

Funding the frontier – the Human Frontier Science Program

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The Human Frontier Science Program (HFSP) is a global program of scientific funding that is supported by 13 countries¹ and the European Union. HFSP is now 21 years old. Since its establishment in 1989, we have funded over 5000 scientists in over 60 countries with postdoctoral fellowships and research grants on cutting-edge topics in the life sciences.

HFSP was founded on the initiative of the former Prime Minister of Japan, Yasuhiro Nakasone at a time when Japan wished to take a more active role in the international community following its post-war industrial success. The international credentials of HFSP are clear from its origin at the level of the G7 summit in Venice in 1987. It was established with funds from Japan and with the support of the G7 nations, the European Union (who traditionally represent the non-G7 EU members) and, in 1991, of Switzerland. Since 2004, HFSP has welcomed Australia, the Republic of Korea, New Zealand, India and Norway as contributing members and now has a broad intercontinental membership in Europe, North America and the Asia-Pacific region.

From our broad global membership it will come as no surprise that HFSP funding programs all have an international element in the spirit of “science without borders” with a strong emphasis on intercontinental collaboration. We also have a clear commitment to supporting early career scientists. In addition, two factors are important for understanding HFSP’s *scientific* aims: (1) the scope of the research supported is defined as “Research into the complex mechanisms of living organisms” and (2) the term “Frontier Science” in our name is to be understood as the essence of our scientific mission.

The frontiers of science are always on the move. For many years, a reductionist, more analytical approach to molecular life science prevailed (gene X or signalling molecule Y is essential for function Z), and this was reflected in the grants and fellowships funded especially in the first 10 years of the Program. However, with the rapid acceleration in our knowledge, biology has now entered into a more integrative, quantitative phase geared to understanding the emergence of complexity from the interaction of biological molecules, cells, and organisms. This requires input from non-biological disciplines such as physics, chemistry, computer science and engineering and in recent years we have placed considerable emphasis on the interaction of scientists from different disciplines in investigating biological questions. The founders of HFSP foresaw the importance of interdisciplinary approaches and these now provide the basis for much of the research at the frontier of biology.

¹ HFSP is funded by contributions from Australia, Canada, European Union, France, Germany, India, Italy, Japan, Republic of Korea, Norway, New Zealand, Switzerland, UK and USA.

Research at the frontier is by its very nature a leap into the unknown. It is intrinsically risky and requires a high degree of creativity and innovation. Applications to HFSP must propose much more than “business as usual”. This requirement is expressed in different ways in the grant and fellowship program as will be described below. It is important to note, however, that our review process favours risk and absolute priority is given to projects that aim to open new horizons in our understanding of living systems. Excellence and risk are two key elements in HFSP funding.

A common misconception is that HFSP is a biomedical funding program. This arises from a misinterpretation of “Human” in our name. Rather than thinking of the Program as one of “Human Science”, it is to be understood more in the sense of “Frontier Science” being a quintessential human activity. The aim of our funding is to address fundamental biological questions related to complex biological systems. The emphasis of an application to HFSP must therefore be on basic biology: projects of a “bench to bedside” nature are out of scope, as are those aimed solely at developing diagnostic methods or therapies, or to improving agricultural yields. The potential for practical outcomes is not taken into account in making funding decisions.

Research Grants

HFSP research grants enable scientists in different countries to collaborate on well-focussed projects. The emphasis is on intercontinental collaborations, normally between 2-4 laboratories. Two programs are available: Young Investigator Grants are for teams of scientists who are all within 5 years of starting their first independent positions; Program Grants are for scientists at any stage of their careers, but in practice often include at least one junior faculty member. Grant applications are reviewed in two steps, with a short letter of intent (650-700 applications are received each year) followed by full applications from 80-90 invited teams. Both steps are rigorously reviewed and 32-35 grants are awarded per year.

Clearly, given the discussion above, applicants are expected to attack key problems at the frontier of biology and this is the primary criterion used when evaluating proposals. Technology development is welcome if it has a potential high impact, but grant teams consisting only of engineers, chemists or physicists are rarely successful. Such projects should preferably be biology-driven and teams should include a biology component at least to establish proof of principle.

HFSP grants aim to allow the applicants to pursue a new project, taking them beyond the work already being done in their laboratories. They also aim to stimulate new collaborations to bring together scientists with the expertise necessary for the team to embark on a new direction. To encourage new and adventurous collaborations, HFSP does not require preliminary results, just well argued, innovative ideas. The way the collaboration is formulated is critical in the evaluation of the applications, even at the letter of intent stage.

- Each team member must have a track record showing that he or she is able to perform the research
- Each team member must have a clear and essential role to play. Collaborators should not be chosen merely as tokens to fulfil the intercontinental and interdisciplinary requirements. No preference is given to applications that

include a team member from any specific country – only the general principle of intercontinental distribution is considered. Scientists who are approached to join a team should be very clear about the active role they are expected to play in the project.

- It is insufficient for a team member merely to provide reagents. The interaction between collaborators must be iterative.
- The way the team will interact must be clearly demonstrated. In the case of a combination of theoretical and experimental approaches it is important to give details of the modelling strategy and to show how each approach will inform the others. It is insufficient - and we see this far too often - to present the experimental approaches with a bland statement saying no more than “then we will model it”.
- Team members should not have collaborated previously. An exception can be when two team members have worked together before but addition of other collaborators allows their work to take off in a new direction.
- Large teams are to be avoided since they tend to be based more on a shared interest than a focussed collaboration. In general, the most successful Young Investigator Grants have 2-3 team members and the Program Grants 3-4.

Postdoctoral Fellowships

HFSP provides two kinds of postdoctoral fellowship: Long-Term Fellowships are for scientists within 3 years of obtaining a PhD, who already have experience in biology but wish to broaden their experience through advanced training in a different field. Cross-Disciplinary Fellowships are similar, but are for those with a PhD in non-biological subjects who wish to apply their expertise to questions in the life sciences. Approximately 700 applications are received each year for around 90 fellowships. Approximately 10% of applications are for Cross-Disciplinary Fellowships.

A key element in the HFSP fellowship program is the broadening of expertise. Long-Term Fellowship applicants are expected to move into a new field within the life sciences to equip themselves with the breadth of expertise necessary in the modern biological sciences. Cross-Disciplinary Fellows are by definition moving into a new discipline and it is noteworthy that the applications received for this program tend to be far more innovative than those for Long-Term Fellowships. Perhaps the fact that these applicants are making such a major change of field makes them more adventurous and willing to take scientific risks. Within this small group of applicants, the success rate is therefore significantly higher.

HFSP aims to fund independently minded young scientists who are actively seeking to expand their expertise to further their interests in key biological questions. They should be immersing themselves in a new scientific literature and learning new techniques. The proposed projects should be original and not just an extension of the PhD thesis or a regurgitation of the host supervisor’s grant proposal. Applicants wishing to go to large, well established labs should avoid being absorbed into the mainstream of the laboratory’s interests where they may be working on the obvious next step in the host’s research. HFSP will not support what one reviewer has called “plug-in postdocs”.

HFSP expects bright young scientists to formulate their own research projects. Some allowance for “rough edges” in the project description is made for applicants making large leaps into another field, for instance in the Cross-Disciplinary Fellowships, but it is usually quite obvious if the proposal is written by the host supervisor. Applicants and host supervisors are asked to describe how the proposal came about and reviewers look for evidence of originality on the part of the applicant.

Career Development Awards (CDA)

The CDA program was started as a mechanism to encourage HFSP Fellows to return home after it became clear that many chose to stay in the host country. CDAs are only for former HFSP Long-Term and Cross-Disciplinary Fellows. They provide start-up funds of \$100,000 per year for three years for former Fellows returning to their country of citizenship.

The CDA is intended to support the transition to independence of former HFSP Fellows. Candidates’ careers are expected to move forwards with the award. Candidates just returning to the laboratories where they did their PhDs are discouraged and we give priority to young scientists seeking new institutions where they are clearly initiating independent careers. In some smaller countries this can be difficult but it must be very clear in the application that the candidate’s position is independent and that he or she has not just been sent abroad by the home institution to bring back expertise to the same laboratory.

The CDA is an individual grant that is meant to encourage new departures for the awardees as they set up their independent laboratories. We are looking for projects that are not just a continuation of the work performed during the fellowship but reflect the opportunities offered by independence to pursue imaginative, high risk projects. Until now, the success rate of the CDAs has been as high as 40%. However, as everywhere, HFSP is under budgetary constraints and the frontier nature of the proposed projects and the elements of innovation and risk will play an increasing role in the competitive CDA review.

Summary

Over the last 21 years, HFSP has funded thousands of highly talented scientists throughout the world, performing cutting edge research in the life sciences. Since 2001 we have brought together the current awardees annually in a stimulating scientific meeting that has led to new collaborations between scientists from different fields and a sense among many awardees that they are members of the HFSP community. This is now being extended with the establishment of an alumni network. Hopefully, we will continue to attract like-minded scientists to submit creative applications that will further extend this global community of innovative researchers.