benefit from inspiring presentations, and the knowledge they gain can come to good use in their work. Likewise, when we encounter challenges in aspects of our work that do not immediately concern our own research, be it administration, leadership or teaching, we typically resort to asking scientific experts of these topics for their research results, experience and advice. It is thus natural to make use of scientific exchange resources in subjects of sustainability and the climate, both as an interdisciplinary effort and towards making informed decisions in our professional life.

**References**

* ETH mission statement: <https://ethz.ch/mission-statement>
* Cambridge Zero: <https://www.zero.cam.ac.uk> (information on changes to curriculum at the bottom of the page)
* Yale: <https://sustainability.yale.edu/academics-research>
* ETH critical thinking: <https://ethz.ch/critical-thinking>
* <https://en.wikipedia.org/wiki/Sustainable_Development_Goals>
* <https://sustainabledevelopment.un.org>

**4.6.A High-Profile Colloquium Talks on Sustainability Topics**

Establish a high-profile talk by a renowned researcher (external or internal) on a key sustainability topic aimed at all ETH members (employees, students) to be held once per semester.

Comments

* This could have a serious impact if supported, implemented and advertised by the ETH school board as an ETH-wide activity.
* This is not reasonably implementable at D-PHYS; the idea has been communicated to ETH sustainability office.
* An existing format is the ETH lecture series “Pioneers in Sustainability” which however is not widely known or advertised: <https://ethz.ch/en/the-eth-zurich/sustainability/dialog/pioneers-in-sustainability.html>
* Encourage discussion of the presented material by following the talk up with an informal apéro.
* This may draw students’ attention to job opportunities with aspects of sustainability.
* This has a natural outreach component, it will encourage discussions among ETH members and will strengthen overall ETH sustainability efforts.
* Until then (or in addition), D-PHYS may reserve one slot of the “Zurich Physics Colloquium” per semester to a topic in an area of sustainability intersecting with physics.

**4.6.B Teaching of Climate Crisis Basics**

Ensure that future D-PHYS alumni (or more generally ETH alumni) will possess a basic knowledge of aspects of the climate crisis, e.g. by establishing a lecture course on this topic.

Comments

* Contents of the anticipated lecture course include but are not limited to the keywords:
  + Sustainable Development Goals (SDGs)
  + Paris Agreement
  + scope 1, 2, 3 emissions
  + national and international policies and standards
  + relevant mechanisms of society, economy, politics
* Further working knowledge could be acquired in a dedicated living labs project, see below suggestion on PRISMA course.
* This suggestion is not specific to D-PHYS; furthermore, the potential supply and expertise of lecturers at D-PHYS for such a course is low; the idea has been communicated to ETH sustainability office.
* An interdisciplinary course could be delivered by some expert department in the form of a MOOC to all ETH students of a given level.
* Alternatively, we may resort to external MOOCs (see below) and encourage students to participate in them. External MOOCs may also serve as a resource for students with a deeper interest in sustainability.
* In order to expedite the establishment of such a course at ETH level, it would be useful to actively signal a demand and to indicate how to incorporate it into the physics curriculum.
* Communicate the course explicitly as a low-intensity course that provides bites of information with significant societal relevance (and thus is perceived as a refreshing moment in a high-intensity weekly schedule). Make sure to shield students from additional time pressure.

**References**

* TU Delft sustainability, educational resources: <https://www.tudelft.nl/en/sustainability/education/>
* Sample MOOC: <https://www.tudelft.nl/en/sustainability/circular-economy-an-introduction/>

**4.6.C Introduce PRISMA at D-PHYS**

Introduce PRISMA as an elective course in the Physics Bachelor degree.

Description

* Pilot project launched by VSETH students (Medea Fuchs, Patrick Althaus); funded by Innovedum; currently based at chair of Prof. Stefano Brusconi (MTEC).
* Aims to make critical thinking at ETH more hands-on and engaging by providing a one semester course during which small teams of Bachelor students solve a real-world problem
* Each semester is dedicated to one particular SDG, e.g. SDG 11.
* Sustainable Cities and Communities in HS20; cooperation with Zurich Smart City Lab).
* Each team is coached by a Master student.
* Will provide students with the opportunity of carrying out a living lab project that solves a sustainability issue in their local environment.
* Will consolidate facts learnt in the lecture course and understand the relevance of these facts by seeing them in a real-world context.

Comments

* This interdisciplinary course has already been accepted as elective course by 10 other departments, including D-MATH, D-INFK and D-ARCH.
* The course fits well with increased flexibility during the 3rd bachelor year achieved by the concurrent bachelor reform.
* This suggestion clearly requires further discussion with the teaching committee at D-PHYS.
* Master and doctoral students serving as coaches will benefit in various ways:
  + Within the PRISMA course, each team of Bachelor students is led by a Master student.
  + In preparation, PRISMA offers coaching training for these master students based on techniques used in the high-profile ETH week.
  + PRISMA coaching would go even further and help master and doctoral students to acquire strong communication, teaching and team-leading skills.

**4.6.D Credit Points**

Courses with sustainability/climate context are made creditable towards physics bachelor/master degrees.

Comments

* The department may ensure that the rules governing the crediting of courses in humanities and social sciences equally apply to non-physics courses with topics in climate and sustainability. This would naturally include the previously mentioned courses.
* The department may decide on the implementation of a minimum number of credit points in the physics bachelor/master from sustainability topics (requires coordination with the teaching committee at D-PHYS).
* Correspondingly, the learning goals for our degrees may explicitly mention a basic understanding of climate and sustainability as a relevant skill.
* The department may make some relevant internal/external MOOCs creditable.
* Actively encourage enrolment for these courses by highlighting them in the course catalogue and by advertising them, for example, during the introductory lectures at the start of the first semester.
* Creating a demand for such courses will lead to broader availability.

**4.6.E Sprinkle Sustainability**

Sprinkle aspects of sustainability in established lecture courses, homework exercises including data analysis and programming, student seminars and lab experiments.

Comments

* Include homework exercises or examples using data from climate change research in new “Data Analysis” course in 1st year of Physics Bachelor.
* The physics lab courses may dedicate some experiments to topics with connections to sustainability. A natural point of introduction would be a general revision of experiments such as the present one which has been initiated in response to the coronavirus pandemic. We could attempt to solicit advice from D-USYS, e.g. Prof. Reto Knutti.
* In order to advertise sustainability and reinforce awareness, the SSC could develop a collection of micro-presentations on topics of sustainability (with potential connections to physics) to be delivered by SSC students within the breaks of major physics lectures.
* Illustrate links to sustainability, where appropriate, in activities not explicitly focused on this topic, potentially in the form of supplementary materials for the benefit of interested students.

**4.6.F Teaching of Sustainability Topics at D-PHYS**

Members of D-PHYS offer specialised lecture courses and other educational formats to engage physics students in sustainability topics.

Comments

* Physics within D-PHYS is mostly carried out as fundamental research. Working expertise in applied physics relating to sustainability and the climate crisis is rare within D-PHYS and experts are hosted at other departments.
* Michael Dittmar offers the two-semester specialised course “Energy and Environment in the 21st century”:
  + This is the only lecture course at D-PHYS with a clear connection to sustainability.
  + It attracts between 40 and 60 registrants.
  + The lecturer will retire in early 2021. The department needs to make up its mind whether the course shall be continued, replaced with an alternative content or whether it has to be dropped altogether.
  + Niklas Beisert offers a series of 10-minute presentations “Give the Climate a Break” on the basics on the climate crisis:
  + The presentations are offered to interested students during the breaks of selected lecture courses of the physics curriculum. The format has been introduced within “Quantum Field Theory” in HS19 and an iteration is planned for “Allgemeine Mechanik” in HS20.
  + The format provides long-term exposure to the topic and a broad reach with minimal investment on the student side.
  + This format can also involve representation by various ETH institutions involved in sustainability such as SSC, ETH sustainability, as well as presentations by highly committed students.
* The department may consider to offer a student (pro)seminar on topics from the intersection of physics and sustainability:
  + The contents can be designed in collaboration with participating students.
  + Doctoral students and postdocs can be involved in the supervision of seminar students.
  + This represents an opportunity to engage in the subject at a professional level and to satisfy the teaching obligations at the same time.
  + The seminar can serve as a first step in establishing a more formalised course.