



A European Programme in Mouse Functional Genomics

Harnessing European strengths in mouse genetics and genomics

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Rationale

The genetic make-up or genome of the mouse is now known. We now need to determine the function of these genes and the role that alteration of these genes plays in disease. This is functional genomics.

The mouse model plays a pivotal role in the investigation of human diseases and their diagnosis and treatment. It has a number of key features that makes it a suitable animal model for humans:

- The genome is 90% identical to the human genome
- It is possible to alter the genome in the mouse to produce models of human diseases including genetic disease
- Alteration of the mouse genome may also produce alterations in the normal functioning of organs, systems and behaviours which will give insights into the mechanism behind their normal functioning and possible treatments for malfunction
- The mouse model is used for drug screening and testing therapies including gene delivery and gene therapy

The key challenge for functional genomics in the 21st century will be the systematic determination of the function of all 30,000 or so genes in the mammalian genome and their role in disease. The mouse will play a pivotal if not a key role in achieving this endeavour. However, the success and speed of this enterprise will depend upon a number of factors including:

- The continued development of novel and large-scale approaches to determining the expression and action of genes in model organisms, particularly the mouse
- Improved bioinformatics platforms that will allow an increasingly sophisticated integrative approach to analysing gene function information from sequence to phenotype
- Improved access to resources, not only information, but also genetic material and mutant mice
- Enhancing the interface between academic research and the pharma and biotech industries

The overriding concern in bringing these approaches to bear is that an increasingly collaborative and trans-national dimension will need to be developed to ensure rapid progress. It is clear that it will be important to assess and engage the European dimension and its role in ensuring that EU nations are winners in this venture.

Europe is currently a powerhouse for research into mouse genetics and genomics, collectively at least equalling if not surpassing the US in worldwide impact. This research is competitive at the moment but fragmented. In order to stay competitive it requires more coordination at the European level. Individual European research centres are at the leading edge of studies in mammalian genetics and the use of mouse models to elucidate the genetic bases of disease. Moreover, laboratories in Europe have taken the lead in a number of new research and development areas in the field of mouse functional genomics that are a vital underpinning to the future use of the mouse as a pivotal model organism. To tackle future challenges, fragmentation has to be overcome and coordination is required across spectrum of mouse genetics expertise in the areas of:

- Mutagenesis
- Phenotyping
- Genomics
- Archives
- Informatics

Most member states in Europe perform research into mouse functional genomics. Much of this is funded by national public and charitable funding mechanisms and by the European Commission. There is currently cross-border collaboration at the level of individual research scientists and research institutes. The majority of this research is funded by the European Commission. The research would benefit from further links between research laboratories and joint applications for funding.

Some member states may have national research strategies which cover mouse functional genomics. The research would further benefit by coordination between national programmes and that of the European Commission. Greater interaction between research scientists and the national policy makers would allow priorities for research to be set. Calls for research could also be coordinated to allow better use of public research funds. The quality of research supported could also be enhanced by using common criteria for evaluation of research proposals and panels of international experts in the field.

Currently the European Commission provides support for infrastructures, such as the development of databases of anatomy, or the European Mutant Mouse Archive. The funding from the EC for these cannot continue indefinitely. This would progressively use up all the funds available for research, so no new research or infrastructures could be established. Collaboration between policy makers within member states may allow definition of new strategies that would secure funding to the competitive and essential infrastructures

Without further integration Europe could lose its competitive edge. Indeed, in several areas there is evidence of an existing and growing community that is dependent upon integrated, pan-European approaches in mouse genetics, genomics and allied activities. It is clear that the European mouse genetic community is ready and willing to engage in further integration and collaboration.

PRIME (**P**riorities for **M**ouse Functional Genomics across **E**urope) is a Coordination Action project funded by the European Commission under FP6 with the aim of harnessing the national programmes and national research strengths and determine ways to add value by coordinating them at a European level.

There are two ways to add value at a European level

1. Large-scale, high-throughput projects with a critical mass of research labs across Europe, tackling issues such as large scale production of Gene mutation production and archiving of mouse lines, phenotyping and gene expression
2. Integrated projects, bringing together researchers in a variety of fields from mouse functional genomics research, through to human genetics to pharmaceutical therapies. These are largely funded by the European Commission as Integrated Projects and Networks of Excellence under FP6 and are grouped together as the EuroMouse projects

Large-scale, high throughput mouse functional genomics projects

The mouse genome sequence is now known. The European and national effort needs to drive this on to determine the products and function of each of these genes and provide a comprehensive functional annotation of the mouse genome.

Mutation



Phenotyping



Expression



Archiving



Mutation

Extensive methods are available to modify the mouse genome and to study the relationship between gene and phenotype. There are two distinct approaches to mouse mutagenesis – gene-driven and phenotype-driven. In the former approach, a defined lesion is introduced into the mouse genome, followed by investigation of its phenotype. In contrast, the phenotype-driven approach aims to search large random collections of mutations, usually generated by ENU mutagenesis, for phenotypes of interest.

Phenotyping

Once an interesting phenotype is discovered underlying genetic lesion can be identified and investigated further. Both approaches depend upon phenotyping tools.

Expression

Determining the pattern of gene expression, both in individual tissues and throughout development, aging and disease. Use can be made of informatics to produce a digital atlas of gene expression available via the web.

Archiving

Central repositories are available for retaining genetically altered mice and to provide the scientific community with access to an extensive range of mutant mouse lines.

Mutagenesis

Increasing the depth and breadth of the mouse mutant resource is key to achieving a functional understanding of the mammalian genome. Powerful and affordable toolkits are available for mouse mutagenesis. Now that the mouse genome is known, the effort is turning to producing a resource of mice with conditional knock outs in all of the genes. EUCOMM (the European Conditional Mouse Mutagenesis Programme) has been funded under by the European Commission under FP6. It focuses on generating libraries of ES cells carrying conditional mutations. This has been joined by a sister programmes in Canada NorCOMM (the North

American Conditional Mouse Mutagenesis Programme) and KOMP (the Knockout Mouse Project) in the USA.

ENU mutagenesis approaches, both phenotype-driven and gene-driven, will also make a significant contribution. Ultimately, comprehensive libraries of mouse mutants for every gene in the genome will be generated. Indeed, the goal of mouse geneticists is to have available a range of mutant alleles for every gene, including hypomorphs, gain-of-function and dominant negatives as well as null alleles. All of these mutations will require phenotyping.

Links have already been formed between the research groups working on the EUCOMM, NorCOMM and KOMP projects. They met at the Mouse Mutagenesis Meeting that was held as part of the planning process for PRIME. The EUCOMM and NorCOMM project (with key scientists and policy makers) were brought together under PRIME for a simultaneous press release with a live satellite link between Europe (during the EuroMouse Meeting, Venice) and Canada in October 2005. A steering group has been formed between the funders of the 3 initiatives: European Commission, Genome Canada, NIH and the Wellcome Trust.

Discussions between these groups have identified that there is a need to generate mice from the ES cells resources in these projects and add further value to them by phenotyping them.

CONCLUSIONS – Mutagenesis

These large-scale mutagenesis projects will form a tremendous resource available to all researchers. Links should be maintained between the European projects and similar mutagenesis programmes in North America. There need now is to develop mice from these ES cell resources and add further value to them by phenotyping them.

New mutagenesis technologies

Already Europe is a leader in the development and utilisation of many mutagenesis technologies but this is an area where new technologies are speeding up progress. A number of areas would be substantially enhanced by a European approach.

Conditional Mutagenesis – enhancing the utility and access of conditional approaches, specifically cre mutagenesis

- Ensuring the establishment of accessible cre zoos
- Assembling and disseminating information on validated cre transgenics
- Implementing a forum for the discussion of future tissue targets and promoters for construction of new cre lines
- Examining new approaches to cre delivery, including protein transduction

Gene trap mutagenesis – enhancing the utility and breadth of the gene trap approach

- Ensuring the integration of the application of novel conditional gene trap approaches being developed across Europe, and establishing an appropriate forum for this task
- Establishing mechanisms for the distribution of gene trap lines

Transposable elements – developing a novel enabling technology

- Examining novel approaches to the use of transposable elements for systematic genome-wide mutagenesis in the mouse, building on promising early work in Europe

ENU mutagenesis – building on the already large European effort in this sphere

- Ensuring that novel developments in gene-driven ENU approaches in Europe are translated more generally to the genetics community, by establishing mechanisms for access to both mutagenised ES cells and DNA/sperm archives

RNAi – maintaining Europe at the forefront of this exciting technology

- Implementing a coordination forum for both technology development and access to RNAi library resources
- Establishing appropriate archives of RNAi libraries
- Examining and developing new delivery systems

CONCLUSIONS – New mutagenesis technologies

There are enormous opportunities to develop an integrated approach to mutagenesis across Europe; by integrating technology development and enhancing delivery of resources generated, to the wider community, through the establishment of appropriate archives. Integrating efforts should be underpinned by the establishment of forums or working groups to drive and oversee developments.

Phenotyping

As presented above, there is now a need to provide phenotypes for the mutants being produced in the large-scale mutagenesis programmes. Without appropriate tools and technologies for phenotyping, the value of a mouse mutant is lost. We need to standardise our approaches to how we undertake phenotyping. If mouse genetic centres around the world use various environmental conditions, or adopt quite different test procedures, then much of the ensuing datasets will not be comparable. To varying degrees, the phenotype assay is clearly crucial to determining the measured output. This would argue for adopting standardised approaches, or standard operating procedures (SOPs), for phenotyping.

A new FP6 project funded by the European Commission, EUMODIC (European Mouse Disease Clinic), will undertake a primary phenotype assessment of up to 650 of the mouse mutant lines generated in EUComm. In addition, a number of these mutant lines will be subjected to a more in depth secondary phenotype assessment. The EUMODIC consortium will build on the work in the EUMORPHIA project that delivered a comprehensive database – EMPReSS - of Standard Operating Procedures that can be used to determine the phenotype of a mouse. EUMODIC has developed a selection of these screens, EMPReSSslim, which is structured for comprehensive, primary, high-throughput phenotyping of large numbers of mice. It will also adopt innovative approaches to the generation and assessment of cohorts of age-matched mutants and controls for phenotyping.

EUMODIC will function as a distributed mouse clinic. A key driver is to bring an increased multidisciplinary approach to the study of mouse biology to ensure that mouse genetics is integrated with diverse skills in pathology, physiology, clinical genetics and computational biology, amongst others. Primary phenotyping will be performed at 4 of the main mouse clinics in Europe, the: German Mouse Clinic at GSF, Germany; the Institute Clinique de la Souris, Strasbourg, France; MRC Mammalian Genomics Unit, Harwell, UK and the Wellcome Trust Sanger Institute, UK. Lines of interest will be passed as frozen embryos or sperm to secondary phenotyping centres across Europe that have expertise in investigating that particular phenotype.

The sharing of genomic and phenotype data via databases is of prime importance to coordinate research across Europe and to allow wider access to and therefore better use of mouse models.

Notwithstanding the efforts in EUMODIC, a number of areas are judged vital for the development of mouse phenotyping:

Exploiting mouse mutants across Europe - Access to phenotyping platforms

- Ensuring through training and infrastructure investment that the flow of mouse mutants as frozen material is enhanced - from laboratory to phenotyping centre and from mutagenesis centre to phenotyping centre

Bioengineering

- Ensuring that developments in miniaturisation and nanotechnologies European-wide are brought to bear on mouse phenotyping platforms

Pre-clinical disease models

- Ensuring that the large number of potential mouse disease models generated by Europe are harnessed by the biotech/pharma industries

Phenotype data – dissemination of data on standard mouse strains

- Examining the future role and configuration of databases of phenotype information, both in a European and Worldwide context

Standardising secondary and tertiary mouse phenotyping

- Standardising secondary and tertiary phenotyping

CONCLUSIONS – Phenotyping

A continuing effort will be required for the foreseeable future in the development and application of phenotyping platforms taking advantage of multidisciplinary strengths across Europe. These platforms also need to be developed to manage the large-scale phenotyping efforts that will be needed to phenotype the mice coming out of the large-scale mutagenesis programmes. This ongoing programme will need to take into account technology advances, to continue to interact with industry and to tackle the integration and dissemination of the vast swathes of phenotype data that will be generated.

Gene Expression

Phenotyping extends from the organismal level to the molecular. Study of the transcriptome and the proteome of the mouse will considerably enhance our understanding of genetic and disease processes. The combined benefits of functional annotation of the mouse genome and molecular phenotypic characterisation of its mutants promise to act as an impetus for future detailed studies of mammalian gene function. This area will substantially benefit from the linkage of diverse activities across Europe in the area of mouse functional genomics:

High throughput systematic studies of mouse gene expression

- Building on the achievements of EURExpress and the availability of the complete sequence of the mouse genome to move towards a description of the developmental and adult expression of every gene in the mouse genome
- Ensuring linkage with European efforts in mouse phenotyping by integrating part of the effort with the analysis of mouse strains and mutants

Integrated studies of the transcriptome and proteome

- Increasing molecular phenotyping, including integration of the study of the transcriptome and proteome

CONCLUSIONS – Gene expression

There are enormous opportunities to bring together mutant production, phenotyping and gene expression analysis. The successful integration of these approaches will depend upon close cooperation between different European centres and will enormously improve the breadth and depth of the readout of functional information.

Archives

A key theme, that pervades all of these projects, is the requirement for appropriate archives of resources created. Providing stable, long-term archives remains a significant challenge for nations of the EU. Aside from identifying the critical archives that need to be created, we need to resolve a number of other issues:

Creating and maintaining archives – ensuring competitiveness in the long term

- There is an urgent need to develop and assess business models for the long term support and stability of mouse and cell archives

Maintaining and integrating current archives

- Ensure that existing archives, such as EMMA, are sustained and further integrated into the growing European mouse functional genomics programme

Clearly there is now an international dimension to the need for archiving mouse lines. To this end, members of PRIME have been involved in the initiative to establish FIMRe (the International Federation of Mouse Resources) to explore ways to enhance access to mutant mice for the scientific community by facilitating an easy exchange of preserved material among repositories. Archives within Europe (including EMMA), USA, Japan and Australia are represented in this group.

The goals of FIMRe are to:

- Coordinate repositories and resource centres to:
 - archive valuable genetically defined mice and ES cell lines being created worldwide
 - meet research demand for these genetically defined mice and ES cell lines
- Establish consistent, highest quality animal health standards in all resource centres
- Provide genetic verification and quality control for genetic background and mutations
- Provide resource training to enhance user ability to utilize cryopreserved resources

CONCLUSIONS – Archiving

A coherent strategy, based upon sound business principles, needs to be developed to maintain the growing number of archives that will be required to sustain the European mouse functional genomics programme. These need to be applied to existing archives to ensure their long term future.

Bioinformatics

Bioinformatics underpins all of the activities in the generation and characterisation of mouse models. However, given the increasing large-scale integration of experimental activities, local solutions to informatics problems are inappropriate. Increasingly, European groups are working together on broad informatics solutions to fundamental problems in the capture, mining and interpretation of functional genomics data. There is also an important need to explore the integration of existing databases, e.g. EMMA and Pathbase and new databases.

Data capture

- Ensuring capture and standardisation of *primary* data from all sources within the wider European programmes
- Assessing the balance between data capture to central databases or to interconnected local databases

Data mining

- Using informatics tools for comparative genomics to compare mouse genomes with other mammalian genomes for the identification of essential DNA

Knowledge structures

- Developing appropriate vocabularies and ontologies for the description of functional information from gene to phenotype
- Developing stronger inter-relations between informaticians and biologists

Maintaining and disseminating data

- Ensuring the long-term maintenance and relevance of all European data through appropriate curation, and its integration with worldwide datasets

The way forward

PRIME has established two working groups to bring together informaticians involved in the development and maintenance of databases that store phenotype information; the EuroPhenome working group to integrate European phenome databases and the International Phenome Database working group to explore wider issues of integrating phenome databases worldwide.

CONCLUSIONS – Bioinformatics

There are enormous challenges and difficulties in this arena that threaten the success of both national and EU programmes. From data capture, to data interpretation and mining to data dissemination, an integrated and European approach will be necessary to sustain European Mouse Functional Genomics. At the outset, a European forum to discuss the developing informatics needs in mouse functional genomics programmes is paramount.

The way forward

EUMODIC will lead the way forward in the large-scale effort for phenotyping the mutants that will be coming out of EUComm and the other mutagenesis programmes. There is a need to determine ways of expanding this effort via European and national funding. The existing mouse clinics (GMC, ICS, MRC and Sanger) are exploring sources of national funding. However this will not be able to support the entire effort and European funding will be required. In addition to this, new primary phenotyping clinics are being established and will join this effort. These will require pump-priming from the European Commission and continued support.

EMMA functions as a repository for mouse lines generated in these projects. Funding is required to develop the archive and to maintain it. It should be extended further to include lines produced from other EU-funded and national research programmes. In addition to this, funding will be required for the resources produced from these projects, which will include:

- ES cells containing the conditional and knock-out mutations
- mouse lines derived from the ES cell lines archived as frozen sperm and embryos
- data on the ES cells, mouse lines and associated phenotypes

There are a number of ways that infrastructures can be funded:

- By grants at the national or European level
- By charge to users
- By commercial partners in partnership allowing them to charge a commercial rate
- By commercial partners contributing towards their cost and becoming privileged users in return
- From core funding at institutes for maintenance of infrastructures
- Top-slicing within the ERA of projects to provide funding for database infrastructure

Infrafrontier: The European Infrastructure for phenotyping and archiving of mammalian models

There is tremendous synergy between the EUCOMM, EUMODIC and EMMA projects, whereby mice are generated in EUCOMM for phenotyping in EUMODIC and subsequent archiving in EMMA. Links between all of these projects have been formed and explored in PRIME. Clearly these projects and their associated data can be seen as a European resource, as well as contributing to basic research. One method to support them in future, would be a strategic approach to bring them all together under ERAnet programme funding in FP7.

This proposed programme, called Infrafrontier (The European Infrastructure for Phenotyping and Archiving of mammalian model) will organise two complementary and linked European infrastructure networks for large scale and comprehensive phenotyping (Phenomefrontier) and archiving (Archivefrontier) of mouse models. Infrafrontier will be embedded in a global effort to standardise and optimise the phenotypic characterisation of medically relevant models and in addition state of the art archiving and dissemination of such.

Phenomefrontier

It can be envisioned that within the next decade over 25,000 new mouse models will be generated in Europe. It will be necessary that this large number get access to comprehensive functional and molecular characterization. Phenomefrontier will provide a European platform, which will give access to comprehensive phenotyping to every laboratory, including latest *in vivo* imaging technology and informatics tools to handle the phenotype data. Phenomefrontier is a program that aims to play a leading role on the worldwide level.

Archivefrontier

To make full use of mouse models, it will be essential to make them accessible to every laboratory in Europe. Archiving and distribution of mouse models, under highest quality standards, and dissemination of knowledge are the main topics of Archivefrontier. Instruments will have to be implemented which are not available currently. New freezing methods are being tested to optimize and speed up the process. The community will have to be trained to work with such material. The proposed infrastructure aims to play a leading role on the worldwide level. Mouse centres where research and infrastructure coexist, and that are leaders with respect to

excellence and national importance, will be selected to become part of this infrastructure. The European Mouse Mutant Archive (EMMA) will coordinate this project.

Infrafrontier is necessary to ensure the appropriate coverage of phenotyping and archiving infrastructure in the different areas of Europe. It would give Europe a leading position in a worldwide competition on resources and knowledge for medically relevant mouse models. Europe will need such an infrastructure to make efficient use of emerging resources. It is required to speed up the discovery of molecular mechanisms of diseases and health - this is an important step for the future of molecular medicine and the advancement of diagnosis and therapy. Academia and industry will have to work together to develop new instruments and technologies for *in vivo* imaging using non-invasive methods.

Infrafrontier will not only operate within Europe. It will take a global lead and coordinate with associated programmes worldwide. Continuing with initiatives such as FIMRe and International Phenome database working group.

EuroMouse

The EuroMouse Meeting in Venice, October 2006, brought together researchers from most of the mouse functional genomics projects funded by the European Commission. Over 100 scientists were present representing 70 institutes across 17 countries within the European Union. Scientists from outside the European Union were also present and a live satellite link was formed to bring together a simultaneous press release from the EUCOMM and NorCOMM projects.

This meeting highlighted the benefit of European funding. Many of the projects were large consortia, Integrated Projects and Networks of Excellence. These projects bring together critical masses of researchers who can tackle research areas from a variety of disciplines for example:

- physicists expert in imaging with biologists with disease models to apply the imaging to
- researchers studying the mouse as a model with other model organisms and human clinicians and geneticists
- biologists with pharmacists with near-market experience who can develop therapies

It is a recommendation of the PRIME committee that funding for such projects and networks be maintained in FP7.

Following on from this meeting, we are producing a brochure to promote the use of the mouse as a model for human disease. It will contain A5 flyers outlining each of the EuroMouse projects. The brochure is aimed at a broad readership covering politicians, research funders, clinicians, charities and patient organisations.

EuroMouse projects

Project Acronym	Project Title	Present at EuroMouse	Participating in Brochure
EUCOMM	The European Conditional Mouse Mutagenesis Program	✓	✓
EUMORPHIA	Understanding Human Diseases through Mouse Genetics	✓	✓
EMMA	European Mutant Mouse Archive	✓	✓
EURExpress	Large-scale gene expression analysis by RNA <i>in situ</i> hybridisation	✓	✓
EuroHear	Advances in hearing science: from functional genomics to therapies	✓	✓
FunGenES	Functional genomics in Engineered mouse ES Cells	✓	✓
EuReGene	European Renal Genome Project	✓	✓
BIOSAPIENS	A European Network for Integrated Genome Annotation	✓	✓
FLPFLEX	A flexible toolkit for controlling gene expression in mouse	✓	✗
MUGEN	Murine models of human immunological diseases	✓	✓
LYMPHANGIO GENOMICS	Genome-Wide Discovery and Functional Analysis of Novel Genes in Lymphangiogenesis	✓	✓
MYORES	European Muscle Development Network	✓	✓
MOLECULAR IMAGING	Integrated technologies for <i>in vivo</i> molecular imaging	✓	✓
PATHBASE	European Mutant Mouse Pathology Database	✓	✗
COST B24	Laboratory animal science and welfare	✓	✗
PRIME	Priorities for Mouse Functional Genomics Research across Europe	✓	✓
EVIGENORET	Functional Genomics of the Retina in Health and Disease	✓	✓
IMDEMI	Innovative Mouse Models for Functional Genomics in Immunology	✓	✗
CALLIMIR	Studying the biological role of microRNAs in the Dlk1-Gtl2 imprinted domain	✗	✓
ENDOTRACK	Tracking the Endocytic Routes of Polypeptide Growth Factor Receptor Complexes and their Modulatory Role on Signaling	✗	✓
HEROIC	Highthroughput epigenetic regulatory organisation in chromatin	✗	✓
MAIN	Targeting Cell Migration in Chronic inflammation	✗	✓
EUCLOCK	Entrainment of the circadian clock	✗	✓
DNA REPAIR	DNA Damage Response and Repair Mechanisms	✗	✗
WOUND	A multi-organism functional genomics approach to study signalling pathways in epithelial fusion/wound healing	✗	✗
EuTRACC		✗	✗
ANEUPLOIDY		✗	✗
CASIMIR	Coordination and Sustainability of International Mouse Informatics Resources	✗	✓
EUMODIC	The European Mouse Disease Clinic: A distributed phenotyping resource for studying human disease	✗	✓

Training

A significant expansion in training activities will be vital to a successful European Mouse Functional Genomics programme in two respects:

1. Ensuring better dissemination of skills in mouse genomics including archiving, phenotyping and mutagenesis
2. Bringing diverse skills in physiology, pathology, clinical sciences and mathematics and statistics to mouse genetics

Europe is well situated to use its diverse skills base to enormously enhance PRIME and a number of critical developments will be required that can be enabled both through coordinated actions and Marie Curie fellowships.

Training centres – disseminating mouse functional genomics skills

- Identifying and supporting a number of training centres that will aim to deliver mouse functional genomics skills to the wider community
- Developing training at the European level to make use of and benefit the Marie Curie training programme

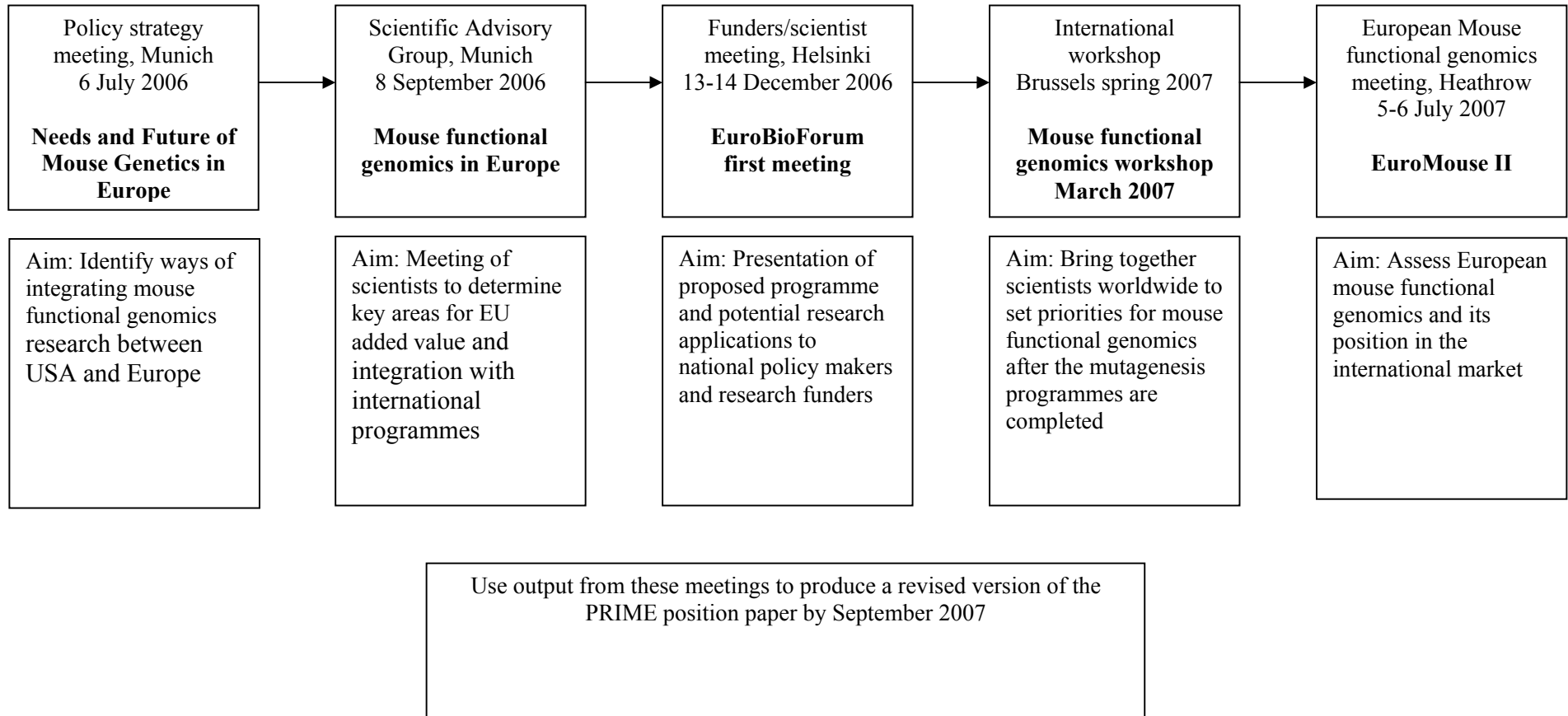
Training centres – enhancing the use of multidisciplinary approaches within mouse functional genomics

- Ensuring that training centres also provide opportunities to bring physiologists, pathologists, clinicians and others to mouse biology and guaranteeing that mouse functional genomics is increasingly immersed in multidisciplinary approaches.
- Publicising training and research opportunities for physiologists, pathologists and clinicians in mouse functional genomics

CONCLUSIONS – Training

Europe has a critical mass in the diverse multidisciplinary skills base that will be required to maintain the EU at the forefront of mouse functional genomics. It will be vital to ensure that closer integration in research efforts across Europe is matched by a commensurate focus on training. Within the research networks, it will be important to establish training centres not only for the dissemination of mouse functional genomics skills but also for importing skills and approaches from physiology, pathology, clinical, computational and mathematical fields.

Formation of the European Programme in Mouse Functional Genomics



Coordination

Coordination of research activities at national, regional and European level

Research into mouse functional genomics could be significantly strengthened by promoting the networking and coordination of research and innovation activities at national, regional and European level. This could be achieved by setting up mechanisms to exchange information on national research policies and research programmes. This will also allow greater integration between national research programmes and research programmes funded by the European Commission (EC). Mechanisms could be explored to allow continuation of research funding, particularly for infrastructures, once EC funding has ended.

Coordination of research activities at national, regional and European level.

- Disseminating contents of national research programmes and results from research. Publicising national research strategies
- Identifying priorities for research, gaps in research and complementary research programmes
- Identifying areas for joint calls for research
- Identifying mechanisms for joint or complementary research calls, evaluation of research proposals and ways to jointly support research

Future support for European infrastructures

- Discussing mechanisms to continue support for infrastructures established by the EC, such as archives and databases, once EC funding has ended. Determining whether there should be national support or whether they can be self-supporting

Improved animal welfare

- Discussing mechanisms to improve conditions of animals used in scientific research
- Standardising animal housing and handling across Europe; setting minimum guidelines
- Establishing a forum of scientists and policy makers to discuss European and national directives and guidelines on animal welfare

CONCLUSIONS – Coordination

The major goal of PRIME should be to improve coordination and integration of research activities in mouse functional genomics in Europe. This would involve the establishment of a forum where scientific leaders in the field would discuss with national and EC research policy makers and research funders to define the best strategy for achieving a better integration. Mechanisms should be established to share information on national strategies, research priorities, ongoing research programmes and outputs from this research. This would allow coordination both between national programmes and with the EC research programmes. Mechanisms should also be determined to coordinate research through joint or complementary calls, assessment of proposals and provision of funding.