Virtual Tour Guide Notes

Introduction

Welcome to the Babraham Institute's Biological Support Unit (BSU) Virtual Tour. This guide is designed to help you navigate the tour and provide key insights into how we care for animals used in research. Our goal is to ensure transparency about the highly regulated work conducted here and to demonstrate how we uphold the highest standards of animal welfare.

The Babraham Institute and our research

At the Babraham Institute, scientists study fundamental processes in our cells: how they develop, survive, function, age, and die. This basic biology underpins future medical advances, just as past research led to the treatments we receive today. The benefits will be felt in future generations, but without today's basic science, there will be no foundation for tomorrow's medical research.

This 3 (and a bit) minute video will give you an overview of the research the Institute does:
https://www.youtube.com/watch?v=9JAd07bwG6g

Scan here to access video from a device

The Tour

We encourage you to explore the tour at your own pace. Look out for "i" information buttons to learn more about each area and the videos to see key aspects of animal care. You can learn more about how and why animals are used in the Institute's research on our website: www.babraham.ac.uk/our-research/animal-research

Facility Overview

The BSU is divided into different areas, each with a specific role in ensuring research integrity and animal welfare. During the tour, you will be able to explore:

- The Experimental Unit – Where research studies are conducted under carefully controlled conditions.
- The GM-Transgenic Unit – Housing genetically modified mice in high-health status environments.
- The Containment & Import Unit – Ensuring that animals from external sources are safely quarantined.
- Central Services – Providing sterilisation, cage cleaning, and water purification.
- Administrative Areas – Offices for regulatory oversight and compliance.

Recommended Routes

You can explore the facility in any order you would like but we have also provided a few recommended routes to help you get started and to give an idea of what topics you might encounter in each unit. On these recommended routes, we have also highlighted a few points of particular interest that often capture people's interest.

Recommended Route 1 – How the BSU supports the Institute's science

Estimated time to complete: 5 minutes

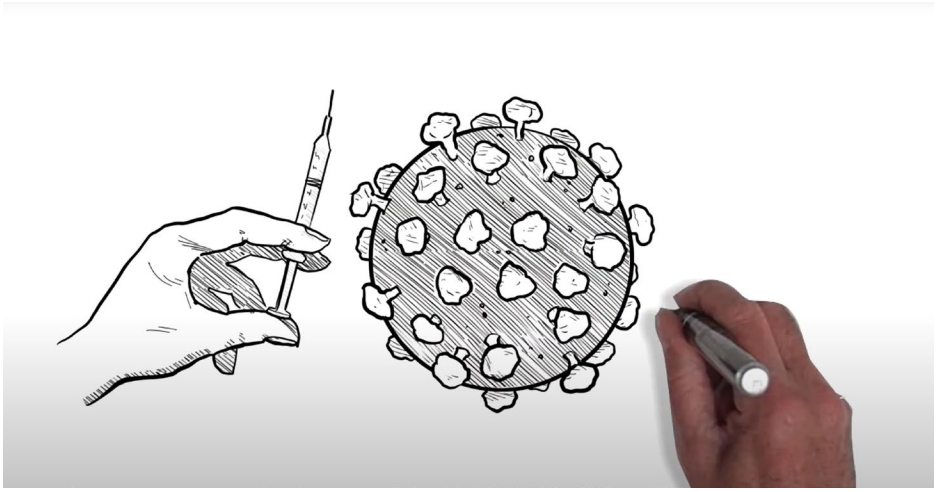
This recommended route will have you exploring our Experimental Unit and discover how the work of the facility supports specific Institute research into health ageing.

Just click the Experimental Unit arrow to get started.

Points of interest:

- **Air Showers** - At the start of the route you will pass through an air shower, just like staff do every day. In the air shower, jets of 25 meters per second wind (that's 56 miles per hour; the equivalent of violent storm gusts!) are blown at you to forcibly remove any dust, debris, dirt, and even many microbial pathogen germs. It's quite loud and quite the buffeting to start your shift at work, but it is also incredibly important to ensure staff are as clean as possible so that they don't bring any illnesses into the facility and affect the mice.
- **Genotyping and Differences in Genes** – A lot of our research looks to understand how differences in our DNA and genes can impact on how we age. These differences may lead to us being more or less likely to get certain age-related illnesses. Genotyping mean checking which genes an animal has. This involves taking a small sample (in mice often a small piece of tissue from their ears) and using machines to read the genetic information stored in their microscopic cells. It allows researchers to work out which genes cause which observed differences whether it be in health or how one member of a species looks compared to another.
- **Daily Welfare Checks** – As you go through the unit, keep in mind that every mouse (there are approximately 1,000 mice in this unit and 20-25,000 mice in the whole facility at any one time) receives daily checks from our experienced animal technicians. They do this by completing a thorough visual check on each mouse, looking for a multitude of signs such as: hunched posture, poor coat condition and dehydration. The check also includes a thorough review of environmental conditions both within the cage and the surrounding room, recording temperature and humidity levels, food and water access, and the overall cage environment. Any concerns are immediately addressed and reported to our animal care and welfare officers or vets.
- **Breeding Mice** – In this unit you will see a small holding room where mice can be bred and housed before being involved in a research study (you will see our larger holding rooms in our recommended route 2). One reason that mice are so needed in ageing research is that they can breed quickly with an adult female mouse having litters of up to 8 pups every 21 days. This enables large sample sizes which allows researchers to be confident that any results seen are true results and not just happening by chance in one singular mouse. Mice also age far faster than us. A 2-year-old mouse is the equivalent to a 70 year old human. This means that researchers can measure the impact of age on specific bodily systems in a shorter timespan than if the work was being carried out in humans. Imagine, if we instead used humans, needing to wait 50 years to see how one person's immune system changes to know if science could make useful medicines to help older people and how that would limit the amount of people who could benefit from discoveries. We also use donated human samples, other model organisms, cells and computer modelling wherever possible.
- **Immunology Research at the Institute** – The procedure rooms you see are where many vital discoveries have been made over the years at the Institute. One relatively recent example of this is our research to understand how the immune system responds differently to vaccines, depending on how old you are, and the impact this has on people's ability to fight off illnesses like COVID-19. In this study we measured the immune response in young mice when they were treated with a vaccine. We then compared this to the response older mice had when they were treated with the same vaccine and we saw that the older mice had a much

lower immune response. This meant that they were less protected from getting a serious infection compared to younger mice. Through this work we were able to work out how many doses of a vaccine, and how long between each dose, an older mouse needed to have the same immune response as a younger mouse. Because we knew how the ages of the mice related to ages in humans, we were able to carry out this research quickly and then apply the results to humans. This work helped inform the medical decisions to give older people more doses of the COVID-19 vaccine and helped protect more people from the virus. You can hear more about this work in this animated explainer video: https://www.youtube.com/watch?v=PPJjnORi0Lw



Scan here to access video from a device

Recommended Route 2 – How our work is regulated and what we do to reduce, refine and replace mouse models in our work

Estimated time to complete: 10 minutes

This recommended route will have you exploring our Administrative Areas and GM-Transgenic Unit to discover regulations and processes that ensure animal welfare is always our first priority.

First click the Admin arrow to get started. When you're done there, next click the GM-Transgenics arrow for the second half of this route.

Points of interest:

- **The 3Rs** – The use of animals in research is governed by UK law, and we follow the 3Rs principles to ensure animal welfare is prioritised. Replacement focuses on using alternative research methods where possible. Reduction ensures minimal animal use through careful experimental design. Refinement enhances welfare by improving housing, handling, and procedures.
- **Cryopreservation and Genetic Models** – In this unit you can see how we make small alterations to mouse DNA through microinjection (the process of injecting tiny amounts of DNA into a cell to then be incorporated into the cell's DNA. This is one way that we can research and discover what specific genes actually do. We can use this knowledge to explore how natural variation in genes between different people affect important bodily processes, like the immune system, and can lead to specific people having a higher chance of developing age-related health conditions. We also use cryopreservation (freezing embryos to -196°C in liquid nitrogen) to store genetically modified mouse lines. These embryos can be thawed and born at a later date. This reduces the need to continually breed mice to have them ready for when they're needed for specific research. This minimises animal numbers while preserving valuable genetic material, and facilitates global research collaboration.
- **Hatches and Movement Between Units** – Our controlled-access hatches work like airlocks and help prevent contamination, minimise animal stress, and ensure an efficient transfer of materials between biosecure zones.
- **Scale of Holding Rooms** – Our holding rooms house thousands of mice in carefully regulated conditions. Environmental controls maintain temperature and humidity, while individually ventilated cages provide filtered air to prevent disease. They also have constant supply of water automatically provided to each cage.
- **Mouse Checks** - Daily welfare checks ensure every mouse is monitored for health, hydration, and behavior. Any issues are reported to our veterinary team for prompt intervention. Each of our trained animal technicians will check on approximately a thousand mice each day. There are also automatic sensors so if anything goes wrong with water provision (e.g. if there is a breakdown in the water supply) or temperature, an alarm will sound and staff will be alerted. Even if it's the middle of the night, we have staff on call who will be automatically alerted to any problems and will be able to get to the Institute within 40 minutes to resolve any issues and prevent any harm to the animals.

- **Enrichment** – Items are added to each cage which allow the animals to display natural behaviours. These include cardboard tunnel, wooden chew sticks and nesting material. Animals also receive supplementary enrichment such as seeds distributed through the cage material.
- **Staff Staying in the Unit and COVID-19 Protocols** - During COVID-19, our work did not stop. The mice still needed to be cared for and the Institute also undertook vital research to support the development of vaccines to help combat the disease. How we worked did change though. Strict measures were put in place to ensure both staff and animal safety. Limited personnel, working in specific group bubbles used enhanced PPE, remote monitoring, and increased hygiene measures to help maintain research integrity as well as staff and animal health.

Recommended Route 3 – How we keep the unit running and get things in and out of the facility

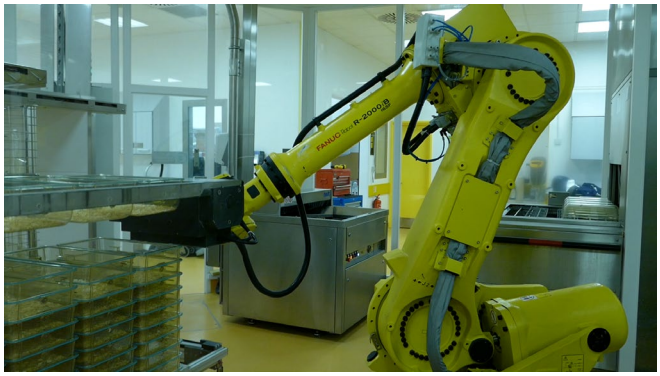
Estimated time to complete: 10 minutes

This recommended route will have you exploring our experimental unit and discover how the work of the Biological Support Unit supports specific Institute research into health ageing.

First click the Containment and Import arrow to get started. When you're done there, next click the Central Services arrow for the second half of this route.

Points of interest:

- **Getting Things In and Out** – You see throughout the tour that staff follow specific processes to get in and out of the units for work. For staff this involves showering, changing into medical grade scrubs, and not leaving during their shifts. However, it's not just staff that go in and out of the units. Cages, bedding, everything, even our staff's lunches need to be clean when they enter. You will see how heat is often used to sterilise items but for heat sensitive items (like laptops, mobile phones, staff lunches, etc.) we can use chemical disinfection.
- **Autoclave (big and benchtop)** - Sterilisation is crucial for maintaining hygiene. Large-scale autoclaves clean bulk items like cages, while benchtop autoclaves handle smaller equipment such as surgical tools. Autoclaves are like big pressure cookers. Items inside are heated under pressure to 121°C to ensure all microbes are destroyed and to provide total sterility.
- **Robot and Backup Systems** – Throughout the whole tour, you see the scale of the work. This scale enables lots of important research to be undertaken. However, it does also lead to practical challenges. One of these is how to clean and refill so many cages with bedding. If staff were doing this it would take a huge number of them, working all day long, to keep up. Instead we use robots to do a lot of this work. Our Pegasus robotic arm is similar to robotic arms used in car manufacturing and processes approximately 500 cages an hour. Of course we do also have a number of back up machines and processes to enable staff to fill cages quickly just in case our robot ever breaks down!



- **Laundry** – Throughout the facility, staff are required to change into scrubs to help prevent contamination from the outside world. We have up to 50 members of staff working each day and that means there are a lot of scrubs that need washing. We have a whole laundry room where we wash the scrubs ready to redistribute to the changing rooms in each of the units of the facility.

Animal Welfare is our Top Priority

This last section provides additional information about how we ensure the animal's welfare is always our top priority and explores how we use other research models to reduce the need for mice in our work.

The 3Rs: Replacement, Reduction, and Refinement

The use of animals in research is strictly regulated under UK law. We follow the 3Rs principles to ensure that animal welfare is our top priority:

- Replacement – Using alternative methods whenever possible, such as computer models or cell cultures. For example, living cells can be studied in a dish, bathed in artificial nutrients. Altering the genome of these cells to study a particular protein is far easier than in a live animal.
- Reduction – Using the minimum number of animals required for meaningful results. This involves careful experimental design and statistical analysis to ensure that we obtain valid results with the fewest animals possible.
- Refinement – Improving housing, handling, and procedures to enhance animal welfare. This includes providing environmental enrichment to encourage natural behaviors and minimise stress.

Animal Welfare and Daily Care

Our trained animal technicians perform daily health checks on every mouse, ensuring their well-being. Each cage is monitored for food, water, temperature, and general environmental conditions. Enrichment, such as nesting materials, tunnels, and chew sticks, is provided to encourage natural behavior.

All technicians are trained in humane handling techniques and follow strict Home Office guidelines. In case of any health concerns, a Named Veterinary Surgeon is immediately consulted.

Automation and Technology

To improve efficiency and minimise stress for the animals, we use automated systems such as:

- Robotic cage washers and sawdust dispensers – Ensuring a hygienic environment with minimal human intervention.
- Individually Ventilated Cages (IVCs) – Providing clean, filtered air to prevent disease spread.
- Microbiological Safety Cabinets – Protecting both animals and researchers during procedures.

Regulation and Transparency

The Babraham Institute is a signatory to the Concordat on Openness on Animal Research, committing to transparency about our work. We also hold accreditation from the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) International, demonstrating our commitment to the highest standards of animal care.

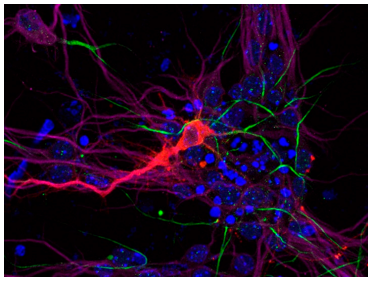
All research involving animals is licensed under the UK Animals (Scientific Procedures) Act 1986. This means before any work is undertaken, a research proposal must be written and submitted for review. During the review, a panel of people including: animal welfare experts, scientists, and members of the public read the proposal and question the researchers involved to make sure that the work they are proposing is important, couldn't be done in any other way, and will be carried out with the animal's care in mind. There are also always named persons, including veterinary surgeons and welfare officers, who oversee compliance and ensure ethical standards.

Reducing the Use of Mice

The Babraham Institute uses a variety of models in our research, this includes mice but also nematode worms, fruit flies, yeast, computer modeling software and human cell samples. A research model is a way that scientists study living things to understand how they work. Using research models helps scientists find answers without always needing to test directly on humans, making research safer.

The Institute is always working to reduce the need for using mice in research and looks to use alternatives wherever possible. However, sometimes research requires us to use mice because the results are too unknown to carry out in humans but too complex to use simpler, non-mammalian, models like fruit flies or cell samples.

You can read more about the alternative research models we use below:

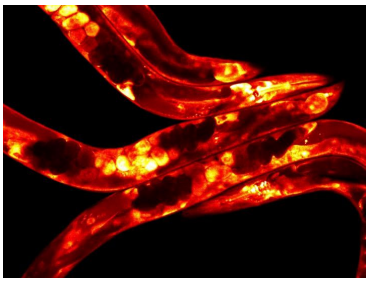


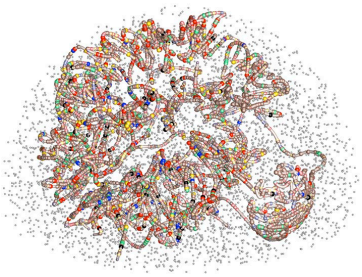
Cell Culture

Living cells can be studied in a dish, bathed in artificial nutrients. Altering the genome of these cells to study a particular protein is far easier than in a live animal. Cell culture makes it possible to study how cells respond to chemicals, proteins or other cells and to image cell shape and movement in real time. We can even follow the movement of individual proteins inside them.

Simple Organisms

We learn a lot from simple model species. We use yeast to learn about the effect of environmental pressure on shaping our genomes, with clear relevance to how tumour cells develop drug resistance. We use yeast, nematode worms and fruit flies to help understand the ageing process.





Computer Modelling

Today's research generates vast amounts of data. Thousands of individual human genomes have been sequenced, we can analyse multiple biological read outs from single cells and the activity of tens of thousands of genes can be determined in one experiment. Computer modelling uses these large data sets to generate new hypotheses. This sometimes avoids the need for animal experiments and data-sharing also prevents duplication of work, some of which may have involved animals.

Human Samples

Other research at the Institute uses cells and tissues donated from medical patients or tissue banks to improve our understanding of how cells communicate, grow and die, or how age affects the functioning of our immune system.