SUMMARY

In *Strategic Foresight on New Biology – The Core of the Life Sciences*, the Biosciences Committee of the Royal Netherlands Academy of Arts and Sciences presents a strategic plan for biology in the Netherlands. The plan is based on three different analyses:

- an analysis of the challenges and opportunities for society in the life sciences and how these relate to the key economic sectors of the Netherlands;
- an analysis of the international position of Dutch research in biology and the potential for maintaining and enhancing that position;
- an analysis of the key priorities of Dutch research and education in biology and related disciplines.

The first analysis shows that the life sciences are currently in a state of rapid and dramatic change, and that these developments have important implications for everyday life and offer enormous opportunities for the Dutch knowledge economy. They have become possible because biologists have now gained access to the building blocks of life and because the science of biology can now offer explanations and make predictions that have a huge impact on other scientific disciplines and areas of application. That is why scientists today refer to the 'New Biology', a cross-disciplinary science that encompasses such fields as health, agriculture, horticulture, biodiversity, and materials and energy supply. It is precisely at the interface between separate disciplines that we can expect to see crucial breakthroughs, for example in new areas such as synthetic biology and nanobiotechnology. Collaboration between parties is and will remain vital.

The Netherlands has a unique, robust position in the New Biology, thanks to its internationally prestigious researchers and its innovative, outward-looking enterprises. The New Biology drives the knowledge economy in six of the Netherlands' nine key economic sectors, i.e. life sciences & health, agro-food, horticulture and propagation materials, chemicals, energy, and water.

The second analysis confirms the observation that Dutch biological research is among the best in the world, but also shows that that position is under threat. Knowledge institutions, enterprises and government – the 'golden triangle' – have cooperated closely on promoting research, innovation and knowledge valorisation in the past ten years. There is nevertheless a risk that the Netherlands will lose the momentum that it has built up in the New Biology compared with its neighbours in Europe, for three reasons:

In the past decade, government and enterprise have invested less in education and research in the Netherlands than in most other countries in the West, and growth in investment has slowed. The downward trend is starting to have a demonstrable effect on Dutch scientific output and its impact, which has been outstanding until now.

Young people are very interested in New Biology university programmes; the number of students enrolled in such programmes has doubled in the past ten years and graduates have an excellent position in the labour market, but there has not been a concomitant increase in the number of tenured teaching positions – indeed, there has even been a decline. The training of tomorrow's top Dutch biologists is being eroded.

Dutch incentive funding for public-private partnerships and knowledge valorisation is drying up precisely at a time when other European countries and emerging economies in Asia are investing more in their knowledge economies. Unlike the Netherlands, other countries are grasping the opportunities offered by rapid changes in the New Biology.

The Netherlands is one of the world leaders in the New Biology, but it must, crucially, continue to invest in this area of science if it hopes to maintain its position in the global rankings.

Finally, the Biosciences Committee analysed which disciplines within the broader field of New Biology have focus, mass and impact in the Netherlands. A cluster analysis of the publications of all Dutch full-time professors in the life sciences produced a list of eight key disciplines within the field of New Biology in which the Netherlands is active. The Netherlands has enough focus and mass in five of these disciplines to remain competitive internationally. In addition, Dutch professors in these five key disciplines comprise a relatively large proportion of the group of internationally prestigious, most-cited biologists. These disciplines can therefore be considered the core of the life sciences in the Netherlands:

- Physiology and Neurobiology
- Cell Biology and Developmental Biology
- Ecology and Evolutionary Biology
- Microbiology
- Plant Biology

These disciplines have focus, mass and international impact; reinforcing them will generate the most benefits for the Netherlands in terms of both the sciences and the economy.

Analysis of priorities at institutional level reveals that each of the institutions has already defined its approach to the New Biology, both in research and in teaching. Far from being a 'free-for-all', choices have already been made, in part owing to an earlier sector plan, i.e. Biology: A Vital Interest, and the work carried out by the research schools active in this area. All this has provided a sound basis for defining the relevant research and Master's programme while retaining a broader Bachelor of Science programme.

Based on these analyses, the Committee makes eight specific recommendations to knowledge institutions, enterprises and government, including an investment plan of at least EUR 70 million. Its general advice to all the relevant parties is as follows: recognise the specific importance of the New Biology for key Dutch economic sectors and acknowledge the urgent need to take steps to boost education and research, innovation and knowledge valorisation; appoint an implementation group for that purpose, comprised of representatives of knowledge institutions (science faculties, research institutes, the Academy and the Netherlands Institute of Bioscience-NIBI), research funds (NWO-ALW and STW), enterprise and government and authorise this group to implement the investment and other measures in consultation with the knowledge institutions.

THE EIGHT RECOMMENDATIONS ARE:

1. Improve academic performance in biology study programmes by defining distinct profiles and encouraging research universities and universities of applied sciences to cooperate on providing information to students and on selecting and referring students.
2. Maintain a broad academic Bachelor's Degree programme in biology, continue defining – per institution -the distinct profile of academic Master's Degree programmes in biology and related programmes, and make both more appealing to talented students by introducing honours programmes across the board.
3. Make outreach and communication one of the explicit aims of the organisation, so that the public's knowledge of science improves and its commitment to research increases.
4. Join universities in investing in one hundred extra tenure track positions in biology and related courses through the direct funding mechanism.
5. Concentrate on the five key disciplines in which the Netherlands has focus, mass and impact.
6. Make innovation, knowledge valorisation, social relevance and entrepreneurship part of the relevant programmes of study and get enterprises involved in doing so.
7. Invest in knowledge valorisation by start-up companies by continuing the successful LifeSciences@work programme.
8. Invest in talented graduates and equipment by supporting research, innovation and knowledge valorisation incubators in the five key disciplines of the New Biology in which the Netherlands has focus, mass and impact.