

**PLEASE NOTE: THIS SKILLS STATEMENT IS CURRENTLY BEING UPDATED. IF YOU HAVE ANY QUERIES, PLEASE EMAIL [postgrad.studentships@bbsrc.ac.uk](mailto:postgrad.studentships@bbsrc.ac.uk).**

## **BBSRC Skills Statement: Scientific and Core Skills for UK Bioscience**

The BBSRC Skills Statement brings together in one place the research-specific expertise and cross-cutting skills that BBSRC is seeking to support through its Training Grants. This statement is intended to help institutions in planning how to address BBSRC's strategic priorities for research training.

BBSRC supports studentships in research areas across its remit. The areas described here cover:

- BBSRC's broad strategic research priorities and enabling technologies to exploit new ways of working (**section A**).
- Specific strategically important and vulnerable niche skills (**section B**), which have been identified as areas where increased student capacity is required in order to maintain or develop an adequate supply of skilled researchers within the UK.
- Cross-cutting core bioscience and generic professional skills (**section C**), which are the skills that are increasingly expected of today's bioscience researchers and are expected to be included as part of all BBSRC funded studentship programmes.

This document draws on BBSRC's Strategic Plan 2010-2015 (and the consultation which informed it) and associated Delivery Plan, BBSRC's Niche Skills and other reviews, as well as views gathered from BBSRC committees, panels and groups on which BBSRC is represented.

Further information can be found in the references listed throughout the document or you can email queries to [postgrad.studentships@bbsrc.ac.uk](mailto:postgrad.studentships@bbsrc.ac.uk).

## A. Strategically important research areas

BBSRC's Strategic Plan 2010-2015 "The Age of Bioscience"<sup>1</sup> outlines its current strategic priorities for research. Studentships addressing the areas described in this section should develop the skills needed to support research in the subject in question. BBSRC does *not* expect all its studentships to be relevant to its strategic priority areas, or expect a single institution to offer studentships across the whole BBSRC remit. However, across the complete portfolio of studentships funded through the Doctoral Training Partnerships, BBSRC intends to ensure that there is an appropriate balance of studentships providing sufficient training within the research community to maintain an adequate supply of high quality researchers for all the areas given below.

BBSRC's strategic research priorities are:

1. Food Security
2. Bioenergy and Industrial Biotechnology
3. Basic Bioscience Underpinning Health

Together with the following research enabling theme:

4. Exploiting New Ways of Working – including the need for researchers to develop and use new bioanalytical, bioinformatic and biological technologies, and to recognise the importance of taking a systems approach to biological problems

### 1. **FOOD SECURITY:** Bioscience for a sustainable supply of sufficient, affordable, nutritious and safe food, adapting to a rapidly changing world

A review of high level skills needs for food security<sup>2</sup> identified that there may be a shortage in the supply of highly skilled people in a number of niche research areas (see also section B). As part of other activities in this area, and as a contributing member of the Global Food Security programme<sup>3</sup>, BBSRC wishes to support the development of skills and expertise relating to the following research areas:

- **Animal health and welfare:**
  - Endemic and exotic diseases of animals (including aquaculture and fisheries), including food-borne zoonoses, welfare-related disease and non-transmissible diseases
  - Farm animal welfare: improving the conditions and management of farmed animals to minimise pain, suffering, distress or lasting harm
  - Genetics and genomics for improved animal breeding
- **Crop science:**
  - Increasing the efficiency and sustainability of crop production and reducing waste in the food chain
  - Minimising negative environmental impacts and preserving biodiversity and other ecosystem services
  - Pre-competitive research that can be translated into practice, such as plant breeding

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<sup>1</sup> <http://www.bbsrc.ac.uk/publications/planning/strategy/strategic-plan-index.aspx>

<sup>2</sup> <http://www.bbsrc.ac.uk/web/FILES/Reviews/1001-high-level-skills-for-food.pdf>

<sup>3</sup> <http://www.foodsecurity.ac.uk/assets/pdfs/gfs-strategic-plan.pdf>

- Crop protection: enhancing yield and quality of crops through prevention and combating of pests, diseases and weeds; generating crops adapted to future environments
- **Diet and health:** Enhancing food quality for improved nutrition
- **Microbial food safety:** Animal and plant diseases and their causative organisms that have impacts on human health
- **Agricultural systems and environment:**
  - Agricultural landscapes and systems
  - Soil science
  - Interactions of crop farming practices with the environment
  - Impacts of climatic and other environmental factors on agricultural systems

## 2. **BIOENERGY AND INDUSTRIAL BIOTECHNOLOGY:** Production and processing of energy and industrial materials from biological sources

Bioenergy and Industrial Biotechnology (IB)<sup>4</sup> is a broad research area, incorporating cross-disciplinary underpinning technologies that make use of biological resources to process and produce chemicals, materials and energy. These resources include plants, algae, marine life, fungi and other micro-organisms.

BBSRC wishes to build capacity in all areas of IB but in particular is looking to support training that addresses the following skills and research expertise:

- **Biocatalysis and other biological processes:** the production of industrial chemicals from living organisms, including through **synthetic and systems approaches**. This is an area where **cross-disciplinary research** involving biologists, chemists and engineers, as well as integration with the chemicals industry, is of particular importance. So too will be a focus on skills for **bioprocessing** and for the discovery of **novel bioactives** from first principles.
- **Bioenergy:** fundamental research on future bioenergy production, particularly liquid biofuels using **synthetic and systems approaches**
- **Biologics:** including underpinning bioscience and technology development to improve **bioprocessing**, particularly where there are clear links with industry
- **Non-food crops:** developing processes to increase the production of high value **chemicals from plants**

## 3. **BASIC BIOSCIENCE UNDERPINNING HEALTH:** Driving advances in fundamental bioscience for better health and improved quality of life across the life course

BBSRC wishes to support the development of skills and expertise relating to the following research area:

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<sup>4</sup> <http://www.bbsrc.ac.uk/organisation/policies/reviews/scientific-areas/1102-industrial-biotechnology-bioenergy-report.aspx>

- **Lifelong Health and Wellbeing:** the basic molecular, cellular, tissue and systems mechanisms responsible for longevity or premature ageing and how these are modulated by diet, exercise and developmental factors

**4. EXPLOITING NEW WAYS OF WORKING:** Enabling innovative working practices in an era of rapid technological advancement, the next generation internet, and quantitative and computational approaches to bioscience.

This enabling theme is cross-cutting and drives bioscience research in all areas – the need for researchers to develop and use new bioanalytical, bioinformatic and biological technologies to accelerate discovery and preserve UK world class status. This includes an emphasis on the development and use of systems and modelling approaches to the study and solution of biological problems. The Exploiting New Ways of Working priority embraces multidisciplinary and quantitative approaches and covers the development of research expertise and skills as follows:

- Research expertise in and for the development of the next generation of bioanalytical and biological technologies, in areas including (but not exclusively) bioimaging, 'omics technologies and biomolecular characterisation
- Research expertise in the development of the next generation of computational and bioinformatic tools, and resources to drive data intensive bioscience and tackle the bioscience data deluge
- Research expertise in synthetic biology, an emerging area at the interface of biology, engineering, chemistry and IT that focuses on the design and construction of new biological parts, devices, and systems, and the re-design of existing, natural biological systems for useful purposes
- Boosting skills, across the biosciences, to ensure that all researchers are effective in exploiting new tools and methodologies relevant to their research as they become available

Two recent BBSRC Strategic Reviews have identified additional skills gaps in Exploiting New Ways of Working. These are the Review of Next Generation Sequencing<sup>5</sup> and the Review of the Computational Requirements of the Biosciences<sup>6</sup>.

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<sup>5</sup> <http://www.bbsrc.ac.uk/organisation/policies/reviews/scientific-areas/1102-next-generation-sequencing-review.aspx>

<sup>6</sup> <http://www.bbsrc.ac.uk/news/research-technologies/2011/110120-n-computational-requirements-review.aspx>

## **B. Other strategically important and vulnerable ‘niche’ research skills**

In October 2009, BBSRC published a report on “Strategically important and vulnerable capabilities in UK bioscience”<sup>7</sup>. This review of ‘niche’ research skills in the UK identified a number of areas where BBSRC wishes to ensure an adequate supply of skilled people; many of these are relevant to the broad research areas described in section A. Typically niche skill areas do not require large numbers of expert scientists, and the low number needed can itself create difficulties for recruiting people into an area.

Niche skills that BBSRC is particularly keen to support include the following:

### **Relating to Food Security:**

- Plant physiology
- Plant breeding
- Plant pathology, especially entomology and mycology
- Soil science
- Horticulture
- Agroecology

### **Relating to Exploiting New Ways of Working:**

- Data visualisation
- Next Generation Sequencing

### **Other areas:**

- **Systematics and Taxonomy**

This area covers systematics and taxonomy for all groups, but particularly microbes (including fungi), algae and plants. This includes research at all levels, from genetic and molecular studies to morphological approaches.

The development of skills in systematics and taxonomic approaches are important in the following scientific areas:

- identifying emerging threats from climate change, disease and invasive species
- underpinning agricultural development and food security through the identification and development of drought or pest resistant races from combining trait, genetic and distribution data
- ensuring that the UK retains a pool of trained professionals able to provide taxonomic identifications
- interpreting the outputs from various ‘omic’ based approaches
- searching for bioactive compounds of commercial potential therapeutic importance

- ***In vivo* skills**

This area covers whole animal physiology and integrative mammalian biology, including the development of skills for the handling of both laboratory and large animals, particularly where these skills are developed through collaboration with industry. Skills needs in this area are still considered to be vulnerable by the industry and are described in more detail in the ABPI review<sup>8</sup>.

<sup>7</sup> <http://www.bbsrc.ac.uk/organisation/policies/reviews/consultations/0905-bioscience-research-skills.aspx>

<sup>8</sup> <http://www.abpi.org.uk/Details.asp?ProductID=338>

## C. Core Bioscience and Generic Professional Skills

In order to address the complexities and challenges facing modern biologists, BBSRC has identified areas of 'core bioscience skills' which all future bioscientists need to develop. These core bioscience skills build on the broader generic and professional skills that BBSRC, along with the other Research Councils, regard as vital for all PhD students to develop.

This section represents the skills areas which are increasingly being seen as core for the next generation of bioscientists. BBSRC does not wish to be overly prescriptive on the depth that any one student should attain in these skills. However, institutions holding BBSRC Training Grants should have mechanisms in place to provide access to such training, assess individual training needs in these areas and monitor skills development. Institutions may not wish to provide all the training themselves, but rather seek to draw on external training opportunities – for example, the *Biotechnology YES* competition<sup>9</sup> for the development of entrepreneurial awareness, or *Researchers in Residence*<sup>10</sup> for outreach opportunities.

### Core Bioscience Skills

The two groups of core skills for bioscientists are:

#### 1. Mathematics and data analysis

The use of mathematics and data analysis to manage and interpret biological data through:

- Mathematical and data handling skills
- Statistics and experimental design

#### 2. Multidisciplinary approaches to understanding biological systems

Understanding the value of collaborative and coordinated interdisciplinary approaches to biological research; for example:

- Multidisciplinary approaches to understand biological systems<sup>11</sup>, including an understanding of how modelling can inform subsequent rounds of experiments
- Veterinary and medical research collaboration to identify common approaches to tackling problems relating to animal diseases
- Biological and chemistry / engineering approaches to industrial biotechnology
- Biological and computational approaches to managing and analysing large datasets in the biosciences

### Generic Professional Skills

As part of RCUK, BBSRC funds the Vitae programme<sup>12</sup> to help research organisations provide generic and professional development for PhD students and postdoctoral researchers.

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<sup>9</sup> <http://www.biotechnologyyes.co.uk/>

<sup>10</sup> <http://www.researchersinresidence.ac.uk/rir/>

<sup>11</sup> See further information on systems approaches to biological research at:

<http://www.bbsrc.ac.uk/science/systems-approach.aspx>

<sup>12</sup> <http://www.vitae.ac.uk/>

BBSRC also supports the development by Vitae of the 'Researcher Development Statement'<sup>13</sup>, which outlines the areas of professional development that research organisations should be addressing in their training programmes. The Researcher Development Statement replaces the Research Councils' Joint Skills Statement, and covers the domains shown.

These skills include those that encourage students to understand the impact of their research. BBSRC defines impact as the demonstrable contribution that excellent research makes to society



and the economy. Impact embraces all the extremely diverse ways in which research-related knowledge and skills benefit individuals, organisations and nations by:

- fostering global economic performance, and specifically the economic competitiveness of the United Kingdom
- increasing the effectiveness of public services and policy
- enhancing quality of life, health and creative output

BBSRC recognises that the impact of excellent research is extremely broad, and is found in areas as diverse as industry, schools, local and national government, news and media, and international relations. Further information on BBSRC policy and guidance on impact of bioscience research can be found on the BBSRC website<sup>14</sup>.

In particular, BBSRC would wish to see the development of skills in the following two areas:

### 1. Social impact of research

- Public engagement and outreach opportunities<sup>15</sup>
- Ethical awareness training, including animal welfare and the replacement, refinement and reduction of animals in research<sup>16</sup>
- Awareness of the legal and societal context of biological research
- Understanding how research can be used to develop evidence-based policy

### 2. Commercial impact of research

- Commercial awareness
- Business and management skills
- Entrepreneurial awareness

<sup>13</sup> <http://www.vitae.ac.uk/rds>

<sup>14</sup> <http://www.bbsrc.ac.uk/organisation/policies/position/policy/impact-policy.aspx>

<sup>15</sup> See the Concordat for Engaging the Public with Research at: <http://www.publicengagement.ac.uk/why-does-it-matter/concordat>

<sup>16</sup> See NC3Rs: <http://www.nc3rs.org.uk/>