

Report on the State of the Sciences in Israel 2022

Executive Summary



האקדמיה הלאומית הישראלית למדעים
المجمع الوطني الإسرائيلي للعلوم والآداب
THE ISRAEL ACADEMY OF SCIENCES AND HUMANITIES

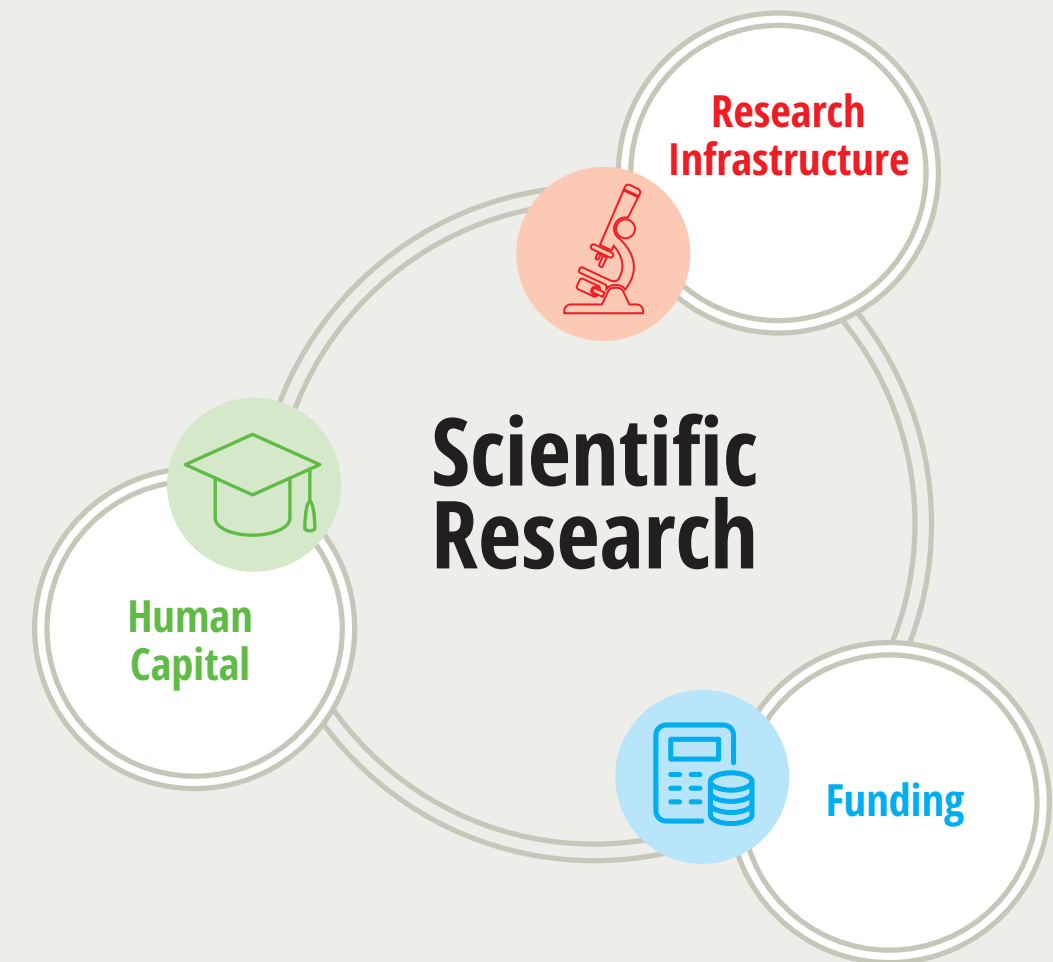
Introduction

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The 2010 amendment to The Israel Academy of Sciences and Humanities Law (1961) obliges the Academy to submit a triennial report to the government and the Knesset on the state of the sciences in Israel. The 2022 report, like its predecessors, surveys the state of the sciences in the country with an emphasis on basic research, pointing to achievements, gaps and challenges and offering recommendations for addressing them, for the sake of shoring up and advancing science and research in Israel. Basic science is the keystone of Israel's advanced economy. Its contribution to the country's security and social resilience is invaluable.

A dedicated 23-member committee worked for two years on preparing the report, with six subcommittees devoted to examining selected topics or areas. The committee members, all senior scholars in a variety of scientific fields, met with dozens of professionals in Israel's systems of higher education and scientific research, including role players in the Council for Higher Education and its Planning and Budgeting Committee, and in institutions of higher education, government ministries, and major research and philanthropic funds. They also received written reports, made field visits and collected diverse, multi-year and comparative data on the state of the sciences in Israel. The chapters of the report present the committee's conclusions, each focusing on two or three issues of especial importance – not necessarily the only ones – to the advancement of research in the field under discussion, and offering recommendations for strengthening the field.

The main points, conclusions and recommendations of the report's chapters are presented below. For in-depth discussions and detailed recommendations, please consult the respective chapters of the Hebrew report.



The building blocks of outstanding scientific research

Advancing science in Israel depends upon the availability and development of these building blocks.

Science in Israel: A Snapshot

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The achievements of Israeli science

Israeli science registers considerable achievements, attesting to its excellence, thanks mainly to the human capital that graces Israel's research institutions.

11

Israel's international rank in the percentage of most-cited publications out of the total of the country's scientific publications

7

Israel's rank in winning prestigious ERC grants

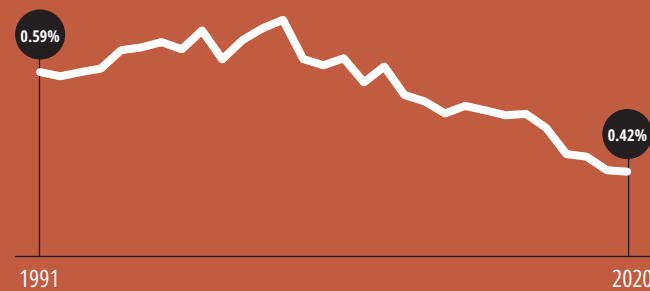
However, Israel tends to achieve less than reference countries resembling it in demographic and physical size and possessing high scientific intensity, indicating the potential still latent in Israel's ability, as a relatively small country, to stand alongside the countries that lead world science.

The national investment in basic research

Despite the real increase in funding allocated to academic R&D in Israel, Israel lags behind most OECD countries in the extent of that increase.

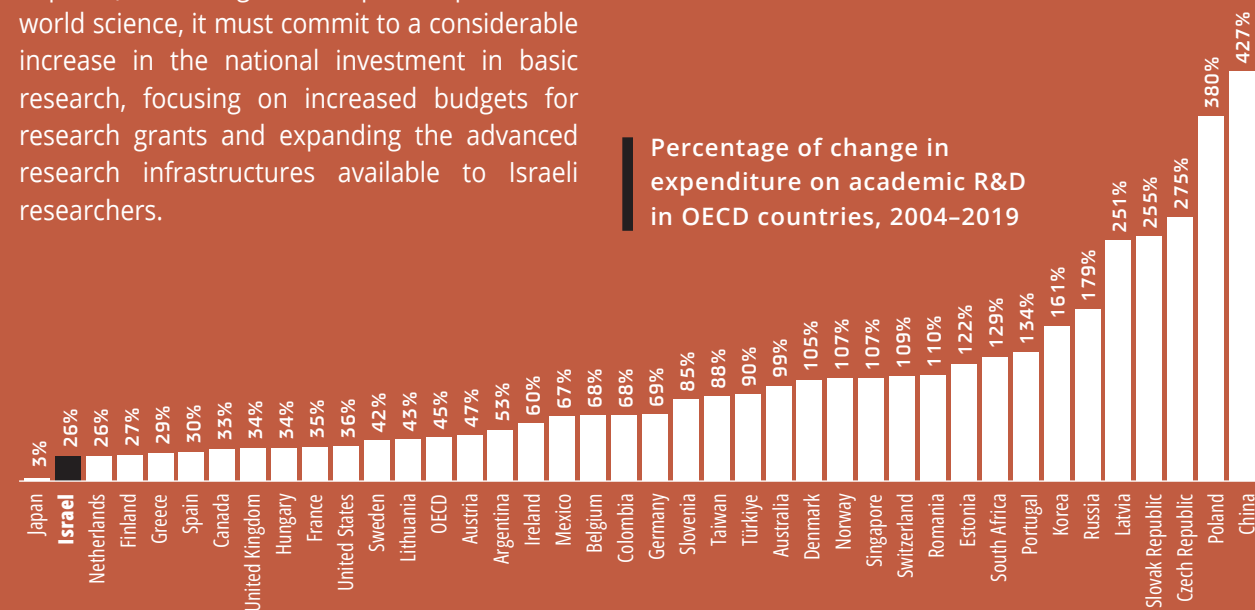
Furthermore, in the last twenty years, Israel's national expenditure on academic R&D as a percentage of GDP has decreased significantly. This is reflected in Israel's decline to average status from its earlier rank as a leading country in this index.

Therefore, for Israel to maintain (and even improve) its leading and competitive position in world science, it must commit to a considerable increase in the national investment in basic research, focusing on increased budgets for research grants and expanding the advanced research infrastructures available to Israeli researchers.



Israel's expenditure on academic R&D as a percentage of GDP

Percentage of change in expenditure on academic R&D in OECD countries, 2004–2019

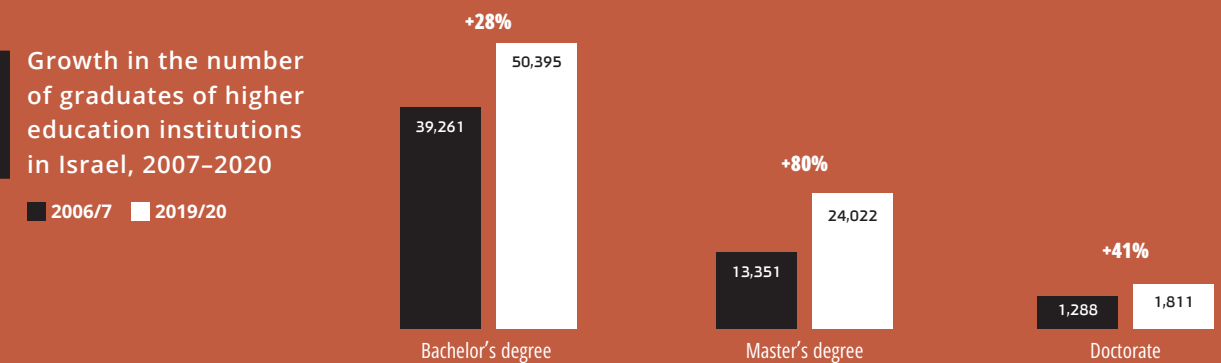


Human capital in Israel

Israel's population is relatively educated compared to the OECD member countries, and the number of graduates of Israel's higher education system has grown considerably over the years.

Educational attainment in Israel (2021):

24% Bachelor's degree | 13% Master's degree | 1% Doctorate

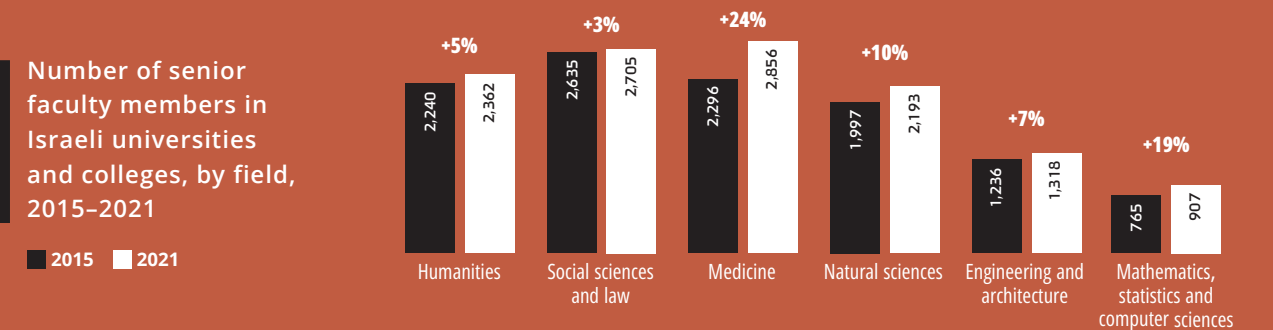


Growth in the number of graduates of higher education institutions in Israel, 2007–2020

However, only about half of the doctoral degree recipients in Israel ultimately join academic faculties, indicating the growth potential of scientific research in Israel, in both academic and industrial contexts.

The state of the various fields of science

Recent years have seen considerable growth in the exact sciences, life sciences and medicine in Israel. In contrast, the humanities and social sciences have experienced very moderate growth, and even decline.



Number of senior faculty members in Israeli universities and colleges, by field, 2015–2021

This situation demands achievement of a delicate balance between strengthening the academic staff in the fields of the exact sciences, the life sciences and medicine, to promote Israel's scientific excellence in these fields, training the quality personnel needed by the economy, and preserving and cultivating research in the humanities and the social sciences.

International Research

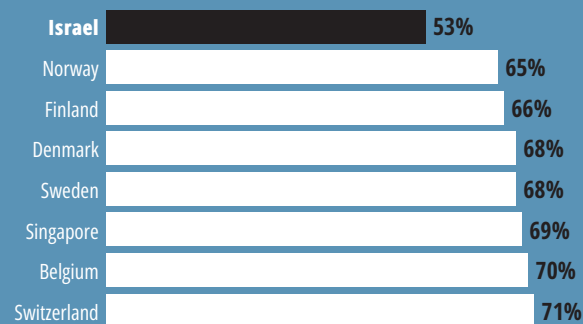
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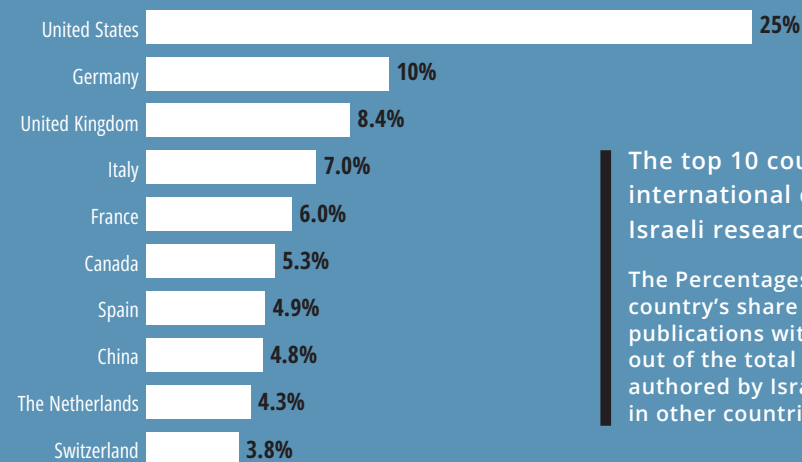
Science is a human enterprise transcending eras and borders. Today, more than ever, scientific endeavors are carried out in collaboration among researchers from various countries. Israel's participation in the global scientific effort and its scientists' collaborations with their colleagues around the world constitute central elements in Israel's belonging to – and its standing within – the community of nations.

International research and its funding

Though the scope of Israeli researchers' international collaborations is large, it is smaller than that in reference countries of notable scientific excellence.



Share of Israeli researchers' publications authored jointly with researchers from other countries (as against comparable countries), 2010–2020



The top 10 countries for international collaboration with Israeli researchers, 2018--2020

The Percentages represent the country's share of co-authored publications with Israeli researchers out of the total number of papers co-authored by Israelis with researchers in other countries

▣ **New bi-national programs with countries distinguished for their scientific excellence must be established and budgeted, while expanding the existing funds and taking steps to exploit their potential.**

Foreign faculty and students

Maintaining a high proportion of foreign faculty and students has a huge positive effect on the quality of academic research and teaching. Unfortunately, the proportion of foreign faculty and students in Israel is small, and Israel has difficulty recruiting outstanding foreign postdoctoral fellows.

Less than 3%

of senior faculty

50%

of postdoctoral fellows

3%

of bachelor's degree students

5%

of master's degree students

8%

of doctoral students

▣ **The number of foreign researchers, postdoctoral fellows and students in Israel must be increased, without compromising on their excellence. All the relevant bodies in the higher education system and in Israel's government ministries and philanthropic foundations should be mobilized for this purpose.**

Research Infrastructures

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State-of-the-art research infrastructures are foundational to the ability of researchers to conduct competitive and groundbreaking research. It is imperative to ensure that the need for these infrastructures is reflected in the budgeting and planning processes of scientific research in Israel, and that those processes rest upon orderly mechanisms to support the researchers' needs.

Research infrastructures in Israel

Though Israel provides relatively extensive funding for the establishment of personal research infrastructures for new researchers, funding for veteran researchers is lacking. Also, unlike in other countries around the world, there is no regular mechanism in Israel for assessing the need for national research infrastructures and formulating a comprehensive and long-term strategy in this regard.

- ▣ **Israel's state support for research infrastructures – both personal research infrastructures for veteran researchers and institutional and national infrastructures – must be increased considerably, while expanding access to and utilization of existing research infrastructures.**

Research infrastructures abroad

De facto, Israel, as a small state, lacks the capacity to maintain very large advanced research infrastructures. Therefore, the success of its scientists depends largely upon Israel's ability to provide them with access to advanced research infrastructures abroad.

- ▣ **Israel must strive to join large research projects abroad, on the basis of criteria of scientific excellence. To this end, mechanisms are needed to examine the possibilities for joining research infrastructures abroad and to support this participation. In this context, Israel should endeavor to expand its involvement in the European Strategy Forum for Research Infrastructures (ESFRI).**
- ▣ **There is a need for a national database of research infrastructures and international organizations of which Israel is a member.**



The Humanities

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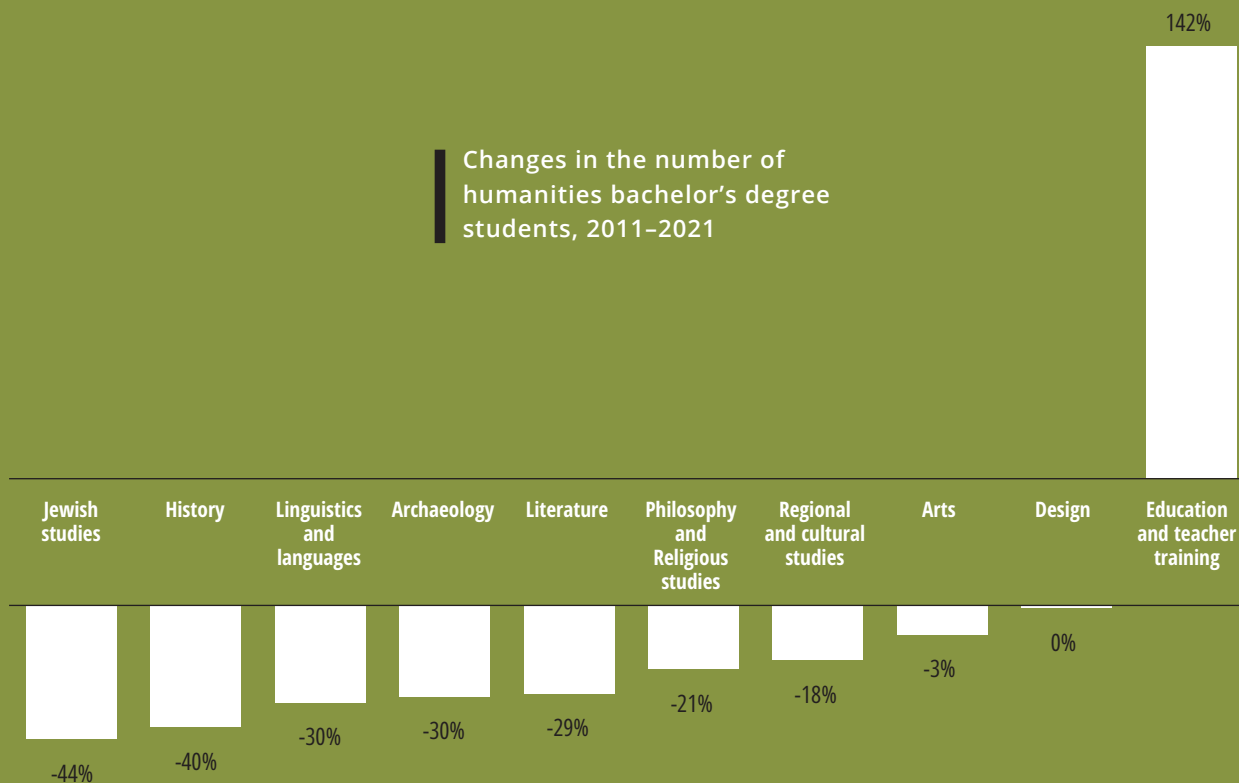
The humanities have a huge social and economic impact. However, for several decades, the humanities in Israel and throughout the world have been subject to an extended crisis, manifested in the declining prestige of the humanistic fields within the general public and a reduction of activity in these fields in institutions of higher education.

Humanities faculty:

20%
of total faculty

+5%
2015–2021

Humanities graduates:



Humanities budgeting and funding

The means and extent of humanities budgeting in Israel do not provide adequate support for research in this area and may even lead to the creation of incentives for development in inappropriate directions.

- ▣ Israel must formulate a budgeting policy to ensure a critical mass of outstanding researchers in the various humanities fields, regardless of the number of students in the field.
- ▣ Israel must adjust the budgeting of the humanities, especially in the Planning and Budgeting Committee model, to fit the nature of research in this area.
- ▣ A considerable increase in funding is needed for the processes of generating publications in the humanities.

Research skills

Mastery of languages is at the heart of humanities research, yet humanities faculties have limited capacity to support its acquisition due to the paucity of students and teachers of ancient languages. Furthermore, the digital humanities are vital to the future of humanities research, and there is a need for training in the technological and computational skills they require.

- ▣ A national blueprint for research language study frameworks should be drawn up.
- ▣ Support for university training frameworks for future researchers in the digital humanities should be strengthened.

Research infrastructures

Although the principal research infrastructures required for the humanities are data infrastructures for collecting and preserving source materials and making them accessible, funding for the establishment and operation of such infrastructures is limited. Technological developments in recent decades have created new opportunities in this regard, but their realization requires financial, technological and skilled human resources whose current scope is insufficient.

- ▣ A framework is needed to finance infrastructural research projects in the humanities for the purpose of data collection, storage and access.
- ▣ Increased support is needed for the digitization of materials in the humanities, expanding the accessibility of scanning and digitizing infrastructures of various types of materials, and establishing a national digital database (a data-repository) to enable their storage and access.

The Social Sciences

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In recent years, extensive changes in the methods and focus of research in the social sciences have moved them away from their classic affinity with the humanities and drawn them closer to the methods and approaches that characterize the natural sciences. Much of the social science research carried out in Israel has considerable relevance to issues of concern to the public and to Israel's decision makers.

In most universities, the social sciences (including law and business administration) are among the largest fields, but their proportion is decreasing.

Social sciences faculty:

24%
of total faculty

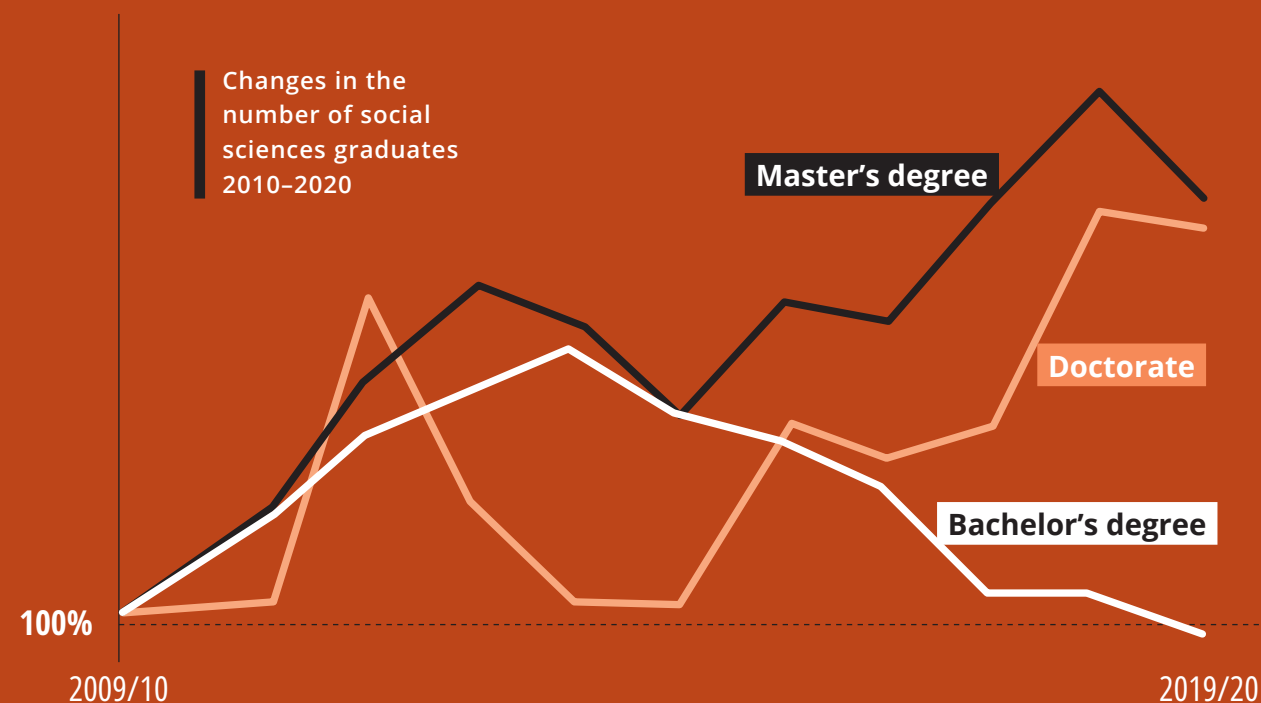
+3%
2015–2021

Social sciences graduates:

42%
of bachelor's degree graduates

50%
of master's degree graduates

18%
of doctorates



Training graduate students

Optimal training of outstanding social science research students requires them to devote most of their time and efforts to study and research, as is the case with the natural sciences, but support for such training is currently insufficient.

45%
of doctoral students receive a scholarship

NIS 4,000 (c. US\$ 1,100) / month
average scholarship for doctoral students

▣ Collaborations should be established among the research institutions in Israel for the purpose of training research students in the social sciences and increasing the range of advanced training courses offered in these fields.

▣ New funding frameworks for research students in the social sciences must be established and existing frameworks expanded (at both the national and the institutional levels), while increasing the amount of individual scholarships.

Research infrastructures

Support for research infrastructures in the social sciences is lacking, and access is needed to greater resources than were required in the past. Among other things, this is due to methodological changes and technological developments, which have led to a demand for new research infrastructures, such as access to big data (and tools to process it) and imaging devices.

- ▣ The methodological changes taking place in the social sciences demand a national examination of the adjustments needed in public support for research infrastructures in the field.
- ▣ Accessibility to researchers of the administrative databases of public bodies should be expanded.

The public role of research in the social sciences

In recent years, there is a general feeling of distancing between the social sciences, on the one hand, and the public and decision makers, on the other, reducing the mutual contributions that might develop from a close and fruitful relationship between them. It is important to strengthen the connection between the social sciences and their corresponding arenas of action.

- ▣ Researchers in the social sciences should be encouraged to create a closer interface with Israeli society and with Israel's decision makers and to summarize their studies in Hebrew.
- ▣ Public sector and civil society employees should be encouraged to pursue advanced studies, even if their goal is not to pursue an academic career.

The Exact Sciences

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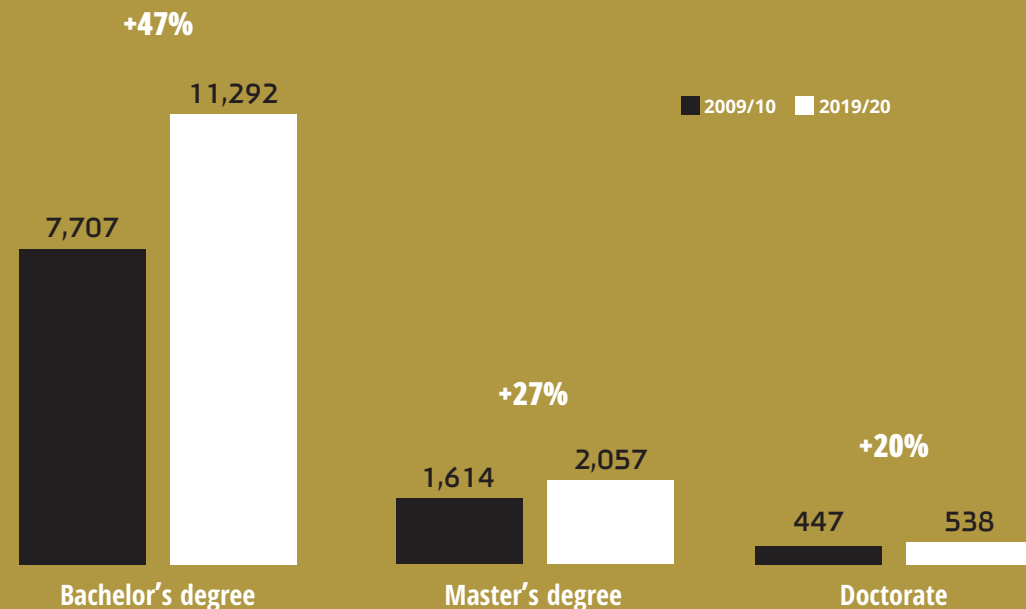
The exact sciences in Israel have enjoyed constant growth in recent years, mainly due to the flourishing of the high-tech industry and its demand for skilled personnel in the field.

Exact sciences faculty:

(2015-2021)



Exact sciences graduates:



Brain drain to the high-tech industry

The academic system in Israel faces challenges in recruiting faculty members and graduate students in the exact sciences and retaining existing ones, due to competition with the high-tech industry. To address this issue, the academic system should seek creative solutions that do not depend solely on improving wage conditions.

- ▣ Collaboration with industry should be enhanced through increased flexibility for faculty members, allowing for more collaboration and increasing the number of permitted hours for industry engagement. Additionally, intellectual property rules should be made more flexible.
- ▣ Funding to research students should be increased, especially in selected fields, by granting them funding from the commencement of their master's degree studies.

Excessive duration of laboratory setup for new researchers

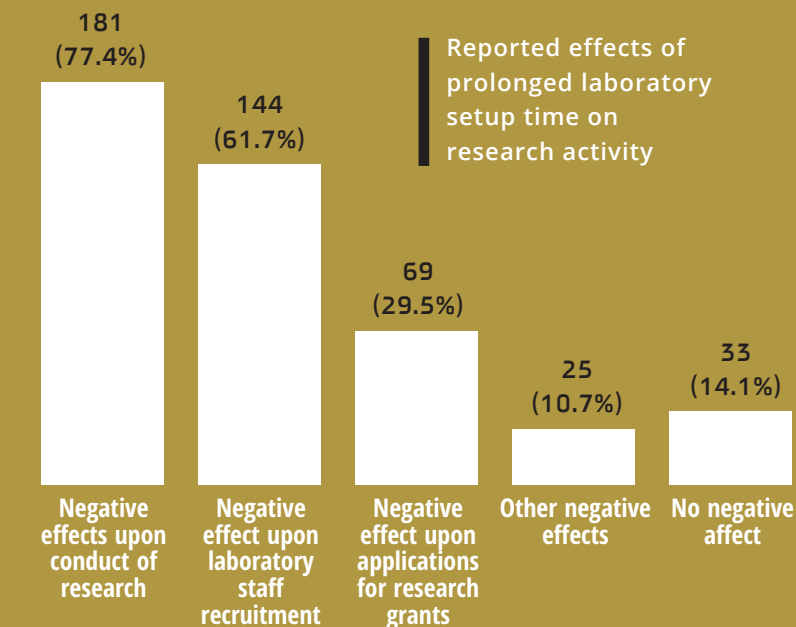
The process of setting up laboratories for new researchers in the universities tends to experience unnecessary delays. This happens due to various reasons such as inefficient project planning and management, difficulties in securing available space for new labs, regulatory burdens, and procurement challenges. Such delays significantly hinder the ability of new researchers to conduct groundbreaking and competitive research on an international scale, and triggers frustration.

17 months

Average setup time for laboratories

20%

of researchers received their laboratories over two years after starting work at the university



▣ Shortening the time it takes to establish laboratories should be a goal, with incentives created for achieving it and ongoing follow-ups in this regard to be carried out both by the research institutions and by the Council for Higher Education.

▣ The research institutions' handling of this issue can be improved, for example, by commencing the planning and setting up of laboratories for new researchers as early as possible, before they actually begin working at the institution, and making temporary laboratories available to them in the interim.

Conservatism in recruiting faculty

The recruitment processes in Israel's academic institutions are very conservative. Many institutions prefer to avoid the risk of recruiting faculty whose research has yet to bear extensive fruit, thereby missing opportunities to integrate faculty members who later prove to be outstanding researchers. This conservatism, resting on the practice of granting tenure to almost every senior faculty member, also makes it difficult to deal with the shortage of senior faculty in the exact sciences and engineering in Israel.

▣ Less conservatism should be shown in recruiting new faculty members, and outstanding researchers whose full bloom still lies ahead should be given a chance. This can be accomplished by gradually and carefully moving the decisive point for judging a faculty member's excellence from the entry stage to that of granting tenure.

The Life Sciences and Medicine

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Throughout the years, the extensive research in the life sciences and medicine carried out in Israel has garnered much recognition and many international achievements. The life sciences and medical sciences are among the largest fields of research in Israel in terms of the funding and manpower allocated to them. Resources allocated to this field sometimes equal and even surpass those allocated to all of the exact sciences combined.

Life sciences and medicine faculty:

25%
of total faculty

+24%
2015–2021

Life sciences and medicine graduates:

10%
of bachelor's degree graduates

14%
of master's degree graduates

32%
of doctorates

Life sciences and medicine research grants:

35%
of the Israel Science Foundation's budget for new personal research grants

NIS 280,000 (c. US\$ 80,000)
average annual funding per grant

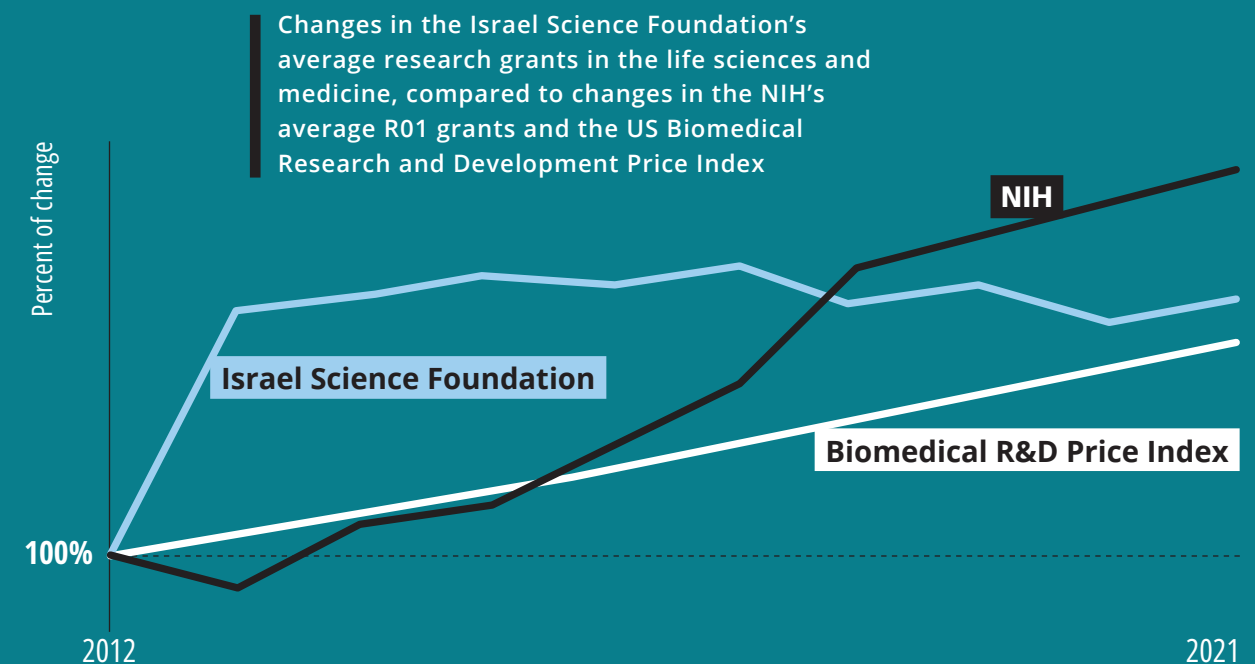
Research by physicians

Physician-researchers are physicians who, in addition to their clinical work, conduct basic or applied scientific research. The combination of clinical work and scientific research has the potential to contribute greatly to scientific research and the quality of medical care in Israel, and it also carries economic benefits. Nevertheless, this field is under-exploited on account of the many hindrances to the activity of physician-researchers.

- ▣ Extensive funding should be allocated to physician-researchers at the beginning of their careers to support the establishment and development of their research activities.
- ▣ Incentives should be introduced for the hospitals, the health funds and their departments to encourage research activity among physicians
- ▣ Dedicated positions must be created for physician-researchers, to guarantee the orderly and long-term allocation to selected physicians of protected time for research.

Research costs in the life sciences and medicine

The cost of research in the life sciences and medicine tends to be exceptionally high, due to the need for advanced scientific equipment, staff and consumables in large quantities, as well as the high cost of animal research. Moreover, in recent years, there has been an increase in the cost of research inputs in the field. In the absence of corresponding adjustments in funding allocations, these rising costs erode the ability of Israeli science to conduct groundbreaking and competitive research on a global level.



- ▣ An index of the cost of research inputs in the life sciences and medicine should be developed. There is a need to examine their scope, how they are funded, and the extent to which their funding must be adjusted to allow for the increase in costs.
- ▣ Ways to lower the cost of research inputs in Israel should be examined, among other things, by looking into market conduct, regulation in this area, and possible collaborations among research institutions in Israel.

Research in the Academic Colleges

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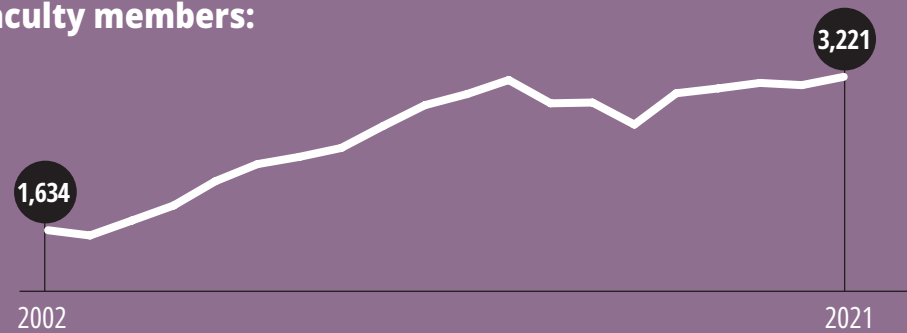
Since the 1990s, the number of academic colleges and their share in the higher education system in Israel has increased considerably.

20 Publicly funded colleges | **9** Non-publicly funded colleges | **22** Academic colleges of education

Number of senior faculty members:

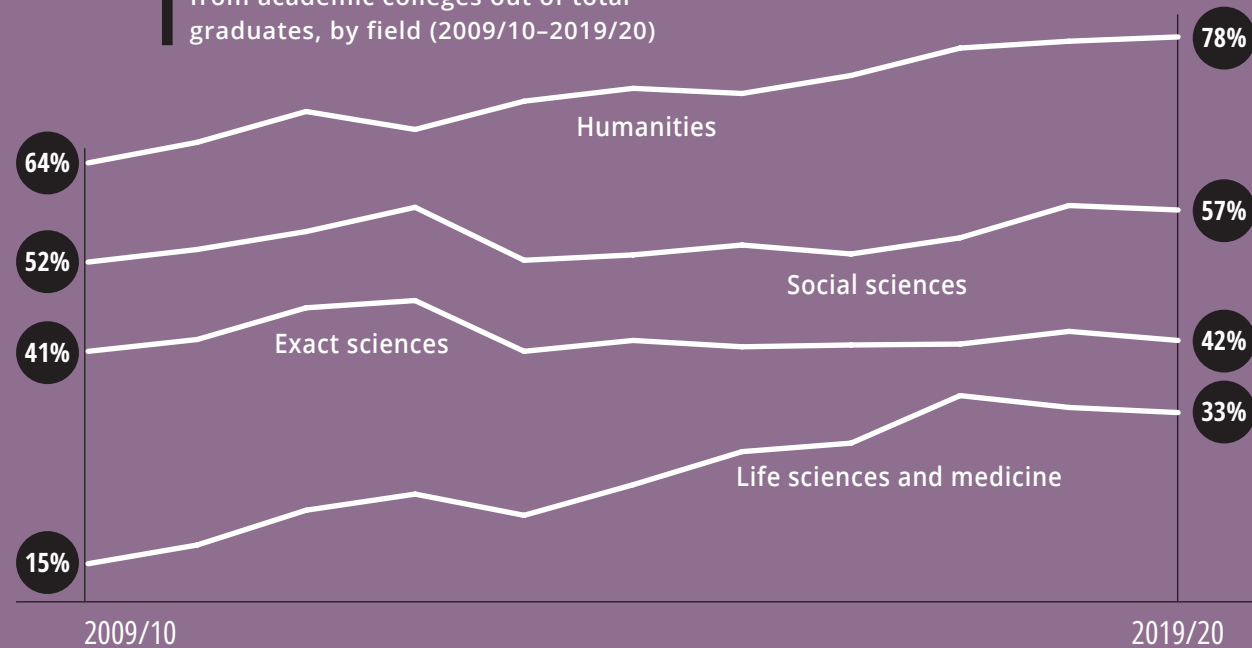
28%
of total senior faculty

+97%
2002–2021



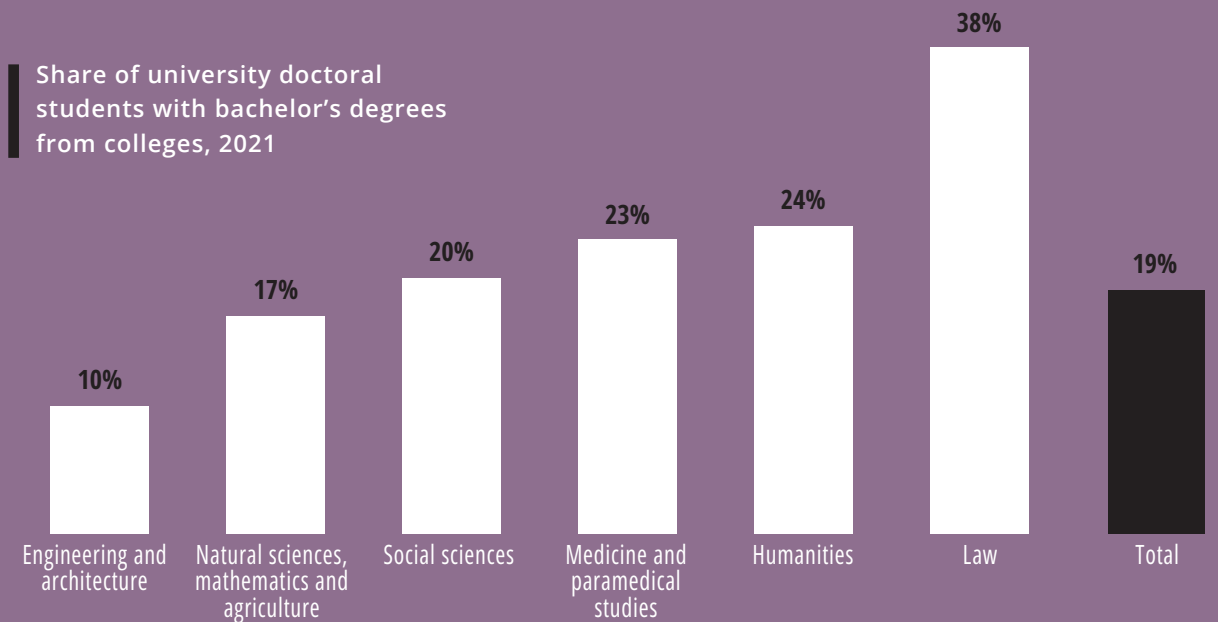
Number of graduates:

Share of bachelor's degree graduates from academic colleges out of total graduates, by field (2009/10–2019/20)



The colleges originally were intended mainly to enable the expansion of access to higher education in Israel, primarily at the first degree level, in contrast to the universities, which were meant to uphold the banner of research excellence and train future scholars. Yet, over the years, research activity in the colleges has expanded greatly, especially with regard to applied research. But the colleges also excel in basic research, and an increasing number of their graduates have been integrated into advanced studies at universities.

Share of university doctoral students with bachelor's degrees from colleges, 2021



In light of these trends, the role of research in Israel's colleges should be examined. Enhancing it has the potential to contribute to the quality of teaching in these institutions and to Israel's science, security and economy. In particular, the cultivation of applied research in colleges can help them meet industry needs with up-to-date and useful knowledge, enhancing the comparative and technical advantages of Israeli industry at an international level. There is an opening here for an economic return, in a way that does not equate the colleges with the universities or put them into competition with each other.

As part of this process, the main challenges hindering the flourishing of research activity in colleges must be confronted. Foremost among these is the paucity of resources typically available to colleges for research activities. Addressing these challenges is not up to the colleges or the higher education system (especially the Planning and Budgeting Committee of the Council for Higher Education) alone. They must also be addressed by bodies with an interest in promoting this issue, both in government ministries and in industry.

- ▣ Research authorities in colleges should be strengthened.
- ▣ Access to research infrastructures for scholars in colleges should be expanded.
- ▣ There is a need for a dedicated, competitive and excellence-based track for selected researchers in colleges.

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The Israel Academy of Sciences and Humanities
Albert Einstein Square, P.O.B 4040, 9104001, Jerusalem
Telephone: +972-25676222
www.academy.ac.il



Online report