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Science Popularization During Wars and Crises: Challenges and Opportunities

White paper

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Content

Executive Summary

The "Science Popularization During Wars and Crises: Challenges and Opportunities" White Paper analyses the state of the sphere of popular science in Ukraine during the pandemic and after the beginning of the full-scale Russian invasion. The problem for our research is that Ukraine doesn't have a formed understanding of the value of science popularization as an essential part of a modern state and society, and this misunderstanding has deepened during COVID-19 and the state of war, on the background of the spread of pseudoscientific concepts and ideas.

The primary method of our analytical research is desk research combined with 15 expert half-structured remote interviews with science popularizers.

The book contains four sections. In the first section, based on the analysis of normative legal acts and research of Ukrainian and foreign scientists, we offer definitions of the terms "science popularization" and "science popularization during crises". We also provide the main characteristics of science popularization during crises. In the second section, we analyze the sphere of science popularization in Ukraine based on the database of 166 popular science initiatives we created while preparing the White Paper. In the third section, we review science popularization in Ukraine during the pandemic and after the beginning of the full-scale Russian invasion. In the fourth section, we analyze how science popularization can counteract the spread of disinformation and pseudo-expertise during crises.

Key research findings:

- The stakeholders of the Ukrainian popularization sphere (state authorities, business, scientific, and journalistic community) have no understanding of its importance and value during crises. For example, on April 14, 2021, the Cabinet of Ministers of Ukraine approved a *plan of measures* to popularize natural sciences and mathematics until 2025. However, there are no means of evaluating its implementation, and it's uncertain at which stage are the implementation measures in 2023. The plan wasn't adapted to the new post-pandemic and martial law conditions.
- The role of science popularization during crises is significant. The international research we have analyzed allows us to state that during crises, it doesn't just increase the level of awareness of the population about vital topics but also creates conditions to unify the people and increase the level of economic development and overall society's resilience. It's especially true for countries in a state of war, as the examples of science popularization in the USA during the Cold War and South Korea show.
- The Ukrainian sphere of science popularization has been developing

relatively slowly because of the majority of actors' lack of resources and attention. The real impetus was the Revolution of Dignity in 2013-2014 when many new popular science projects appeared. It's important that the initiatives of science popularization in Ukraine happened simultaneously with the active development of civil society — thus, the initiatives were mostly grassroots. In this period, the science popularization sphere was developing independently from the state and without state funding. With the help of in-depth expert interviews, we have identified the main motives for the desire to popularize science. Based on our database, we state that the peak number of popular science projects was at the beginning of the pandemic in 2020, but the growth of this sphere ended earlier.

- Because of the pandemic and the full-scale invasion, the Ukrainian science popularization sphere changed: the number of popular science projects decreased a bit, the trust in science increased, popularization went online, the audience broadened, new sources of funding appeared, the influence and presence of Russian science popularizers decreased, and the demand for Ukrainian popular science books increased. The pandemic and the war gave the impetus to medical, historical, and radiophysical popularization projects.
- During crises, we shouldn't perceive science popularization as a panacea in counteracting the rapid spread of disinformation, fakes, and pseudo-experts. Still, it plays a significant part in increasing the general educational level of the public and forming critical thinking. Without the popularization sphere, the influence of pseudo-scientific ideas will be more substantial, leading to destructive consequences in society.
- Science popularization in Ukraine may become a significant factor in counteracting Russian disinformation. Still, one should not build popularization on a rapid reaction-answer to the next fake from Moscow but rather create an integral structure with its own formulated narrative that will fight disinformation more or less but, first of all, will educate the audience on critical thinking. This way will protect it from the spread of the enemy's ideas.
- Ukrainian experience in science popularization during crises can be beneficial for the Eastern European countries that are undergoing the process of decolonization and where the image and the influence of Russian science were undeniable.

OUR KEY RECOMMENDATIONS

For central and local authorities:

1. Science popularization sphere aimed at increasing the level of understanding of the popularization's value. The document can be treated as a part of state measures for unifying society under martial law, economic revival, and increasing society's educational level.
2. Deepen the support for developing the science popularization sphere on the state and local levels and contribute to organizing and holding popular science events.
3. Continue to work on a full-scale launch of the direction of support for popular science projects in the National Research Foundation of Ukraine. Provide appropriate funding for this direction.
4. Create diversified support programs for science popularization on the state, regional, and local levels. Provide the ability for science popularization projects to participate in participatory budgets. Include funding to support science popularization participatory projects in local and state budgets and attract funding from international donors.
5. Initiate prizes, distinctions, and rewards in the science popularization sphere.
6. Initiate an audit of book publishing funded by the state and include funding

for popular science book publishing in the state budget, especially in natural and technical sciences.
7. Support private initiatives of Ukrainian popular science book publishing using legal and financial stimuli, particularly through state foundations like the Ukrainian Book Institute or the Ukrainian Cultural Foundation.
8. Engage science popularizers in state and local communication campaigns about overcoming the consequences of crises.
9. Continuously engage science popularizers in all possible state programs of counteracting propaganda and disinformation of the enemy, while it's more effective to outpace Russian fakes than to debunk them.
10. Develop legal grounding for creating press services and information centers at scientific institutions and universities that would contribute to popularization activity and simplify journalists' search for experts.

For the scientific community:
1. Be open to communication and collaboration with the existing popular science projects to popularize your developments. Respond to requests from businesses to explain complex scientific questions, and be ready to join expert groups in times of crisis.
2. Adapt popular science projects to the needs of different target audiences. Popularization shouldn't be a plain simplification of complex scientific information; first of all, it should motivate the audience to evaluate it critically.
3. Treat science popularization activities not as an additional workload but as participation in overall popularizing your field of knowledge and increasing its social weight. At the same time, there should be no formal load of popularization activities for scientists, and if it's imposed by administrative methods, the orders should include additional resources.
4. Spread the understanding that science popularization is a necessary element to attract resources for the development of scientific research and new people who would do this research.

For the media:
1. Start special advanced training courses for scientific journalists involving experts from countries with a high level of scientific journalism, at least until our professionals gain the necessary knowledge and experience.
2. Create and popularize among journalists an informal database of scientific experts on different topics who would professionally evaluate some "hot" events or phenomena.
3. Contribute to developing a network of science communicators who would help journalists of the central and regional media to find the necessary experts or give commentary within the limits of their expertise.
4. Collaborate with and actively engage the Ukrainian scientific diaspora to science popularization in the Ukrainian media. Consider it an additional means of their reintegration into the Ukrainian area.

For the business community:
1. Consider your participation in support of popular science projects as another dimension of your social responsibility. Follow the best practices of the international businesses.
2. Pay attention to popular science projects in your field. If there are none, encourage their creation among Ukrainian scientists and stakeholders, for example, by organizing a special grant competition.
3. For high-tech businesses, science popularization is one of the ways to spread understanding of the necessity of the offered goods and services among the population and also broaden the circle of potential employees.
4. Continue to support popular science

projects and book publishing; remember that growth in the popularity of a specific professional field will, in the future, increase the state's overall economic development.
5. Engage the popularizers more intensely in holding public lectures, trainings, and seminars for the company's employees.

For the countries in crisis or war conditions:
1. Encourage initiatives to develop popular science projects. The Ukrainian experience shows that the popularizers see their activity not just as a communication of scientific knowledge to the broad public but also as a part of their civil activities. The Revolution of Dignity was an impetus not just for volunteering and non-profit initiatives but also for popular science.
2. The existence of a grassroots popular science community is useful for society; it contributes to the population's education and increases the level of critical thinking. The state should pay attention to popular science projects, even if it wasn't involved with their organization, and offer support in critical moments.
3. Understand that the sphere of science popularization is not a panacea in fighting fakes, disinformation, and pseudo-expertise, and it won't defeat these phenomena by itself. However, it is necessary to prevent their appearance and overcome the negative consequences of their existence.
4. Oversimplification of scientific information may lead to an increase in polarization and politicization of society and contribute to the spread of pseudoscientific ideas.
5. During crises, science popularization may be considered a part of the overall state measures to unify society and increase the level of patriotism.
6. Science popularization is also a part of entertainment (or edutainment) for the population that lives in crisis conditions and is under constant stress. Improving the psychoemotional state of the vulnerable groups of the people and society overall is one of the aims of popular science projects.

Preface

Periods of natural disasters and wars usually lead to a decline in science in general. Funding for scientific developments gets cut, funds are transferred to other needs, infrastructure is destroyed, and scientists don't have appropriate conditions (material and psychological) to do and popularize research.

In such periods, fakes, pseudoscientific theories, and bloggers without due expertise gain popularity in society, and researchers and scientific research take the back seat. Spreading the results of research and increasing the population's educational level should become a foundation to explain complex questions that arise to people, and this way, popularize scientific knowledge. Science should structure complex societal reality and help fight the spread of antiscientific ideas. Besides that, science should play an important part in fighting enemy`s disinformation campaigns, especially when society is in a state of war. The enemy may spread antiscientific ideas to reach their military and political goals.

Besides that, there are several opportunities for popularizing science in such periods. For example, the beginning of the full-scale invasion of the Russian army on February 24, 2022, breathed new life into popularizing Ukrainian history. Many podcasts, YouTube projects, radio-, and television shows were created. Historians are now involved more often in explaining the nature of the current war and drawing analogies with the past. Military historians are invited to explain events on the frontlines. Their media involvement became part of the informational counteraction to Russian propaganda.

The problem of our research is that in Ukraine, no understanding of the value of science popularization as an important part of the modern state and society has been formed; this lack of understanding grew more profound during the state of war, which has led to the spread of pseudoscientific theories and ideas.

To consider this problem in full, we set **these goals:**

1. Based on an analysis of the international experience of science popularization during natural disasters and wars, to highlight the main challenges and opportunities faced by scientists from other countries;
2. To analyze the sphere of science popularization based on our database of popular science projects in Ukraine;
3. To research the changes to the popular science sphere in Ukraine during the pandemic and the full-scale Russian invasion;
4. To analyze how science popularization may counteract Russian propaganda;
5. To create recommendations for improving the efficiency of science popularization activities in fighting propaganda and disinformation;
6. To formulate recommendations for support of popular science by the government, society, business, scientific communities and institutions, and international donors, and also emphasize the role of science popularization in the postwar revival of Ukraine.

The central hypothesis of our White Paper is that the full-scale Russian invasion on February 24, 2024, has become not only a challenge but also an opportunity for the popularization of Ukrainian science that allowed this sphere to become a significant factor in counteracting Russian disinformation. In general, other countries in similar circumstances may use the Ukrainian example of science popularization, particularly in questions of countering disinformation and creating conditions for popularization.

Our main **method** is desk research combined with 15 in-depth half-structured remote interviews with a defined category of science popularizers in Ukraine and Poland. The main criteria for the choice of respondents were personal contacts, as the authors of this research have been popularizing science in Ukraine for a long time. We also tried to choose well-known channels with big audiences (first of all, YouTube channels like "Клятий раціоналіст" ("Damned rationalist"), "WAS: Популярна історія" ("WAS: Popular History"), and others) and took into account different spheres of knowledge, formats of popularization, and year of creation. We also paid attention to the media with popularization sections and popular science publishers.

Within the framework of our research for the white paper, we have also created a database of popular science initiatives in Ukraine that contains over 160 resources. Based on this database, we made generalizations and conclusions about the state of Ukrainian science popularization. From over 160 projects related to the popularization of science and technology, we were able to define the time frame for the existence of 122 of them. These are websites, pages in social media, video channels, and periodicals. TikTok is poorly represented in the analysis. The basis for this list was the list by *Anton Senenko* on the site.ua website, the *"Network about Science"* database on the "My Science" portal, and the paper *Ukrainian Popular Science Journals: on the Way of Attempts and Failures by O. Boldyrev, Chytomo*; it was further supplemented by the participants of the expert group.

The authors of the White Paper express their gratitude to Ukrainian science popularizers who kindly agreed to answer our questions during the in-depth interviews: Kyrylo Bezkorovainyi, Olha Maslova, Artem Albul, Eduard Andriushchenko, Vadym Zhulenko, Dmytro Simonov, Ilona Zamotsna, Vitalii Liaska, Leonid Horobets, Natalia Atamas, Anna Nikolaeva, Lilia Kazantseva, Yevhen Synytsia, Serhii Honcharov, Yakub Bokhinskii, Jaan Aru.

Section 1. What is science popularization? Popularization's goals and its added value during crises

Popular science as a practical sphere is poorly researched theoretically, so even the term itself is highly discussed. The *UNESCO report* from 1986 considers science popularization as a process of transferring complex scientific ideas and knowledge to people who don't have professional education or experience in science, with the goal of making the material accessible and clear for the broad population, facilitating the growth of interest to science, increase in educational culture and understanding of the scientific method. Different researchers also *consider* science popularization as a collaboration between science, pedagogy, and the media, as a *practice* of researchers going out into the non-scientific public (with the *loss* of scientific completeness because of simplifications), and as an activity of a popularizer — the bearer of *privileged* access to scientific information.

Ukrainian law mentions science popularization but doesn't define it. The majority of these mentions are in the Law of Ukraine *"About Science and Scientific-Technical Proceedings"*.

Ukrainian researchers are also looking for the definition. In particular, they highlight three main approaches to understanding the term "science popularization":

1. as a process of stirring the interest, enthusiasm, and love of the broad audience to a specific object or subject of societal reality;
2. as a complex of measures for the spread, and in a way, for propaganda of knowledge in society, with a tendency to create the mainstream;
3. as a way of explaining and presenting information about science and its gains in a popular and clear form for the mass audience so that to understand it, the audience wouldn't need to have a professional level of training in the subject of communication.

*We offer to define the term **"science popularization"** as measures of spreading complex scientific knowledge in a popular manner for the broad public, which isn't professional in this field, through a popularizer (a person or an institution) that communicates such knowledge.* The social function of science popularization remains outside of this definition; Ukrainian science popularizer Darka Ozerna writes about it in her methodological manual *How to Talk about Science and Yourself in It*: *"The goal of science popularization is to bring science into the social discourse, to make science a part of the agenda for the broad masses, to spread scientific knowledge and scientific method of gaining knowledge in society. Science popularization creates an informational field that affects everyone in it."* As we will see further, not all popularizers have such goals.

Science popularization in the public discourse is considered an undeniable good. Explaining scientific problems in plain language increases the public's engagement in scientific topics and creates trust in researchers as a social group (as they often are considered weird "sages from an ivory tower"), which makes the government more ready to fund scientific research. Science popularization in spheres like medicine, radiobiology, or chemistry can increase the population's safety from factors that may harm health.

However, the efficiency of popularization is hard to evaluate. Science popularization is well-developed in countries where society as a whole treats scientists and scientific research favorably. It's hard to tell here which one is the cause: the high authority of science in society that allows its active popularization or popularization itself is the driving force for improving citizens' trust in the scientific sphere. It's likely that at a particular stage, these two processes mutually reinforce each other in a positive feedback loop.

Popularization in itself may have adverse effects if done without consideration of societal function. The authors of the *UNESCO report* spotlight a couple of general problems of science popularization:

- simplification and distortion of information. One of the main traps is the necessity to simplify complex scientific concepts as much as possible to make them accessible to a broader audience, which may lead to the loss of accuracy and distortion of the essence of scientific facts and laws;
- sensationality. Efforts to gain public attention may lead to the distortion of facts or the creation of sensational headlines, which may violate scientific objectivity and undermine trust in science in general;
- absence of context. When trying to gain simplicity and accessibility, it may be challenging to convey deep context and connections between different scientific aspects;
- shift of the focus. Sometimes, popularization may draw public attention to separate popular aspects, advantageous for the media appeal, while less attractive but important scientific spheres may remain undervalued;
- communication barrier. The report also emphasizes difficulties in forming effective communication between scientists and public representatives. The lack of scientific education in the public is visible here. Science popularization demands a certain level of scientific literacy from the audience, and its lack may complicate the transfer of the correct information.

In light of the complexity of high-quality science popularization, realizing the heterogeneity of the community of popularizers is essential. Among these people, a couple of clusters may be outlined:

- scientists who go out in public to talk about their own or someone else's research in the field they know;
- former researchers who left their scientific careers and changed qualifications to become writers, bloggers, TV presenters, etc.;
- educational workers;

- scientific journalists;
- science amateurs.

There are several reasons why people are motivated to popularize science. From the results of our in-depth expert interviews, we were able to identify a couple of groups of such reasons:

- the researchers' desire to structure knowledge in their and adjacent spheres, reach the level of broad generalizations, and get criticism of their ideas that would be impossible to publish in scientific journals. We may compare this desire with lecturing but for a wider audience;
- the researchers' need to influence decision-making in society and the state and advocate the interests of scientists and the scientific sphere;
- social responsibility: the desire to increase the educational level of the society, especially in connection with dangers in crisis times (illnesses, radiation, poisonous substances);
- popularizers who don't represent science, gain access to scientists, can speak with them about unusual and various topics;
- social capital, recognition, and fame;
- additional or primary income.

Often, a combination of a couple of reasons motivates a person to popularize science.

THE TERM "SCIENCE POPULARIZATION DURING CRISES".

*Under **crisis**, we understand a time of instability for the country or society that stands at a threshold of a dramatic change that demands immediate attention and solution.*

Communication of scientific knowledge is decisive during a crisis period. Christopher Reddy, in his *"Science communication in a crisis: an insider's guide"*, from his own experience of participation as a scientist in groups that had to react to oil spills in water basins, claims that the researchers have to communicate their knowledge correctly to the main groups of stakeholders in an emergency and give correct, fast and practical advice from their scientific experience. In the author's opinion, the accent on communication of scientific knowledge is key in a crisis.

There's a special term for science popularization during crises — emergency popular science. This activity concerns public safety measures, including spreading information about the necessary measures in an emergency.

Popular science at these times is directed at heightening society's preparedness for emergencies and is connected to the popularization of the necessary knowledge and skills for saving the lives of citizens. The process of presenting scientific information in such cases includes gathering information, clarifying goals, understanding the audience's needs, forming the general narrative, and its visual transformation.

*We offer to understand the term "**science popularization during crises"** as a complex of measures for the distribution of complicated scientific knowledge, the need for which is formed in the context of a crisis, directed at increasing the population's preparedness for an emergency.* Usually, this popularization method is connected to the popularization of methods and technologies directed at raising awareness about the crisis through a popularizer (a person or an institution) that can communicate scientific knowledge about the crisis swiftly and reliably, takes the needs of the audience into account, and joins to the planning of political steps to solve the crisis.

In periods of crisis, science popularization may be countered by the distribution of a specific type of *science-related populism*, and scientists-popularizers can join the development of strategies to counteract *disinformation.*

The COVID-19 pandemic highlighted the successes and failures of science popularization in different countries. The

pandemic is a recent crisis that touched most countries in the world. Much research analyzed the correlation between the swift spread of morbidity and science popularization. We should note two key factors that can be relevant for the other periods of crisis: in such periods, science gets politicized, and the population can become polarized around science.

In such periods, science is under the conditions the researchers define as post-normal, in which the available knowledge is very uncertain and incomplete. Under normal circumstances, science *is done* through a lasting activity in which researchers engage to broaden and clarify the available scientific knowledge. In periods of crisis, creating new knowledge is tightly connected to the political necessity to manage the crisis. This also draws attention to how scientific knowledge can be transformed into political decision-making. For example, political actors were involved in communicating questions related to the pandemic. The results of particular German *research* about experts who dominated the media show that these were primarily politicians - as opposed to previous pandemics when more scientific experts were involved.

In times of crisis, science also becomes one of the reasons for the political polarization of society. The Swedish researcher Roderik Rekker *thinks* that, in recent years, polarization around science has gained some threatening features, especially in climate change discussions in the USA. When evaluating the level of acceptance or unacceptance of scientific ideas about climate change, the author offers to consider scientific polarization as its particular expression in convictions around scientific facts. The question of vaccination became one of the forms of such polarization around science during the pandemic. The topic of vaccination, in general, became a *global* problem not only during the COVID-19 pandemic but also during other mass spreads of virus infections. Some *research* suggests that denial of vaccination is a consequence of a significant religious influence on some societies, for example, in the USA. Others *argue* that vaccine skepticism was due to spirituality in general and low scientific literacy, for instance, in some European countries, such as Greece.

Overall, the general trust in science has grown over the pandemic, at least in some countries. This is evidenced by the *research* done in Great Britain, the EU, the USA, and Canada. During that time, scientists became more public, and politicians started to use scientific terminology to explain the challenges of the pandemic to the population. One of the surveys held in Germany before and after the start of the pandemic *included the statement*: *"We should rely more on common sense, and science is not needed"*. The answers showed that the lack of trust in science clearly decreased after the pandemic outbreak. Before the pandemic, only 33% unequivocally denied the statement that science is unnecessary, whereas this number rose to 62% after the outbreak. A high percentage of mistrust was peculiar primarily for the adherents of the Alternative für Deutschland populist right-wing party.

On the contrary, in other regions of the world, the reputation of science decreased during the pandemic. Spanish researchers *suggested* that the pandemic became a real catastrophe for science, especially in the part of communication and popularization. During the pandemic, disinformation spread rapidly because of the mistrust between scientists and journalists. The quantity of scientific publications grew, but their quality didn't. The pandemic politicized science, as was stated above. The connections between science and society grew weaker as society swiftly needed accessible and reliable information, which the scientific sphere couldn't always provide.

Thus, in times of pandemic, on the one hand, in some countries, trust in science and researchers grew, and the popularization of certain scientific spheres facilitated the awareness of the population about the illness and became a necessary condition to save lives and overcome obstacles of the spread

of COVID-19. On the other hand, it led to the growth of mistrust in science, became the reason for scientific polarization of society through the spread of disinformation, and was characterized by politicization.

War has a *considerable* impact on the popularization of science. At least, this is how it was during the Second World War compared to the previous armed conflicts. In this war, science had a much more significant impact than in the previous conflicts. That's why it's sometimes called "the war of physicists" because of the creation of the atomic bomb. At that time, the need arose for people who could explain scientific developments in layman terms, that is, for popularizers who wouldn't necessarily be scientists.

The Cold War contributed to the growth of the popularization of science. At the beginning of the 1950s, the editors of US publications *stated* that they enlarged the volume of scientific materials at least two times. At that time, the need to highlight science news and orientation on the newest scientific developments also became a unique feature of science popularization in the USA. Several factors, like postwar renewal, economic growth, the spread of television, and new ideological opposition to the USSR in the cosmic sphere, facilitated this.

The question of science popularization became internationally recognized during the renewal after the Second World War. In the UN framework, UNESCO was created — an organization that specifically addressed the questions of education, science, and culture. The organization distinguished science popularization as one of its priorities. At the end of the 1940s, there appeared the *Memorandum on the Popularization of the International and Social Implications of Science* (1947), separate UNESCO programs on *science popularization through children's books* (1949), *through cheap books* (1949), *scientific education for factory workers* (1951), *science for the youth* (1952), *methods and techniques of science popularization* (1951), *science lectures* (1954), and also reports about *the spread of science* in Italy, Poland, Hungary, and other countries (1955). Science popularization on an international level *was considered* one of the elements of cultural diplomacy.

During the war and the period of postwar renewal, the states usually instrumentalize science for their own goals. For example, after the Six-Day War in 1967, Israel *launched* a popular science program on state TV that had the goal of involving the Arab population in the newly annexed territories to live under new conditions and, therefore, changing their opinion on the State of Israel. Science popularization there was one of the means of propaganda. With the help of these programs, the state spread the idea about the country's scientific potential and encouraged the Arab population to become part of it.

Another example of science popularization in the postwar period is South Korea, where this sphere *is called* science culture. After the Korean War (1950-1953), the government saw an opportunity for economic growth in science and technology polarization. Two periods in the history of the development of science popularization in South Korea are distinguished: 1) 1930-1970s, when the state was helming this process, launching the national Science Day; 2) 1980-2000s, when the government promoted science programs based on practical experiments on the phenomena of everyday life, held competitions (from 1983) and science festivals for students (from 1997), and also introduced laws and developed long-term plans for promotion of science culture.

In the war period, science, like any other sphere, is instrumentalized and works for the military needs. Many experimental directions that didn't get funding for years have a chance for their own scientific breakthrough. However, in war periods, scientific freedom is absent; science undergoes significant politicization and even participates in propaganda.

Section 2. Analysis of the sphere of science popularization in Ukraine

Science popularization in Ukraine started as a continuation of science popularization in the USSR but then went its own way. In the Soviet Union, there were popular science magazines and books, popular science TV shows, and a network of scientific circles for children and youth. In independent Ukraine, there were attempts to create analogs of what was left from of the Union, but they were often unsuccessful. At the beginning of the 2010s, Ukrainian science popularizers started to pay attention to North American and European popular science. At the same time, with the development of the Ukrainian Internet, a network of Ukrainian popular science blogs started to form, the first readers of which oriented on the Russian popular science market.

A significant number of Ukrainian science fans were oriented toward Russian popularization even after the beginning of the Russian-Ukrainian war. In Russia, large popular science projects and networks were funded by a couple of donors from big businesses who supported online projects, events, and book publishing. Therefore, Russian popularizers had more favorable conditions in the middle of the 2010s. For instance, hundreds of people attended lectures by Asia Kazantseva from 2016 to 2018; they also bought her books, while most Ukrainian popularizers didn't have such opportunities. A number of Russian projects also tried to open affiliations in Ukraine, including "Курилка Гутенберга" ("Gutenberg's Smoking Room") and "N+1". The atmosphere of the Russian-Ukrainian war and confrontation was an obstacle to their spread, but part of the audience treated the message "science is beyond politics" positively.

Social changes during the Revolution of Dignity sped up the development of the popular science sphere, while the war and the pandemic had a classical crisis impact: many projects disappeared, but many new ones were created in their place. There were attempts to popularize science during all years of independence, but new projects were created

most actively between 2014 and 2017[1]. If, in an interval between 1994 and 2009, we see the appearance of less than 30 popular science projects, during the four years mentioned above, there were 49. However, the appearance of new ones doesn't save from the disappearance of old ones: 46 projects (38%) ceased to exist, 34 of which lived for 1 to 7 years, and a part of them disappeared because their owners stopped paying for hosting their websites. Peaks of the project disappearance, as could be expected, were in 2020 — at the beginning of the pandemic — and in 2022 — at the beginning of the full-scale Russian invasion. In 2020, projects about epidemiology actively appeared, while in 2022, historical projects were developing.

The field of popular science is moved by the efforts of volunteers, is not self-supporting, and suffers from a lack of resources. The fastest growth of active popular science projects was between 2013 and 2017, when their quantity grew (9-12 projects per year). Since 2018, on the other hand, we have seen saturation, and the growth in numbers has stopped; for our sample, it's 83 (2017), 87 (2018), and 88 (2019). However, this doesn't mean the demand is satisfied; rather, human and financial resources are lacking. The maximum amount of popular science projects in Ukraine (94) was seen in the crisis year 2020 when donors like the International Renaissance Foundation or the European Commission directed a part of their funds to fight the pandemic for support of popular science projects that worked to refute the myths around COVID-19. With the end of most of these projects, the overall number of popular science resources went back to the level of 84-85, and in 2023, it fell to 73.

In Ukraine, there's a lack of systemic support for science popularizers at the levels of the state, local authorities, big corporations, and charities. The state — the Ministry of Education and Science, the NASU, the Junior Academy of Science, and universities — declare the necessity to popularize science, but there are no mechanisms for its support. There are no state grants or programs that would support popular science projects. The possibility to open grant programs for support of science popularization appeared in the Law of Ukraine "About Science and Technology" 2016, but the bylaws for such programs at the National Research Foundation of Ukraine were approved only in 2023, and still, no competition has been announced. A NASU competition for science popularization was first held at the beginning of 2023 and was highly criticized. Despite the generally accepted EU documents, the state funds that take care of culture don't consider science a part of culture. Local authorities are not interested in propaganda of scientific values, though they are ready to take part in opening entertainment centers related to science. Most private charities don't see science popularization as a priority. There are several projects connected to the popularization of science created by private companies. Still, usually, they are directed to whitewash the reputation of dubious entrepreneurs and often disappear after fulfilling this function, like the *Innovation House* or Lucky Books projects.

State institutions formally acknowledge the necessity of science popularization, but with the lack of resources, this activity is often limited to "ritual communication". The management of scientific institutions may formally require the employees to popularize the proceedings of the institution, but without funding and additional people, this may turn into imitation. For instance, during the regular popular science "Science Festival" event, which was held in the 2010s on the National Science Day, some institutions presented solemn meetings of the scientific council, conferences of young scientists, or exhibitions of scientific work of the employees in the institution's library as measures for science popularization. Many scientists consider simple educational practices for students of the appropriate specialties — special lecture courses or laboratory practice — science popularization.

[1] Here and futher - Appendix 1. Science popularizers database

This is probably the reason why, in the 2018 survey of researchers, half of the respondents claimed in their self-evaluation that they took part in science popularization. This erroneous understanding of popularization activities is supported by sections about popularization in yearly reports. Without additional time and resources, scientists may imitate such activities.

The Ukrainian scientific community has a large stratum of active people interested in popularizing science. Despite the lack of funding, the science popularization sphere is moved by volunteers. The explosion of popularization in 2014-2017 was primarily created by non-profit projects. For example, in the events of the «Дні науки» ("Science Days") project in 2013-2019, over 200 speakers and demonstrators from all over Ukraine took part, usually researchers, postgraduates, and students. Even despite the crisis, war, and overall welfare decline in 2013, over 100 researchers and activists joined a volunteer platform «буДні науки» ("Work Days of Science") that aims to promote science reform and the increase in prestige of scientific work, in particular, through popularization. While we have around 70-80 thousand scientists[2] in the country, the involvement of many hundreds of them in popularization creates human resources able to influence the promotion of scientific values.

Science popularization in Ukraine is inseparable from science advocacy and civil activism. Many popularizers explain science in plain terms to influence the scientific policy of the state and society, and also with a desire to develop an independent Ukraine. For example, many scientists active in popularization are involved in science reform, the solution of urban problems, environment protection, and volunteering for the army or socially insecure social groups. By creating horizontal connections in other communities and having a stance on civil and political issues, these scientists and popularizers have the potential to broaden the audience of citizens interested in science.

Science popularizers are atomized, are not recognized by the mainstream media, and have problems countering pseudoscientists and manipulators. A large number of separate popularizers and popular science projects don't create a cumulative effect because of their separateness. Ukrainian popularizers episodically collaborate but, in general, have their own aims. Because of this, even in the environment of scientists-popularizers, the existence of manipulators who sell their own commercial products, not always with a scientifically verified effect, under the pretense of popularization, is publicly ignored. Public discussions of conflicts of interest and pseudoscientific propaganda are usually connected to short-lived scandals and personal arguments on social media and don't lead to the creation of policies and principles for the field. Russian popularization market is still a painful problem; even after 2014 and 2022, it is trying to spread its influence on Ukrainian society. Mainstream media are not eager to popularize science, usually because of the conservatism of the senior management of the editorial offices, and spreading of pseudoscientific topics isn't considered unethical[3].

Popularization is often done by non-specialists. These may be both amateurs who dig deep into the topic and those who retell popular science books. The latter forms a demand for misleading content instead of unique scientific content. Science popularizers without a scientific background may not have a systemic vision; they distort the information and primitivize it too much, satisfying the demand for simple answers to complex questions (for example, *Chernyak Blog*). The task of a professional science communicator or a scientist-popularizer is to give an understanding that everything is much more complicated than it looks at first glance,

[2] Scientific and scientific-technical activities in Ukraine in 2019: a scientific-analytical report / T.V. Pysarenko, T.K. Kuranda, et al. – Kyiv: UkrINTEI, 2020. – 109 p.
[3] Interview with Dmytro Simonov

and current information tomorrow may become obsolete.

In the Ukrainian science popularization ecosystem, the link of mediators between science, businesses, media, and society is lacking. In the UK, there is *the Council for Science and Technology*, which has a whole number of instruments that allow science communicators to get funds for communicating scientific research done in universities to society. The plan for science communication is a part of a general scientific plan of universities, and its results are taken into account when the budget is considered. Otherwise, the university won't get enough funding for its research. However, not every country can afford such levers of influence to involve scientists in educational activities. For example, science communicators in Poland play the part of mediators when there's a need to hold a popular science event. Communicators offer alternative funding when classical financial means can't be used (for example, funding from the national foundation)[4]. The mechanics are that scientific centers address commercial companies with an offer of a social event and a proposal to provide advertising, or the communicators offer to get funding from a nongovernmental civil sector. This stimulates the creation of a unified communication campaign between scientific centers, simplifying receiving the information. Besides that, there's both volunteering and commercial support for science popularization. The most efficient method is to write a proposal and give it to someone who can fund it or provide recommendations for further actions.

Book publishers treat Ukrainian authors-science popularizers with suspicion, though there is progress. Before 2020, not many publishers were ready to print books of Ukrainian scientists and science popularizers. With the appearance of the "Vikhola" publisher, the situation improved, as the publisher has shown that Ukrainian popular science can be profitable. However, the awareness of owners and managers of publishing houses remains an obstacle: like the management of the mainstream media, they are certain that science isn't attractive to most readers. "Vikhola" started to publish local authors because of a technical problem — they didn't have the costs to buy copyrights from foreign authors or experience leading such negotiations. Under the influence of "Vikhola", other publishers have also started to publish popular science books. However, the authors of the books say that the fees are small and wouldn't allow them to earn a living.

We have to "cultivate" Ukrainian popular science authors. Many scientists can write high-quality books, and people will buy them. The system of grant stimuli for book publishing in Ukraine isn't flexible enough; it obligates to do a promo campaign for books that are not sold but given to libraries for free. The Ukrainian context is both an advantage and a disadvantage for book publishing and content-making abroad; this is motivated by a certain mistrust of Ukrainian science by foreign readers and too small a number of translators ready to translate from Ukrainian into, say, Finnish or Croatian to make it profitable and high-quality. Ukrainian book publishing is a way to fight the inferiority complex of both authors and readers, who were in the biased Russian environment for a long time, where Russian and English language books were the best, and Ukrainian ones were perceived with prejudice.

[4] Interview with Jakub Bochinski, September 23, 2023

Section 3. Science popularization in Ukraine during the pandemic and full-scale Russian invasion

During the pandemic, science popularization went online, and part of the audience fell away due to the impossibility of offline events. The online format has its advantages and disadvantages; the loss of the effect of the presence of the lector and, correspondingly, the loss of the unique experience is a disadvantage, as science popularization also contains elements of performance, interaction with the audience, and different levels of immersion and interpersonal interaction. A certain level of immersion and interaction with the audience allows one to adapt to the spectator offline. On the other hand, online, the lecturer doesn't see the faces of the audience and can't understand their reaction. Therefore, it's harder to see whether the information should be simplified more or if it's possible to move on to the next question. When discussing the target audience of popular science content, the respondents can't define it clearly; it's a broad audience, both geographically and in age.

The move of popular science content online has several advantages. For instance, the most crucial benefit is the ability to increase the scale of the lecture's audience to move outside the limits of the auditorium, the city, or even the country. Besides that, the pandemic has provoked the development of different platforms for online meetings that allow recording the event and then publishing it on the websites of institutions, social media, and YouTube. This has allowed the audience to be broadened even more. Moreover, the practices of online meetings during the lockdown allowed an almost complete erasure of borders for the popularization of science. Any scientist or science communicator in the world can now read a lecture for Ukrainians if there's a possibility of overcoming or avoiding the language barrier. Science journalists can now conduct interviews with scientists from other countries, which speeds up the science popularization process and makes it cheaper. People started to trust science much more during the COVID-19 pandemic, and the demand for Ukrainian content grew since the full-scale invasion began. In particular, an acute demand for expertise appeared during the pandemic, though in a bit primitivized form (informational needs of the audience were limited to questions of washing hands, wearing masks, and keeping social distance). Respondents note that one of the tasks of science popularization in Ukraine is fighting the inferiority complex when there's a widespread opinion that it's better to refer to foreign scientists than our own. Therefore, scientists' visibility in Ukrainian and international contexts validates their scientific oeuvre.

Because of the self-limitation in social media during the war, the networks between

scientists and popularizers have broken. Facebook/Meta has allowed Ukrainian users in the first days of the full-scale invasion to hide their pages. Many users used this feature and also hid the names of their social contacts. If before that, it was possible to review the content of the social network page of a specific person for an analysis of contacts with high and low reputations, now, strangers look more unpredictable. This may erode trust at the beginning of communication and collaboration in social media and hinder the identification of pseudo-scientific networks.

In science popularization, burnout happens as well. Loss of motivation is an important reason for the burnout. Because of journalists' incompetence, there are cases where science popularizers are brought in to discuss a particular topic. Yet, during the conversation, they find themselves answering questions on entirely differnt subjects, be it of social significance or international politics. After the interview, certain remarks from the expert may be taken out or manipulated out of context, to draw attention to the social media pages of the media outlet in question. This discourages the popularizer from communicating with such journalists and providing comments in general.The second factor is financial: most respondents stated that they haven't looked for state funding, and some tried to attract funds and grants from the non-governmental sector but were denied. The respondents gain additional funding from video monetization on YouTube, Patreon, and BuyMeACoffee. Around half of the respondents note the lack of enthusiasm to seek additional funding sources for their activity. Attraction of funds for science popularization is mostly spontaneous and is often based on warm personal contacts when the donors may be interested in the project's implementation.

"This is a fruitful time for all the popularizers, as people have understood the importance of the verified information. During the pandemic, it was important to understand whether it was necessary to wear masks, whether the use of sanitizers was worth it, and whether to keep social distance. That's why science popularizers who explained all this showed themselves relatively well"[5].

Consumers must look for content by themselves instead of content that should seek out its consumers. Science popularizers usually create content fueled by their own enthusiasm. Currently, there's no additional funding for advertising or promotion online. The quality of science popularization content in Ukraine is relatively poor compared to the science popularization content from Russia, as this is not just a financial but political question — for a long time, researchers from Russia were loudly visible in the informational space[6]. Ukrainian popularizers refuse to refer to Russian sources and try to use Ukrainian or English-language sources of verified information.

The priority task for science popularization is to choose an appropriate platform and format. The target audience is of equal importance. There's an issue of catching trends and choosing the right moment when the content may be timely. The value of information is its timeliness. However, when chasing the information drive, there's a danger of losing the depth of elaboration, accuracy, and reliability of the material, as one of our respondents notes. One of the solutions may be a hot database of scientists who are ready to give expert commentary and write columns for the media.

"In the 'Science Against COVID' project, there were two mini-seasons where we gave informational digest, at first, to illuminate primary scientific information. We tried to outrun the media in the interpretation of

[5] Interview with Kyrylo Bezkorovainy, August 4, 2023
[6] Interview with Vadym Zhulenko, August 28, 2023

scientific publications. In the second season, we tried to explain separate research publications about the coronavirus pandemic or vaccination more in-depth."[7]

Ukrainian science popularization may influence neighboring countries. For instance, our respondents note that Ukraine and its experience in science popularization may be useful for Belarus, where the language question and the question of identity are very acute, as the majority of the content it produces is in Russian. When asked whether the Ukrainian popular science content may be interesting abroad, our respondents answered that the quality has to be high to go to the international level, where the Russian narrative tends to dominate. Building a community by the Ukrainian diaspora, who may be a voice for Ukraine, is also relevant.

The media may help broaden the audience for science popularization. Well-known TV channels, radio, and online publications help scientists be heard by thousands by inviting them to comment on some phenomenon or event. This way, the efficiency of their public appearance grows exponentially. However, many Ukrainian scientists refuse to give commentary to journalists, as they fear that their words will be distorted during the editing of the material. The level of training of scientific journalists in Ukraine is indeed low, so training with the involvement of international experts can improve the situation.

The pandemic and the full-scale invasion have benefitted the development of the Ukrainian YouTube segment. Ukrainian language channels started to develop intensely after February 24, 2022, as many people have refused to use the Russian language completely. Popularizers of natural, social sciences, and humanities are not an exception. However, YouTube has an interesting limiting factor — the financial question connected to copyrights for illustrations that are sometimes too expensive, but using them improves the quality and meaningfulness of the content.

The war causes psychological exhaustion for both popularizers and consumers of popular science information, but for many, popular science helps hold on. All of our respondents noted during the interview that they couldn't produce content for the first couple of months of the full-scale invasion, and the people were only interested in the news. However, in the summer of 2022, people started paying more attention to popular science content online and offline. This served as an opportunity to distract and forget about the war.

During pandemics, nuclear war threats, or other types of industrial disasters, the need to hear from researchers-experts of the corresponding fields grows in society. During the danger, people are moved by fear, and they try to fight uncertainty by at least understanding what may happen to them. Thus, we saw bursts of public demand for information on coronavirus, atomic energy, the consequences of the terror attack on the Kahovka Hydroelectric Power Plant, sleep and recovery during mass shellings, reproductive technologies of delayed parenthood for the military, etc.

Among the hypotheses of our research was the question of **whether the experience of science popularization in Ukraine during the war may be useful for other countries.** Our respondents are unanimous in their positive answers.

The science popularization sphere is a part of the life of all Ukrainian society; therefore, like all other Ukrainians, our popularizers are an example of resilience and endurance. Despite all the difficulties, they proceed with their work, organizing special events for the military that aim to help their psychoemotional state. For example, in our in-depth interview, Olga Maslova noted that in spring 2022,

[7] Interview with Artem Albul, August 28, 2023

she organized events for the military where she spoke about the importance of sleep in emergency conditions[8]. She is also a co-author of a *booklet about sleep and rest for the military.*

Even while at the frontlines, Ukrainian scientists proceed with their popularization projects[9]. For example, Vitalii Shevchuk, the author of the "Цікава наука" ("Interesting Science") project, Vakhtang Kipiani, the main editor of the "Історична правда" ("Historical Truth") online publication, the historian Oleksandr Alfiorov, and the radiobiologist Serhii Paskevych all serve in the Ukrainian Armed Forces and proceed with their popular science projects.

Science popularization is one more example of the activity that continues despite all... as this is one of the components of society's life. It's what gives benefit, entertainment, and unity. It's a component of ordinary life in Ukraine now. The fact that it still exists is a sign of our resilience, strength, and survival"[10].

Ukrainian popular science sphere is an example of **how popular science projects can be in solidarity, be selfless, exist without donor funding[11]**, and proceed with their activities fueled by their own enthusiasm without stable funding. The popular science projects included in our research exemplify how it's possible to create content and exist in crisis periods.

The Ukrainian experience exemplifies how popular science book publishing in crisis times may become profitable and gain a new stimulus for development[12]. A short pause that was visible in all spheres of social life, in general, lasted until the summer of 2022, and then the recovery period started. Popular science publishing wasn't an exception, and the level of the Ukrainian demand for reading returned to prewar times. It has even grown to a certain extent, as, for example, the "Локальна історія" ("Local History") magazine is planning to start its own publishing of popular science books[13].

"In June of 2022, we published the book 'A Zoological Walk in a Supermarket' by Leonid Horobets. Then we saw that people needed books. We launched preorders and saw that the demand was at the same level as before the war."[14]

The Ukrainian experience in science popularization may be of use, first of all, to the countries of Eastern Europe that are undergoing the decolonization process, and where the image and the influence of Russian science were undeniable, for example, Belarus, Bulgaria, Armenia, Azerbaijan, Romania, Hungary, Moldova, and Slovakia. It's doubtful this experience may be copied; rather, it can be adapted to other unique crisis conditions[15].

[8] Interview with Olga Maslova, August 10, 2023
[9] Interview with Vitali Liaska, August 29, 2023
Interview with Lilia Kazantseva, August 30, 2023
[10] Interview with Olga Maslova, August 10, 2023
[11] Interview with Serhii Goncharov, August 28, 2023
[12] Interview with Ilona Zamotsna, "Vikhola" publisher, August 22, 2023
[13] Interview with Vitali Liaska, August 29, 2023
[14] Interview with Ilona Zamotsna, "Vikhola" publisher, August 22, 2023
[15] Interview with Anna Nikolaieva, August 25, 2023

Section 4. Science popularizers vs. disinformation and pseudo-expertise

Russian disinformation and pseudo-expertise, especially in its political dimension, has strengthened in Ukraine after the annexation of Crimea and the beginning of the armed conflict in Donbas in 2014. The "Українська призма" ("Ukrainian Prism") analytical center, together with colleagues from countries of Eastern and Central Europe, have done research to evaluate the *Disinformation Resilience Index*. The analytics have ascertained that Eastern and Central European countries *became a laboratory* to try out new methods of Russian propaganda. The Ukrainian authorities and non-profits have put a lot of effort into improving national resilience in different spheres, in particular, in the information space. At the same time, the Russians continued to lead systemic information warfare that focused first of all on the vulnerable groups of society (senior people, Russian-speaking minorities, the faithful of the church of Moscow Patriarchate, youth under 25, etc.). To do this, they were *using lies*, spreading disinformation about specific people or political forces, or creating a whole stream of contradictory information to confuse the audience. *The main techniques* of the Russian influence on information were socio-cognitive hacking, false identities, malicious use of technology, disinformation, rhetoric manipulation, and symbolic actions.

Partially, the Russian disinformation campaign in Ukraine had its results. According to the conclusions of *the research on the audience of (pro)Russian media* done by the analytics of Texty.org.ua, in 2021, Ukrainian users made 118 million visits to poor-quality news websites per month. These websites spread fakes, manipulations, and Russian propaganda. Pro-Russian Telegram channels had more than 2 million subscribers, pro-Russian YouTube channels received more than 120 million views per month, and nearly 61% of Ukrainian Facebook users published links to unreliable websites. Two of these websites have made it to the top ten informational pages in the Ukrainian Facebook segment.

On the eve of the full-scale invasion, a campaign in Russia began to justify the need to start the war. The analytics of the *Atlantic Council* have identified the main claims Russia used to convince its citizens of the need to wage a war. Among these claims are: "The Ukrainian army and volunteers commit violence against the civilians", "Ukraine doesn't exist as a state", "Ukrainians are Nazis", "Russia wants peace and bears responsibility for the "protection" of the region", "Ukraine supports terrorism", and "The west creates tension in the region". In the international information space, they started to spread open lies about the existence of secret bio labs on Ukrainian territory and the attempts to create a "dirty atomic bomb".

After February 24, 2022, Russian disinformation in Ukraine has strengthened. Russian state officials, foreign language Russian media resources, proxy sources, separate pages on social media, hacker attacks and operations, the activity of Russians in international institutions, and the Russian church spread it. The analytics of the Dixi group have shown *with the example* of the disinformation campaign around the situation at the Zaporizhzhia Nuclear Power Plant, that by discrediting Ukraine, Russia, at the same time, has tried to show itself a reliable and safe partner who defends the plant from an industrial catastrophe and other outer threats.

Russian disinformation undermines the human right to access to information. The analysts of the independent non-profit organizations have prepared a report *"Disinformation as a Human Rights Abuse in the Context of the Russian Invasion of Ukraine"*, where they justify the claim that *disinformation* is, in fact, a limitation of the human right to access to information, and free forming and expression of opinions, and, in general, undermining trust to democratic institutions, propaganda of violence, and justification of war crimes and crimes against humanity. That's why Russian disinformation has at least a couple of dimensions: international, directed at the illumination of the war in Ukraine in the light beneficial to Russia and undermining the support our country has; Ukrainian, directed at division and spread of mistrust to the Ukrainian authorities and the Ukrainian Armed Forces; and regional, directed at existing or historical contradictions between Ukraine and its closest neighbors.

Trust in science helps both society and science itself. The experience of fighting fakes about the pandemic we have analyzed shows that public trust in science during the pandemic *has allowed the creation* of a foundation for enlarging its role in society and implementing science-based policies. For Ukraine, this is also a chance for societal support of a rational reform of the scientific sphere provided with appropriate resources. To do this, we should learn a lesson from the pandemic — **an essential condition of success for popularization measures during crises is to create a stable collaboration between scientists, journalists, and the public and to take the audience's demands into account.** The research results show that different media audience members have different information needs and thus prefer different communication styles. That's why popularizers have to adapt their scientific information to the chosen audience's needs.

Researchers should reach out to mass media. During crises, scientific journalists have to play a particular part; it's crucial for them to carefully choose scientific experts to comment on the problems that arise in the crisis to avoid the spread of disinformation, conspiracy theories, and society's polarization. The experience of the pandemic *shows* that scientists with verified expertise in the appropriate scientific field should appear in mass media (instead of those who don't have enough experience in the appropriate field). The public's desire to receive clear, scientifically verified decisions can be naïve to a certain extent. However, independent decision-making in complex scientific questions without relying on scientific data can have more negative consequences. That's why the role of scientists-communicators is rather important here.

In Ukraine, there's a critical lack of scientific journalists. The science popularizers we interviewed also noted an acute lack of scientific journalists in Ukraine who would understand the specifics of reporting on popular science topics and wouldn't distort the information they got from scientists. In Ukraine, before the pandemic, there were three specialized courses in scientific journalism — at the Ukrainian Catholic University, the National University of Kyiv Mohyla Academy, and the Taras Shevchenko Kyiv National University.[16] Since 2021, there are also such courses at the Uzhhorod National University, Ivan Franko Lviv National University, and Vasyl Stefanyk Prykarpattia National University. In 2021, the Inscience non-profit started a course called "Science, COVID-19, Vaccination: How to Create High-Quality Content" together with the UN Children's Fund (UNICEF) in Ukraine with the support of the US Agency of International Development (USAID). This is, of course, too little for the scale of the whole country, especially in the conditions of the war and information attacks of the enemy[17]. Thus, there's a need to

[16] It should be noted that there's also a course in popular science journalism at the Yurii Fedkovych Chernivtsi National University since 2017 [in Ukrainian]
[17] Interview with Kyrylo Bezkorovainy, Kunsht magazine, August 4, 2023

create separate courses for representatives of other journalistic specialties or, in general, for those who would like to popularize science. This need appeared before the full-scale invasion and even before the pandemic[18].

The social sciences and humanities popularizers consider themselves able to withstand Russian disinformation. People and projects that popularize such sciences as history, ethnology, anthropology, and politology see the possibilities and successes of such a fight. The war and a special accent of Russian propaganda on historical questions have positively affected the development and growth of the audience of several Ukrainian channels.[18]

Like the pandemic in its time, the full-scale Russian invasion gave a new impetus to popularizing projects in certain directions. The topics for popularization appeared that were not encompassed by the existing projects, which provoked the appearance of new ones, like the channel *"Пороблено"* ("Cursed"). The war also provoked a change in the topics of channels; for example, a historical YouTube channel "WAS. Популярна історія" *("WAS. Popular History")* was mostly Russian-speaking before the full-scale war and encompassed general historical topics, whereas, after the beginning of the invasion, it became fully Ukrainian and started to pay more attention to elucidating questions of the military history.[19]

"People started to look for their own identity. In the first year of the war, our print circulation has tripled. The war has prompted people to become interested in their own history."[20]

"After the full-scale invasion, we have understood that there is no anthropological research at all currently. So when to popularize science if not now?"[21]

The attempts to counteract disinformation among the Russian citizens weren't successful. The channels that had a high percentage of Russian-speaking viewers at the beginning of the full-scale invasion have even oriented their products toward counteracting disinformation among Russians. Later, seeing that it had no effect, they abandoned this idea.

"...now the feeling that ordinary Russians could be convinced looks naive. They are in an information blockade and don't know that the Russian army is bombing cities and civilian neighborhoods; they believe their propaganda that they attack military objects only. Now, it sounds ridiculous that many Ukrainians have hoped for them being convinced. It looked appropriate and like a contribution to counteracting the aggressor at that moment. We thought that if we made videos with the truth about the war on a Russian-speaking channel with a couple of hundred subscribers, this would have a certain effect. These were the shots of civilian neighborhood shellings with a textual explanation. The videos everyone in Ukraine could see looked unavailable to many Russians."[22]

During the war, scientists and popularizers are facing the problem of mythmaking and propaganda on the Ukrainian side. The Ukrainian popularizers we interviewed think that one should pay attention to the topic of popularization, how it will be perceived in society, and whether it won't inadvertently play along with Russian propaganda[23]. For example, it's believed that the practice of snokhachestvo (the practice when the head of the family has sexual intercourse with his daughter-in-law)was characteristic only to Russian rural society in the 18th - 19th centuries. Ukrainian ethnologists have documented it in Hutsulshchyna as well. This fact is known to researchers, but is it worth

[18] Interview with Olga Maslova, August 10, 2023
[19] Interview with Eduard Andriushchenko, August 24, 202
[20] Interview with Vitali Liaska, August 29, 2023
[21] Interview with Anna Nikolaieva, August 25, 2023
[22] Interview with Eduard Andriushchenko, August 24, 2023
[23] Interview with Vitali Liaska, August 29, 2023

it to elucidate this question to the public while popularizing ethnological research in Ukraine while we are at war?

"...We haven't found the answer to this question. Should we explain this now to Ukrainian society, which currently clearly believes that we differ from Russians by not having this terrible tradition? But we had it. Such topics also exist. We should think about whether we should raise them or not. Like, we will raise it now. What will we do with it? What will we gain from it? A small circle of researchers knows about this. Should we talk about it now?" [24]

At the same time, keeping silent about the existence of myths in our own society is against scientific values. When choosing a topic for popularization, the role of the popularizer is important; they should understand the needs of their audience and the general context in which society lives during the crisis.

Disinformation is generated easier than debunked. Popularizers, and scientists in general, have a hard time counteracting disinformation and fakes because of their material preparation methods.

"...a scientist is limited by the need to constantly look for sources of information, while an author of fakes isn't limited by anything, they can simply write..."[26]

A swift reaction to Russian disinformation leads to blind following the narrative formed by the enemy instead of constructing our own. Reactive behavior is the easiest way to create content: here's the myth, here's the refutation. However, the efficiency of direct refutations is *doubtful*. Our respondents think so too:

"...because Russia is a trigger, Russia is a catalyst, we want to deconstruct Russian myths, but when you start doing this in one way or another, you move into the Russian paradigm. It's a big problem."[26]

"...To debunk myths and say that it's bad and not true — it doesn't work. You probably just make this topic more visible and hot."[27]

The desire to react swiftly to the current event without enough expertise may turn out to be a communication failure and spread of disinformation. For example, a well-known story about the trenches in the Red Forest in Chornobyl[28], where there were indeed trenches, but not in the place and not with the consequences the media excitedly talked about. Yes, the Russians really dug trenches in the most contaminated place in the Exclusion Zone — the Red Forest. However, it's important to differentiate: there is the "Red Forest" point of temporary location of radioactive waste — storage clamps where the contaminated biomass (trees, shrubs, and the top layer of soil) were buried — and also the Red Forest tract — the territory where this biomass was taken from. The Russians trenched their positions not on the storage clamps but on the cleaned-up territory of the tract. Ukrainian media have also spread information from Russia about the supposed lethal cases of acute radiation syndrome. After the de-occupation, the representatives of the IAEA arrived on the grounds where the trenches were dug and took the soil probes. Even if the Russians lived there without getting out for all these 35 days, they would have gotten the cumulative dose of 0.6 mSv, whereas for the development of the slightest symptoms of acute radiation syndrome, a two-orders larger dose — 0.5 Sv — is needed. Still, this story has already become one of the legends of this war and is told in this format even by *official information sources* and certain opinion leaders.

[24] Interview with Anna Nikolaieva, August 25, 2023
[25] Interview with Leonid Horobets, August 11, 2023
[26] Interview with Vitali Liaska, August 29, 2023
[27] Interview with Serhii Honcharov, August 28, 2023
[28] Interview with Kateryna Shavanova, August 15, 2023

A useful method of counteracting disinformation is explaining the general methodology and cognitive distortions of the supporters of pseudoscientific ideas. The "Клятий раціоналіст" ("Damned Rationalist") project — the channel that existed before the full-scale invasion and the pandemic — is an example of such content adaptation to new crisis conditions. After a short pause at the end of February 2022, the channel returned to its audience with new videos of a more social direction. Among others, there were videos with popularization of blood donations, analysis of the Russian newspeak, etc., and also detailed overviews of stereotypes and pseudoscientific myths, like magical thinking, medical charlatanism, etc. This way, the channel aimed to counteract Russian disinformation indirectly.[29]

"...The best way to fight disinformation is to cultivate critical thinking,"[30] — thinks Kateryna Shavanova. After all, if a person relies on scientific information in their worldview, they are less prone to fall for manipulation of all sorts and enemy propaganda. It's important to promote explanations of the meaning of critical thinking to the audience, about the need to work with sources, and to teach how to check information[31], and science popularizers should orient on forming their own full-blown popular science discourse independent of the informational news stream[32].

For well-known foreign Ukrainian studies researchers and Ukrainian diaspora representatives, it's easier to counteract disinformation abroad. The whole world's attention to Ukraine has provoked interest in Ukrainian history and culture. We should only mention the number of views of the course about the history of Ukraine by the historian of Ukraine, Timothy Snyder, and his personal role in popularizing this scientific field in the world. Or the historical research of the Ukrainian historian Serhii Plokhii, the Harvard Ukrainian Research Institute director. The role of researchers in Ukrainian studies and our scientific diaspora in this area is important also because it's hard for science popularizers from Ukraine to reach out to the international audience.

International sanctions contribute to decreasing disinformation in Ukraine through Russian book publishing. Because of the imposed sanctions, there has occurred a reorientation of foreign book publishing in Ukraine, companies for which often sold the copyright for translations through Russia. This allowed Russians to adapt translations to their information needs as well.

"...the book publishing abroad is too engaged with Russians. That is, a lot of agencies, for example, sold copyrights for a book in Ukraine through Russia. Because of this, we couldn't translate part of the books into Ukrainian because Russians had the copyright."

Pseudo-expertise is a factor that contributes to the spread of disinformation. The desire of the audience to get swift and plain answers to complex questions, and, on the other hand, insufficient flexibility of the state authorities, low professionalism of the media, and low publicity of the researchers become the reasons for the pseudo-experts' rapid gain in popularity. The analysts from Texty.org.ua, in their *analysis of the most popular "experts"* in Ukraine, state that Ukrainian YouTube during this period is developing relatively chaotically, and the television has become uninteresting and unable to satisfy the growing demand for more new information, which has led to the spread of pseudo-expertise. We should also mention the *disinformation campaigns during the pandemic* in Ukraine, the marches of the so-called "anti-vaxers" and conspiracy theorists who tried to gain political weight this way.

[29] Interview with Artem Albul, "Клятий раціоналіст", August 28, 2023
[30] Interview with Kateryna Shavanova, August 15, 2023
[31] Interview with Olga Maslova, August 10, 2023
[32] Interview with Leonid Horobets, August 11, 2023

Journalists play a crucial role in choosing experts. *An expert* is considered a person with the knowledge and experience in the field that is being publicly commented on. Scientific experts should have a reputation in the scientific community through publications in respected scientific journals. Journalists can check the information about such experts in the profile at Google Scholar, Scopus, or Web of Science or by visiting a page of an official institution the expert is affiliated with[33]. At the same time, during the pandemic, medical professionals who don't have scientific publications but are competent in treating and preventing certain diseases can have specific expertise. However, this competency is hard to verify, so the medics who openly stated pseudoscientific ideas have often become popular in the media.

Journalists, in their choice, are often moved by the interests of the media sphere more than the question of the expert's reputation in his field. The research shows that, in reality, it's not the researchers most respected in the scientific sphere who become experts in the media. Journalists are moved by other factors, like the news context, local or regional proximity, political and cultural intelligibility, influence of the institutions, availability of the researcher, and their ability to speak clearly. The media popularity of a scientist, their previous statements, and controversies around these statements also influence the journalists' choice.

It's possible to expose a pseudo-expert by a number of signs, but it will be unconvincing for a part of their audience. For example, the English-speaking popular science channel *Veritasium*, in their video from 2022, "The 4 things it takes to be an expert," gives four conditions to consider a person an expert. These are deliberate practice, a valid environment, many repetitions, and timely feedback.

"...the problem is that a person who pretends to be an expert is not limited in their claims; they can absolutely freely interpret data and give the audience that, for which there's a demand and what the audience wants to hear. That's why it's much easier for any pseudo-expert to win supporters and simply to gain views and clicks than for a person who will care about the correctness of their every word."[34]

Our respondents also note in the in-depth interviews the fact that it's hard to fight pseudo-experts, persons, who deliberately give distorted information to a specific audience, as they are aware of the audience's demand and give "simple answers to complex questions". As well as to convince the audience who listens to pseudo-experts of the falseness of their opinions.

In their turn, real experts and scientists offer their audience to think critically, to look for more information sources, to analyze it, and to understand that there are, in fact, no simple answers. We can counteract pseudo-experts through the educational level of the media representatives (journalists), who would care about the correctness of the given information, understand their target audience, and strive to engage scientists to comment. The bigger the presence of such experts in the information space, the higher the probability that the undecided and those on the edge between the opinions of a pseudo-expert and an expert will be engaged on the side of critical thinking. The experts and science popularizers themselves should be more socially active, understand the situation with expertise in their field, and contribute to building the institute of reputation.

[33] Interview with Vitali Liaska, August 29, 2023
[34] Interview with Artem Albul, "Клятий раціоналіст", August 28, 2023

Recommendations

Our recommendations are structured according to the main stakeholders of the science popularization sphere in Ukraine.

We think that all the groups **should contribute to the spread of understanding of the value of science popularization and its importance in the development of a modern state; they should perceive it as a social boon and, in times of crisis, as one more means of support for society's resilience and counteracting the negative consequences of the crisis.**

General recommendations during crises:

1. Support popularization projects with all available resources, as many are vulnerable to crisis factors.
2. Spread the understanding among the stakeholders that science popularization is a necessary element of creating intellectual and technological resilience to crises in society, even despite the absence of direct and measurable results of science popularization.
3. Engage scientists and popularizers in the communication of complex scientific subjects in crisis periods, where expertise and clear language can influence public opinion.
4. Contribute to the visibility of the local scientists to increase trust in popular science information among the population in critical periods.

For central and local authorities:

1. Consider the possibility of creating an overall state strategy for developing the science popularization sphere aiming to increase the level of understanding of the popularization's value. The document can be considered a part of state measures to unify society in conditions of war, economic revival, and an increase in the society's educational level.
2. Continue supporting the development of the science popularization sphere on the state and local levels and contribute to organizing and holding popular science events.
3. Continue to work on a full-scale launch of the direction of support for popular science projects in the National Research Foundation of Ukraine. Provide appropriate funding for this direction.

4. Create diversified support programs for science popularization on the state, regional, and local levels. Provide the ability for science popularization projects to participate in participatory budgets. Include funding to support science popularization participatory projects in local and state budgets and attract funding from international donors.
5. Initiate prizes, distinctions, and rewards in the science popularization sphere.
6. Initiate an audit of book publishing funded by the state and include funding for popular science book publishing, especially in natural and technical sciences, in the state budget.
7. Support private initiatives of Ukrainian popular science book publishing using legal and financial stimuli, particularly through state foundations like the Ukrainian Book Institute or the Ukrainian Cultural Foundation.
8. Engage science popularizers in state and local communication campaigns about overcoming the consequences of crises.
9. Continuously engage science popularizers in all possible state programs of counteracting propaganda and disinformation of the enemy, while it's more effective to outpace Russian fakes than to debunk them.
10. Develop legal grounding for creating press services and information centers at scientific institutions and universities that would contribute to popularization activity and simplify journalists' search for experts.

For the scientific community:

1. Be open to communication and collaboration with the existing popular science projects to popularize your developments. Respond to business requests to explain complex scientific questions, and during crises, be ready to join expert groups.
2. Adapt popular science projects to the needs of different target audiences. Popularization shouldn't be a plain simplification of complex scientific information; first of all, it should motivate the audience to evaluate it critically.
3. Look at science popularization activities not as an additional workload but as participation in overall popularizing your field of knowledge and increasing its social weight. At the same time, there should be no formal load of popularization activities for scientists, and if it's imposed by administrative methods, the orders should include additional resources.
4. Spread the understanding among colleagues and the scientific community that science popularization is a necessary element to attract resources for the development of scientific research and new people who would do this research.

For the media:

1. Start special professional courses for scientific journalists involving experts from countries with a high level of scientific journalism. At least until our professionals gain the necessary knowledge and experience.
2. Create an informal database of scientific experts on different topics who would give a professional evaluation of some "hot" events or phenomena and popularize it among journalists.
3. Contribute to developing a network of science communicators who would help journalists from the central and regional media find the necessary experts or give commentary within the limits of their expertise.
4. Collaborate with and actively engage the Ukrainian scientific diaspora in popularizing science in the Ukrainian media. Consider it an additional means of their reintegration into Ukrainian space.

For the business community:

1. Consider your participation in support of popular science projects as another dimension of your social responsibility. Follow the best practices of the international businesses.
2. Pay attention to popular science projects in your field. If there are none, encourage

their creation among Ukrainian scientists and stakeholders, for example, by holding a separate grant competition.
3. For high-tech businesses, science popularization is one of the ways to spread understanding of the necessity of the offered goods and services among the population and also broaden the circle of potential employees.
4. Continue to support popular science projects and popular science book publishing; remember that growth in the popularity of a certain professional field will, in the future, increase the state's overall economic development.
5. Engage the popularizers more intensely in holding public lectures, trainings, and seminars for the company's employees.

For the countries in crisis or war conditions:

1. Encourage grassroots initiatives to develop popular science projects. The Ukrainian experience shows that popularizers see their activity not just as communication of scientific knowledge to the broad public but also as a part of their civil activities. The Revolution of Dignity has become an impetus not just for volunteering and non-profit initiatives but also for popular science.
2. The existence of a grassroots popular science community is useful for society; it contributes to the population's education and increases the level of critical thinking. The state should pay attention to popular science projects, even if it wasn't involved with their organization, and offer support in certain moments.
3. Understand that the sphere of science popularization is not a panacea in fighting fakes, disinformation, and pseudo-expertise, and it won't defeat these phenomena by itself. However, it is a necessary condition to prevent their appearance and overcome the negative consequences of their existence.
4. Oversimplification of scientific information may lead to the increase in polarization and politicization of society and contribute to the spread of pseudoscientific ideas.
5. During crises, science popularization may be considered a part of the overall state measures to unify society and increase the level of patriotism.
6. Science popularization is also a part of entertainment (or edutainment) for the population that lives in crisis conditions and is under constant stress. Improving the mental state of the vulnerable groups of the population and society overall is one of the aims of popular science projects.

Sources

1. (1986). Science popularization: its history, triumphs and pitfalls. URL: *https://unesdoc.unesco.org/ark:/48223/pf0000071156.locale=en*.
2. Martín Bonfil Olivera. Science popularization as a study subject. URL: *https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=21b5eaa68c14bcbfdde1278b74b43d146b12f8f3*.
3. Désirée Motta-Roth, Anelise Scotti Scherer (2016). Popularização da ciência: a interdiscursividade entre ciência, pedagogia e jornalismo. Bakhtiniana, Rev. Estud. Discurso 11 (2) • May-Aug 2016. URL: *https://doi.org/10.1590/2176-457323671*.
4. Somsen, G. (2022). Afterword: Science popularization, dictatorships, and democracies. History of Science, 60(3), 430–435. *https://doi.org/10.1177/00732753211073422*.
5. Gunnarsson Andreas (2012). Unleashing Science Popularisation. Studies on Science as Popular Culture. URL: *https://gupea.ub.gu.se/bitstream/handle/2077/28928/gupea_2077_28928_1.pdf?sequence=1&isAllowed=y*.
6. Закон України «Про наукову і науково-технічну діяльність». URL: *https://zakon.rada.gov.ua/laws/show/848-19#Text*.
7. Комащенко І. І. Популяризація наукових результатів в умовах сучасного інформаційного світу. Science and Education a New Dimension. Humanities and Social Sciences, VI(29), I.: 178, 2018 Sept. *https://doi.org/10.31174/SEND-HS2018-178VI29-14*.
8. Озерна Дарка. Як говорити про науку та себе в ній. Практичні поради з популяризації науки та гендерно чутливого викладання STEAM. URL: *https://ukraine.unfpa.org/sites/default/files/pub-pdf/2_posibnyk_dlya_naukovyc_29.08_veb_2.pdf*.
9. Crisis. URL: *https://www.merriam-webster.com/dictionary/crisis*.
10. Reddy Christopher (2023). Science Communication in a Crisis An Insider's Guide. Routledge. 172p.

11. Li, Hong, and Kuohsun Wen. (2022). Research on Design of Emergency Science Popularization Information Visualization for Public Health Events-Taking "COVID-19"as an Example Sustainability 14, no. 7: 4022. *https://doi.org/10.3390/su14074022*.
12. Harambam, J., Grusauskaite, K., & de Wildt, L. (2022). Poly-truth, or the limits of pluralism: Popular debates on conspiracy theories in a post-truth era. Public Understanding of Science, 31(6), 784–798. *https://doi.org/10.1177/09636625221092145*.
13. Bennett, W., & Livingston, S. (Eds.). (2020). The Disinformation Age (SSRC Anxieties of Democracy). Cambridge: Cambridge University Press. doi:10.1017/9781108914628.
14. Post, S., Bienzeisler, N., & Lohöfener, M. (2021). A desire for authoritative science? How citizens' informational needs and epistemic beliefs shaped their views of science, news, and policymaking in the COVID-19 pandemic. Public Understanding of Science, 30(5), 496–514. *https://doi.org/10.1177/09636625211005334*.
15. Leidecker-Sandmann, M., Attar, P., Schütz, A., & Lehmkuhl, M. (2022). Selected by expertise? Scientific experts in German news coverage of COVID-19 compared to other pandemics. Public Understanding of Science, 31(7), 847–866. *https://doi.org/10.1177/09636625221095740*.
16. Rekker, R. (2021). The nature and origins of political polarization over science. Public Understanding of Science, 30(4), 352–368. *https://doi.org/10.1177/0963662521989193*.
17. Rutjens, B. T., Zarzeczna, N., & van der Lee, R. (2022). Science rejection in Greece: Spirituality predicts vaccine scepticism and low faith in science in a Greek sample. Public Understanding of Science, 31(4), 428–436. *https://doi.org/10.1177/09636625211061520*.
18. Rutjens, B. T., Sutton, R. M., & van der Lee, R. (2018). Not All Skepticism Is Equal: Exploring the Ideological Antecedents of Science Acceptance and Rejection. Personality and Social Psychology Bulletin, 44(3), 384–405. *https://doi.org/10.1177/0146167217741314*.
19. Rutjens, B. T., Zarzeczna, N., & van der Lee, R. (2022). Science rejection in Greece: Spirituality predicts vaccine scepticism and low faith in science in a Greek sample. Public Understanding of Science, 31(4), 428–436. *https://doi.org/10.1177/09636625211061520*.
20. Has the pandemic changed public attitudes about science? URL: *https://blogs.lse.ac.uk/impactofsocialsciences/2021/03/12/has-the-pandemic-changed-public-attitudes-about-science/*.
21. Bromme R, Mede NG, Thomm E, Kremer B, Ziegler R (2022) An anchor in troubled times: Trust in science before and within the COVID-19 pandemic. PLOS ONE 17(2): e0262823. *https://doi.org/10.1371/journal.pone.0262823*
22. Bienvenido León, Ignacio López-Goñi & Ramón Salaverría (2022) The Covid-19 catastrophe: A science communication mess?, Church, Communication and Culture, 7:1, 6-22, DOI: 10.1080/23753234.2022.2031236.
23. Atamanenko, A., & Martyniuk, N. (2022). Science diplomacy in the globalized world: conceptualization of the phenomenon. Acta De Historia & Politica: Saeculum XXI, (04), 88–98. *https://doi.org/10.26693/ahpsxxi2022.04.088*
24. Katz-Kimchi, M. (2012). Screening science, producing the nation: popular science programs on Israeli television (1968–88). Media, Culture & Society, 34(5), 519–536. *https://doi.org/10.1177/0163443712442699*.
25. Science Culture in Korea. URL: *https://www.wissenschaftskommunikation.de/science-culture-in-korea-4993/*.
26. Наукова та науково-технічна діяльність в Україні у 2019 році: науково-аналітична доповідь / Т.В. Писаренко, Т.К. Куранда та ін. Київ: УкрІНТЕІ, 2020. 109 с.
27. Disinformation Resilience in Central and Eastern Europe. URL: *https://prismua.org/wp-content/uploads/2018/06/DRI_CEE_2018.pdf*.
28. Індекс стійкості до російської дезінформації. URL: *https://prismua.org/dri/*.
29. Тихомирова Є. Б. Аналітична робоча група зі стратегічних комунікацій East Stratcom: аналіз оглядів дезінформації. International relations, part «Political sciences», No 15 (2017). URL: *http://*

journals.iir.kiev.ua/index.php/pol_n/article/download/3115/2796.
30. Посібник з протидії дезінформації. Розроблено працівниками Центру протидії дезінформації робочого органу Ради національної безпеки і оборони України за підтримки Консультативної місії Європейського Союзу в Україні. URL: *https://cpd.gov.ua/announcement/posibnyk-z-protydiyi-dezinformacziyi/*.
31. Сотні тисяч. Яка аудиторія (про)російських медіа в Україні. URL: *https://texty.org.ua/projects/103537/pro-audytoriyu-prorosijskyh-media-v-ukrayini/*.
32. Narrative Warfare. How the Kremlin and Russian News Outlets Justified a War of Aggression against Ukraine. URL: *https://www.atlanticcouncil.org/wp-content/uploads/2023/02/Narrative-Warfare-Final.pdf*.
33. Бойові комарі, брудна бомба і втеча Зеленського. 10 найабсурдніших фейків російської пропаганди. URL: *https://www.pravda.com.ua/columns/2023/01/10/7383506/*.
34. «Настав той день, коли ми всі визнали, що інформація стала ще одним видом зброї»: архітектура російської дезінформації. URL: *https://dixigroup.org/wp-content/uploads/2023/08/ukr-paper_arhitektura-rosijskoyi-dezinformacziyi.pdf*.
35. Disinformation as a Human Rights Violation. URL: *https://www.dt-institute.org/disinformation-as-a-human-rights-violation/?fbclid=IwAR19PDXICkrzgZi89yC2pkWidQ7fQCSKghXD6-5_JJsYBElgkFboqL3gRX4*.
36. Дезінформація як порушення прав людини в контексті російського вторгнення в Україну: фаховий звіт. URL: *https://rpr.org.ua/news/dezinformatsiia-iak-porushennia-prav-liudyny-v-konteksti-rosiyskoho-vtorhnennia-v-ukrainu-fakhovyy-zvit/*.
37. Has the pandemic changed public attitudes about science? URL: *https://blogs.lse.ac.uk/impactofsocialsciences/2021/03/12/has-the-pandemic-changed-public-attitudes-about-science/*.
38. Post, S., Bienzeisler, N., & Lohöfener, M. (2021). A desire for authoritative science? How citizens' informational needs and epistemic beliefs shaped their views of science, news, and policymaking in the COVID-19 pandemic. Public Understanding of Science, 30(5), 496–514. *https://doi.org/10.1177/09636625211005334*.
39. Leidecker-Sandmann, M., Attar, P., Schütz, A., & Lehmkuhl, M. (2022). Selected by expertise? Scientific experts in German news coverage of COVID-19 compared to other pandemics. Public Understanding of Science, 31(7), 847–866. *https://doi.org/10.1177/09636625221095740*.
40. How to counter pseudoscience; it's not about the evidence. URL: *https://cognitiontoday.com/how-to-counter-pseudoscience-its-not-about-the-evidence/*.
41. Топ найпопулярніших «експертів» у ютубі: від всюдисущого Жданова до «хороших росіян». URL: *https://texty.org.ua/articles/110296/top-najpopulyarnishyh-ekspertiv-v-informacijnomu-youtube-vid-vsyudysushoho-zhdanova-do-horoshyh-rosiyan/?src=main*.
42. Агресор ніколи не обмежується танками – в інформаційному просторі теж війна. URL: *https://www.ukrinform.ua/rubric-antifake/3317602-infodemia-ak-kreml-spriae-posirennu-covid19-v-ukraini.html*.
43. Leidecker-Sandmann, M., Attar, P., Schütz, A., & Lehmkuhl, M. (2022). Selected by expertise? Scientific experts in German news coverage of COVID-19 compared to other pandemics. Public Understanding of Science, 31(7), 847–866. *https://doi.org/10.1177/09636625221095740*.
44. The 4 things it takes to be an expert. URL: *https://www.youtube.com/watch?v=5eW6Eagr9XA&ab_channel=Veritasium*.

Appendix 1. List of Popular Science Projects in Ukraine

This table was compiled by the authors of the white paper at their discretion in the limited time available and at the time of preparing the study. It may contain an incomplete list of popular Ukrainian science projects. The authors did not set out to create a full-fledged guide to such projects. The list allows us to see general trends in the development of science popularisation in Ukraine.

№	Title	Type	Creation	Activity	Closed	Field	Description
1	*AIN.ua*	texts	1999	Yes	No	IT, technology, startups	Probably the biggest website in Ukraine dedicated to technology, startups, etc.
2	*Alpha Centauri*	videos, some texts	2014	Yes	No	astronomy, universe, technology	Popular science resource about the universe, live videos of the carrier rocket launches, Mars rovers, etc.
3	*Археологія. Новини (Ukr. "Archaeology. News")*	links, events	2014	Yes	No	archaeology	Archaeology news.
4	*ANTONOV Company*	texts and photos	2014	Yes	No	aviation, technology	The Antonov planes design bureau.
5	*Astronomy in ua*	texts and videos	2015	Yes	No	astronomy	A wonderful group about astronomy news, events, etc.
6	*BBC. Science*	texts	unknown	Yes	No	science overall	A wonderful section on the BBC website. Professionally and clearly about science in Ukrainian.

№	Title	Type	Creation	Activity	Closed	Field	Description
7	*Банк Лекцій (Наукова світлиця)* *(Ukr. "Lecture Bank. Scientific Chamber")*	videos	2016	No	2020	science overall	Hundreds of video records of popular science lectures on different topics.
8	*Batrachos*	texts	2011	Yes	No	biology, ecology	A website of two biologists, dedicated to biology, zoology, ecology, etc.
9	*Вища освіта – портал* *(Ukr. "Higher Education - Portal)*	links	2014	Yes	2022	science and education	Not just about higher education, but also about science in universities.
10	*Всесвіт* *(Ukr. "Universe")*		2017	Yes	No	astronomy, universe	Interesting popular science group about the universe in Ukrainian.
11	*Всесвіт UA* *(Ukr. "Universe UA")*	videos	2020	Yes	No	astronomy, universe	Very high-quality Ukrainian language YouTube channel about the universe.
12	*CEDOS*	texts	2010 (2015)	Yes	No	science and education	A powerful analytical center with a lot of interesting research in the science and education field.
13	*Газета Світ* *(Ukr. "World Newspaper")*	texts	1997	Yes	No	science and education	Popular science publication that has been published as a printed magazine since 1997. Recently, it has also gone online, and lately, there are fascinating articles about the research of Ukrainian scientists.
14	*Defence Blog*	texts	Невідомо	Yes	No	military technology	Popular military science.
15	*Defense Express*	texts, videos	2001 (2012)	Yes	No	military technology	Popular military science.
16	*Оборонно-промисловий кур'єр* *(Ukr. "Defense and Industry Courriere")*	texts	2017	Yes	No	military technology	Popular military science.
17	*Дзеркало тижня. Наука* *(Ukr. "Weekly Mirror. Science")*	texts	unknown	Yes	No	science and education	A number of professional and competent articles about science and events connected to it.
18	*State Museum of Natural History*	texts, videos	2011	Yes	No	biology, ecology, geology	The page is constantly filled with interesting posts.

№	Title	Type	Creation	Activity	Closed	Field	Description
19	*Довколаботаніка (Ukr. "Around Botany")*	texts, videos, images, jokes	2016	Yes	No	botany, zoology, scientific process	A website and a group dedicated mostly to scientific humor and organization of interesting popular science events.
20	*Explorer.life*		unknown	unknown	unknown	geography, travel	A great resource about researchers and travelers.
21	*Експедиція XXI (Ukr. "Expedition XXI")*	texts, videos	2004 (2018)	Yes	No	biology, geography, Antarctic, travel	A wonderful resource of the National Antarctic Scientific Center - about the Antarctic, science, and travel.
22	*Екологія життя (Ukr. "Ecology of Life")*	texts	2009	No	2022	ecology, chemistry	A very interesting popular science website and group in Facebook about ecology. Clear, accurate, with links to sources.
23	*Збруч.Наука (Ukr. "Zbruch. Science")*	texts	unknown	unknown		science overall	The website has a wonderful section about science analytical articles, blogs, news.
24	*INgenius*	texts, events	2016	Yes	No	medicine	Blog about medical sciences, interesting and useful content.
25	*Клятий раціоналіст (Ukr. "Damned Rationalist")*	videos	2015	Yes	No	science overall, myths, critical thinking	One of the best popular science channels in the country. About critical thinking and myth debunking.
26	*Крымские истории в диалогах (Rus. "Crimean Stories in Dialogues")*	audio	2018	No	one-time	history	About the history of Crimea since ancient times to modernity.
27	*Pivdenne State Design Office*	texts, audio, videos	2016	No	2022	rocket science, universe	Everything about rocket science in Ukraine.

№	Title	Type	Creation	Activity	Closed	Field	Description
28	*Куншт* *(Ukr. "Kunsht")*	texts, audio, videos	2015	Yes	No	science overall	A fascinating popular science website where all the articles and podcasts are made by scientists and professionals. High quality and diversity of information. Almost a standard for the Ukrainian media market.
29	*Lacuna*	videos	2017	temporarily stopped	2022	?	Short videos about many incomprehensible things — from quantum physics to neural networks.
30	*Learning Bioinformatics Together in Ukraine*	texts, videos	2016	a bit	No	bio-informatics	A group of bioinformatics in Ukraine.
31	*Likbez. Історичний фронт* *(Ukr. "Likbez. Historical Front")*	texts, videos	2014	Yes	No	history of Ukraine, myths	Nice posts and videos about myths in our history.
32	*Lviv University Mineralogy Museum*		2018	Yes	No	geology	A wonderful page of Lviv National University Mineralogy Museum with a lot of interesting facts about minerals and their beautiful photos.
33	*Моя наука* *(Ukr. "My Science")*	texts	2011	Yes	No	science overall	The website that started as a joint project with the initiative group of NASU scientists.
34	*Музейний портал* *(Ukr. "Museum Portal")*	texts	2011	Yes	No	museums	An extensive list of museums in Ukraine and museums about Ukraine in the world. Great work.
35	*Мікроб і Я* *(Ukr. "Microbe and Me")*	texts	2018	Yes	No	micro-biology	A great popular science website about microbiology, myths about food products, and other things that are related to microbes.
36	*https://www.science-community.org/*	texts, announce-ments	unknown	No	2022	science overall	About grants, opportunities, and science conferences.

№	Title	Type	Creation	Activity	Closed	Field	Description
37	*Наукова світлиця (Ukr. "Scientific Chamber")*	videos, events	2015	No	2022	science overall	A great enlightenment project with a lot of activities — both lecture records and popular science events all over Ukraine.
38	*Наукуїмо (Ukr. "Science We Eat")*	videos	2020	Yes	No	science overall, mostly biology, mathematics	A great YouTube channel where great scientists show their labs, tell about the research of the European level, debunk myths, and tell exciting stories.
39	*Наука та Всесвіт (Ukr. "Science and Universe")*	videos	2014	temporarily stopped	2020	universe	A great Ukrainian language YouTube channel with a lot of videos from NASA, ESA, Nature, and TED about the universe and science.
40	*Наше небо (Ukr. "Our Sky")*	texts, videos	2016	Yes	No	astronomy, universe	A website about astronomy and the universe by an employee of the NASU Main Astronomical Observatory Ivan Kriachko. The author also has a channel where one can listen to his popular science lectures.
41	*Новое время. Научпоп (Rus. "New Times. Popular Science")*	texts	unknown	unknown	unknown	science overall	A great section about science where latest events in the scientific world are tracked.
42	*Пан Бібліотекар (Ukr. "Mr. Librarian")*	texts	2009	Yes	No	Наукометрія	Everything about scientific journals, citations, scientometrics, etc.
43	*PinkNoiseNews*	texts	2019	Yes	No	scientometrics	A great resource by two scientists, Adnrii Cherninsky and Dmytro Isaiev about science news.

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44	*Prometheus*	videos	Невідомо	Yes	No	science and education	A platform for mass free online courses with a lot of materials for developing critical thinking. Over 700 thousand Ukrainians are already studying here.
45	*Природничо-географічне товариство (Ukr. "Naturalistic and Geographic Society")*	texts, videos	2015	Yes	No	geography, ecology, local history	A Facebook group with tens of thousands of subscribers with interesting posts about nature by the Vytachiv Gymnasium.
46	*Помилки та фальсифікації в наукових дослідженнях (Ukr. "Errors and Falsifications in Scientific Research")*	texts	unknown	Yes	No	science and education	A website for the materials about the most notorious cases of plagiarism or pseudoscience.
47	*Pulsar*	texts	2014	temporarily stopped	2022	biology, other natural sciences	An interesting popular science magazine, where articles are written by scientists and experts.
48	*Стромата (Ukr. "Stromata")*	texts	2016	Yes	No	paleontology, biology, archaeozoology	A wonderful popular science group about paleontology, history of science, comparative anatomy, history of climate, people, animals, and a bit about everything.
49	*Sciences.in.ua*	videos	2016	temporarily stopped	2018	science overall	A popular science resource with interesting, high-quality interviews with our scientists.
50	*ScienceUkraine*	texts	2014	No	2020	science overall	A great popular science website and a group with regularly updated news.
51	*SpaceUkraine*	texts	2017	No	2018	universe	A popular science resource. Unfortunately, it is updated very rarely.
52	*StreetAstronomy*	texts, events	2015	Yes	No	astronomy, universe	A website about astronomy with regularly updated astronomy news and news about future meteor showers.

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53	*Symbolon. Центр середньовічних та ранньомодерних студій* *(Ukr. "Symbolon. The Center of Mediaeval and Early Modern Studies")*	texts, videos images	2017	No	2020	history	A group about the history of Middle Ages and early modern times.
54	*Спільне Commons*	texts	unknown	unknown	unknown	social sciences	A great resource with high-quality articles about Ukrainian science among other things.
55	*Sci-DIY*	videos	2013	tempo-rarily stopped	2020	physics	A channel where the author regularly posts many beautiful, interesting, and useful videos about known physical phenomena. Made really well.
56	*Tokar.ua*	texts, videos	unknown	Yes	No	universe, technology	A nice website with high-quality Ukrainian translations of popular science videos. Mostly about the universe, but there are other topics.
57	*TechToday*	texts	unknown	unknown	unknown	technology	A lot of information about modern technology.
58	*Ukrainian Scientists Worldwide*	Блоги	2010	Yes	No	science overall	The biggest and most dynamical group of Ukrainian scientists from all over the world on Facebook. Allows one to keep one's finger on the pulse of events very easily.
59	*ХабблТраббл* *(Ukr. "HubbleTrouble")*	videos	2019	tempo-rarily stopped	2022	astronomy, universe	A YouTube channel about the universe and science, filmed by a boy Bohdan who studies in the third grade at school.
60	*Цікава наука* *(Ukr. "Interesting Science")*	videos	2016	Yes	No	science overall	A very popular website and group where animated popular science videos translated into Ukrainian are posted. Very high quality.

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61	*Chornobyl.in.ua*	texts	2007	No	2022	nuclear physics, radiobiology	About science in the Exclusion Zone: Chornobyl, Prypiat, the Chornobyl Nuclear Power Plant.
62	*Vernadsky Station Team*	texts, photos, videos	2011	Yes	No	Antarctic	A group of participants of the Antarctic expeditions. Very interesting.
63	*WAS.media*	texts	unknown	Yes	No	history	A high-quality and interesting website about history. Little-known facts, myths debunking, etc.
64	*Arsenal of Ideas*	events	2015	No	2018	science and education	A festival where children can engage in adult professions, in particular, science.
65	*Вільний університет Майдан моніторинг* *(Ukr. "Free University. Maidan Monitoring")*	videos, events, texts	2014	Yes	No	science overall	A Kharkiv organization that organizes popular science lectures.
66	*Головна астрономічна обсерваторія*	events, brochures	unknown	unknown	unknown	astronomy	Not a lot of popular science here, but it's the best and most exciting observatory in Ukraine. On this website, they regularly post invitations to watch stars, astronomy tours, etc.
67	*Real Science*	videos, events	2016	Yes	No	science overall	About the development of world science and achievements of Ukrainian scientists in different fields for a broad audience, facilitation of the dialogue between scientists and representatives of business, authorities, society.

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68	*Дні науки (Ukr. "Science Days")*	events, videos	2013	light activity	Yes	science overall	Popular science event that takes place in scientific institutions of many cities simultaneously. The goal of the event is to acquaint Ukrainian society with Ukrainian scientists, research laboratories, and achievements of Ukrainian and world science.
69	*Музей популярної науки і техніки «Експериментаніум» (Ukr. "Museum of Popular Science and Technology Experimentanium")*	events	2012	Yes	No	physics, technology	A constant exposition with over 250 interactive exponents dedicated to mechanics, optics, electricity, magnetism, and acoustics.
70	*Клуб аматорів астрономії Астрополіс (Ukr. "Astronomy Amateurs Club Astropolis")*	videos, events, texts	2005	Yes	No	astronomy	They give a free opportunity for citizens to look at the stars, planets, comets, and the Moon a couple of times a year. Trips to the outskirts of Kyiv.
71	*Клуб любителів астрономії АстроДніпро (Ukr. "Astronomy Enthusiasts Club AstroDnipro")*	videos, events, texts	2015	Yes	No	astronomy	Interesting astronomical events.
72	*Kyiv Mini Maker Faire*	events	unknown	unknown	unknown	robotics, engineering	Popular science events with demonstrations of robotics, engineering, experiments, etc.
73	*Музей Космонавтики імені С. Корольова (Ukr. "S. Koroliov Cosmonautics Museum")*	events, texts	2012	Yes	No	universe	A very powerful museum in Zhytomyr where interesting events are held regularly.
74	*Навчальний центр Футурум (Ukr. "Learning Center Futurum")*	texts, events	2017	Yes	No		An educational center of the Junior Academy of Sciences, dedicated to interest children in finding out more about the world.

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75	*Наукові пікніки (Ukr. "Scientific Picnics")*	events	2013	tempo-rarily stopped	2020	science overall	Popular science events held a couple of times a year. In parks in some cities, scientists gather with their microscopes, bacterial strains, and reactors and demonstrate them to passers-by for free.
76	*Nobilitet*	events	2017	Yes	No	physics, physiology, chemistry, economics, literary criticism	A yearly popular science conference where they tell about Nobel prizes in simple terms.
77	*Про що розповідає археологія (Ukr. "What Archaeology Tells Us")*	texts, events	2016	tempo-rarily stopped	2022	archaeology	Very interesting meetings with archaeologists, a lot of relevant information about new finds.
78	*СаЛо — самопаль-на лабораторія (Ukr. "SaLo - Self-Made Laboratory")*	texts, images	2016	No	2021		A community of the like-minded that popularizes science and, a couple of times a year, allows people to look at the starry sky through telescopes.
79	*Школа науки DESK (Ukr. "Science School DESK")*	events, videos	2017	No	2020	biology	Besides posting interesting posts, their main aim is to interest children in science through work in a laboratory.
80	*15x4*	events, videos	2016	No	2020	science overall	Popular science lecture courses — 4 lectures 15 minutes each.
81	*Колосок (Ukr. "Wheat Ear")*	texts	2003	Yes	No		Popular nature sciences magazine for children. Printed edition, but on the website, they have an archive of PDFs of magazines till 2015. Very interesting.
82	*У світі математики (Ukr. "In the World of Mathematics")*	texts	unknown	unknown	unknown		Popular science magazine about mathematics.

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83	*UA:Радіо Культура — програма Модуль знань (Ukr. "UA: Radio Culture - Module of Knowledge Program")*	audio	unknown	unknown	unknown		A radio with interesting guests, professional talks.
84	*ФізКультура (Ukr. "PhysCulture")*	audio, texts	unknown	unknown	unknown		A radio program about science, healthy lifestyle, and common sense by *Daria Ozerna*.
85	*Ембріологічний ранок (Ukr. "Embriological Morning")*	videos	unknown	unknown	unknown	embryology	A small YouTube channel by embryologists. A morning program by Oksana Lyzohub and Pavlo Mazur.
86	*Про здорове (Ukr. "About Healthy")*	texts	unknown	unknown	unknown	medicine, health	A project that aims to present recommendations for healthy eating, recommended by the Ministry of Health of Ukraine, and the first Healthy food plate for Ukrainians. Relevant, simple, and modern advice on healthy ration from the best Ukrainian experts.
87	*Здоровий Подкаст (Ukr. "Healthy Podcast")*	audio	unknown	unknown	unknown	medicine, health	A podcast about science-based medicine, with humor and relevant advice. A family doctor, Violetta Liika, and a doctor and a medical blogger, Andrii Med Goblin, explain how to stay healthy and debunk medical myths.
88	*STEMisFEM*	events, texts, videos, art	unknown	unknown	unknown	Stem	An educational project for popularization of STEM specialties among the girls.
89	*Deep Dark UA*	texts	unknown	unknown	unknown	astrophysics	The universe is deep and dark. It's not as frightening to peer into it together. A light digest on astrophysics in Ukrainian.

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90	*Туди-Сюди. Подкаст від Локальна історія (Ukr. "Here and There Podcast by Local History")*	audio	unknown	unknown	unknown	history	A podcast about large migrations on the Ukrainian territory by "Local History" ("Локальна історія").
91	*Локальна історія (Ukr. "Local History")*	texts, videos	(2013) 2018	Yes	unknown	history	A multimedia online platform about the past and present of Ukraine.
92	*Наукою по ковіду (Ukr. "Science Against COVID")*	videos	unknown	unknown	unknown	medicine, health	Every week, MED GOblin Andriy Semiankiv, Ph.D. in Medicine, prepares digests of medical research on coronavirus to keep you up to date with the latest news. A presenter of the digests is Клятий раціоналіст Artem Albul.
93	*Cup of Immunology*	texts, events	unknown	unknown	unknown	immunology	A club created to spread knowledge about immunology in the Ukrainian-speaking medical community.
94	*Агент Маргарита (Ukr. "Agent Margaryta")*	videos	unknown	unknown	unknown	ecology, environment protection	Knowledge about nature, protection of plants and animals.
95	*Твоя Підпільна Гуманітарка (Ukr. "Your Underground Humanitites")*	texts, videos	unknown	unknown	unknown	humanities, history, literary criticism	An educational portal by Ostap Ukrainets, Yevhen Lir, and Kateryna Dudka, dedicated to humanities. Lectures, interviews, discussions — everything you love.

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96	*Наука як по маслу (Ukr. "Science Smoothly")*	texts, audio	unknown	unknown	unknown	science overall	A show directed at science popularization and broadening of the worldview. The guests in the studio talk about their topics, scientific work, and projects that go outside the box of traditional laboratory research and also share information that may be interesting to people who are distant from science.
97	*Палладінський лекторій (Ukr. "Palladin Lectory")*	videos	unknown	unknown	unknown	biology	Monthly popular science lectures by the NASU Palladin Biochemistry Institute.
98	*Геноміка ЮА (Ukr. "Genomics UA")*	events, videos, texts	unknown	unknown	unknown	bioinforma-tics	A non-profit organization that organizes events of informal education, and also works to make genomics and bioinformatics more present in education, more broadly used in research, and industry. There are two territorial projects: the Odesa Bioinformatics Club, the organization's first project, and the Kyiv Bioinformatics Club.
99	*Нотатки молод-шого наукового співробітника (Ukr. "Notes of Junior Scientific Officer")*	texts	unknown	No	2022	ecology, ornithology, natural preserves	Science, nature, life in the blog of Yurii Moskalenko, a scientist at the NASU Black Sea Biosphere Reserve, Ph.D. in Biology, a specialist in ornithology, ecology, and preservation of nature. Yurii is also an author of two other web projects, among them an unofficial website of the Reserve bsbr.ks.ua.

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100	*The Universe. Space. Tech*	texts	2003	Yes	No	universe, technology	A publication whose materials are prepared not only by journalists but also by scientists from universities and research institutes, published every two months. The magazine organizes a “Cosmic Shots” club for every issue with invited speakers. The format of the events is three mini-lectures of the specialists in the field, accompanied by a glass of Georgian wine. At the events, topics from the magazine are discussed. The date of foundation of the Museum of Cosmonautics in Zhytomyr is 1970. Universe. Space. Tech. Starting in 2022, the magazine will be published once a year. Space shots were last held in 2020.
101	*mutation.me*	texts, videos	unknown	Yes	No	biomedicine	A medical researcher writes a blog about interesting publications and shares their own materials for colleagues and patients.
102	*Квантум (Ukr. “Quantum”)*	texts, videos	2019	No	2020	science overall	A popular science online media that popularizes Ukrainian science. There are stories about research by Ukrainian scientists, interviews with scientists, explanations of their wild ideas, discussions, and debunking of the most popular myths.

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103	*Майбутнє без раку (Ukr. "Future Without Cancer")*	texts	2015	No	2017 (2020)	medicine, oncology	An important educational initiative directed at the decrease of cancer morbidity and mortality in Ukraine, that growth faster than mortality from heart and vascular diseases.
104	*Ukrainian Brain Bee*	competition	unknown	Yes	No	neurobiology	A competition among the pupils in neurosciences.
105	*Molecula.club*	videos	2014	a little bit	2022	medicine, pathophysiology	Molecular medicine for all.
106	*Молекулярно про Рак (Ukr. "Molecularly About Cancer")*	texts	2012	No	2019	medicine, oncology	The blog tells about new research in cancer biology. The posts are short reviews in Ukrainian. The format is not strictly scientific, but the research is reviewed rather in detail.
107	*Український Центр Охорони Кажанів (Ukr. "Ukrainian Bat Protection Center")*	texts, videos	2005	Yes	No	zoology, ecology	People often treat bats — these useful, nice, and, at the same time, very vulnerable animals — a bit biased. This treatment often leads to sad consequences. On this site, among other things, there are stories about who bats are, why they should be protected, and why they need our friendliness
108	*Український біологічний сайт (Ukr. "Ukrainian Biological Website")*	texts	unknown			biology	The goal is to review the state of biological research and education in Ukraine.
109	*Про біологію українською (Ukr. "About Biology in Ukrainian")*	texts, videos	2008	a little bit	unknown	biology	A blog with useful information for biology students.
110	*Астроосвіта (Ukr. "Astroeducation")*	texts	unknown	Yes	No	astronomy	A website of the astronomer Ivan Kriachka about astronomical education.

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111	*Historians.in.ua*	texts	2012	Yes	No	history, humanities	Internet network for scientists in humanities in Ukraine and the world.
112	*Весела наука (Ukr. "Funny Science")*	events	unknown	No	unknown	interesting experiments	A project, created by the adults with vivid interest to incredible things that surround us, that we use, and don't always understand, and with the desire to stir this interest in their children. And the children of their friends. And of their neighbors. And then - in all the children.
113	*Геліантус (Ukr. "Heliantus")*	events	unknown	unknown	unknown	natural history	A yearly nature sciences game in physics, chemistry, biology, and geography for school pupils. The game aims to form a holistic image of nature and a scientific worldview in schoolchildren, based on the knowledge of physics, chemistry, biology, geography, and continuous interest in natural phenomena.
114	*LabPrice*	texts	2008 (2016)	Yes	No	chemistry, biochemis-try	There's a section of popular science news.
115	*Ми і Всесвіт (Ukr. "We and the Universe")*	texts	2010	No	2019	astronomy	A blog about our universe, and astronomical research of its objects. And about the place of humanity in the universe.
116	*Журнал «Країна знань» (Ukr. "Magazine Country of Knowledge")*	texts	2001	Yes	No	science overall	A magazine with articles on different topics — physics, chemistry, biology and geography, history of world cultures... there's probably no field of knowledge that's not presented here.

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117	*https://imbg.livejournal.com/*	texts	2010	No	(2014)	molecular biology	The first unofficial blog of the scientific institute.
118	*Журнал «Станіславівський натураліст»* *(Ukr. "Stanislaviv Naturalist")*	texts	2007	No	2021	biology, ecology	A magazine edited by professional biologists, both students and researchers. All the published information is verified.
119	*Taras Shevchenko Kyiv National University Astronomical Observatory*	events	2006	temporarily stopped	2020	astronomy, physics	The observatory offers tours of the starry sky on clear days and popular lectures on news from different fields of astronomy by professionals.
120	*Ukrainian Science Club*	texts, events	2008	No	unknown	natural and technical sciences	Among the club's priorities are popularization of achievements of both Ukrainian and world scientists through collaboration with scientific societies and the media.
121	*http://science-ua.info/*	texts	2014	No	2016 (2018)	natural sciences	A website about the latest research by Ukrainian (and not only) scientists in different scientific fields: physics, chemistry, biology, medicine, astronomy, etc.
122	Юный натуралист (Rus. "Young Naturalist")	texts	1996	No	2013	natural history	An addition to the «Наука-Фантастика» that was then in decline. The magazine was black-and-white, with colored photos on the cover; it was published irregularly.
123	Натураліст (Ukr. "Naturalist")	texts	1996	No	2013	zoology, ecology	The authors of the magazine were leading Ukrainian zoologists, naturalists, aquarists, etc. On the pages, black-and-white photos were mixed with comic-like illustrations.

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124	«National Geographic» in Ukrainian	texts	2013	No	2014	geography, history, natural sciences	Nice articles and photos about nature and the world.
125	«Світова географія» (Ukr. "World Geography")	texts	1997	No	2015	geography, ecology, universe	Articles about different countries, Ukrainian travelers and diaspora, reports from Antartic and leading world laboratories.
126	*Паросток (Ukr. "Sprout")*	texts	1995	Yes	No	biology, ecology	Science and fiction magazine for children.
127	Світогляд (Ukr. "Worldview")	texts	2006	Yes	No	science overall	Popular science texts.
128	*Зелені Карпати (Ukr. "Green Carpathians")*	texts	1994	No	2021	ecology, environment protection, ethnography	Popular science texts about nature and people of the Carpathians.
129	Pauca Verba	texts	2012	No	2015	natural sciences	Popular science texts.
130	Воєнна історія (Ukr. "War History")	texts	2002	No	2014	history	Part of the articles in the magazine were about popular science.
131	Елементарно, Академія наук (Ukr. "Elementary. Science Academy")	audio	2014	No	2020	science overall	Popular science texts.
132	Індекс Хірша (Ukr. Hirsh Index")	audio	2014	No	2016	science overall	Popular science texts.
133	Конкурс наукових зображень ВМУА (Ukr. "Competition of Scientific Images by Wikimedia Ukraine")	photos, art	2015	Yes	No	science overall	Scientific photos.
134	Brainy	events, videos	2015	No	2018	neurobiology	Lectures by "Chasopys"(«Часопис»).
135	*Канал імені Т.Г.Шевченка (Ukr. "T. H. Shevchenko Channel")*	videos	2019	Yes	No	history	A popular history channel with many inaccuracies and free interpretation of historical events.
136	*Історія без міфів (Ukr. "History Without Myths")*	videos	2020	Yes	No	history	Invite scientists as guests.
137	*Pivden Artbook*	videos	2020	Yes	No	history of the Ukrainian science	Popular videos about the history of the Ukrainian South.

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138	*Їсти. Пити. Говорити* (Ukr. "Eat. Drink. Talk")	videos	2021	Yes	No	culinary history	A video blog about food.
139	*Дарка Бунтарка* (Ukr. "Rebel Darka")	videos	2015	Yes	No	history of fashion	A video blog about the history of fashion.
140	*Цікава історія* (Ukr. "Interesting History")	videos	2020	Yes	No	history	A historical videoblog.
141	*ДокКульт* (Ukr. "DocCult")	videos	2020	Yes	No	history of wars	A channel with animated videos about events of the Ukrainian and world history.
142	*Історія для дорослих* (Ukr. "History for Adults")	videos	2021	Yes	No	history for grownups	Not broadly known stories about famous people.
143	*Обличчя Незалежності* (Ukr. "The Face of Independence")	videos	2021	Yes	No	history of the 20th century	A video blog with monologues of Ukrainian dissidents and members of the resistance movement in the USSR.
144	*Історична правда* (Ukr. "Historical Truth")	videos	2020	Yes	No	history	Nice history texts.
145	*Історія На Карті* (Ukr. "History on a Map")	videos	2022	Yes	No	history	Stories about key events and personalities in history with usage of maps for better understanding.
146	*Книга-мандрівка. Україна* (Ukr. "Journey Book. Ukraine")	videos	2018	Yes	No	Ukrainian history for children	Popular history cartoons.
147	*Останній Гетьман* (Ukr. "The Last Hetman")	videos	2017	Yes	No	history	Videos about personalities that influenced the history of Ukraine.
148	*комік плюс історик* (Ukr. "Comic Plus Historian")	videos	2022	Yes	No	history	Light and sometimes humorous videos about the past.
149	*SPQR. Стародавній Рим та Стародавній Світ* (Ukr. "SPQR. Ancient Rome and Ancient World"	videos	2020	Yes	No	history of Rome, earlier was in Russian	Videos about significant events in the history of Ukraine and the world.

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150	*Kozak UA*	videos	2012	Yes	unknown		Low quality of video and sound, sensational material.
151	*Олександр Алфьоров* (Ukr. "Oleksandr Alfiorov")	videos	2019	Yes	unknown	history	Videos about the history of Ukraine and the world .
152	*Буде тобі наука* (Ukr. "You Will Have Science")	audio	2019	Yes	unknown	science overall	A popular science podcast.
153	*Історична свобода* (Ukr. "Historical Liberty")	audio	2017	Yes	unknown	history	A podcast about Ukrainian history without anger and passion.
154	*Простими словами* (Ukr. "In Plain Words")	audio	2019	unknown	unknown	psychology	A podcast about mental health during the war.
155	*Пороблено* (Ukr. "Cursed")	videos + podcasts	2023	Yes	unknown	ethnology	Everything about the symbolism and meaning of the beliefs, rituals, and texts, about traditions and their influence on our lives.
156	*Гліб Репіч* (Ukr. "Hlib Repich")	videos	2018	Yes	unknown	chemistry	A popular science podcast about chemistry, but too much advertising.
157	*https://www.facebook.com/newiglass*	texts	2016	No	2016	science overall	A popular science blog.
158	*https://www.tiktok.com/@chernyak.blog*	videos	unknown	unknown	unknown	personal development	Translations from scientific to plain language of how to live better, more efficiently, and more happily. Videos about the scientific approach to personal and professional development, the brain workings, cognitive science, how the organism works, philosophy, logotherapy, productivity, and motivation.
160	*https://www.tiktok.com/@inforulesua*	video	unknown	unknown	unknown		Popularization of fact-checking.
161	*https://www.tiktok.com/@scienceua*	video	unknown	unknown	unknown		A science news digest.

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162	https://www.tiktok.com/@stemcellkids	video	unknown	unknown	unknown		Science for children.
163	https://www.tiktok.com/@janovska.geo	video	unknown	unknown	unknown	geography	Interesting videos about geography.
164	https://www.tiktok.com/@obrazpublicua	video	unknown	unknown	unknown	cognitive biases	Interesting videos about formation of cognitive distortions and how the brain works.
165	https://www.tiktok.com/@astro0night	video	unknown	unknown	unknown	astronomy	Videos about astronomy.
166	https://www.tiktok.com/@yehorslupitskyi	video	unknown	unknown	unknown	physics and biology	Interesting videos about physics and biology.
167	Non-Governmental Organization «Youth Online»	Videos, Events, Texts	2016	yes	no	Biotechnology	The organization is dedicated to educating youth in Zaporizhzhia and recently in Dnipro. They focus their efforts on ensuring that young people feel comfortable by creating projects that promote STEM among girls, provide career guidance for youth, and inspire them to engage with culture in a broad sense. They are implementing the Skin Open Source project to promote biotechnology among the communities of Zaporizhzhia and Dnipropetrovsk regions, aiming to address urgent issues in medicine and agriculture through biotechnology.
168	National Scientific Center «Kharkiv Institute of Physics and Technology»	Texts, Events	1928	Yes	No	theoretical physics, research, R&D	National Scientific Center for Research in the Field of Physical Sciences. It is one of the largest and oldest in Ukraine. Located north of Kharkiv in Pyatykhatky.

№	Title	Type	Creation	Activity	Closed	Field	Description
169	*Youth Non-Governmental Organization «UkrTeenScience»*	Events, Videos	2020	Yes	No	Science	Promotion of science and engagement of youth in the scientific process in collaboration with the public sector, business, and the state.
170	*Center for the Development of Museology and Monument Studies*	Texts, Events, Videos	2022	Yes	No	Heritage science	Professionally and accessibly about the cultural, social, political, and economic impacts of heritage; technologies for managing these impacts, museum development, and models for the sustainable development of heritage areas.
171	*Non-Governmental Organization «Ukrainian Scientific and Educational IT Society»*	Events, Texts, Videos	2019	Yes	No	Information Technology	The Non-Governmental Organization “Ukrainian Scientific and Educational IT Society” is a voluntary association of individuals created to: – Support the successful development of higher education, scientific research, and development in the field of information technology in Ukraine, effective interaction with relevant industrial enterprises and organizations, and international cooperation for the implementation of joint scientific and educational projects; – Increase the influence of the scientific and pedagogical community on the formation and implementation of the development strategy for higher education in general and information technology in particular.

№	Title	Type	Creation	Activity	Closed	Field	Description
172	*V. N. Karazin Kharkiv National University*	University	1805	Yes	No	Biology	A classical university with a long tradition of research, a center of science and culture in Ukraine, with a high international reputation.
173	*S. P. Korolev National Museum of Cosmonautics*	Events	1970	Yes	No	Space	A museum of cosmonautics in Ukraine, located in Zhytomyr, the hometown of the Ukrainian Soviet scientist in the field of rocket engineering and cosmonautics, Serhiy Pavlovych Korolyov.
174	*INSIENCE (Non-Governmental Organization “ INSIENCE”)*	Events, Texts, Videos	2018	Yes	No	Science	An organization that promotes science and evidence-based medicine and enhances their value for society, business, and the state through popular science projects. We make Ukrainian scientists and doctors visible and foster the development of critical thinking by promoting a scientific approach to understanding the world.
175	*Solomia Today*	Texts, Images	2017	No	No	Biology	The main task is to understand yourself better each day of the menstrual cycle.

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