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communicating SCIENCE

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## Declaration on the Future of Science Communication

Science communication[1] for action and engagement – a proposal developed by the participants of the International Summer School "Communicating Science" 2021 in Berlin.

*This document was developed in five days by 50 young researchers from 26 countries. It offers recommendations for the future of science communication. In seven working groups, the participants came up with ideas of how to empower young researchers to communicate science and research. The document reflects the current state of ongoing discussions and aims to stimulate further exchange on the issue in society, politics and academia.*

*The declaration is the outcome of the Summer School "Communicating Science", a project funded by the Federal Ministry of Education and Research (Germany) and organized by the Alexander von Humboldt Foundation and Wissenschaft im Dialog.*

1 We use science communication and research communication interchangeably in this document. Both terms refer to the communication of biological, natural and social sciences as well as humanities research.

## KEY OBSERVATIONS

The current **infodemic**[2] requires high-quality science communication to cut through the white noise.

Good science communication (SciComm)[3] fosters **dialogue** between scientists and diverse audiences, increases **scientific literacy**, promotes public **trust in science**, and strengthens **decision-making** processes on all levels.

Good science communication is **multifaceted** and entails communication about the methods and processes that lead to scientific knowledge as well as information on the working conditions and journeys of the researchers involved.

A crucial task of science communication is to **build bridges between disciplines** and foster communication between researchers in different fields (from natural sciences to humanities & social sciences) and diverse audiences.

If we **encourage creativity** in the choice of modes and formats in research communication, we pave the way for more inclusive and accessible ways of establishing knowledge transfer/production channels.

**Diversity** in science communication adds value for both communicators and dialogue partners and should be seen as **an integral aspect** of science communication.

We need to **strengthen, extend, and advertise existing SciComm initiatives** and programmes.

High-quality science communication can only be realised through **adequate funding and support**.

2 According to the WHO an infodemic describes the state of "too much information including false or misleading information in digital and physical environments during a disease outbreak. It causes confusion and risk-taking behaviours that can harm health. It also leads to mistrust in health authorities and undermines the public health response." (WHO Website, "Infodemic", n.d.) For further information see the WHO Situation Report 13, 2020.

3 In the following we will also refer to science communication as SciComm.

## KEY ACTIONS & RECOMMENDATIONS

### Funding

- Ensure **dedicated allocation** of a part of research grant money for SciComm.
- Make SciComm mandatory as an **assessment criterion in major grant proposals**.
- Create **new researcher-communicator positions** where involvement in SciComm is a dedicated part of either a researcher's job profile alongside their research work or a separate position dedicated solely to the purpose of communicating science.
- **Introduce public-private collaborative funding plans** that include major stakeholders.

### Training

- Integrate accredited, internationally recognised science communication training programmes into all stages of research training.
- Encourage experienced communicators to cooperate with universities, research organisations, government and funding institutions to offer guidance on improving the quality of science communication training.
- **Make training programmes and offers more visible and more accessible.**

### Quality

- Establish **easily recognisable quality standards to increase public trust in SciComm**.
- **Embed** science communication in the existing research paper **publication process**.
- Move towards more **research- and evidence-based science communication**, grounded in established methods and standards to meet public needs more effectively.

### Creative Formats

- Establish a **collaborative network** of scientists interested and/or active in science communication.
- Encourage new scientific formats that complement conventional

ways of producing and presenting long term projects (such as PhD research projects).

- **Enable partnerships and collaborations** amongst artists, researchers, and institutions.
- Foster collaboration with science journalism and find new approaches to make use of spaces in established media to disseminate scientific knowledge.

### Interdisciplinarity

- Initiate an **Erasmus-type programme for interdisciplinary exchange** amongst early career researchers.
- Focus on communicating the **methods of scientific research** to bring researchers together and to improve science communication.

### Diversity

- **Strengthen and extend international networks** in science and research communication.
- Increase diversity in science and amongst science communicators **with appropriate institutional support**.
- Enable more cooperation with experts in **communication, marketing and branding**.
- Establish communication in a **plurality of languages**.
- Ensure **true open access** for publications and data for all nations and institutions.
- **Focus on accessibility** for all abilities.

### Culture Change

- Create working conditions for researchers that enable and support them in communication efforts.
- Implement a multi-stakeholder **communication department in every university** and research institute comprising researchers, communicators and Public Relation experts **to help researchers find the resources** to disseminate their research.
- Promote a change of attitude by including **science communication talks in regular events** such as workshops, colloquiums and keynotes.

**Date: 9 September 2021, Berlin**
**The following participants of the Summer School "Communicating Science" endorse the executive summary of the joint proposal:**

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# FUNDING


## Abstract

Funding has always been a limiting factor for research and its associated fields. Although short-term science communication fellowships exist, they are not adequate to create employment opportunities, nor to fight the 'infodemic' that the world is currently facing. Here we outline the current state of funding in science communication and highlight areas that require improvement. We also suggest innovative approaches such as introducing dual researcher-communicator positions or dedicated science communication positions, and improving the influx of private funding for fellowships. We recommend to

- create new fellowships for science communication through collaborations between the public sector and private stakeholders that work closely with the research landscape.
- increase budget allocation for SciComm in existing research projects to 15-20% and making science communication a grant criterion.
- introduce dual, full-time researcher-communicator positions at research institutes where researchers are employed to undertake science communication activities in addition to their research projects (within the scope of their paid contracts – going beyond existing models where communication is frequently an unpaid addition).
- empower organisations like the Science Media Centres that exist in some countries to improve accuracy in journalistic pieces through increased funding. Additionally, funding for emergency task forces worldwide to allow researchers to conduct rapid, on-site fact-checking in crisis situations where scientific evidence and science-media cooperation is needed to inform the public and legislators.


## Background / Description of the Current Situation

The aim of this section is to highlight some ideas on how to provide adequate funding for research and science communication. In a

context of growing societal challenges, we believe that science and research communication can complement the efforts of scientists and researchers without competing for existing funds specifically earmarked for research. Hence, it is important to reflect on additional funding options by involving more stakeholders, coordinating their efforts, and using the funds in an efficient manner.

We have identified several initiatives that could serve as blueprints for a coherent funding strategy for science and research communication. These range from short-term fellowships and funding for science communication events and projects, such as the "European researchers' night", to dedicated funding within grants that have outreach requirements. For instance, the European Commission funding schemes (Horizon 2020, ERC and MSCA) require open access (Horizon, 2020, article 29) and science communication to the public (ibid., article 38.1). The "NWA Science Communication" from the Dutch Research Council finances projects that strengthen the connection between science and society up to a maximum of €150,000 per project. Additionally, there is increasing interest from the private sector in investing in science communication. One successful example is the VolkswagenStiftung's Science Communication and Knowledge Transfer grant. To encourage researchers involved in science communication of outstanding quality, prizes exist, such as the annual Science Communication Prize for science writing awarded by the European Commission.

However, there is a lack of PhD and postdoctoral fellowships that focus on research and science communication. Also, many research grants still do not allocate a specific portion for public engagement purposes, nor is science communication one of the grant review criteria (although that might differ according to disciplines and countries). Within Germany, initiatives are usually isolated with no effective coordination or monitoring. They are still considered separate from public relations efforts and their impact is not assessed adequately. Although universities and institutes have paid positions in communication and outreach and even though, in recent years, many former researchers/science journalists have moved to press offices and are responsible for "communication and outreach", these jobs are often

occupied by education and/or communication specialists with limited involvement of researchers themselves. This leads to researchers being overburdened with an additional unpaid workload.

## Recommendations

### Creation of public and private sector collaborative funds for SciComm

We recommend the creation of competitive research communication fellowships with appropriate funding dedicated to the dissemination of scientific activities. These fellowships could be funded on a European level by the EU institutions.

On a national level, there could be cooperation between the national ministries of research and private corporations. Such cooperation could take the shape of a joint fund. Stakeholders that are close to the research landscape, such as publishers and industries with sizable research and development units, could be approached to contribute to the fund. It could also involve the sharing of experience in funding science communication, for example by replicating the existing schemes of the Humboldt Foundation or the VolkswagenStiftung.

On a local level, universities and research institutes could access the fund to disseminate knowledge amongst hard to reach communities. This would enable them to tailor the scientific message to local needs.

### New dual research-communication positions

We recommend the creation of a researcher position with the dual purpose of conducting research in a specialised field and communicating it. Those holding these positions would facilitate communication for distinct departments in research institutes whilst staying active within their field of study. Researcher-communicator positions would be either created within institutes or would be included in research proposals.

### Increase budget allocation for research communication

We suggest that the inclusion of a public engagement plan be man-

datory for every project funding application. Science communication should constitute 15-20% of the total budget of each project, depending on the field of research. In addition to the increase in financial resources, this will have the effect of boosting SciComm departments in research institutes and establishing SciComm as a systematic step in the research process. The responsibility to set and enforce quality and result requirements for research communication sections would be incumbent on the funding agencies reviewing these projects.

**Funding for science-media cooperation and emergency research fund**

We recommend enhancing reliable and easily identifiable platforms providing evidence-based facts to prevent the spread of misinformation and confusion in case of high-impact scientific events. The recent pandemic has particularly demonstrated that objective scientific facts must be easily accessible to media and political actors. In several countries, Science Media Centres that facilitate cooperation between researchers and journalists are an existing institutionalised approach to this issue. We recommend that public institutions and government bodies provide further financial support to these initiatives to increase their visibility and make them a go-to source for all media and political actors. As an extension to the current structure, we also suggest creating a task force of scientific experts able to travel and conduct independent scientific investigations (much like science correspondents) on sites where reliable information cannot be obtained otherwise. The task force would collect data and find effective and reliable ways to inform the public and legislators in times of (global) crises.

# TRAINING


## Abstract

The recent concept of science communication as a tool for the dissemination of research findings that is beneficial for scientists and for society has raised several concerns about the viability of its application. One of the most relevant aspects hindering the development of SciComm is the lack of training that scientists receive during the course of their studies. This section addresses the current situation in terms of training at European universities and presents a proposal on how SciComm should be implemented in Bachelor's and postgraduate courses. There are currently several science communication courses all over Europe, including BSc and MSc programmes, as well as courses that are part of PhD programmes, which indicate the relevance that this topic has gained at science institutions. However, it represents a small percentage compared to all the institutions that do not have any programmes or courses directed to communicating science. That is why we present an approach in which science communication should be addressed by universities and research institutions. It is composed of three levels, starting with the concepts and tools necessary to plan a strategy for the dissemination of science and research, through interdisciplinary workshops and practical exercises, and finishing with the development of a communication project for their own research at the highest level.


## Background / Description of the Current Situation

Public awareness and interest in SciComm have increased and the researchers who engage in public understanding of science have received massive attention. Examples such as Christian Drosten talking in a podcast (Coronavirus-Update) or Mai Nyugen Kim (MaiLab) broadcasting videos on YouTube, both on a regular basis, are indicative of a shift in public perception of SciComm in Germany. The different formats show that more stages have been built for researchers to communicate their work, but many have not been trained specifically in the field of SciComm. The emerging discipline of SciComm may not yet be well equipped to offer sufficient training for current and upcoming generations of scientists from multi- and interdisciplinary fields.

Nonetheless, there are good examples in which training in SciComm is taken seriously and efforts are made to cultivate educational structures. Imperial College London (UK), where this subject has been taught since the early 1990s, is one of the pioneers in postgraduate education in SciComm. Currently, it offers the MSc programme "Science Communication" at the Centre for Languages, Culture and Communication. There are other good practice examples of universities offering whole Bachelor's and Master's programmes solely dedicated to SciComm, e.g., the BSc/MSc in "Science Media Communication" at the Department of Science Communication at Karlsruhe Institute of Technology (Germany), the Master's in Comunicazione della Scienza "Franco Prattico" (Master of science communication - Franco Prattico) at the International School for Advanced Studies of Trieste, or the BSc in "Communication Science" at the University of Amsterdam (The Netherlands). Apart from dedicated university programmes, young scientists are encouraged to engage in SciComm training as part of their PhD/GradSchool curriculum, e.g., at the Humboldt Graduate School at Humboldt-Universität zu Berlin (Germany) or the Potsdam Graduate School at the University of Potsdam (Germany). For example, GradSchool students in Sweden are asked to write a popular summary of their thesis which is published on the universities' webpages. Apart from that, existing institutes dedicated to SciComm (e.g., the European Science Communication Institute) offer workshops to a broad range of participants, although their visibility amongst young scientists is limited.

However, the topic of training in SciComm deserves more attention as it is facing several challenges:

- The awareness of SciComm amongst young scientists is still not developed well and young scientists often actively have to engage in SciComm training at advanced stages of their careers.
- Many universities do not offer training in SciComm, often due to a lack of funding and trained staff or challenges in implementing SciComm programmes.
- The quality of SciComm is often not the focus of attention, which is key to precise and effective communication.

**Our vision** is to raise awareness of the importance of SciComm amongst students at an early stage and to enable young scientists to receive high quality SciComm training which is multi-facetted, interdisciplinary, easily accessible and results in communication that is effective and precise.

## Recommendations

In order to achieve the desired goals in SciComm training we therefore suggest the following changes:

- SciComm courses should be organised and offered to students at all stages (Bachelor's to PhD).
- Universities and institutions need to make SciComm courses, training and programmes more visible (e.g., more posters, announcements on the website and social media) to engage young scientists at an early stage of their career and to advertise these resources to scientists at all career stages.
- To ensure good quality scientific training, an interdisciplinary model is envisioned. For example, experienced communicators should cooperate with the university as well as experts from communication research and public outreach.
- SciComm career options should be more visible for young professionals and should be recognised and valued by academia, the research community and the general public.

A detailed model of how SciComm could be integrated at all stages of university education can be found in the supplementary section.

### Actors implementing the vision

The change in SciComm training requires several stakeholders. Here, we categorise them in three groups:

1. Governmental institutions: The ministries of research and economic affairs should collaborate in order to provide structured and funded SciComm training programmes.

2. Universities and academic institutions: Increasing the visibility of SciComm courses (posters, newsletters, social media) and fostering collaboration amongst experts in SciComm, academic staff and non-university science communication organisations (e.g., Wissenschaft im Dialog) is key. Universities should implement more access to different courses/workshops on SciComm to all students (from Bachelor's to doctoral studies). Students' committees/associations could be involved in helping to organise workshops and seminars.
3. Professionals (science communicators, public outreach professionals, media and art professionals, journalists, etc.) may take part in the courses organised at the university.

## Supplementary Section

A standardised, internationally recognised certificate system after finishing SciComm courses is proposed. In the following section, we will describe three levels of certification from Bachelor's to doctoral levels:

### Bachelor's

We suggest that a science communication course "Introduction to Science Communication" should be available at that level, but elective, so that any students interested have the opportunity to join. It should be offered in all tracks (natural sciences, social sciences, medical sciences and the humanities) and the course should be conducted in an interdisciplinary and international environment. The course should be awarded ECTS points, but no grades. The course should offer an overview of the principal aspects of science communication, focusing on the profile of the participating science communicators, highlighting their relevance for science and the career prospects for science communicators. The course should also provide all possible methods of science communication and a methodology to identify the target audience.

### Master's

As only a limited percentage of Master's students will have access to doctoral education, whilst others will subsequently move to jobs (including research and research-based jobs) outside academia, it is

important to integrate science communication into their training. For this reason, we recommend that SciComm courses should be compulsory. The students may choose and complete either the **Introductory** or the **Intermediate Course in Science Communication**. The courses will not be graded but will lead to a certificate as a bonus on CVs and PhD applications. The intermediate course should be more practical, so we propose a workshop where all the concepts of the introductory course are applied. There should be practical exercises where different methods of science communication are used to connect with diverse types of target audiences.

### Doctoral studies

Students will be involved in a more specific science communication course, linked to their field of research. The educators are: i) experienced science communicators, ii) experts, who are informed about the current situation, roles and aims of SciComm, and iii) people working at the Science Public Relations Department. In this part of the course it is important to apply the concepts and practical activities to their own research. To obtain the certificate for the highest level of science communication education it will be necessary to present a science communication project where one of the methods studied is used for disseminating one‘s own research. The strategy for science communication must be presented in a report, identifying goals, targets groups, activities, etc. The project could be presented directly to a sample audience and receive instant feedback on the perception they have of the chosen communication method.

## QUALITY AND PURPOSE

### Background / Description of the Current Situation

More and more sources of information challenge us both individually and as a society. Opinion and decision-making processes are disturbed by information noise, and populist movements are gaining strength. Science and society face a new challenge. Science can no longer rely on being recognised as trustworthy by default. Society can no longer rely on accessible information being reliable and trustworthy.

Science and society can master this challenge together. It is going to be a communication challenge.

### Why Science Communication?

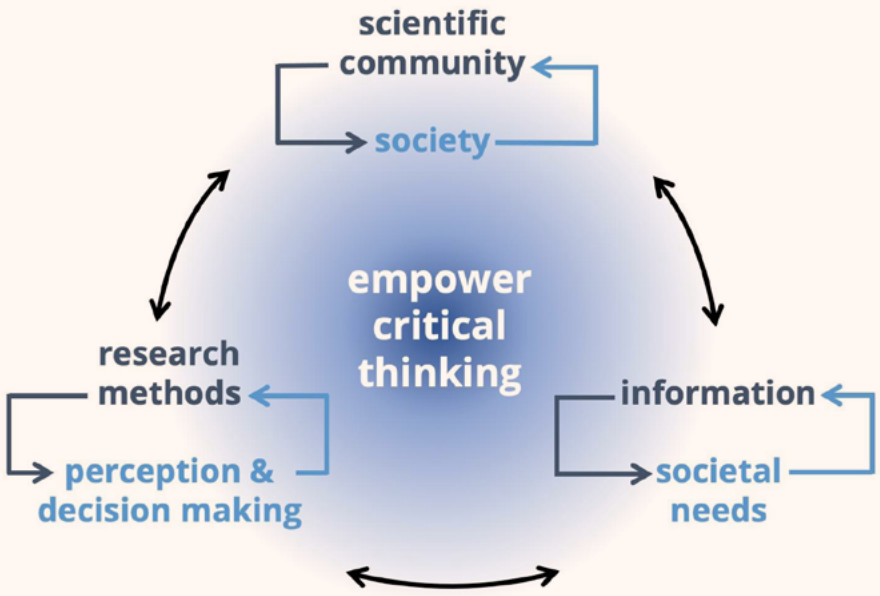


Figure 1: The fundamental components of empowering critical thinking across society (light blue) and the scientific community (dark blue)

A key purpose of science communication is to empower critical thinking both in the scientific community and general public. This encompasses increasing scientific literacy (“the ability to engage with science-related issues, and with the ideas of science, as a reflective

citizen", OECD PISA, 2017) amongst the public and encouraging societal input in the research process. It is crucial to see science communication as an opportunity for creating a dialogue with the public and furthering mutual understanding. An honest exchange of ideas will not only help increase public trust in researchers and the research process but can also be crucial in fostering collaborative research decisions.

It is important to not only focus on communicating specific results but also to explain the methods and processes that lead to those results as well as information about the working conditions and journeys of the people involved (e.g., Humans of Ligo, Faces of OzGrav amongst others). A culture of communication that includes all of these elements can lead to more public trust in research as well as in researchers. Good science communication (see Figure 2) will hopefully lead to an informed, skilled and scientifically literate public that will be empowered to think critically and make informed decisions about all parts of their lives. Importantly, it can distinguish flawed reporting or incorrect information from rigorous research and reliable content. Similarly, researchers benefit extensively from societal input into their research which can extend resources, enhance impact, increase real-world relevance, and improve their work efficiency.

| | **Scientific Community & Society** | **Information & Societal Needs** | **Research Methods & Perception and Decision Making** |
|---|---|---|---|
| **DOs** | diversify the target groups/include minority groups<br>communicate the (research) process openly and freely<br>discuss the funding sources and motivations clearly | spark interest<br>communicate in a transparent and goal-oriented way<br>make the content understandable for the target group<br>focus on accuracy<br>be evidence based | disseminate good scientific practice<br>communicate the limits and challenges of the research topic<br>discuss honestly |
| **DON'Ts** | be condescending | foster sensationalism<br>oversimplify<br>use jargon<br>indulge in hyperbole | hide problems/ limitations<br>be too complex |

Figure 2: A non-conclusive list of good science communication criteria

## Recommendations

### Specific ideas on how to implement quality control in science communication:

**Develop a validation system** that provides a "peer-review" quality assurance mark for qualified scientists / science communicators on social media platforms – e.g., scientists could apply to an organisation evaluating science communication to receive a "blue star" next to their name on Twitter. This could distinguish them as a trustworthy source and provide an easily recognised mark of quality for the general public to increase trust in the source of information. However, we need to make sure that the validation process is clear and transparent to avoid an elitist view of scientists as the only correct source of information and to prevent harm being done by pseudoscientists. The organisation evaluating science communication would comprise a diverse body of scientists, professional communicators and representatives of the target group for each communication. This body could be part of or linked to the International Society for Science Communicators. In Germany, there is a similar initiative already in place for fact-checking on Facebook (Correctiv.org, 2018), although not focusing specifically on science communication.

**Develop an evaluation system** for the accuracy and integrity of published science communication content and provide quantitative evaluations for information distribution platforms (e.g., Facebook, Twitter, YouTube, others) to use in their algorithmic determination of content distribution. So far, social media platforms are refusing to share or adapt their algorithms, e.g., banning a researcher working on ad transparency and misinformation on Facebook (Vincent, 2021). To be able to address the spread of misinformation, this needs to change. An effective evaluation system can facilitate and incentivise companies and governments to incorporate content *quality* as a factor in digital distribution. One or more organisations consisting of diverse bodies of scientists and professional communicators would evaluate published content and ascribe a qualitative rating (e.g., 1-10), evaluating accuracy and integrity of the content. This rating would be made publicly available and be usable by content providers/distributors in their platforms.

It could be an idea to **embed science communication in the existing research paper submission and peer review process as well as in public funding selection and evaluation criteria** or at least to promote their SciComm efforts - e.g., make it mandatory to submit some form of science communication as part of every research paper submission (just as, e.g., graphical abstracts are required for the Journal of Fluid Mechanics, Taylor & Francis cartoon abstracts, New Journal of Physics, etc.). This would be peer reviewed as part of the overall paper submission and feedback would be included as part of the reviewers' comments. To make this most effective a science communication expert and a non-scientist should be included as reviewers of the science communication content. Public funding should contain more stringent requirements for accessible science communication, both at the selection and later evaluation stages. Part of the funding should be allocated to assess the impact of communication activities carried on during the project.

**Move towards more evidence-based science communication that meets public needs** by making use of current and future research on science communication. It is essential to raise awareness amongst researchers about the available science communication research (see e.g. the International Journal of Science Education) and establish systematic knowledge-transfer to science communication practice. For example, this could be achieved through local workshops in institutions, sessions at conferences, committees for good science communication as part of scientific societies and other science communication activities to inform scientists about best practice in SciComm. In addition, frequent public surveys are needed to gather opinions on what different publics want from science communication and how they perceive science (as done, for example, in the German Science Barometer).

## CREATIVE FORMATS

### Background / Description of the Current Stuation

Recently, we have found ourselves in an environment in which knowledge consumption is increasingly a highly subjective and selective process. In such a landscape, the methods by which research is communicated matter and scientific disciplines are being called upon not only to publish research but also to communicate with the public. With regard to the target audience a range of learning styles and preferences have to be taken into consideration. The medium used for communicating directly influences consumption because certain people opt to watch YouTube videos, for example, whilst others prefer audio, image-based or in-person options. Creative formats for communicating research findings and bringing science to the public must be incorporated to increase the impact of research and expand scientific discourse beyond the realm of library shelves, lectures and articles locked behind paywalls.

Beyond this, we would like to highlight the fact that younger audiences—who often are, and should be, one of the primary targets of science or research communication—move through information formats at a fast pace, with researchers often left trying to keep up. It is also worth noting that high-quality artistic production is vitally important nowadays, since media consumers have usually acquired knowledge that allows them to identify poorly constructed graphs or images. Furthermore, in encouraging creativity in approaching different modes and formats for research communication, we can pave the way for more inclusive and accessible knowledge-producing channels. The *xkcd* webcomic created by Richard Munroe and the podcast RadioLab by WNYC Studios are prime examples of the success such creative approaches can have with both academic and lay audiences. In addition to more artistic perspectives, it is also crucial to provide alternative media content as accessibility options for recipients with sensory disabilities.

### Recommendations

With these motivations in mind, we urge consideration of the following fields for creative potential in research communication:

- Establish a collaborative network that accompanies a research communicator's outreach work.
- Consider alternatives to the conventional ways of producing and defending long term projects such as a PhD research project.
- **Form partnerships and collaborations** between artists, researchers, and institutions.
- Foster collaboration with science journalism and find new approaches to make use of spaces in established media to disseminate scientific knowledge beyond the scope of scientific research outlets.

### Networking

Creative methods for communicating science are not only restricted to fixed formats but rather to the way researchers relate to the community and make other people engage with science and research. So, first of all, we thought about different ways and programmes to get in touch with the community and specifically with young people. Good examples already exist, such as Ring a scientist or Skype a Scientist and the Forschungsbörse in Germany, which aim to create contacts between researchers and students. However, these formats require active searching by the students or teachers, which does not improve the unequal distribution of research communication opportunities and knowledge distribution resulting from demographics and more or less privileged school systems. We therefore suggest the following project proposal to the relevant ministries (in Germany, the Federal Ministry for Education and Research):

### "One researcher, one school, one presentation, one year"

The objective is to establish a partnership between researchers and schools (state-wide, nationwide, international), to enhance the understanding of

- what it means to be a researcher and how science works, as well as
- to gain insights into the specific research topic of the tutor-scientist assigned to the school.

The collaboration will last for one year and should aim to inspire young people to think more about research and its impact on society

(create awareness) and maybe even consider a scientific career (advertisement). We are convinced that a direct dialogue with both an experienced and a young scientist as a role model has a stronger impact on students and creates greater credibility. In addition, assigning one scientist to each school, whether in the town or the countryside, will counteract the concentration of science communication in university cities and those close to research institutions, which are already highly scientific locations. Rather, it will distribute science and research fairly and equally to ALL students by also taking them to remote schools and economically – and systemically – disadvantaged students.

### Consider alternative formats for dissertation publication and defence

Dissertations are almost universally written in traditional text formats. As such, there is untapped potential (especially vis-à-vis research communication) for creative, alternatively-formatted thesis projects. This should include such diverse formats as documentaries, photo exhibitions, art exhibitions, music (even as accompaniment to a defence), video games, etc., but also less common text formats such as poetry. Some successful efforts have been carried out in this area, such as a dissertation from Columbia University published as a graphic novel (*Unflattening,* Sousanis, 2015), which garnered praise for its academic content and for its innovation in the academic field. Furthermore, there are more informal examples of alternative dissertation formats created regularly by initiatives like Dance Your PhD.

Although these non-traditional formats are currently regarded by most institutions as insufficient or even inappropriate as fully-fledged research outputs, increasing the diversity of project and presentation formats in research has the potential to engage and inspire a wider audience whilst still effectively communicating the content of research projects. With alternative formats, there is an increased potential to reach not only outsiders to the field of research, but also communicate across disciplines with other researchers.

As a potential way of achieving this goal, we propose a pilot initiative for alternative dissertation formats. The project would ideally involve a

higher education body that could commit to publishing *all (where possible)* of these theses in alternative form for a certain period of time.

The idea is that traditional thesis formats would still be produced whilst encouraging modified forms and additional outputs. In some cases, traditional dissertations could be by-passed altogether for new project outputs. However, the specific desires and needs of researchers should be honoured.

The researchers involved could be given extra time (such as an extension to their funded time) to work on these alternative formats on their own and/or given the support to collaborate with artists during their research to jointly compose their alternative dissertation output (see the following section). We believe that this pilot project would be instrumental in promoting and exploring the idea of alternative dissertation formats by producing an unprecedented corpus of alternatively-formatted dissertations, by demonstrating the feasibility of creative approaches in academia, and by providing recommendations for future alternatively-formatted dissertation products to come.

### Partnerships and collaborations

The arts and sciences have one very important thing in common: they are usually presented as a solitary endeavour (the romantic genius and the obsessive, isolated scientist) when, in reality, they are a profoundly collaborative process. Thinking about this, and about how to break down the boundaries between arts and research, we propose some approaches to partnership and collaboration.

First, we advocate bringing artists to science and scientists to art. This can be achieved in a number of ways. One approach would entail more artists collaborating on research projects directly. This would mean projects could involve not only the science researchers (e.g., principal investigators, postdocs and PhD candidates, Master's, and Bachelor's students), but also musicians, painters, cartoonists, filmmakers, etc. Although research institutions are already likely to be interested in working with artists, a major obstacle in realising these collaborations is putting these two communities in contact with one another. This

could be achieved through an open call to artists, so that they can apply for a contract within a research project or through the incorporation of artists from the ground up, as an integral part of a research group. Then, they could enter a dialogue with researchers from the beginning, applying their particular skills to enriching the topic at hand and finding new ways to present associated results (and the research process itself) to the public. Another way to go about it is to have particular pairings based on a common interest and creative inclination. So, in this case, it would mean one researcher paired with one artist finding the optimal way to translate and transform a particular researcher's findings into a creative format.

Of course, to achieve this, institutional support is key. So, we would like to have publishing houses and PR departments at universities facilitate these pairings. Some academic journals (like Gastronomica), have open calls for creative submissions that are then published in the journal, next to research articles. There are also institutions that have artists in residence (such as CERN or the Oz-Grav). We would like to see more of this.

Nonetheless, this should also be a mutually beneficial exchange. It is not only a matter of scientists going out to find artists to creatively augment their findings, but also of providing artists with a pathway towards science communication. To this end, we advocate more programmes at art schools that point artists toward the field of science communication as a potential career and source of income.

There are three important and linked groups of actions to significantly improve this aspect:

— Art schools and research departments could provide courses given by artists and experts to researchers, so that they can become acquainted with basic artistic tools, be they digital (Photoshop, Powerpoint, Gimp, Premier, etc.) or analogue (sketching, creative writing or photography). Researchers would benefit from having a better understanding of the process of creative translation.

- Conversely, similar events and courses could be organised for researchers to share their knowledge with art schools and organisations.
- Finally, and perhaps most importantly, courses could be offered directly aimed at improving communication and understanding between researchers and artists as well as facilitating collaboration by providing support in jointly developing projects.

A popular interactive entertainment format, (serious) gaming, or gamification, has significant potential for science communication. The extremely successful simulation video game Kerbal Space Program allows players to design their own space missions to the moon and distant planets. The game enables them to understand fundamental concepts of physics and engineering in addition to eliciting awe of space missions. Other games, like *FoldIt*, solve real protein folding problems using an interactive gaming platform, tapping into the collective power of citizen science.

### Reach

The translation and diversification of knowledge is a stage in itself. Reaching different audiences through a diversity of approaches and formats simultaneously requires considering the process of dissemination and of preliminary networking and scouting activities. Partnering and working with the “fourth estate” (e.g., news media and press) makes sense, as they have already pooled different audiences and segments of the population.

Such a collaboration would also improve the efficacy of any science communication effort and positively influence the scientific mood and engagement of the public. Additionally, providing a stage that is guaranteed to reach a lot of people would also incentivise researchers to create *quality content.*

We propose that the reach of popular traditional media (newspapers, magazines, TV) be used as amplifiers for *deserving, creative* research communication efforts in addition to the role of science journalism as critical observers. Newspapers could provide space for a periodic

(weekly/monthly) special feature dedicated to profiles of scientists, historical background of different research fields, the cutting-edge tools used in research, and opinion pieces pertaining to topics in the natural sciences, social sciences, and humanities. Given the profit-driven business models of media organisations, a financial incentive is necessary. A possible revenue model could involve advertisements for citizen science proposals, calls for recruiting participants for experiments and surveys, and start-ups incubated in collaboration with research institutions.

# INTERDISCIPLINARITY


## Abstract

Boundaries between disciplines should be bridged in order to create multidisciplinary solutions to global crises. We recommend the following:

- especially for scientists, to think beyond their own discipline and remember that scientific methods are used by different research fields, all aiming at a unified knowledge of the world;
- to strengthen and enhance existing SciComm initiatives and programmes; and
- to initiate an **Erasmus-type programme for interdisciplinary exchange**.


## Background / Description of the Current Situation

Our world is currently facing environmental and socio-economic crises (e.g., climate change, pandemics, increased wealth and health disparity), which require multidisciplinary solutions. In order to come up with such solutions, researchers need to understand and collaborate with each other across disciplines (e.g., environmental research, biology, ecology, economics, health sciences, education, psychology), **especially the social sciences and humanities**. Such collaboration will help us understand people and adapt solutions across cultures to ensure the greatest possible impact. With this more holistic approach, we can better inform policy-makers, and strengthen public trust in research.

Science is more than one discipline, it is a **set of methods** to gain knowledge and understand the world, including the people who inhabit and navigate this world. **Science communication** can and must work as the **link** that brings together researchers from different fields and the public (see Kalmár & Stenfert, 2020). To be this link, researchers should engage outside of their field of expertise and communicate in an interconnected manner. By collaboratively reaching out to society and by inviting people to discuss and participate in scientific activities, scientists can more effectively address these issues (Kalmár & Stenfert, 2020).

## Recommendations

**Vision:** Future researchers will be able to communicate and collaborate across disciplines and convey to diverse audiences that research is a **multifaceted human endeavour** that includes research facts, research methods, as well as the history and philosophy of science.

### Changes needed to achieve this vision:

We suggest

- strengthening existing SciComm initiatives and
- initiating a new European programme similar to the Erasmus programme but for interdisciplinary instead of intercultural exchange and
- assessing programmes and initiatives by combining citation network analysis and semantic analysis.

### Strengthen and enhance existing SciComm initiatives and programmes

There are already many SciComm initiatives, but they need to be made more accessible to researchers of different disciplines and to a broader audience. One way to achieve this could be raising awareness of the existing SciComm initiatives* as well as strengthening and extending the existing SciComm networks which should be spear-headed by universities and research institutions.

Interdisciplinary research, currently often only used as a meaningless catchword by many universities and institutions, should be integrated in their mission and vision in a measurable and reportable manner.

Universities and research institutions should build upon and strengthen existing programmes and initiatives that promote interdisciplinarity and communication of research.

Therefore, universities and research institutions should lobby for funding for interdisciplinary SciComm initiatives that bring international researchers together (e.g., the International Summer School “Communicating Science” by Wissenschaft im Dialog and the Alexander von Humboldt Foundation), similarly to specific funding calls for interdisciplinary research (e.g., Leibniz Collaborative Excellence, etc.).

Communication departments should increase the dissemination of information regarding SciComm networks through annual events (e.g., Interdisciplinary Week, Research Communication Week, etc.).

More radically, we propose considering the establishment of a higher education system where students can major in interdisciplinary topics (e.g., Emmett Interdisciplinary Program in Environment and Resources at Stanford University, Interdisciplinary Programs at Carnegie Mellon University). Throughout this programme, students can take courses in multiple disciplines, tackling topics from all angles.

### Initiate an Erasmus programme for interdisciplinary exchange

We propose to create an **Erasmus-type exchange programme for disciplines** instead of (or in combination with) nationalities. Undergraduate students (and possibly Master's and PhD students) could spend a period of time in a department or institute of a different discipline. Since interdisciplinary research highlights the importance of **knowledge integration,** both within a single mind and amongst a team (Wagner et al., 2011), this exchange could **foster identities as well-rounded and transdisciplinary researchers** – just as the original Erasmus programme helped strengthen the identity of young European citizens. Educating and training researchers in methods and frameworks of more than one discipline also opens possibilities for innovation across disciplines which is necessary to solve the global problems of the 21st century.

According to the Erasmus Impact Study (EIS, European Commission, 2014), Erasmus and other mobile students reported higher levels of values and factors considered relevant to employability (e.g., confidence, curiosity, or decisiveness) than non-mobile students. Additionally, 51% of all mobile students and 52% of the Erasmus students "improved their ability to cope with different cultures and approaches, showed more openness to new perspectives, were more decisive, knew their strengths and weaknesses better, were more confident about themselves and increased their competence as problem-solvers" (European Commission, 2014, p. 137). We think it is reasonable to assume that a similar programme focused on a transdisciplinary exchange of skills and knowledge would also have a **positive impact on young researchers**.

The great advantage of launching an Erasmus-type programme for interdisciplinarity is that we can build on existing successful networks and funding mechanisms.

### Assessment of programmes and initiatives

The outcome and impact of these interdisciplinary collaborative programmes and initiatives could be assessed and quantified by combining citation network analysis and semantic analysis in order to explore patterns of relations within and between different scientific fields, as previously done in the literature (e.g., Raimbault, 2019). Furthermore, qualitative methods such as measuring network dynamics could also be used (Wagner et al., 2011).

# DIVERSITY


## Abstract

Diversity amongst science communicators and dialogue partners can improve research and communication and should not be seen as an additional burden. There is an increasing awareness of the need for more diversity amongst science communicators and audiences, but there is still much need for improvement in increasing diversity and supporting communicators from diverse backgrounds.

**Ideas for a better future**

- Increased networking for communicators from developing countries
- Increased diversity in science and amongst science communicators, with appropriate institutional support
- More cooperation with experts in communication, marketing and branding
- Communication in a plurality of languages
- True open access for publications and data for all nations and institutes
- Focus on accessible and inclusive formats

We also suggest several concrete next steps, including an international network in science communication, employing sensitivity readers, and educating and enforcing requirements for accessible formats.


## Background

“By placing equity in the centre of science communication we can develop more inclusive science communication practices.” (Canfield et al., 2020)

In this section, we define diversity as plurality of nationality, ethnic background, gender, sexuality, ability/disability, age, economic background, skin colour, and religious beliefs, amongst other historic and ongoing marginalisations and under-representations.

Diversity in research communication is not an additional burden on an already complex topic, it is an integral aspect of research communication that adds value for both communicators and dialogue partners. Diversity of communicators and partners improves reach and impact, spurs innovative solutions, and results in better communication practices for all involved. Diversity needs to be considered in every aspect and step of science communication, from the original concept of communication onwards.

Given this value statement, we define two aspects of diversity in research communication as an initial framework to identify problems and suggest solutions: diversity of communicators and diversity of dialogue partners.

## Description of the Current Situation

With regard to the diversity of dialogue partners, communication with diverse audiences involves translating complex information into a language and format that participants with other expertise and experience can understand. Access to science and research, scientific engagement, and interest in research itself are constantly increasing – yet there are still communities that are largely neglected and marginalised in these efforts. There is a lack of understanding of the information needs, communication styles, and formats that are appropriate to reach these audiences. With respect to dialogue partners with disabilities, there is a lack of accessible formats, or even recognition that formats should be accessible. The scope of this problem has become particularly clear during the current COVID-19 pandemic in the failure to communicate with some of these groups (Maxman, 2021).

In terms of the diversity of communicators, there is an increasing awareness of the lack of diversity in research in general and in research communication in particular, and the problems this can cause (Canfield & Menezes, 2020; Bienkowski, 2020). It can often result in pressure on researchers from minority or marginalised backgrounds to be involved in outreach activities, without appropriate compensation or recognition. This can lead to a fraught balance between personal life and work

life, and the risk of burnout for those inspired to do SciComm work without peer or institutional support. The pressure to "burn for" diverse and inclusive science communication is a direct contributor to communicators' "burn out".

## Recommendations

### Increased networking with science communicators in developing countries

A dialogue between communicators from countries with different day-to-day realities must be established. Comparing context-specific best practices ("what works here") between regions can bring new perspectives and unexplored ideas for the communicators of the developed countries as well as enriching science and research in general through the recognition and incorporation of different knowledge systems into research practices. A diversity of perspectives must be encouraged.

### Increased diversity in science and science communicators ...

In addition to dialogue partners in developing countries who are not reached by current science communication activities, there are sections of society in developed countries that are difficult to access due to socioeconomic or religious factors, among other reasons. A more diverse scientific community will be able to reach a more diverse and larger group of people from various backgrounds. If we want to reach diverse communities, particularly marginalised groups in developed countries, we need diverse communicators.

### ... with appropriate institutional support

Underrepresented or marginalised groups should be enabled to communicate their research or their realities in a scientific working environment with the support of their institute or with an institutional framework. It is important to keep in mind that representation can create a lot of pressure on engaged individuals without adequate support and recognition. The sustainability of the communication activity also needs to be considered, centering on the well-being of the communicator.

### Increased cooperation with experts in communication, marketing, and branding

Scientists are not the only experts, and science communication should not be reserved only for scientists. Scientists need to understand the needs of their dialogue partners, but there is also a need for the latter to understand scientists. Researchers should ask for more support from experts in other fields like marketing, communications, media, and art. By using expert knowledge and the right tools from diverse fields, we can reach audiences that previously have not engaged with science communication and find the right tools to make the communication accessible to a particular audience (balancing accessibility and resources).

### Communication in a plurality of languages

Language is crucial in the communication of science. Whenever possible and relevant, the communication should take place in as many languages as possible. English may be the language of the scientific community, but this means that a lot of people simply cannot understand the communication.

### True open access for all nations and institutions

Access to papers is too often restricted by paywalls. Open access to articles enables the engagement of a broader and more diverse community, particularly in developing nations. True open access also includes access to code, data, programmes and applications, as well as additional materials reported in scientific articles.

### Focus on accessibility for those of all abilities

Solutions to support accessibility need to be explored and supported by institutions, with the formulation of best practice suggestions.

## Steps Going Forward

### International network in science communication

We need an international network of support for science communication, with a particular focus on developing nations and regions. Communicators with better and faster access to resources could provide

technical know-how, material resources, and translation assistance, thus further enabling collaborations with interested communicators in developing countries. This could help empower and train researchers worldwide, so they can in turn communicate better in their respective countries and contribute to an increase in the overall understanding and acceptance of STEM related fields. We also have a specific project proposal facilitating collaboration amongst scientists in different fields, with different backgrounds, geographical locations, strengths, skills and experience using a matching algorithm. The matching algorithm will cluster people according to their interests, socioeconomic characteristics, abilities and needs according to pre-specified hashtags. The desired outcome is to foster better and more diverse science communication that reaches wider and more diverse communities.

### Sensitivity readers

We propose to employ sensitivity readers in communication activities to ensure there are no misrepresentations of different cultures and groups by communicators. This also ensures that the communication activity is not a top-down approach.

### Accessible formats

Encourage or require (as part of funding) accessible formats, including but not limited to transcripts of videos and podcasts, plain text in web design and writing, subtitling of videos, image descriptions, accessible web design, sign language interpretation and translation into multiple languages. Often, the use of these formats will require a balance between accessibility formats for different audiences. In many regions, accessible formats are already required by law. In this circumstance, awareness of the existing regulations should be increased and enforced, but not only to comply with the law.

# CALL FOR A CHANGE IN ACADEMIC CULTURE


## Abstract

Early career researchers are aware of the impact of science communication on society and disseminating scientific outputs. However, many established researchers and Principal Investigators (PIs) do not share a similar perspective on science communication. Equally, major stakeholders in the field of science and research such as funding bodies and public institutions are not aware of the potential of science communication as a tool for disseminating scientific outputs to society. This creates tension amongst the parties involved resulting in a lack of support for early career researchers to engage in science communication. Thus, a shift in the status quo towards a more inclusive approach that incorporates both science communication and conventional methods of disseminating scientific output in communicating science is required.

Implementation of the following recommendations would thus convey a positive attitude towards science communication and promote science communication:

- Establish a central institution for science communication that helps with funding issues and serves as a bridge between the government and the public through science communicators
- Establish local departments at universities and research institutes around the world comprising researchers, communicators and public relations experts
- Cooperation between different departments or organisations for a promising exchange of knowledge and expertise
- Increase collaboration amongst researchers, communication experts, public relations (PR), and target audiences
- Soft skill training for early career researchers
- Offer elective science communication courses at Master's degree level whilst including Bachelor's students through mentorship programmes
- Include science communication talks into regular events such as workshops, colloquiums and keynotes
- Create awareness about the benefits of science communication (personal, organisational and for citizens)

- Changes in PIs' attitudes towards science communication
- Responsibility for science communication should no longer rest solely on the shoulders of the scientists.
- Scientists should be allowed to choose the way science communication is done and either actively do it themselves or receive help in doing so. Engagement in science communication should not lead to further pressure. Rather, researchers need an adequate support system to do science communication (see sections "Training" and "Funding").
- Addressing the working conditions for academics would also benefit their mental health status, which needs increased attention.

## Description of the Current Situation

There is a growing awareness of the value of science communication and especially new media in directly reaching society. In particular, early career scientists are keen to employ modern and creative formats to enable a dialogue between the community and researchers. However, under the current working culture, we feel a lack of support, resources and recognition for our effort to communicate our research to the public. In addition, most scientists find it difficult to get early access to existing tools and resources within their institutions.

Repeated short-term and part-time contracts (e.g., the Act on temporary employment in higher education / Wissenschaftszeitvertragsgesetz – WissZeitVG – in Germany) create an environment of constant insecurity. There is a culture of taking pride in overextending oneself and others, which is ultimately demotivating and only fosters anxiety and mental distress (Woolsten, 2019; Beadle et al., 2019).

We would like to make one thing very clear: **There is no glory in self-exploitation**.

Under these conditions, we lack the time and support to effectively engage in science communication. Unless science communication activities are recognised as a valuable input to our career development, we have little incentive to leave the ivory tower (Fernández-Bellon & Kane, 2020).

As young researchers, we are notoriously passionate about our work, but we need a change in the academic culture to provide us with the means to bring it to the people.

## Recommendations

Future science communication will require cooperation between different departments or organisations to achieve an efficient flow of information or knowledge from the research shelf to practical applications or citizens' benefit. In this context, the burden should not only be on the scientists. Researchers, communication experts, public relations (PR), and target audiences should collaborate and exchange ideas for making science communication possible and outreaching. This approach may create a synergy for solving problems in the science communication process.

### Changes needed to achieve it

Inherent challenges in science communication such as formats, technologies and processes could be resolved by organising soft skill training for early career researchers (like PhD students / postdocs).

As also mentioned in the section on training, we propose to include elective science communication courses at Master's degree level, with participative projects that involve interested Bachelor's students. Through these projects, we foresee a mentorship programme panning out especially for undergraduate students, which would help the younger generation get insights about science communication at an early stage.

We propose that universities and research institutes around the world establish local science communication departments that bring together the existing expertise of researchers, communicators and public relations professionals. Unlike regular PR departments, these platforms will focus less strictly on press relations. Rather, they will provide a collaborative working environment where researchers and communicators regularly exchange the latest results and communication tools.

We should also look deeper and realise that the main issue arises from the perspective of those in positions of power. We need to understand why many PIs do not see the potential of SciComm and address PIs concerns. This can be achieved by creating awareness about the benefits of science communication for personal, organisational and citizen development. To do this, we propose workshops and colloquiums, primarily targeting principal investigators and people involved in funding and resource allocation efforts. We propose to show these groups the impact SciComm can have and the value of encouraging early career researchers to be a part of this change. We acknowledge that such a change in perspective may not be achieved by enforcing rules and regulations, but by including science communication talks into regular events such as workshops, colloquiums and keynotes. This would also help to see SciComm in a more influential and resourceful light.

### Not pressuring the system further

We acknowledge that researchers are already under pressure with the expansion of the responsibilities they are accountable for (Susi et al., 2019). In view of this, we do not support further obligations that put scientists (especially early career researchers) under even more pressure. This is why we refrain from proposing the obligatory implementation of science communication. Further pressure on scientists could add to already existing mental health issues and lead to burnout and chronic stress (Forester 2021). We are convinced that showing scientists the advantages of investing time in SciComm helps to increase their interest in sharing their research with society and interacting with the public. As mentioned in the section “Training”, researchers need an adequate support system (proper resources and funding) that enables them to do science communication. The goal should be to advance science communication without putting further pressure on researchers or creating additional work.

### Existing international examples

Thus, a growing number of international bodies have started incorporating different aspects of science communication (see e.g. EU-Citizen. Science, the EU online platform on citizen science for sharing knowledge, tools, training and resources for citizen science)

To further these developments, **we propose a central – whether this is national, European or global – body for science communication that serves as a contact and funding point for all research institutions**. We envision it as an institute promoting SciComm and helping interested groups with relevant funding as well as serving as a bridge between governments, researchers and the public, but through the science communicators. For example, the International Astronomical Union has an 'Office of Astronomy for Development', which is a central international organisation providing funding for outreach activities that have a significant impact on society. The organisation we propose could also serve as an international pool of interdisciplinary science communicators, dedicated to contributing to projects with a wider scope beyond the countries and the local groups. A similar approach could be adopted to reach, educate and empower disadvantaged groups in society, so no one is left behind. Science communication can significantly contribute to this endeavour.

We encourage a combined effort of the different actors currently promoting science communication to increase their impact. For example, the Lindau Nobel Laureate Meeting formulated the Lindau Guidelines 2020, an initiative towards open and cooperative science with one of the goals being communicating science to society (Goal 09). A combined effort could significantly help to increase visibility and to reach our common goals.

**To realise a bright future for research, young scientists and scholars must be better supported. Only a change in academic culture will enable a fruitful dialogue between communities and researchers.**

# REFERENCES AND LITERATURE


Arts At CERN. CERN. https://arts.cern/

Author Services Supporting Taylor & Francis Authors (n.d.). *Cartoon abstracts: communicating research in new ways.* Taylor & Francis.
https://authorservices.taylorandfrancis.com/cartoon-abstracts/

Beadle, B., Do, S., El Youssoufi, D., Felder, D., Gorenflos López, J., Jahn, A., Pérez-Bosch Quesada, E., Rottleb, T., Rüter, F., Schanze, J., Stroppe, A., Thater, S., Verrière, A., Weltin, M.. (2019). *Being a Doctoral Researcher in the Leibniz Association: 2019 Leibniz PhD Network Survey Report.*
https://nbn-resolving.org/urn:nbn:de:0168-ssoar-69403-1

Bienkowski, B. (2020, July 15). Diversity and community focus: The future of science communication. *Environmental Health News.*
https://www.ehn.org/diversity-in-science-communication-2646398817.html

Canfield, K. & Menenez, S. (2020). *The State of Inclusive Science Communication: A Landscape Study.* Metcalf Institute, University of Rhode Island. Kingston, RI.
https://inclusivescicomm.org/files/State-of-Inclusive-SciComm-2020.pdf

Canfield, K. N., Menezes, S., Matsuda, S. B., Moore, A., Mosley Austin, A. N., Dewsbury, B. M., Feliú-Mójer, M., McDuffie1, K., Moore, K., Reich, C., Smith, H. M. & Taylor, C. (2020, January 30). Science communication demands a critical approach that centers inclusion, equity, and intersectionality. *Frontiers in Communication.* https://doi.org/10.3389/fcomm.2020.00002

Correctiv.org (2018, December 17). *Über die Kooperation zwischen CORRECTIV.Faktencheck und Facebook*. Correctiv.org. https://correctiv.org/faktencheck/ueber-uns/2018/12/17/ueber-die-kooperation-zwischen-correctiv-faktencheck-und-facebook/

*Dance your PhD Contest* (n.d.). Science Magazine.
https://www.science.org/content/page/official-rules-dance-your-ph-d-contest

*EU-Citizen.Science.* EU-Citizen.Science Konsortium c/o Museum für Naturkunde Berlin.
https://eu-citizen.science/

European Commission (2014). *The Erasmus Impact Study: Effects of mobility on the skills and employability of students and the internationalisation of higher education institutions.* Publications Office of the European Union. https://doi.org/10.2766/75468

Fernández-Bellon, D. & Kane, A. (2020). Unpaid 'CV-boosting' opportunities undermine efforts to reduce pressure and increase diversity of early-career researchers. *Nature Ecology & Evolution, 4* (1570). https://doi.org/10.1038/s41559-020-01307-w

Forrester, N. (2021). Mental health of graduate students sorely overlooked. *Nature, 595,* 135-137.
https://doi.org/10.1038/d41586-021-01751-z

*Gastronomica.* Krishnendu Ray et al.. https://gastronomica.org/

Horizon (2020). *The EU Framework Programme for Research and Innovation. H 2020 Programme:* AGA - Annotated Model Grant Agreement, Version 5.2. https://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/amga/h2020-amga_en.pdf

*Humans of LIGO: Short profiles of people involved with the Laser Interferometer Gravitational-Wave Observatory,* Blogspot. LIGO.
https://humansofligo.blogspot.com/

*International Journal of Science Communication, Part B: Communication and Public Engagement.* Taylor & Francis. https://www.tandfonline.com/toc/rsed20/current

*Journal of Fluid Mechanics.* Cambridge University Press. https://www.cambridge.org/core/journals/journal-of-fluid-mechanics/information/jfm-online-only-in-2020

Kalmár, É. & Stenfert, H. H. (2020). Science Communication as a design challenge in transdisciplinary collaborations. *Journal of Science Communication,* 19(04), 1–12. https://doi.org/10.22323/2.19040301

*The Lindau Guidelines for global, sustainable and cooperative open science in the 21st century* (2020). http://lindauguidelines.org/wp-content/uploads/2021/03/Lindau-Guidelines-2020.pdf

Maxmen, A. (2021, May 12). How the world failed to curb COVID. *Nature.* https://doi.org/10.1038/d41586-021-01284-5

Munroe, R. (n.d.), xkcd. *A Webcomic of Romance, Sarcasm, Math, and Language.* https://xkcd.com/

*New Journal of Physics.* Institute of Physics & Deutsche Physikalische Gesellschaft. https://iopscience.iop.org/journal/1367-2630

OECD PISA (2017). How does PISA for Development measure scientific literacy?. *PISA for Development Brief, 2017*(2). https://www.oecd.org/pisa/pisa-for-development/10-How-PISA-D-measures-science-literacy.pdf

*OzGrav*. ARC Centre of Excellence for Gravitational Wave Discovery. https://www.ozgrav.org

*Radiolab,* Podcast. WNYC Studios. https://www.wnycstudios.org/podcasts/radiolab/podcasts

Raimbault, J. (2019). Exploration of an interdisciplinary scientific landscape. *Scientometrics, 119,* 617–641. https://doi.org/10.1007/s11192-019-03090-3

Sousanis, N. (2015). *Unflattening.* Harvard University Press

Susi, T., Shalvi, S. & Srinivas, M. (2019, June 17). 'I'll work on it over the weekend': high workload and other pressures faced by early-career researchers. *Nature.* https://doi.org/10.1038/d41586-019-01914-z

Vincent, J. (2021, August 4). Facebook bans academics who researched ad transparency and misinformation on Facebook. *The Verge.* https://www.theverge.com/2021/8/4/22609020/facebook-bans-academic-researchers-ad-transparency-misinformation-nyu-ad-observatory-plug-in

Wagner, C. S., Roessner, J. D., Bobb, K., Klein, J. T., Boyack, K. W., Keyton, J., Rafols, I. & Börner, K. (2011). Approaches to understanding and measuring interdisciplinary scientific research (IDR): A review of the literature. *Journal of Informetrics, 5*(1), 14–26. https://doi.org/10.1016/j.joi.2010.06.004

Woolsten, C. (2019). PhD's: The torturous truth. *Nature, 575,* 403-406. https://doi.org/10.1038/d41586-019-03459-7

World Health Organisation (n.d.). *Infodemic.* https://www.who.int/health-topics/infodemic

World Health Organisation (2020, February 2). *Novel Coronavirus (2019-nCoV). Situation Report, 13.* https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200202-sitrep-13-ncov-v3.pdf?sfvrsn=195f4010_6